

THE JOURNAL OF RESEARCH ANGRAU

The J. Res. ANGRAU, Vol. LIV No. (2), pp. 1-130, April - June, 2026

Indexed by CAB International (CABI), AGRIS (FAO) and ICI
<https://epubs.icar.org.in/index.php/TJRA>



ANGRAU

ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY

Lam, Guntur - 522 034

The Journal of Research ANGRAU

(Published quarterly in March, June, September and December)

CHIEF PATRON

Dr. Paladugu Venkata Satyanarayana, Vice-Chancellor, ANGRAU, Guntur

PATRONS

Dr. Ch. Sreenivasa Rao, Dean of Agriculture, ANGRAU, Guntur

Dr. M. V. Ramana, Dean of Agricultural Engineering and Technology, ANGRAU, Guntur

Dr. P. Muniratnam, Dean of P. G. Studies, ANGRAU, Guntur

Dr. G. Jogi Naidu, Dean of Community Science, ANGRAU, Guntur

Dr. V. Sumathi, Director of Research, ANGRAU, Guntur

Dr. G. Ramachandra Rao, Director of Extension, ANGRAU, Guntur

INTERNATIONAL ADVISORY BOARD

Dr. Mithila Jugulam, Professor (Weed Physiology), College of Agriculture, Kansas State University, Kansas State, USA

Dr. Umesh K. Reddy, Professor of Genetics and Genomics, Department of Biology, West Virginia State University, West Virginia, USA

NATIONAL ADVISORY BOARD

Dr. D. K. Yadava, Assistant Director General (Seeds), Crop Science Division, Indian Council of Agricultural Research, New Delhi

Dr. A. Mani, Registrar, ANGRAU, Administrative Office, Lam, Guntur

Dr. V. Chandrika, Associate Director of Research, Regional Agricultural Research Station, ANGRAU, Tirupati

Dr. S. V. Ramana Rao, Principal Scientist, Social Sciences division, ICAR – Indian Institute of Oilseeds Research (IIOR), Rajendranagar, Hyd.

Dr. M. Prabhakar, Principal Scientist (Entomology), ICAR-Central Research Institute for Dryland Agriculture (CRIDA), Santoshnagar, Hyd.

INTERNATIONAL EDITORIAL BOARD

Dr. Padma Nimmakayala, Professor of Research, Department of Biology, West Virginia State University Institute, West Virginia, U.S.A

NATIONAL EDITORIAL BOARD

Dr. B.V.S. Prasad, University Librarian, Acharya N.G. Ranga Agricultural University, Guntur

Dr. Tavva Srinivas, Head (Agribusiness Management), ICAR- National Academy of Agricultural Research management (NAARM), Hyd.

Dr. M. Nedunchezhiyan, Principal Scientist, Regional Centre of ICAR- CTCRI, Dumuduma, Bhubaneswar, Odisha

Dr. K. Vijayalakshmi, Senior Professor, Dept. of Entomology, Prof. Jayashankar Telangana Agricultural University, Rajendranagar, Hyd.

Dr. G. Karuna Sagar, Controller of Examinations, ANGRAU, Guntur, Andhra Pradesh

Dr. T. Murali Krishna, Principal Scientist & University Head (Entomology), Regional Agricultural Research Station, ANGRAU, Tirupati

Dr. M. S. Chaitanya Kumari, Professor and University Head, Department of E.E.C.M., College of Community Science, ANGRAU, Guntur.

EDITOR - IN - CHIEF

Dr. P. Muniratnam

Dean of P.G. Studies, ANGRAU, Guntur
Administrative Office, Lam, Guntur-522 034

MANAGING EDITOR

Dr. P. Anil Kumar

Director, Planning & Monitoring Cell
ANGRAU, Lam, Guntur - 522 034

EDITOR : Dr. K.S. Purnima, Principal Scientist (Extension), Planning & Monitoring Cell, ANGRAU, Lam, Guntur - 522 034

SUBSCRIPTIONS TARIFF

Individual (Annual) : Rs 750/-

Individual (Life) : Rs. 3000/-

Institute (Annual) : Rs. 3000/-

Printing Charges : Rs. 150/- per page

CONTENTS

PART I: PLANT SCIENCES

Potential of <i>Piper chaba</i> for the management of the stored-product pest (<i>Callosobruchus chinensis</i>) ABHISHEK MUKHERJEE, ROHAN DAS and DEBOJOTI CHAKRABORTY	1
Assessment of genetic variability in rice (<i>Oryza sativa</i> L.) for yield and nutritional traits G. HARIPRIYA, T. HARITHA, B. KRISHNA VENI and C. N. NEERAJA	10
Assessment of genetic parameters in maize (<i>Zea mays</i> L.) for yield and associated traits N. SAI UDAY YOGITHA, Y. SATISH, Y. PUSHPA RENI and G. VIJAYA KUMAR	15
Effect of varieties and sowing windows on productivity and nutrient uptake of fodder oat C. LAKSHMI, S. TIRUMALA REDDY, P. MAHESWARA REDDY and CH. BHARGAVA RAMIREDDY and V.CHANDRIKA	22
Genetic variability studies for yield and its attributes, quality and nutritional traits in medium duration rice genotypes (<i>Oryza sativa</i> L.) V. MADHUSUDHAN REDDY, Y. SUNEETHA and C. N. NEERAJA	30

PART II: HOME SCIENCES

Parents' perception of preschool education and their role in children's early learning GRACE ANN MATHEW and NISHA VIKRAMAN	37
Educational intervention and its effect on health management practices in adults with diabetes CELINE MATHEW C.	44
Consumption pattern of convenience food among consumers in Kannur district, Kerala TEENA THOMAS and ANU JOSEPH	52
Examining nutritional status and emotional well being in adolescent girls through diet quality and depressive symptoms S. SAI JANANI, K. LAKSHMI, G. NIRMALA DEVI and BILQUIS	61
Consumer preferences and perception towards ready-to-eat foods among urban consumers in Berhampur city, Odisha ALITA MINZ, ISHANI SAMANTRAY, MANASEE MEHER and ASHMITA BEURA	67

PART III: SOCIAL SCIENCES

Diurnal temperature range variability over Karnataka, India: Spectral evidence of interannual and decadal climate modes (1958–2024) SRINIVASA SASDHAR PONNALURU	76
Factors influencing consumers shift towards cold pressed oils in Guntur, Andhra Pradesh M. CHARITHA, K. UMA DEVI, M. SATISH RAHUL and B. RAMANA MURTHY	84
Perceived effectiveness of Farmer Producer Organisations (FPOs) in socio-economic upliftment of member farmers in Maharashtra DERE AISHWARYA, BABITA KUMAR and RAKESH RATHORE	97

PART IV: RESEARCH NOTES

Training need assessment of extension functionaries working at Rythu Seva Kendras (RSKs) in Srikakulam district of Andhra Pradesh S. NEELAVENI, P. VENKATARAO, S. KIRAN KUMAR, S. ANUSHA and V. HARIKUMAR	108
Sustainable horticulture under mission for Integrated development of horticulture in Himachal Pradesh PANKAJ THAKUR and KUSUM LATAAZAD	115
Development and nutritional assessment of sweetmeat from immature coconut inflorescence C. RATHINA and THILAKAVATHY	122

POTENTIAL OF *PIPER CHABA* FOR THE MANAGEMENT OF THE STORED-PRODUCT PEST (*CALLOSOBRUCHUS CHINENSIS*)

ABHISHEK MUKHERJEE*, ROHAN DAS and DEBOJOTI CHAKRABORTY

Department of Zoology, Maulana Azad College, Kolkata-700001, West Bengal

Date of Receipt : 26-03-2026

Date of Acceptance : 05-05-2026

ABSTRACT

The present study investigated the insect-repellent potential of *Piper chaba* (Piperaceae) stem in multiple formulations-dry powder, fume and water extract-against the pulse beetle *Callosobruchus chinensis* (Coleoptera: Bruchidae), a major pest of stored grains. With the increasing concern over pesticide resistance, toxicity to non-target organisms and residue hazards associated with synthetic insecticides, this research emphasises plant-based alternatives for sustainable pest management. Bioassays were conducted in I-tube (wind tunnel) to evaluate repellency using various concentrations of each formulation, and the results were statistically analysed using chi-square tests and regression analysis. The dry powder of *P. chaba* stem showed a clear dose-dependent repellent response, with 1.75 g dry powder yielding 96.66% repellency ($\chi^2 = 29.36$, $p < 0.001$). Similarly, the fume exhibited full repellency at higher release rates (2–4 ml/min) compared to 60% at 0.5 ml/min ($\chi^2 = 88.71$, $p < 0.001$). Water extracts followed the same trend, with 100% extract achieving complete repellency and diluted forms showing reduced effectiveness ($\chi^2 = 66.25$, $p < 0.001$). Phytochemical screening confirmed the presence of alkaloids, flavonoids, terpenoids, and phenols compounds previously associated with insecticidal activity. Infrared spectroscopy (IR) further validated the presence of functional groups such as O–H, C–H, and C=O, indicative of bioactive molecules. The findings establish *P. chaba* as a potent natural repellent with formulation-specific and concentration-dependent efficacy. Notably, the fume exhibits the highest repellency and richest phytochemical profile. This highlights *P. chaba*'s promise in eco-friendly pest control strategies, although further research is needed to assess toxicity on non-target species, residue safety, and field-level applicability.

Keywords: *Callosobruchus chinensis*, I-tube, *Piper chaba*, Piperine, Repellency, Stored grain pest, Sustainable pest management

INTRODUCTION

Managing pests is a challenging aspect of crop production. Numerous species worldwide are recognized for causing significant yield losses, both quantitatively and qualitatively. In India, insect infestations alone

cause 20–30% reduction in crop output. Among these, *Callosobruchus chinensis* (L) is a particularly destructive pest responsible for severe damage to stored legumes. It is the most prevalent and widely distributed pulse beetle across tropical and subtropical regions,

*Corresponding Author Email: *2007.mukherjee@gmail.com

especially in India, Bangladesh, and Pakistan (Singh *et al.*, 2021).

Excessive use of synthetic pesticides causes environmental pollution, loss of beneficial organisms and also creates pesticide resistant pests. Repeated applications of commonly used insecticides-such as organophosphates, pyrethroids and methyl bromide fumigants-disrupt natural enemy populations and trigger secondary pest outbreaks. These concerns have led to increased interest worldwide in safer plant-derived alternatives. Plant extracts and essential oils have shown effective insect control (de Oliveira *et al.*, 2020).

Piper chaba(Hunter), a culturally important yet scientifically underexplored spice, commonly known as Chui Jhal in Bangladesh and Chavya in India. It is widely consumed in southeastern Bangladesh, Tripura, West Bengal, and parts of southern India, including Tamil Nadu, Kerala and Karnataka. Beyond its culinary use, the plant is used in Ayurvedic medicine, where it is a key component of Panchakolachurna, traditionally prescribed for conditions including psoriasis (Agalcha *et al.*, 2025), epilepsy (Adiga *et al.*, 2024), abdominal disorders, and heartburn. Modern research has identified that *P. chaba* contains bioactive compounds such as chabamide and piperine, which are associated with antimicrobial, immune modulatory, antimalarial, antioxidant, and anticancer activities (Al-Mamun *et al.*, 2024). *P.chaba* is a promising yet under explored botanical candidate which may have role in stored-product pest management.

MATERIAL AND METHODS

Mass Culture of *C.chinensis*

Adults of *C. chinensis* were obtained from local markets. Then a laboratory culture was established and maintained on chickpeas (*Cicer arietinum* L.), an annual legume widely

used for pulse beetle rearing (Banik *et al.*, 2024). For mass culturing, 100 adult beetles of mixed sexes were introduced into a 1000 mL container containing 250 g of chickpeas. The container was lined with fine steel mesh gauze (35-mesh) to ensure adequate aeration and maintain optimal conditions for colony development. The insects were maintained at 27 ± 1 °C, $65 \pm 10\%$ relative humidity, and a 12L:12D photoperiod in a Biological Oxygen Demand (BOD) incubator. After three generations of laboratory rearing, newly emerged adults from the fourth generation (to ensure a homogeneous and laboratory acclimatized insect population for reliable bioassays) were separated by sex. Equal numbers of males and females were used in behavioral assays, with 90 individuals per bioassay.

Preparation of dry powder, water extract and fume of *P. chaba* stem

Dry powder and water extract

Shade dried mature stems of *P. chaba* were cut into small pieces and then ground into dry powder by blender. For aqueous extraction, 100 g of powder was cold-macerated in distilled water for five days at 25 ± 0.2 °C in darkness with periodic agitation. The extract was filtered with filter paper (Whatman No. 1) to obtain the crude aqueous extract. Then the extract was stored at 4 °C for future use.

Fume preparation

Dried stems of *P. chaba* (100 g) were coarsely powdered and subjected to dry heating in a sealed 500-mL twin-neck round-bottom flask maintained at 160 ± 10 °C using an electric mantle. Volatile fumes generated during pyrolysis were directed into a 500-mL gas-wash bottle containing layers of glass wool and silica gel to remove ash particles and moisture, respectively. The purified fumes were channeled into a 2 L glass vacuum desiccator,

Table 1. Phytochemical screening procedure

Sl.No.	Phyto-chemicals	Name of the test	Combinations of solutions	Out come
1	Carbohydrates	Molish's test	2 mL filtrate+ 2 drops of alcoholic α -naphthol+1 mL conc. H_2SO_4 (along the sides of test tube)	A violet ring appeared
2	Proteins	Biuret test	2 ml of extract with a few drops of 2% copper sulphate solution, add 1ml of ethanol, followed by excess of potassium hydroxide pellets	Formation of pink colour in the extract layer indicates presence of protein
3	Alkaloids	Mayer's test	2 ml of extract+few drops of 1 HCl. Take 1mL of this mixture and add 6 drops of Mayer's reagent.	Yellow cream of precipitate.
4	Glycosides	Keller-kiliani test	5 ml of extract+2 ml of glacial acetic acid is contained in one drop of ferric chloride solution	Appearance of brown ring
5	Phenol	Ferric chloride test	Extract aqueous solution+ a few drops 5% ferric chloride sol	Dark green / bluish black colour
6	Flavonoid	Shinoda test	1 ml of extract + three pieces of magnesium chips, and add a few drops of concentrated HCl.	Appearance of an orange, pink or red to purple colour.
7	Tannin	Ferric chloride test	10% Ferric chloride + 2 mL test solution	Dark blue/ green precipitate
8	Terpenoid	Salkowski test	Dissolve plant extract in chloroform followed by adding concentrated Sulfuric acid	Reddish brown colour of interface

which served as the fumigation chamber for bioassays. Humidity (75%) inside the chamber was regulated using a 200 mL beaker containing saturated sodium chloride solution. The setup followed the procedure of Rohitha Prasantha (2020).

Bioassays using dry powder, water extract and fume of *P. chaba* stem

Repellency test with dry powder

The repellent activity of *P. chaba* stem powder was assessed against 30 adult *C. chinensis* using varying quantities of powder (0.75–1.75 g). An I-tube (wind tunnel) apparatus was used, consisting of a rectangular chamber with removable ends and a small entry port for releasing insects.

Powdered stem material was placed at one end of the I-tube, which was sealed before introducing the beetles through the entry port. The I-tube measured 51 cm in length, 15.5 cm in width, and 15.6 cm in height, with a total internal volume of 12,331.8 cm³ (Mukherjee & Makal, 2021). Repellency was evaluated by observing insect movement and avoidance behavior.

Repellency test with fumes

Volatile fumes generated from heated *P. chaba* stem were introduced into the airtight fumigation chamber, maintained at 25 ± 1 °C. The repellency effect was assessed using adult *C. chinensis* at four different fume intensities (0.5 mL/min, 1 mL/min, 2 mL/min and 4 mL/min). After each test, the chamber was thoroughly ventilated, and fumes were discarded following the protocol described by Rohitha Prasantha (2020).

Repellency test with water extract

Repellency bioassays using the aqueous extract followed the same procedure as test with dry powder except that blotting paper strips impregnated with different concentrations of extract were used (100%, 50%, 25%, and 12.5%,). After air-drying, each treated strip was placed inside the I-tube, and adult beetles were introduced to evaluate concentration-dependent repellency.

Qualitative phytochemical screening

Qualitative phytochemical screening

Preliminary phytochemical screening of *P. chaba* extracts was conducted following the standard procedures of Harborne (1984). These qualitative assays enabled the detection of key classes of phytochemicals, including alkaloids, flavonoids, tannins, phenols, saponins, carbohydrates, terpenoids, and glycosides. Tests were based on

characteristic colour changes following the addition of specific reagents (Table 1).

Infrared Spectroscopy (IR) analysis

Infrared spectroscopy was used to identify functional groups and molecular structures of the bioactive constituents in *P. chaba*. Samples were prepared using KBr pellet method: powdered plant material ground with dry KBr and compressed into a transparent pellet. A background spectrum was recorded prior to sample analysis to account for instrument optics and atmospheric CO₂, H₂O absorption. The sample spectra were processed using Fourier Transform algorithms to obtain plots of intensity versus wave number (Remina *et al.*, 2022).

Statistical analysis

Repellency data from dry powder, aqueous extract, and fume bioassays were analysed separately using contingency table chi-square (χ^2) tests to determine the significance of *P. chaba* effects on *C. chinensis*. Regression curves were generated for all three types of assays to evaluate dose-dependency. The insect which does not show any response (classified as “no result”) were excluded from analysis.

RESULTS AND DISCUSSION

Effect of dry powder of *P. chaba* stem on *C. chinensis*

When dry powder of stem were used to test the repellency of insects it showed repellency increased with increasing weight of stem dry powder of *P. chaba*. The highest repellency was observed at 1.75 g (96.66%), whereas the lowest repellency was recorded at 0.75 g (80.00%) in I-tube (wind tunnel) apparatus. A contingency table chi-square (χ^2) test showed a highly significant association between stem powder weight and insect response ($\chi^2 = 29.36$, $p < 0.001$). These results

Table 2. Effect of drypowder of *P.chaba* stem on *C.chinensis*

Weight (Grams)	Repellency Percentage	Non Repellency Percentage	No result (%)
0.75	80	16.66	3.33
1	93.33	3.33	3.33
1.25	93.33	6.66	3.33
1.5	93.33	3.33	0
1.75	96.66	3.33	0

indicate that increasing stem powder weight significantly enhanced the repellency effect against the test insects (Table 2).

Linear regression analysis revealed a strong positive relationship between stem powder weight and repellency percentage ($R = 0.811$, $R^2 = 0.658$) which indicates that approximately 65.8% of the variation in repellency could be explained by the amount of stem powder applied.

Effect of fume of *P. chaba* stem on *C. chinensis*

While testing effect of *P. chaba* stem fume, it showed that increasing fumigation rate increases repellency, reaching 100% at 2 and 4 ml min⁻¹. Contingency table chi-square (χ^2) analysis based on the repellent and non-repellent insects revealed a highly significant association between fumigation rate and insect response ($\chi^2 = 88.71$, $p < 0.001$). These results demonstrate that increasing fumigation rate significantly enhanced insect repellency (Table 3).

Linear regression analysis revealed a strong positive relationship between fumigation rate and repellency percentage ($R = 0.840$, $R^2 = 0.705$), indicating that approximately 70.5% of the variation in repellency was explained by fumigation rate.

Effect of water extract of *P.chaba* stem on *C.chinensis*

In water extract of *P. chaba* stem experiment also, the repellency increased progressively with increasing water extract concentration and reached 100% at the highest concentration (100% extract) tested. Contingency table chi-square (χ^2) analysis based on the repellency and non repellency responses revealed a highly significant association between extract concentration and insect response ($\chi^2 = 66.25$, $p < 0.001$). These results demonstrate that increasing extract concentration significantly enhanced the biological response of the test insects (Table 4).

Linear regression analysis revealed a very strong positive relationship between

Table 3. Effect of fume of *P.chaba* stem on *C.chinensis*

Rate (ml/min)	Repellency Percentage	Non Repellency Percentage
0.5	60	40
1	66.67	33.33
2	100.00	0.00
4	100.00	0.00

Table 4. Effect of water extract of *P.chaba* stem on *C.chinensis*

Concentration	Repellency(%)	Non Repellency(%)	Noresult(%)
12.5% extract	50.00	50.00	9.00
25% extract	80.00	20.00	2.00
50% extract	90.00	10.00	2.00
100% extract	100.00	0.00	0.00

extract concentration and positive response percentage ($R = 0.948$, $R^2 = 0.899$), indicating that approximately 89.9% of the variation in response was explained by extract concentration.

Phytochemical Screening Analysis

Phytochemical screening of *P. chaba* stem (fume and extract) revealed substantial differences in chemical composition (Table 5). The fume exhibited strong and immediate positive reactions for most phytochemical groups, particularly alkaloids, flavonoids, glycosides, carbohydrates, and proteins. In contrast, the crude extract showed fewer positive reactions, though terpenoids were strongly present, and carbohydrates, proteins, and alkaloids showed moderate positivity. These findings indicate that thermal volatilization during fumigation may liberate or transform several bioactive compounds not readily extractable in the crude aqueous extract.

Infrared Spectroscopy

The IR spectrum of *P. chaba* dry stem powder (Fig. 1) revealed several diagnostic peaks corresponding to characteristic functional groups. Such as 3417.77 cm^{-1} (44.25%T): Broad O–H stretching, indicating alcohols, phenols, or carboxylic acids, 2922.28 cm^{-1} (56.24%T): C–H stretching of aliphatic hydrocarbons, 1621.75 cm^{-1} (51.12%T): C=C or C=O stretching, consistent with alkenes, aromatic rings, or carbonyl compounds, 1514.53 cm^{-1} (59.52%T): Aromatic C=C stretching, 1423.98 cm^{-1} (56.22%T): C–H bending of methyl or methylene groups, 1384.32 cm^{-1} (56.34%T): Symmetric bending of $-\text{CH}_2$ groups or aldehydic C–H bending, 1318.67 cm^{-1} (55.70%T): Possible C–H bending or C–O stretching, 1251.00 cm^{-1} (58.32%T): C–O stretching of alcohols, phenols, ethers, or esters, 1030.20 cm^{-1} (47.09%T): Strong C–O stretching typical of

Table 5. Phytochemical screening of *P.chaba*

Phytochemicals & their tests	Fume	Extract
Alkaloid	++	+
Flavonoid	++	-
Tannin	+	-
Phenol	+	-
Glycoside	+	-
Terpenoid	+	++
Carbohydrate	++	+
Protein	+	+

{++denotes instantaneous results: A strong and immediate positive observation, suggesting a significant presence, + denotes A clear positive observation, - denotes No pre sence detected}

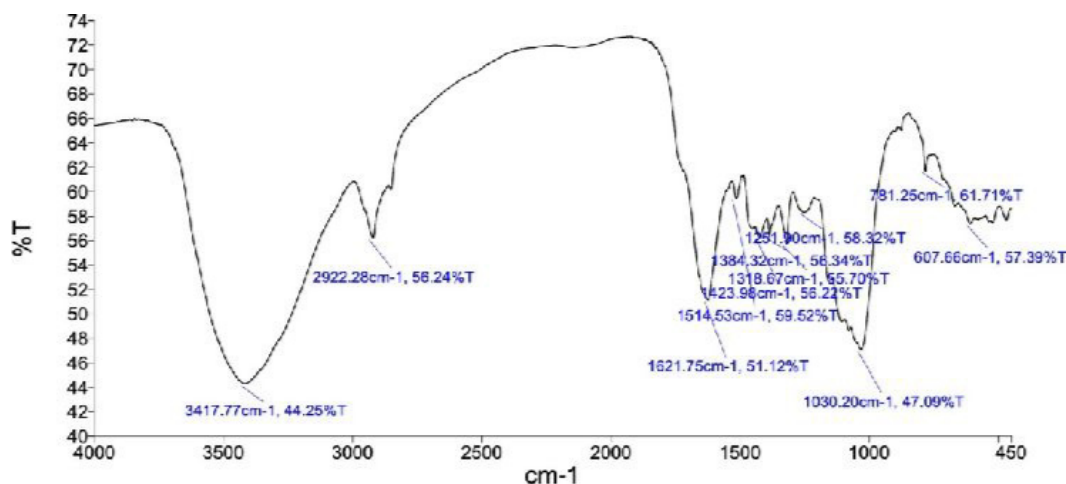


Fig.1. The diagnostic and the fingerprint region of a dry stem powder of *P.chaba* I R spectrum

primary /secondary alcohols or ethers. 781.25 cm^{-1} (61.71%T) and 607.66 cm^{-1} (57.39%T): Aromatic or alkene C–H out-of-plane bending and skeletal vibrations.

Collectively, these spectral features indicate the presence of hydroxylated compounds, saturated and unsaturated hydrocarbons, aromatic structures, and various oxygenated functional groups, consistent with the complex phytochemical profile observed in screening analyses.

This study demonstrates that the dry stem powder of *P.chaba* exhibits dose-dependent repellency against *C.chinensis*. Higher quantities consistently resulted in higher repellency levels, aligning with previous findings for other *P.* species. For example, Ojiako *et al.* (2018) reported that *P.guineense* seed powder significantly suppressed adult survival, oviposition, progeny emergence, and grain damage in *C. maculatus*.

Whereas the fume generated from dry *P. chaba* stems showed even more pronounced repellent effects, with a dose dependent manner. This observation is supported by earlier work demonstrating insecticidal and repellent properties of fumes from plants such

as *Azadirachta indica* (L.), *Cinnamomum zeylanicum* (Presl), *Ocimum sanctum* (L.), and *Lantana camara* (L.) (Rohitha Prasanth, 2020). Heating plant material releases bioactive volatile compounds capable of repelling or killing stored grain pests. Our results similarly indicate that fumigation with *P. chaba* stems likely releases potent volatile phytochemicals that merit further characterization.

Aqueous extracts of numerous plant species also have been widely evaluated for their insect repellent, ovicidal, developmental, and antifeedant effects (Singh *et al.*, 2021). Consistent with these findings, the aqueous dry stem extract of *P. chaba* demonstrated strong repellency against *C. chinensis*, with efficacy decreasing gradually upon dilution. This trend parallels earlier observations from studies using extracts of *Ajuga parviflora* (Benth), *Cymbopogon citratus* (DC.) Stapf, *Nigella sativa* (L.), and *Mesua ferrea* (L.) (Shah *et al.*, 2008).

Several studies have attributed toxic or behavioural effects on pests to compounds such as fatty acids, isobutylamides, alkanes, tannins, steroids, flavonoids, phenols, and

glycosides (Kumar *et al.*, 2024; Pumnuan *et al.*, 2022). In the current study, phytochemical screening of *P. chaba* stem revealed the presence of a broad spectrum of these compounds, including in the fume fraction. Alkaloids, flavonoids, terpenoids, tannins, phenols, glycosides, carbohydrates, and proteins were all detected in the fumes, whereas the aqueous extract contained fewer compound classes. These differences provide the importance of fumigation as a delivery method, as heat may facilitate volatilization or transformation of bioactive constituents.

Infrared spectroscopy further confirmed the presence of functional groups corresponding to alkanes, alkenes, alcohols, aldehydes, ketones, phenols, and amides—findings consistent with earlier analyses of plant extracts (Kumar *et al.*, 2024; Srikanta *et al.*, 2023). The diversity of functional groups suggests that *P. chaba* possesses a complex chemical profile potentially responsible for the observed repellency.

CONCLUSION

This study demonstrated that *P. chaba* possesses significant repellent properties against *C. chinensis* across multiple formulations. Among the tested forms, dry stem fumes exhibited the highest repellency and contained the greatest diversity of phytochemicals. The presence of alkaloids and other bioactive compounds likely underpins this strong repellent effect. However, the efficacy of *P. chaba* is highly dependent on concentration. Future research should therefore prioritize the validation through large-scale field trials to assess practical applicability, persistence, and safety in real storage conditions. With appropriate refinement and safety evaluation, *P. chaba* has the potential to serve as a sustainable botanical alternative for the management of stored grain pests.

REFERENCES

- Adiga, S. H., Adiga, R. S., Bhat, K. M. R. and Upadhyaya, D. 2024. Ayurveda therapy in the management of epilepsy. *Epilepsy & Behavior*, 159, 110026.
10.1016/j.yebeh.2024.110026
- Agalcha, R., Singh, S. K. and Rajoria, K. 2025. Management of chronic plaque psoriasis through Panchkarma: A case report. *Journal of Ayurveda and Integrative Medicine*, 16.
10.1016/j.jaim.2024.101072
- Al-Mamun, M. R., Maniruzzaman, M., Badal, M. M. R. and Haque, M. A. 2024. Comparison of piperine content, antimicrobial and antioxidant activity of *Piper chaba* root and stem. *Heliyon*, 10(19), e38709.
10.1016/j.heliyon.2024. e38709.
- Banik, S., Bhoge, R. S., Kulkarni, S. R., Shelar, V. R., Shinde, S. D. Bankar, D. R. 2024. Biology of pulse beetle (*Callosobruchus chinensis* L.) on chickpea (*Cicer arietinum* L.). *The Pharma Innovation Journal*, 12(12), 2113–2115.
- de Oliveira, A. P. S., Agra-Neto, A. C., Pontual, E. V., Lima, T. A., Cruz, K. C. V., de Melo, K. R., de Oliveira, A. S. and Coelho, L. C. B. B. 2020. Evaluation of the insecticidal activity of *Moringa oleifera* seed extract and lectin (WSMoL) against *Sitophilus zeamais*. *Journal of Stored Products Research*, 87, Article 101615. 10.1016/j.jspr.2020.101615
- Harborne, J. B. 1984. *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis*. 2nd ed. Chapman and Hall, London.
- Kumar, J., Marin, G., Arivoli, S. and Tennyson, S. 2024. Assessment of *P. longum* leaves

- toxicity on *Tribolium castaneum*. Future Journal of Pharmaceutical Sciences, 10, 134.
- Mukherjee, A. and Makal, A. 2021. Visual and olfactory cues for mate recognition in male pumpkin beetle, *Aulacophora-foveicollis*. International Journal of Tropical Insect Science, 41, 725–735.
- Ojiako, F. O., Adesiyun, A. A., Ihejirika, G. O. and Dialoke, S. A. 2018. Efficacy of *Piper guineense* Schumacher seed powder in the control of *Callosobruchus maculatus* (Fabricius, 1775) (Coleoptera: Chrysomelidae) and on the nutritional and organoleptic characteristics of stored cowpea. Polish Journal of Entomology, 87(2), 119–140.10.2478/pjen-2018-0009
- Pumnuan, J., Namee, D., Sarapothong, K., Doungnapa, T., Phutphat, S., Pattamadilok, C. and Thipmanee, K. 2022. Insecticidal activities of *P. retrofractum* fruit extracts against seed beetles and effects on seed germination. Heliyon, 8, e12589.10.1016/j.heliyon.2022.e12589
- Remina, B. C., Subramanian, V. P. and Karthika, K. 2022. Qualitative phytochemical screening and FTIR spectroscopic analysis of *Mitracarpus hirtus* leaf leachates. Kongunadu Research Journal, 9, 75–79.10.26524/kvj.2022.22
- Rohitha Prasantha, B. D. 2020. Effect of high-temperature extracted plant material fume against southern cowpea weevil (*Callosobruchus chinensis* L.) (Coleoptera: Bruchidae) as a non-chemical novel fumigation technique. Chemical and Biological Technologies in Agriculture, 7, 22.10.1186/s40538-020-00188-2
- Shah, M. M. R., Pradhan, M. D. H., Siddique, M. N. A., Mamun, M. A. A. and Shahjahan, M. 2008. Repellent effect of indigenous plant extracts against *Oryzaephilus surinamensis*. International Journal of Sustainable Crop Production, 3, 51–54.
- Singh, K. D., Mobolade, A. J., Bharali, R., Sahoo, D. and Rajashekar, Y. 2021. Plant volatiles as stored grain pest management approach: A review. Journal of Agriculture and Food Research, 4, 100127.10.1016/j.jafr.2021.100127
- Srikanta, A. S., Sumanth, B. M., Sowmyasri, N. G., Athreya, P., Vaishnavi, V., Prajwal, R., Madhunandan, G. R. and Lavanya, L. 2023. Extraction of Pine and spectral analysis using IR and UV visible spectral data. International Journal of Scientific Development and Research, 8, 244–249.

Abhishek Mukherjee, Rohan Das and Debojoti Chakraborty. 2026. Potential of *Piper chaba* for the management of the stored-product pest (*Callosobruchus chinensis*).
The Journal of Research ANGRAU, 54 (2) : 01-09

ASSESSMENT OF GENETIC VARIABILITY IN RICE (*ORYZA SATIVA* L.) FOR YIELD AND NUTRITIONAL TRAITS

G. HARIPRIYA *, T. HARITHA, B. KRISHNA VENI and C. N. NEERAJA

Department of Genetics and Plant Breeding, Agricultural College, Bapatla - 522 101.
Acharya N.G.Ranga Agricultural University, Guntur, Andhra Pradesh, India

Date of Receipt : 10-04-2026

Date of Acceptance : 04-06-2026

ABSTRACT

The present study was conducted using 144 rice genotypes including five checks (BPT 5204, BPT 2841, Chittimuthyalu, Kalanamak, DRR DHAN 45) evaluated for 12 traits at Agricultural College Farm, Bapatla during *kharif*, 2024-25 using augmented block design. Analysis of variance revealed significant differences among genotypes for 12 traits, indicating substantial genetic variability with in the experimental material and hence can be exploited for future crop improvement programme. High genotypic and phenotypic coefficients of variation was observed for protein content (%), antioxidant activity (mgAAE/100g), Fe content (ppm), Zn content (ppm) and grain yield per plant (g), while plant height (cm), number of tillers per plant, number of productive tillers per hill and test weight (g) showed moderate GCV and PCV values. The PCV estimates were higher than GCV for all the characters indicating that substantial variation for these characters was contributed by environmental components. High heritability coupled with high genetic advance as percent of mean was recorded for plant height (cm), number of tillers per plant, number of productive tillers per hill, test weight (g), protein content (%), antioxidant activity (mgAAE/100g), Fe content (ppm), Zn content (ppm) and grain yield per plant (g) indicating that these traits are largely governed by additive gene action and hence direct selection of these traits for improvement of dependent variable (yield) may be rewarding.

Keywords: GCV, Genetic Advance, Heritability, PCV and Rice

INTRODUCTION

Rice (*Oryza sativa* L.; $2n = 24$) is a self-pollinated cereal crop belonging to the family Poaceae and order Poales. It is one the most widely consumed cereals across the world and plays a major role in the global food supply. As the global population continues to rise, the demand for rice is anticipated to escalate correspondingly (Sujarwo Putra *et al.*, 2022). It provides essential micronutrients in addition to being the main source of carbohydrate. Next

to China, India is the world's second-largest producer of rice, grown in an area of 51.42 mha with production and productivity of 14.90 mt and 2899 kg ha⁻¹ respectively. In Andhra Pradesh, it occupies an area of 2.07 mha with production and productivity of 8.01 mt and 3863 kg ha⁻¹ respectively (www.Indiastat.com, 2024-25). In addition to efforts to achieve yield gains, improving the nutritional value of rice has gained global interest. Further, micronutrient studies in rice grain also help

*Corresponding Author Email: haripriya.gadi987@gmail.com; Part of research work for M.Sc. thesis submitted to Acharya NG Ranga Agricultural University, Lam, Guntur.

address the problem of malnutrition among rice consumers particularly in developing nations which cannot afford dietary diversity. The immune system, enzymatic processes, and cognitive development all depend on micronutrients like iron (Fe) and zinc (Zn). So the deficiencies in these micronutrients might impact countries especially where rice is consumed as staple food crop. The low levels of essential nutrients in conventional rice, particularly when polished, causes hidden hunger in populations as they rely on rice as a primary diet.

Genetic variability serves as a critical resource for the effective improvement of crop species. Genetic variability provides extent of variation and the role of environment in trait

expression. Heritability indicates the proportion of genetic contribution to phenotypic variation, while genetic advance as percent of mean reflects the expected improvement under selection. Together, these parameters guide effective selection in crop improvement programs. Hence, in the present study an attempt was made to study variability among 144 rice genotypes.

MATERIAL AND METHODS

The present study was conducted at Agricultural College Farm, Bapatla during 2024-25 *kharif* season. The experimental material comprised of 144 rice genotypes including five checks (BPT 5204, BPT 2841, Chittimuthyalu, Kalanamak, DRR DHAN 45)

Table 1. Analysis of variance for morphological and nutritional traits in rice (*Oryza sativa* L.)

Source of variation	D.F	Days to 50 per cent flowering	Plant height (cm)	Number of tillers per plant	Number of productive tillers per hill	Panicle length (cm)	Number of filled grains per panicle
Block	6	361.71**	460.44**	10.62**	7.07**	6.46**	2503.93**
Treatments	143	80.15**	157.18**	2.50**	1.76**	5.73**	1658.43**
Checks	4	362.69**	1162.43**	10.59**	5.83**	10.97**	11577.09**
Treatment: Test and Test vs. Check	139	72.02**	128.25**	2.27**	1.65**	5.58**	1373.00**
Error	24	1.75	1.26	0.37	0.33	0.96	198.81

Source of variation	D.F	Test weight (g)	Protein content (%)	Antioxidant activity (mgAAE/100g)	Fe content (ppm)	Zn content (ppm)	Grain yield per plant (g)
Block	6	23.32**	11.34**	620.47**	1.85**	74.04*	374.91**
Treatments	143	10.81**	22.16**	375.14**	6.30**	20.36**	87.05**
Checks	4	51.60**	391.15**	5927.40**	128.80**	4.05**	391.79**
Treatment: Test and Test vs. Check	139	9.63**	11.54**	215.37*	2.77**	20.82**	78.28**
Error	24	0.63	0.03	1.50	0.01	0.09	3.14

* Significance at 5 % level and ** Significant at 1 % level

Table 2. Estimates of genetic parameters for morphological and nutritional traits in rice (*Oryza sativa* L.).

S.No.	Character	Coefficient of variation		Heritability (broad sense) (%)	Genetic advance as % of mean
		PCV (%)	GCV (%)		
1	Days to 50 percent flowering	8.97	8.88	97.95	18.13
2	Plant height (cm)	10.16	10.11	99.11	20.77
3	Number of tillers pr plant	16.30	15.08	85.63	28.79
4	Number of productive tillers per hill	15.74	14.28	82.35	26.74
5	Panicle length (cm)	10.24	9.35	83.46	17.63
6	Number of filled grains per panicle	20.41	18.96	86.24	36.32
7	Test weight (g)	18.42	17.81	93.50	35.54
8	Protein content (%)	25.58	25.49	99.35	52.42
9	Antioxidant activity (mgAAE/100g)	26.23	26.14	99.36	53.76
10	Fe content (ppm)	62.32	62.03	99.08	127.38
11	Zn content (ppm)	27.27	27.22	99.62	56.05
12	Grain yield per plant (g)	35.61	35.01	96.62	70.99

GCV- Genotypic Coefficient of Variation

PCV- Phenotypic Coefficient of Variation

using augmented block design. The experimental material including advanced breeding lines 127, released varieties 18 and land races 9 from ARS, Bapatla and ICAR-IIRR, Hyderabad. Each genotype was planted in 3 rows with 3 m length, with a spacing of 20×15 cm. The crop was cultivated following all recommended agricultural practices. Observations were recorded for 12 traits viz., days to 50% flowering, plant height (cm), number of tillers per plant, number of productive tillers per hill, panicle length (cm), number of filled grains per panicle, test weight (g), protein content (%), antioxidant activity (mgAAE/100g), Fe content (ppm), Zn content (ppm) and grain yield per plant (g). Heritability in the broad sense $h^2_{(b)}$ and genetic advance was calculated using the formula provided by Johnson *et al.* (1955). The genotypic and phenotypic coefficients of variation were

determined according to the methods described by Burton (1952). The estimates of PCV and GCV were categorized as low (0-10%), moderate (10-20%), and high (>20%) based on the classification by Sivasubramanian and Madhavamenon (1973). The analysis was carried using R Studio version R.4.4.2.

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among all the genotypes for all the 12 characters studied (Table 1), indicating the presence of sufficient variability for exploitation. The PCV estimates were higher than GCV for all the characters indicating that substantial variation for these characters was contributed by environmental components. Further, the significance of ANOVA for checks reflected that each check

performed differently than the other (including yield and micronutrient checks) indicating that the experiment is sensitive enough to detect treatment differences.

The variability parameters for 12 traits was discussed under (Table 2). In the study, the phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the characters (Table 2). High phenotypic and genotypic coefficients of variations (PCV and GCV) was observed for protein content (%), antioxidant activity (mgAAE/100g), Fe content (ppm), Zn content (ppm) and grain yield per plant (g) which indicated the presence of sufficient genetic variability in the material included. These results are consistent with the experimental findings of Singh *et al.* (2020). Moderate GCV and PCV values was observed for plant height (cm), number of tillers per plant, number of productive tillers per hill and test weight (g). These results were in conformity with the reports of Sao *et al.* (2024), Usha *et al.* (2024) and Kerketta *et al.* (2024). Low GCV and PCV were observed for the traits of days to 50% flowering. Similar results were reported by Usha *et al.* (2024).

In the present study, high heritability coupled with high genetic advance as percent of mean was observed for traits like plant height, number of tillers per plant, number of productive tillers per hill, number of filled grains per panicle, test weight (g), protein content (%), antioxidant activity (mgAAE/100g), Fe content (ppm), Zn content (ppm) and grain yield per plant (g). These findings are consistent with the previous experimental results of Kerketta *et al.* (2024) and Sridevi (2018). High heritability combined with moderate genetic advance as percent of mean was observed for days to 50% flowering and panicle length. These results are in agreement with the experimental findings of Usha *et al.* (2024).

CONCLUSION

The analysis of variance indicated the significant variation among all the genotypes included in the study. Further the significance of ANOVA for checks reflected that each check performed differently than the other (including yield and micronutrient checks) indicating that the experiment is sensitive enough to detect treatment differences. In the present study, the characters *viz.*, plant height (cm), number of tillers per plant, number of productive tillers per hill, test weight (g), protein content (%), antioxidant activity (mgAAE/100g), Fe content (ppm), Zn content (ppm) and grain yield per plant (g), all recorded moderate to high variability and high heritability coupled with high genetic advance as percent mean indicating the predominance of additive gene action. Hence, direct simple selection of yield traits may be rewarding for overall improvement of dependent variable yield.

REFERENCES

- Burton, G.W. 1952. Quantitative inheritance in grasses. Proceedings of the 6th International Grassland Congress. 277-283. Indiastat. Statistical Information About India.2024-25. <https://www.indiastat.com>
- Johnson, H.W., Robinson, H.F and Comstock, R.E. 1955. Estimation of genetic and environmental variability in soybean. Agronomy Journal, 47: 314-318.
- Kerketta, P., Sao, A., Ekka, A., Sai, R and Singh, R. 2024. Application of genetic parameters for betterment of yield and yield contributing traits in rice (*Oryza sativa* L.). International Journal of Advanced Biochemistry Research, 8(4): 346-351.
- Sao, A., Singh, G and Nair, S.K. 2024. Estimation of genetic variability parameters for various yield attributing

- traits in germplasm collection of rice (*Oryza sativa* L.). International Journal of Plant and Soil Science, 36(3) : 158-165.
- Singh, K.S., Suneetha, Y., Kumar, G.V., Rao, V.S., Raja, D.S and Srinivas, T. 2020. Variability, correlation and path studies in coloured rice. International Journal of Chemical Studies, 8(4): 2138-2144.
- Sivasubramanian, S. and Madhavamenon, P. 1973. Combining ability in rice. Madras Agricultural Journal, 60: 419-421.
- Sujarwo Putra, A.N., Setyawan, R.A., Teixeira, H.M and Khumairoh, U. 2022. Forecasting rice status for a food crisis early warning system based on satellite imagery and cellular automata in Malang, Indonesia. Sustainability, 14(15): 8972.
- Usha, M., Khoyumthem, P., Singh, K.N., Sinha, B and Singh, G. 2024. Genetic variability, correlation and path analysis studies for yield traits in stable mutant lines of black aromatic rice of Manipur. Electronic Journal of Plant Breeding, 15(1): 170-177.
- Haripriya, G., Haritha, T., Krishnaveni, B. and Neeraja C. N. 2026. Assessment of genetic variability in rice (*Oryza sativa* L.) for yield and nutritional traits. The Journal of Research ANGRAU, 54 (2) : 10-14

ASSESSMENT OF GENETIC PARAMETERS IN MAIZE (*Zea mays* L.) FOR YIELD AND ASSOCIATED TRAITS

N. SAI UDAY YOGITHA*, Y. SATISH, Y. PUSHPA RENI and G. VIJAYA KUMAR

Department of Genetics and Plant Breeding, Agricultural College, Bapatla - 522 101,
Acharya N.G. Ranga Agricultural University, Guntur, Andhra Pradesh, India

Date of Receipt : 13-02-2026

Date of Acceptance : 17-04-2026

ABSTRACT

The present study was undertaken during the *rabi* season of 2024–25 at the Regional Agricultural Research Station (RARS), Lam, Guntur, Andhra Pradesh, to evaluate the extent of genetic variability, heritability and genetic advance in maize (*Zea mays* L.) inbred lines. A total of 50 inbred lines comprising 48 test entries along with two standard checks (LM 13 and LM 14) are assessed using alpha lattice design with two replications. Data was recorded on thirteen quantitative traits encompassing phenological, morphological and yield-related parameters. Analysis of variance revealed highly significant differences among the genotypes for all the traits studied indicating the presence of considerable genetic variability. The phenotypic coefficient of variation (PCV) exceeded the genotypic coefficient of variation (GCV) for all traits, reflecting the influence of environmental factors on trait expression. High estimates of GCV and PCV were observed for ear height, 100-kernel weight and grain yield per plant suggesting the existence of substantial variability within the genetic material. Moderate variability was recorded for plant height, ear length and SPAD chlorophyll meter reading, whereas relatively low variability was observed for days to 50% anthesis, days to 50% silking and days to maturity. High heritability coupled with high genetic advance as per cent of mean was recorded for plant height, ear height, number of kernels per row, 100-kernel weight and grain yield per plant indicating the predominance of additive gene effects and the potential effectiveness of direct selection for these traits. Moderate heritability with moderate genetic advance was observed for ear length, ear girth, number of kernel rows per ear and SPAD chlorophyll meter reading, suggesting the involvement of both additive and non-additive gene actions.

Keywords: Maize, Genetic variability, GCV, PCV, Heritability, Genetic advance and inbred lines.

INTRODUCTION

Maize (*Zea mays* L.) is a cereal crop of considerable global importance, contributing significantly to agricultural productivity and food security. It ranks second only to wheat in terms of area under cultivation, while attaining

the foremost position in overall production and productivity. After rice and wheat, maize is the third most widely consumed cereal for human use. The crop originated in South America and is taxonomically classified under the family Poaceae. Cytogenetically, it is a diploid species with a chromosome complement of $2n = 20$ and

*Corresponding Author Email: yogithanagati@gmail.com; Part of research work for M.Sc. thesis submitted to Acharya NG Ranga Agricultural University, Lam, Guntur.

constitutes the sole representative of the genus *Zea* (Korsa *et al.*, 2024).

It is widely regarded to have originated through a process of gradual selection from its ancestral progenitor, teosinte (*Zea mexicana*), a primitive grass indigenous to Mexico and Guatemala. Being a C_4 species, maize possesses a highly efficient photosynthetic system, which underpins its superior grain yield potential and enables its cultivation across a broad spectrum of agro-ecological environments (Khan *et al.*, 2024).

Genetic variability represents a fundamental prerequisite for the success of crop improvement programmes, as it forms the basis for effective selection and facilitates the optimal utilization and expansion of the available gene pool. The magnitude of variability in quantitative traits is commonly evaluated using genetic parameters such as the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV), which also provide insights into the relative contribution of environmental factors to trait expression. Heritability serves as an estimate of the proportion of total phenotypic variance attributable to genetic factors and thereby indicates the potential for transmission of traits to subsequent generations. However, heritability estimates alone may not sufficiently predict the response to selection; hence, the combined assessment of heritability and genetic advance is considered more informative, as it provides a reliable indication of the expected genetic gain and aids in the formulation of effective breeding strategies (Ghorpade *et al.*, 2025).

MATERIAL AND METHODS

The experiment was carried out during the *rabi* season of 2024–25 at the Regional Agricultural Research Station (RARS), Lam, Guntur, Andhra Pradesh (16.180° N latitude,

80.290° E longitude and 31.5 m above mean sea level). The experimental material consisted of 50 maize (*Zea mays* L.) inbred lines, comprising 48 test entries along with two standard checks (LM 13 and LM 14), as presented in Table 1.

The trial was laid out in an alpha lattice design with two replications. Each replication was divided into 10 blocks and within each block, five inbred lines were allocated following appropriate randomization. Each genotype was sown in two rows of 4 m length, maintaining a spacing of 60 cm between rows and 20 cm between plants within rows. All recommended agronomic practices and necessary plant protection measures were uniformly applied throughout the crop growth period to ensure proper crop establishment and maintenance.

Observations on pre- and post-harvest traits were systematically recorded from ten randomly selected plants per entry in each replication. A total of thirteen quantitative characters were evaluated, viz., days to 50% anthesis, days to 50% silking, anthesis–silking interval (days), days to maturity, plant height (cm), ear height (cm), ear length (cm), ear girth (cm), number of kernel rows per ear, number of kernels per row, 100-kernel weight (g), grain yield per plant (g) and SPAD chlorophyll meter reading (SCMR).

The analysis of variance for individual traits was carried out in accordance with the standard statistical methodology prescribed by Panse and Sukhatme (1978). The genotypic and phenotypic coefficients of variation (GCV and PCV) were estimated following the approach proposed by Burton (1952). Broad-sense heritability, along with genetic advance expressed as per cent of mean, was computed and categorized based on the criteria suggested by Johnson *et al.* (1955). All statistical analyses were performed using INDOSTAT software (version 9.1).

RESULTS AND DISCUSSION

Analysis of Variance

The analysis of variance revealed highly significant differences among the inbred lines for all the traits under investigation, indicating the existence of substantial genetic variability that can be effectively exploited in breeding programmes (Table 2).

Genotypic and Phenotypic Coefficients of Variation

Phenotypic coefficient of variation (PCV) consistently exceeded the genotypic coefficient of variation (GCV) for all the traits evaluated (Table 3), suggesting a considerable influence of environmental factors on trait expression. High values of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were observed for ear height, 100-kernel weight and grain yield per plant, indicating the presence of substantial variability among the inbred lines under study. These results are in conformity with earlier findings reported by Reddy *et al.* (2022), Singh *et al.* (2024) and Gogoi *et al.* (2025) for ear height; Khan *et al.* (2024) for 100-kernel weight and Pradhan *et al.* (2022), Rani *et al.* (2022) and Sondarava *et al.* (2025) for grain yield per plant.

Moderate values of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were recorded for plant height, ear length and SPAD chlorophyll meter reading (SCMR), reflecting a moderate level of variability among the inbred lines evaluated. These results are in agreement with the findings of Damtie *et al.* (2021), Pradhan *et al.* (2022) and Reddy *et al.* (2022) for plant height; Korsa *et al.* (2024), Singh *et al.* (2024) and Gogoi *et al.* (2025) for ear length and Sravani *et al.* (2021) (PCV value) for SPAD chlorophyll meter reading (SCMR).

Low values of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were recorded for days to 50% anthesis, days to 50% silking and days to maturity, indicating the presence of limited variability among the inbred lines studied. These results are in agreement with earlier findings of Damtie *et al.* (2021), Pradhan *et al.* (2022), Korsa *et al.* (2024), Gogoi *et al.* (2025) and Sondarava *et al.* (2025) for days to 50% anthesis and days to 50% silking and Kinfé and Tsehaye (2015), Reddy *et al.* (2022), Khan *et al.* (2024) and Samskrithi *et al.* (2025) for days to maturity.

Heritability and Genetic Advance

High heritability coupled with high genetic advance as a percent of mean was recorded for traits such as plant height, ear height, number of kernels per row, 100-kernel weight and grain yield per plant. This combination suggests the predominance of additive gene action, indicating that direct selection would be effective for the improvement of these traits. These findings are in agreement with the reports of Singh *et al.* (2024) for plant height; Khan *et al.* (2024) for ear height; Patil *et al.* (2016) for number of kernels per row; Rani *et al.* (2022), Reddy *et al.* (2022) and Veeravishnu *et al.* (2023) for 100-kernel weight and Sondarava *et al.* (2025) for grain yield per plant.

Moderate heritability coupled with moderate genetic advance as a percent of mean was observed for traits such as ear length, ear girth, number of kernel rows per ear and SPAD chlorophyll meter reading (SCMR). This pattern indicates the influence of non-additive gene effects in the expression of these traits. The results obtained in the present study are in conformity with the findings of Reddy *et al.* (2022) for ear length and ear girth; Patil *et al.* (2016) for number of kernel rows per ear and Sravani *et al.* (2021) for SPAD chlorophyll meter reading (SCMR).

Days to 50% silking showed high heritability accompanied by low genetic advance, indicating the involvement of both additive and non-additive gene effects and suggesting limited scope for improvement through direct selection. Comparable results have been reported by Reddy *et al.* (2022), Korsa *et al.* (2024) and Gogoi *et al.* (2025). In contrast, the anthesis–silking interval exhibited

moderate heritability with high genetic advance, reflecting the combined influence of additive and non-additive gene actions in its inheritance. These findings are in accordance with those of Reddy *et al.* (2022) and Khan *et al.* (2024).

Moderate heritability accompanied by low genetic advance as a percent of mean was recorded for days to 50% anthesis and days

Table 1. List of inbred lines evaluated in the study Mean sum of squares

Entry	Inbreds/ Genotypes	Source of the material	Entry	Inbreds/ Genotypes	Source of the material
1	PL 22339	ARS, Peddapuram	26	PL 23030	ARS, Peddapuram
2	PL 22344	ARS, Peddapuram	27	PL 23150	ARS, Peddapuram
3	PL 22348	ARS, Peddapuram	28	PL 23153	ARS, Peddapuram
4	PL 22351	ARS, Peddapuram	29	PL 23239	ARS, Peddapuram
5	PL 22367	ARS, Peddapuram	30	PL 23042	ARS, Peddapuram
6	PL 22373	ARS, Peddapuram	31	PL 23044	ARS, Peddapuram
7	PL 22384	ARS, Peddapuram	32	PL 23058	ARS, Peddapuram
8	PL 22389	ARS, Peddapuram	33	PL 23059	ARS, Peddapuram
9	PL 22390	ARS, Peddapuram	34	PL 23066	ARS, Peddapuram
10	PL 22393	ARS, Peddapuram	35	PL 23077	ARS, Peddapuram
11	PL 22394	ARS, Peddapuram	36	PL 23089	ARS, Peddapuram
12	PL 22406	ARS, Peddapuram	37	PL 23090	ARS, Peddapuram
13	PL 22407	ARS, Peddapuram	38	PL 23091	ARS, Peddapuram
14	PL 22408	ARS, Peddapuram	39	CML 72	CIMMYT
15	PL 22409	ARS, Peddapuram	40	CML 425	CIMMYT
16	PL 22410	ARS, Peddapuram	41	CML 451	CIMMYT
17	PL 22415	ARS, Peddapuram	42	CML 474	CIMMYT
18	PL 22422	ARS, Peddapuram	43	CML 574	CIMMYT
19	PL 22426	ARS, Peddapuram	44	CML 575	CIMMYT
20	PL 22429	ARS, Peddapuram	45	CML 577	CIMMYT
21	PL 22434	ARS, Peddapuram	46	CML 581	CIMMYT
22	PL 22439	ARS, Peddapuram	47	CML 582	CIMMYT
23	PL 22441	ARS, Peddapuram	48	CML 595	CIMMYT
24	PL 22448	ARS, Peddapuram	49	LM 13	PAU, Ludhiana
25	PL 23012	ARS, Peddapuram	50	LM 14	PAU, Ludhiana

Table 2. Analysis of variance for 13 characters under study in 50 inbred lines of maize (*Zea mays* L.)

Source of variation	DF	DFA	DFS	ASI	DM	PH	EH	EL	EG	NKPE	NKPR	HKW	GYPP	SCMR
Replications	1	42.25	7.84	0.25	44.92	597.51	22.49	6.02	2.90	3.42	21.72	16.31	55.25	35.08
Treatments	49	19.58*	20.06**	0.32**	42.08*	1200.20**	381.28**	7.47**	3.80**	3.77**	41.65**	163.42**	1068.19**	55.95**
Blocks within replications	18	8.54	5.69	0.10	25.03	292.20	9.25	3.97	1.39	2.11	15.97	7.74	24.01	18.79
Error	31	10.05	4.90	0.11	19.36	260.81	12.47	2.24	1.29	1.47	7.05	7.26	29.81	15.66
Total	99	80.42	38.48	0.78	131.38	2350.72	425.48	19.70	9.38	10.76	86.39	194.71	1177.25	125.48

DF: Degrees of freedom Where * and ** significant at 5% and 1% level of significance respectively

DFA- Days to 50% anthesis, **DFS**-Days to 50% silking, **ASI**-Anthesis silking interval (days), **DM**-Days to maturity, **PH**-Plant height (cm), **EH**-Ear height (cm), **EL**-Ear length (cm), **EG**-Ear girth (cm), **NKPE**-Number of kernel rows per ear, **NKPR**-Number of kernels per row, **HKW**-100-kernel weight (g), **SPAD** Chlorophyll Meter Reading (SCMR), **GYPP**-Grain yield per plant (g)

to maturity, suggesting the predominance of non-additive gene action in the expression of these traits. The observed moderate heritability is likely attributable to environmental influences rather than inherent genetic variability among the inbred lines, indicating that direct selection may be less effective for their improvement. These findings are consistent with the reports of Pradhan *et al.* (2022) for days to 50% anthesis and Kinfe and Tsehaye (2015) and Patil *et al.* (2016) for days to maturity.

CONCLUSION

The analysis of variance revealed significant differences among the inbred lines, while higher PCV than GCV for all traits indicated environmental influence on their expression. High PCV and GCV values for ear height, 100-kernel weight and grain yield per plant reflected substantial variability, suggesting good scope for improvement through selection. Furthermore, high heritability coupled with high genetic advance for plant height, ear height, number of kernels per row, 100-kernel weight and grain yield per plant indicated the predominance of additive gene action. Hence, these traits are heritable and amenable to effective improvement through direct selection.

REFERENCES

- *Burton, G.W. 1952. Quantitative inheritance in grasses. Proceedings of 6th International Grassland Congress. 277-283.
- Damtie, Y., Assefa, G. and Mulualem, T. 2021. Genetic variability heritability trait associations and path coefficient analysis of maize (*Zea mays* L.) inbred lines at Pawe North western Ethiopia. Pelagia Research Library, 11 (2): 57-64.

Table 3. Estimates of genetic parameters for 13 characters under study in 50 inbred lines of maize (*Zea mays* L.)

S.No.	Character	Mean	Range		Coefficient of variation		Heritability (broad sense) (%)	Genetic advance as % of mean
			Minimum	Maximum	GCV (%)	PCV (%)		
1	Days to 50% anthesis	66.15	58.50	72.00	3.30	5.82	32.15	3.85
2	Days to 50% silking	68.46	60.50	74.50	4.02	5.16	60.75	6.46
3	Anthesis silking interval (days)	2.31	2.00	3.00	14.07	20.24	48.29	20.14
4	Days to maturity	119.20	110.50	128.50	2.83	4.65	36.99	3.54
5	Plant height (cm)	135.50	77.33	190.35	15.99	19.95	64.30	26.42
6	Ear height (cm)	53.15	27.27	83.00	25.55	26.40	93.67	50.94
7	Ear length (cm)	13.88	10.15	17.42	11.64	15.87	53.83	17.60
8	Ear girth (cm)	12.06	9.32	14.61	9.29	13.22	49.34	13.44
9	Number of kernel rows per ear	13.80	10.80	16.90	7.78	11.73	43.97	10.62
10	Number of kernels per row	21.75	10.10	29.95	19.12	22.68	71.04	33.20
11	100 kernel weight (g)	28.07	12.66	56.36	31.48	32.91	91.50	62.03
12	Grain yield per plant (g)	58.15	13.38	53.00	39.19	40.30	94.57	78.50
13	SPAD Chlorophyll Meter Reading (SCMR)	39.22	24.91	50.84	11.44	15.26	56.25	17.68

Ghorpade, T.R., Misal, A.M., Umate, S.M., Kalpande, H.V and Rathod, A.H. 2025. Studies on genetic variability, heritability and genetic advance in maize (*Zea mays* L.) inbred lines. International Journal of Advanced Biochemistry Research. 9 (8): 1639-1642.

Gogoi, D., Bordoloi, D., Sarma, A and Barua, N.S. 2025. Correlation and path analysis of early inbred lines of maize (*Zea mays* L.) for yield and yield related traits. Indian Journal of Plant Genetic Resources, 38 (01): 123-130.

Johnson, H.W., Robinson, H.F and Comstock, R.E. 1955. Estimates of genetic and environmental variability in soybean. Agronomy Journal. 47: 314-318.

Khan, S.A., Iqbal, A.M., Shikari, A.B., Dar, Z.A., Wani, M.A., Mahdi, S.S., Waza, S., Ahanger, M.A., Bangroo, S and Islam, N. 2024. Diversity analysis of highland temperate maize (*Zea mays* L.) inbred lines. SKUAST Journal of Research. 26 (1): 38-45.

- Kinfe, H. and Tsehay, Y. 2015. Studies of heritability, genetic parameters, correlation and path coefficient in elite maize hybrids. *Academic Research Journal of Agricultural Science and Research*,3 (10): 296-303.
- Korsa, F., Dessalegn, O., Zeleke, H and Petros, Y. 2024. Genetic variability for the yield and yield related traits in some maize (*Zea mays* L.) inbred lines in the Central Highland of Ethiopia. *International Journal of Agronomy*. 1: 1-13.
- Panase, V. G and Sukhatme, P. V. 1978. *Statistical Methods for Agricultural Workers*, ICAR, New Delhi.
- Patil, S.M., Kumar, K., Jakhar, D.S., Rai, A., Borle, U.M. and Singh, P. 2016. Studies on variability, heritability, genetic advance and correlation in maize (*Zea mays* L.). *International Journal of Agriculture, Environment and Biotechnology*, 9 (6): 1103-1108.
- Pradhan, P., Thapa, B., Ghosh, A., Subba, V., Sahu, C.R and Kundagrami, S. 2022. Genetic variability assessment on yield attributing traits in maize (*Zea mays* L.) inbred lines. *The Pharma Innovation Journal*. 11 (5): 1642-1645.
- Rani, M., Anusha, C., Lavanya, G.R and Kiran, M.S. 2022. Genetic variability and interrelationship in maize (*Zea mays* L.) genotypes for grain yield and yield component characters. *International Journal of Environment and Climate Change*,12 (11): 3264-3271.
- Reddy, S.G.M., Lal, G.M., Krishna, T.V., Reddy, Y.V.S and Sandeep, N. 2022. Correlation and path coefficient analysis for grain yield components in maize (*Zea mays* L.). *International Journal of Plant & Soil Science*. 34 (23): 24-36.
- Samskriti, S., Sharma, D and Kandel, B.P. 2025. Genetic parameters estimation of promising maize hybrids in sundarbazar, lamjung. *Agricultura*, 134 (1-2): 133-134.
- Singh, S., Sudan, R.S., Kumar, B., Singh, P and Sharma, M. 2024. Genetic divergence in maize (*Zea mays* L.) inbred lines under subtropical conditions of Jammu region of India. *Plant Archives*, 24 (2): 1829-1836.
- Sondarava, P.M., Patel, M.B., Parmar, D.J., Borkhatariya, T.H., Vadodariya, J.M and Akbari, K.M. 2025. Appraisal of genetic variability, heritability and genetic advance for quantitative traits in maize (*Zea mays* L.). *Horizon*,3 (2): 22-29.
- Sravani, D., Bharathi, D., Reddi Sekhar, M. and Nirmal Kumar, A.R. 2021. Estimation of genetic parameters for quantitative traits in maize (*Zea mays* L.) inbred lines. *The Pharma Innovation Journal*, 10 (8): 501-503.
- Veeravishnu, S., Sudhir Kumar, I., Harish Chanar S.R., Pushpalatha, G and Krishnam Raju, K. 2023. Genetic variability and association studies for grain yield and its component traits in maize (*Zea mays* L.) inbreds. *The Pharma Innovation Journal*,12 (5): 295-299.

Yogitha,S.N., Satish, Y., Pushpa reni, Y. and Vijaya kumar, G. 2026. Assessment of genetic parameters in maize (*Zea mays* L.) for yield and associated traits. *The Journal of Research ANGRAU*,54(2):15-21

EFFECT OF VARIETIES AND SOWING WINDOWS ON PRODUCTIVITY AND NUTRIENT UPTAKE OF FODDER OAT

C.LAKSHMI *, S.TIRUMALA REDDY, P. MAHESWARA REDDY, CH.BHARGAVA RAMI REDDY and V.CHANDRIKA

Department of Agronomy, S.V. Agricultural College, Tirupati-517 502,
Acharya N. G. Ranga Agricultural University, Guntur, Andhra Pradesh, India

Date of Receipt : 15-04-2026

Date of Acceptance : 09-06-2026

ABSTRACT

A field experiment was conducted during *rabi*, 2024-25 on sandy clay loam soils of dryland farm, S.V. Agricultural College, Tirupati, with the objective to find out optimum time of sowing and yield parameters of fodder oat in Southern Agro-Climatic Zone of Andhra Pradesh. The experiment was laid in the randomized block design with factorial concept and replicated thrice. Treatments include three varieties viz., V_1 : RO-11-1, V_2 : OS-403 and V_3 : OS-6 with five sowing windows viz., S_1 : October I FN, S_2 : October II FN, S_3 : November I FN, S_4 : November II FN and S_5 : December I FN. The results showed that the significantly higher green (18104 kg ha^{-1}) and dry fodder yield (4735 kg ha^{-1}) and N, P and K uptake by the crop at harvest (142 kg ha^{-1} , 21.6 kg ha^{-1} and 138 kg ha^{-1} respectively) were obtained with RO-11-1 sown during November II FN. The available N, P_2O_5 and K_2O in the soil (208 kg ha^{-1} , 53.6 kg ha^{-1} and 223 kg ha^{-1} respectively) at harvest recorded higher with OS-403 sown during October I FN compared to all other treatments.

Keywords: Fodder oat, Nutrient uptake, Productivity, Sandy loam soils, Sowing windows

INTRODUCTION

Livestock is a vital component of Indian agriculture, contributing 25.6% to the agricultural GDP and supporting nearly 58% of the population through allied sectors like poultry and fisheries. Despite being the world's top milk producer and home to 57.3% of global buffalo and 14.7% of cattle populations (Anonymous, 2019), India faces a critical shortage of quality feed and fodder up to 40% for green fodder and 23% for dry fodder. Only 4.4% of agricultural land is dedicated to fodder cultivation, creating a significant gap between demand and supply.

Oat (*Avena sativa* L.), a nutrient-rich *rabi* fodder crop, has the potential to address this fodder deficit, particularly in the Southern regions of India where it is not traditionally grown and widely cultivated in north-western India under irrigated and cool conditions. It is soft, palatable and highly nutritious rich in protein, fibre, essential amino acids like lysine and minerals. Oat is a dual-purpose crop used for food and fodder. Its quick growth, high biomass and suitability for green fodder, silage or hay make it a valuable choice. However, productivity is influenced by varietal performance and sowing time, with both early

*Corresponding Author Email: clakshmi01112000@gmail.com

and late sowing reduce yields. To promote oat cultivation in non-traditional areas like southern India, awareness of improved production practices and climatic adaptability is essential.

Efficient nutrient uptake is a critical determinant of crop growth, yield and quality particularly in fodder crops like oat (*Avena sativa* L.), which are cultivated for their high biomass and nutritional value. Oat, being a fast-growing and nutrient-demanding crop, requires a balanced and timely supply of essential nutrients to achieve optimal fodder yield and quality. Among these, nitrogen (N), phosphorus (P) and potassium (K) are the most influential macronutrients affecting plant metabolism, chlorophyll synthesis, root development and dry matter accumulation. Monitoring nutrient uptake and soil nutrient status at harvest helps assess fertilization efficiency, variety performance and nutrient depletion. Since nutrient uptake is closely associated with environmental factors, it is essential to evaluate how different sowing times and varieties influence the absorption and utilization of nutrients in fodder oats. Moreover, understanding the changes in soil nutrient availability at harvest helps in developing location specific nutrient management strategies that ensure sustainable fodder production without exhausting soil reserves.

MATERIAL AND METHODS

The investigation was carried out during *rabi*, 2024-25 on sandy loam soils of dryland farm of S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The soil was neutral in reaction (6.8 pH), low in available nitrogen (220 kg ha⁻¹), medium in available phosphorus (34 kg ha⁻¹) and medium in available potassium (249 kg ha⁻¹) status. The field experiment was conducted with randomised block design with

factorial concept consisting of fifteen treatments and replicated thrice. Treatments include three varieties viz., V₁: RO-11-1, V₂: OS-403 and V₃: OS-6 with five sowing windows viz., S₁: October I FN, S₂: October II FN, S₃: November I FN, S₄: November II FN and S₅: December I FN. The crop was sown at 30 x 10 cm spacing with a seed rate of 100kg ha⁻¹. Recommended dose of fertilizer was 80 – 40 – 30 N, P₂O₅ & K₂O kg ha⁻¹, entire dose of phosphorus and potassium fertilizers were applied as basal at the time of sowing whereas nitrogen was applied in split application, 50% of N was applied as basal and 50% was applied as top dressing at 30 DAS. Irrigation and weeding were done as and when required. All the growth parameters viz., plant height, leaf: stem ratio, leaf area index and dry matter production were recorded before harvesting of the crop. The crop was harvested for green fodder at 50% flowering stage, where the quality parameters like crude protein and crude fibre content at their peak stages. A fresh sample taken from each treatment at harvest stage was oven dried to a constant weight, ground and subsequently used for quality analysis. The data collected on various crop parameters were statistically evaluated using the randomised block design with factorial concept method.

Green fodder yield of forage oat from the net plot area was taken separately by leaving 5 cm stubbles from ground surface and expressed in kg ha⁻¹. After harvesting fodder oat from net plot area, heaps were left in the field for one week for sun drying. Then dry fodder yield of oat from net plot area was weighed and total dry fodder yield was expressed in kg ha⁻¹. Nutrient uptake was estimated by taking the whole plant at harvesting stage, then dried and analysed for nutrient content. The nutrient uptake was calculated using the following formula:

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient content (\%)} \times \text{Dry matter production (kg ha}^{-1}\text{)}}{100}$$

Post-harvest soil nutrient status was estimated by taking the soil samples at 0-15 cm depth from each treatment plot after harvest of the crop and analysed for chemical properties by using Alkaline potassium permanganate method for available nitrogen, Olsen's method for available phosphorous and Flame photometry for available potassium in the soil.

RESULTS AND DISCUSSION

Data pertaining to growth parameters, yield, N, P and K uptake by fodder oat and post-harvest soil nutrient status at harvest as influenced by varieties and sowing windows was discussed here under.

Growth parameters, green and dry fodder yield

Critical observation of the data, (Table 1) revealed that all the growth parameters of fodder oat at harvest viz., plant height, leaf to stem ratio, leaf area index and dry matter production significantly recorded higher values by the variety RO-11-1 among the varieties evaluated. The lowest values of these growth parameters were registered with OS-403 variety which was comparable with that of OS-6. The difference in growth parameters among the varieties might be due to their genetic makeup and environment adaptability during the crop growth period. These findings are similar to Murali *et al.*, (2021) and Koushal *et al.*, (2024).

Among the sowing windows tried, significantly taller plants, higher leaf to stem ratio, higher leaf area index and higher dry matter production at harvest were noticed with

fodder oat sown during November II FN, while all these parameters were at their lowest during October I FN (Table 1). This might be attributed to better growth response of fodder oat because of availability of optimum temperature (Max.Temp-29.9 °C, Min.Temp-17.7°C), relative humidity (67.6%) and suitable photoperiod (5.9 h day⁻¹) that prevailed during the crop growth period. Similar results were obtained by Kumar *et al.*, (2021) and Megharaja *et al.*, (2023).

The variety RO-11-1 registered higher green and dry fodder yield which was significantly higher than the variety OS-6, while OS-403 registered the lower green and dry fodder yield which was statistically similar to that of OS-6 (Table 1). Increase in green and dry fodder yield of RO-11-1 than other varieties could be attributed to its genetic potentiality resulting in better performance of growth and yield parameters. Further, the performance of RO-11-1 variety in producing higher values of plant height, leaf area and leaf to stem ratio has resulted in increased accumulation of photosynthates which were directly related to the production of bulk herbage. Similar results were obtained by Kashyap *et al.*, (2022), Samal *et al.*, (2023), Jindal *et al.*, (2024) and Satpal *et al.*, (2024).

November II FN sown crop recorded significantly higher green and dry fodder yield over other sowings. The next best treatment was December I FN followed by November I FN and October II FN with significant disparity among them. The lower green and dry fodder yield was recorded during October I FN (Table 1). The higher green and dry fodder yields were recorded during November II FN might be due to congenial microclimate and macroclimate that might have led into luxuriant vegetative growth in the forms of plant height, leaf stem ratio, leaf area index and dry matter accumulation where these parameters

Table 1. Growth parameters, green and dry fodder yield of fodder oat at harvest as influenced by varieties and sowing windows

Treatments	Plant height (cm)	Leaf: stem ratio	Leaf area index	Dry matter production (kg ha ⁻¹)	Green fodder yield (kg ha ⁻¹)	Dry fodder yield (kg ha ⁻¹)
Varieties						
V ₁ : RO-11-1	102	0.64	1.43	2728	12538	3643
V ₂ : OS-403	94	0.53	1.27	2360	11467	2648
V ₃ : OS-6	95	0.58	1.31	2401	11558	2710
SEm±	1.4	0.014	0.027	42.7	176	87
CD (P=0.05)	4	0.04	0.08	124	510	254
Sowing windows						
S ₁ : October I FN	83	0.44	0.94	820	3335	829
S ₂ : October II FN	89	0.51	1.21	1484	5966	1502
S ₃ : November I FN	97	0.58	1.34	2972	14513	3581
S ₄ : November II FN	112	0.72	1.67	3807	18104	4735
S ₅ : December I FN	104	0.65	1.53	3398	17354	4354
SEm±	1.8	0.018	0.035	55.1	227	113
CD (P=0.05)	5	0.05	0.10	160	659	328
Varieties×Sowing windows						
SEm± 3.2	0.031	0.060	95.5	394	195	
CD (P=0.05)	NS	NS	NS	NS	NS	NS

ultimately lead to higher fodder yield compared to remaining sowing windows. These results were in conformity with the findings of Kumar *et al.*, (2021), Murali *et al.*, (2021), Megharaja *et al.*, (2023) and Samal *et al.*, (2024).

Nutrient uptake

Nutrient uptake of fodder oat varieties revealed that maximum nitrogen, phosphorus and potassium uptake was observed with RO-11-1 which was significantly higher than variety OS-6. Whereas, the uptake levels were at their minimum with OS-403, which was on par with OS-6 variety (Table 2 & Fig 1). The differences in the genetic makeup of varieties might have

resulted into varied root geometry and concomitant nutrient mobilization potential through root exudates which leads to differences in nutrient content and finally uptake in oat. The present findings corroborate with that of Satpal *et al.*, (2018) and Samal *et al.* (2023).

Among the sowing windows tried, November II FN sown crop resulted in significantly higher nitrogen, phosphorus and potassium uptake, while the lowest values were registered during October I FN (Table 2). The increased nutrient uptake might be due to favourable weather conditions that prevailed

Table 2. Nutrient uptake (kg ha⁻¹) of fodder oat at harvest as influenced by varieties and sowing windows

Treatments	Nitrogen	Phosphorus	Potassium
Varieties			
V ₁ : RO-11-1	127	16.6	109
V ₂ : OS-403	98	14.3	80
V ₃ : OS-6	102	15.2	84
SEm±	2.8	0.30	2.4
CD (P=0.05)	8	0.9	7
Sowing windows			
S ₁ : October I FN	71	11.2	53
S ₂ : October II FN	92	12.5	67
S ₃ : November I FN	109	14.1	86
S ₄ : November II FN	142	21.6	138
S ₅ : December I FN	128	17.4	114
SEm±	3.6	0.38	3.2
CD (P=0.05)	10	1.1	9
Varieties × Sowing windows			
SEm±	6.3	0.66	5.5
CD (P=0.05)	NS	NS	NS

during crop period which enhanced dry matter accumulation. This in turn, improved nutrient absorption from the soil and led to greater nutrient accumulation in the plants. The results were in conformity with the findings of Kadam *et al.* (2020), Kumar *et al.*, (2021) and Samal *et al.*(2023).

Post-harvesting soil nutrient status

The data presented on post-harvest soil available nutrient status of nitrogen, phosphorus and potassium revealed that significantly higher values registered with variety OS-403, which was comparable with OS-6, while the lower nutrient status of all the above nutrients was observed with variety RO-11-1 (Table 3 & Fig 2). The variations in varieties might be due to the variations in their

uptakes. Varieties which recorded significantly higher biomass yield have the increased nutrient uptake which ultimately resulted in lower soil available nutrient status.

With regard to sowing windows, October I FN sown crop recorded significantly higher post-harvest soil available nutrients followed by October II FN, November I FN and December IFN with significant difference among them. The lower values were registered during November II FN (Table 3).The higher availability of available nutrients in the soil during October I FN might be due to micro and macro climate prevailed during the crop growth period. Similar results were collaborated with findings of Kadam *et al.* (2020) and Kumar *et al.* (2021).

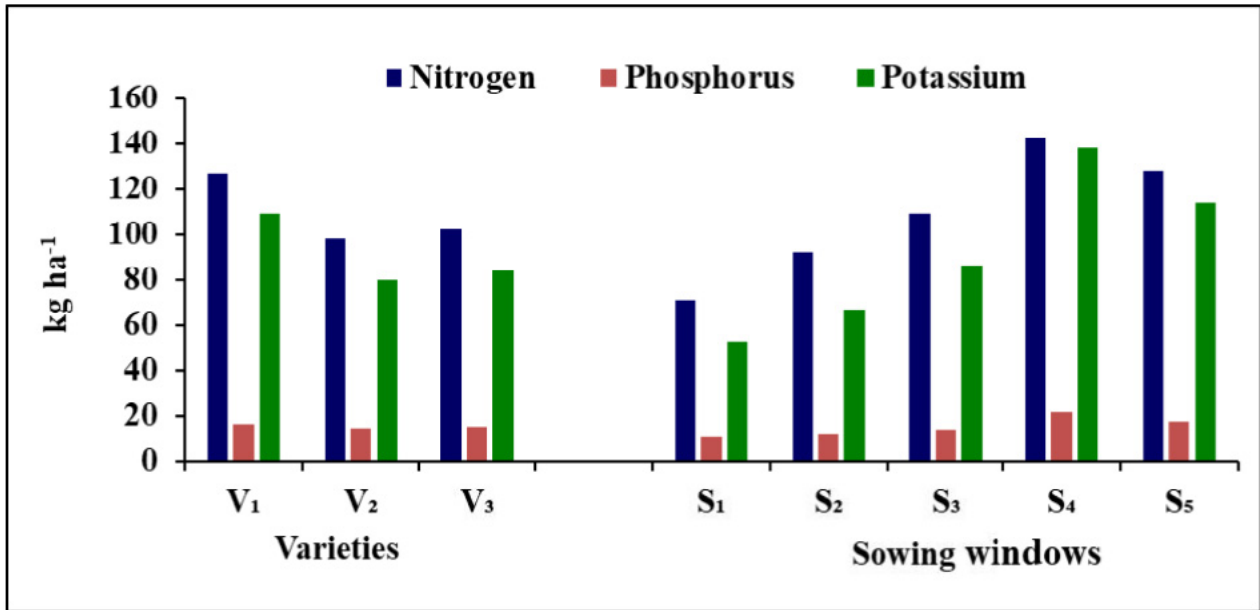


Fig. 1. Nutrient uptake (kg ha^{-1}) of fodder oat at harvest as influenced by varieties and sowing windows.

Table 3. Post-harvest soil available nutrient status (kg ha^{-1}) of fodder oat as influenced by varieties and sowing windows

Treatments	Available N	Available P_2O_5	Available K_2O
Varieties			
V ₁ : RO-11-1	153	42.5	169
V ₂ : OS-403	184	50.3	192
V ₃ : OS-6	176	48.5	186
SEm $\pm$	3.9	0.75	4.2
CD (P=0.05)	11	2.2	12
Sowing windows			
S ₁ : October I FN	208	53.6	223
S ₂ : October II FN	192	50.9	209
S ₃ : November I FN	173	47.1	187
S ₄ : November II FN	132	39.6	135
S ₅ : December I FN	152	44.4	158
SEm $\pm$	5.0	0.97	5.4
CD (P=0.05)	15	2.8	16
Varieties $\times$ Sowing windows			
SEm $\pm$	8.7	1.68	9.3
CD (P=0.05)	NS	NS	NS

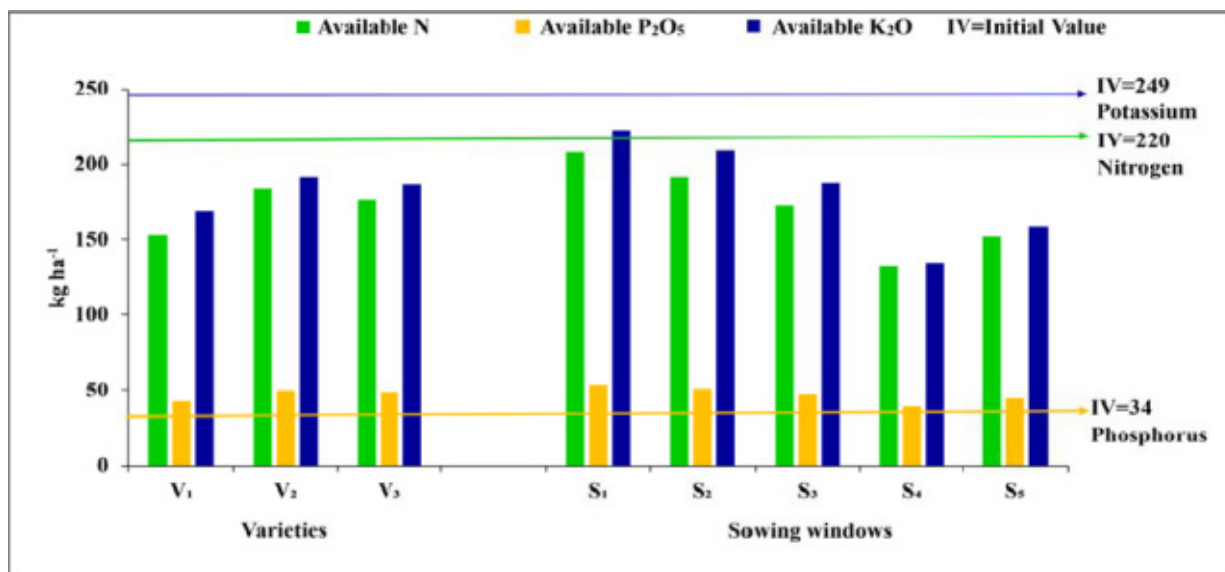


Fig. 2. Post-harvest soil available nutrient status (kg ha^{-1}) of fodder oat as influenced by varieties and sowing windows.

CONCLUSION

The variety RO-11-1 sown during November II FN was found to be most efficient to obtain better growth parameters, higher yield (green fodder (18104 kg ha^{-1}) and dry fodder yield (4735 kg ha^{-1})), higher nutrient uptake by the crop (N, P and K uptake (142 kg ha^{-1} , 21.6 kg ha^{-1} and 138 kg ha^{-1} respectively) and available N, P_2O_5 and K_2O in the soil (208 kg ha^{-1} , 53.6 kg ha^{-1} and 223 kg ha^{-1} respectively) at harvest recorded higher with OS-403 variety of fodder oat sown during October I FN in the Southern Agroclimatic Zone of Andhra Pradesh.

REFERENCES

- Anonymous. 2019. 20th Livestock Census, Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying. Govt. of India. [online] Available from: <https://pib.gov.in/>
- Jindal, Y., Phogat, D.S., Thakral, N.K., Satpal and Tokas, J. 2024. HFO 427: A single-cut oat variety for South zone of India. Forage Research, 50(2): 228-231.
- Kadam, S.S., Solanki, N.S., Arif, M., Dashora, L.N and Upadhyay, B. 2020. Growth, yield and economics of dual purpose oats (*Avena sativa* L.) as affected by sowing time, cutting schedules and nitrogen levels. Range Management and Agroforestry, 41(1): 87-93.
- Kashyap, S., Jha, S., Pandey, N and Chandravanshi, M. 2022. Forage yield and quality of single cut fodder oats (*Avena sativa* L.) under different nitrogen levels in Chhattisgarh plains. Forage Research, 48(3): 372-374.
- Koushal, S., Mahajan, A.Y., Singh, A., Hazarika, S and Sharma, R. 2024. Comparative analysis of growth and seed yield among different oat varieties. Plant Archives, 24(2): 1445-1451.
- Kumar, G.S., Jayaramaiah, R., Koler, P and Bhairappanavar, S.T. 2021. Influence of dates of sowing and nitrogen on yield, quality parameters, nutrient uptake and economics of fodder oats in Southern transition zone of Karnataka. Mysore Journal of Agricultural Sciences, 55(1): 16-23.

- Megharaja, R.H., Sinare, B.T., Danawale, N.J., Andhale, R.P., Damame, S.V., Patil, M.R and Reddy, V. 2023. Effect of sowing windows and cutting management on growth and seed yield of oat (*Avena sativa* L.). Pharma Innovation Journal, 12(2): 968-72.
- Murali, B., Susheela, R., Shanti, M and Shashikala, T. 2021. Effect of time of sowing, seed rate and cultivar on oat green fodder, dry matter and crude protein yield. Indian Journal of Animal Nutrition, 38(4): 400-406.
- Samal, R.P., Nanda, G., Kumar, M and Sattar, A. 2023. Yield, quality and profitability of fodder oat varieties in response to different dates of sowing. Forage Research, 48(4): 477-481.
- Samal, R.P., Nanda, G., Sattar, A. and Kumar, M. 2024. Productivity and thermal requirement of fodder oat varieties under different micro-environments in Bihar. Indian Journal of Agronomy, 69(2): 223-227.
- Satpal., Sheoran, R.S., Tokas, J. and Jindal, Y. 2018. Quality, yield and economics of oat (*Avena sativa* L.) genotypes for fodder under different nitrogen levels. International journal of chemical studies, 6(1):1987-1991.
- Samal, R.P., Nanda, G., Kumar, M and Sattar, A. 2023. Yield, quality and profitability of

Lakshmi, C., Tirumala Reddy, S., Maheswara Reddy, P., Bhargava Ramireddy, Ch. and Chandrika, V. 2026. Effect of varieties and sowing windows on productivity and nutrient uptake of fodder oat. The Journal of Research ANGRAU, 54(2) : 22-29

GENETIC VARIABILITY STUDIES FOR YIELD AND ITS ATTRIBUTES, QUALITY AND NUTRITIONAL TRAITS IN MEDIUM DURATION RICE GENOTYPES (*Oryza sativa* L.)

V. MADHUSUDHAN REDDY *, Y. SUNEETHA and C. N. NEERAJA

Department of Genetics and Plant Breeding, Agricultural College, Bapatla-522 101,
Acharya N.G. Ranga Agricultural University, Guntur, Andhra Pradesh, India.

Date of Receipt : 30-04-2026

Date of Acceptance : 19-06-2026

ABSTRACT

The experiment was conducted during *kharif*, 2024 at Regional Agricultural Research Station, Maruteru. Sixty-four genotypes of medium duration rice (*Oryza sativa* L.) were evaluated for genetic variability, heritability and genetic advance as per cent of mean for 15 quantitative traits. Analysis of variance revealed significant differences for all the characters under study. High genotypic coefficient of variation (GCV) 21.000% and phenotypic coefficient of variation (PCV) 20.642% were observed for the character *viz.*, grains per panicle. High heritability coupled with high genetic advance as percent mean was observed for grains per panicle, no of grains per cm panicle, grain density, test weight, grain yield per plant and high protein content indicating the effectiveness of simple selection in improvement of these traits.

Key words: GCV, Genetic variability, Genetic advance, Heritability, PCV and Rice

INTRODUCTION

Rice (*Oryza sativa* L., $2n=24$) is a self-pollinating cereal crop that belongs to the Poaceae family and the Cyperales order. Rice is widely cultivated in tropical and subtropical regions worldwide. Over half of the global population relies on rice as a staple food, and it is typically consumed in large quantities in the countries where it is produced. China is the leading producer of rice and India is second largest producer of rice. Rice is a primary staple food in South and Southeast Asia, where 90% of the world's rice is both produced and consumed. In India, rice is cultivated in 514.23 lakh hectares yielding 1490.70 lakh tons with an average productivity of 2899 kg per hectare (www.Indiastat.com, 2024-25). In Andhra Pradesh, rice is grown on 20.75 lakh hectares,

producing 80.16 lakh tons, with a productivity of 3863 kg per hectare (www.Indiastat.com, 2024-25).

Adequate genetic variability is considered a critical requirement for any crop improvement program. The extent of variation in quantitative traits is often assessed using genetic parameters like the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV). These measures also help indicate how much environmental factors influence the expression of these traits. In some cases, phenotypic selection based on performance may not be effective, as genotypes may perform poorly in subsequent segregating generations. The genotypic coefficient of variation indicates the extent of genetic variability and represents the

*Corresponding Author Email: madhuvenna156@gmail.com; Part of research work for M.Sc. thesis submitted to Acharya NG Ranga Agricultural University, Lam, Guntur.

heritable portion of the variability. Therefore, selecting genotypes based on heritability and genetic advance is crucial. By assessing genetic variability along with heritability estimates, it becomes possible to predict the genetic gain that can be expected through selection (Burton and Devane, 1953). Hence, evaluating variability in grain yield, its attributes, quality, and nutritional parameters in rice genotypes is vital for developing selection criteria to enhance yield through breeding.

MATERIAL AND METHODS

The present study was conducted during *kharif*, 2024 at Regional Agricultural Research Station, Maruteru, Andhra Pradesh. The experimental material used in the present study comprised of 64 genotypes (*Oryza sativa* L.) developed by ANGRAU with different genetic backgrounds. Among the 64 genotypes, BPT 3082 was obtained from ARS, Bapatla while remaining genotypes from RARS, Maruteru. The experiment was laid in Simple lattice design with two replications adopting 20cm x15cm spacing. To ensure healthy crop stand recommended agronomic practices and integrated plant protection measures were diligently implemented all through the evaluation time. Data was recorded for 15 characters *viz.*, days to 50% flowering, days to maturity, plant height (cm), ear bearing tillers per plant, panicle length (cm), grains per panicle (cm), no of grains per cm panicle, grain density (g/cm^3), test weight (g) and grain yield per plant (g). Quality parameters are head rice recovery (%), kernel length (mm), kernel breadth (mm), kernel L/B ratio and nutritional parameter protein content (%). The data was statistically analysed to estimate Phenotypic Coefficient of Variation (PCV) and Genotypic Coefficient of Variation (GCV) as indicated by Burton and Devane (1953). Heritability in broad sense was computed as the ratio of genetic

variance to the total phenotypic variance and narrow sense heritability was the ratio of additive genetic variance to the total phenotypic variance as suggested by Lush (1949) and genetic advance as percent of mean was calculated based on the formula Genetic Advance (GA) = $Kx \sigma_p^2$ which was given by Jhonson *et al.* (1955). The statistical analysis was done using INDOSTAT version 9.50.

RESULTS AND DISCUSSION

Analysis of Variance

Analysis of variance indicated significant differences among the genotypes for all the characters under study indicating the existence of sufficient amount of variability in the genotypes studied (Table 1). The phenotypic coefficient of variation (PCV) was slightly higher in magnitude than genotypic coefficient of variation (GCV) for all the characters (Table 2) indicating that the apparent variation was not only due to genotypes but also due to influence of environment.

Phenotypic and Genotypic Coefficients of Variation

The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were high for grain per panicle similar results were obtained by Singh *et al.* (2020a). The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were low for days to 50 percent flowering, days to maturity, plant height, panicle length, head rice recovery, kernel length, kernel breadth and kernel L/B ratio. The results are in agreement with Anusha *et al.* (2024) for days to 50 percent flowering, Harsharaj *et al.* (2024) for days to Maturity, Devi *et al.* (2022) for plant height, Gnaneswari *et al.* (2023) for panicle length, Lingaiah *et al.* (2018) for head rice recovery, Usha *et al.* (2024) for kernel length,

Table 1. Analysis of variance for grain yield, yield components, quality and nutritional traits in medium duration rice genotypes in rice (*Oryza sativa* L.)

Source	Df	Days to 50 per cent flowering	Days to maturity	Plant height	Ear bearing tillers per plant	Panicle length	Grains per panicle	No of grains per cm panicle	Grain density
Replication	1	7.508	7.508	2.915	4.133	0.003	56.445	0.125	0.000
Genotypes (Unadjusted)	63	46.387**	46.715**	141.992**	1.622**	6.380**	9420.199**	11.087**	0.026**
Blocks within Replication adjusted	14	2.722	2.722	2.885	0.731	0.210	60.285	0.232	0.000
Intra block Error	49	2.324	2.324	2.142	0.595	0.283	72.991	0.156	0.000

** Significant at 1 per cent level of probability

32

Source	Df	Test weight	Grain yield per plant	Head rice recovery	Kernel length	Kernel breadth	Kernel L/B ratio	Protein content
Replication	1	0.051	2.349	2.055	0.003	0.002	0.003	-0.002
Genotypes (Unadjusted)	63	16.653**	50.137**	37.779**	0.247**	0.036**	0.137**	2.240**
Blocks within Replication adjusted	14	0.008	2.562	0.147	0.001	0.000	0.001	0.000
Intra block Error	49	0.006	2.917	0.134	0.001	0.000	0.001	0.001

** Significant at 1 per cent level of probability

Table 2. Estimates of genetic parameters for yield attributing, quality and nutritional traits in 64 medium duration rice genotypes

S.No.	Characters	Mean	Range		Coefficient of variation		Heritability (%)	Genetic advance as per cent of mean
			Minimum		Maximum			
			Minimum	Maximum	PCV (%)	GCV (%)		
1.	Days to 50 % flowering	106	96	119	3.849	5.169	55.451	5.905
2.	Days to maturity	136	126	149	3.077	3.990	59.467	4.887
3	Plant height (cm)	134.35	108.6	146.7	6.067	6.470	87.909	11.717
4	Ear bearing tillers per plant	10	8	14	6.599	10.093	42.749	8.889
5	Panicle length (cm)	27.25	22.8	31.22	6.415	6.689	91.953	12.671
6	Grains per panicle	330	175	477	20.642	21.000	96.621	41.797
7	No of grains per cm panicle	12.11	6.07	16.7	19.277	19.486	97.872	39.286
8	Grain density (gm/cm³)	0.6	0.38	0.89	18.958	19.115	98.356	38.731
9	Test weight (g)	16.18	11.16	21.29	16.908	18.705	81.708	31.484
10	Grain yield per plant (g))	29.3	18.4	36	16.002	21.000	96.621	29.135
11	Head rice recovery (%)	60.14	49.3	68.65	6.851	7.583	81.631	12.752
12	Kernel length (mm)	5.34	4.52	6.19	6.440	6.729	91.596	12.697
13	Kernel breadth (mm)	1.83	1.61	2.15	7.153	7.499	90.979	14.054
14	Kernel L/B ratio	2.93	2.32	3.38	8.824	9.050	95.066	17.724
15	Protein content (%)	7.56	5.4	9.94	13.825	14.174	95.126	27.776

PCV: Phenotypic coefficient of variation

GCV: Genotypic coefficient of variation

Devi *et al.* (2019) for kernel breadth and Bandi *et al.* (2018) for kernel L/B ratio. The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were moderate to moderate for no of grains per cm panicle, grain density, test weight and protein content. The results are conformity with Lakshmi *et al.* (2020) for test weight. Moderate phenotypic and low genotypic co variance were characterized for ear bearing tillers per plant. The similar results were observed for Devi *et al.* (2022) and high phenotypic and moderate genotypic co variance reported for grain yield per plant by Nagajyothi (2001).

Heritability and Genetic Advance

Heritability estimates along with genetic advance as percent of mean would be more useful in predicting yield under phenotypic selection than heritability estimates alone as suggested by Johnson *et al.* (1955). High heritability coupled with high genetic advance as per cent of mean was observed for grains per panicle, no of grains per cm panicle, grain density, test weight, grain yield per plant and protein content. Similar results are conformity with Harsharaj *et al.* (2024) for grains per panicle, Suhana *et al.* (2023) for test weight, Bhargavi *et al.* (2021) for grain yield per plant and Rao *et al.* (2020) for protein content indicating the preponderance of additive gene action. High heritability coupled with moderate genetic advance as per cent of mean was observed for plant height, panicle length, head rice recovery, kernel length, kernel breadth and kernel L/B ratio. The results are in agreement with Sao *et al.* (2024) for plant height, Deepthi *et al.* (2022) for panicle length, Singh *et al.* (2020a) for head rice recovery, Priyanka (2021) for kernel length, Manivelan *et al.* (2022) for kernel L/B ratio indicating the preponderance of additive and non-additive gene action. Moderate heritability coupled with low genetic advance as per cent of mean for

days to 50 percent flowering, days to maturity and ear bearing tillers per plant. The above results are in conformity with Lingaiah *et al.* (2018) for days to 50 percent flowering, Singh *et al.* (2020a) for days to maturity and Devi *et al.* (2020) for ear bearing tillers per plant were indicating the role of both additive and non-additive gene action in governing the traits.

CONCLUSION

The present study revealed that the trait grains per panicle exhibited high phenotypic and genotypic coefficient of variation along with high heritability and high genetic advance, suggesting the presence of additive gene action. This trait can be effectively improved through direct phenotypic selection. High PCV and GCV values for no of grains per panicle reflected substantial variability, suggesting good scope for improvement through selection. High heritability coupled with high genetic advance as per cent mean was observed grains per panicle, no of grains per cm panicle, grain density, test weight, grain yield per plant and high protein content indicating the effectiveness of simple selection in improvement of these traits.

REFERENCES

- Anusha, K., Srinivas, B., Hari, Y., Shankar, V.G., Om Prakash, S. and Kumar, R.S. 2024. Genetic variability studies for yield and yield attributing traits in rice (*Oryza sativa* L.) Genotypes. Journal of Experimental Agriculture International, 46(8): 700-709.
- Bandi, H.R.K., Satyanarayana, P.V., Babu, D.R., Chamundeswari, N., Rao, V.S. and Raju, S.K. 2018. Genetic variability estimates for yield and yield component traits and quality traits in rice (*Oryza sativa* L.). International Journal of

Current Microbiology and Applied Sciences,7(5): 01-10.

- Bhargavi, M., Shanthi, P., Reddy, V. L. N., Mohan Reddy, D and Ravindra Reddy, B.2021. Estimates of genetic variability, heritability and genetic advance for grainyield and other yield attributing traits in rice (*Oryza sativa* L.). The Pharma Innovation Journal, 10 (5): 507-511
- Burton, G.W and Devane, E.M. 1953. Estimating heritability in tall Fescue (*Festuca arundinaceae*) from replicated clonal material. Agronomy Journal, 51:515-518.
- Deepthi, K.P., Mohan, Y.C., Hemalatha, V., Yamini, K.N and Singh, T.V.J. 2022. Genetic variability and character association studies for yield and yield related, floral and quality traits in maintainer lines of rice (*Oryza sativa* L.). The Pharma Innovation Journal, 11 (2): 191-197.
- Devi, K.R., Chandra, B.S., Hari,Y., Prasad, K.R., Lingaiah, N and Mohanrao, P.J.2020.Genetic divergence and variability studies for yield and quality traits in elite ricegeno types (*Oryza sativa* L.). Current Journal of Applied Science and Technology, 39(18): 29-43.
- Devi, K.R., Chandra, B.S., Venkanna, V and Hari, Y. 2019. Variability, correlation and path studies for yield and quality traits in irrigated upland rice (*Oryza sativa* L.).Journal of Pharmacognosy and Phytochemistry, 8 (6): 676-684.
- Devi, K.R., Hari, Y., Chandra, B.S and Prasad, K.R. 2022. Genetic association, variability and path studies for yield components and quality traits of high yielding rice (*Oryza sativa* L.) genotypes. International Journal of Bio-resource and Stress Management, 13 (1): 81-92.
- Gnaneswari, V.M., Krishnan, V., Anandhan, T., Vengadessan, V., Nadaradjan, S and Tamilzharasi, M. 2023. Assessment of genetic variability and diversity analysis in medium duration rice accessions. Electronic Journal of Plant Breeding, 14 (1) : 329-335.
- Harshraj, S., Ashutosh, K., Harmeet, S. J., Bal, K., Nilesh, T., Suhel, M and Pratiksha Pawar. 2024. Genetic variability, correlation and path-coefficient analysis for yield and yield attributing traits in aerobic rice (*Oryza sativa* L.). Electronic Journal of Plant Breeding,15(1): 226 - 232
- India Stat. Statistical Information About India. 2024-25. <https://www.indiastat.com>
- Johnson H.W., Robinson, H.E and Comstock R.E.1955. Estimation of genetic and environmental variability in soybean. Agronomy Journal,47:314-318.
- Lakshmi, V.G.I., Sreedhar, M., Gireesh, C and Vanisri, S. 2020. Genetic variability, correlation and path analysis studies for yield and yield attributes in African rice(*Oryza glaberrima* L.) germplasm. Electronic Journal of Plant Breeding,11 (2):399-404.
- Lingaiah, N., Sarla, N., Radhika, K., Venkanna, V., Reddy, D.V.V and Raju, S. 2018. Variability studies in F2 population of rice (*Oryza sativa* L.). International Journal of Agriculture Sciences,10 (9): 5956-5957.
- Lush,J.L.1949. Heritability of quantitative characters in farm animals. Proceeding of 8th Congress Genetics. Hereditas, 35: 356-375.

- Manivelan, K., Juliet Hepziba, S., Suresh, R., Theradimani, M., Renuka, R and Gnanamalar, R.P. 2022. Inherent variability, correlation and path analysis in lowland rice (*Oryza sativa* L.). Biological Forum–An International Journal, 14 (2): 771-778.
- Nagajyothi, B.2001. Studies on performance and heterosis of ricehy brids for yield, yield components and certain grain quality characters. M.Sc. (Ag) Thesis. Acharya N.G. Ranga Agricultural University, Hyderabad, India.
- Priyanka, K. 2021. Characterization of rice genotypes for morphological, physiological and quality traits. M.Sc (Ag.) Thesis. Acharya N.G. Ranga Agricultural University, Guntur, India.
- Rao, N.N.D., Roja, V., Rao, V.S and Rao, V.S. 2020. Assessment of genetic parameters for yield and nutrional traits in rice (*Oryza sativa* L.). Journal of Pharmacognosy and Phytochemistry, 9 (6): 1641-1646.
- Sao, A., Singh, G., Nair, S.K. and Harish, G.D., 2024. Estimation of genetic variability parameters for various yield attributing traits in germplasm collection of rice (*Oryza sativa* L). International Journal of Plant and Soil Science, 36(3):158-165
- Singh, K.S., Suneetha, Y., Kumar, G.V., Rao, V.S., Raja, D.S and Srinivas, T. 2020 a. Variability, correlation and pathstudies in coloured rice. International Journal of Chemical Studies, 8 (4):2138-2144.
- Suhana, T., Gabrial, M.L and Roopa, L.G. 2023. Assessment of genetic diversity of rice (*Oryza sativa* L.) under Prayagraj. International Journal of Plant & Soil Science,35(20): 732-746.
- Usha, M., Khoyumthem, P., Singh, K.N., Sinha, B and Singh, G. 2024. Genetic variability, correlation and path analysis studies for yield traits in stable mutant lines of black aromatic rice of Manipur. Electronic Journal of Plant Breeding, 15(1):170-177.

Madhusudhan Reddy, V., Suneetha, Y and Neeraja, C.N. 2026.Genetic variability studies for yield and its attributes, quality and nutritional traits in medium duration rice genotypes (*Oryza sativa* L.).The Journal of Research ANGRAU,54 (2) : 30-36

PARENTS' PERCEPTION OF PRESCHOOL EDUCATION AND THEIR ROLE IN CHILDREN'S EARLY LEARNING

GRACE ANN MATHEW* and NISHA VIKRAMAN

Department of Home Science, St. Teresa's College, (Autonomous)
Ernakulam, Kerala - 682 011

Date of Receipt : 02-02-2026

Date of Acceptance : 08-05-2026

ABSTRACT

The present study was carried out in 2023 and adopted a quantitative research design to assess parents perception on preschool education and their involvement in children's early learning. The area selected for the study was Ernakulam district of Kerala and the sample was 400 parents of 3 to 6-year-old children attending either preschool or Anganwadi that were selected through stratified random sampling. The findings showed that parents highly value preschool education and desire meaningful involvement, yet remain doubtful about giving early academic instruction. 80% of respondents agreed or strongly agreed that preschool is crucial. Strengthening parent-teacher partnerships, providing parental training on developmentally appropriate practices, and fostering opportunities for parents' participation may help bridge this gap.

Keywords: Early literacy, Parents' perception, Parental involvement, Parent teacher partnership, Preschool education

INTRODUCTION

Parental involvement is crucial to attain the full potential of Early Childhood Education. Parents serve as the first educators and play an essential role in the holistic development of a child. The importance of Early Childhood Education (ECE) has become increasingly recognized as crucial for shaping the future of individuals and societies around the globe. Children's formative years are vital for holistic development, reinforcing the importance of ECE during this stage (United Nations Educational, Scientific and Cultural Organization, 2010). This period, spanning the first eight years of a child's life, is a pivotal time for cognitive, emotional and social growth.

Evidence consistently shows that experiences during these early years establish a foundation for future achievements in academics, relationships, and health outcomes (Heckman, 2006). Parental engagement has a strong impact on children's academic, social, and behavioural outcomes, often exceeding the influence of socio-economic status as emphasised by Wildmon *et al.*, (2024). Similarly, it is the responsibility of the parents to create an environment at home that encourages learning and development (Kong & Yasmin, 2022). Common forms of involvement include home-based learning, academic support, school interaction, and providing resources (Kambona, 2025).

*Corresponding Author Email: graceannmathew15@gmail.com

When parents actively participate in their child's learning, children tend to achieve higher academic performance, exhibit better social skills, demonstrate improved behaviour, and enjoy greater graduation rates. Parents can create a connection between home and school by providing emotional and cognitive support. Research highlights that children who receive greater cognitive stimulation at home benefit more significantly from preschool programs (Cabrera *et al.*, 2020). The implications of parental involvement extend beyond academic success. When parents actively engage in their child's education, they are better equipped to advocate for their child's needs and ensure that the learning environment nurtures their overall development. By participating actively in the educational process, parents can help shape policies that address their children's needs, fostering a supportive environment where every student can flourish.

Epstein's (2002) framework about parental involvement outlines six types that shows different ways parents can engage in their children's educational journey. These types represent unique forms of involvement that can impact student achievement and development. The typologies, such as parenting, communicating, volunteering, learning at home, decision-making, and collaborating with the community, show that parental involvement can manifest in numerous ways, ranging from direct support at home to active participation in school policies and community collaborations. Using this framework, the present study adopts a holistic approach that includes several aspects of involvement, including home-based support, school interaction, and volunteering. This study is significant as it examines how parents view and participate in Early Childhood Education (ECE) during the most crucial years of child development. In contrary to many

existing studies that mostly focus on the outcomes of parental involvement, this research emphasises on understanding how parents perceive preschool education and their roles within it. Furthermore, the study provides empirical insights that can guide educators, policymakers, and practitioners in designing effective parent engagement strategies. The findings of the study highlight parents' growing interest to get involved in classroom settings and to participate in the curriculum formation.

MATERIAL AND METHODS

The present study carried out in 2023, adopted a quantitative research design to assess parents perception on preschool education and their involvement in children's early learning. The area selected for the study was Ernakulam district of Kerala and the samples were 400 parents of 3 to 6-year-old children attending either preschool or Anganwadi. In the present study, demographic information was limited to variables such as the type of institution attended by the child (Anganwadi, government, CBSE, ICSE, Montessori, and kindergarten). Stratified sampling was applied during the selection of institutions. Based on the syllabus or management type, the entire population of preschool was first divided into six strata that are Anganwadi Centres (Government-run), Government schools (State Syllabus), CBSE schools, ICSE schools, Montessori schools and Kindergarten schools. From each stratum, schools/centers were selected using simple random sampling. An average of 10 parents were selected from each selected institution through random sampling. In total 40 schools were included in the study. The questionnaires were then distributed to the parents by the teachers. The data were collected through a survey after obtaining parental consent. The

Table 1. Importance of Preschool Education**(n=400)**

Preschool education is crucial for a child's development	Frequency	Percentage
Strongly Disagree	7	1.75
Disagree	9	2.25
Neutral	64	16
Agree	163	40.75
Strongly Agree	157	39.25
Total	400	100

questionnaire was designed to gather parents' perception across eight dimensions like importance of preschool education, pre-preschool introduction of alphabets, teaching basic concepts before preschool, introducing concepts beyond the syllabus, right to discuss syllabus with teachers, weekly classroom observation, participation in classroom activities and equal parenting roles in education. The collected data were systematically coded and percentage analysis was done.

RESULTS AND DISCUSSION

The study examined parental perceptions regarding preschool education and the role of parents in supporting early learning under eight components based on the

Epstein's (2002) framework about parental involvement. The findings have been presented below under 8 components:

A. Importance of Preschool Education

A substantial majority of parents affirmed the critical role of preschool education in child development. Approximately 80% of respondents agreed or strongly agreed that preschool is crucial, whereas only about 4% expressed disagreement (Table 1), indicating a broad agreement on the importance of early childhood education. This aligns with empirical evidence showing that preschool education improves cognitive, social, and emotional outcomes particularly when paired with consistent parental engagement (Marti *et al.*, 2018).

Table 2. Pre-Preschool Introduction of Alphabets**(n=400)**

Parents should introduce alphabets to children before entering the preschool	Frequency	Percentage
Strongly Disagree	64	16
Disagree	86	21.5
Neutral	89	22.25
Agree	98	24.5
Strongly Agree	63	15.75
Total	400	100

Table 3. Teaching Basic Concepts (Shapes, Colours, Numbers) Before Preschool (n=400)

Children should be taught concepts like shapes, colours, size, numbers before going to preschool

	Frequency	Percentage
Strongly Disagree	75	18.75
Disagree	119	29.75
Neutral	70	17.5
Agree	66	16.5
Strongly Agree	70	17.5
Total	400	100

Table 4. Introducing Concepts beyond the Syllabus (n=400)

Parents should introduce new concepts and ideas to children apart from the school syllabus

	Frequency	Percentage
Strongly Disagree	86	21.5
Disagree	101	25.25
Neutral	93	23.25
Agree	74	18.5
Strongly Agree	46	11.5
Total	400	100

Table 5. Right to Discuss Syllabus with Teachers (n=400)

Parents should have a right to discuss with teachers about the syllabus

	Frequency	Percentage
Strongly Disagree	4	1
Disagree	14	3.5
Neutral	57	14.25
Agree	143	35.75
Strongly Agree	182	45.5
Total	400	100

B. Pre-Preschool Introduction of Alphabets

Views were more varied regarding early academic exposure. Only 40.25% of parents supported introducing alphabets before preschool, whereas 37.5% disagreed and 22.25% remained neutral (Table 2), revealing

substantial mixed responses. This hesitation may be attributed to the belief that it is the responsibility of formal preschool structures to introduce alphabets. Research increasingly emphasizes that readiness should be holistic, balancing emergent literacy and numeracy with socio-emotional foundations (Naeem & Khan, 2023).

Table 7. Participation in Classroom Activities**(n=400)**

Parents should get a chance to participate in children's classroom activities	Frequency	Percentage
Strongly Disagree	2	0.5
Disagree	2	0.5
Neutral	16	4
Agree	123	30.75
Strongly Agree	257	64.25
Total	400	100

C. Teaching Basic Concepts (Shapes, Colours, Numbers) Before Preschool

Similarly, responses were divided on whether children should learn cognitive concepts before preschool enrolment. Approximately 34% agreed, whereas 48.5% disagreed, indicating a stronger resistance to early academic instruction (Table 3). Studies have found that parent involvement is often limited when parents lack guidance, resources, or knowledge about developmentally appropriate practices (Thamarasseri, 2025).

D. Introducing Concepts Beyond the Syllabus

Only about 30% of respondents agreed that parents should introduce concepts outside the formal syllabus. In contrast, nearly 47% disagreed, and 23% remained neutral,

reflecting a conservative view of parental instructional roles (Table 4).

E. Right to Discuss Syllabus with Teachers

Parents showed overwhelming support for active communication with teachers, with more than 81% agreeing or strongly agreeing that they should have the right to discuss the syllabus. Only 4.5% disagreed (Table 5).

F. Weekly Classroom Observation

A notably high proportion (93.25%) supported weekly opportunities to observe their children in the classroom, indicating a strong desire for transparency and involvement (Table 6), which is in line with the research finding showing parents who engage in their children's early education feel a stronger connection to the school community, which enhances their overall satisfaction and encourages continued involvement.

Table 8. Equal Parental Roles in Education**(n=400)**

Both parents must have an equal role in children's education	Frequency	Percentage
Strongly Disagree	1	0.25
Disagree	12	3
Neutral	63	15.75
Agree	158	39.5
Strongly Agree	166	41.5
Total	400	100

G. Participation in Classroom Activities

About 95% of parents favoured participation in classroom activities, suggesting parents' eagerness for collaborative engagement with teachers and children (Table 7). Prior research shows that collaborative home–school partnerships significantly enhance children's academic motivation, self-regulation, and mental well-being (Ngadni & Chen, 2024; Cai *et al.*, 2024).

H. Equal Parental Roles in Education

Most parents (81%) agreed that both parents should share equal responsibility in their children's education, underscoring a strong normative belief in co-parental participation (Table 8). Research confirms that both parents' involvement contributes to more consistent learning and strengthens relationships with teachers (Akshaya, 2025). Encouraging both maternal and paternal involvement may benefit children's early learning.

CONCLUSION

The findings of the study indicated strong parental interest in their participation in preschool activities and in the syllabus structuring. The majority of parents recognise the importance of preschool for children's overall development. In contrast, parents expressed mixed feelings about introducing alphabet, shapes, and numbers before preschool. Parents also showed limited enthusiasm for introducing concepts beyond the formal syllabus, likely reflecting uncertainty about curricular expectations or limited confidence in their own abilities. This implies that preschools may need to provide structured support to empower parents to extend children's learning at home in meaningful and developmentally appropriate ways.

On the other hand, parents showed overwhelming support for communication, transparency, and collaborative involvement with schools. The high levels of agreement regarding weekly observation, classroom participation, and rights to discuss the syllabus reflect strong parental motivation to be involved. The findings of this study reinforce these empirical patterns, highlighting parents' agreement with the need of engagement. Finally, the strong support for equal parental responsibility underscores the changing attitudes toward co-parenting. Overall, the findings showed that parents highly value preschool education and desire meaningful involvement, yet remain doubtful about giving early academic instruction. Strengthening parent–teacher partnerships, providing parental training on developmentally appropriate practices, and fostering opportunities for parents' participation may help bridge this gap.

Funding

This research was supported by Mahatma Gandhi University, Kottayam, Kerala (University Junior Research Fellowship).

REFERENCES

- Akshaya, E. 2025. Influence of parental involvement on Early Childhood Care and Education: Teachers' perspectives. *The Journal of Research ANGRAU*, 53(2): 68-74. <https://epubs.icar.org.in/index.php/TJRA/article/view/172674>
- Cabrera, N. J., Jeong Moon, U., Fagan, J., West, J. and Aldoney, D. 2020. Cognitive stimulation at home and in child care and children's preacademic skills in two-parent families. *Child Development*, 91(5):1709–1717.
- Cai, L., Huang, P. and Guo, Y. 2024. Relationship between parental involvement and children's positive

- mental character during early years: the moderating role of parent-teacher relationship and teacher-parent relationship. *Frontiers in psychology*.
- Epstein, J. L., Sanders, M. G., Simon, B. S., Salinas, K. C., Jansorn, N. R. and Van Voorhis, F. L. 2002. *School, family, and community partnerships: Your handbook for action* (2nd ed.). Corwin Press.
- Heckman, J. J. 2006. Skill Formation and the Economics of Investing in Disadvantaged Children. *Science*, 312(5782), 1900–1902. <https://doi.org/10.1126/science.1128898>
- Kambona, W. 2025. Exploring parental involvement in early childhood education in Sub-Saharan Africa: A systematic review. *Social Sciences & Humanities Open*, 11(1), Article 101367.
- Kong, C. and Yasmin, F. 2022. Impact of parenting style on early childhood learning: Mediating role of parental self-efficacy. *Frontiers in Psychology*, 13, Article 928629.
- Marti ,M., Merz, E.C., Repka, K.R., Landers, C, Noble K.G. and Duch H. 2018. Parent involvement in the getting ready for school intervention is associated with changes in school readiness skills. *Front Psychol*.DOI: 10.3389/fpsyg. 2018. 00759. PMID: 29904362; PMCID: PMC5991166.
- Naeem, S. and Khan, N., 2023. Parental Involvement and AcademicMotivation in Early Years: A Quantitative Analysis. *Global Educational Studies Review*,VIII(II), 257-270.[https://doi.org/10.31703/gesr.2023\(VIII-II\).24](https://doi.org/10.31703/gesr.2023(VIII-II).24)
- Ngadni, I. and Chen, S.Y. 2024. The Role of Preschool Teachers, Parents, and Principals in Facilitating Home-School Partnership in Early Childhood Education. *International Journal of Academic Research in Business and Social Sciences*.
- Thamarasseri, I. 2025. Parents as facilitators for learning experiences in children. *I-manager's Journal on School Educational Technology*, 20(3), 1–10.
- United Nations General Assembly. 2015. Transforming our world: The 2030 agenda for sustainable development. https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf
- Wildmon, M. E., Anthony, K. V. and Kamau, Z. J. 2024. Identifying and navigating the barriers of parental involvement in early childhood education. *Current Issues in Education*, 25(1).<https://doi.org/10.14507/cie.vol25iss1.2146>

Grace Ann Mathew and Nisha Vikraman.2026. Parents' perception of preschool education and their role in children's early learning.The Journal of Research ANGRAU,54(2) : 37-43

EDUCATIONAL INTERVENTION AND ITS EFFECT ON HEALTH MANAGEMENT PRACTICES IN ADULTS WITH DIABETES

CELINE MATHEW C.

Department of Home Science, Nirmalagiri College, Kannur - 670701, Kerala

Date of Receipt : 12-03-2026

Date of Acceptance : 29-05-2026

ABSTRACT

The present study aimed to assess the effectiveness of an educational intervention on dietary practices, lifestyle behaviors and glycemic control among diabetic patients. A structured educational programme supported by a computer-based software package was implemented among 33 diabetic patients in the experimental group, while 35 patients served as controls. The intervention emphasized dietary modification, physical activity, medical monitoring and risk factor awareness. Results indicated that 12 out of 15 recommended dietary practices were significantly adopted by the experimental group following intervention. Post-intervention, there was a marked increase in the intake of green leafy vegetables, other vegetables, and fruits, along with a reduction in the consumption of cereals, fats and fleshy foods. Significant improvements were also observed in health management behaviors, including daily exercise, periodic blood glucose monitoring, and regular physician visits ($P < 0.01$). Glycemic control improved substantially, as evidenced by a reduction in mean fasting plasma glucose from 172.21 ± 47.49 mg/dl to 127.03 ± 1.15 mg/dl and HbA1c from $9.53 \pm 1.64\%$ to $7.50 \pm 0.99\%$ ($P < 0.01$). The study demonstrates that educational intervention is an effective strategy for improving dietary practices, lifestyle behaviors, and glycemic control among diabetic patients.

Key words: Educational intervention, Dietary practices, Diabetes management, Glycemic control

INTRODUCTION

The prevalence of *Diabetes mellitus* has rapidly increased in India as a result of urbanization, sedentary lifestyles, and a shift to westernized dietary habits. *Diabetes mellitus* has become a major global public health concern. Inadequate self-care behaviors, poor food habits and decreased physical activity have all been found to be major causes of poor glycemic control and the emergence of problems connected to diabetes. Therefore,

consistent lifestyle modification, particularly with regard to nutrition, exercise and medical monitoring as well as pharmaceutical treatment are necessary for effective diabetic control.

The pre-requisite for diabetes care is dietary management since poor food choices have a direct impact on blood glucose levels. Structured nutritional and dietary education dramatically increases dietary adherence and lowers fasting blood glucose and HbA1c levels in people with type 2 diabetes (Eshete *et al.*,

*Corresponding Author Email: srcelinesh@gmail.com

2023). The significance of patient education in attaining glycemic control is highlighted by systematic reviews and meta-analyses, which further verify that diet-focused educational interventions lead to clinically significant drops in HbA1c (Shiferaw *et al.*, 2021).

Diabetes control is greatly aided by lifestyle choices including regular medical monitoring and physical activity in addition to dietary habits. Research indicates that educational interventions greatly enhance self-care practices, such as regular doctor visits, blood glucose monitoring, and exercise (Majumdar *et al.*, 2025; Kim *et al.*, 2020). Education programs based on behavioral theory have also demonstrated efficacy in improving diabetic patients' self-management abilities and adherence to advised lifestyle behaviors (Ranjbar *et al.*, 2024).

Recent advancements in educational delivery methods, including computer-based, web-based and digital platforms, have further strengthened the impact of diabetes education. Technology-assisted interventions have been shown to improve dietary compliance, increase patient engagement, and enhance glycemic outcomes (Dening *et al.*, 2023). Similarly, social media-based and micro learning educational strategies have demonstrated significant improvements in diabetes knowledge, self-efficacy and self-care behavior related to diet and glucose monitoring (Rahbar *et al.*, 2024).

Long-term and community-based research further demonstrates the lasting benefits of structured educational programs. Evidence from randomized clinical trials and community interventions shows consistent improvements in dietary habits, physical activity levels, and metabolic outcomes among participants who receive structured diet and

exercise education (El-Deyarbi *et al.*, 2024; Ernawati *et al.*, 2021). However, despite the growing body of supporting evidence, these educational interventions remain underutilized in routine diabetes care, especially in healthcare settings with limited resources.

In this context, the present study aimed to examine the effects of a structured educational intervention on dietary habits, lifestyle behaviors, medical monitoring, and glycemic control in individuals with diabetes.

MATERIAL AND METHODS

The study adopted an experimental pre-test and post-test control group design to evaluate the effectiveness of an educational intervention on dietary practices and glycemic control among diabetic patients. The study was conducted at Dia-Care Hospital, Kannur, Kerala and included a total of 68 diabetic patients who were selected based on their willingness to participate and ability to cooperate throughout the study period. The selected subjects were randomly assigned into two groups by drawing lots, comprising a control group with 35 participants and an experimental group with 33 participants. Two participants from the experimental group were excluded from the final analysis due to irregular participation in the intervention sessions. A structured educational intervention was developed in the form of a computer-based software package designed to deliver key health messages related to diabetes management. The intervention focused on dietary modification, physical activity, medical monitoring, and prevention of diabetes-related complications. The educational programme was administered only to the experimental group over a defined intervention period, while the control group continued to receive routine medical care without additional educational

Table 1. Socio-economic profile of the subjects included in educational intervention

Particulars	Control (n=35)		Experimental (n=33)		Total (n=68)	
	Frequ- ency	Per- cent	Frequ- ency	Per- cent	Frequ- ency	Per- cent
Gender						
Male	12	34.3	19	57.6	31	45.6
Female	23	65.7	14	42.4	37	54.4
Age group (yrs)						
<30	2	5.7	3	9.1	5	7.4
31-40	3	8.6	5	15.2	8	11.8
41-50	8	22.9	9	27.3	17	25.0
51-60	15	42.9	12	36.4	27	39.7
>60	7	20.0	4	12.1	11	16.2
Education						
Primary school	14	40.0	3	9.1	17	25.0
Secondary school	12	34.2	17	51.5	29	42.6
Graduation	5	14.3	8	24.2	13	19.1
PG/professional	4	11.4	5	15.2	9	13.2
Occupation						
Service personnel	14	40.0	17	53.6	31	45.6
Business	5	14.3	6	18.2	11	16.2
Agriculture	3	8.6	3	9.1	6	8.8
House wife	13	37.1	7	21.2	20	29.4
Income (Rs/month)						
2500-4500	6	18.2	5	15.2	11	16.7
4501-7000	4	12.1	7	21.2	11	16.7
7001-9500	11	33.3	8	24.2	19	28.8
9501-15000	6	18.2	9	27.3	15	22.7
≥15001	6	18.2	4	12.1	10	15.2

Table 2. Medical monitoring and diabetic management practices of target group at pre and post-intervention periods.

Statement	Control (n=35)			Experimental (n=33)		
	Pre-test %	Post-test %	Z-test	Pre-test %	Post-test %	Z-test
Daily exercise (1/2 hr)	31.4	42.9	0.996 ^{ns}	27.3	66.7	3.489 ^{**}
Practicing yoga	5.7	5.7	0	6.1	12.1	0.861 ^{ns}
Practicing stress alleviation	5.7	8.6	0.465 ^{ns}	6.1	9.1	0.466 ^{ns}
Periodic blood testing	28.6	40.0	1.015 ^{ns}	15.2	90.9	9.470 ^{**}
Visiting physicians regularly	68.6	60.0	0.751 ^{ns}	39.4	93.9	5.764 ^{**}
Use of diabetic foot wear	11.4	11.4	0	3.0	3.0	0
Regular eye check-up	14.3	14.3	0	12.1	12.1	0
Use of Ayurveda/herbal medicine	2.9	11.4	1.412 ^{ns}	0.0	0.0	0
Use of herbal medicine	2.9	2.9	0	0.0	0.0	0
Use of insulin injection	34.3	25.7	0.786 ^{ns}	12.1	12.1	0

input. Baseline data were collected from both groups during the pre-intervention period using structured questionnaires to assess dietary practices, lifestyle behaviors and diabetes management practices. Dietary intake was assessed using the 24-hour dietary recall method. Clinical and biochemical parameters, including fasting plasma glucose and glycated hemoglobin (HbA1c), were obtained from medical records and laboratory reports. Following the completion of the educational intervention, the same data collection procedures were repeated during the post-intervention period. The collected data were coded and analysed using appropriate statistical techniques.

RESULTS AND DISCUSSION

Demographic details

The socio-economic characteristics of diabetic patients selected for the educational intervention study are furnished in table 1.

A total of 68 patients enrolled themselves for educational intervention. They were randomized as the control (n=35) and experimental (n=33) groups. Out of the total of 68 patients 31 (45.6%) were male and 37 (54.4%) were female. The age group of the majority of subjects ranged between 41 to 60 years (64.7%) reflecting same trend on both control and experimental groups. The educational status of the group ranged between primary school to PG/ professional education. Majority of the subjects had education up to secondary level. Totally two-third of the subjects (67.6%), had education up to school level and only one third (32.3%), reported to have higher education. Government servants and professionals like officers, teachers, nurses and retired personnel together constituted 45.6 percent. Second highest group was housewives (29.4%), followed by business men (16.2%)

Table 3. Effect of intervention on blood glucose

Particulars	Pre-test		Post-test	
	Frequency	%	Frequency	%
*FPG level (mg/dl)				
Normal (80-110)	3	9.1	9	27.27
Impaired diabetic (110-125)	1	3.03	6	18.18
Diabetic (>125)	29	87.87	18	54.55
Pooled	33	100	33	100
**HbA1c level				
Good (4.2-5.9 %)	0	0	2	6.06
Fair (6.0-7.5 %)	5	15.15	18	54.55
Poor glycemic (>7.5 %)	28	84.85	13	39.39
Pooled	33	100	33	100

and agriculturists (8.8%). Majority of the subjects (51.5%) reported had a monthly income of 7000 to 15000/- rupees.

Effect of Diabetic intervention on changes in medical monitoring and exercise pattern

Desirable behavioural changes in the management practices of diabetes were also noticed in the case of medical monitoring. There was a significant ($P<0.01$) increase in the periodic blood testing and regular visits to physicians among the patients, who underwent the education programme. An increase in the practice of stress alleviation techniques and yoga, observed during the post-intervention period was not at all of any significant extent. But daily exercise for half an hour by the patients, became more popular after education programme and was adopted by a significantly ($P<0.01$) more number of patients belonging to the experimental group.

Glycemic control: Fasting Plasma Glucose (FPG) and HbA1c levels after intervention.

The HbA1c assay is the standard measurement of chronic glycemia and measures the amount of glucose that binds to haemoglobin over a period of time. The normal recommended HbA1c readings for diabetics should fall within the reference range of 6.5 to 7.0 percent. Glycemic control as measured by HbA1c was divided into two groups according to the ADA: Group 1: controlled if HbA1c $<7\%$ and Group 2: uncontrolled if HbA1c $\geq 7\%$. In the present study, an attempt was made to evaluate the effect of dietary modification and physical activity. The educational intervention could be associated with a better glycemic control among the experimental group. The details are given in table 3 and fig.1.

Most of the diabetic patients in the study had poor glycemic control (84.85%) and a high FPG level (87.87%) during the pre-test period. The post-test results after educational intervention showed tremendous improvement in the blood picture. There was notable reduction in FPG level of the subjects from 87.87 percent (pre-test) to 54.55 percent (post-test). Similarly, HbA1C level also showed

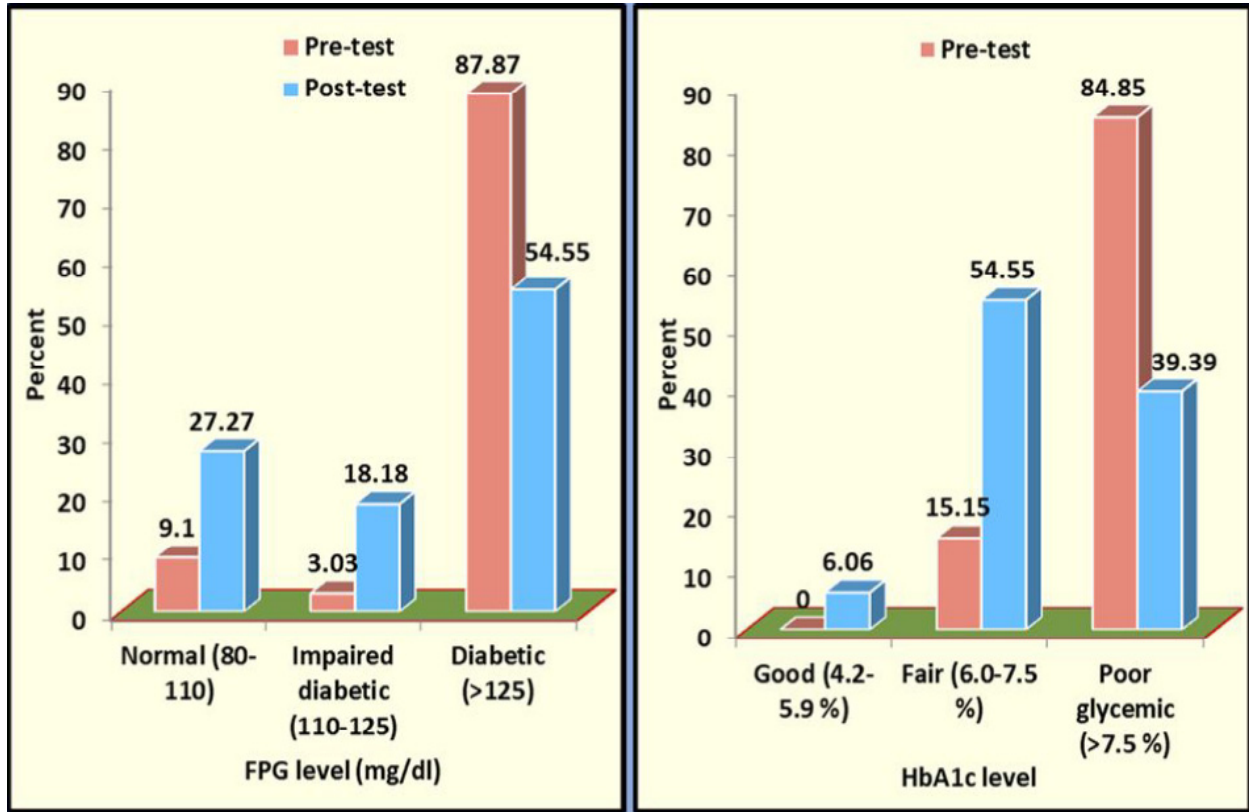


Fig. 1. Effect of intervention on blood glucose

a tell-tale decline between pre (84.85%) and post (39.39%) test period. Thus, the education programme did prove to be effective to bring about remarkable glycemic control among the subjects.

Mean FPG and HbA1c levels of experimental subjects

The Mean FPG and HbA1c levels of experimental subjects who underwent the educational intervention are shown in the table 4. As the table shows, there was a statistically

significant ($P < 0.01$) reduction in the mean values of HbA1c and FPG of experimental subjects due to educational intervention. Significant improvement in the glycemic control by the subjects was an encouraging outcome of the diabetic education. (Rao and Thomas, 2025).

CONCLUSION

The study demonstrates that a structured educational intervention significantly improved dietary practices,

Table: 4. Mean FPG and HbA1c levels of experimental subjects

Particulars	Experimental (n=33)		t-value
	Pre-test	Post-test	
FPG (125mg/dl)	172.21± 47.49	127.03 ± 1.148	5.651**
HbA1c (7%)	9.53± 1.64	7.50 ± 0.999	8.360**

** Significant 0.01 levels

lifestyle behaviors and glycemic control among diabetic patients. Post-intervention, 12 of 15 recommended dietary practices were adopted, with reduced intake of cereals, fats and fleshy foods and increased consumption of vegetables and fruits. Daily exercise increased from 27.3% to 66.7%, periodic blood glucose testing from 15.2% to 90.9%, and regular physician visits from 39.4% to 93.9% ($P<0.01$). Glycemic control improved markedly, with poor HbA1c levels declining from 84.85% to 39.39% and elevated fasting plasma glucose decreasing from 87.87% to 54.55%. Mean fasting plasma glucose reduced from 172.21 ± 47.49 mg/dl to 127.03 ± 1.15 mg/dl, and mean HbA1c from $9.53\pm1.64\%$ to $7.50\pm0.99\%$ ($P<0.01$), confirming the effectiveness of the educational intervention.

REFERENCES

- Dening, J., Mohebbi, M., Abbott, G., George, E. S., Ball, K. and Islam, S. M. S. 2023. A web-based low carbohydrate diet intervention significantly improves glycaemic control in adults with type 2 diabetes: Results of the T2 Diet study randomised controlled trial. *Nutrition & Diabetes*, 13(1), 12. <https://doi.org/10.1038/s41387-023-00240-8>
- El-Deyarbi, M., Ahmed, L. A., King, J., Al Nuaimi, H., Al Juboori, A., Mansour, N. A., Jarab, A. S., Abdel-Qader, D. H. and Aburuz, S. 2024. Effect of structured diet with exercise education on anthropometry and lifestyle modification in patients with type 2 diabetes: A 12-month randomized clinical trial. *Diabetes Research and Clinical Practice*, 213, 111754. <https://doi.org/10.1016/j.diabres.2024.111754>
- Ernawati, U., Wihastuti, T. A. and Utami, Y. W. 2021. Effectiveness of diabetes self-management education (DSME) in type 2 diabetes mellitus (T2DM) patients: Systematic literature review. *Journal of Public Health Research*, 10(2), 2240. <https://doi.org/10.4081/jphr.2021.2240>
- Eshete, A., Lambebo, A. and Mohammed, S. 2023. Effect of nutritional promotion intervention on dietary adherence among type II diabetes patients in North Shoa Zone Amhara Region: A quasi-experimental study. *Journal of Health, Population and Nutrition*, 42, 49. <https://doi.org/10.1186/s41043-023-00393-3>
- Kim, G. H., Park, Y. and Lim, H. S. 2020. The association between diabetes education and glucose control in diabetic patients: Using the 2008 and 2013 Korea National Health and Nutrition Examination Survey. *Clinical Nutrition Research*, 9(2), 81–89. <https://doi.org/10.7762/cnr.2020.9.2.81>
- Majumdar, A., Memon, F., Jatoti, M. and Chandio, F. 2025. Impact of health education on attitude, knowledge, and glycemic control in type II diabetes mellitus patients. *Physical Education, Health and Social Sciences*, 3, 296–315. <https://doi.org/10.63163/jpehss.v3i4.847>
- Rahbar, S., Zarifsanaiey, N. and Mehrabi, M. 2024. The effectiveness of social media-based microlearning in improving knowledge, self-efficacy and self-care behaviors among adult patients with type 2 diabetes: An educational intervention. *BMC Endocrine Disorders*, 24, 99. <https://doi.org/10.1186/s12902-024-01626-0>
- Ranjbar, F., Karimi, M., Zare, E. and Ghahremani, L. 2024. The effect of

educational intervention based on the behavioral reasoning theory on self-management behaviors in type 2 diabetes patients: A randomized controlled trial. BMC Public Health, 24(1), 1761. <https://doi.org/10.1186/s12889-024-19207-0>

Rao, S. and Thomas, J. 2025. Effectiveness of structured diabetes self-care education on dietary practices and glycemic control: A community-based

study. Journal of Community Health Nursing, 42(1):15–25.

Shiferaw, W. S., Akalu, T. Y., Desta, M., Kassie, A. M., Petrucka, P. M. and Aynalem, Y. A. 2021. Effect of educational interventions on knowledge of the disease and glycaemic control in patients with type 2 diabetes mellitus: A systematic review and meta-analysis of randomised controlled trials. BMJ Open, 11(12), e049806. <https://doi.org/10.1136/bmjopen-2021-049806>

Celine Mathew, C. 2026. Educational intervention and its effect on health management practices in adults with diabetes. The Journal of Research ANGRAU, 54 (2): 44-51

CONSUMPTION PATTERN OF CONVENIENCE FOODS AMONG CONSUMERS IN KANNUR DISTRICT, KERALA

TEENA THOMAS* and ANU JOSEPH

Department of Home Science, St. Teresa's College, Ernakulam, Kerala-682 011

Date of Receipt : 08-04-2026

Date of Acceptance : 26-06-2026

ABSTRACT

The consumption of convenience foods has been steadily increasing in recent years, making it important to understand the factors driving this trend. The present study examines the socio-economic factors influencing convenience food consumption patterns among consumers in Kannur district, Kerala, India. A total of 175 respondents, aged 18 to 75 years, including both males and females, representing various socio-economic strata, participated in the survey. The results of the study reveal that convenience food consumption was predominantly higher among individuals of the younger age group (35%), those residing in rural areas (33%) and people with higher educational qualifications (24%). Expenditure on convenience foods constitute less than 10% of their monthly income. The study also identifies social media advertisements and recommendations from relatives and friends as significant factors influencing the purchase of convenience foods. The frequent purchase of items such as biscuits and bread was a more common consumable among the subjects. This study revealed an increase in the consumption of ready-to-eat and ready-to-cook products in rural areas compared to other regions.

Key Words: Consumption pattern, Convenience food, Geographical areas, Monthly expenditure, Socio-Economic factors

INTRODUCTION

Convenience foods are those foods that save time in food acquisition and preparation and are often designed to provide a time-saving option for busy consumers who may not have the time or skills to prepare meals. The Ministry of Consumer Affairs in India designates convenience food as often prepared foodstuffs that can be sold as hot, ready-to-eat dishes, at room temperature and shelf-stable products, or as refrigerated or frozen food products that require minimal preparation. In India, earlier, there was a preference for consuming fresh foods directly from the farm,

with limited acceptance of value-added foods. The rise in the consumption of convenience food is a result of various factors such as urbanisation, digitalisation, time scarcity, sedentary lifestyles, high disposable income, ease and convenience of food preparation, lack of cooking skills and ability, acceptability across age groups and easy availability (Hena *et al.*, 2023). Statista Market Forecast (2023-2027) predicts that revenue in the convenience food market amounts to US\$ 448.69bn in 2025, and the world market is expected to grow annually by 6.05%. In the Indian scenario, the convenience food

*Corresponding Author Email: teenathomas90@gmail.com

segment's compound annual growth rate is projected to be 20.93%. The convenience food market in India has grown rapidly and is expected to continue to expand in the coming years. India is the world's second-largest food producer, next to China and has the potential to overtake China and become the biggest food industry.

Convenience foods have been created to be more appealing to customers. The consumption of these foods has become increasingly popular in many countries worldwide, but the factors that influence this trend may vary depending on the local demographic context. Demographic criteria, such as age, gender, income, education, and cultural background, can influence consumers' preferences and behaviours regarding convenience food consumption.

Consumption patterns in Kerala have significantly changed in the last three decades, influenced by migration, investment, and cultural imagination (Mannathukkare, 2023). A study conducted among college students in Kerala found that convenience food consumption was high, with 94% of participants reporting that they consumed at least one type of convenience food on a weekly basis, and the most commonly consumed convenience foods were instant noodles, biscuits, and packaged snacks (Mohan *et al.*, 2019). This study was limited to a specific population in Kerala (college and school students). The present study conducted a comparative analysis of consumption patterns across urban, semi-urban, and rural areas in Kannur. The study evaluates the influence of demographic and socioeconomic factors on the consumption of convenience foods. The results indicate significant variations across population segments, underscoring the role of demographic determinants in shaping convenience food consumption.

MATERIAL AND METHODS

This study was conducted in the rural, semi-urban and urban areas of Kannur district, Kerala. Based on simple random sampling, 175 respondents were selected. Different areas were selected based on the Indian census data (2011). The study comprised 122 females and 53 males in the age group of 18-75 years. The respondents were from across all sections of society and included mainly students, employed and unemployed from various socio-economic groups and also from various geographic locations in Kannur.

The data for the study was collected using a Google Form Demographic details were collected using the modified version of Kuppasamy's socioeconomic status scale. The modified Kuppasamy scale is one of the most widely used tools for assessing socioeconomic status (SES) in urban India, originally designed to evaluate individual SES but later adapted for family-level assessment. It comprises three index parameters—education, occupation, and total income (Javalkar *et al.*, 2024). The data collected using Google Forms can be easily exported and analysed using various statistical software. The Google form was forwarded to selected consumers, who were in the age group of 18-75 years. The different aspects included demographic details of the respondents, their consumption patterns, attitudes towards convenience food, monthly expenditure patterns for convenience foods, dining-out habits, sources of information about convenience food, and the frequency of purchasing selected ready-to-cook and ready-to-eat foods. Data gathered using the form is stored in a spreadsheet.

Statistical Analysis

The collected data were tabulated and analysed using the R statistical software tool. The results of the study were interpreted using frequency, percentage, and Chi-square tests.

Table 1. Demographic Details of the Selected Samples (n=175)

Demographic Characteristics				
Demographic Variables		Rural N (%)	Semi Urban N (%)	Urban N (%)
Age	Less Than 30	31 (18%)	22 (13%)	16 (9%)
	31-40 Years	20 (11%)	22 (13%)	8 (5%)
	41-50 Years	18 (10%)	11 (6%)	7 (4%)
	Above 50 Years	11 (6%)	6 (3%)	3 (2%)
Sex	Male	19 (11%)	20 (11%)	14 (8%)
	Female	61 (35%)	41 (23%)	20 (11%)
Education	High School	12 (7%)	4 (2%)	3 (2%)
	Intermediate/Diploma	5 (3%)	8 (5%)	3 (2%)
	Graduate	23 (13%)	20 (11%)	8 (5%)
	Professional Degree	20 (11%)	8 (5%)	6 (3%)
	Post Graduate	20 (11%)	21 (12%)	14 (8%)
Monthly Income	d" 6174	9 (5%)	4 (2%)	2 (1%)
	6175-18,496	18 (11%)	9 (5%)	1 (1%)
	18,497-30,830	11 (7%)	9 (5%)	4 (2%)
	30,831-46,128	13 (8%)	7 (4%)	3 (2%)
	46,129-61,662	7 (4%)	10 (6%)	9 (5%)
	61,662-1,23,321	12 (7%)	13 (8%)	8 (5 %)
	e"1,23,322	6 (4%)	6 (4%)	7 (4%)

RESULTS AND DISCUSSION

Analysis of data is done from the results obtained from 175 subjects from the Kannur district. The result obtained from this is represented in tables. Table 1 shows the demographic details of the selected subjects across Urban, Semi-Urban and Rural Areas of Kannur district.

In this study, it was observed that a significant percentage of the subjects had attained a high level of education. Specifically, 31% of the subjects had completed postgraduate studies, 29% had undergraduate degrees, and 19% held professional degrees. And the majority of these subjects were categorised within the middle-income status.

The majority of individuals prefer to consume convenience food. This research indicates that individuals with higher incomes prefer convenience food to those with lower or middle incomes. Moreover, postgraduates demonstrate the highest percentage of consumption at 24%, while only 6% of individuals with intermediate or diploma prefer convenience food. The majority of individuals, despite rural or urban regions, spend less than 10 % of their monthly income on convenience foods. According to Engel's law of consumption, as household income (and expenditure) increases, the percentage that is spent on food decreases, but the absolute amount spent on food increases. This study

Table 2. Demographic Characteristics and Convenience Food Consumption (n=175)

Characteristics	Category	Yes (n, %)	No (n, %)
Monthly Income	d" 6,174	10 (6%)	5 (3%)
	6,175 – 18,496	18 (11%)	10 (6%)
	18,497 – 30,830	20 (12%)	4 (2%)
	30,831 – 46,128	18 (11%)	5 (3%)
	46,129 – 61,662	22 (13%)	4 (2%)
	61,663 – 123,321	26 (15%)	7 (4%)
	e" 123,322	16 (10%)	3 (2%)
Education	High school	12 (7%)	7 (4%)
	Intermediate / Diploma	11 (6%)	5 (3%)
	Graduate	44 (25%)	7 (4%)
	Professional degree	28 (16%)	6 (3%)
	Post graduate	42 (24%)	13 (7%)
Area of Residence	Rural	58 (33%)	22 (13%)
	Semi-urban	49 (28%)	12 (7%)
	Urban	30 (17%)	4 (2%)

confirms that people with different income levels spend a proportionate amount of their income on convenience food consumption. According to Sandri *et al.*, (2024), convenience food is more prevalent among young individuals with higher education, who typically exhibit a lower BMI, a higher healthy nutrition index, and reduced consumption of sugary beverages compared to their peers with basic education. Convenience food was more prevalent in rural and semi-urban areas than

in urban areas, with 33% of rural dwellers opting for convenience foods compared to 17% in urban areas.

It is clear from table 3 that the majority of the subjects preferred to dine out among all age groups. The statistical analysis indicates a relationship between age and dining out preference, with younger individuals preferring food from outside sources over home-cooked meals.

Table 3. Age and dining out preferences of selected subjects. (n=175)

Age	Dining out preferences		P value
	Yes	No	
< 30 years	62(35%)	7(4%)	0.004
31-40 years	39(22%)	11(6%)	
41-50 years	25(14%)	11(6%)	
>50 years	11(6%)	9(5%)	

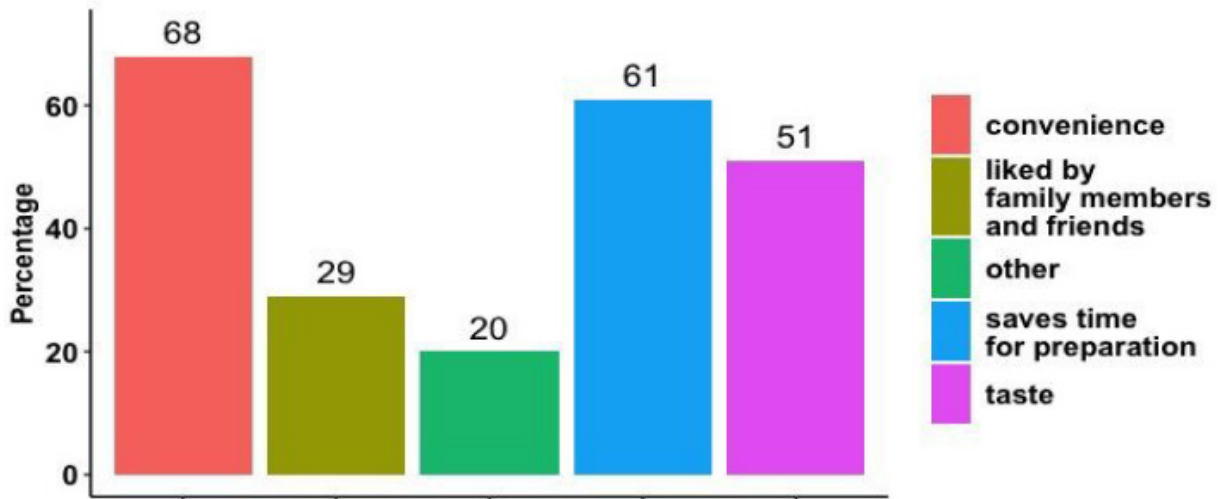


Fig. 1. Reasons for purchasing ready-to-eat products

The individuals with higher income and higher educational groups dine out more frequently than others. This study also revealed that rural dwellers opt for convenience food because of its easy availability. Urbanisation itself does not increase the quantities of food consumed. According to NIN-ICMR dietary guidelines (2024), unhealthy, highly processed, high-fat, sugar and salt foods have become more affordable and accessible than healthier alternatives.

Differences in average quantities consumed in urban, urbanising, and rural areas suggest that merely living in more urbanised areas is not associated with higher quantities of food consumed (Bhartendu *et al.*, 2020).

Determinants of Ready-to-Eat Product Purchases

According to Fig. 1, the primary motivations for purchasing ready-to-eat foods are convenience (68%), time efficiency (61%), and variety (51%). Ding *et al.* (2020)

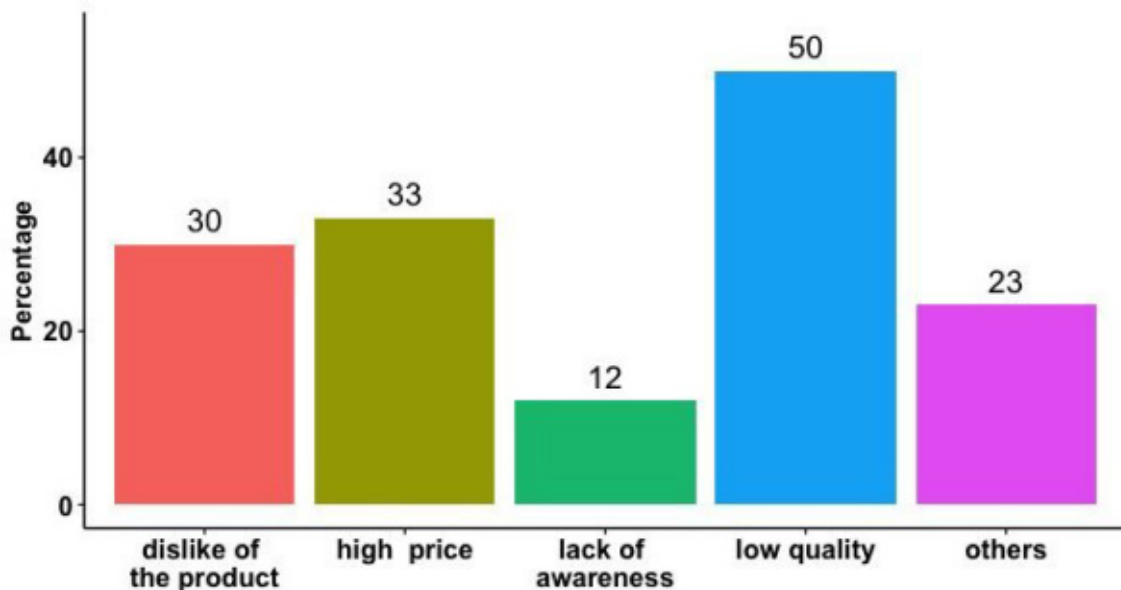


Fig. 2. Reasons for not purchasing ready-to-eat products

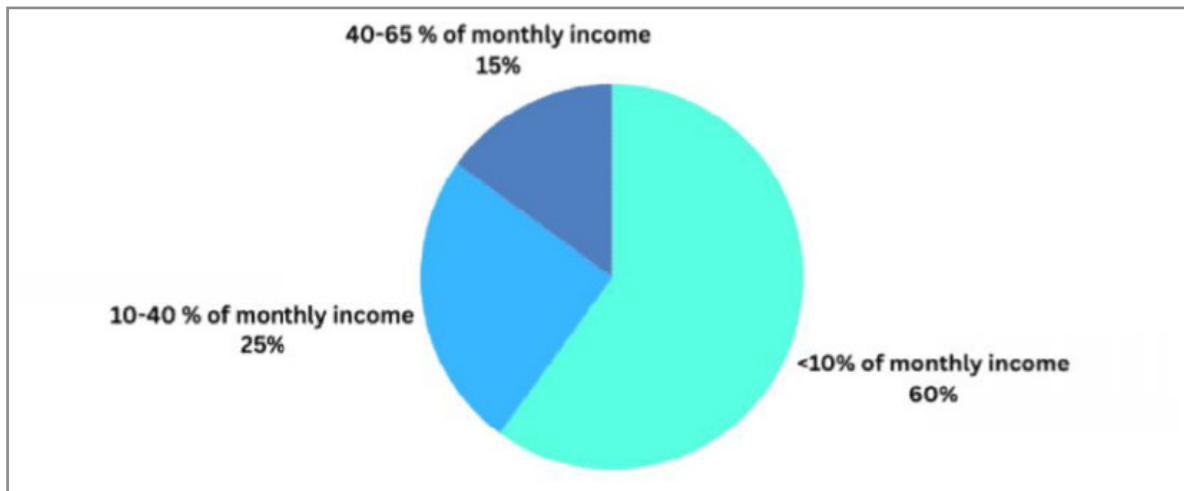


Fig 3. Monthly expenditure for convenience food

also supported that convenience was the primary factor motivating consumers to purchase ready-to-eat (RTE) foods.

Fig. 2 illustrates the deterrents to purchasing ready-to-eat products, with the primary concern being their perceived inferior quality (50%), followed by high price (33%). These findings suggest that quality concerns and elevated costs are predominant issues, which may contribute to the reluctance of certain individuals to purchase convenience food products.

Monthly expenditure for convenience food

The percentage of subjects' monthly expenditures on convenience foods is depicted in Fig. 3.

The majority of the subjects (60%) allocate less than 10 % of their family income towards the purchase of convenience foods. Approximately 25% of individuals, irrespective of their income status, expend between 10 % and 40 % of their monthly family income on

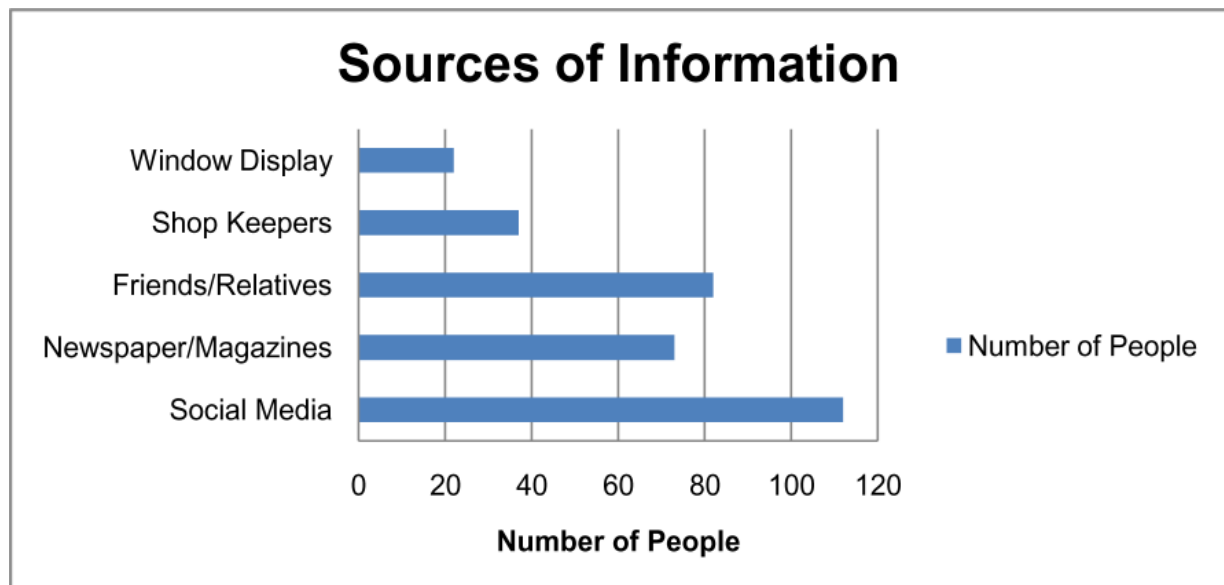


Fig 4. Source of Information

Table 4. Frequency of purchasing different food items**(n=175)**

Category	Food Item	Daily	Fort- night	Once a Week	Twice a Week	Occasi- onally	Never
Ready-to-eat Foods	Sweets	5(3%)	13(9%)	47(32%)	24(16%)	52(35%)	8(5%)
	Biscuit	14(9%)	14(9%)	70(44%)	31(19%)	24(15%)	6(4%)
	Bread	4(3%)	22(14%)	51(33%)	32(21%)	40(26%)	7(4%)
	Cakes	0(0%)	10(7%)	24(17%)	16(11%)	87(60%)	8(6%)
	Fried Snacks	15(10%)	23(16%)	28(19%)	22(15%)	53(36%)	7(5%)
	Fried Chicken	1(1%)	22(15%)	30(20%)	13(9%)	53(36%)	29(20%)
	Ice Cream	3(2%)	20(13%)	16(11%)	16(11%)	76(51%)	18(12%)
	Pickles, Dry Chutney	11(8%)	16(11%)	17(12%)	8(6%)	56(39%)	35(24%)
	Ready To Drink Beverages	3(2%)	10(7%)	13(9%)	11(8%)	50(36%)	52(37%)
	Ready To Serve Beverages Like Squash	1(1%)	11(8%)	12(9%)	8(6%)	48(36%)	55(41%)
Ready-To-Cook Foods	Packed Rice	7(5%)	20(14%)	30(20%)	30(20%)	27(18%)	34(23%)
	Flour	3(2%)	19(13%)	45(27%)	35(22%)	7(4%)	40(29%)
	\Packed half cooked chapatis	3(2%)	19(13%)	45(27%)	35(22%)	7(4%)	40(29%)
	Oats, Break-fast Cereals	8(6%)	21(15%)	36(25%)	19(13%)	41(29%)	17(12%)
	Grated Coconut	10(7%)	0(0%)	10(7%)	5(4%)	11(8%)	98(73%)
	Cut Vegetable Packet	3(2%)	1(1%)	5(4%)	7(5%)	14(11%)	107(77%)
	Karkidaka Kanji Packet	1(1%)	4(3%)	5(4%)	5(4%)	38(28%)	83(61%)
	Cake Mixes	1(1%)	0(0%)	5(4%)	6(5%)	34(26%)	86(65%)
	Rice flours (Idiyappam, appam)	12(8%)	19(13%)	32(22%)	15(10%)	38(26%)	30(21%)
	Masala Powders	14(9%)	26(17%)	46(29%)	21(13%)	36(23%)	13(8%)
	Noodles, Pasta	2(1%)	4(3%)	36(25%)	55(38%)	15(10%)	34(23%)

these items. There is a statistically significant relationship between income status and the purchasing behaviour of convenience food ($p=0.003$)

Sources of information regarding convenience foods

Fig. 4 indicates the various reliable sources which influence the selection of convenience foods.

Dynamic marketing and advertising are being done by convenience food manufacturers so that the customers are attracted towards the product (Srinivasan and Shende, 2020). Food labelling is critical in disseminating information about food products between the customers and the food producers. Information about the ingredients on food labels helps consumers to better understand and make healthier food choices (Perumal *et al.*, 2022). The study concluded that advertisement through social media was most influential, with 112 respondents citing it as their primary source by selecting of different branded convenience foods. Friends and relatives also play a significant role, with 48 percent of respondents reporting them as an influential source. Newspaper and magazine advertisements were mentioned by 73 respondents, while shopkeepers and salespersons were reported by 37 respondents. Interestingly, window displays were the least effective source, with only 22 respondents considering them for brand awareness.

Frequency of purchasing ready-to-eat and ready-to-cook products

Table 4 indicates the frequency of different food items summarising the consumption frequency of selected ready-to-eat and ready-to-cook food items among the respondents.

The tabulated data in table 4 illustrates a clear preference for ready-to-eat high-sugar

high-fat foods over ready-to-cook products among consumers. Specifically, biscuits and bread stand out as the most frequently purchased items, with 44% and 33% of respondents indicating a preference for these products weekly, respectively. Following closely behind the packed half-cooked chapatis, which garnered a significant 27% of the respondents' preference in weekly purchases. Additionally, masala powders were noted as being frequently purchased, with 29% of respondents expressing a preference for them. Junk food such as noodles, pasta, fried chicken, ready-to-drink beverages and ice cream are preferred to buy twice a week or occasionally. Frequency of purchasing different food ingredients, such as ready-to-cook and ready-to-use, and consuming high-fat, sugar and salt-convenience food is more frequently bought than healthy food choices. Biscuits and bread are the most frequently purchased items. The packed half-cooked chapatis were bought weekly. Masala powders and breakfast ingredients were noted as frequently purchased.

CONCLUSION

This study identifies the food consumption patterns in Kannur district, Kerala, with a growing preference for convenience foods across various socio-demographic groups. The primary drivers of this trend are convenience, time efficiency, and variety. Higher-income and better-educated groups are more likely to dine out frequently, while rural residents are influenced by the easy availability of convenience foods. Despite the widespread consumption, convenience foods account for less than 10% of monthly income for most individuals, consistent with Engel's law of consumption. Marketing and advertising, especially via social media, significantly influence consumer choices. Additionally, the frequent purchase of items such as biscuits, bread and masala powders highlights the

increasing reliance on ready-to-eat and ready-to-cook products. This shift underscores the necessity for heightened awareness about the nutritional quality of convenience foods and the potential health consequences of their increased consumption.

REFERENCES

- Bhartendu, P., Kumar, S. and Singh, A. 2020, Food consumption patterns in urban and rural India: An analysis, *Journal of Nutritional Sciences*, Vol. 45(3): 215–229.
- Ding, Y., Yang, J. and Wang, Z. 2020, Consumer motivations for purchasing ready-to-eat foods: A comparative study, *Journal of Consumer Research*, Vol. 32(2):101–112.
- Government of Kerala, 2021, *Kerala Economic Review*, Vol. 34(1): 22–38. Retrieved on September 23, 2025, from <https://kerala.gov.in>
- Hena, N., Singh, A. and Kaushal, M. 2023, Factors driving the growth of convenience foods in India, *Journal of Food Studies*, Vol. 12(3):45–62.
- Javalkar, S.R., Naveen, H.S., Davalgi, S. and Vidya, G.S. 2024, Socio-economic status assessment in India: history and updates for 2024, *International Journal of Community Medicine and Public Health*, Vol. 11: 1369–1377.
- Mannathukkaren, N. 2023. 'Enjoying life': Consumption, changing meanings, and social differentiation in Kerala, India, *Modern Asian Studies*, 57(2): 505–554.
- Ministry of Consumer Affairs, India, 2020, *Guidelines on convenience foods*, Government of India. Retrieved on September 23, 2025, from <https://consumeraffairs.nic.in/sites/default/files/file-uploads/comparative-test-by-consumers-association-of-india/Heat-Ready.pdf>
- Mohan, R., Nair, V. and Pillai, S. 2019, Consumption of convenience foods among college students in Kerala, *Journal of Nutrition and Dietetics*, 56(2): 150–159.
- NIN-ICMR. 2024. *Dietary Guidelines for Indians*, National Institute of Nutrition – Indian Council of Medical Research. Retrieved on September 23, 2025, from https://main.icmr.nic.in/sites/default/files/upload_documents/DGI_07th_May_2024_fin.pdf
- Perumal, K., Balakrishnan, B. and Idris, M.Z. 2022. Food labelling from consumers' perspectives: A review, *Muslim Journal of Social Science and Humanities*, 8(2): 112–130.
- Sandri, E., Pardo, J., Cantín Larumbe, E., Cerdá Olmedo, G. and Falcó, A. 2024. Analysis of the influence of educational level on the nutritional status and lifestyle habits of the young Spanish population. *Frontiers in Public Health*, 12:1341420.
- Srinivasan, S. and Shende, P. 2020, Impact of marketing and advertising on the purchase behaviour of convenience foods in India, *International Journal of Business and Management Studies*, Vol. 12(4):189–204.
- Statista. 2023. *Global convenience food segment (2023–2027)*, Statista Market Forecast. Retrieved on September 23, 2025, from <https://www.statista.com>

Teena Thomas and Anu Joseph. 2026. Consumption pattern of convenience foods among consumers in Kannur district, Kerala. *The Journal of Research ANGRAU*, 54(2) : 52-60

EXAMINING NUTRITIONAL STATUS AND EMOTIONAL WELL BEING IN ADOLESCENT GIRLS THROUGH DIET QUALITY AND DEPRESSIVE SYMPTOMS

S.SAI JANANI *, K. LAKSHMI, G. NIRMALA DEVI and BILQUIS

Department of Food Science and Nutrition, College of Community Science,
Acharya N.G. Ranga Agricultural University, Guntur, Andhra Pradesh, India

Date of Receipt : 18-03-2026

Date of Acceptance : 25-06-2026

ABSTRACT

Adolescence is a critical developmental stage marked by heightened nutritional demands and emotional sensitivity, particularly among girls. The present study was conducted in the year 2024 with an objective to assess the diet quality and emotional functioning of 100 adolescent girls aged 11–18 years in Guntur district of Andhra Pradesh- using the Diet Quality Index–International (DQI-I) and the Depression, Anxiety, and Stress Scale–Youth Version (DASS-Y). Dietary Information was gathered via 24-hour recall and evaluated using Indian Food Composition Table IFCT (2017), with DQI-I scoring based on ICMR–NIN (2020) guidelines. Emotional functioning was evaluated using DASS-Y, categorizing severity across depression, anxiety and stress. Data on DQI-I scoring showed that 15 percent of the girls had excellent diet quality, 85 percent were under the “Good but Needs Improvement” category (>60–80) and none had poor diet quality (<60). Results of DASS-Y showed high emotional distress 86percent had moderate to extremely severe anxiety, 79 percent had moderate to severe stress, and 72 percent showed depressive symptoms. Older adolescents (15–18 years) exhibited significantly higher levels of stress and anxiety compared to younger ones, as confirmed by t-tests and chi-square analyses. A strong negative correlation ($r = -0.6798$, $p < 0.001$) was observed between DQI-I and DASS-Y scores, with 46.21 percent of the emotional variation explained by diet quality. These findings underscore the critical role of nutrition in mental health and highlight the need for integrated dietary and psychological interventions to promote holistic well-being among adolescent girls.

Keywords: Adolescent girls, Anxiety, Depression, DASS-Y, Emotional functioning, Mental health, Nutritional status, Diet Quality Index–International (DQI-I), Stress,

INTRODUCTION

Adolescence, typically defined as the age between 11 and 18 years, is a period of rapid growth and profound physiological, psychological and emotional changes. In this crucial period of growth, adolescents go through increased nutritional demands to

support their accelerated physical and cognitive development. Adolescent girls are especially at risk because of the onset of menstruation, hormonal shifts and socio-cultural pressures, which often result in poor dietary practices and heightened emotional sensitivity. A sufficient and well-balanced diet

*Corresponding Author Email: islavathsaijanani07@gmail.com; Part of research work for M.Sc. thesis submitted to Acharya NG Ranga Agricultural University, Lam, Guntur

is necessary for maintaining psychological well-being in addition to physical health. Inadequate intake of essential nutrients can compromise growth, immunity, and cognitive performance, while also increasing the risk of emotional disturbances such as depression, anxiety, and stress.

In order to evaluate adolescents overall dietary quality, the Diet Quality Index–International (DQI-I) is a widely used tool. The current study findings DQI-I developed by Mediratta and Pulkit (2023), which is based on ICMR–NIN (2020) recommendations, was employed. This tool evaluates four key components of diet—variety, adequacy, moderation, and overall balance—and provides a composite score that reflects the nutritional quality of the individual's dietary intake. Low DQI-I scores are indicative of inadequate consumption of nutrient-rich foods such as vegetables, fruits, dairy products, and micronutrients, which may be linked to poor mental health outcomes. Emotional functioning, particularly the presence of depressive symptoms, is another critical aspect of adolescent health. Depression, anxiety and stress are common among adolescents and are impacted by a number of things, such as inadequate diet, academic pressure, family environment and social relationships.

In this study, the Depression, Anxiety and Stress Scale–Youth Version (DASS-Y) was used to measure emotional functioning, a reliable and validated instrument designed specifically to evaluate emotional states in adolescents. The scale categorizes severity levels and helps identify adolescents at risk of psychological distress. While both nutrition and emotional well-being play vital roles in adolescent development, there is a lack of research exploring the relationship between these aspects among adolescent girls in India. Hence, this study aimed to evaluate the

nutritional status of girls aged 11–18 years using the Diet Quality Index–International (DQI-I) and to examine their emotional functioning by detecting depressive symptoms through the DASS-Y scale. This study aims to generate evidence on the interrelationship between dietary quality and emotional well-being, and to inform upcoming initiatives that support adolescent girls' emotional and nutritional well-being.

MATERIAL AND METHODS

A cross-sectional assessment was conducted during the year 2024, to assess adolescent girls' emotional functioning and nutritional status by examining their diet quality and the existence of symptoms of depression. The research was conducted among a total of 100 adolescent girls aged 11–18 years, who were split into two age groups: 11–14 years ($n = 50$) and 15–18 years ($n = 50$). The participants were selected using a purposeful random sampling from schools and colleges in Guntur district, Andhra Pradesh. Prior to gathering data, official consent was acquired from the respective school and college authorities, and Informed consent was obtained from the parents or guardians of the participants.

The research study was presented before the Institutional Human Ethics Committee (IHEC) of the university before taking up the study at the field level.

The nutritional intake of the participants was evaluated using the 24-hour dietary recall method. Each adolescent girl was interviewed to recall all foods and beverages consumed during the previous day, including the time of consumption, type of food and portion sizes. Standard measuring tools such as measuring cups, were used to ensure accurate estimation of quantities consumed. Intake of nutrients was calculated using the Indian Food Composition Tables (IFCT, 2017), covering energy,

macronutrients, and key micronutrients such as iron, calcium, and vitamin C. To evaluate overall diet quality, the Diet Quality Index–International (DQI-I) method developed by Mediratta and Pulkit (2023) was adopted, with modifications made based on the most recent ICMR-NIN Recommended Dietary Allowances (RDA), 2020, specific to the Indian adolescent population. The DQI-I assesses diet across four major components: variety (20 points), adequacy (40 points), moderation (30 points), and balance (10 points), summing to a total score of 100. The variety component measures diversity across food groups and within protein sources, the adequacy component evaluates sufficient intake of essential nutrients, moderation captures the consumption of nutrients to be limited, such as saturated fats and sodium and then balance assesses the proportion of energy derived from macronutrients. The total diet quality score for each participant had been calculated using these components.

The Depression, Anxiety and Stress Scale – Youth Version (DASS-Y) was used to measure emotional functioning, a validated instrument designed to measure emotional distress in adolescents (Szabó and Lovibond, 2022). The DASS-Y has 21 items total, including seven measures evaluating stress, anxiety, and depression. Participants

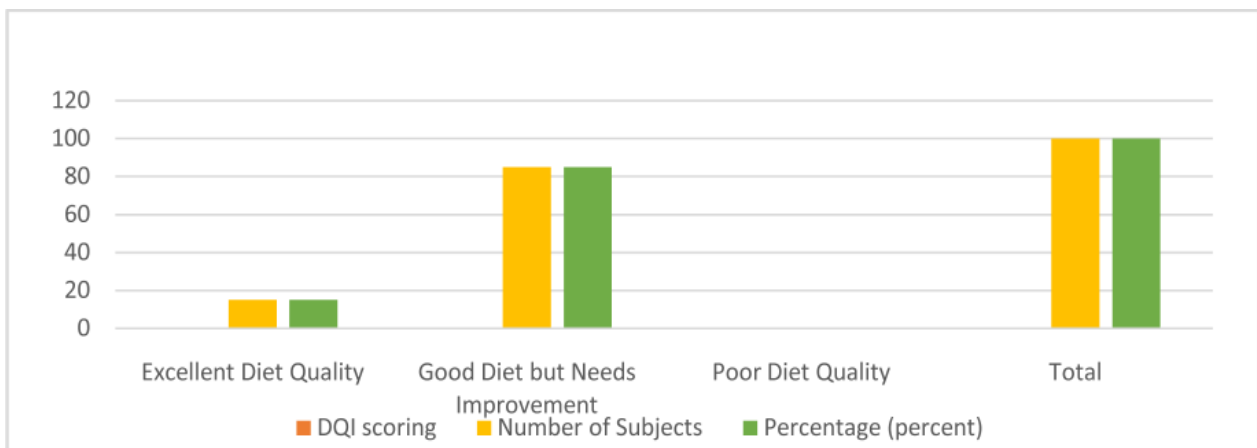
responded to each item based on their experiences over the past week using a 4-point Likert scale starts from 0 (“Did not apply to me at all”) to 3 (“Applied to me very much or most of the time”). Scores for each emotional domain were calculated and interpreted according to severity levels- normal, mild, moderate, severe, and extremely severe. This tool helped identify adolescents experiencing psychological distress and in need of emotional support.

By integrating dietary quality assessment through DQI-I and emotional assessment through DASS-Y, this study aims to explore the interrelationship between nutrition and emotional well-being among adolescent girls in Guntur District.

RESULTS AND DISCUSSION

Diet Quality Index (DQI-I)

The distribution of adolescent girls by overall DQI-I score categories, only 15 percent had excellent diets, marked by high ranking and nutrient adequacy, while 85 percent fell into the “Good but Needs Improvement” group, reflecting adequate but imbalanced diets needing better moderation and nutrient density (Acharya and Singh, 2014). None of the girls had a poor diet quality, indicating overall acceptable intake but highlighting the



Graph 1. Distribution of adolescent girls by overall DQI-I score categories

Table 2. Distribution of Adolescent Girls by Severity Categories of Depression, Anxiety and Stress (DASS-Y) (n=100)

Severity Category	Stress		Anxiety		Depression	
	No.	(%)	No.	(%)	No.	(%)
Normal	13	13	4	4	28	28
Mild	5	5	7	7	15	15
Moderate	32	32	32	32	30	30
Severe	47	47	18	18	21	21
Extremely Severe	3	3	39	39	6	6
Total	100	100	100	100	100	100

necessity of focused interventions to enhance diet quality in the majority.

The results related to Dietary assessment of the subjects based on DQI-I scores are represented in graph 1.

The assessment of emotional functioning indicated a high occurrence of stress, anxiety, and depression among adolescent girls, with anxiety and stress being particularly severe. Nearly 47 percent of participants experienced severe stress, and 32 percent reported moderate stress, indicating that 79 percent were under significant emotional strain. Only 13 percent had normal stress levels, while mild 5 percent and extremely severe 3 percent stress were less common.

Anxiety levels were the most severe, with 39 percent reporting extremely severe anxiety followed by 18 percent severe and 32 percent

moderate, meaning that 86 percent of girls showed anxiety symptoms above normal. Mild and normal anxiety levels were seen in just 7 percent and 4 percent of participants, respectively.

Depression was also widespread, with 30 percent experiencing moderate symptoms, 21 percent severe, and 15 percent mild. Although 28 percent reported normal levels, a total of 72 percent had depressive symptoms above the normal range, though generally less intense than anxiety or stress.

These results demonstrate a significant impact on mental health, with majority of girls facing moderate to extreme emotional challenges. The results support earlier findings by Szabó and Lovibond (2022) and Sharma and Malik (2022), emphasizing the urgent requirement for focused adolescent mental health support.

Table 3. Mean (DASS-Y) scores among Adolescent Girls

Emotional Function	Mean scores of the subjects			t-value	Significance ($p < 0.05$)
	11-14Years (n=50)	15-18 years (n=50)	Total subjects (N=100)		
Depression	13.28 ± 7.61	16.6 ± 9.82	14.68 ± 8.55	-1.89	Not significant
Anxiety	22 ± 5.31	25 ± 5.05	23.26 ± 5.62	-2.90	Significant
Stress	21 ± 6.65	28 ± 5.12	24.64 ± 6.66	-5.90	Highly significant

Table 4. Chi-square Test Results for Emotional Function Components

Emotional Function	Chi-square Value (χ^2)	Degrees of Freedom (df)	p-value	Significance
Stress	14.05	4	0.0071	Significant ($p < 0.01$)
Anxiety	4.86	4	0.302	Not Significant
Depression	16.80	4	0.0021	Significant ($p < 0.01$)

The emotional functioning assessment revealed age-related differences among adolescent girls. While older adolescents (15–18 years) had a greater mean depression score (16.6 ± 9.82) than younger ones (13.28 ± 7.61), There was no statistically significant difference ($t = -1.89$, $p > 0.05$), though a rising trend was noted. Anxiety levels showed a significant increase with age ($t = -2.90$, $p < 0.05$), with older girls scoring higher (25 ± 5.05) than younger ones (22 ± 5.31), likely due to academic and social pressures. The most significant difference was in stress scores, with older adolescents reporting much higher levels (28 ± 5.12) than younger peers (21 ± 6.65), supported by a highly significant t-value of -5.90 ($p < 0.01$). These results imply that anxiety and stress intensify with age, emphasizing the necessity of focused mental health interventions during late adolescence, consistent with findings by Szabó and Lovibond (2022) and Sharma and Malik (2022).

The relationship between age group (11–14 years and 15–18 years) and severity levels

of emotional functioning components-stress, anxiety, and depression-among adolescent girls was assessed. A strong correlation was observed between age and stress severity ($\chi^2 = 14.05$, $p = 0.0071$), with older adolescents exhibiting higher levels of stress. This may lead to increased academic, social, and emotional pressures during late adolescence.

Similarly, a significant relationship was found for depression ($\chi^2 = 16.80$, $p = 0.0021$), where more older adolescents were classified under moderate to extremely severe categories, indicating a rise in depressive symptoms with age. In contrast, the association between age and anxiety was not significant ($\chi^2 = 4.86$, $p = 0.302$), indicating that levels of anxiety were fairly distributed across both age groups.

Overall, the findings highlight that emotional disturbances-particularly stress and depression-intensify with age, underscoring the need for age-specific psychological support

Table 5. Pearson Correlation Coefficient Between Diet Quality Index–International (DQI-I) Scores and Depression, Anxiety, and Stress Scores Among Adolescent Girls

Parameter	Depression	Anxiety	Stress
Pearson correlation coefficient (r)	-0.2316	-0.6160	-0.7255
Coefficient of determination (r^2)	0.05365	0.3795	0.5264
p-value	0.02041	8.979×10^{-12}	1.372×10^{-17}
Covariance	-7.3980	-12.9273	-18.0525
Sample size (n)	100	100	100
t-statistic	-2.3571	-7.7419	-10.4361

and early intervention strategies for adolescent girls.

Correlation between DQI-I and DASS-Y Scores

Statistical analysis of the data on DQI and DASS-Y scores indicates a strong negative relationship between quality of diet (DQI-I scores) and emotional distress (DASS-Y scores) among adolescent girls. This suggests that better diet quality is significantly p -value (7.429×10^{-15}) associated with lower levels of depression, anxiety, and stress. The r^2 value of 0.4621 implies that 46.21 percent of the variation in emotional functioning can be explained by diet quality.

The observed negative covariance (-38.3778) and the notably high t -value (-9.1761) suggest a strong inverse association between the variables. These outcomes are consistent with existing literature that emphasizes the influence of dietary patterns on mental health, especially during adolescence. In conclusion, the findings highlight the essential role of nutritious and well-balanced diets in fostering emotional health among adolescent girls.

CONCLUSION

The study assessed the diet quality and emotional functioning of 100 adolescent girls (11–18 years) using the DQI-I and DASS-Y scales. Findings revealed high emotional distress, among adolescents' depressive symptoms. Older adolescents exhibited significantly higher stress and anxiety, with age-related differences. Poor diet quality, marked by inadequate intake of key nutrients,

was common. The results highlight a clear link between poor nutrition and emotional distress, emphasizing the necessity for integrated dietary and mental health interventions to support adolescent well-being.

REFERENCES

- Acharya, R. and Singh, R. 2014. Nutritional status and dietary intake of adolescent girls of Uttar Pradesh. *Indian Journal of Community Health*, 26(2): 188–192.
- Indian Council of Medical Research – National Institute of Nutrition (ICMR–NIN). 2020. *Nutrient Requirements for Indians: Recommended Dietary Allowances and Estimated Average Requirements*. Hyderabad: ICMR–NIN.
- Indian Food Composition Tables (IFCT). 2017. *Indian Food Composition Tables*. Hyderabad: National Institute of Nutrition, Indian Council of Medical Research.
- Mediratta, P. and Pulkit. 2023. Diet Quality Index–International (DQI-I) for Indian adolescents: A revised method using ICMR RDA 2020 guidelines. *International Journal of Nutrition and Health Sciences*, 15(1): 45–58.
- Sharma, N. and Malik, S. 2022. Prevalence and predictors of emotional disorders among school-going adolescents. *Indian Journal of Psychological Medicine*, 44(4): 342–349.
- Szabó, M. and Lovibond, P.F. 2022. Development and Validation of the DASS-Y: A youth version of the Depression Anxiety Stress Scales. *Assessment*, 29(6): 1198–1212.

Sai Janani, S., Lakshmi, K., Nirmala Devi, G. and Bilquis. 2026. Examining nutritional and emotional well being in adolescent girls through diet quality and depressive symptoms. *The Journal of Research ANGRAU*, 54(2) : 61-66

CONSUMER PREFERENCES AND PERCEPTION TOWARDS READY-TO-EAT FOODS AMONG URBAN CONSUMERS IN BERHAMPUR CITY, ODISHA

ALITA MINZ*, ISHANI SAMANTRAY, MANASEE MEHER and ASHMITA BEURA

P.G. Department of Home Science, Berhampur University, Bhanja Bihar,
Berhampur, Odisha-760 007

Date of Receipt : 04-03-2026

Date of Acceptance : 15-05-2026

ABSTRACT

Rapid urbanization and evolving lifestyles have significantly increased the consumption of Ready-to-Eat (RTE) food products in developing cities. This cross-sectional study examines the availability, popularity, nutritional perceptions and consumer preferences regarding RTE foods in Berhampur City, Odisha. A structured questionnaire was administered to 100 respondents selected through random sampling from urban and semi-urban areas. Results revealed that 55% of consumers occasionally consume RTE foods, primarily driven by convenience (50%) and taste (45-50%). While 45% of respondents perceived RTE food availability as neutral to adequate, 35% considered these products popular in the local market. Notably, 36% of consumers preferred healthy/organic RTE options, indicating rising health consciousness. However, 46% expressed skepticism about the balanced nutritional value of RTE foods, with 37% rating nutritional quality as poor. The study identifies convenience, taste and affordability as primary purchase drivers, while health benefits and brand reputation exert minimal influence. These findings provide valuable insights for manufacturers, retailers, and policymakers to balance convenience with nutritional quality in the growing RTE food sector.

Keywords: Berhampur, Consumer preferences, Food consumption patterns, Market dynamics, Nutritional value, Ready-to-Eat foods

INTRODUCTION

The global food industry has witnessed remarkable transformation in recent decades, with Ready-to-Eat (RTE) food products emerging as a significant segment driven by urbanization, lifestyle changes, and increasing workforce participation Asioli *et al.*(2017). In India, the RTE food market has expanded substantially, particularly in tier-2 and tier-3 cities where traditional eating patterns are

gradually shifting toward convenience-oriented food choices (Temgire & Borah, 2021).

Berhampur, known as the “Silk City” of Odisha, represents a typical example of urban transformation in southern India. With a population of approximately 421,000 and a literacy rate of 90%, the city serves as an important commercial and educational hub Census of India (2011). The increasing student population, working professionals, and

*Corresponding Author Email: am.hsc@buodisha.edu.in

nuclear families have contributed to growing demand for convenient food options. During emergencies such as cyclones and floods-common in coastal Odisha-RTE foods serve as essential food sources, further highlighting their significance in the regional context.

RTE foods encompass a wide range of products including packaged snacks, instant noodles, frozen meals, pre-cooked dishes, and microwaveable products that require minimal preparation before consumption. While these products offer undeniable convenience, concerns persist regarding their nutritional adequacy, high sodium and preservative content, and potential health implications. Understanding consumer perceptions, preferences, and purchasing behavior is crucial for developing healthier RTE options that align with both convenience needs and nutritional requirements.

Despite the growing RTE food market in India, limited research has examined consumer behavior and market dynamics in smaller cities like Berhampur. This study with the objective to analyze consumer preferences and factors influencing purchasing decisions and examine consumer perceptions regarding the nutritional value of RTE foods, addresses this gap by investigating the availability, popularity, nutritional perceptions, and factors influencing RTE food consumption in Berhampur City, providing insights applicable to similar urban centers in developing regions.

MATERIAL AND METHODS

A descriptive study was conducted in Berhampur City, Odisha, during 2024-2025. The study employed a mixed-method approach combining quantitative data collection with qualitative insights. A total of 100 respondents were recruited through random sampling from various locations across urban (55%) and

semi-urban (45%) areas of Berhampur City. The sample included students, working professionals, and homemakers representing diverse socio-economic backgrounds.

Primary data were collected using a structured questionnaire administered via Google Forms. The questionnaire comprised five sections:

1. Demographic information (age, gender, income, occupation, residential area)
2. RTE food consumption patterns and availability
3. Factors influencing purchase decisions
4. Nutritional awareness and perceptions
5. Consumer preferences and trends

The questionnaire included both closed-ended and multiple-choice questions utilizing Likert scales for rating responses. Data were collected through social media platforms and personal networks, ensuring diverse representation across demographic segments. Collected data were compiled and analyzed using descriptive statistics, including frequency distribution and percentage analysis. Results were presented through tables and graphical representations (bar graphs and pie charts) to facilitate interpretation of consumer behavior trends and market dynamics.

RESULTS AND DISCUSSION

Socio-Demographic Profile

The demographic analysis revealed (Table 1) that the majority of respondents (69%) belonged to the 18-24 age group, indicating predominant participation by young adults, particularly students and early-career professionals. Male respondents constituted 64% of the sample. The middle-class income group represented 53% of respondents, followed by lower class (29%) and upper class (18%), reflecting the socio-economic

Table 1. Socio-demographic characteristics of respondents (n=100)

Demographic Variable	Category	Percentage (%)
Age Group	18-24 years	69
	25-34 years	26
	35-44 years	2
	45-54 years	2
	55+ years	1
Gender	Male	64
	Female	35
	Others	1
Income Level	Upper class	18
	Middle class	53
	Lower class	29
Residential Area	Urban	55
	Semi-urban	45

composition of Berhampur City. The distribution between urban (55%) and semi-urban (45%) areas ensured adequate representation from different residential zones.

Consumption Patterns and Availability of RTE Food

Frequency of Consumption : From fig.1, among respondents, 55% reported consuming RTE foods “sometimes,” while 25% consumed them “rarely.” Only 5% never consumed RTE foods, and 12% consumed them “often.” This indicates moderate consumption patterns with occasional usage being most prevalent, similar to findings by Tam *et al.* (2017) among university populations.

Availability Perception: Regarding RTE food availability in Berhampur City (Fig. 2), 45% of respondents rated it as “neutral” (neither low nor high), while 30% perceived availability as “high.” Only 13% considered availability “low,” suggesting that RTE products are reasonably accessible through supermarkets, local stores, and online

platforms, consistent with the expansion of modern retail formats in tier-2 cities (Jena & Palta singh, 2023).

Popularity Assessment: When asked about RTE food popularity, 35% of respondents considered these products “popular,” 26% remained neutral, and 15% rated them as “very popular.” Only 1% viewed RTE foods as “not popular.” (illustrate from Fig.3) This indicates growing acceptance and market penetration, though awareness and adoption could be further enhanced.

Factors Influencing Purchase Decisions

Fig. 4 illustrate the primary drivers for purchasing Ready-To-Eat (RTE) food among consumers in Berhampur City are centered on sensory appeal and practicality. Taste emerged as the most influential factor, cited by 29% of respondents. This is followed closely by Convenience (26%) and Affordability (24%), which represent the core utility of RTE products for the urban consumer.

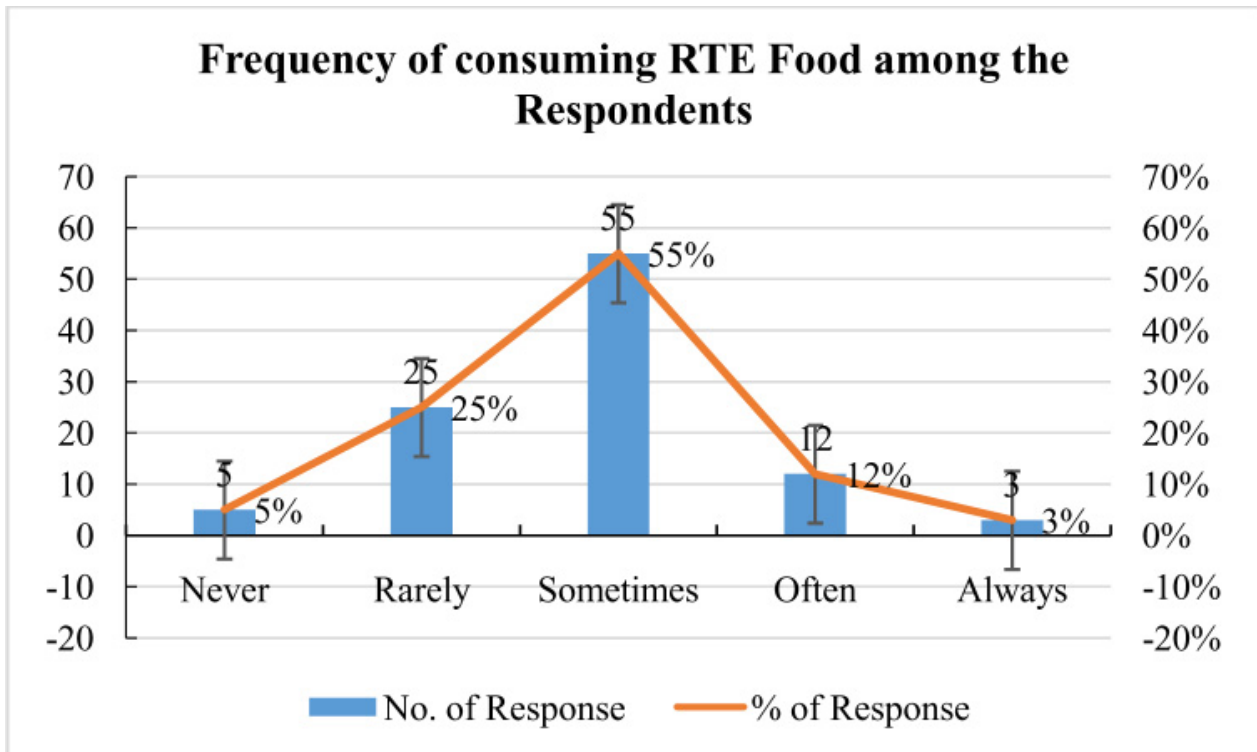


Fig. 1. Frequency of consuming RTE Food among the Respondents

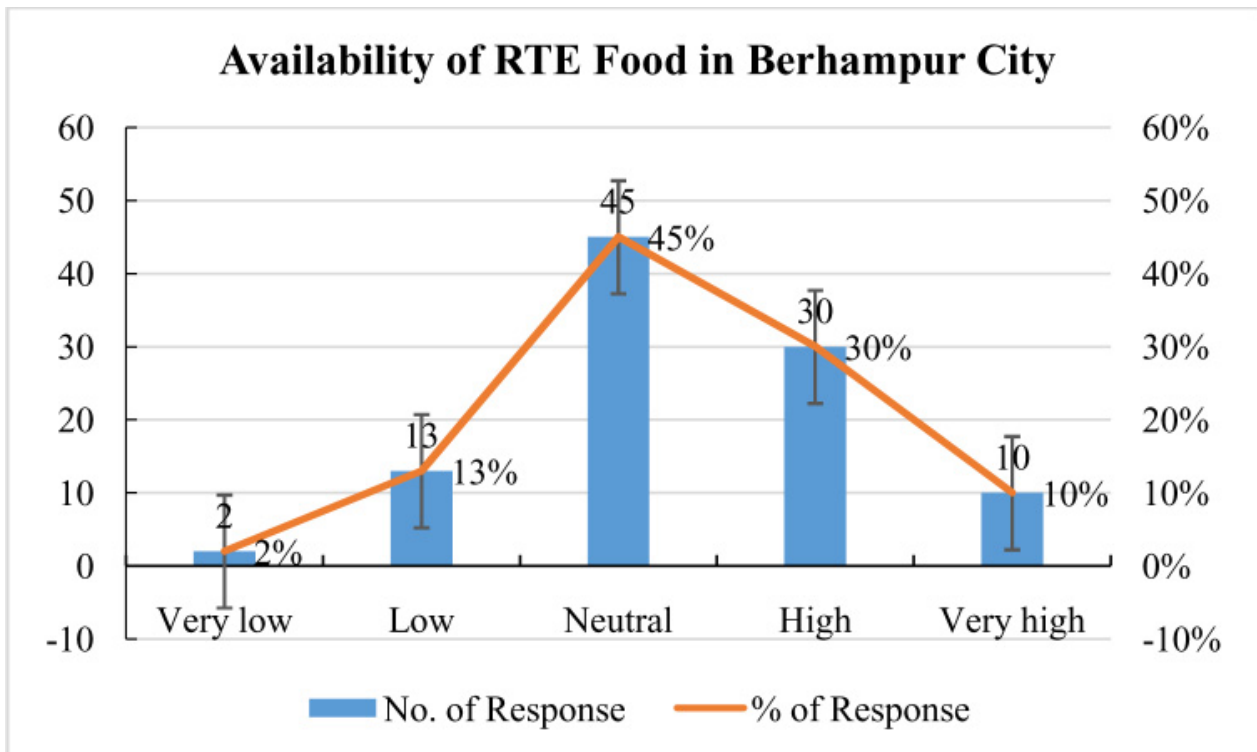


Fig. 2. Availability of RTE Food in Berhampur City

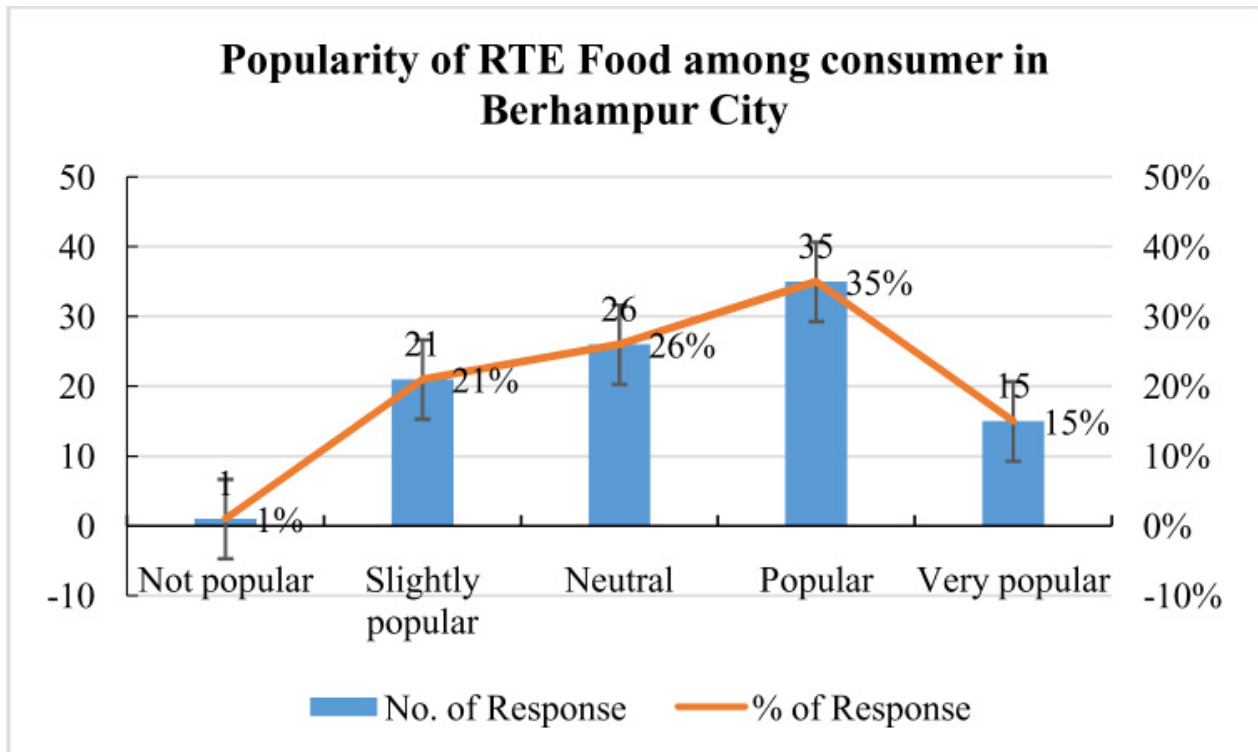


Fig. 3. Popularity of RTE Food among consumer in Berhampur City

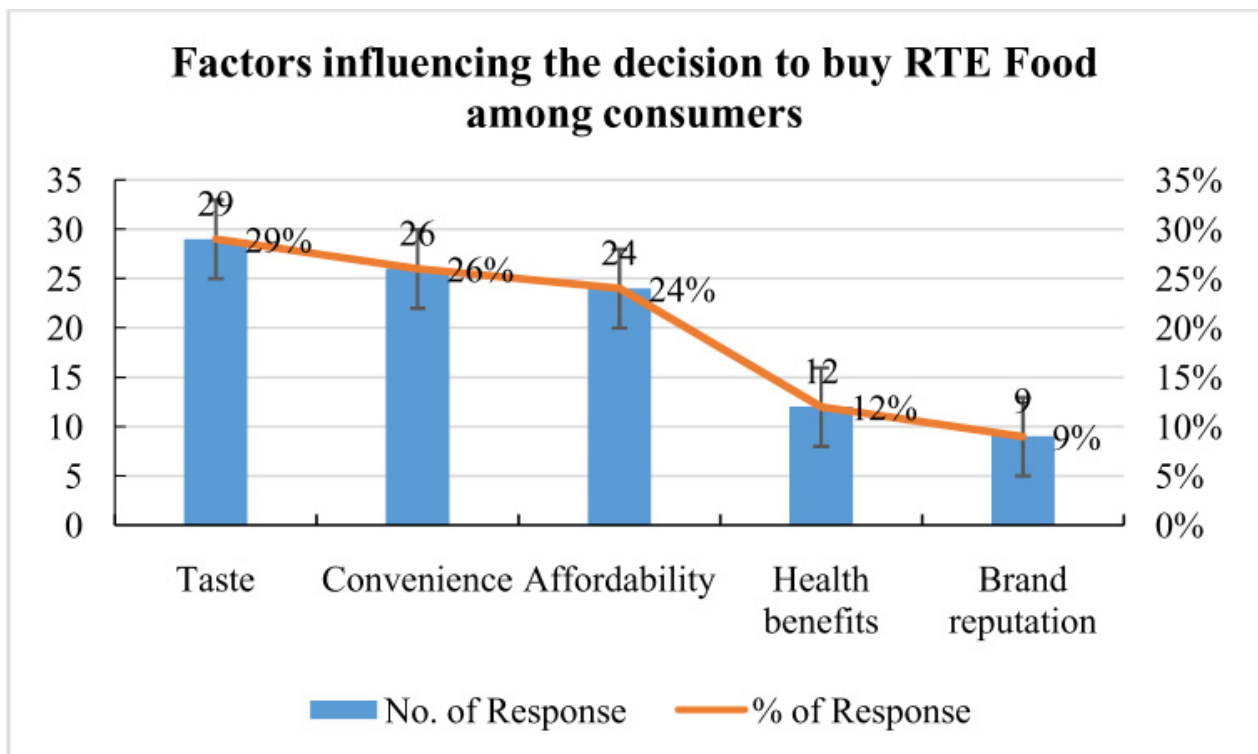


Fig. 4. Popularity of RTE Food among consumer in Berhampur City Consumer Preferences and Trends

In contrast, Health benefits (12%) and Brand reputation (9%) played a significantly smaller role in the decision-making process. This disparity suggests that for the majority of consumers, pragmatic considerations like immediate gratification and ease of access outweigh long-term health concerns or brand loyalty.

These findings align with research by Imtiyaz and Soni (2022), who identified convenience and specific product attributes as the primary determinants of RTE food purchases in emerging economies.

The dominance of convenience as a purchase driver reflects the time-constrained lifestyles of urban populations, particularly working professionals and students. However, the relatively low emphasis on health benefits raises concerns about nutritional awareness and long-term dietary implications.

The highest preference for healthy/organic RTE options (36%) indicates emerging health consciousness among consumers, reflecting broader trends toward clean-label and organic food products Siddiqui *et al.*, (2022). Packaged snacks (34%) and instant noodles (21%) remain popular due to their widespread availability and affordability. The relatively low preference for frozen meals (6%) may be attributed to concerns about freshness and limited cold storage infrastructure in households.

Consumer Perceptions and Awareness on RTE foods

Nutritional Value Rating: Consumer perceptions of RTE food nutritional value were mixed: 29% remained neutral, 27% rated it as “good,” while 24% considered it “poor” and 13% “very poor.” Only 7% rated nutritional

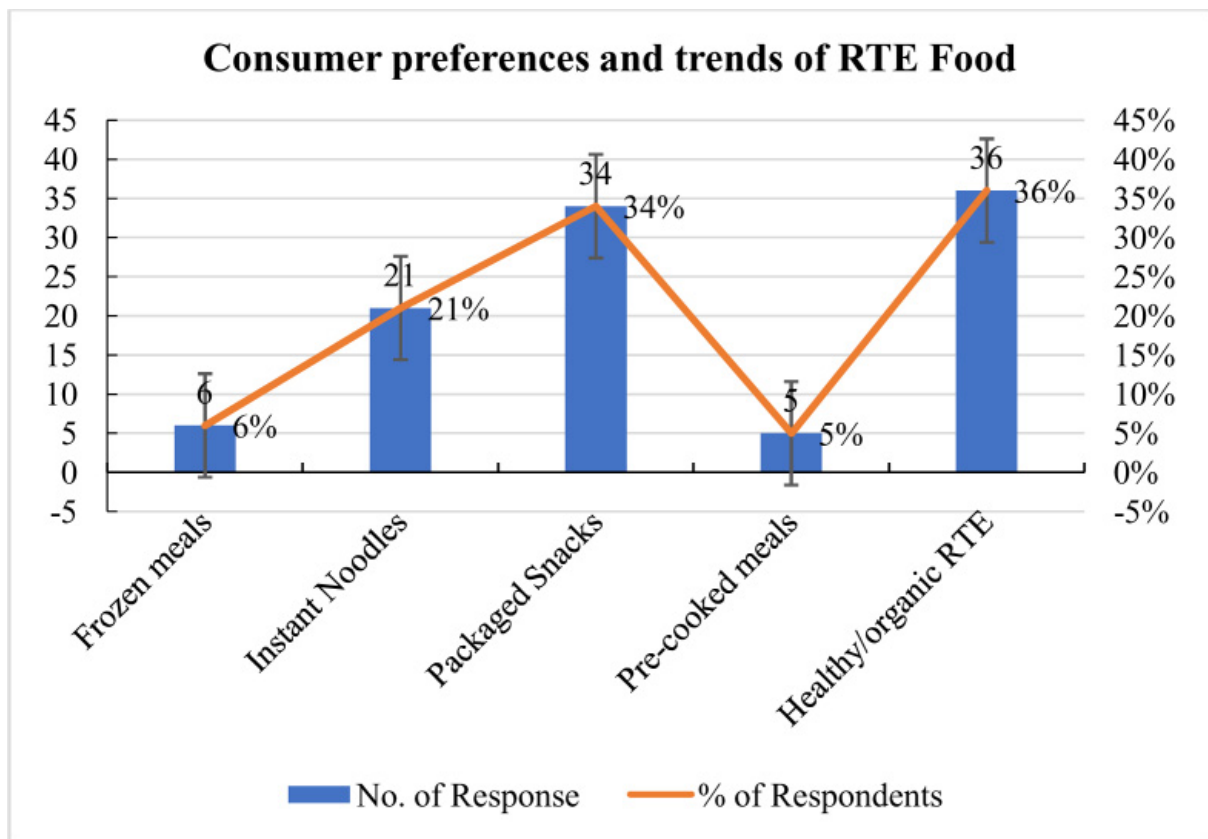


Fig. 5. Consumer preferences and trends of RTE Food

Table 2. Consumer Perceptions and Awareness on RTE foods (n=100)

Section	SL No.	Responses	No.of respondents Respondents	% of the
Nutritional value of Ready to Eat Food	1	Very poor	13	13%
	2	Poor	24	24%
	3	Neutral	29	29%
	4	Good	27	27%
	5	Very good	7	7%
Balanced nutrition provides by RTE Food	1	Strongly disagree	9	9%
	2	Disagree	37	37%
	3	Neutral	29	29%
	4	Agree	20	20%
	5	Strongly agree	5	5%
Checking of ingredients and preservatives in RTE Food by the consumer	1	Never	7	7%
	2	Rarely	20	20%
	3	Sometimes	35	35%
	4	Often	14	14%
	5	Always	24	24%
Taste and quality of RTE Food	1	Very poor	2	2%
	2	Poor	8	8%
	3	Neutral	27	27%
	4	Good	52	52%
	5	Excellent	11	11%
Perceiving the price of RTE food by consumer	1	Very expensive	4	4%
	2	Expensive	24	24%
	3	Reasonable	31	31%
	4	Affordable	35	35%
	5	Very affordable	6	6%

value as “very good.” This skepticism aligns with findings by Remnant and Adams (2015), who reported high levels of saturated fat and salt in supermarket ready meals.

Balanced Nutrition Perception: A significant proportion (46%) disagreed that RTE foods provide balanced nutrition, while only 25% agreed. This skepticism reflects

growing consumer awareness about the nutritional limitations of processed foods, consistent with public health concerns about high sodium, sugar, and preservative content in RTE products Blake *et al.*(2021).

Ingredient Checking Behavior: Encouragingly, 35% of respondents “sometimes” check ingredients and

preservatives, while 24% “always” check. Only 7% never check ingredients, indicating rising health consciousness and label-reading behavior. This suggests opportunities for manufacturers to improve transparency and communicate nutritional information more effectively.

Taste and Quality: The majority of respondents (52%) rated RTE food taste and quality as “good,” while 27% remained neutral and 11% rated it as “excellent.” Only 10% expressed dissatisfaction (poor or very poor ratings), suggesting general acceptance of RTE food quality in terms of sensory attributes.

Price Perception: Regarding pricing, 35% of respondents perceived RTE foods as “affordable,” 31% as “reasonable,” and 24% as “expensive.” Only 4% considered them “very expensive.” This generally positive price perception indicates that RTE products are competitively priced for the target consumer segments in Berhampur.

CONCLUSION

The study provides comprehensive insights into the consumer preferences and market dynamics of Ready-to-Eat (RTE) foods in Berhampur City. While convenience, taste, and affordability remain the primary drivers of consumption, a growing skepticism regarding nutritional quality presents a significant challenge for the industry. The rising preference for healthy and organic RTE options signals a shift in consumer expectations toward products that successfully balance convenience with nutrition. To address these evolving needs, a multi-stakeholder approach is essential. Manufacturers are encouraged to improve nutritional profiles by reducing sodium, sugar, and preservatives while adopting clean-label practices and vitamin fortification. Retailers should expand

the availability of healthy options and create dedicated sections for organic products, while policymakers must establish firm nutritional standards and mandate transparent labeling. Ultimately, consumers are urged to develop better label-reading skills and incorporate RTE foods judiciously into a balanced diet, advocating for a marketplace that prioritizes both ease and well-being.

REFERENCES

- Asioli, D., Aschemann-Witzel, J., Caputo, V. 2017. Making sense of the ‘clean label’ trends: A review of consumer food choice behaviour and discussion of industry implications. *Food Research International*, 99(1), 58-71.
- Blake, C. E., Frongillo, E. A. and Warren, A. M. 2021. Elaborating the science of food choices for rapidly changing food systems in low-and middle-income countries. *Global Food Security*, 28, 100503.
- Census of India. 2011. Population statistics for Berhampur city. Government of India.
- Imtiyaz, H. and Soni, P. 2022. Understanding consumers’ purchase intention and consumption of convenience food in an emerging economy: Role of marketing and commercial determinants. *Journal of Agriculture and Food Research*, 10, 100380.
- Jena, L. and Paltasingh, T. 2023. Techno globalization and the emerging trends of fast food restaurants: A study in the twin cities of Odisha. *Odisha Journal of Commerce*, 44(2), 49-64.
- Remnant, J. and Adams, J. 2015. The nutritional content and cost of supermarket ready-meals. *Appetite*, 92, 36-42.

- Siddiqui, S. A. and Zannou, O. 2022. Avoiding food neophobia and increasing consumer acceptance of new food trends. *Sustainability*, 14(16), 10179.
- Tam, R., Yassa, B. and Parker, H. 2017. University students' on-campus food purchasing behaviors, preferences, and opinions on food availability. *Nutrition & Dietetics*, 74(1), 105-111.
- Temgire, S. and Borah, A. 2021. Recent trends in ready to eat/ready to cook food products: A review. *The Pharma Innovation Journal*, 10(5), 211-217.

Alita Minz, Ishani Samantray, Manasee Meher and Ashmita Beura. 2026. Consumer preferences and perception towards ready-to-eat foods among urban consumers in Berhampur city, Odisha. *The Journal of Research ANGRAU*, 54 (2) : 67-75

DIURNAL TEMPERATURE RANGE VARIABILITY OVER KARNATAKA, INDIA: SPECTRAL EVIDENCE OF INTERANNUAL AND DECADEAL CLIMATE MODES (1958–2024)

SRINIVASA SASDHAR PONNALURU*

Department of Economics, Vijayanagara Srikrishnadevaraya University,
Bellary - 583105, Karnataka, India

Date of Receipt : 06-05-2026

Date of Acceptance : 18-06-2026

ABSTRACT

Diurnal temperature range (DTR), defined as the difference between daily maximum and minimum temperatures, is an important indicator of climatic variability and land–atmosphere interactions. This study examines the temporal variability of DTR over Karnataka, India, using monthly temperature data for 1958–2024. Monthly DTR anomalies were analysed using Welch and Lomb–Scargle spectral techniques with statistical significance assessed against an AR(1) red-noise background. The results reveal variability across multiple timescales, including interannual ($H=2-5$ years), sub-decadal ($H=8-9$ years), and a statistically significant decadal cycle near 16–17 years. Additional low-frequency variability around 30 years indicates gradual climatic modulation of DTR. These findings highlight the presence of multi-timescale climate variability influencing diurnal temperature behaviour in southern India, with potential implications for agricultural planning and climate adaptation.

Keywords: Climate Variability, Diurnal temperature range, ENSO, Karnataka, Spectral analysis.

INTRODUCTION

Temperature variability plays an important role in agricultural productivity and environmental processes, particularly in regions where climate strongly influences crop growth and water availability. In addition to mean temperature levels, differences between daytime and night-time temperatures affect plant respiration, phenology, and grain filling. The diurnal temperature range (DTR), defined as the difference between daily maximum and minimum temperatures, is therefore a useful indicator of climatic variability and land–atmosphere interactions.

Recent studies show that climate change often affects daytime and night-time temperatures asymmetrically, with minimum temperatures increasing more rapidly than maximum temperatures in many regions. Such changes modify the diurnal temperature cycle and influence regional climate behaviour (Donat *et al.*, 2016; Zhang *et al.*, 2019). Temperature variability is controlled by multiple processes, including atmospheric circulation, land–surface interactions, soil moisture conditions, and cloud cover (Sun *et al.*, 2017). Large-scale climate assessments further indicate that these processes operate across a wide range of temporal scales from

*Corresponding Author Email: sasdhara@vskub.ac.in

interannual oscillations to multi-decadal variability (IPCC, 2021).

In the Indian region, several studies have reported increasing temperature variability and changing climatic conditions associated with monsoon dynamics and long-term warming (Krishnan *et al.*, 2020). High-resolution climate datasets also reveal substantial spatial heterogeneity in temperature and rainfall patterns across the Indian peninsula (Pai *et al.*, 2021). Within Karnataka, climatic conditions vary considerably due to contrasts between humid coastal regions, the Western Ghats, and the semi-arid interior plateau (Simpson *et al.*, 2024).

Temperature variability also has important implications for agricultural systems. Crop growth and productivity depend not only on average temperature but also on fluctuations in day–night temperature differences. Elevated night-time temperatures can increase crop respiration and reduce grain filling, thereby affecting yields (Lobell *et al.*, 2015). Climate variability has also been shown to account for a significant portion of global crop yield fluctuations (Ray *et al.*, 2015; Lesk *et al.*, 2016).

While many studies have examined long-term trends in temperature and climate extremes, comparatively little attention has been given to the temporal structure of temperature variability itself. Climatic variables often exhibit variability across multiple timescales associated with large-scale climate modes and land–atmosphere feedbacks. Spectral analysis provides a useful approach for identifying such periodic components by decomposing time-series variance into frequency bands.

While previous studies have primarily focused on long-term temperature trends and extremes, the temporal structure of diurnal

temperature variability across multiple climatic timescales remains relatively underexplored, particularly at sub-national scales in India. This study addresses this gap by applying spectral analysis to identify dominant periodicities in DTR over Karnataka.

This study examines the temporal variability of diurnal temperature range over Karnataka during 1958–2024 using spectral analysis techniques. Specifically, Welch and Lomb–Scargle periodograms are used to identify dominant interannual, sub-decadal, and decadal modes of variability in DTR. Understanding these temporal patterns can improve regional climate characterization and provide insights relevant for agricultural planning in southern India.

MATERIAL AND METHODS

The study focuses on Karnataka in southern India, which extends from the humid coastal plains along the Arabian Sea to the elevated Western Ghats and the semi-arid interior Deccan plateau. These physiographic contrasts produce substantial spatial variation in temperature and rainfall regimes. Coastal districts generally exhibit smaller diurnal temperature ranges due to maritime influence, whereas interior districts experience larger day–night temperature contrasts typical of semi-arid climates.

Temperature data and DTR calculation

Monthly maximum (Tmax) and minimum (Tmin) temperature data were obtained from the TerraClimate dataset, a high-resolution global climate dataset widely used in climatological research (Abatzoglou *et al.*, 2018). The dataset provides monthly climate variables at approximately 4km spatial resolution and covers the period from 1958–2024. The TerraClimate dataset is quality-controlled and contains negligible missing values. Standard consistency checks were

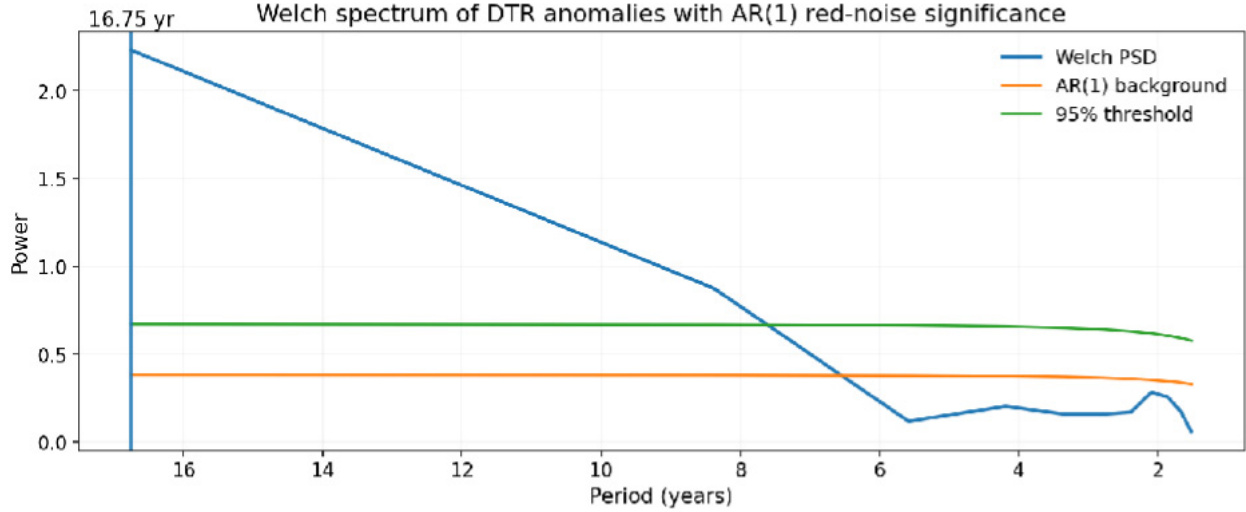


Fig.1. Welch power spectrum of deseasonalized DTR anomalies over Karnataka (1958–2024) with AR(1) red-noise background and 95% confidence threshold. The dominant decadal peak (~16–17 years) exceeds the red-noise threshold, indicating statistically significant low-frequency variability.

performed prior to analysis, and no interpolation was required. The data processing workflow involved aggregation of gridded temperature data to monthly district-level values, computation of DTR ($T_{\max} - T_{\min}$), removal of the seasonal cycle to obtain anomalies, linear detrending, and standardization to ensure comparability across time prior to spectral analysis.

Diurnal temperature range was calculated as: $DTR = T_{\max} - T_{\min}$

DTR anomaly construction

To isolate variability beyond the seasonal cycle, monthly DTR anomalies were calculated by removing the mean annual cycle. Monthly climatological means were first computed for each calendar month across the study period, and these values were subtracted from the original DTR series. The resulting anomaly series was linearly detrended and standardized prior to spectral analysis to ensure that the estimated spectra reflect intrinsic variability rather than seasonal or long-term linear trends.

Spectral analysis

Temporal variability in DTR was examined using two complementary spectral techniques. Spectral analysis is particularly suited for identifying periodic components in climate time series that are not readily observable in the time domain. First, the Welch periodogram was applied to the monthly anomaly series. The Welch method estimates power spectra by dividing the time series into overlapping segments, computing spectra for each segment, and averaging the results. This procedure reduces variance in spectral estimates and improves the stability of detected periodicities.

Second, the Lomb–Scargle periodogram was used to examine lower-frequency variability and verify spectral features identified using the Welch method. The Lomb–Scargle approach is widely used in geophysical time-series analysis for detecting periodic signals.

Statistical significance of spectral peaks was assessed against a first-order autoregressive [AR(1)] red-noise background.

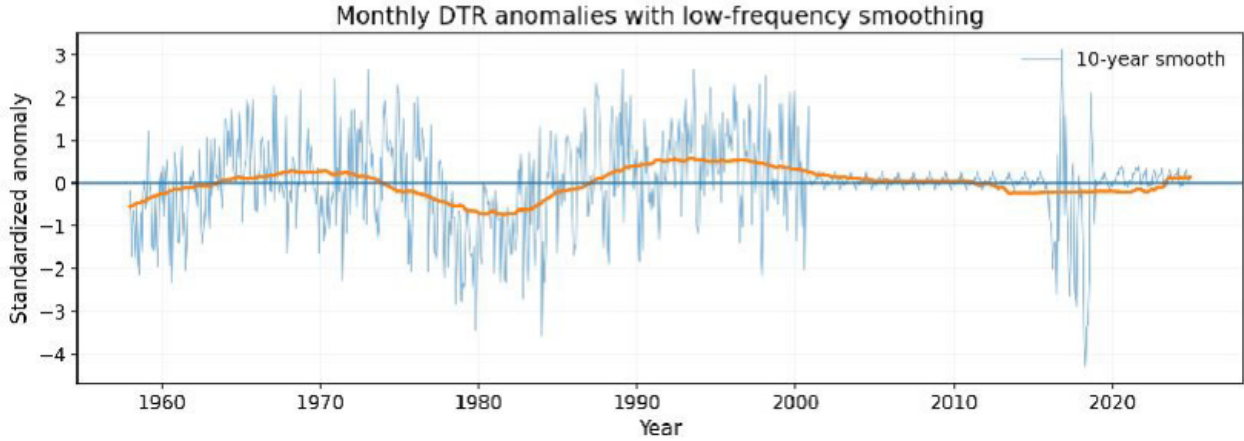


Fig.2. Monthly DTR anomalies over Karnataka (grey) and smoothed low-frequency component (bold), illustrating non-stationary decadal variability.

The lag-1 autocorrelation coefficient of the anomaly series was used to construct the theoretical red-noise spectrum, and peaks exceeding the 95% confidence level were considered statistically significant. The analysis is conducted at the state level to capture broad-scale climatic variability; however, sub-regional heterogeneity within Karnataka may exist and warrants further investigation.

Spectral computations were performed using Python scientific libraries including NumPy, SciPy, and Astropy.

RESULTS AND DISCUSSION

Temporal variability of DTR anomalies

The deseasonalized diurnal temperature range (DTR) anomaly series for Karnataka during 1958–2024 shows pronounced interannual variability together with slower multi-year fluctuations (Fig. 2). Positive anomalies indicate periods when daytime warming dominates relative to night-time warming, whereas negative anomalies reflect relatively stronger increases in minimum temperatures.

The anomaly series exhibits clear multi-year oscillatory behaviour rather than purely random variability. Such patterns are

consistent with the influence of interacting atmospheric and land–surface processes that modulate the balance between daytime heating and nocturnal cooling. In monsoon-dominated regions such as southern India, these processes are further affected by variability in large-scale ocean–atmosphere systems. The presence of slow oscillations in the anomaly series suggests that DTR variability is influenced by climatic processes operating across multiple temporal scales.

Spectral characteristics of DTR variability

The Welch power spectrum of the DTR anomaly series reveals several distinct peaks corresponding to different timescales of variability (Fig. 1). The strongest peak occurs at approximately 16–17 years, indicating a pronounced decadal-scale component in DTR variability across Karnataka. This peak exceeds the 95% confidence threshold derived from the AR(1) red-noise background, confirming that the signal is statistically significant and unlikely to arise solely from autocorrelated climate noise.

Additional spectral peaks occur within the sub-decadal band near 8–9 years and the interannual band between approximately 2 and

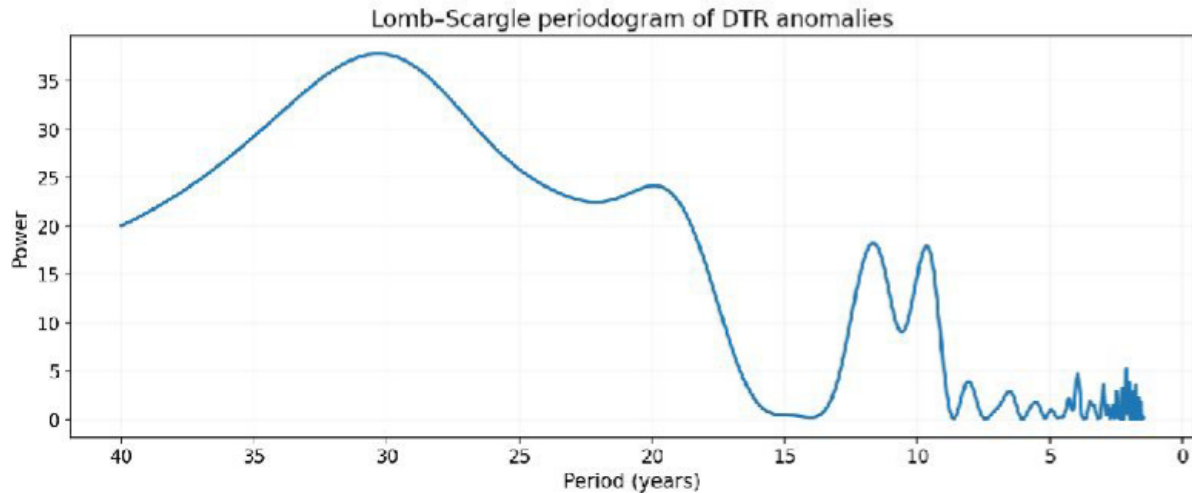


Fig.3. Lomb–Scargle periodogram of DTR anomalies highlighting enhanced low-frequency power associated with long-term climate modulation.

5 years. Although these peaks do not exceed the red-noise significance threshold, they indicate moderate variability at shorter timescales. Together, these results suggest that DTR variability over Karnataka is characterized by a hierarchy of temporal scales rather than by a single dominant oscillation.

Low-frequency variability

The Lomb–Scargle periodogram provides additional insight into longer-period variability (Fig.3). The spectrum shows enhanced power at periods of roughly 30 years, indicating substantial low-frequency variability in the DTR series. Rather than representing a discrete oscillatory cycle, this broad low-frequency signal likely reflects gradual modulation of the regional temperature regime.

Such behaviour is consistent with observational evidence from India indicating asymmetric warming between daytime and night-time temperatures, with minimum temperatures increasing more rapidly in several regions. These gradual shifts can generate persistent low-frequency variability in DTR that appears in spectral analysis as enhanced power at long periods.

Interpretation of dominant climatic timescales

The interannual variability observed in the 2–5 year band broadly coincides with the characteristic periodicity of the El Niño–Southern Oscillation (ENSO). ENSO influences atmospheric circulation and monsoon dynamics across the Indian subcontinent, affecting cloud cover, radiation balance, and surface moisture conditions. These factors influence both daytime heating and nocturnal cooling and can therefore modulate DTR behaviour.

The sub-decadal variability near 8–9 years may reflect interactions among ocean–atmosphere processes such as the Indian Ocean Dipole (IOD) and longer-term modulation of ENSO activity. Persistence in land-surface conditions, including soil moisture and vegetation cover, may also contribute to multi-year temperature variability through land–atmosphere feedback mechanisms.

The strongest spectral signal identified in this study, near 16–17 years, suggests the presence of decadal-scale modulation in diurnal temperature behaviour. Such variability

may arise from gradual adjustments in the regional climate system, including land-use change, irrigation expansion, and aerosol influences, which can alter the surface energy balance and preferentially affect night-time cooling.

Implications for agricultural systems

Variability in diurnal temperature range has important implications for agricultural systems. Crop growth depends not only on mean temperature conditions but also on the balance between daytime and night-time temperatures. Elevated night-time temperatures can increase plant respiration and reduce grain filling in several crops, while larger diurnal temperature ranges may increase evapotranspiration and crop water demand. In Karnataka, crops such as paddy, maize, and pulses are particularly sensitive to night-time temperature increases during critical growth stages.

The presence of multi-timescale variability in DTR suggests that agricultural temperature conditions in Karnataka may be influenced by climate oscillations operating over several years or decades. Periods characterized by sustained increases in night-time temperatures may therefore influence crop productivity and heat stress conditions, particularly in semi-arid regions with limited irrigation resources. Recognizing these temporal patterns can support improved climate risk assessment and agricultural planning.

Robustness and limitations of spectral analysis

Spectral techniques provide valuable insights into the temporal structure of climatic variability but require careful interpretation. The identification of dominant periodicities depends on the statistical properties and length of the underlying time series as well as

Table 1. Welch power spectrum of DTR anomalies over Karnataka (1958–2024) with AR(1) red-noise significance threshold.

Period (years)	Power
16.8	2.23
8.4	0.87
4.2	0.2
3.4	0.16
2.1	0.28

assumptions regarding background noise behaviour. In this study, spectral significance was evaluated against a first-order autoregressive [AR(1)] red-noise model. The dominant peak near 16–17 years exceeds the 95% confidence level, confirming the statistical robustness of the decadal signal (Table 1).

Lower-amplitude peaks in the interannual and sub-decadal ranges do not exceed the significance threshold and should therefore be interpreted cautiously. These peaks may reflect weak climatic signals combined with residual autocorrelation in the time series. Additionally, the broad low-frequency power detected in the Lomb–Scargle spectrum likely reflects non-stationary climatic behaviour associated with gradual changes in the regional temperature regime rather than a strictly periodic oscillation.

Association with ENSO and IOD variability

To examine whether the interannual variability in DTR is associated with large-scale climate modes, monthly DTR anomalies were compared with the Oceanic Niño Index (ONI) and Dipole Mode Index (DMI) at lags of 0–6 months (Table 2). The results indicate a weak but statistically significant negative association between DTR anomalies and ONI at a lag of six months ($r = -0.098$, $p < 0.01$), suggesting a delayed ENSO influence on diurnal

Table 2. Association between DTR anomalies and ENSO/IOD indices

Model	Lag (months)	Corre- lation	p- value	NW Coefficient	NW p-value
ONI	6	- 0.098	0.005	- 0.116	0.085
DMI	0	0.064	0.068	0.176	0.183
ONI (joint)	6	—	—	- 0.113	0.09
DMI (joint)	0	—	—	0.15	0.241

temperature variability. In contrast, the association with DMI is weak and statistically insignificant across all lags.

Newey–West regression estimates confirm these findings, with the ENSO coefficient remaining marginally significant at the 10% level, while the IOD effect is not statistically significant. These results suggest that ENSO contributes modestly to interannual variability in DTR, whereas IOD influence is minimal. Overall, the statistical evidence supports interpreting the interannual spectral variability as consistent with ENSO timescales, although ENSO explains only a small proportion of the observed variability.

CONCLUSION

This study examined the temporal variability of diurnal temperature range (DTR) over Karnataka using spectral analysis of monthly temperature data for the period 1958–2024. The results reveal that DTR variability is characterized by multiple temporal scales, including interannual fluctuations near 2–5 years, sub-decadal variability around 8–9 years, and a statistically significant decadal signal near 16–17 years. Complementary Lomb–Scargle analysis further indicates strong low-frequency variability near 30 years, indicating gradual climatic modulation of diurnal temperature behaviour.

These findings indicate that DTR variability over Karnataka reflects the

combined influence of short-term climate oscillations and longer-term structural changes in the regional climate system. Because day–night temperature differences influence crop respiration, evapotranspiration, and heat stress conditions, multi-timescale variability in DTR may have important implications for agricultural systems in semi-arid and monsoon-dominated regions. Incorporating such climatic signals into agricultural advisories and seasonal planning frameworks could improve preparedness for temperature-related risks and support climate-resilient agricultural strategies in Karnataka.

Future research may extend the present analysis using wavelet methods or climate-mode correlation studies to further investigate the drivers of diurnal temperature variability in the region.

ACKNOWLEDGEMENT

The author acknowledges financial support from The Indian Council of Social Science Research (ICSSR) New Delhi under major Research Project Grant G133.

REFERENCES

- Abatzoglou, J. T., Dobrowski, S. Z., Parks, S. A., and Hegewisch, K. C. 2018. TerraClimate, a high-resolution global dataset of monthly climate and climatic water balance from 1958–2015. *Scientific Data*, 5, 170191. <https://doi.org/10.1038/sdata.2017.191>

- Donat, M. G., Lowry, A. L., Alexander, L. V., O’Gorman, P. A., and Maher, N. 2016. More extreme precipitation in the world’s dry and wet regions. *Nature Climate Change*, 6, 508–513. <https://doi.org/10.1038/nclimate2941>
- IPCC (2021). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge. <https://doi.org/10.1017/9781009157896>
- Krishnan, R., Sanjay, J., Gnanaseelan, C., Mujumdar, M., Kulkarni, A., and Chakraborty, S. 2020. *Assessment of Climate Change over the Indian Region*. Springer Nature, Singapore. <https://doi.org/10.1007/978-981-15-4327-2>
- Lesk, C., Rowhani, P., and Ramankutty, N. 2016. Influence of extreme weather disasters on global crop production. *Nature*, 529, 84–87. <https://doi.org/10.1038/nature16467>
- Lobell, D. B., Hammer, G. L., McLean, G., Messina, C., Roberts, M. J., and Schlenker, W. 2015. The critical role of extreme heat for maize production in the United States. *Nature Climate Change*, 3, 497–501. <https://doi.org/10.1038/nclimate1832>
- Pai, D. S., Sridhar, L., Rajeevan, M., Sreejith, O. P., Satbhai, N. S., and Mukhopadhyay, B. 2021. Development of a new high spatial resolution rainfall data set for India and its long-term climatological analysis. *Mausam*, 72(1), 1–20. <https://doi.org/10.54302/mausam.v72i1.82>
- Ray, D. K., Gerber, J. S., MacDonald, G. K., and West, P. C. 2015. Climate variation explains a third of global crop yield variability. *Nature Communications*, 6, 5989. <https://doi.org/10.1038/ncomms6989>
- Simpson, R., Abhilash, K. P., Kavaya, R., and Hiremath, S. 2024. Examining Two Decades of Climate Variability in Karnataka: Insights from Temperature and Rainfall Trends. *International Journal of Environment and Climate Change*, 14(2), 97–109. <https://doi.org/10.9734/ijecc/2024/v14i74255>
- Sun, Y., Zhang, X., Zwiers, F. W., Song, L., Wan, H., Hu, T., Yin, H., and Ren, G. 2017. Rapid increase in the risk of extreme summer heat in Eastern China. *Nature Climate Change*, 7, 320–324. <https://doi.org/10.1038/nclimate3279>
- Zhang, X., Alexander, L., Hegerl, G., Jones, P., Tank, A. K., Peterson, T., Trewin, B., and Zwiers, F. 2019. Indices for monitoring changes in extremes based on daily temperature and precipitation data. *Climate Dynamics*, 52, 4245–4259. <https://doi.org/10.1007/s00382-018-4366-2>

Srinivasa Sasdhar, P. 2026. Diurnal temperature range variability over Karnataka, India: Spectral evidence of interannual and decadal climate modes (1958–2024). *The Journal of Research ANGRAU*, 54(2) : 76-83

FACTORS INFLUENCING CONSUMERS SHIFT TOWARDS COLD PRESSED OILS IN GUNTUR, ANDHRA PRADESH

M. CHARITHA, K. UMA DEVI*, M. SATISH RAHUL and B. RAMANA MURTHY

Institute of Agribusiness Management, S. V. Agricultural College, Tirupati - 517502
Acharya N G Ranga Agricultural University, Guntur, Andhra Pradesh, India

Date of Receipt : 27-02-2026

Date of Acceptance : 22-05-2026

ABSTRACT

The study examined the consumer perceptions and factors influencing the consumers to shift from refined oils to cold pressed oils in Guntur and Tenali towns. A total of 120 respondents were interviewed using a structured and pre-tested schedule to ensure accuracy and engagement. The high KMO value and significant Bartlett is a strong justification for factor analysis. All participants were fully aware of cold-pressed oils but only 20.83 per cent currently used them. Health consciousness (70%), taste (41.67%) and traditional processing (35%) emerged as key reasons for preference. Using principal component analysis, nine influencing components were extracted, including brand trust, health awareness, social influence and product accessibility, accounting for over 67 per cent of the total variance. The findings aim to reduce the awareness and adoption gap by generating region-specific insights.

Keywords: Cold-pressed oils, Consumer behaviour, Edible oil preferences, Factor analysis, Health awareness

INTRODUCTION

India, being one of the largest producers and consumers of edible oils, has seen a growing interest in healthier, minimally processed alternatives such as cold-pressed oils. Among the nine major oilseed crops grown, edible varieties such as groundnut, sesame, sunflower, mustard and safflower were suitable for cold-pressed oil extraction (Ministry of Agriculture and Farmers Welfare, 2023). Global forecasts by Food and Agriculture Organization (FAO) and International Market Analysis Research and Consulting Group (IMARC, 2023) also project a steady rise in

demand for cold pressed oils due to increasing urbanization, dietary diversification, and wellness-focused consumer behaviour. According to Food Safety and Standards Authority of India (FSSAI), 2021 and IMARC, 2023), the cold-pressed oil market in India is expected to reach Rs.10,000 crore by 2027, with a Compound Annual Growth Rate (CAGR) of 6.5 per cent. The cold pressed oils extracted without heat or chemicals retain natural antioxidants, essential fatty acids, vitamins and minerals making these oils more nutritious, flavorful and aromatic and are perceived as beneficial for health-conscious consumers (Krishnaveni *et al.* 2022).

*Corresponding Author Email: k.umadevi@angrau.ac.in; Part of research work for MBA (Agri. Business Management) project submitted to Acharya NG Ranga Agricultural University, Lam, Guntur

Refined oils continue to dominate Indian households due to their lower prices, wider availability, and stronger brand presence. However, some consumers reported concerns about adulteration and artificial additives, preferring cold-pressed oils for their natural extraction methods (Kirubashini and Priyadharshini, 2018). The widely used refined oils have less nutrient content due to chemical treatment and thermal refining. The cold-pressed oils result in 30% fewer emissions and 92% less pollution than refined oils. Therefore, many of the health-conscious customers preferred cold pressed oils (Kanimozhi and Hariharan, 2023). This shift in consumer preference towards cold pressed oils resulted with the increase in health awareness, socio-cultural practices, and nutritional knowledge among consumers. Yamini *et al.* (2024) showed that health benefits with highest mean score of 4.34, followed by quality (4.08) and taste (3.54) were the main factors influencing consumers to shift from refined oils to cold pressed oils.

The cold-pressed oils gained prominence in urban and semi-urban markets post-covid resulting in the emergence of many cold pressed oil mills. These oils retain 40 per cent more antioxidants and polyphenols than refined oils, reducing cardiovascular risks (Kumar and Sharma, 2023). Nowadays, regional brands compete in the market using the terms like wood-pressed, chemical-free and traditionally made for attracting the health-conscious consumers (Sridevi and Ranjani, 2022). The Andhra Pradesh state is one of the top producers of groundnut and sesame, especially in districts like Guntur, Anantapur, and Kurnool (NABARD Annual Report, 2022–23). Favourable climate, supporting infrastructure, and traditional food preferences contributed to high production and consumption of cold pressed oils in the state. The cold-pressed oil units are promoted under

the PMFME scheme of Ministry of Food Processing Industries (MoFPI, 2023) in Guntur district. However, consumer preference largely remained in favour of refined oils. Previous studies showed that higher pricing, limited awareness, concerns related to product authenticity and established cooking habits acted as major constraints to adoption. However, the shift towards cold-pressed oils was more pronounced among urban and economically affluent consumers. Thus, pricing strategies that result in mass adoption need to be focused to reach maximum number of consumers (Lee and Gupta, 2023). Tang *et al.* (2024) established that consumers' attitudes and health beliefs greatly influenced oil-switching decisions along with the perceived behavioral control and peer influence.

The rapid urbanization in towns like Guntur, Mangalagiri, Tenali, and Ponnur might have resulted in higher literacy rates and better health consciousness among consumers. The government programmes such as PM Formalisation of Micro Food Processing Enterprises (PMFME), National Mission on Edible Oils – Oil Palm (NMEO-OP), and NABARD-supported rural food clusters encouraged traditional processing methods and local entrepreneurship. In Guntur district, oilseeds such as groundnut and sesame are extensively cultivated and many cold-pressed oil mills were established with the support of the government. However, studies indicate that price sensitivity, low awareness, and traditional cooking habits still limit their adoption. Keeping this in view, the study focused on examining consumer preferences and perceived factors influencing their shift from refined oils to cold-pressed oils.

MATERIAL AND METHODS

The study was purposively conducted in Guntur district of Andhra Pradesh, with a special focus on Guntur and Tenali towns which

are the evolving centers for cold-pressed oil production under the PM Formalization of Micro Food Processing Enterprises (PMFME) scheme. This is evident from PMFME-supported enterprises such as KPS Natural oils and Morning Star oils in Guntur district (www.pmfmeap.org). A pre-structured interview schedule was used to collect data from 120 respondents (60 each in Guntur and Tenali towns). The study was restricted to cold-pressed edible oils extracted from groundnut, sesame, sunflower and coconut.

Factor analysis was used to identify the factors influencing consumer preferences and perceptions towards cold-pressed edible oils. Kaiser-Meyer-Olkin (KMO) measure of Sampling Adequacy (Acceptable if KMO > 0.6) and Bartlett's test of sphericity ensured data suitability for the analysis. The statements (24 No.) measured on a five-point likert scale ranging from strongly disagree (1) to strongly agree (5) were used for analyzing the factors influencing consumer preferences. The statements were made based on existing literature, expert consultation, and field relevance to consumer behaviour in edible oil usage. Extraction was done using Principal Component Analysis (PCA) followed by Varimax rotation to enhance interpretability. A Correlation Matrix was prepared to examine whether variables were sufficiently correlated. Further, extraction of initial factors was done with Eigenvalues $e \geq 1$. The Varimax orthogonal rotation was done to simplify factor loadings and the variables loading strongly (>0.5) on a factor were grouped and named accordingly.

The general linear form is:

$$F_i = a_1x_1 + a_2x_2 + \dots + a_nx_n$$

where:

- F_i = factor score for factor i
- x_n = observed variables

- a_n = factor loading (weight) of each variable on the factor.

RESULTS AND DISCUSSION

Purchasing behaviour of the respondents towards shift to cold pressed oils

The sample consumers were categorized into regular and irregular users based on the usage frequency of cold pressed oils over time. All the 120 respondents were aware of cold-pressed oils, but only 20.83 per cent were the regular users of cold pressed oils exclusively. The remaining 79.17 per cent of respondents are found to be irregular users of cold pressed oils i.e., using less frequently.

The purchasing behaviour of the sample respondents is depicted in Table 1. Purchase frequency reported for both regular and irregular users of cold pressed oils in the study. Table 1 indicates that 45.83 per cent of respondents bought oils monthly while 32.5 per cent every 15 days. Additionally, 12.51 per cent purchase oil less frequently i.e., beyond one month and 9.16 per cent make weekly purchases. This indicates that majority of consumers prefer to purchase oil on a monthly basis.

The effect of packaging on consumer preferences was assessed based on the level of importance given to packaging when selecting cold-pressed oils. The respondents (52.51%) considered packaging to be moderately important when choosing cold pressed oils while 28.33 percent rated it as highly important. Some of them (19.16%) felt that packaging was not important in their purchase decision. These findings indicate a moderate influence of packaging on buying decisions.

Price was a major concern (62.5%) while 27.5 per cent had moderate concern and 10

Table 1. Consumer perceptions towards purchase of cold pressed oils (n=120)

S.No.	Particulars	Frequency	Percentage
A	Frequency of purchase		
1	Weekly	11	9.16
2	Every15 days	39	32.5
3	Monthly	55	45.83
4	Above 1 month	15	12.51
B	Importance of packaging		
1	Highly Important	34	28.33
2	Moderately Important	63	52.51
3	Not Important	23	19.16
C	Price concern		
1	Major	75	62.5
2	Moderate	33	27.5
3	No concern	12	10
D	Willingness to pay		
1	Yes	72	60
2	No	48	40
E	Recommend cold-pressed oils to others		
1	Very Unlikely	0	0
2	Unlikely	0	0
3	Neutral	21	17.51
4	Likely	44	36.66
5	Very Likely	55	45.83
F	Intention to shift from refined to cold-pressed oils		
1	Already shifted	47	39.17
2	Planning	60	50
3	Not planning	13	10.83

per cent reported none. Thus, high pricing remained a significant barrier. Majority (60%) were willing to pay more for genuine cold-pressed oil. Recent studies confirm that high price concern and willingness to pay can coexist, reflecting a shift in modern consumer behaviour (Andika and Setyanta, 2024).

Consumers valued authenticity and quality while price remained a concern for a considerable portion. Furthermore, 45.83 per cent were very likely and 36.66 per cent were likely to recommend cold-pressed oils. Some (17.51%) remained neutral, and none were unlikely to recommend, indicating high

satisfaction. Majority (50%) were planning to shift while 39.17 per cent had already shifted and 10.83 per cent were not planning to. This showed an encouraging trend toward adoption. Despite this, complete adoption remained elusive due to the intention-behaviour gap driven by price sensitivity (62.5%), limited retail availability (Rank VI, mean score 14.27), and brand authenticity concerns, with the non-adopting 10.83 per cent representing habit-driven consumers preferring refined oils (Tang *et al.*, 2024).

Factors Influencing Consumers to Shift from Edible Refined Oils to Cold Pressed Oils

In recent years, cold pressed oils have emerged as a healthier alternative to refined edible oils, attracting consumer interest due to their nutritional value, chemical-free nature, and natural extraction process. However, consumer decision-making is influenced by multiple underlying factors, including health concerns, brand trust, social influence and economic considerations. Kumari and Gowthamy (2019) highlighted that cold-pressed oils were perceived as safer and word-of-mouth recommendations from family members (31.4%) significantly influenced the shift from refined to cold pressed oils. Health consciousness emerged as the primary driver, associating cold-pressed oils with lower cholesterol and fewer chemical additives. Higher income levels and education were positively correlated with adoption (Devi and Rao, 2021).

The SPSS software was used to perform the factor analysis for identifying the factors that influence the consumers to shift towards cold pressed oils. The exploratory factor analysis was conducted on all 120 respondents comprising both regular and irregular users of

cold pressed oils. Overall, 24 perception statements on cold pressed oils were considered for the analysis. The objective is to cluster the statements into key dimensions representing different aspects that drive the shift from refined to cold pressed edible oils. The mean score was estimated and ranked for each statement and presented in Tables 2 and 3.

Table 2 shows that the most influential factor encouraging consumers to shift from refined to cold-pressed oils was Health and Wellness (HW), as reflected by the strong agreement on statements related to disease prevention, overall health benefits and the perception that cold-pressed oils are chemical-free and healthier. This was followed closely by Product Quality and Functional Attributes (QA), where consumers rated cooking benefits, aroma and purity as important aspects. Price Sensitivity and Perceived Value (PV) also played a considerable role, indicating that affordability, discounts and the belief in value for money significantly impacted purchase decisions. Factors like Brand Trust and Credibility (TC) and Social Influence and Awareness (IA) were also noted to be important, suggesting that recommendations from family and friends, exposure through advertisements and trust in certified or well-known brands shaped purchasing behaviour of the respondents.

Table 3 reveals that “Health and Wellness” emerged as the most influential factor with the highest mean score of 14.99 and therefore secured the first rank. This indicates that factors such as health benefits, nutritional value, disease prevention and overall well-being played a major role in motivating consumers to shift towards cold-pressed oils. The second rank was obtained by “Product

Table 2. Factors influencing consumers to shift from refined to cold pressed oils (n=120)

Factor	Statement	Mean score
Health & Wellness (HW)	I use cold-pressed oil to prevent lifestyle diseases (HW1)	3.78
	Cold-pressed oil is healthier than refined oil (HW2)	3.75
	Using cold-pressed oil makes me feel more health-conscious (HW3)	3.74
	I prefer cold-pressed oil because it is free from chemicals (HW4)	3.72
Product Quality & Functional Attributes (QA)	Cold-pressed oil has better cooking properties than refined oil (QA1)	3.79
	The natural extraction process makes cold-pressed oil superior in quality (QA2)	3.75
	Cold-pressed oil retains its original aroma and flavor (QA3)	3.61
	I trust the purity of cold-pressed oil (QA4)	3.51
Price Sensitivity & Perceived Value (PV)	Cold-pressed oil is too expensive compared to other oils (PV1)	3.75
	I look for discounts or offers when buying cold-pressed oil (PV2)	3.67
	Cold-pressed oil offers good value for money (PV3)	3.66
	I am willing to pay more for the quality of cold-pressed oil (PV4)	3.46
Brand Trust & Credibility (TC)	I avoid buying cold-pressed oil from unfamiliar brands (TC1)	3.63
	Organic certification influences my purchase decision (TC2)	3.60
	I trust cold-pressed oil from established or reputed brands (TC3)	3.58
	I prefer brands that clearly mention the source of oilseeds (TC4)	3.53
Social Influence & Awareness (IA)	My friends and family influenced my decision to use cold-pressed oil (IA1)	3.66
	I have seen many advertisements or social media posts about cold-pressed oil (IA2)	3.65
	People around me recommend using cold pressed oil (IA3)	3.57
	I am aware of the health and environmental benefits of cold-pressed oil (IA4)	3.43
Availability & Convenience (AC)	Cold-pressed oil is available at my nearby stores (AC1)	3.61
	I prefer brands that offer cold-pressed oil in multiple pack sizes (AC2)	3.60
	The product packaging makes it easy to store and use (AC3).	3.56
	I find it easy to order cold-pressed oil online (AC4)	3.50

Quality and Functional Attributes” with a mean score of 14.66, highlighting the strong impact of cooking performance, aroma, taste and other functional characteristics on purchasing decisions. “Price Sensitivity and Perceived

Value” ranked third with a mean score of 14.54, suggesting that cost considerations, perceived value for money and affordability significantly influenced consumer preferences. “Brand Trust and Credibility” secured the fourth rank

Table 3. Summary of the Factors Influencing Consumers to Shift from Edible Refined Oils to Cold Pressed Oils.

S.No.	Factor	Mean score	Rank
1	Health & Wellness (HW)	14.99	I
2	Product Quality & Functional Attributes (QA)	14.66	II
3	Price Sensitivity & Perceived Value (PV)	14.54	III
4	Brand Trust & Credibility (TC)	14.34	IV
5	Social Influence & Awareness (IA)	14.31	V
6	Availability & Convenience (AC)	14.27	VI

with a mean score of 14.34, indicating that trust in reputed brands, organic certifications and transparent sourcing practices were also considered important by consumers. “Social Influence and Awareness” ranked fifth with a mean score of 14.31, showing that although family members, friends, social media and consumer awareness remained important considerations, they were comparatively less influential than health and quality factors among the respondents. Finally, “Availability and Convenience” received the lowest mean score of 14.27 and was ranked sixth, implying that while consumers valued easy accessibility, nearby store availability, and online purchasing options, convenience considerations were relatively less important in influencing their shift towards cold-pressed oils.

“Health and Wellness” (HW), assigned Rank I in Table 3, recorded the highest mean score of 14.99, indicating that health benefits, nutritional value, disease prevention and overall well-being were highly prioritized by consumers while purchasing cold-pressed oils. “Product Quality and Functional Attributes” (QA) obtained a mean score of 14.66 and was assigned Rank II, showing that cooking performance, aroma, taste and functional characteristics considerably influenced

consumer behaviour. “Price Sensitivity and Perceived Value” (PV) with a mean score of 14.54 secured Rank III, reflecting the importance of affordability, cost consciousness, and perceived value for money in purchasing decisions. “Brand Trust and Credibility” (TC) received a mean score of 14.34 and was placed in Rank IV, indicating that trust in reputed brands, organic certifications, and transparent sourcing practices were valued by consumers. “Social Influence and Awareness” (IA) with a mean score of 14.31 was assigned Rank V, suggesting that family members, friends, social media, and public awareness remained a major consideration among respondents. Finally, “Availability and Convenience” (AC) obtained the lowest mean score of 14.27 and was placed in Rank VI, implying that accessibility and convenience factors had relatively less influence on consumers’ shift towards cold-pressed oils.

The results of Kaiser Meyer Olkin (KMO) measure of sample adequacy and Bartlett’s test of sphericity used to examine the relevance of factor analysis are presented in Table 4.

It can be observed from table 4 that the KMO value was 0.635, indicating that the sample was sufficiently large to proceed with factor analysis. The approximate chi square value of 739.938 with 276 degrees of freedom,

Table 4. Kaiser-Meyer-Olkin and Bartlett's test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		635
Bartlett's Test, of Sphericity	Approx. Chi-Square	739.938
	DF	276
	P-value	<0.001

as determined by Bartlett's test of sphericity was significant ($p < 0.001$) confirming substantial intercorrelations among variables, thereby justifying factor analysis.

Principal Component Analysis

The results of the principal component analysis using the 24 statements that grouped the benefits derived by shifting to cold pressed oils to the respondents are depicted in Table 5. The initial eigen value scolumn in Table 5 indicated that SPSS initially extracted all 24 benefits from the variable analyzed. However, only nine factors with eigenvalue greater than one were ultimately extracted.

The scree plot in Fig. 1 shows that the curve begins to flatten after the

ninth benefit, hence nine components were extracted from the 24 variables analysed for research. The total variance explained presented in table 5 also suggests to retain up to 9 factors as per Kaiser's rule. The factors 1 to 9 have eigen values more than or equal to one and contribute meaningfully. The model explains 67.46 per cent of the total variance at 9th component which exceeds the typical minimum threshold of 60 per cent.

Exploratory Factor Analysis (EFA) was conducted using Principal Component Analysis with Varimax rotation to identify the major factors influencing consumer decisions to shift from refined oils to cold-pressed oils. The rotated solution converged in 11 iterations,

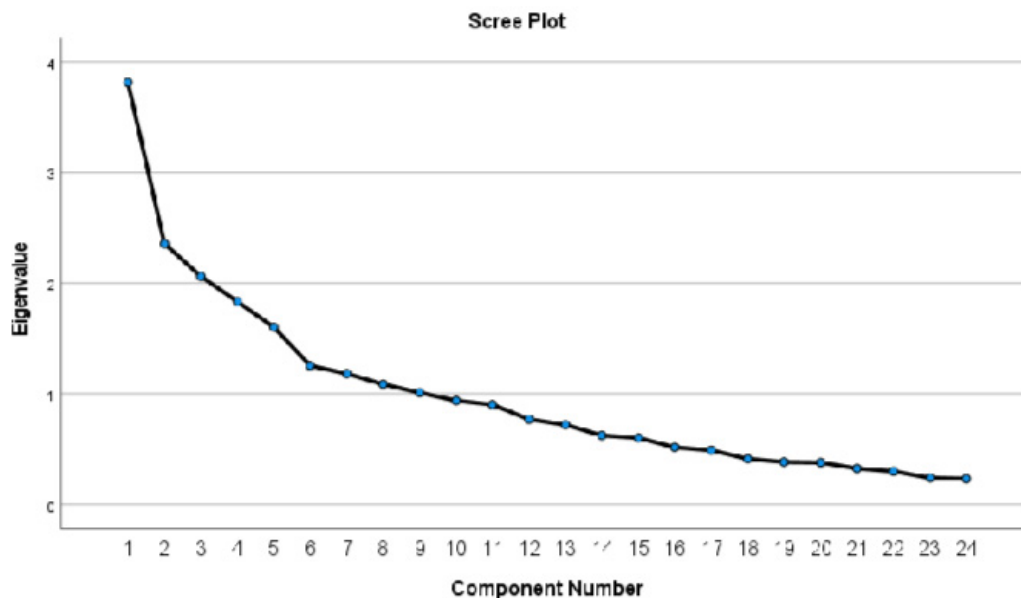


Fig. 1. Scree Plot showing eigenvalues against component number

Table 5. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.814	15.890	15.890	3.814	15.890	15.890	2.624	10.935	10.935
2	2.355	9.814	25.704	2.355	9.814	25.704	2.614	10.890	21.825
3	2.060	8.584	34.289	2.060	8.584	34.289	1.901	7.921	29.746
4	1.833	7.636	41.925	1.833	7.636	41.925	1.777	7.406	37.151
5	1.601	6.671	48.596	1.601	6.671	48.596	1.686	7.025	44.176
6	1.253	5.219	53.815	1.253	5.219	53.815	1.566	6.525	50.702
7	1.181	4.919	58.734	1.181	4.919	58.734	1.499	6.245	56.947
8	1.085	4.520	63.254	1.085	4.520	63.254	1.295	5.395	62.342
9	1.009	4.202	67.456	1.009	4.202	67.456	1.227	5.114	67.456
10	.936	3.901	71.357						
11	.901	3.753	75.110						
12	.767	3.197	78.307						
13	.718	2.993	81.300						
14	.622	2.592	83.892						
15	.601	2.502	86.394						
16	.515	2.145	88.539						
17	.488	2.032	90.571						
18	.411	1.712	92.283						
19	.382	1.593	93.876						
20	.378	1.573	95.449						
21	.324	1.352	96.801						
22	.298	1.243	98.044						
23	.239	.994	99.038						
24	.231	.962	100.000						

Extraction Method: Principal Component Analysis.

Table 6. Rotated Component Matrix

Component	Items	Factor loadings
Brand Trust and Health Awareness	TC3	0.812
	HW1	0.804
	AC2	0.644
	IA4	0.609
	TC1	0.490
Product Quality and Accessibility	QA2	0.823
	QA4	0.757
	AC1	0.676
	IA3	0.655
	PV2	0.547
Social Influence and Chemical-Free	HW4	0.663
	IA1	0.650
	HW3	0.521
	PV4	0.460
Online Convenience and Value for Money	AC4	0.812
	PV3	0.721
Functional Benefits and Price Concern	QA1	0.867
	PV1	0.675
Certification and Media Influence	TC2	0.834
	IA2	0.555
Sensory and Packaging Appeal	QA3	0.768
	AC3	0.711
Transparency in Sourcing	TC4	0.706
Comparative Health Belief	HW2	0.851
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. ^a		
a. Rotation converged in 11 iterations.		

resulting in the extraction of nine different components with eigenvalues greater than one. These components explained the maximum variance among the observed variables. The rotated component matrix in Table 6 revealed a clear factor structure with

all items loading significantly above or equal to 0.50 on their respective constructs confirm construct validity.

The factor, Brand Trust and Health Awareness, included high loadings on

statements such as “I trust cold-pressed oil from established or reputed brands” (0.812) and “I use cold-pressed oil to prevent lifestyle diseases” (0.804). This indicates that consumers are influenced by trusted brands and health motivations.

The Product Quality and Accessibility factor included items like “The natural extraction process makes cold-pressed oil superior in quality” (0.823) and “Cold-pressed oil is available at my nearby stores” (0.676) indicating that purity, accessibility, and peer recommendations drive purchase. The Social Influence and Chemical-Free Preference factor featured “My friends and family influenced my decision” (0.650) and “I prefer cold-pressed oil because it is free from chemicals” (0.663) highlighting the importance of social circles and chemical-free products.

The Online Convenience and Value for Money factor included items such as “I find it easy to order cold-pressed oil online” (0.812) and “Cold-pressed oil offers good value for money” (0.721) emphasizing how digital access and affordability shaped consumer choices. The Functional Benefits and Price Concern factor combined items like “Cold-pressed oil has better cooking properties than refined oil” (0.867) and “It is too expensive compared to other oils” (0.675) showing that consumers weigh cooking performance against cost.

The Certification and Media Influence factor involved items such as “Organic certification influences my purchase decision” (0.834) and “I have seen advertisements or social media posts” (0.555) indicating the influence of labels and media exposure. The Sensory and Packaging Appeal factor included items such as “Cold-pressed oil retains its original aroma and flavor” (0.768) and “The product packaging makes it easy to store and

use” (0.711) reflecting the importance of sensory experience and packaging design. The Transparency in Sourcing factor was defined by a single item “I prefer brands that clearly mention the source of oilseeds” (0.706) pointing to a consumer preference for traceability. The Comparative Health Belief factor with item “Cold-pressed oil is healthier than refined oil” (0.851) revealed strong perception of health superiority as a key driver.

A blend of factors such as accessibility, social validation, brand reliability and perceived health benefits supported by both emotional and functional considerations together resulted in transition from refined to cold-pressed oils. These findings are in line with Kanimozhi and Hariharan (2023), Krishnaveni *et al.* (2022), Sridevi and Ranjani (2022). Thus, the factor analysis identified nine key factors influencing the shift to cold-pressed oils including health awareness, brand trust, product purity, price sensitivity, convenience, social influence, certification, packaging and source transparency.

Thus, a multi-dimensional strategy is needed for increasing the consumption of cold pressed oils. A deeper awareness among target consumer segments, building credibility through certification and professional endorsements, ensuring affordability and expanding availability both offline and online may foster the consumers to shift towards cold pressed oils. There is limited knowledge about the health benefits and processing methods of cold-pressed oils in the region. Hence, awareness programs through mass media, health camps and educational content on packaging can help the common man to make informed decisions. The cold-pressed oils may be sold in small trial packs and usage guides may be provided to educate consumers about cooking applications and flavor compatibility.

CONCLUSION

The study revealed that all 120 respondents were fully aware of cold-pressed oils. However, only 20.83 per cent were regular users, highlighting a persistent awareness-adoption gap. The remaining 79.17 per cent were found to be irregular users. Monthly purchase was the dominant buying pattern (45.83%), while price remained a major concern for 62.5 per cent of respondents. Despite this, 60 per cent expressed willingness to pay a premium for genuine cold-pressed oil and 89.49 per cent were likely or very likely to recommend these oils to others, reflecting high satisfaction levels. The nine principal components, namely Brand Trust and Health Awareness, Product Quality and Accessibility, Social Influence and Chemical-Free Preference, Online Convenience and Value for Money, Functional Benefits and Price Concern, Certification and Media Influence, Sensory and Packaging Appeal, Transparency in Sourcing and Comparative Health Belief extracted through factor analysis collectively explaining 67.46 per cent of the total variance. Interest in cold-pressed oils was primarily driven by Health and Wellness (rank I, mean score 14.99), followed by Product Quality and Functional Attributes (rank II, mean score 14.66) and Price Sensitivity and Perceived Value (rank III, mean score 14.54). Brand Trust and Credibility (rank IV) and Social Influence and Awareness (rank V) also shaped consumer decisions, while Availability and Convenience ranked last. However, persistent concerns about price, limited access and brand credibility acted as significant deterrents. This gap between awareness and adoption revealed critical areas for intervention. The cold-pressed oil millers, policy makers and nutritionists seeking to promote healthier edible oil choices

must address these barriers for increasing the consumption of cold-pressed oils.

REFERENCES

- Andika,A. and Setyanta, B. 2024. Health vs. price sensitivity: Analyzing willingness to pay a premium for organic food among low- and middle-income consumers in Indonesia. *SAR Journal*. 7(3): 257–267. <https://doi.org/10.18421/SAR73-12>
- Census of India. 2011. Provisional Population Totals: Andhra Pradesh. Office of the Registrar General & Census Commissioner, Government of India.
- Devi, M. and Rao, S. 2021. Comparative study on consumer preferences for cold-pressed vs refined oils in South India. *Indian Journal of Extension Education*. 57(3): 45–52.
- Kanimozhi, S. and Hariharan, P. 2023. A study on the customer preference and purchase decision of refined oil and cold-pressed oil among households in India. *Asian Journal of Management*, 14(1): 52–56.
- Kirubashini, B. and Priyadharshini, K. 2018. Consumer satisfaction towards cold-pressed edible oil with special reference to Coimbatore city. *International Journal of Management, Technology and Engineering*, 8(X): 506–513.
- Krishnaveni, D., Sakthirama, V. and Balu, S. 2022. Re-emergence of traditionally prepared cold-pressed edible oil in Southern India – an exploratory study. *Ethno Med*, 16(1-2): 1–6.
- Kumari, R. K. and Gowthamy, S. K. 2019. Consumer awareness and preference of cold-pressed oils. *International Journal*

of Research and Analytical Reviews, 6(1): 641–645.

Lee, M. and Gupta, S. 2023. The psychology of premiumisation: Behavioural drivers and price barriers in India's cold-pressed oil market. *Journal of Consumer Psychology*, 33(4): 512–530.

Ministry of Agriculture and Farmers Welfare. 2023. Annual Report 2022-23. Government of India, New Delhi.

National Bank for Agriculture and Rural Development (NABARD). 2020. Cluster Development for Traditional Food Processing Units. NABARD, Mumbai.

Sridevi, V. and Ranjani, G. 2022. Analysis of consumer buying behaviour and satisfaction towards cold-pressed oil:

Special reference to GSR Vaagai Mara Chekku Allai, Kovaipudur, Coimbatore District. *Journal of Emerging Technologies and Innovative Research*, 9(6) : 721–725.

Tang, W., Li, X. and Chen, Y. 2024. Structural equation modelling of cold-pressed oil preferences in China: The role of environmental values and health consciousness. *Food Quality and Preference*, 113: 105087.

Yamini, S., Srilatha, Ch., Radhika, P. and Supriya, K. 2024. Consumer perception and purchasing behaviour of cold-pressed oils in Hyderabad. *International Journal of Agricultural Extension and Social Development*, 7(10): 239–241.

Charitha,M., Uma Devi, K., Satish Rahul, M. and Ramana Murthy, B. 2026.Factors influencing consumers shift towards cold pressed oils in Guntur, Andhra Pradesh. *The Journal of Research ANGRAU*,54(2) : 84-96

PERCEIVED EFFECTIVENESS OF FARMER PRODUCER ORGANISATIONS (FPOS) IN SOCIO-ECONOMIC UPLIFTMENT OF MEMBER FARMERS IN MAHARASHTRA

DERE AISHWARYA, BABITA KUMAR and RAKESH RATHORE*

School of Business Studies, Punjab Agricultural University, Ludhiana-141004

Date of Receipt : 24-03-2026

Date of Acceptance : 19-06-2026

ABSTRACT

This paper aims to study the effectiveness of Farmer Producer Organisations (FPOs) in the socio-economic upliftment of member farmers in Maharashtra as perceived by them. FPOs from three districts of Maharashtra were selected. All member farmers from 30 FPOs were selected as the population for the study. From each FPO, 10 farmer members were selected. A list of member farmers was obtained from each FPO based on their convenience, availability, and willingness to respond. Primary data was collected through a pre-structured and pre-tested questionnaire. Mean, percentage, one-sample t-test, were used for the analysis of collected data. Results of the study revealed that farmer members were aware of the business plan of FPOs (5.00), followed by awareness regarding the working of FPOs (3.72). Member farmers join FPO to get a better price for produce (5.00), enhance their income (5.00), and save on input cost (4.35). FPOs have enhanced their income by better realization for their produce (4.62), followed by FPO facilitating the availability of extension services (4.53). Member farmers were satisfied with FPOs business operations such as transparency in business operations (4.45) and enhancement in income on account of joining FPOs (4.41). The major reason to join the FPO was to increase the income, avoids involvement of middlemen and save input cost for the farmer members.

Keywords: Awareness, Belongingness, Benefits, FPO, Satisfaction

INTRODUCTION

Producer organizations enable farmers to get the benefits of their produce in the market because they help to improve market access and increase marketable surplus at the household level. The Farmer Producer Organization (FPO) are in the nascent stage of their empowerment of shareholder membership farmers and they need not only technical support but also adequate financial support to setup facilities, strengthen market linkages for sustaining their business

operations (NABARD National Paper – PLP, 2021). Farmers face a lot of challenges when in operation, like lack of market access and credit linkages, inadequate financial support, lack of managerial skills, training issues, withdrawal of support from funding organizations, etc. To overcome the problems of small and marginal farmers, the need of Farmer Producer Organization (FPO) was felt. FPOs fulfil forward and backward linkages, giving members need based support like bargaining power, economies of scale, and better prices. Small and marginal farmers, who

*Corresponding Author Email: rathore@pau.edu

are relatively younger, educated, and more informed have a greater probability of membership in FPOs and such participation leads to an increase in income. Social capital and self-efficacy play a major role in forecasting the performance of FPO (Pant *et al.*, 2024).

A study by Parthiban *et al.*, 2015, found that the majority 90 percent of the Tamil Nadu Mango Growers Federation members were involved in some social organizations. More than half of its members had a medium level of cosmopolitanism. Farm produce promotion society plays a proactive role in meeting the purpose of the organization, and the benefit-cost ratio was found to be increasing over the year (Talukdar & Vatta, 2025). Membership in the organization directly influences the socio-economic condition of the members. The income and employment of the members of the organization were significantly higher compared to the non-members. The study by (Kakati & Roy, 2021) revealed the financial performance of the FPOs was below par. Over time, liquidity and solvency trends of FPO were improving while other measures of performance such as efficiency and profitability were meagre.

To maximize the price received for the agricultural produce, the FPO can come up with the ideas of product differentiation and adopt an incentive-based model so that farmers in a group will participate actively. The government and non-government organizations are looking forward to the producer company as a component of economic development. Farmer collectives are viewed as an important element in linking smallholders with modern markets (input and output) as they provide many benefits for this interface. Producer's organisations not only help farmers buy or sell better due to scale benefits but also lower

transaction costs for sellers and buyers, besides providing technical help in production and creating social capital (Joshi *et al.*, 2018).

In order to build a sustainable Farmer Producer Organization, an ecosystem is needed besides certain policy reforms, particularly in the agricultural marketing systems like agri-logistics, infrastructure, technology and credit support, etc.). In this context, present study was carried out with objectives of to study the role of Farmer Producer Organizations in the socio-economic up-liftment of the member farmers in Maharashtra.

MATERIAL AND METHODS

The study was conducted in Maharashtra state of India during 2022. There were 771 Farmer Producer Organizations promoted by NABARD and SFAC operational in different districts of Maharashtra. The populations of the study consist of all the member farmers of the Farmer Producer Organizations of Maharashtra. Maharashtra is divided into 36 districts and out of these 36 districts; three districts with maximum number of registered Farmer Producer Organizations were selected. The districts with maximum number of FPOs are Pune (85), Ahmadnagar (34) and Nashik (48). Out of these district 10 FPO per district were selected conveniently. Hence total 30 Farmer Producer Organizations were selected. From each Farmer Producer Organization 10 members were selected based on their convenience, availability and willingness to respond. Therefore total 300 member farmers were selected and surveyed. List of member farmers was obtained from each of these Farmer Producer Organizations (FPO). Primary data were collected with the help of pre-structured and non-disguised interview schedule.

Table 1. Demographic profile of the respondents**(n=300)**

Profile	Frequency	Percentage (%)
Gender of respondents		
Male	244	81.33
Female	56	18.67
Age of respondents (years)		
26-35	56	18.67
36-45	59	19.67
46-55	62	20.67
56-65	84	28.00
Above 65 years	39	13.00
Education of respondents		
Illiterate	4.0	1.33
Below primary	30	10.0
Primary	18	6.00
Middle	61	20.33
Matric	76	25.33
10+2	73	24.33
Graduate and above	38	12.67
Type of family of respondents		
Nuclear family	168	56.00
Joint family	132	44.00
Total	300	100
Family size of respondents (no.)		
Upto 4 members	22	7.33
5-8 members	137	45.67
More than 8 members	141	47.0
Main occupation of respondents		
Agriculture	222	74.00
Services/other	56	18.67
Business	22	7.33
Subsidiary Occupation(s)*		
Dairy farming	60	18.98
Poultry Farming	46	14.55
Floriculture	55	17.40
Vegetable growing	155	49.05

Profile	Frequency	Percentage (%)
Source of information about FPO*		
Relatives/Friends	257	71.98
Village sarpanch	100	28.01
Member of any social organization		
Village Panchayat	21	17.79
Agricultural Society	13	11.0
Marketing Committee	10	8.47
Milk Collection Committee	15	12.71
Self Help Group	42	35.59
Cooperative Society/Bank	17	14.40
None	182	60.66
Total	300	100

(Source: Primary data) (*Multiple responses were taken)

To study the socio-economic upliftment of the members after joining the organization, the members of the FPOs were asked to provide information about social empowerment, perception of members, benefits and satisfaction regarding the Farmer Producer Organization etc. The questionnaire consisting of close ended questions on Likert scale (1 to 5 where 5=strongly agree 4=agree 3=neutral 2 disagree 1=strongly disagree). The collected data were grouped into tables and analysed using various statistical tools like percentage, mean score, standard deviation, one sample t-test and paired t-test

RESULTS AND DISCUSSION

Demographic profile of the respondents

The perusal of Table 1 showed that out of total respondents 81.33 percent were male farmers and 18.67 percent were female farmers. The majority of the farmers 28 percent were between 56-65 years age group followed by 20.67 percent were between 46-55 years age group. Majority of the farmers 25.33

percent were educated up to matric level followed by 24.33 percent were up to higher secondary level. The majority 56 percent were had nuclear family.

The perusal of Table 1 that the majority of the farmers 47 percent were had more than eight members in their family. The majority 74 percent members had agriculture as main occupation along with vegetables cultivation as subsidiary occupation. For majority of farmers 71 percent relatives and friends were important source of information to the farmers about FPO. The majority of FPO members 35.59 percent were also member of Self Help Group.

The respondents were asked to rate the statements in which different parameters regarding benefits were listed and were recorded on a five-point Likert Scale ranging from strongly disagree (1) to strongly agree (5) and one sample t-test was applied. The assumed mean have been compared with mid value scale ($\mu=3$)

Table 2. Awareness, involvement and belongingness of member farmers of FPOs
(n=300)

Statements	Mean	SD	t-value	p-value
Extent of awareness regarding the business plan of FPO	5.00	0.00	-	-
Extent of belongingness with FPO	3.86	0.84	17.70	<.001
Extent of awareness regarding the working of FPO	3.72	0.44	27.95	<.001
Extent of awareness regarding the business model of FPO	2.85	0.79	-3.34	<.001
Extent of awareness regarding the working of Cluster-Based Business Organization (CBBO)	2.40	0.49	-21.32	<.001
Extent of involvement in creating business plan for FPO	1.00	0.00	-	-
Extent of involvement in routine FPO activities	1.00	0.00	-	-
Overall mean	2.83	0.36	5.24	<.001

(Source: Author computation from primary data)

Table 2 showed that members were aware about the business plan of the FPO among the members (5.00). The extent of belongingness with FPO (3.86) and awareness regarding the working of FPO was quite high (3.72) results in line with study of (Shivanjali & Jahanara, 2024). Awareness regarding the business model of FPO was less (2.85) and awareness regarding the working of Cluster-Based Business Organization (CBBO) was least (2.40). Least mean score was observed to the statement extent of involvement in creating business plan for FPO (1.00) and extent of involvement in routine FPO activities (1.00)

Table 3 depicted that primary reason to join the FPO was to increase the income (5.00) and get good prices (5.00) result in line with finding of (Joshi *et al*, 2018). Farmers get the better bargaining and negotiation power was equally important for member farmers (4.99). Least important reasons were to connect with other members (2.15) and for gaining employment (1.47). A study by Aditi *et*

al., (2025) suggested a positive correlation between FPOs involvement and higher per capita family income, especially within economically deprived farming segments, supporting the argument that FPOs play a constructive role in enhancing farmers' financial outputs.

The perusal of Table 4 showed that highest mean difference was seen in the parameter that members shared information of any kind with other members (2.94). The members were also able to handle the adverse situations and crisis better for self and other (2.50). Followed by mean difference was members saw improvement in their social integration and cooperation among members (2.10). All the statements indicated that there was significant up-liftment in the social status of the farmers after joining the FPO. The study by (Jha & Singh, 2025) FPOs, mainly women-led have further empowered women farmers to access markets, increase incomes, and strengthen their role in the agricultural value chain as well.

Table 3. Reasons to join FPOs**(n=300)**

Statements	Mean	S.D.	t-value	p-value
To get better prices of the produce	5.00	0.00	-	-
I understand FPO help in enhancing my income	5.00	0.00	-	-
To enjoy better bargaining and negotiation power	4.99	0.08	42.55	<.001
To avoid high interest and commission of middlemen	4.47	0.50	51.12	<.001
I understand FPO help in cost savings for inputs	4.35	0.68	34.23	<.001
Easy access to financial services	4.11	0.71	26.84	<.001
For better handling of produce and avoid post-harvest hassle	3.99	0.73	23.52	<.001
To get benefit of branding, export and packaging, etc.	3.98	0.65	25.95	<.001
To get information about latest government schemes and programs	3.94	0.70	23.37	<.001
To get timely information regarding market, weather, agricultural technology and extension services	3.88	0.76	19.88	<.001
To avail transportation and warehousing facility	3.88	0.72	20.98	<.001
For connecting with other members	2.15	0.44	-33.35	<.001
Overall	3.93	0.52	44.85	<.001

(Significant at 1% level)

Table 5 revealed FPO members have positive perception about benefits of FPO as members. The highest mean score was observed to the statement FPO has enhanced my income by better realization for their produce (4.62) followed by FPO facilities availability of extension services (4.53) and FPO has provided an opportunities to connect with consumers and market (4.49). Overall farmers' members were getting benefits of FPO as members. Educated youth of should join the FPO and join the training program organised by the FPO as it will be help in enhancement of income and reduce the unemployment level. Member farmers of market-centric FPOs revealed significant advantages (Prabhavathi *et al.*, 2024). Similar study by (Sharma *et al.*, 2023; Pasupuleti *et al.*, 2025) found being a

member of FPO; farmers experienced an increase in output value and income of farmers.

Table 6 revealed that the FPO does not have a formal organizational structure (3.47) finding in support of finding of (Kujur *et al.*, 2019). Members had fewer problems regarding the cohesion of members (1.80) and there was no issue with respect to priority given to large farmers over small farmers (1.24). The overall mean was found to be (1.66) and factor was significant. There was relatively more problem regarding the dependence on limited directors (1.79) than other two parameters i.e., problem regarding participation by the members (1.61) decision power to few board of director (1.33). The problem regarding the product development has found to be significant (1.56).

Table 4. Social empowerment of members by FPOs
(n=300)

Statements	Means difference	SD	t-value	p-value
I share the information of any kind with other members for their benefit	2.94	0.74	68.56	<.001
I am able to handle the adverse situations and crisis better for myself and others	2.50	0.81	53.34	<.001
I see an improvement in the social integration and cooperation among members	2.10	1.01	35.78	<.001
I do the post-harvest waste disposal using environment friendly techniques	1.98	1.02	33.47	<.001
My image among my fellow farmers and in society has improved	1.59	0.81	33.71	<.001
I feel sense of leadership in myself after joining FPO	1.27	1.34	16.35	<.001
I am more open to new technologies and help others in adopting improved technology	1.01	1.14	15.40	<.001
There is improvement in my communication skills	0.97	1.12	15.06	<.001
I feel motivated in doing social work	0.83	0.97	14.74	<.001
I participate in village administration and improvement of village	0.70	0.95	12.73	<.001
I participate in social activities for social upliftment of villagers	0.40	1.01	6.82	<.001
Overall	1.48	0.99	27.81	<.001

(Source: Author computation from primary data)

The less pressing were the problems like trust issues between members (1.33) transparency of functioning of FPO (1.25). FPOs did not face marketing related issues (1.31) or there was no problem while creating contact with markets (1.26). FPO did not face quality issues (1.27). The farmers did not feel that the products of FPO is not price competitive (1.32). All statements were found to be significant at 1% level of significance. The perusal of Table 7 that highest mean score was observed to the statement transparency in business operation and accounts (4.45). This can be attributed to that the members were satisfy with

transparency in business activities of an FPOs followed by enhancement of income on account of joining of FPOs (4.41) and regularity of meeting held with members similar results were reported by (Navya *et al.*, 2022). Least mean score was corresponded to the statement opportunities for participating in FPOs decision making (2.98). Similarly (Singha *et al.*, 2024) reported majority 70 per cent members of FPOs had reported medium level of achievement of FPOs, still there is huge scope for their further enhancement and achievement in agriculture and allied activities and thereby enhance their income on sustainable basis.

Table 5. Benefits to members of FPOs**(n=300)**

Statements	Mean	SD	t-value	p-value
FPO has enhanced my income by better realization for my product(s)	4.62	0.48	58.15	<.001
FPO facilitates the availability of extension services	4.53	0.72	36.28	<.001
FPO has provided me the opportunities to connect with the consumers/markets	4.49	0.64	40.24	<.001
I receive timely information from FPO regarding new farming schemes launched by government and non-governmental agencies	4.38	0.95	24.93	<.001
FPO has help me to save on my input cost	4.25	1.01	21.25	<.001
FPO helps me to access better information regarding choice of crop/product, price and technologies	4.25	0.91	23.57	<.001
FPO has provided me the opportunities to connect with other members (physically and digitally)	4.24	1.10	19.43	<.001
FPO helps me to access better information regarding the weather conditions	4.12	1.02	18.94	<.001
FPO has facilitated the availability of agricultural inputs for me	4.09	0.70	26.98	<.001
FPO has provided me the opportunity to train in various agricultural technologies and subsidiary occupations	3.93	0.72	22.53	<.001
FPO membership has inculcated a sense of entrepreneurship	3.81	0.74	18.93	<.001
FPO provides well-built infrastructure (warehousing, Transportation processing etc.)	3.79	0.95	14.39	<.001
Because of FPO I feel I can reach out to others in times of crisis	3.60	0.71	14.75	<.001
I receive employment opportunities for myself and my family members	3.35	0.65	9.25	<.001
Overall	4.10	0.80	24.97	<.001

(Source: Author computation from primary data)

The formation of the Farmer Producer Organizations was considered to bring farmers together to bring them out of vicious circles of the poverty. It is combining the efforts of the farmers by collective bargaining; marketing and

bulk purchasing of inputs can bring profits to the farmers' results in line of (Michalek *et al.*, 2018). Majority FPOs had 250-499 members and had more than 80 per cent active farmers with 18.6 per cent female members in the FPOs. The FPOs sought help from the

Table 6. Perception of members regarding FPOs (n=300)

Statements	Mean	SD	t-value	p-value
FPO does not have a formal organizational structure	3.47	0.94	3.05	<.001
FPO is not having the required infrastructure	2.26	1.33	-9.63	<.001
FPO is not able to undertake the required level of value addition	2.18	1.14	-12.36	<.001
CEO is not having adequate business skills	1.98	0.95	-18.45	<.001
Continuity of sales around the year is a challenge in market place	1.94	1.13	-16.22	<.001
There is conflicts in FPO members	1.86	1.04	-18.94	<.001
Operational of FPO are not undertaken in regular manner	1.83	0.74	-26.98	<.001
All the members are not involved in group activities	1.83	0.97	-20.67	<.001
There is lack of cohesion among FPO members	1.80	1.08	-19.10	<.001
There is too much dependence on limited number of directors/members	1.79	1.10	-19.05	<.001
FPO has not been able to create a viable business plan	1.78	0.78	-26.82	<.001
Very few numbers of active members are there	1.77	0.99	-21.44	<.001
FPO lacks financial prudence	1.77	0.89	-23.76	<.001
There is lack of participation from FPO members	1.61	0.99	-24.17	<.001
There are implementation issues related to business plan	1.59	0.66	-36.73	<.001
FPO is suffering from poor credit linkages	1.59	0.67	-36.07	<.001
There is problem of poor product development	1.56	0.68	-36.20	<.001
Lack of expert advice in extension services, financial services etc.	1.56	0.75	-33.02	<.001
Board of Directors do not possess business acumen	1.49	3.19	-8.14	<.001
Only few members/Board of directors control decision making	1.33	0.47	-61.69	<.001
There are trust issues among FPO members	1.33	0.47	-61.41	<.001
FPO products are not price competitive	1.32	0.46	-62.57	<.001
FPO faces marketing related problems	1.31	0.46	-63.50	<.001
FPO products suffer from quality issues	1.27	0.44	-67.38	<.001
Business plan of FPO is not communicated to the members	1.26	0.44	-67.43	<.001
FPO is not able to connect with the markets	1.26	0.43	-68.59	<.001
Lack of transparency in the functioning of FPO especially related to financial matters	1.25	0.43	-69.44	<.001
Large farmers get priority over the small farmers	1.24	0.42	-71.25	<.001

(Source: Author's computation from primary data)

Table 7. Satisfaction level of members of FPOs**(n=300)**

Statements	Mean	SD	t-value	p-value
Transparency in business operations and accounts	4.45	0.98	25.43	<.001
Enhancement in income on account of joining FPO	4.41	0.94	25.71	<.001
Regularity of meetings held with members	4.35	1.03	22.66	<.001
Social empowerment being a member of FPO	4.31	1.05	21.50	<.001
Communication of business plan to the members by board of directors	4.11	1.32	14.56	<.001
Opportunities for participating in FPO business activities	3.66	0.96	11.80	<.001
I satisfy with overall performance of FPO	3.63	0.77	14.14	<.001
Enhancement in Nutritional, Educational, and Habitat security	3.45	0.91	8.42	<.001
Opportunities for participating in FPO decision making	2.98	0.71	-.56	0.57
Overall	3.92	0.96	15.96	<0.06

(Source: Author's computation from primary data)

experts to prepare the financial statements and for preparation of financial budget. FPOs prepared a business plan for period of an annum and modified the plan every quarter or on need basis.

CONCLUSION

The findings implicated that FPOs helps in enhancing member farmers' income by better realization of their produce and FPOs also helps members to connect them with market. Farmers' members were aware about business activities of FPOs. Transparency in business operation and accounts followed by enhancement in income on account of joining of FPOs was important for satisfaction of farmer members. Farmer members also saved input cost in agriculture operations. The major reason to join the FPOs was to increase the income avoids involvement of middlemen and saving input cost of the farmers members to enhance the income, enjoy better bargaining and negotiation power, saving the cost on inputs and easy access to financial services. The farmers must be encouraged to participate

in the different activities undertaken by the FPOs.

REFERENCES

- Aditi, Rawat, R. K., Acharya, D. and Parida, J. K. 2025. Does participation in Farmer Producer Organizations (FPO) help boost farmers' income in India. *South Asia Economic Journal*, 26(1):77-94. <https://doi.org/10.1177/13915614251328534>
- Jha, S. and Singh, D. 2025. From financial inclusion to social transformation: NGOs, SHGs and FPOs in women empowerment. *Archives of Current Research International*, 25(10):34–46.
- Joshi, S. K. and Choudhary, V.K. 2018. Performance of Farmer Producer Organizations (FPOs) in different regions of Chhattisgarh state: A case study. *Indian Journal of Agriculture Economics*, 73(3): 399-406
- Kakati, S. and Roy, A. 2021. Financial performance of Farmer Producer Companies of India: A study from 2013-

- 2014 to 2018-2019. International Journal of Rural Management, Retrieved from doi: 10.1177/ 09730052211034700 on 30.08.2021.
- Michalek, J., Ciaian, P., and Pokrivcak, J. 2018. The impact of producer organizations on farm performance: The case study of large farms from Slavakia. Food Policy 75:80-92
- Kujur, P., Gauraha, A.K., and Netam, O.K. 2019. The socio-economic impact of Farmer Producer Organizations in Chhattisgarh plains. Journal of Entomology and Zoology Studies, 7(9): 1104-06
- Navya, D., Madhu Babu, K., Naik, R., and Srikanth, V. 2022. A study on performance of Farmer Producer Organisations in Telangana state. Indian Research Journal of Extension Education, 22 (4): 112-117
- Parthiban, S.R., Nain, M.S., Singh, R., Kumar, S., and Chahal, V.P. 2015. Farmers' Producer Organization in reducing transactional costs: A study of Tamil Nadu Mango Growers Federation (TAMAFED). Indian Journal of Agricultural Science, 85:1303-7
- Pant, S.C., Kumar, S., and Joshi, S.K. 2024. Social capital and performance of farmers' groups in producer organizations in India: examining the mediating role of self-efficacy. Journal of Agribusiness in Developing and Emerging Economies, 14(3): 519-535. <https://doi.org/10.1108/JADEE-07-2022-015>
- Prabhavathi, Y., Siddayya, Ganapathy, M.S. and Girish, M.R 2024. An economic analysis of FPOs in the state of Andhra Pradesh: A comparative study based on business strategy. Indian Journal of Agricultural Economics, 79 (2):187-197
- Pasupuleti, S., Nikam, V., Veeram, H. and V, P. K. 2025. Farmer Producer Organization-based value chain to leverage the income of small farmers: An empirical evidence from India. Journal of Asian and African Studies, 61(4): 3343-3361.
- Singha, A., Sharma, J.K. and Singha, A.K. 2024. Critical analysis of group dynamics effectiveness of Farmer Producer Organisations (FPOs) members in Assam, India. Asian Journal of Agricultural Extension, Economics & Sociology, 42(2): 222-232
- Sharma, M., and Singh, R., Chiphang, S. and Prasad, A. 2023. Impact assessment study of Farmer Producer Organizations (FPOs) on livelihood of farmers in Meghalaya. Indian Journal of Extension Education, 59(3): 43-47
- Shivanjali, P. and Jahanara 2024. A study on the knowledge and attitude of the farmers about FPO in empowering the farmers through crop production. International Journal of Agriculture Extension and Social Development, 7(8): 50-53
- Talukdar, U. and Vatta, K. 2015. Economic and financial efficiency of Farmers' Producer Organizations: A case study of FAPRO in Hosiarpur district of Punjab. Economic Affairs, 60(3): 439-444

Aishwarya Dere , Babita Kumar and Rakesh Rathore. 2026. Perceived effectiveness of FPOs in socio-economic upliftment of member farmers in Maharashtra. The Journal of Research ANGRAU, 54(2): 97-107

TRAINING NEED ASSESSMENT OF EXTENSION FUNCTIONARIES WORKING AT RYTHU SEVA KENDRAS (RSKS) IN SRIKAKULAM DISTRICT OF ANDHRA PRADESH

S.NEELAVENI*, P. VENKATARAO, S. KIRAN KUMAR, S. ANUSHA and V. HARIKUMAR

Agricultural Polytechnic, Thogaram, Amadalavalasa - 532185, Srikakulam district.

Acharya N. G. Ranga Agricultural University, Guntur, Andhra Pradesh, India

Date of Receipt : 06-04-2026

Date of Acceptance : 10-06-2026

Agriculture sector faces persistent structural challenges including low productivity, inadequate irrigation, limited land development and exposure to climate related risks (Shaba and Alam, 2024). Trained agricultural extension personnel especially Village Agricultural Assistants (VAAs) can meet at least certain challenges that are being faced by agriculture sector. Hence, several programmes on human resource development are being taken up including agricultural extension personnel by front line extension institutes of ICAR, different organizations of Government of India and other voluntary organisations. One of the factor for success of such human resource development programmes is training need assessment for successful intervention of schemes and programmes. Krishi Vigyan Kendras are the front line extension institutes primarily involved in training such extension functionaries like VAAs, farmers, women and rural youth for improving their quality of life. Capacity building of the farmers can be one of the means to address these challenges (Kumar *et al.*, 2024). Training is one of the important methods of capacity building. According to Sanjeev *et al.*, (2012), it is a process of acquiring new skills, attitudes, and knowledge that facilitates entry into a profession or enhances productivity within an organization or enterprise. Training needs assessment refers

to the process whereby such needs are indicated, prioritized and selected for specific action as part of the training programme. Roy *et al.*, (2021) found that there was significant improvement in the levels of knowledge, attitude and skill as a result of training. Rajat Kumar Nath *et al.*, (2025) found that 71.25 per cent of the farmers had medium to very high need of training in the area of value chain development. The most sought-after training needs were the use of herbicides, vermicomposting, prevention of rotting and contract negotiation skills.

Performance is enhanced and updated by improving Agricultural Extension Personnel technical and social competencies which can be brought by identifying their needs with respect to technological and managerial aspects. Keeping this in view, KVK Amadalavalasa conducted the study on training need assessment of Agricultural Extension personnel with an objective of assessment of training needs of Agriculture Extension Personnel (VAAs -Village Agricultural Assistants of RSK) in Srikakulam district.

An Ex-post facto Research design was used for the study. Srikakulam district was selected purposively as it is one of the most backward districts where strategies developmental activities are crucial for

*Corresponding Author Email: neelaveniseepana@gmail.com

progress. Agriculture Extension Personnel selected were Village Agricultural Assistants (VAA) and Village Horticulture Assistants (VHA), purposively as they implement the technology at field level. Srikakulam District was selected purposively, out of 30 mandals in Srikakulam, 12 mandals were selected randomly. From each selected mandal five VAA/VHA were selected randomly for the study purpose. Thus, a total sample size became 60 VAAs and VHAs for the study purpose. The training needs were self-assessed by an individual VAAS by giving weightage from 1-3 on 3 point continuum in the given structured set of questionnaires. The statistical tools used are weighted mean score, frequency, percentage, mean and standard deviation.

$$\text{Calculation of weighted mean : } \frac{\text{WMS} = \frac{S_1 + S_2 + S_3 + \dots + S_N}{N}}{\text{Score (WMS)}}$$

WMS-Weighted mean score

S1- Score given by 1st respondent on the item

S2- Score given by 2nd respondent on the item

S3- Score given by 3rd respondent on the item

SN- Score given by Nth respondent on the item

RESULTS AND DISCUSSION

Majority (90%) of the Agricultural Extension Personnel (VAAs/VHAs) are young, indicating a relatively new or recently recruited workforce. Most personnel (about 95%) have either a diploma or undergraduate degree; only a small fraction (5%) have higher education. Almost half of the personnel have less than 2 years of experience, indicating a relatively inexperienced workforce. Over 95% have undergone fewer than 5 trainings, suggesting

a need for increased capacity-building efforts. While most personnel have conducted some trainings (especially in the 2–5 range), only a few have conducted more than 5. Overall Summary regarding profile of Agricultural Extension personnel was that majority of the VAAs were predominantly young and relatively inexperienced, with limited exposure to training (both received and delivered). Educational qualifications are mostly diploma or B.Sc. Ag, with very few having postgraduate qualifications. These findings suggest a need for ongoing training, mentorship, and skill enhancement programs to empower the young workforce for effective extension delivery.

Training needs of VAAs

General Training needs

New Market Avenues and Market Intelligence (WMS=2.91) is the most important training need among all general topics. It likely reflects a strong demand among extension personnel to understand market trends, find better prices, and help farmers access new markets.

Similar studies conducted by Kiran *et al.*, (2016), on the post-harvest training needs of farm women in the Junagadh district of Gujarat, it was found that farm women desired training in areas such as selecting selling locations, pest control, timing of spraying, rodent control, storage pest management, seed bin information, threshing, and winnowing. Similarly, the significance of marketing has also been emphasised in various studies (Kiran *et al.*, 2016). Rajnath *et al.*, (2025) revealed that Post-harvest management and farm business management got the highest weightage from the experts out of all four dimensions taken for the study. This may be because these components are very crucial for effective value chain development.

Table 1. Profile characteristics of Agricultural Extension Personnel (n=60)

S.No.	Variable	Frequency	Percentage
1.	Age		
	a.Young age (<30 years)	54	90.0
	b.Middle age (31-45 years)	6	10.0
	c.Old age (>45 years)	Nil	Nil
2.	Education		
	a. Diploma	26	43.33
	b. B.Sc., Ag.	31	51.66
	c. Post-graduation and above	3	05.0
3.	Job Experience:		
	Low (<2 years)	29	48.33
	Medium (2-5 years)	24	40.00
	High (>5 years)	7	11.67
4.	Trainings undergone		
	Low (<2)	31	51.67
	Medium (2-5)	26	43.33
	High (>5)	3	05.0
5.	No of training conducted to the farmers		
	Less (<2 no)	21	35.0
	Medium (2-5)	36	60.0
	High(>5)	3	05.0

Closely ranked group (Rank II), with very close scores (2.85–2.88) topics like Weather-based agro-advisory (2.88), Farming situation-based extension strategies (2.88), Use of ICT in TOT and farm video production (2.86), farm machinery (2.86) Cost reduction technologies (2.85), Good Agricultural Practices (GAP) (2.85), and Drudgery reducing technologies (2.85). These are high-priority training areas, just behind market intelligence. Field staff want practical tools to reduce costs, improve productivity, and use technology more effectively in training delivery.

The results were in line with that of Sengupta, 2023 and Martel *et al.*, 2021, who

reported that drones provide enhanced spatial and temporal resolutions compared to conventional techniques like manual scouting or satellite imaging, enabling farmers to monitor crop health, identify diseases, and evaluate soil conditions with remarkable precision.

Training need assessment in Paddy

For Paddy, 6 training topics, with mean scores between 2.86 and 2.89 which obtained very high weighted mean scores were preferred. Top-ranked topics (Rank I) were high yielding, situation and location-specific varieties in paddy (2.89) and Integrated Crop Management (ICM) in paddy (2.89). These are

Table 2. Training needs of VAAs under RSKs Srikakulam in General (n=60)

S.No.	General	Rank	Weighted mean Score
1.	Farm Machinery	II	2.86
2.	Organic farming	IV	2.82
3.	Weather-based agro advisory	II	2.88
4.	Compatibility of Agricultural chemicals	III	2.84
5.	Use of ICT in TOT and Farm video production	II	2.86
6.	Farming situation-based extension strategies	II	2.88
7.	Scope for Value addition in agriculture horticulture and allied sectors	III	2.84
8.	Cost reduction technologies	II	2.85
9.	Good Agricultural Practices	II	2.85
10.	Drudgery reducing technologies in Agriculture	II	2.85
11.	New Market Avenues and Market intelligence.	I	2.91

considered most essential for training. Field staff really want help in identifying the right paddy varieties for specific conditions and using holistic ICM practices. Varietal selection helps farmers choose crops that suit their local climate, soil, and disease pressures, which directly affects yield. Integrated Crop Management (ICM) combines practices like Fertilizer management, Pest & disease control, Water use and Planting techniques. This gives farmers a holistic approach to maximize yield and minimize cost. So, when extension personnel ask for more training in these areas, it shows they want to give better, more tailored advice to farmers, especially for improving productivity and profitability in paddy.

This was followed by Seed Production of paddy (2.88), Pest/disease diagnosis and Integrated management (2.88), Weed management in different sowing systems (2.88). Staff need technical skills in pest/weed control, Seed production and sowing-system-specific advice, which were regularly requested from farmers of the region.

Training need assessment in Mesta

Training needs on ICM in Mesta and retting techniques were given top priority. Agricultural Extension Personnel needed better understanding of the whole production processes including retting techniques which is a key step in fibre extraction. Training needs on high yielding varieties in Mesta. High Yielding Varieties (2.44) and Seed production (2.20) were given medium priority unlike paddy. Pest/disease management, weed control, and water management all scored low because pests and diseases are less problematic in Mesta.

Training need assessment in Pulses

Pertains to training needs on pulses, All scores are very close (2.86–2.88) indicating consistent, strong need of the topics. High yielding varieties and Diagnosis of pests/diseases (2.88) were given top priority. Seed production and Post-harvest operations (2.86) were next topics after varietal selection and field diagnosis in pulses

Table 2. Training needs of VAAs under RSKs Srikakulam in Paddy (n=60)

Paddy			
1.	Seed Production of paddy	II	2.88
2.	High yielding, situation and location specific varieties in paddy	I	2.89
3.	Diagnosis of pests, diseases disorders in paddy and their integrated management in Paddy	II	2.88
4.	Weed management in different sowing systems in Paddy	II	2.88
5.	Water management and Irrigation techniques in Paddy	III	2.86
6.	ICM in paddy	I	2.89

Table 3. Training needs of VAAs under RSKs Srikakulam in Mesta (n=60)

Mesta			
1.	Seed Production of mesta	II	2.2
2.	High yielding, situation and location specific varieties in mesta	II	2.44
3.	Diagnosis of pests, diseases disorders in paddy and their integrated management in mesta	IV	1.99
4.	Weed management in mesta	III	2.11
5.	Water management and Irrigation techniques in mesta		1.88
6.	ICM in mesta and mesta retting techniques	I	2.55

Table 4. Training needs of VAAs under RSKs Srikakulam in Pulses (n=60)

Pulses			
1.	Seed Production of Pulses	III	2.86
2.	High yielding, situation and location specific varieties in pulses	I	2.88
3.	Diagnosis of pests, diseases disorders in pulses and their integrated management in pulses	I	2.88
4.	Weed management in pulses	II	2.87
5.	ICM in pulses	II	2.87
6.	Post-harvest operations and storage of pulses	III	2.86

Training need assessment in Maize

Diagnosis of pests/diseases (2.88) weed management (2.76), High yielding, situation and location specific varieties in Maize (2.65), ICM in Maize (2.56), Water management and Irrigation techniques in Maize (2.34) and Seed production (1.94) were prioritised training needs by VAAs. This is because of severe infestation of fall army worm and incidence of

diseases like blight in Maize in North coastal zone of Andhra Pradesh.

Training need assessment in Ragi

ICM in Ragi (2.56), Selection HYV (2.56) and Seed production (2.56) were identified as top areas of training needs in Ragi. Diagnosis of Pests, diseases and disorders in ragi and their management followed.

Table 5. Training needs of VAAs under RSKs Srikakulam in Maize (n=60)

Maize			
1.	Seed Production of Maize		1.94
2.	High yielding, situation and location specific verities in maize		2.65
3.	Diagnosis of pests, diseases disorders in maize and their integrated management in maize	I	2.88
4.	Weed management in Maize		2.76
5.	Water management and Irrigation techniques in maize		2.34
6.	ICM in Maize		2.56

Table 6. Training needs of VAAs under RSKs Srikakulam in Ragi (n=60)

Ragi			
1.	Seed Production of ragi	I	2.56
2.	High yielding, situation and location specific verities in ragi	I	2.56
3.	Diagnosis of pests, diseases disorders in ragi and their management in ragi	II	2.45
4.	Weed management in different sowing systems in ragi	III	2.34
5.	ICM in Ragi	I	2.56
6.	Post-harvest operations and storage of ragi	III	2.34

Table 7. Training needs of VAAs under RSKs of Srikakulam in Sugarcane (n=60)

Sugarcane			
1.	Machinery used in Sugarcane	I	2.89
2.	High yielding, situation and location specific verities in Sugarcane	I	2.89
3.	Diagnosis of pests, diseases disorders in sugarcane and their integrated management in Sugarcane	II	2.88
4.	Weed management in different sowing systems in Sugarcane	II	2.88
5.	Water management and Irrigation techniques in Sugarcane	III	2.67
6.	ICM in Sugarcane	1	2.89

Table 8. Managerial Training needs of VAAs under RSKs Srikakulam (n=60)

Managerial needs			
1.	Time management	I	2.89
2.	Stress management	II	2.85
3.	Leadership skills	III	2.83
4.	Process documentation	III	2.65

Training need assessment in Sugarcane

High yielding, situation and location specific varieties (2.89), Farm machinery, ICM in Sugarcane (2.89) followed by weed management and plant protection Sugarcane(2.88) were the prioritized training needs by VAAs in sugarcane crop.

Training need assessment in Managerial needs

Among managerial needs given by VAAs was Time management (2.89), Stress management (2.85) and Leadership skills (2.83) followed by Process documentation (2.65). This is due to the reason that majority of the RSK staff were young age with less experience. Also, this shows an orientation towards building personality along with work capacities.

The study showed that more than fifty percent of the respondents had low level of training. The most preferred training areas were farm machinery(2.86), farming situation based extension(2.88), weather based extension(2.88) and ICTs(2.86). With respect to paddy, seed production(2.88) was closely followed by high yielding varieties(2.89). This calls for specific training interventions for effective discharge of duties.

REFERENCES

- Kiran, C., Patel, S. R., & Sandip, K. 2016. Training needs of farm women in relation to post harvest technology in legumes crop. Gujarat Journal of Extension Education, 27(2), 185-189.
- Kumar, V., Chauhan, J. K., Upadhyay, A. D., Pal, P., Lahiri, B., Ghosh, A. and Chandegara, A. K. 2024. Assessment of training effectiveness for fish farmers of Tripura. Indian Research Journal of Extension Education, 24(2), 10-18.
- Martel, J., Devos, L. and Terryn, N. 2021. The integration of UAVs and AI for improved precision agriculture. Agronomy, 11(10), 2027.
- Rajkumar Nath M. S. Nain, Nishi Sharma, R. N. Padaria, L. Muralikrishnan, Bikram Barman Anirban Jana and Sakaray Vaishnavi. 2025. Value Chain Development of IARI Variety of Carrot: A Training Need Assessment. The Indian Journal of Agricultural Sciences, 61(2), 51-55.
- Roy, A., Som, Bhattacharyya, S. and Das, B.K., Pandit, A., and Yadav, A.K. 2021. Impact of trainings in Increasing farmers' income: Evidence from Bihar, Indian Journal Environmental Biology, 42(2), 499-504i.
- Shaba, S. A., & Alam, M. M. 2024. Farmers' satisfaction with agricultural extension: a service quality-based assessment. Indian Journal of Extension Education, 60(3), 1-6. <https://doi.org/10.48165/IJEE.2024.60301>
- Sajeev, M. V., Singha, A. K. and Venkatasubramanian, V. 2012. Training needs of farmers and rural youth: An analysis of Manipur State, India. Journal of Agricultural Sciences, 3(2), 103-112.
- Sengupta, P. 2023. Can precision agriculture be the future of Indian farming? - A case study across the South-24 Parganas district of West Bengal, India. Biology and Life Sciences Forum, 30(1), 3.

Neelaveni, S., Venkatarao, P., Kiran kumar, S., Anusha, S. and Harikumar, V. 2026. Training need assessment of extension functionaries working at RSKs in Srikakulam district of Andhra Pradesh. The Journal of Research ANGRAU, 54(2) : 108-114

SUSTAINABLE HORTICULTURE UNDER MISSION FOR INTEGRATED DEVELOPMENT OF HORTICULTURE IN HIMACHAL PRADESH

PANKAJ THAKUR* and KUSUM LATA AZAD

Department of Public Administration, Himachal Pradesh University, Shimla-171005

Date of Receipt : 22-04-2026

Date of Acceptance : 16-06-2026

Horticulture plays a pivotal role in the socio-economic landscape of Himachal Pradesh, a predominantly agrarian state with diverse agro-climatic zones conducive to a wide range of fruits, vegetables, flowers, and spices. Unlike the plains, the hill terrain and climatic conditions of Himachal Pradesh favors horticulture over traditional cereal crops. Over the past three decades, horticulture has emerged as a significant driver of agricultural growth, rural employment, and income generation. The Mission for Integrated Development of Horticulture (MIDH), launched in 2014 by the Government of India, is a centrally sponsored scheme aimed at promoting holistic horticulture development through interventions in area expansion, planting material, irrigation, post-harvest infrastructure, market linkages, and capacity building. In Himachal Pradesh, MIDH places emphasis on sustainable horticulture practices to address environmental concerns such as soil degradation, water scarcity, and pest resistance, while ensuring profitability for farmers. Sustainable horticulture in the state includes practices such as organic farming, IPM, INM, mulching, vermicomposting, drip irrigation, and bio-fertilizer application. These methods aim to conserve resources, reduce chemical dependency, and enhance long-term productivity. However, adoption rates vary due

to multiple factors, including awareness, market access, affordability, and institutional support. This study is unique as it brings together two perspectives—those of departmental officials responsible for MIDH implementation and the farmers who are the scheme's ultimate beneficiaries—in Shimla and Kullu districts. Understanding both viewpoints is essential for identifying bottlenecks and aligning policy with ground realities. In this connection, the study was conducted to examine the types of sustainable horticulture practices promoted under MIDH in Shimla and Kullu districts and to compare perspectives of officials and farmers to identify convergence and gaps in sustainable horticulture implementation.

In *Horticulture Development in Himachal Pradesh: A Paradigm Shift* traces the transformation of the state's agriculture from subsistence farming to a diversified, market-oriented horticulture economy. The paper highlights the role of government initiatives, improved planting material, and market linkages in expanding fruit cultivation, particularly apples, across high-altitude areas. It also underscores challenges such as declining apple productivity, climate variability, and the need for diversification into other high-value crops. The author emphasizes

*Corresponding Author Email: pankajthakur511251@gmail.com

strengthening infrastructure, promoting research-driven cultivation practices, and enhancing farmer training as essential for sustaining the state's horticultural growth (Sharma, 2011).

In *Annual Report 2014–15* outlines India's position as the second-largest producer of fruits and vegetables globally, while noting productivity gaps compared to leading nations. The report emphasizes the role of the Mission for Integrated Development of Horticulture (MIDH) and its sub-missions in enhancing infrastructure, promoting sustainable practices, and supporting value chains, particularly in Himalayan states. It also highlights persistent challenges such as inadequate cold storage, high post-harvest losses, and limited processing capacity, recommending infrastructure expansion, public–private partnerships, and market integration to boost farmer incomes and reduce wastage (Ministry of Agriculture and Farmers Welfare, 2015).

Research article namely “Advances in Protected Cultivation Technologies for Horticultural Crops” examine the role of greenhouse, shade net, and polyhouse systems in enhancing productivity, quality, and year-round supply of high-value crops. The paper emphasizes how protected cultivation mitigates climatic risks, optimizes water and nutrient use, and supports the production of disease-free planting material. It highlights the adoption trends, government incentives under schemes like MIDH, and the potential for integrating precision farming tools to improve economic returns and sustainability in horticulture (Kumar *et al.*, 2021)

In “Economics of Horticultural Production” discusses the sector's increasing share in India's agricultural GDP, supported by high-value crop diversification, urban market demand, and targeted government schemes.

They stress the importance of accurate cost of cultivation estimates, value addition through processing, and strong market linkages to improve profitability. The chapter also emphasizes sustainable production methods, infrastructure investment, and informed crop planning as key drivers of long-term economic viability (Baruah *et al.*, 2023).

Report “Sustainable Farming – Sustainable Future” underscores the importance of organic and climate-resilient agriculture in safeguarding environmental health, improving soil fertility, and ensuring long-term food security. It details flagship initiatives such as PKVY, MOVCDNER, the clean plant programme, and PM-PRANAM, highlighting their role in promoting organic clusters, providing virus-free planting material, and incentivizing fertilizer-free farming. The report also outlines significant achievements under MIDH, including area expansion, organic farming coverage, and protected cultivation, framing these interventions as critical to building a sustainable and resilient horticulture sector (Ministry of Agriculture & Farmers' Welfare, 2024).

These works collectively inform the present study by framing sustainable horticulture within both global best practices and the specific challenges faced in the Indian and Himachali context. They emphasize the critical role of policy, training, market linkages, and certification systems - elements central to the Mission for Integrated Development of Horticulture (MIDH) and its effectiveness in promoting sustainable farming transitions in hill regions.

Based on the fruit production data from the last five years, Shimla and Kullu districts have consistently recorded the highest horticultural output in their respective zones. Therefore, the present study was conducted in two districts - Shimla from the South Zone

and Kullu from the North Zone. These districts were selected due to their agro-climatic suitability, high fruit productivity, and effective implementation of the Mission for Integrated Development of Horticulture (MIDH) scheme.

This descriptive study employed a mixed-method approach, integrating quantitative and qualitative data to evaluate the promotion, awareness, and adoption of sustainable horticulture practices under MIDH in Himachal Pradesh. From each district, three blocks with significant horticultural activity were chosen. The sample comprised 12 departmental officials (6 from Shimla and 6 from Kullu) directly involved in MIDH implementation, and 384 horticulture farmers (192 from each district) selected through stratified random sampling to ensure representation across the selected blocks. Two structured questionnaires - one for officials and another for farmers - were used to collect data on the types of sustainable practices promoted, methods of dissemination, adoption frequency, challenges faced, and perceptions of MIDH's effectiveness. Quantitative data were analyzed using descriptive statistics (frequencies and percentages) in Microsoft Excel, while

qualitative responses from open-ended questions were thematically analyzed to capture contextual insights. Tables and figures were prepared to present key findings, supported by narrative interpretation. This design enabled a comparative assessment of policy-level promotion strategies and ground-level adoption patterns, identifying both convergence and gaps between the two perspectives.

Officials were asked to identify which sustainable horticulture practices are promoted in their blocks or districts. The responses have been presented in Table 1. All the officials reported promoting key sustainable horticulture practices - organic farming, Integrated Pest Management, Integrated Nutrient Management, vermin composting, drip/micro-irrigation, and bio-fertilizer use - reflecting a comprehensive approach to environmental sustainability under MIDH. Mulching was slightly less emphasized (91.7 percent), and a small share (8.3 percent) mentioned additional localized innovations. These results indicate that sustainable horticulture promotion is firmly embedded in Mission for Integrated Development of

Table 1. Sustainable Practices Promoted under Mission for Integrated Development of Horticulture as Reported by Officials,

(n = 12)

S. No.	Sustainable Practice	Frequency (n)	Percentage
1	Organic farming	12	100
2	Integrated Pest Management (IPM)	12	100
3	Integrated Nutrient Management (INM)	12	100
4	Vermicomposting	12	100
5	Drip/Micro-irrigation systems	12	100
6	Mulching techniques	11	91.7
7	Use of bio-fertilizers	12	100
8	Others (please specify)	1	8.3

Source: Primary Probe.

Table 2. Awareness of Sustainable Horticulture Practices**(n = 384)**

Sl. No	Responses	Frequency	Percentage
1	Yes	175	45.6
2	No	0	0
3	Not familiar with the term 'sustainable' but I use some of these practices	209	54.4

Horticulture implementation at the grassroots level, aligning closely with the scheme's policy framework.

Farmers' Perspective of Sustainable Horticulture Practices

To assess the level of awareness among farmers regarding sustainable horticultural practices promoted under MIDH, beneficiaries were asked if they were familiar with techniques such as organic farming, drip irrigation, mulching, and vermicomposting, which aim at long-term soil and crop health. The responses are presented in Table 2.

The findings in Table 2 reveal that 45.6 percent of farmers were formally aware of sustainable practices promoted under MIDH, while 54.4 percent reported using some techniques without associating them with the term "sustainable." Notably, none of the respondents were entirely unaware, suggesting that MIDH interventions - whether through formal training or informal channels -

are reaching the farming community. This indicates practical uptake of environmentally friendly methods, even when technical terminology is not well understood.

Sources of Learning

Beneficiaries were asked to identify the primary source through which they learned about sustainable horticultural practices such as organic farming, drip irrigation, mulching, or vermicomposting. Each respondent could select only one option. The responses are shown in Table.3

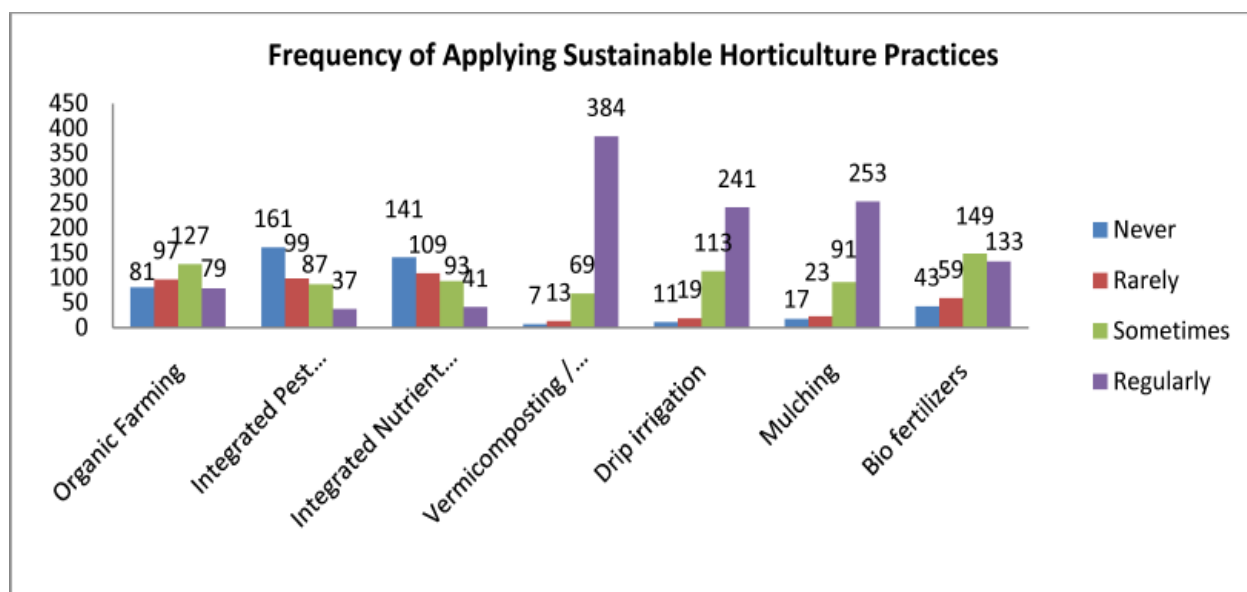
According to Table-3, training programs and camps emerged as the primary source of knowledge (44.0 percent), underscoring their central role in skill development. Internet and social media were the second-most common source (23.4 percent), reflecting increasing digital engagement, particularly among younger farmers. Peer learning through fellow farmers accounted for 19.5 percent, while direct interaction with government officials was

Table 3. Sources of Learning about Sustainable Horticultural Practices**(n = 384)**

S.No.	Response Option	Frequency (n)	Percentage
1	Government Officials	45	11.7
2	Trainings/Camps	169	44.0
3	Fellow Farmers	75	19.5
4	Internet/Social Media	90	23.4
5	Other (specify)	5	1.3
	Total	384	100

Source: Primary Probe

n=384



Source: Author's Framework

Fig. 1. Frequency of Application of Sustainable Practices by Farmers

relatively low at 11.7 percent. These findings point to the need for strengthening departmental field outreach while continuing to leverage both traditional and digital platforms for information dissemination.

Frequency of Applying Sustainable Practices

Beneficiaries were asked to indicate how frequently they apply key sustainable horticulture practices promoted under MIDH. Each respondent rated their frequency of use for multiple practices on a four-point scale: *Regularly*, *Sometimes*, *Rarely*, or *Never*. The compiled responses are summarized below in

The adoption pattern shows significant variation across practices. Vermicomposting/cow dung use was nearly universal and regular, indicating strong integration into local farming systems. Mulching (65.9% regular use) and drip irrigation (62.8% regular use) also showed high uptake, likely influenced by visible benefits and subsidy support. Bio-fertilizers were used regularly by about one-third of farmers, with

many applying them occasionally. Organic farming adoption was mixed, with only one-fifth practicing it regularly and a similar proportion never using it. IPM and INM recorded the lowest consistent use (below 11%), suggesting the need for more technical guidance and practical demonstrations for these methods.

Integration into Regular Farming

To assess the **overall adoption** of sustainable horticultural practices, farmers were asked if they consider such practices as a regular part of their farming system. The responses are summarized in Table-4

As per Table-4, sustainable horticulture is integrated to some degree in the practices of nearly 60% of farmers, though only 2.3% have fully embraced it as a core production system. A substantial proportion (40.1%) do not consider these methods part of their regular operations, indicating that partial adoption - often limited to specific techniques - is more common than system-wide sustainability transitions.

Table 4. Adoption of Sustainable Horticulture Practices as a Regular Farming Activity

Sr. No	Responses	Frequency	Percentage
1	Yes, to a great extent	9	2.3
2	Yes, to some extent	221	57.6
3	No	154	40.1

Source: Primary Probe

Table 5. Challenges in Adopting Sustainable Horticulture Practices (n = 384)

Sr.No.	Challenge	Frequency (n)	Percentage
1.	Lack of knowledge	172	44.8
2.	High cost of inputs	148	38.5
3.	No market for organic produce	131	34.1
4.	Not suitable for land/climate	84	21.9
5.	Lack of departmental support	57	14.8
6.	Other	11	2.9

Challenges in Adoption

While many farmers are aware of and have adopted some sustainable horticulture practices, several challenges still hinder their full-scale implementation. Beneficiaries were asked to select all the obstacles they faced in adopting such practices. The responses are summarized in Table-5

The constraints in Table-5, highlight knowledge gaps (44.8 percent) as the most pressing barrier, followed by high input costs (38.5 percent) and lack of assured markets for organic produce (34.1 percent). Climatic or land-related unsuitability was cited by (21.9 percent), while (14.8 percent) pointed to insufficient departmental support. A small share (2.9 percent) mentioned other issues such as labor shortages and certification hurdles. These challenges point to the need for an integrated strategy combining capacity building, financial assistance, market development, and climate-specific solutions to encourage broader and more consistent adoption of sustainable horticulture under MIDH.

This descriptive study examined sustainable horticulture practices promoted under the Mission for Integrated Development of Horticulture (MIDH) in Himachal Pradesh from the perspectives of both officials and farmers. Officials reported unanimous promotion of core sustainable practices such as organic farming, IPM, INM, vermicomposting, drip irrigation, mulching, and bio-fertilizer use. Training programs and awareness campaigns were the main methods used to encourage adoption. From the farmers' side, although nearly half were formally aware of sustainable horticulture, many were already using some practices without associating them with the term "sustainability." Vermicomposting, mulching, and drip irrigation were the most regularly adopted, while IPM and INM had low uptake. The main constraints identified were lack of knowledge, high costs, and absence of organic market linkages. The findings highlight a clear policy–practice gap. While MIDH has succeeded in promoting awareness and initiating adoption, sustained

and comprehensive integration of sustainable practices into regular farming remains limited.

REFERENCES

- Baruah, K., Tare, K., Sherpa, T. L., and Kaushik, K. 2023. Economics of horticultural production, *Advances in horticulture*. Vol.1: 236-259.
- e-Udhyana (Himachal Pradesh Government). (n.d.).e-Udhyana: Digital services for horticulture in Himachal Pradesh. Government of Himachal Pradesh. Retrieved from the website (<https://eudyan.hp.gov.in>) on 05.06.2025.
- Kumar, R., Singh, D., Kumar, P., Singh, B., and Meena, V. S. 2021. *Advances in protected cultivation technologies for horticultural crops*. In M. Kumar, R. Kumar, and S. K. Singh (Eds.), *Protected cultivation and smart agriculture* (pp. 3266–3284). Springer.https://doi.org/10.1007/978-981-16-3001-1_18
- Leifeld, J. 2012. How sustainable is organic farming? *Agriculture, Ecosystems & Environment*, 150(1), 121–122. <https://doi.org/10.1016/j.agee.2012.01.020>
- Ministry of Agriculture & Farmers' Welfare. 2024. Sustainable farming – sustainable future: Transforming agricultural sector with organic farming reforms. Government of India. Retrieved from the website (<https://pib.gov.in/PressReleasePage.aspx?PRID=2043922>) on 06.06.2025.
- Ministry of Agriculture and Farmers Welfare. 2015. Horticulture. In *Annual report 2014–15*. Government of India. Retrieved from the website (<https://agricoop.nic.in>) on 10.06.2025.
- Ministry of Agriculture and Farmers Welfare. 2022. MIDH guidelines. Retrieved from the website (MIDH-Suraksha) on 11.06.2025
- Mission for Integrated Development of Horticulture.(n.d.).Mission for Integrated Development of Horticulture (MIDH), Government of India. Retrieved from the website (<https://midh.gov.in>) on 11.06.2025
- Sharma, K. D. 2011. Horticulture development in Himachal Pradesh: A paradigm shift. *Indian Journal of Agricultural Economics*, Vol 66(3), 418–431.

Pankaj Thakur and Kusum Lata Azad. 2026. Sustainable horticulture under mission for Integrated development of horticulture in Himachal Pradesh. *The Journal of Research ANGRAU*, 54(2) : 115-121

DEVELOPMENT AND NUTRITIONAL ASSESSMENT OF SWEETMEAT FROM IMMATURE COCONUT INFLORESCENCE

C.RATHINA* and THILAKAVATHY

Department of Food Science and Nutrition, Avinashlingam Institute for Home Science and Higher Education for Women, Coimbatore - 641 043, Tamil Nadu

Date of Receipt : 07-04-2026

Date of Acceptance : 23-06-2026

Coconut (*Cocos nucifera*) is a highly versatile crop cultivated in tropical regions for its various edible and non-edible applications (Pham, 2016). While coconut based products such as oil, milk and water are well-documented, limited research has focused on the potential use of coconut inflorescence, particularly its immature stage, as a functional food ingredient. Coconut inflorescence, often referred to as the “coconut flower,” has traditional culinary applications but remains underutilized in contemporary food processing (Bourdeix and Prades, 2017). The coconut inflorescence or the flowering part of the coconut tree, is typically harvested before it fully matures. Traditionally, it has been used in various indigenous culinary practices and holds cultural significance in certain regions. However, its broader culinary potential remains largely untapped. By transforming this underutilized resource into a sweetmeat, this study not only seeks to diversify coconut-based products but also to enhance the economic value derived from coconut farming (Malhija and Kumaran, 2020).

This study conducted in 2022 aimed to develop a value-added sweetmeat from immature coconut inflorescence and evaluate its nutritional composition. Nutritional evaluation is a critical aspect of this research, as it provides insights into the health benefits

and dietary contributions of the sweetmeat. Immature coconut inflorescence is known for its unique composition, rich in dietary fibers, vitamins and minerals, which could offer significant health benefits in treating lifestyle diseases. Assessing these nutritional properties will help establish the sweetmeat as a viable and healthy addition to modern diets.

Selection and Collection of Coconut Inflorescence:

Freshly harvested coconut inflorescence with vibrant green color buds were selected. Wilted, discolored, or damaged inflorescence was avoided. The buds were examined to ensure they were intact and free from mold or pests. The inflorescence was assessed for texture, ensuring firmness and crispness, and any soft or mushy samples were excluded. A pleasant, slightly sweet aroma was considered an indicator of quality.

Selection of Ingredients

Good quality jaggery, turmeric powder, cumin seed powder, dry ginger powder, cardamom powder, coconut milk and rice flour were sourced from local stores.

Processing of Coconut Inflorescence

The outer leaf was removed from the inflorescence, and the flowers were cut until the buds were visible. The stem part was not

*Corresponding Author Email: 21phfnf005@avinuty.ac.in

Table 1 presents the ingredient composition used in sweetmeat preparation.

S.No.	Ingredient	Quantity (g/ml)
1	Coconut inflorescence	100 g
2	Jaggery	50 g
3	Turmeric powder	2.5 g
4	Cumin powder	2.5 g
5	Dry ginger powder	2.5 g
6	Coconut milk	80 ml
7	Rice flour	10 g
8	Cardamom powder	2.5 g

used. Only the tender portion was utilized, avoiding the hard portions. The flowers were ground before the browning reaction occurred.

COMPOSITION OF SWEETMEAT

Preparation: The chopped coconut inflorescence was mixed with thick coconut milk and simmered on medium heat. Jaggery syrup was added, followed by spices (turmeric, cumin and dry ginger) and mixed thoroughly. The mixture was simmered on low heat for 10-15 minutes. A slurry of rice flour, cardamom powder and additional coconut milk were added and stirred in. The mixture was cooked for 2-3 minutes until thickened, then cooled and stored in an airtight container.

SENSORY EVALUATION

A panel of 10 semi-trained members evaluated the sweetmeat using a 9-point hedonic scale for appearance, color, flavor,

texture, taste, and overall acceptability. Statistical analysis was conducted using SPSS software, employing one-way ANOVA and T-tests. For Phytochemical analysis Ethanolic extracts of the sweetmeat were analyzed for alkaloids, flavonoids, saponins, tannins, steroids, and anthraquinones following standard protocols (Salawu *et al.*, 2016; Shaikh & Patil, 2020). For nutritional analysis, macronutrients, vitamins, and minerals were determined using the AOAC (1990) official method. The antioxidant potential of sweetmeat was assessed using the DPPH method, comparing its scavenging effect to ascorbic acid. The IC₅₀ value was derived from the absorbance inhibition curve.

Organoleptic tests of the sweetmeat depend on its appearance, colour, flavour, texture, taste and overall acceptability of the product. Table 2 shows the sweetmeat of their organoleptic quality factors. Coconut inflorescence obtained a good score of 8.67±0.67 for its appearance. Appearance of the sweetmeat depends on appearance of the coconut inflorescence and other raw ingredients and on processing technique. Sweetmeat obtained the score 7.36±0.63 for its colour. Colour of the sweetmeat depends on the colour quality of the ingredients. The flavor and smell of the products depends on

Table 2. Sensory (Organoleptic) Evaluation of Sweetmeat

S.No.	Attribute	Mean ± SD
1	Appearance	8.48 ± 0.67
2	Color	7.36 ± 0.63
3	Flavor	8.55 ± 0.85
4	Texture	6.78 ± 0.57
5	Taste	9.13 ± 0.68
6	Overall Acceptability	8.67 ± 0.45

Table 3. Nutrient Composition (per 100 g)

S.No	Proximate Composition	Amount Mean $\pm$ SD
1	Energy(Kcal)	277 $\pm$ 1.6
2	Carbohydrate(g)	5.1 $\pm$ 1
3	Protein(g)	10.7 $\pm$ 0.4
4	Fat(g)	2.85 $\pm$ 0.1
5	Calcium(mg)	98.1 $\pm$ 0.1
6	Magnesium(mg)	77 $\pm$ 1.5
7	Iron(mg)	3.8 $\pm$ 0.3
8	Dietary fibre(g)	24.4 $\pm$ 0.1
9	Folate (μ g)	5.7 $\pm$ 0.05
10	Phosphorous(mg)	140 $\pm$ 1
11	Potassium(mg)	79.5 $\pm$ 0.1
12	Selenium(mcg)	11.5 $\pm$ 0.3
13	Zinc(mg)	0.08 $\pm$ 0.005
14	Vitamin A(mcg)	1.2 $\pm$ 0.05
15	Vitamin B1(mg)	0.05 $\pm$ 0.005
16	Vitamin B2 (mg)	0.14 $\pm$ 0.01
17	Vitamin B5(mg)	0.60 $\pm$ 0.05
18	Vitamin C (mg)	1.8 $\pm$ 0.05
19	Vitamin E (mg)	0.3 $\pm$ 0.05
20	Vitamin A(mcg)	1.2 $\pm$ 0.05
21	Vitamin B1(mg)	0.05 $\pm$ 0.005
22	Vitamin B2 (mg)	0.14 $\pm$ 0.01
23	Vitamin B5(mg)	0.60 $\pm$ 0.05
24	Vitamin C (mg)	1.8 $\pm$ 0.05
25	Vitamin E (mg)	0.3 $\pm$ 0.05

the volatile constituents of sweetmeat. The flavour mean score was 8.67 $\pm$ 0.85. Texture of the sweetmeat depends mainly upon the Selection of coconut inflorescence and the proportion of jaggery used. The wide variation in the quality parameter of sweetmeat can be attributed to the processing conditions and type

of raw material used. The mean score of texture was 6.78 $\pm$ 0.57. Taste is also influenced by the quality of the raw materials used in the processing of coconut inflorescence. The mean taste score of sweetmeat was 9.13 $\pm$ 0.68. In overall acceptability test, Hedonic scale showed that the sweetmeat was highly acceptable with score of 8.67 $\pm$ 0.45 for all quality characteristics by the panel members.

Nutritional Composition

Table 3 provides the nutrient profile of the sweetmeat. Minerals of sweetmeat was 3.8mg of iron , 9.81 mg of calcium , 77 mg of magnesium, 140 mg of phosphorous, 79.5mg of potassium, 11.5 mcg of selenium & 0.08 mg of Zinc. Vitamins like A, B1, B2, B5, C and E Content were found to be 1.2 mcg, 0.05, 0.14, 0.60, 1.8, 0.3 mg respectively.

Phytochemical Composition

Phytochemicals are natural bioactive compounds found in vegetables, fruits, medicinal plants, aromatic plants, leaves, flowers and roots which act as a defense system to combat against diseases. A number of bioactive compounds from plants like isoflavones, diosgenin, resveratrol, quercetin, catechin, sulforaphane, tocotrienols & carotenoids are proven to reduce the risk of cardiovascular diseases and aid in cardioprotection which is the leading cause of global death. Table 4 and 5 gives the details on the phytochemical Screening of sweetmeat by both qualitative and quantitative method.

The phytochemical analysis of the sweetmeat by qualitative method revealed that alkaloids and flavonoids were highly present, steroids and tannins were present.

The phytochemical analysis of the sweetmeat showed the presence of 4.2mg/gm of alkaloids, 2.5 mg/gm of Flavonoids, 0.3 mg/gm of Tannins and 0.02 mg/gm of steroids

Table 4. Phytochemical screening by Qualitative Method

S.No	Phytochemicals	Eathonolic extract of Sweetmeat
1	Alkaloids	+++
2	Flavonoids	+++
3	Steroids	+
4	Tannins	+
5	Terpenoids	-
6	Anthraquinones	-

(+++)-Highly Present(++)-Moderately Present (+)-Presence (-)-Absence

Table 5. Phytochemical Screening by Quantitative Method

S.No.	Parameters	Amount (mg/gm)
1	Alkaloids	4.2
2	Flavonoids	2.5
3	Tannins	0.3
4	Steroids	0.02

Antioxidant Activity

DPPH (1-Diphenyl 2-picryl hydrazyl) is one of the free radicals widely used for testing preliminary radical scavenging activity of sweetmeat. It showed the maximum inhibitory activity in the aqueous extract at 60mg/mL. The percentage of inhibition was from 10, 25, 50, 100, 150 at 52, 11, 22, 40, 60mg/mL for sweetmeat and the IC₅₀ value for sweetmeat was 60mg/ml while for standard it was found to be 123mg/ml. Table 6 shows the antioxidant activity of sweetmeat.

According to (Fidrianny *et al.*, 2015), lower the value, higher the antioxidant property. The sweetmeat exhibited an IC₅₀ value

of 123mg. Hence, the product developed exhibited good antioxidant property.

The development and evaluation of sweetmeat from immature coconut inflorescence demonstrated its potential as a nutritious and functional food product. The formulation was well-accepted organoleptically and contained essential nutrients. The presence of bioactive compounds and antioxidant properties further highlights its potential health benefits. Nutritional evaluation is a critical aspect of this research, as it provides insights into the health benefits and dietary contributions of the sweetmeat. Assessing these nutritional properties will help establish the sweetmeat as a viable and healthy addition to modern diets. Future research should explore the long-term stability and commercial feasibility of this novel product.

REFERENCES

- AOAC. 1990. Official methods of analysis. Association of official analytical chemists. 15th Edition. Washington DC. USA. pp. 256. Yellamanda Reddy, T and Sankara Reddy, G.H. 2005. Principles of

Table 6. Antioxidant activity of Sweetmeat

Name of the Assay	10mg	25mg	50mg	100mg	150mg	IC ₅₀
DPPH Scavenging activity	5.2%	11.6%	21.8%	40.9%	60.7%	123mg

- Agronomy. Kalyani Publishers, Ludhiana, India. pp. 125.
- Bourdeix, R., and Prades, A. 2017. A global strategy for the conservation and use of coconut genetic resources 2018-2028.
- Fidrianny, I., Rizkiya, A., and Ruslan, K. 2015. Antioxidant activities of various fruit extracts from three solanum sp. using DPPH and ABTS method and correlation with phenolic, flavonoid and carotenoid content. J Chem Pharm Res, 7(5), 666-72.
- Malhija, N. and Kumaran T. 2020. Coconut inflorescence sap nutritional characteristics and health effects. Journal of Basic and Applied Research in Biomedicine, 6(1), 50-52.
- Pham, L. J. 2016. Coconut (*Cocos nucifera*). In Industrial oil crops pp. 231-242. AOCS Press.
- Shaikh, J. R. and Patil, M. 2020. Qualitative tests for preliminary phytochemical screening: An overview. International Journal of Chemical Studies, 8(2), 603-608. <https://doi.org/10.22271/chemi.2020.v8.i2i.8834>.
- Salawu, S. O., Alao, O. F., Faloye, O. F., Akindahunsi, A. A., Boligon, A. A., and Athayde, M. L. 2016. Antioxidant potential of phenolic - rich two varieties of Nigerian local rice and their anti-cholinesterase activities after *in vitro* digestion. Nutrition & Food Science, 46 (2), 171-189.

Rathina C. and Thilakavathy. 2026. Development and nutritional assessment of sweetmeat from immature coconut inflorescence. The Journal of Research ANGRAU, 54(2):122-126

Statement about the ownership and other particulars about the Journal
THE JOURNAL OF RESEARCH ANGRAU (since 1973)
Form IV (SEE RULE 8)

Place of Publication : Guntur

Periodicity of publication : Once in three months (Quarterly)

Printer's Name : Ritunestham Press, Guntur

Nationality : INDIAN

Address : Ritunestham Press
8-198, Kornepadu, Guntur - 522 017

Publisher's Name : Dr. P.Muniratnam

Address : Dean of P.G. Studies, Administrative Office,
Acharya N.G. Ranga Agricultural University,
Lam, Guntur- 522 034, Andhra Pradesh

Editor -in - Chief 's Name : Dr. P.Muniratnam

Nationality : INDIAN

Address : Dean of P.G. Studies, Administrative Office,
Acharya N.G. Ranga Agricultural University,
Lam, Guntur- 522 034, Andhra Pradesh

Name and address of the individuals who own the Journal and partners or share holders holding more than one percent of the total capital : Acharya N.G.Ranga Agricultural University,
Administrative Office,
Lam, Guntur- 522 034,
Andhra Pradesh

I, Dr. P. Muniratnam, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Sd/- Dr. P.Muniratnam

Signature of the Publisher

