

Diversified Nutritive Coconut Value-Added Products: Technologies and Innovations

Coconut-based agribusiness has emerged as a promising sector with significant domestic and international market potential, driven by the growing demand for value-added coconut products and modern processing technologies. However, the coconut industry has faced several challenges in recent years, including fluctuating market prices, competition from cheaper vegetable oils such as palm oil, and shortages of skilled labour. In this context, product diversification and value addition have become essential for stabilizing the coconut oil-driven market and revitalizing the industry in a cost-effective and globally competitive manner. These challenges, in turn, have encouraged farmers and entrepreneurs to explore innovative coconut-based agribusiness opportunities in India.

Keywords: Coconut; Kalparasa[®]; Nutrition; Value added products

IN this context, India has developed a range of processing equipment and technologies for the production of diversified coconut-based value-added products. The institutes have designed and standardized several machines and processing units, including copra dryers utilizing different energy sources, coconut splitting devices, coconut deshelling & dehusking machines, snowball tender coconut machines, coconut grating machines, tender coconut punch and cutter units, manual and power operated coconut slicing machines, coconut testa removers, coconut pulverizers, blanching units, coconut chips dryers (electrical and rotary), coconut flaking machines, infrared dryers, coconut milk expellers, virgin coconut oil cookers, and fermentation tanks for virgin coconut oil production. These technologies facilitate the integration of various unit operations in coconut processing and help in completing the coconut value chain efficiently.

The value-added product technologies developed can broadly be categorized into fresh kernel-based products, mature coconut water-based products, tender coconut-based products and inflorescence sap-based products, and thereby opening new avenues for entrepreneurship, income generation, and sustainable growth of the coconut sector.

Fresh coconut kernel based products

Coconut milk-based products: The global coconut milk market is experiencing robust growth, with market values estimated between USD 1.6 and 2.7 billion during the year 2023, and projections suggesting expansion to over USD 7 billion by 2032 at a compound annual growth rate (CAGR) of 12–17%. India, one of the leading coconut producers, is witnessing rapid expansion in its coconut milk sector, with a projected CAGR of 19.2% between



Virgin coconut oil

2023 and 2033. There are a number of coconut milk based products.

Virgin coconut oil (VCO): Virgin coconut oil is a premium value-added coconut product obtained through natural and mechanical extraction of coconut milk. Unlike conventional coconut oil, VCO retains natural bioactive compounds such as vitamin E, antioxidants, polyphenols, and lauric acid, which contribute to its nutritional and therapeutic value. Due to its antimicrobial and health-promoting properties, virgin coconut oil finds extensive applications in functional foods, cosmetics, nutraceuticals, and pharmaceutical formulations. The global demand for Virgin Coconut Oil (VCO) is witnessing rapid growth in recent years, driven by increasing consumer preference for organic cosmetics, functional beverages, and health-oriented diets. The global VCO market is currently valued between USD 2.6 and 3.15 billion and is projected to expand at a compound annual growth rate (CAGR) of 8.5–12.6% in the coming years. The Asia-Pacific region continues to dominate both production and consumption, accounting for nearly 40% of the market share.

Table 1 Nutritional information of Hot processed VCO (per 100g)

Calories (kcal)	900
Cholesterol (mg)	0
Total phenolic content (mg Gallic Acid equivalent))	2.9
Total flavonoids (mg Quercetin Equivalent)	6.6
Moisture (%)	0.1
Free fatty acids (%)	0.1

CPCRI has developed efficient technologies for the production of Virgin Coconut Oil (VCO) through both hot processing and accelerated fermentation methods using skimmed coconut milk, creating significant opportunities for small-scale coconut-based enterprises. The institute has also standardized quality parameters for different VCO variants and developed chemometric techniques for detecting adulteration in virgin coconut oil and coconut oil, thereby ensuring product authenticity, quality assurance, and enhanced market competitiveness in domestic and international markets. The nutritional content of VCO is given in Table 1.

Further, the residues of virgin coconut oil production stream including the defatted coconut flour (DCF), popularly known as coconut milk residue (CMR) and VCO cake were diversified to different value added products. VCO processing from 500 nuts give rise to about 200 kg husk, 67 kg shell, 50 L nut water, 3.3kg testa, 25kg milk residue and 5kg VCO cake. The per cent recovery of coconut milk residue and VCO cake ranged from 38.5 to 55.6% and 6.3 to 8.8% respectively

Coconut milk residue (CMR) based value-added products: Coconut milk residue at 2.9% moisture level contains 46.5% crude fibre, 5.3% protein, and 49.2% crude fat. It has 4 times more fibre than oat bran, 2 times than wheat bran, which in fact, is calorie free. Some of the value-added products developed from the milk residue are described below,

Low fat desiccated coconut flour: Milk residue can be dried to 3-5% moisture content and sold as low fat desiccated coconut flour, which can be used for the preparation of bakery and of low calorie foods.



Desiccated coconut powder

It can be used as fillers, bulking agents and substitute for wheat flour, rice flour and potato flour at certain levels and incorporated into baked and extruded food products. Five % coconut milk residue flour can replace proportionate amounts of wheat flour and non-fat dry milk powder used in school nutrition programmes without affecting the baking qualities and food value.

CMR based extruded snacks: A coconut milk residue-based extruded snack formulation containing 20% coconut milk residue, which was commercialized as *Kalpa Krunch* is a nutritious and crunchy ready-to-eat snack prepared using coconut milk residue blended with rice, corn, or millet flour and flavored with various spices and herbs for enhanced sensory appeal.



Kalpa krunch

CMR based NutriPuttu: *NutriPuttu* is a healthier and fibre-rich version of the traditional Kerala breakfast staple, developed using a combination of rice flour and CMR, a nutritious by-product rich in dietary fibre. Compared to regular *puttu* powder, *NutriPuttu* contains higher levels of protein, fibre, and healthy fats while retaining the authentic taste and texture of traditional *puttu*. The product provides about 395.25 kcal of energy and 7.09 g fat per 100 g and has a shelf life of 90 days. It also represents an eco-friendly innovation that promotes the valorisation of coconut processing by-products.

CMR based wafer cone: 'Kalpa Wafer Cones' are crispy and nutrient-rich wafer cones developed using sweet potato flour enriched with coconut milk residue, coconut milk and coconut sugar. The incorporation of coconut-based ingredients enhances the dietary fibre content while contributing essential nutrients and health-promoting fatty acids. The developed wafer cones contained 3.45% moisture, 6.94% protein, 24.67% fat, 3.49% fibre, and 1.15% ash, indicating their superior nutritional quality. With a balanced proximate composition, the product offers a sustainable and healthier alternative to conventional wafer cones through the effective utilization of coconut processing by-products.

CMR based pasta: Coconut milk residue-based pasta is a nutritious cold-extruded product prepared from coconut milk residue and wheat semolina. Incorporation of 10% coconut milk residue was found optimum for cooking quality, texture, and sensory attributes, while also enhancing the fibre, protein, and mineral content of the product. By supplementing 10% CMR in pasta, maximum Daily Recommended Allowance (DRA) of 6.5g fibre can be met.



Coconut milk residue-based pasta

CMR infused dark chocolate: Coconut milk residue (CMR) also finds promising applications in the chocolate industry. Since cocoa butter is an expensive and limited raw material, CMR can be utilized as a functional ingredient in bean-to-bite dark chocolate formulations. Partial replacement of cocoa butter with CMR enhanced the fibre and mineral content, particularly iron and manganese, without affecting the taste or consumer acceptability of the chocolate. Moreover, chocolate



Kalpa velvet chocolate

containing up to 10% CMR retained its valuable phenolic compounds, highlighting the potential of coconut processing by-products in developing healthier and more sustainable chocolate products.

Flavored coconut milk from CMR: A ready to drink low fat coconut milk was developed using the coconut milk extracted from CMR which had 69.60% moisture, 14.85% fat, 11.65% carbohydrates, 2.80% protein, and 1.10% minerals. The beverage formulation was further standardized by optimizing fat and solids-not-fat content along with sweetness, emulsifier, colour, and flavour levels to achieve desirable quality, stability, and consumer acceptability. The product was commercialized as 'Kalpa Bliz'.

VCO cake based muffins: Muffins enriched with virgin coconut oil (VCO) cake have been developed as soft, healthy, and nutritious baked products suitable for consumers of all age groups. Incorporation of 40 g VCO cake per 100 g flour blend significantly enhanced the nutritional quality of the muffins, resulting in 8.49% protein, 18.46% fat, 1.14% crude fibre, and 1.15% minerals. The technology effectively utilizes VCO processing by-products while producing value-added functional bakery products.

Coconut milk kulfi: The process technology for coconut milk-based kulfi has also been commercialized by the institute



Coconut vegan kulfi



Frozen coconut delicacy

under the brand name 'Kalpa Kulfi'. It is a non-dairy, coconut milk-based frozen dessert formulated using coconut milk, coconut sugar, and cardamom, offering a rich creamy texture and distinctive coconut flavour. Completely vegan and free from dairy ingredients, Kalpa Kulfi serves as a healthy plant-based alternative to conventional kulfi and is enriched with essential vitamins, minerals, and healthy fatty acids, thereby promoting value addition of coconut-based ingredients

Frozen coconut delicacy: Frozen coconut delicacy is a premium vegan dessert prepared from coconut milk, coconut sugar, tender coconut pulp, and tender coconut water, serving as a healthy non-dairy alternative to ice cream. The product is diabetic-friendly and enriched with vitamins, minerals, and healthy fatty acids, making it a nutritious value-added coconut product with high consumer appeal. In addition, another composite frozen dessert variant was developed using coconut milk as the fat source and skimmed milk powder as the protein source, offering a more economical alternative to the completely vegan formulation. The nutritional content of the products is presented in Table 2.

Coconut milk peda and paneer: An innovative coconut milk-based peda was standardized using the second and third extractions of coconut milk along with coconut sugar. Incorporation of 30% coconut sugar was optimum for achieving desirable taste and texture, with coconut sugar-based peda showing better acceptability than refined sugar variants. The product had a recovery of 50–53% and possessed a rich nutritional profile containing 23.5% moisture, 42.5% carbohydrates, 23.75% fat, 5.6% protein, and 3.01% minerals, making it a healthier and value-added alternative to conventional milk peda.

Coconut milk-based paneer is an innovative value-added product prepared from the second and third extractions of coconut milk. To achieve desirable texture and consistency, the formulation is fortified with protein sources such as soy protein, egg albumin, or skim milk powder, resulting in a nutritious and functional alternative to conventional paneer.

Foam mat dried coconut milk powder: Foam mat dried coconut milk powder was developed at the institute as a low-investment alternative to conventional spray-dried coconut milk powder with better shelf life and ease of transportation. The technology involves drying coconut milk incorporated with foaming agents, foam stabilizers,

Table 2 Nutritional information of the coconut delicacies

Parameter	Coconut milk delicacy	Vegan coconut delicacy
Moisture (%)	62.66± 4.72	56.65 ± 5.35
Total solids (%)	37.33± 2.46	43.34± 2.87
Total minerals (%)	0.52 ± 0.0023	0.64 ± 0.0042
Weight per volume (g/L)	588.23 ± 14.36	612.24 ± 12.43
Crude protein (%)	4.7 ± 0.25	5.0 ± 0.42
Crude fat (%)	11.00± 0.20	11.05± 0.56



Other coconut delicacy



Coconut milk powder

and encapsulating materials to obtain a free-flowing powder. The powder contained 97.82% total solids, 52.07% fat, 27.29% carbohydrates, 8.24% protein, and 7.47% minerals, with a Hausner ratio of 1.16 indicating good flowability. The process was successfully upscaled

with a powder recovery of $33.0 \pm 0.7\%$ (w/v).

Coconut milk halwa: Coconut milk-based halwa was developed as a value-added traditional sweet using coconut milk, sugar, and wheat flour. The optimized formulation consisted of 70% coconut milk (pooled extraction), 25% refined sugar, and 5% refined wheat flour, achieving an overall acceptability score of 8.5. The optimized halwa contained 11% moisture, 57.1% carbohydrates, 30.6% fat, 0.7% protein, and 0.6% ash. These products demonstrate the potential of coconut ingredients in the development of nutritious and commercially viable bakery and confectionery products.

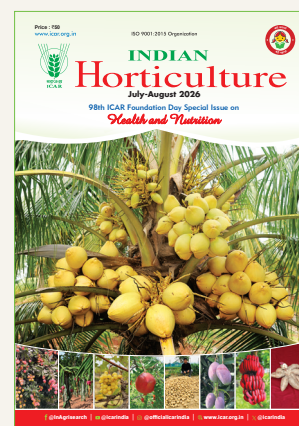
Shelf stable coconut gratings: A preservation protocol was developed for producing shelf-stable coconut gratings using different hurdle techniques. The treated coconut gratings were packaged in laminated pouches and vacuum sealed, resulting in an extended shelf life of up to 7 days under ambient conditions and 21 days under refrigerated storage. Among the treatments evaluated, a combination of 3% salt, 0.05% citric acid, 0.05% sodium citrate, and 0.05% sodium benzoate showed particularly promising results. The



PRINT ADVERTISEMENT FOR INSERTION IN

INDIAN
Horticulture

Bi-Monthly



INSERTION	BLACK & WHITE (₹)	COLORED (₹)	COVER (₹)
Single	10,000	20,000	25,000
*Multiple (Per Insertion)	8,000	18,000	20,000

*More than 3 (three) insertions

For further details, contact:

Business Manager

Directorate of Knowledge Management in Agriculture
Indian Council of Agricultural Research

Krishi Anusandhan Bhavan, Pusa, New Delhi 110 012.
Telefax: 011-2584 3657; E-mail: bmicar@gmail.com

treated samples exhibited minimal changes in pH, titratable acidity, and free fatty acid content, while maintaining sensory acceptability. Economic analysis further revealed a benefit–cost ratio of 1.31, indicating the commercial viability and profitability of the preservation technology.

Coconut chips: Coconut chips are healthy ready-to-eat snacks prepared from partially mature coconut kernels through slicing, osmotic dehydration, and hot-air drying. They serve as a nutritious alternative to conventional junk foods, as they are rich in dietary fibre, healthy fats, carbohydrates, and natural antioxidants. It contains approximately 622 kcal energy, 48.10 g fat, 46.13 g carbohydrates, 6.13 g crude fibre, 1.24 g protein, and 1.36 g total minerals per 100 g, making them an energy-dense and fibre-rich healthy snack option. Unlike many commercial snack products, coconut chips do not require deep-oil frying during processing, making them a healthier option for consumers. The chips can be prepared in sweetened, salted, spicy, or flavoured varieties, thereby enhancing consumer appeal and marketability. Their crisp texture, pleasant taste, and extended shelf life when packed in laminated pouches make them a promising value-added coconut product with significant market potential.

A standardized process technology has also been developed for the production of jaggery-based coconut chips using jaggery syrup or coconut sap (Kalparasa®) as the osmotic medium. The incorporation of jaggery or coconut sap enhances the nutritional quality of the product by increasing its mineral, antioxidant, and micronutrient content while imparting a natural flavour and sweetness. Coconut chips are considered a good source of dietary fibre, essential minerals, and energy, making them suitable as a healthy snack for health-conscious consumers.

Coconut cake: Coconut-based cake is an innovative confectionery product developed by replacing conventional ingredients with coconut-derived products such as coconut milk, coconut sugar, desiccated coconut powder, coconut milk powder, coconut vinegar, and virgin coconut oil. The optimized formulation consisted of coconut milk as the major ingredient, followed by wheat flour, coconut sugar, desiccated coconut powder, virgin coconut oil, coconut milk powder, and coconut vinegar, along with baking agents, and vanilla essence. The standardized baking conditions included preheating and baking at 180°C for 10 and 40 minutes, respectively. The developed cake contained 25% fat, 2% protein, and 20% moisture, offering improved nutritional quality and sensory appeal.

Mature coconut water-based products

Mature coconut water-based vinegar: Mature coconut water-based vinegar is a value-added product produced through alcoholic and acetic fermentation of sugar-enriched mature coconut water. It serves as a natural and healthier alternative to synthetic vinegar available in the market and is widely used in pickles, salads, and fish preservation. Studies have shown that coconut water vinegar possesses desirable physicochemical and nutritional properties, including mild acidity, high mineral content, and good storage stability. Compared with conventional vinegars, it is particularly rich in potassium



Coconut water based vinegar

and sodium, making it a nutritionally valuable product. The product offers significant potential as a natural alternative to conventional fruit and synthetic vinegars.

Coconut water jelly: Coconut water jelly is a value-added product prepared from mature coconut water blended with coconut sugar or refined sugar along with suitable gelling agent. The product possesses a pleasant taste, attractive texture, and good nutritional quality. Coconut water jelly contains appreciable amounts of total sugars, protein, potassium, vitamin C, and phenolic compounds, making it a nutritious and refreshing food product. Its unique flavour, nutritional benefits, and consumer appeal provide significant scope for commercialization in the value-added coconut product sector.

Mature coconut water based squash: Mature coconut water-based squash is a refreshing value-added beverage prepared from mature coconut water blended with refined sugar, lemon, ginger, citric acid, and permitted preservatives. The product combines the natural nutritional qualities of coconut water with enhanced flavour and consumer appeal. It can be conveniently served after dilution with water in a 1:3 ratio, making it suitable as a refreshing health drink. The squash possesses good shelf stability and offers significant potential for commercialization as a functional coconut-based beverage product.

Tender coconut-based products

Carbonated tender coconut water: The ICAR-CPCRI developed a standardized technology for the production of carbonated tender coconut water as a refreshing value-added beverage. The technology involves the processing and carbonation of tender coconut water under hygienic conditions to retain its natural flavour, nutrients, and refreshing qualities while improving shelf life and



Young tender coconut

consumer acceptability. It serves as a healthy alternative to synthetic soft drinks, as it is rich in electrolytes, minerals, and bioactive compounds. The product has significant market potential owing to the increasing consumer demand for natural and functional beverages.

Snow Ball Tender Coconut: It is an innovative value-added coconut product prepared by completely removing the husk, shell, and testa from tender coconuts to obtain a smooth, ball-shaped nut with an attractive snowy white appearance. The product is marketed as a premium and refreshing natural beverage option and is often considered an aristocratic welcome drink due to its appealing presentation and freshness. Proper hygienic processing and suitable packaging techniques enable the product to be preserved for up to 15 days under refrigerated conditions without significant quality deterioration. Snow Ball Tender Coconut has considerable commercial potential in hotels, resorts, supermarkets, and export markets owing to the increasing consumer preference for convenient and natural health drinks.

Preservation protocol for minimally processed tender coconut: A preservation protocol has been standardized for minimally processed tender coconuts to maintain the colour, freshness, and overall quality of trimmed tender nuts during storage. The developed technology employs a combination of organic acids and resorcinol treatment to effectively reduce browning and quality deterioration.

Using this protocol, the shelf life of minimally processed tender coconuts can be extended up to four weeks under refrigerated conditions while retaining their sensory and nutritional attributes. The technology offers significant potential for improving the marketability and export prospects of tender coconut products.

Tender coconut dessert: Tender coconut dessert (pudding) is a refreshing value-added product developed from tender coconut water and kernel with desirable taste, texture, and nutritional quality. The process protocol has been standardized. Studies were conducted to extend the shelf life of the product by developing suitable preservation protocols aimed at reducing enzyme activity and microbial load. Superior efficacy of biopreservatives over conventional chemical preservatives in maintaining the quality and safety of the tender coconut dessert, highlighting its potential as a healthy and commercially viable functional food product.

Kalparasa® and its value added products

Kalparasa® tapping technology: Kalparasa® tapping technology is an innovative coconut inflorescence sap collection method developed using a specialized “coco sap chiller” to obtain fresh, hygienic, and non-alcoholic coconut sap. The technology prevents natural fermentation immediately after tapping, thereby preserving the freshness and nutritional quality of the sap.

SUSTAINABLE DEVELOPMENT GOALS RELATED TO FRUITS AND VEGETABLES



SDGs 2 3

Health benefits of fruit and vegetables
Harness the goodness

Fruit and vegetables have multiple health benefits. They strengthen the immune system, combat malnutrition and help prevent non-communicable diseases.



SDGs 2 3

Diversified diet and a healthy lifestyle
Live by it, a diverse diet

Adequate amounts of fruit and vegetables should be consumed daily as part of a diversified and healthy diet.



SDGs 2 3

Food loss and waste
Respect food from farm to table

Fruit and vegetables are worth more than their price. Maintaining their quality and assuring their safety across the supply chain, from production to consumption, reduces losses and waste and increases their availability for consumption.



SDGs 2 3

Food loss and waste
Innovate, cultivate, reduce food loss and waste

Innovation, improved technologies and infrastructure are critical to increase the



SDGs 2 8 12 13 14 15

Food loss and waste
Respect food from farm to table

Fruit and vegetables are worth more than their price. Maintaining their quality and assuring their safety across the supply chain, from production to consumption, reduces losses and waste and increases their availability for consumption.



SDGs 2 8 12 13 14 15

Food loss and waste
Respect food from farm to table

Fruit and vegetables are worth more than their price. Maintaining their quality and assuring their safety across the supply chain, from production to consumption, reduces losses and waste and increases their availability for consumption.



SDGs 2 8 12 13 14 15

Food loss and waste
Respect food from farm to table

Fruit and vegetables are worth more than their price. Maintaining their quality and assuring their safety across the supply chain, from production to consumption, reduces losses and waste and increases their availability for consumption.



SDGs 2 8 12 13 14 15

Food loss and waste
Respect food from farm to table

Fruit and vegetables are worth more than their price. Maintaining their quality and assuring their safety across the supply chain, from production to consumption, reduces losses and waste and increases their availability for consumption.

efficiency and productivity within fruit and vegetable supply chains to reduce loss and waste.

SDGs 1 2 12 15

Sustainable value chains
Foster sustainability

Sustainable and inclusive value chains can help increase production, and help to enhance the availability, safety, affordability and equitable access to fruit and vegetables to foster economic, social, and environmental sustainability.

SDGs 1 2 3 4 5 8 11 12 15

Highlighting the role of family farmers
Growing prosperity

Cultivating fruit and vegetables contributes to a better quality of life for family farmers and their communities. It generates income, creates livelihoods, improves food security and nutrition, and enhances resilience through sustainably managed local resources and increased agrobiodiversity.



SDGs 1 2 3 4 5 8 11 12 15

Highlighting the role of family farmers
Growing prosperity

Cultivating fruit and vegetables contributes to a better quality of life for family farmers and their communities. It generates income, creates livelihoods, improves food security and nutrition, and enhances resilience through sustainably managed local resources and increased agrobiodiversity.



SDGs 1 2 3 4 5 8 11 12 15

Highlighting the role of family farmers
Growing prosperity

Cultivating fruit and vegetables contributes to a better quality of life for family farmers and their communities. It generates income, creates livelihoods, improves food security and nutrition, and enhances resilience through sustainably managed local resources and increased agrobiodiversity.



SDGs 1 2 3 4 5 8 11 12 15

Highlighting the role of family farmers
Growing prosperity

Cultivating fruit and vegetables contributes to a better quality of life for family farmers and their communities. It generates income, creates livelihoods, improves food security and nutrition, and enhances resilience through sustainably managed local resources and increased agrobiodiversity.



SDGs 1 2 3 4 5 8 11 12 15

Highlighting the role of family farmers
Growing prosperity

Cultivating fruit and vegetables contributes to a better quality of life for family farmers and their communities. It generates income, creates livelihoods, improves food security and nutrition, and enhances resilience through sustainably managed local resources and increased agrobiodiversity.



SDGs 1 2 3 4 5 8 11 12 15

Highlighting the role of family farmers
Growing prosperity

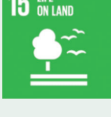
Cultivating fruit and vegetables contributes to a better quality of life for family farmers and their communities. It generates income, creates livelihoods, improves food security and nutrition, and enhances resilience through sustainably managed local resources and increased agrobiodiversity.



SDGs 1 2 3 4 5 8 11 12 15

Highlighting the role of family farmers
Growing prosperity

Cultivating fruit and vegetables contributes to a better quality of life for family farmers and their communities. It generates income, creates livelihoods, improves food security and nutrition, and enhances resilience through sustainably managed local resources and increased agrobiodiversity.



SDGs 1 2 3 4 5 8 11 12 15

Highlighting the role of family farmers
Growing prosperity

Cultivating fruit and vegetables contributes to a better quality of life for family farmers and their communities. It generates income, creates livelihoods, improves food security and nutrition, and enhances resilience through sustainably managed local resources and increased agrobiodiversity.

Source: Fruit and vegetables – your dietary essentials, FAO background paper, FAO, Rome

Kalparasa® is light orange to honey in colour and is rich in natural sugars, amino acids, minerals, antioxidants, and vitamins, making it a highly nutritious health drink. The technology offers significant potential for the production of value-added coconut beverages and related functional food products. The biochemical and nutritional profile of Kalparasa® is as follows;

Table 3. Biochemical and nutritional profile of Kalparasa® (per 100 mL)

Biochemical parameters	Average
pH	7.18
Total sugar (g)	15.18
Reducing sugar (g)	0.554
Amino acids (g)	0.245
Protein (g)	0.165
Phenolics (mg)	5.10
Antioxidant activity (mM TE)	0.321
Sodium (mg)	90.6
Potassium (mg)	168.4
Phosphorus (mg)	3.9
Manganese (mg)	0.012
Copper (mg)	0.031
Zinc (mg)	0.020
Iron (mg)	0.053

Coconut sugar: Coconut sugar is a natural sweetener produced by concentrating Kalparasa®, the fresh coconut inflorescence sap. It is considered a healthier alternative to refined sugar due to its low glycemic index and rich nutritional profile. During the concentration process to sugar, intermediary products such as Neera syrup and Neera honey are also obtained, which possess good nutritional value and commercial potential as natural sweeteners. Coconut sugar contains appreciable amounts of amino acids, dietary fibre, antioxidants, and essential minerals, particularly potassium and sodium, which contribute to its high electrolyte content. It is also a good source of vitamin E and B-complex vitamins. Owing to its nutritional and functional properties, coconut sugar has gained considerable importance as a value-added coconut product with strong domestic and international market potential. The nutritional composition of coconut sugar is given below.

Kalpa bean to bite dark chocolate: Homemade bean-to-bite chocolate using coconut sugar is an innovative value-added product developed through a complete standardized processing protocol for chocolate preparation using coconut sugar as a natural sweetener. The technology includes carefully standardized unit operations such as fermentation, drying, roasting, cracking, winnowing, grinding, tempering, moulding, and cold storage to ensure product quality and flavour development. The unique blending of cocoa beans with coconut sugar enhances the

nutritional and sensory properties of the chocolate while providing a healthier alternative to refined sugar-based products. This technology offers promising opportunities for small-scale entrepreneurship and artisanal chocolate production.

Kalparasa based nutribar: Kalparasa®-based Nutribar is a nutritious value-added product prepared using concentrated Kalparasa® along with energy-rich ingredients such as peanut, green gram, and cocoa powder. The formulation involves concentrating Kalparasa® to about 75–80°Brix and blending it with selected ingredients before moulding into nutribars. The product is rich in protein, dietary fibre, and essential minerals, making it a healthy energy snack suitable for all age groups. Owing to its nutritional benefits and natural ingredients, the Kalparasa®-based Nutribar has significant potential as a functional food product in the health snack market.

Spray dried Kalparasa® powder: Spray-dried Kalparasa powder is a value-added product developed by converting fresh Kalparasa® into a free-flowing powder through spray drying technology. The process enhances shelf life, facilitates easy transportation and storage, and improves product convenience without significantly affecting its nutritional quality. The powder can be reconstituted at a 2:1 ratio with water to simulate the taste and characteristics of fresh Kalparasa®. Rich in natural sugars, minerals, and bioactive compounds, the product offers excellent potential as a convenient functional beverage ingredient and health drink supplement.

Coconut sugar-based chukka kappi mix (dry ginger coffee): Coconut sugar-based chukku kappi mix is an innovative value-added product developed using coconut sugar as a healthier alternative to conventional sugarcane jaggery. The product combines coconut sugar with traditional spices such as dry ginger, black pepper, cumin, basil, clove, cinnamon, and cardamom to create a convenient two-in-one herbal coffee mix. The optimized formulation consisted of 0.5 g coffee powder and 12.5 g spice-infused coconut sugar per 120 mL of water. Studies revealed that spice incorporation significantly enhanced

Table 4. Nutritional information of coconut sugar

Total calories	380kcal
Total sugars (g)	92
Protein (g)	2.9
Dietary Fibre (g)	2.5
Phenolics (mg)	25
Minerals	
Potassium (g)	1.0
Phosphorous (mg)	80
Magnesium (mg)	30
Sodium (mg)	50
Zinc (mg)	2.1
Manganese (mg)	0.1
Iron (mg)	2.2
Total calories	380kcal

the micronutrient content, total phenolic content, and antioxidant activity of the product while also improving sensory qualities such as aroma, taste, and overall acceptability. The developed product demonstrates excellent potential as a functional health beverage and provides a promising value-addition opportunity for coconut sap entrepreneurs.

Kalparasa® infused coconut flakes: Process methodology for coconut flakes using neera syrup as osmotic medium was optimized. Infusion of flakes enhances the nutritional value of the developed flakes. Based on the bioactive profile, coconut flakes dried using infra-red at 65°C showed good qualities, including improved rehydration ratio, hygroscopicity, bulk density, and tapped density. Further analysis revealed significant enhancements in protein, carbohydrate, and fat content, as well as increased total phenolic content, antioxidant activity (DPPH), and ferric reducing antioxidant power (FRAP).

Kalpa Qbitz (nata-de-coco):

Kalpa Qbitz are fiber-rich, cubic nata de coco pieces soaked in the natural sweetness of coconut neera. The Institute produces these cubes using elite bacterial strains to valorize fermented kalparasa and mature coconut water that typically goes to waste.

Sap based vinegar: Sap vinegar is a nutritionally rich value-added product produced through controlled alcoholic and acetic fermentation of partially fermented coconut sap. Studies have shown that sap vinegar

possesses higher acidity, total phenolic content, and antioxidant activity compared to coconut water vinegar and conventional apple cider vinegar. It is also rich in essential minerals such as iron, manganese, and zinc, contributing to its functional and nutritional properties. The high phenolic and antioxidant content makes sap vinegar a promising health-oriented product with good storage stability and consumer appeal. Owing to its superior functional qualities and natural origin, neera vinegar has significant potential as a cost-effective and nutritious alternative to conventional fruit vinegars.

SUMMARY

The coconut industry has evolved significantly from traditional raw nut utilization to diversified value-added processing. Products such as virgin coconut oil, coconut milk powder, desiccated coconut, tender coconut beverages, coconut flour, and sap-based sweeteners have opened new opportunities for farmers, entrepreneurs, and food industries.

Sustainable growth of the coconut sector depends not only on technological innovations but also on effective marketing, consumer awareness, export promotion, and entrepreneurship development. With increasing global demand for natural, plant-based, and functional foods, coconut-based products hold tremendous potential for future expansion in domestic and international markets.

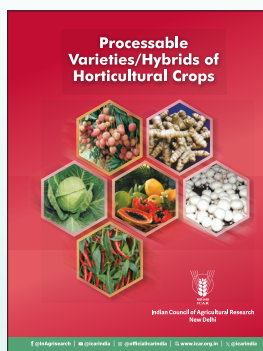
For further correspondence, contact:

¹Dr. K B Hebbar, Director, ICAR- Central Plantation Crops Research Institute, Kudlu, Kasargod 671 124, Kerala, India; ²ICAR-Indian Institute of Spices Research, Kozhikode 673 012, Kerala, India. Email: directorcpcr@gmail.com



Nata de coco jelly

Processable Varieties/Hybrids of Horticultural Crops



This book will be useful for the processing industry as it provides information on the recent varieties /hybrids of horticultural crops and their availability. The information provided in this document will help the Indian farmers and Food Processing Industry in identifying suitable crops and varieties/hybrids based on their processing qualities for strengthening entrepreneurship.

TECHNICAL ASPECTS

Pages: v + 168; Price: ₹ 100.00, US\$ 15.00; Postage: ₹50

ISBN No.: 987-81-7164-298-9

For obtaining copies, please contact:

Business Unit

ICAR-Directorate of Knowledge Management in Agriculture

Krishi Anusandhan Bhawan – I, Pusa, New Delhi 110012

Tel: 011-25843657; email: businessuniticar@gmail.com

website: www.icar.gov.in

SCAN QR Code

