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STANDARDISATION AND QUALITY ASSESSMENT OF MANGO PULP INCORPORATED CHEESE USING *STREPTOCOCCUS THERMOPHILUS*

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ABSTRACT

The present experiment was carried out in 2023 at the Department of Community Science, College of Agriculture, Vellanikka, Kerala Agricultural University. It focused on the development and quality assessment of cheese incorporated with mango pulp using *S. thermophilus* as the starter culture. The microbial populations prepare starter culture was determined through serial dilution and plating on M17 agar at 37°C for *Streptococcus* count. Mango pulp was incorporated in to cheese at different concentrations from 10% to 25% while plain cheese served as the control.After evaluating the sensory qualities, it was found that the cheese prepared with 10 percent mango pulp had an overall acceptability score of 8.38. Based on the sensory results, both the control and optimised sample were subjected to physio-chemical evaluation. The mango-pulp enriched cheese showed moisture content of (56%), energy (289 kcal), carbohydrate (15.67g $100g^{-1}$), protein (20.78g 100 g^{-1}), fat (17.98g 100 g^{-1}), pH (4.78) and titratable acidity (0.56) in the mango cheese.Enumeration of starter culture indicated adequate microbial viability during cheese preparation. The results indicated the feasibility of producing nutritionally enriched cheese through incorporation of mango pulp.

Keywords: Cheese, Mango pulp, Organoleptic evaluation,Standardisation

INTRODUCTION

Cheese production has been noticed for centuries as an effective method for preserving and concentrating milk nutrients. It is widely recognised as one of the earliest processed foods developed by humans. Cheese, a broadly defined category of fermented milk-based food products, is produced worldwide in a vast array of flavours, textures and forms. Cheese is the ripened or unripened soft or semi-hard and extra hard product, which may be coated, and in which the whey protein/casein ratio does not exceed that of milk (Fox *et al*., 2017). The cheese-making process crucially involves transforming liquid milk into a solid curd containing casein and milk fat, while expelling most of the water and typically the whey proteins. This transformation is facilitated by adding rennet to coagulate the casein gel. The formed cheese curd acts as the basic structure of cheese and is subsequently enhanced through processes such as pressing, salting, and ripening. In recent years, cheese has gained prominence in the dairy market as an effective carrier of high-quality probiotics. Compared to

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more acidic fermented dairy products like yogurt, kefir, and buttermilk, cheese offers several benefits. It helps protect probiotics from the highly acidic conditions of the gastrointestinal tract, thereby creating a more favourable environment for their survival during gastric transit.Additionally, the dense matrix and relatively high-fat content of cheese may offer extra protection to probiotic microorganisms in the stomach (Silva *et al*., 2021).

Among the various food plants, fruits and vegetables are reported to have health improving benefits. The protective effect of fruits and vegetables has generally been attributed to their antioxidant constituents such as vitamin A, ascorbic acid, á-tocopherol, â- and á-carotene and glutathione. Alkaloids, trepenoids, sulfur-containing compounds, phenolic and polyphenolic compounds are other antioxidants present in fruits and vegetables, which reduces oxidative damage by neutralizing the activities of free-radicals (Jideani *et al*., 2021).

Incorporating fruits components into dairy products represents a promising strategy to improve nutritional value while enhancing sensory appeal**.** Various studies indicate that the phytochemicals in mango have anti-inflammatory effects on several chronic inflammatory conditions. Thus, the present study aims to develop and standardize mango pulp incorporated cheeses using *Streptococcus thermophilus* as a starter culture and to evaluate their physicochemical qualities.

MATERIAL AND METHODS

Collection and processing of raw materials

The experiment was conducted from June 25, 2023 to December 11, 2023 at the Department of Community Science, College of Agriculture, Vellanikka, Kerala Agiculture University. The starter culture and Fresh cow's milk required for the study was procured from College of Dairy Science and Technology, Kerala Veterinary and Animal Sciences University, Mannuthy. The mango variety "*Alphonso*" was selected for the study and was collected from the Department of Fruit Science, College of Agiculture, Kerala Agriculture University. Mango was processed into pulp without addition of preservatives according to the modified procedure suggested by Jayathunge *et al*. (2020). Mangos were washed, blanched, peeled and cut into pieces. The pieces were then processed into pulp heated to 80^{o}C for 20 min until the total soluble solids reaches to 19^{o}Brix. Other ingredients required for the preparation of cheese were rennet, food grade calcium chloride and sodium chloride were purchased from the local market.

Enumeration of starter culture

The microbial analysis of the starter culture was carried out prior to its use in cheese preparation. A 100µl of starter culture was homogenised in 90 mL of sterile saline solution for 3 min. For microbial enumeration, starter culture homogenates were serially diluted and appropriate aliquots were plated onto M17 agar at 37°C for *Streptococcus* count. Plates were incubated at the appropriate temperatures for 48 hr. After incubation, the plates containing 10 to 300 colony forming units (CFU) were selected and the microbial count was calculated.

Standardisation of mango pulp incorporated cheeses

Cheese was prepared as per the standard procedure of Mehaia (2002) with necessary modifications. *S.thermphillus* was activated in maintenance broth (MRS) at 30^{o}C for 24hrs. After activation, the culture was centrifuged (1500 rpm/5 min/ 4^{o}C) in order to obtain pellet. Pellet was inoculated in 10% skim milk powder (30^{o}C, 24 hrs). Milk was pasteurized (72^{o}C for 5 min) and cooled down to 32^{o}C. At this temperature, starter culture activated in skim milk powder was added at a

Table 1. Treatments for the standardisation of mango pulp incorporated cheeses

Sl.No	Treat-ments	Composition of cheese
1	T_1	100% Milk
2	T_2	90% Cheese +10% MP
3	T_3	85% Cheese +15% MP
4	T_4	80% Cheese + 20% MP
5	T_5	80% Cheese + 25% MP

ratio of 1%. Cheese was prepared using *S.thermophilus*as the starter culture. For the coagulation of the milk and the whey separation rennet enzyme (0.05%) and calcium chloride (0.1%) were added 30 min after addition of the starter culture to obtain a firm structure added. The milk was allowed to coagulate for 90 min. The formed coagulum was cut and pressed overnight and was then salted in a 15% saline solution. Prepared cheese was stored in plastic containers at 4°C for 48 hrs. Mango pulp incorporated cheeses were prepared by the adding mango pulp at various concentrations ranging from 10 - 25 percent in different treatments (T_2 – T_5), respectively (Table1) (Plate1). Plain cheese without the addition of pulp served as control (T_1). The experiment was carried out using completely randomised design (CRD) and was in three replications.

Organoleptic evaluation

The organoleptic evaluation of the mango pulp incorporated cheese was conducted by a panel of selected 20 judges using a nine-point hedonic scale as described by Jellineck, 1985,the evaluation was carried out with replications at the College of Agriculture, Vellanikkara. The panellists were asked to express their preference on a nine-point hedonic scale (9 for like extremely to 1 for dislike extremely). Each treatment was evaluated for their appearance, colour, texture, taste, flavour and overall acceptability.

Physio-chemical qualities assessment

The physico-chemical qualities like moisture (Kirk and Sawyer, 1991), energy (Eneche, 1991), carbohydrates, protein, fat (Sadasivam and Manickam, 1997), pH (Rehman and Fox, 2002) and titratable acidity (Ercan, 2009) of the selected mango pulp incorporated cheeses were estimated using the standard procedures.

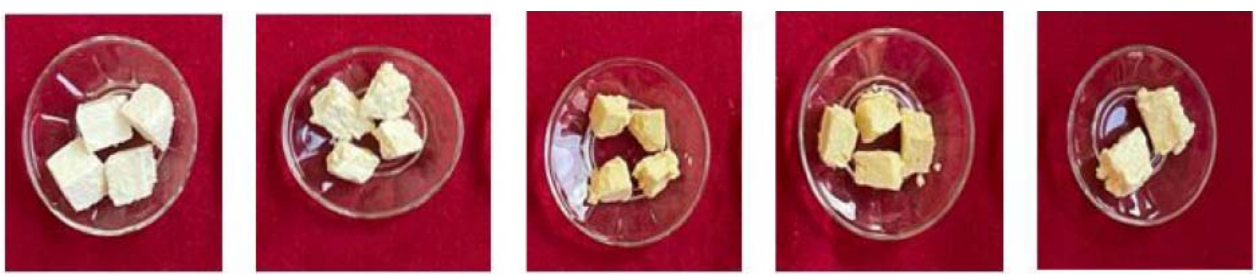
Statistical analysis

The data obtained from the organoleptic evaluation, were tabulated and analysed using a Completely Randomized Design (CRD). The scores obtained from the panellist were analysed using Kendall's Coefficient of Concordance (W). While physio-chemical qualities were analysed by using an independent t test.

RESULTS AND DISCUSSION

Enumeration of starter culture

Colonies grown on M17 agar after inoculation of the highest dilution of samples



T_1 T_2 T_3 T_4 T_5

Plate 1. Treatments for the standardisation of mango pulp incorporated cheeses

were chosen for further investigations. Sixth dilution of the cheese sample was found to have fifty colonies in M17 media. Shani *et al*. (2021) found that *S. salivarius* subsp. *thermophilus* colonies fom cheese in M17 had maximum viability and the lowest proportion of non-specific isolate.

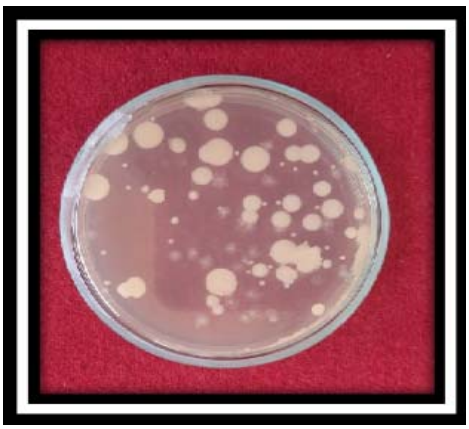


Plate 2: Enumeration of *streptococcus thermophillus*

Organoleptic Evaluation

Organoleptic evaluation of mango pulp incorporated cheeses were carried out using a nine-point hedonic scale and the results revealed that treatment T_2 (90% cheese + 10% mango pulp) had a maximum means core in all the sensory attributes like appearance (8.42), colour (8.37), flavour (8.37), texture (8.33), taste (8.42) and overall acceptability (8.42) followed by T_3, T_4 and T_5. Among the different incorporation levels, 10 percent mango pulp was found to be the most acceptable.Further, increase in mango pulp concertation resulted in a significant decline in sensory attributes such as appearance, colour, flavour and texture (Table 2). Ramteke *et al*. (2020) conducted a study to optimise the levels of mango pulp and spices in quarg type cheese to prepare mango herbal quarg type cheese. The sensory evaluation was carried out in respect of flavour, body and texture, colour and appearance and overall acceptability. The preliminary trials examined varying levels of mango pulp, cardamom and clove leading to the selection of five treatments for detailed study. A study conducted by Kankhare *et al*. (2019) studied the consumer acceptability of mango herbal quarg cheese. The findings revealed that 12 percent consumers rated the product as excellent, 60 percent as very good and 28.00 percent as fair increases quality. It further more satisfied analysis indicated that consumer perception and preference were significant influence by gender whereas factor such as occupation, education and age did not have a significant effect on acceptability.

Nutrient analysis of the cheeses

Based on the organoleptic evaluation of mango pulp incorporated cheeses, the treatment T_2 (90% cheeses and 10% mango pulp) was found to be most acceptable formulation. The nutritive value of selected mango pulp-based cheese along with the control (100% cheese) was analysed and the results are given in Table 3. The mango pulp-based cheeses had a moisture (56%), energy (289 kcal), carbohydrate (15.67g $100g^{-1}$), protein (20.78g 100 g^{-1}), fat (17.98g 100 g^{-1}), pH (4.78) and titratable acidity as lactic acid content (0.56) and shown in Table 3. Proximate composition of mango herbal quarg type cheese includes 9.04% fat, 11.19% protein, 4.24% total carbohydrate, 25.82% total solids, 74.18% moisture, 1.40% ash, 1.01% acidity and 4.54 pH (Kankhare *et al*., 2019). Significant difference was observed with respect to fat content in both the treatments, while other parameters were non-significant.

CONCLUSION

The increasing demand for functional and value-added dairy products encouraged the development of innovative formulations that combine nutritional benefits with consumer acceptability. In this study, cheese enriched with mango pulp was successfully developed and evaluated for sensory and physio-chemical characteristics. Among different formulations tested, the sample containing 90% cheese and

Table 2. Mean score for organoleptic evaluation of mango pulp incorporated cheeses fermented with *S.thermophilus*

Sl.No.	Parameters	T_1	T_2	T_3	T_4	T_5	Kendall's W value
1.	Appearance	8.93 (4.93)	8.42 (3.63)	8.33 (3.33)	7.82 (2.10)	7.00 (1.00)	0.940**
2.	Colour	8.86 (4.93)	8.37 (3.69)	8.20 (3.07)	7.86 (2.33)	6.62 (1.00)	0.931**
3.	Flavour	8.71 (4.87)	8.37 (4.00)	8.04 (3.03)	7.62 (2.10)	6.60 (1.00)	0.958**
4.	Taste	8.57 (4.60)	8.42 (4.00)	8.17 (3.40)	7.51 (2.00)	6.64 (1.00)	0.908**
5.	Texture	8.91 (4.90)	8.33 (3.70)	8.24 (3.40)	7.51 (2.00)	6.60 (1.00)	0.961**
6.	Overall acceptability	8.73 (4.77)	8.42 (3.93)	8.20 (3.30)	7.45 (1.93)	6.77 (1.07)	0.930**
7.	Total mean rank score	8.78	8.38	8.19	7.62	6.70	

***Significant at 1% level*

Table 3. Nutritional qualities of mango pulp incorporated cheese

Parameters	T_1 (100% Cheese)	T_2 (90% cheese+ 10% MP)	t - value
Energy (kcal)	283	289	0.482^{NS}
Carbohydrate (g/100 g)	12.35	15.67	2.414^{NS}
Protein (g/100 g)	20.19	20.78	0.470^{NS}
Fat (g/100 g)	15.67	12.98	2.714^{*}
pH	6.56	5.76	1.236^{NS}
Titratable acidity(as lacticacid) (%)	0.78	0.56	2.323^{NS}
Moisture (%)	48	56	1.428^{NS}

*NS - Non Significant; * Significant at 5% level*

10% mango pulp demonstrated the most favourable sensory profile with highest overall acceptability score (8.38). The product also shows desirable nutritional and compositions attributes, include increased carbohydrates and moisture content compared with control sample. Cheese serves an effective delivery system for beneficial microorganism because its relatively moderate acidity and compact structures provide protection for probiotic bacteria during digestion. The findings of this study suggest that *S. thermophilus* can be used as a starter culture to enhance the sensory characteristics of soft cheese. Overall,

mango pulp incorporated cheese can be a potential functional dairy product with potential health benefits.

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