

Evaluation of physicochemical and sensory properties of garlic-mint paneer

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Abstract

This research is to develop functional paneer by adding natural herbs like garlic (*Allium sativum*) and mint (*Mentha arvensis*) to enhance the sensory appeal and nutritional value. Buffalo milk was used to prepare paneer with varying concentrations (0.5%, 1%, and 2%) of garlic and mint. The prepared samples were evaluated for sensory characteristics and proximate composition. Based on sensory characteristics like colour, flavour, texture, and overall acceptability, 1% garlic and mint added to functional paneer showed better results, along with improved nutritional values. This research suggests that herbal fortification is a promising strategy to produce dairy products with enhanced functional properties.

Keywords: Functional paneer, herbs, physicochemical, sensory characteristic, textural characteristics

Introduction

Paneer is a staple dairy product in many Indian households, prized for its soft texture, high protein content, and versatility in cooking. Global health consciousness and interest in herbal substitutes have increased due to the rise of functional foods. The food and dairy industry are using fortification to increase the value of its products as a result of this shift in customer preferences. This article discusses about the food fortification and their role in disease prevention (Ansari and Kumar, 2012) [1].

In spicy Indian cuisines, garlic is a key ingredient. It is abundant in phytochemicals and organosulfur compounds that have several health benefits and anti-aging properties. It is mostly used for flavouring food, treating infections, curing colds and curing conditions including cancer and heart diseases (Borek, 2001) [6].

The organosulfur compound such as Allicin or diallyl thiosulfinate is the main constituent of garlic that has antimicrobial activity against both gram positive and gram-negative bacteria (Ellmore and Feldberg, 1994) [7]. The garlic extract has the efficacy in reducing the growth of many pathogens including *S. aureus*, *S. albus*, *S. typhi*, *E. Coli*, *L. Monocytogenes*, *A. niger*, *Pseudomonas aeruginosa* and *Proteus morganii* (Kumar and Berwal, 1998) [8].

The stems and leaves of peppermint contain menthol is used medicinally and as a flavouring in foods (Blumenthal *et al.*, 2000) [5]. Balakrishnan, 2015 [4] discussed about the therapeutic uses of peppermint. A common tea flavouring, peppermint can also help with digestion or calm an upset stomach. It is frequently used to treat headaches, skin irritation, nausea, diarrhea, menstrual cramps, flatulence, and anxiety related to depression because of its numbing and relaxing properties. The primary ingredients in peppermint, menthol and methyl salicylate, have relaxing effects on the gastrointestinal tract and antispasmodic properties.

In this context, the addition of natural herbs like garlic (*Allium sativum*) and mint (*Mentha arvensis*) to paneer presents a promising opportunity. By enriching paneer with these ingredients, it may be possible to create a product that is both nutritious and functionally beneficial. The present study was designed to develop and evaluate a garlic and mint fortified paneer.

Materials and Methods

Materials

Milk: The farm located on the campus of the College of Food and Dairy Technology supplied the buffalo milk.

Garlic: Fresh garlic was procured from the local market at Alamathi, Chennai, India.

Mint: Fresh mint was purchased from the local market at Alamathi, Chennai, India.

Citric Acid: Citric acid was purchased from Srihari Scientific, Chennai, Tamil Nadu.

Treatments

Arora *et al.*, (2022) [3] studied about the development of value-added paneer with different ratio of herbs like garlic and mint leaf. Herbs serve a variety of purposes, such as culinary flavourings, preservatives and medicinal ingredients. Garlic has hypotensive effects, whereas mint has antioxidants. Garlic and mint (1:1) *viz.* 0.5, 1 and 2% was added and optimization of product was done by sensory evaluation.

Table 1: Treatment combination of Garlic and Mint (1:1 ratio)

Treatments	Garlic	Mint
Control	-	-
T ₁ (0.5%)	2.5 g	2.5 g
T ₂ (1%)	5 g	5 g
T ₃ (2%)	10 g	10 g

Product Development

The process of preparing garlic and mint flavoured paneer from buffalo milk begins with the filtration or clarification of fresh buffalo milk to remove impurities. The milk is then heated to 95°C for 5 minutes to ensure microbial safety. Garlic and mint are added during this stage to infuse flavour. The mixture is subsequently cooled to 70°C, followed by the addition of 1% citric acid as a coagulant. After allowing the mixture to stand for 5 minutes to facilitate curd formation, the whey is drained off. The resulting curd is pressed to remove excess moisture and then immersed in pasteurized chilled water at 4°C to improve texture and firmness. It is left to drain for 15 minutes before being packaged. Lastly, to maintain freshness and prolong shelf life, the food is stored in a refrigerator at temperatures ranging from 5°C to 7°C. Arora *et al*, 2022 [3] explained the process of preparation of functional paneer added with garlic and mint.

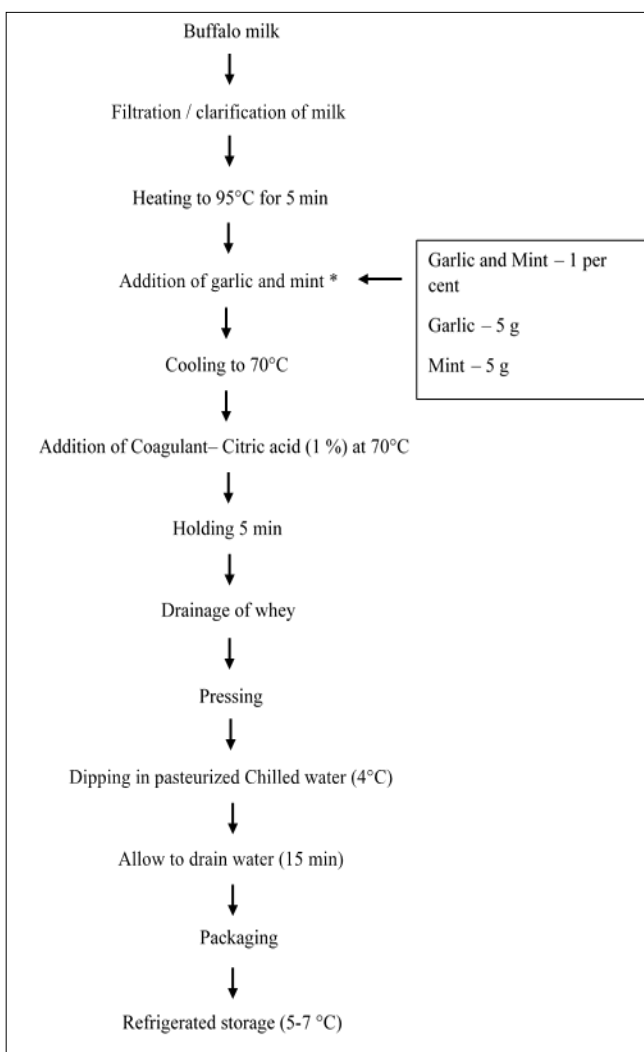


Fig 1: Flow chart for the Preparation of the Functional Paneer

Sensory evaluation

The sensory properties of paneer samples were judged by semi-trained judges from the College of Food and Dairy Technology, Chennai. Each panelist was served with a standard score card ('9' point hedonic scale) for recording score for sensory attributes such as colour and appearance, flavour and taste, body and texture and overall acceptability of the product.

Proximate analysis

Moisture, Protein, Ash and Fat Determination

Moisture, crude protein, ash and total fat of the functional paneer were determined using standard analytical method (AOAC, 2012) [2].

Carbohydrate Determination

The total carbohydrate was determined by difference. The sum of percentage of moisture, ash, crude fiber, protein and fat was subtracted from 100 (AOAC, 2012) [2].

$$\text{Total Carbohydrate (\%)} = 100 - (\text{Protein \%} + \text{Moisture \%} + \text{Fibre \%} + \text{Fat \%} + \text{Ash \%})$$

Energy value

The energy value was determined by calculation from fat, carbohydrate and protein content using the Atwater's conversion factor; 4.0 kcal/g for protein, 9.0 kcal/g fat and 4.0 kcal/g for carbohydrate (Steve *et al*, 2013) [10].

$$\text{Energy value} = (\text{Protein} \times 4) + (\text{Fat} \times 9) + (\text{Carbohydrates} \times 4)$$

Methods for textural analysis of paneer

The textural profile analysis (TPA) of the paneer sample was conducted using the Stable Micro System TAXT plus Texture Analyzer. A P75R cylindrical probe was used for TPA analysis, operating at a pretest speed of 2 mm/sec, a post test speed of 10 mm/sec, and applying 80% compression. TPA is a two-bite test that involves the first and second compression cycles. The textural parameters recorded included hardness, adhesiveness, cohesiveness, springiness, gumminess and chewiness. The textural properties of paneer were assessed using specific settings.

Table 2: Instrumental Settings for Compression Testing with Cylindrical Probe

Caption	Value/unit
Probe	P75R cylindrical probe
Test mode	Compression
Pre-test speed	1 mm/sec.
Test speed	5 mm/sec.
Post test mode	5 mm/sec
Target mode distance	10 mm
Trigger type	Auto force
Trigger force	5.0 g
Advanced options	Off
Count	2

During the compression test, the data obtained were used to determine the following textural parameters.

1. Hardness

Hardness is defined as the value of the peak force of the first compression of the product. Hardness (N) = Maximum force in Newton of the first compression in the double-bite test.

2. Adhesiveness

Adhesiveness is the work necessary to overcome the attractive forces between the surfaces of the sample and the other materials with which sample comes in contact. It is negative force area for the first bite curve.

3. Springiness

Springiness is the extent to which a product physically springs back after deformation during the first compression. Springiness = (Time taken in 2nd compression) / (Time taken in 1st compression).

4. Cohesiveness

Cohesiveness is the extent to which a material can be deformed before it ruptures depending on the strength of internal bonds. Cohesiveness = (Area under 2nd compression) / (Area under 1st compression).

5. Gumminess

It is the energy required to masticate a sample to a state ready for swallowing a product of hardness and cohesiveness. Gumminess = Hardness x Cohesiveness

6. Chewiness

Chewiness is the energy required in masticating a solid food product to make it ready for swallowing. Chewiness = Hardness x Cohesiveness x Springiness

7. Resilience

Resilience = (Area after peak in 1st compression) / (Area before peak in 1st compression)

Statistical analysis

Statistical analysis was carried out to study the effect of different parameters on all the dependent variables. All the analysis were performed using IBM SPSS® 20.0 for determination of significance between the control and the treatments during the assessment of quality parameters (Snedecor and Cochran, 1994)^[9].

Result and Discussion

Sensory scores of Functional Paneer using 9- point hedonic scale

Table 3: Sensory scores (Mean ±SE) of functional paneer using 9- point hedonic scale

Parameter	Colour and appearance	Body and texture	Flavour and taste	Overall acceptability
Control	7.95±0.353 ^{bc}	8.2±0.200 ^c	8.3±0.152 ^b	8.1±0.233 ^c
Treatment 1	7.4±0.163 ^{ab}	7.5±0.166 ^b	7.2±0.249 ^a	7.3±0.151 ^b
Treatment 2	8.3±0.213 ^c	8.6±0.163 ^c	8.4±0.163 ^b	8.4±0.162 ^c
Treatment 3	6.8±0.249 ^a	6.7±0.213 ^a	6.6±0.211 ^a	6.7±0.250 ^a
F value	6.646 ^{**}	19.905 ^{**}	18.579 ^{**}	14.037 ^{**}

Average of ten trials, (Different superscripts in a same row differs significantly) Highly Significant (P<0.01); Control – paneer; Treatment 1 - 0.5% Garlic and mint added paneer; Treatment 2 - 1% Garlic and Mint added paneer; Treatment 3 - 2% Garlic and Mint added paneer

Colour and Appearance

Mean ± SE scores of control, T₁, T₂ and T₃ sample were 7.95 ± 0.353, 7.4 ± 0.163, 8.3 ± 0.213 and 6.8 ± 0.249 respectively. Statistical analysis showed that a highly significant (P<0.01) was observed between the control and treatments. The highest mean value for colour and appearance was recorded in the T₂ when compared to control, T₁ and T₃.

Body and Texture

Mean ± SE scores of control, T₁, T₂ and T₃ sample were 8.2 ± 0.200, 7.5 ± 0.166, 8.6 ± 0.163 and 6.7 ± 0.213 respectively. Statistical analysis showed that a highly significant (P<0.01) was observed between the control and treatments. The highest mean value for body and texture was recorded in the T₂ when compared to control, T₁ and T₃.

Flavour and Taste

Mean ± SE scores of control, T₁, T₂ and T₃ sample were 8.3 ± 0.152, 7.2 ± 0.249, 8.4 ± 0.163 and 6.6 ± 0.211 respectively. Statistical analysis showed that a highly significant (P<0.01) was observed between the control and treatments. The highest mean value for flavour and was recorded in the T₂ when compared to control, T₁ and T₃.

Overall acceptability

Mean ± SE scores of control, T₁, T₂ and T₃ sample were 8.1 ± 0.233, 7.3 ± 0.151, 8.4 ± 0.162 and 6.7 ± 0.250 respectively. Statistical analysis showed that a highly significant (P<0.01) was observed between the control and treatments. The highest mean value for overall acceptability was recorded in the T₂ when compared to control, T₁ and T₃.

Proximate analysis of control and treatments

Moisture

Mean ± SE scores of control, T₁, T₂ and T₃ sample were 54.43 ± 0.009, 53.79 ± 0.015, 53.37 ± 0.009 and 52.88 ±

0.010 respectively. Statistical analysis showed that a highly significant (P<0.01) was observed between the control and treatments. The highest mean value for moisture was recorded in the control and followed by T₁, T₂, and T₃.

Fat

Mean ± SE scores of control, T₁, T₂ and T₃ sample were 26.2 ± 0.139, 26.55 ± 0.012, 26.75 ± 0.012 and 26.80 ± 0.011 respectively. Statistical analysis showed that a highly significant (P<0.01) was observed between the control and treatments. The highest mean value for fat was recorded in the T₃ and followed by T₂, T₁ and control.

Protein

Mean ± SE scores of control, T₁, T₂ and T₃ sample were 14.291 ± 0.001, 14.291 ± 0.001, 14.469 ± 0.000 and 14.648 ± 0.030 respectively. Statistical analysis showed that a highly significant (P<0.01) was observed between the control and treatments. The highest mean value for protein was recorded in the T₃ and followed by T₂, T₁ and control. The mean value of T₁ and control were recorded as same.

Carbohydrate

Mean ± SE scores of control, T₁, T₂ and T₃ sample were 3.161 ± 0.001, 3.361 ± 0.001, 3.253 ± 0.001 and 3.423 ± 0.001 respectively. Statistical analysis showed that a highly significant (P<0.01) was observed between the control and treatments. The highest mean value for carbohydrate was recorded in the T₃ and followed by T₁, T₂ and control.

Ash

Mean ± SE scores of control, T₁, T₂ and T₃ sample were 1.918 ± 0.000, 2.008 ± 0.000, 2.158 ± 0.000 and 2.249 ± 0.000 respectively. Statistical analysis showed that a highly significant (P<0.01) was observed between the control and treatments. The highest mean value for ash was recorded in the T₃ and followed by T₂, T₁ and control.

Table 4: Proximate analysis of functional paneer

Parameters	Moisture	Fat	Protein	Carbohydrate	Ash
Control	54.43 ± 0.009 ^d	26.2 ± 0.139 ^a	14.291 ± 0.001 ^a	3.161 ± 0.001 ^a	1.918 ± 0.000 ^a
Treatment 1	53.79 ± 0.015 ^c	26.55 ± 0.012 ^a	14.291 ± 0.001 ^a	3.361 ± 0.001 ^c	2.008 ± 0.000 ^b
Treatment 2	53.37 ± 0.009 ^b	26.75 ± 0.012 ^{bc}	14.469 ± 0.000 ^b	3.253 ± 0.001 ^b	2.158 ± 0.000 ^c
Treatment 3	52.88 ± 0.010 ^a	26.80 ± 0.011 ^c	14.648 ± 0.030 ^c	3.423 ± 0.001 ^d	2.249 ± 0.000 ^d
F value	3237.687**	15.003**	22171.329**	7146.726**	23582.411**

Average of six trials,

Highly Significant (P≤0.01); Control – paneer; Treatment 1 - 0.5% Garlic and mint added paneer; Treatment 2 - 1% Garlic and Mint added paneer; Treatment 3 - 2% Garlic and Mint added paneer

Textural properties of paneer

The graphical representation of the textural properties of paneer was given in the figure 2. It was observed from the table 5 that the hardness values for the control and treated (T₂) paneer were 32.079 N and 32.017 N, respectively. Additionally, the adhesiveness ranged from 0.289 to 0.309 for the control and treatment (T₂). The springiness for treated paneer and control ranged from 2.057 to 2.077, respectively. The cohesiveness parameter was identical at 0.627 for both the control and treatment (T₂). The gumminess values ranged from 20.068 to 20.062 for control and treated paneer. The chewiness ranged from 41.397 to 41.267 for the control and treatment (T₂). The resilience varied from 0.520 to 0.154 for the control and treatment (T₂). The textural parameters including hardness, adhesiveness, springiness, cohesiveness, gumminess, chewiness, and resilience having alternative maximum values for both the control and treatment (T₂).

Table 5: Textural parameter of control and functional paneer

Parameters	Control	Treatment (T ₂)
Hardness (N)	32.079	32.017
Adhesiveness	0.289	0.309
Springiness	2.077	2.057
Cohesiveness	0.627	0.627
Gumminess (N)	20.068	20.062
Chewiness (N)	41.397	41.267
Resilience	0.520	0.154

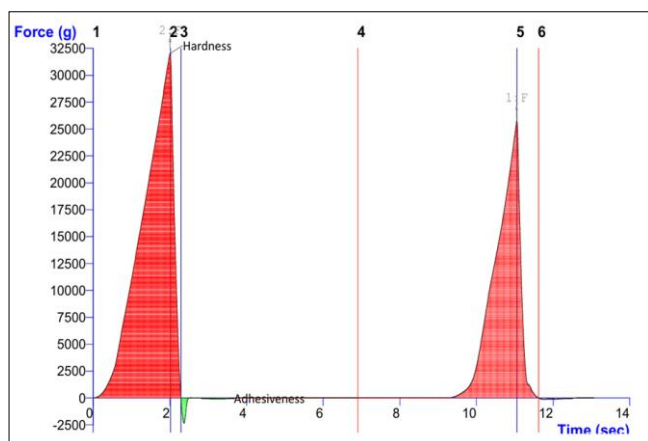


Fig 2: Instrumental texture profile analysis obtained with a Stable Micro System TAXT plus

Conclusion

The present study demonstrated that enriching paneer with garlic and mint can significantly enhance its functional qualities and nutritional profile. Among the formulations tested, the paneer containing 1% garlic and mint (Treatment 2) showed the most favourable results in terms of appearance, texture, taste, and overall acceptability. Moreover, the paneer with added herbs

showed improved levels of protein, fat, and ash content, indicating its potential as a health-oriented dairy product. These results highlight the feasibility of using natural plant-based additives to develop innovative functional foods that align with modern dietary preferences and health trends.

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