

Effect of Clove Extract on Sensory Attributes and Shelf Life of *Paneer*

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Abstract

Paneer is a delicious nutritious, and tempting indigenous dairy product formed by heat-acid coagulation. It has shelf life of only one day at room temperature and up to a week at refrigeration temperature due to high moisture content (about 55%). Hurdles like temperature, spices, packaging etc. can be used to increase shelf life of *paneer*. Clove is a globally important spice, which is used in food product for its flavor and its functional properties. It has a number of functional properties including: antioxidant, anti-inflammatory, antimicrobial, and antifungal properties. Clove extract, prepared by extraction of clove @ 0.3, 0.4 and 0.5% by weight of milk, was incorporated into milk from which *paneer* was prepared. *Paneer* was prepared using the milk as per standardised method. It was observed that *paneer* incorporated with clove extract @ 0.3 % was acceptable and selected for further analysis. Colour, body and texture, flavour and overall acceptability scores of treated sample were lower than of control. It was found that the shelf life of both control and clove added *paneer* was only one day under ambient temperature. However, under refrigeration temperature, the shelf life of control *paneer* was 8 days, whereas clove added *paneer* remain acceptable for up to 14 days.

Keywords: *Paneer*, clove, Sensory, Shelf life, Storage study

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Introduction

Paneer is an important heat acid coagulated indigenous milk product that is used as cooking ingredient along with vegetable. Because of its high moisture content (about 55%), *paneer* has a shelf life of not more than one day at room temperature and up to a week at refrigeration temperature [1]. Hurdles like humectants, spices, microwave, smoking, packaging etc. can be used for enhancing the shelf life of *paneer*. Most natural plant-derived antimicrobials have been shown to be highly effective in controlling foodborne pathogenic bacteria and in extending the shelf life of food and dairy products [2]. Plant extracts are generally regarded as relatively safe for human consumption [3].

Many essential oil derived from medicinal plant, herb, and spices have been reported to be safe for use and to exhibit strong antimicrobial activity against a wide range of microorganism [4, 5]. At present, spices are primarily used for flavor enhancement in food rather than for shelf extension. In addition to imparting flavor, certain spices contribute to the extension of food shelf life due to their bacteriostatic or bactericidal properties, while others inhibit rancidity through their antioxidant activity [6]. Generally Spices show antimicrobial activity due to phenolic component [7]. The ability of phenolics to interfere with cellular metabolism through a number of mechanisms (substrate complexing, membrane disruption, enzyme inactivation and metal chelation) is well known [8]. Clove is widely used as a flavoring agent in pastries, condiments, and sauces. It is also widely used as medicine, particularly in dental care products, for the treatment of toothache, gum disorders, and oral infections, due to its analgesic and antimicrobial properties. The main antimicrobial component of clove is eugenol. Eugenol is the principal bioactive compound in clove essential oil, typically consist about 80-90% of the clove essential oil [9]. Clove essential oil and clove extracts show broad antibacterial and antifungal activity against common food-borne and spoilage organisms [10]. Clove essential oil reduces counts of spoilage bacteria and pathogens and extend shelf life of food products [11]. The novelty of this study was the use of clove extract, a natural source of eugenol, as a bio-preservative and functional ingredient in *paneer*. The study was conducted to investigate the effect of clove extract on sensory attributes and shelf life of *paneer*.

Materials and methods

Preparation of paneer

Paneer was prepared by a standardized method [1]. Fresh toned milk was procured from Experimental Dairy Plant of Southern Regional Station of ICAR- National Dairy Research Institute, Bengaluru for *paneer* preparation. Milk was heated to 90°C without holding and cooled to 80°C and was coagulated with by adding 1 percent citric acid (2 g/litre of milk) solution at 80°C. Acid was slowly added to the heated milk with continuous slow stirring until the curd and clear slightly yellow-greenish whey separated out. The mixture was then allowed to settle down for 5 minutes and whey was drained out through using muslin cloth. After removal of whey, pressing of curd was done with the weight of 35-40 g/cm² for 15-20 minutes into muslin cloth lined perforated wooden cubical hoop. Finally prepared *paneer* sample was kept in cold water at 5-7°C for 2 hours. The *paneer* removed from water and placed on a wooden plank for 10-15 min for draining occluded water and cut into 1cm cubes for further studies.

Spice extract preparation

Required quantity of ground clove (@ 0.3, 0.4 and 0.5% by weight of milk) was weighed and taken into a beaker. Water (about 3 times weight of spice) was added to ground clove and kept at room temperature (25°C) for 12 hours. This soaked ground clove was again ground in a grinder and filtered through muslin cloth. This filtrate of ground clove was added to milk during boiling of milk for *paneer* preparation.

Clove paneer preparation

In the preparation of clove *paneer*, same procedure was followed as given above.

Sensory evaluation

Nine-point Hedonic scale method [12] was used for sensory evaluation of all *paneer* samples by a panel of 7 semi trained judges. The *paneer* samples were coded to preserve the identity of the samples presented to the judges. The samples were evaluated for color and appearance, body and texture, flavor and overall acceptability on the Hedonic scale ranging from 1 to 9 and the preferences were recorded in the sensory performance of *paneer* provided to the panelists.

Shelf life

Paneer was packed in packaging material (polystyrene cups), stored at ambient temperature (30±1°C) and refrigeration temperature (7±1°C). Samples were taken out at regular interval for evaluating sensory and microbial analysis.

Analytical methods

Standard plate count and yeast-mold counts of the control *paneer* and clove *paneer* were estimated as per the method of ISI [13].

Statistical analysis

Data of sensory analysis obtained in the study were subjected to statistical analysis by one way ANOVA using MS-Excel package version 2007. The differences among treatments were measured at 5% level of significance.

Result and discussion

Effect of clove extract on sensory quality of paneer

Paneer was prepared by incorporating clove extract at level of 0.3, 0.4, and 0.5% (w/w), calculated on the basis of milk weight. The clove incorporated *paneer* was then subjected to sensory evaluation by judges. It was observed that *paneer* incorporated with clove extract at a level of 0.3% received the highest flavor score (**Table 1**). So, *paneer* incorporated with 0.3% clove extract was selected for further studies.

Table1 Effect of incorporation of clove extract on sensory score of *paneer*

Treatment	Color and appearance	Body and texture	Flavor	Overall acceptability
Control	8.03±0.05 ^a	7.58±0.12 ^a	7.88±0.18 ^a	8.00±0.10 ^a
0.3% Clove	7.21±0.10 ^b	7.45±0.15 ^a	7.58±0.12 ^a	7.61±0.10 ^b
0.4% Clove	6.86±0.12 ^c	7.05±0.18 ^b	6.78±0.10 ^b	6.95±0.13 ^c
0.5% Clove	6.23±0.12 ^d	6.63±0.10 ^c	6.56±0.16 ^b	6.81±0.15 ^c

Note: Values with a different superscript (a, b) in a row is significantly different at $p < 0.05$

The color and appearance score of clove incorporated *paneer* were significantly lower ($p \leq 0.05$) than those of the control *paneer*, which was attributed to a change in *paneer* color from white to slightly darker.

By addition of 0.3% clove extract, color and appearance score decreased ($p \leq 0.05$) from 8.03 for control to 7.21 for clove *paneer* (Table1). Body and texture score decreased ($p \leq 0.05$) from 7.58 for control to 7.45 for clove *paneer*. Decrease in body and texture score observed in clove *paneer* could be due to the increased hardness of the product. Havanur and Adi [14] also reported clove oil increased the hardness of *paneer*. Flavor score of *paneer* decreased from 7.88 for control *paneer* to 7.58 for clove *paneer*, which may be due to intense clove flavor. The overall acceptability scores also decreased ($p \leq 0.05$) from 8.00 for control to 7.61 for clove *paneer*, which might be due reduction of color and hardening of body of clove *paneer* (Table 1).

Changes in sensory quality of clove paneer during storage

Sensory evaluation of control and clove incorporated *paneer* during storage at ambient ($30 \pm 1^\circ\text{C}$) and refrigeration temperature ($7 \pm 1^\circ\text{C}$) was carried out by a panel of seven judges. Sensory attributes such as color and appearance, body and texture, flavor, and overall acceptability were evaluated.

Color and appearance

The color and appearance scores of control and clove added *paneer* during storage are presented in **Tables 2** and **3**. The results indicated that the score decreased significantly ($p \leq 0.05$) during storage at ambient and refrigeration temperature. Score of control and clove *paneer* decreased from 8.03 to 5.60 and from 7.21 to 5.53, respectively after two days storage at ambient temperature (Table 2). Color and appearance of control and clove sample became yellowish on surface due to slime production on second day. While during storage at refrigeration temperature, score of control after 12 days and clove *paneer* after 16 days decreased from 8.03 to 6.21 and from 7.21 to 6.19, respectively (Table3). Dry surface appearance was observed in both *paneer* samples during storage at refrigeration temperature. Darkness of clove extract incorporated *paneer* increased during storage at refrigeration temperature. Similar results during storage of *paneer* samples were also reported earlier by various research workers [15-17]. The decrease in appearance score of clove *paneer* was comparatively with slower rate as compared to control sample that may be due to antimicrobial action of clove extract that inhibit other biochemical reaction resultant in deterioration of product.

Table 2 Effect of incorporation of clove extract on sensory score of *paneer* during storage at $30 \pm 1^\circ\text{C}$

Sensory attribute	Type of <i>paneer</i>	Storage period (days)		
		0	1	2
Color and appearance	Control	8.03±0.05 ^{aA}	7.50±0.15 ^{bA}	5.60±0.12 ^{cA}
	Clove	7.21±0.10 ^{aB}	6.61±0.10 ^{bB}	5.53±0.15 ^{cA}
Body and texture	Control	7.88±0.12 ^{aA}	7.23±0.10 ^{bA}	5.87±0.17 ^{cA}
	Clove	7.45±0.15 ^{aB}	7.10±0.10 ^{bB}	5.96±0.15 ^{cA}
Flavor	Control	7.63±0.16 ^{aA}	7.13±0.10 ^{bA}	5.10±0.15 ^{cA}
	Clove	7.58±0.10 ^{aA}	7.00±0.10 ^{bA}	5.50±0.10 ^{cA}
Overall acceptability	Control	7.98±0.10 ^{aA}	7.43±0.15 ^{bA}	5.21±0.22 ^{cA}
	Clove	7.61±0.10 ^{aA}	7.21±0.17 ^{aB}	5.31±0.15 ^{bA}

Note: Values with a different superscript (a, b) in a row or column (A,B between control and treated) are significantly different at $p < 0.05$

Body and texture

The body and texture scores of control and clove added *paneer* during storage are presented in Tables 2 and 3. The results indicated that the score decreased significantly ($p \leq 0.05$) during storage at ambient and refrigeration temperature. Score of control and clove *paneer* decreased from 7.88 to 5.87 and from 7.45 to 5.96, respectively after two days storage at ambient temperature (Table 2). Body of control and clove *paneer* became soft and sticky; while storage at refrigeration temperature, score of control after 12 days and clove added *paneer* after 16 days decreased from 7.88 to 6.93 and from 7.45 to 6.41, respectively. The body and texture score of both sample of *paneer* decreased during storage, which may be due to hardening of *paneer* caused by moisture evaporation from *paneer* at refrigeration temperature (Table 3). Mishra *et al.* [18] also reported that body and texture of *paneer* decreased during storage at ambient and refrigeration temperature.

Flavor

The Flavor scores of control and clove added *paneer* during storage are presented in Tables 2 and 3. The results indicated that the flavor score decreased significantly ($p \leq 0.05$) during storage at ambient and refrigeration temperature. Flavor score of control *paneer* and clove *paneer* reduced from 7.63 to 5.10 and from 7.58 to 5.50, respectively after two days storage at ambient temperature (Table 2).

During storage at refrigeration temperature, score of control after 12 days and clove *paneer* after 16 days decreased from 7.63 to 5.15 and from 7.58 to 5.23, respectively (Table 3). At refrigeration temperature spoilage occurred due to development of bitterness in *paneer*.

Overall acceptability

Overall acceptability scores of control and clove added *paneer* during storage is given in Tables 2 and 3, which showed that scores significantly decreased during storage ($p \leq 0.05$) at ambient and refrigeration temperature. Score of control and clove *paneer* decreased from 7.98 to 5.21 and from 7.61 to 5.31, respectively after two days of storage at ambient temperature (Table 2). While at refrigeration temperature, score of control after 12 days and clove *paneer* after 16 days storage decreased from 7.98 to 5.40 and from 7.61 to 5.42, respectively (Table 3). Decreasing sensory scores of *paneer* during storage period was also reported by Bhattacharya *et al.* [1] and Thippeswamy *et al.* [19].

Table 3 Effect of incorporation of clove extract on sensory score of *paneer* storage at $7 \pm 1^\circ\text{C}$

Sensory attribute	Type of <i>paneer</i>	Storage period (days)					
		0	4	8	12	14	16
Color and appearance	Control	8.03 $\pm$ 0.05 ^{aA}	7.88 $\pm$ 0.12 ^{abA}	7.65 $\pm$ 0.17 ^{bA}	6.21 $\pm$ 0.10 ^{cA}	-	-
	Clove	7.21 $\pm$ 0.10 ^{aB}	7.06 $\pm$ 0.10 ^{abB}	6.95 $\pm$ 0.13 ^{abB}	6.86 $\pm$ 0.12 ^{bcB}	6.61 $\pm$ 0.11 ^c	6.19 $\pm$ 0.12 ^d
Body and texture	Control	7.88 $\pm$ 0.13 ^{aA}	7.45 $\pm$ 0.15 ^{bA}	7.06 $\pm$ 0.16 ^{cA}	6.93 $\pm$ 0.15 ^{cA}	-	-
	Clove	7.45 $\pm$ 0.15 ^{aB}	7.23 $\pm$ 0.12 ^{abA}	6.93 $\pm$ 0.15 ^{bcA}	6.85 $\pm$ 0.13 ^{bcA}	6.61 $\pm$ 0.11 ^{cd}	6.41 $\pm$ 0.17 ^d
Flavor	Control	7.63 $\pm$ 0.05 ^{aA}	7.33 $\pm$ 0.12 ^{abA}	7.13 $\pm$ 0.13 ^{bA}	5.15 $\pm$ 0.13 ^{cA}	-	-
	Clove	7.58 $\pm$ 0.12 ^{aA}	7.13 $\pm$ 0.13 ^{bA}	7.08 $\pm$ 0.14 ^{bA}	6.95 $\pm$ 0.13 ^{bB}	6.78 $\pm$ 0.10 ^b	5.23 $\pm$ 0.15 ^c
Overall acceptability	Control	7.98 $\pm$ 0.10 ^{aA}	7.53 $\pm$ 0.05 ^{bA}	7.21 $\pm$ 0.10 ^{cA}	5.40 $\pm$ 0.13 ^{dA}	-	-
	Clove	7.61 $\pm$ 0.10 ^{aB}	7.23 $\pm$ 0.12 ^{bA}	7.11 $\pm$ 0.10 ^{bA}	6.93 $\pm$ 0.17 ^{bcB}	6.71 $\pm$ 0.10 ^c	5.42 $\pm$ 0.13 ^d

Note: Values with a different superscript (a, b) in a row or column (A,B between control and treated) are significantly different at $p < 0.05$

Table 2 showed that keeping quality of both control and clove added *paneer* was only one day at ambient temperature. The shelf life of both control and clove added *paneer* at refrigeration temperature was 8 and 14 days, respectively (Table 3). Shelf life improvement of clove *paneer* might be due to low temperature, antimicrobial property of clove and synergistic effect of these factors. Havanur and Adi [14] reported that clove oil extended the keeping quality of *paneer* up to 40 days at refrigerated temperature.

Changes in microbial count of clove paneer during storage at $7 \pm 1^\circ\text{C}$

Microbial counts viz. standard plate count (SPC) and yeast and mold count of control and clove added *paneer* were analyzed. The data on changes in standard plate count (SPC) and yeast and mold count during storage are given in **Figures 1 and 2**.

Standard plate count (SPC)

It is seen from Figure 1 that SPC of control and clove *paneer* continuously increased during the storage at refrigeration temperature. Standard plate count after 8 days in control *paneer* from 4.71 to 5.29 $\log_{10}$ cfu/g and from 4.50 to 5.54 $\log_{10}$ cfu/g after 14 days in clove *paneer*, which was within the microbial count limits specified by Bureau of Indian Standards for *paneer*. Kumar and Bector [20] also observed elevated standard plate counts (SPC) in *paneer* during storage at 15°C.

Yeast and mold count

Figure 2 shows a sharp rise in yeast and mold count in the control *paneer*, while in clove *paneer* the count increased at a slower rate throughout the storage period. In control *paneer*, the yeast and mold count rise from 62 to 213cfu/g after 8 days, whereas in clove added *paneer*, it increased from 36 to 229 cfu/g after 14 days. Kumar and Bector [20] also reported that the yeast and mold count of *paneer* increased from 10 to 50 per g after 4 days and further to 250 per g after 7 days of storage at 15°C. Sachdeva and Singh [21] also reported that SPC and Yeast-mold count rose in *paneer* during storage at 8-10°C. Mishra *et al.* [22] also reported an increase in SPC and yeast-mold counts in *paneer* during storage at 7°C.

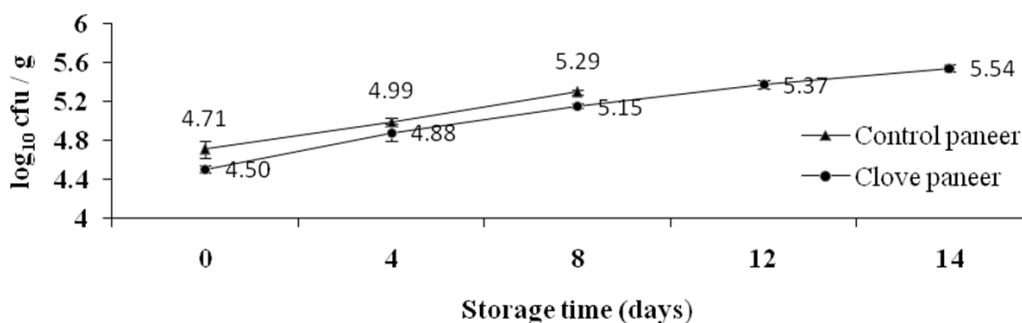


Figure 1 Changes in standard plate count of clove *paneer* during storage at 7±1°C

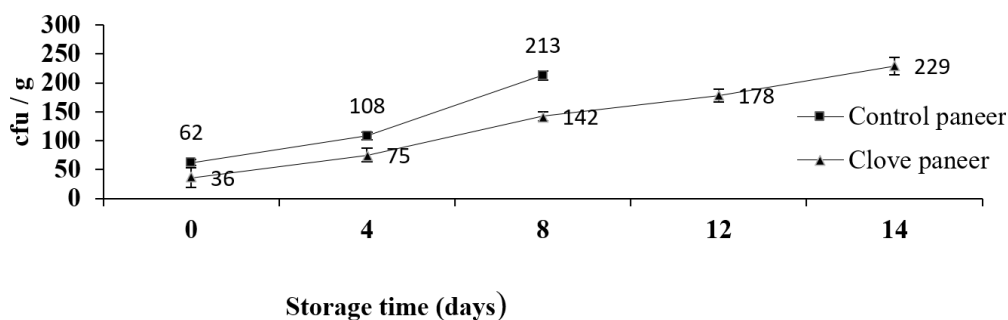


Figure 2 Changes in yeast and mold count of clove *paneer* during storage at 7±1°C

Conclusion

From the above result, it may be concluded that keeping quality of clove *paneer* was only one day at room temperature which is similar to control *paneer*. Under refrigeration temperature, clove *paneer* exhibited a keeping quality of 14 days, compared to only 8 days for the control. Thus clove extract did not enhance the keeping quality of *paneer* at room temperature, while it slightly enhanced at refrigeration temperature in respect of control.

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