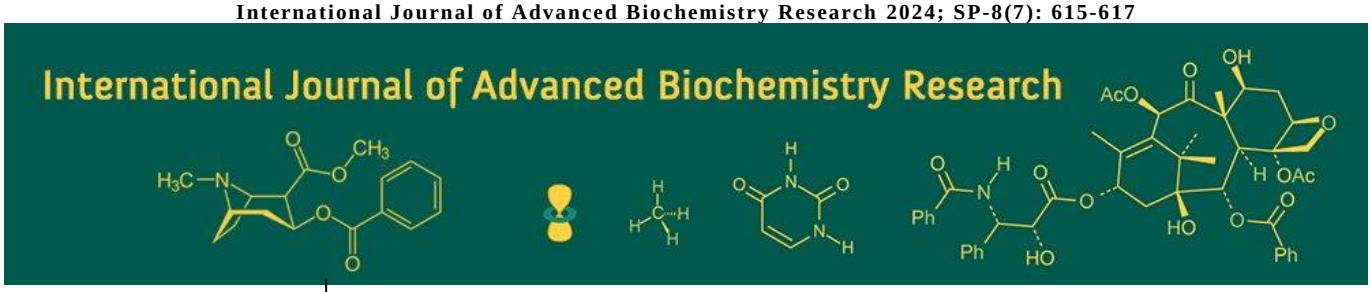

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Comparative study on the effect of citric acid and lactic acid coagulation on paneer quality

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Abstract
Paneer, a staple in South Asian cuisine, is typically prepared through the coagulation of milk using various acids. This study focused on the comparative effects of citric acid and lactic acid as coagulants on the sensory and chemical qualities of paneer. This research was conducted by analyzing paneer samples prepared using milk with varying fat levels (3.0%, 4.5%, and 6.0%) and evaluating their texture, flavor, moisture content, nutritional profile, and chemical composition. The findings indicated that the choice of coagulant significantly impacts the overall quality of paneer, with notable differences observed in the sensory attributes and chemical composition. Citric acid was found to provide a consistent yield and characteristic texture, while lactic acid influenced the flavor and overall quality differently. This study aims to optimize paneer production methods and enhance product quality.

Keywords: Citric acid, chemical composition, fat, paneer, quality of paneer

Introduction
Paneer, a popular fresh cheese in South Asian cuisine, is traditionally prepared by coagulating milk with an acid**.** The choice of coagulant significantly influences the sensory and chemical properties of paneer**.** Among the commonly used coagulants, citric acid and lactic acid are prominent due to their availability and ease of use**.** It also has particular value for those who possess the problem of lactose intolerance but is not suitable for persons who suffer from heart disease, hypertension, or renal problems because it is rich in fat and protein**.** Paneer is mainly used for the preparation of some very popular vegetable dished *viz,* Pea paneer, Karahi Paneer, chhola paneer, palak paneer, paneer pakora, Sahi paneer etc.
According to PFA rules (1984), paneer is a product obtained from cow or buffalo milk or a combination thereof by precipitation with sour whey or lactic acid or citric acid **.**It should not contain more than 70% moisture and milk fat content be not less than 50 percent on a dry matter basis but in skimmed milk paneer, milk fat content should not exceed 13 percent of dry matter **.**According to B**.**I**.**S **.**the moisture content in paneer should not be more than 60%. Milk solids may also be used in the preparation of this product **.**Citric acid, derived from citrus fruits, is widely used in the commercial production of paneer, providing a consistent yield and characteristic texture **.**Lactic acid, a product of lactose fermentation, offers a different set of properties that can alter the texture, flavor, and overall quality of the final product **.**Understanding the comparative effects of these coagulants on paneer is essential for optimizing production methods and improving product quality **.**This study aims to evaluate the impact of citric acid and lactic acid coagulation on the sensory attributes and chemical composition of paneer **.**By analyzing parameters such as texture, flavor, moisture content, and nutritional profile, this research seeks to provide a comprehensive understanding of how these coagulants influence paneer quality. (Ray and De 1953) [9].

Materials and Methods
The present investigation entitled “Study on the effect of fat levels on the quality of paneer” was carried out in the Department of Animal Husbandry & Dairying, R**.**B**.**S**.** College, Bichpuri, Agra. The variables involved in this study *viz.* Fat levels (%) of Milk 3**.**0, 4**.**5, and6**.**0), thus in all 9 samples were compared in Complete at Randomised Design (C.R.D.)

with 3 replications**.** Parameters to be recorded Chemical analysis (Moisture, Protein, Fat, Lactose, Ash, and Acidity). For the sake of convenience, the experimental technique has been divided as under*:* Preparation of Sample for Chemical Analysis:- Paneer samples prepared in the laboratory were analyzed for various constituents**.** 10**.**0 gm**.** of sample from each side of the block was taken and transferred into a porcelain dish and thoroughly mixed with the spatula**.** Samples of paneer were then subjected to the following analysis**.**

Methodology

Determination of Lactose

The well-known iodometric method, described by (Rangoppa and Acharya, 1947) [8], was employed far the determination of lactose. 1.0 g. of well mixed and well ground product was mixed with 10 ml. of lukewarm distilled water. It was transferred into a 100 ml. volumetric flask. About 50 ml. of distilled water, 10 ml. of Mayer's reagent, and 2 ml. of N Sulphuric Acid were added to it. The volume was made up to the mark with distilled water. The contents of flask were mixed and filtered through a dry Whatman No. 1 filter paper. 25 ml. of the filtrate was pipetted out into a 250 ml conical flask and neutralized with N/10 NaOH using a piece of litmus paper. 20 ml. of N/10 iodine and 30 ml. of N/10 NaOH were added and the contents were mixed by a rotatory movement. The flask was then kept in the dark for about 20 minutes to complete the reaction. The flask was taken out after a specified time and 4 ml. of normal sulphuric acid was added to liberate the unused iodine in a free state. The excess of iodine was titrated against N/10 sodium thiosulphate solution using a starch indicator towards the end of titration. A blank determination was also carried out simultaneously under identical conditions using 10 ml. of water instead of the sample.

Calculation

Iodine used in oxidizing the lactose = No. of ml of N/10 $Na_2S_2O_3$ used in blank – No. of ml. of $Na_2S_2O_3$ used in the sample.

1.0 ml. N/10 iodine = 0.01705 lactose

$$\text{Lactose \%} = \frac{Vol.\ of\ N/10\ Iodine\ used \times 4 \times 0.01705 \times [100 - (P + F \times 1.11)]}{Wt.\ of\ sample\ taken\ in\ (g.)}$$

Where:
P = weight of protein in the sample taken
F = weight of fat in the sample taken

Determination of Ash

A clean silica dish was dried in an oven at 102 °C for about 2 hours. It was then transferred into a desiccator, cooled and weighed (W_1). 5.0 g. of thoroughly mixed homogeneous sample was accurately weighed in the dish (W_2). It was then carefully charred on a low flame of a burner till no more fumes were emitted. The dish was then kept into the muffle furnace and maintained at 550 °C for 4-5 hours. It was then taken out of the furnace and the cooling was completed in the desiccator. The dish along with the ash was weighed accurately but quickly (W_3). The total ash percentage was expressed as. (Mathur 1995) [3].

$$\text{Total ash \%} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

Determination of Titratable Acidity

The method as recommended by the (IS 11964, 1987) has been employed. 1.0 gm. of homogeneous sample of paneer was weighed into a dry and clean porcelain dish. Then, 10 ml. of distilled water was added followed by 1.0 ml. of 0.5 percent phenolphthalein indicator and mixed the content. The content of the dish was titrated against N/10 NaOH solution to a persistent faint pink colour and the number of ml. of used N/10 NaOH was noted. The acidity was calculated and expressed as percentage of lactic acid by the following formula:
1 ml of N/10 NaOH = 0.009 g. of lactic acid.

$$\text{Acidity \%} = \frac{Vol.of\ \ N/10 NaOH \times 0.009}{Wt.\ of\ sample\ \ (gm.)} \times 100$$

Result and Discussion

The paneer samples were prepared in the laboratory of the Department of A.H. & Dairying R.B.S. College, Bichpuri, Agra during the investigation entitled "Study on the effect of fat levels on the quality of paneer". Were subjected to sensory evaluation and chemical analysis. Thereafter, data were converted into recovery of total solids in paneer. The yield (%) was also reported. The data thus obtained were statistically analyzed using CRD and tested at 5% level of significance.

Lactose content (%) of Paneer

The data presented in table 1 indicated that average lactose content in paneer was decreased with the increase in fat content of milk used. The highest average lactose content (2.92%) was observed in the case of paneer samples prepared from milk having 3.0% fat. The samples prepared from milk testing 6.0% fat were found to contain the lowest average lactose content of 2.01% in paneer. The statistical analysis of data (Table 1) revealed that fat levels of milk had a significant effect (p<0.05) on the lactose content of paneer. All fat levels have differed statistically from one another regarding the lactose content in paneer. It is well established that lactose being water soluble, remains in the whey during the process of coagulation. So, paneer samples which retained a higher amount of whey, contained higher lactose content. Pal *et al*. 1991 [6], and Pal *et al*. 1993 [5] also reported a positive correlation between lactose and moisture content of paneer.

Ash content (%) of Paneer

The data presented in Table 2 indicated that the average ash content in paneer was decreased with the increase in fat content of milk used. The highest average ash content (1.91%) was observed in the case of paneer samples prepared from milk having 3.0% fat. The samples prepared from milk testing 6.0% fat were found to contain the lowest average ash content 1.73% in paneer.

Table 1: Lactose content (%) of Paneer

S. No.	Fat Levels of milk	Min.	Max.	Average
1.	3.0	2.88	2.97	2.92
2.	4.5	2.19	2.26	2.23
3.	6.0	1.98	2.05	2.01

Analysis of Variance

S. No.	Source of variance	D.F.	S.S.	M.S.S.	F
1.	Treatment	2	1.357	0.679	441.96*
2.	Error	6	0.009	0.002	

* Significant at 5%, CD at 5%, 0.08

Table 2: Ash content (%) of Paneer

S. No.	Fat Levels of milk	Min.	Max.	Average
1.	3.0	1.88	1.94	1.91
2.	4.5	1.79	1.85	1.82
3.	6.0	1.70	1.76	1.73

Analysis of Variance

S. No.	Source of variance	D.F.	S.S.	M.S.S.	F
1.	Treatment	2	0.048	0.024	27.00*
2.	Error	6	0.005	0.001	

* Significant at 5%, CD at 5% 0.06

The statistical analysis of data (Table 2) revealed that fat levels of milk had a significant effect (p<0.05) on the ash content of paneer. All fat levels differed statistically from one another regarding the ash content in paneer. Reduction in ash content with increasing fat levels was also noticed by Pal and Yadav (1992) [4]. It is well established fact there is an intimate association between protein and ash content in the milk system. In other words, the paneer samples higher in protein would also be higher in ash content and vice versa.

Acid content (%) of Paneer

The data presented in the table-3 indicated that average acid content in paneer was decreased with the increase in fat content of milk after certain level. The highest average acid content (0.31%) was observed in case of paneer samples prepared from milk having 3.0%. The samples prepared from milk testing 6.0% fat were found to contain the lowest average acid content of 0.29% in paneer.

Table 3: Acid content (%) of Paneer

S. No.	Fat Levels of milk	Min.	Max.	Average
1.	3.0	0.31	0.32	0.31
2.	4.5	0.30	0.32	0.30
3.	6.0	0.28	0.30	0.29

Analysis of Variance

S. No.	Source of variance	D.F.	S.S.	M.S.S.	F
1.	Treatment	2	0.0006	0.0003	1.5 NS
2.	Error	6	0.0012	0.0002	

* Significant at 5%; NS – Non Significant

The statistical analysis of data (Table-3) revealed that fat levels of milk had a non-significant effect (p<0.05) on the acid content of paneer. The relatively higher acidity in low fat paneer might be due to its higher level of protein and greater retention of colloidal phosphate. Protein and phosphate contribute maximum to the titratable acidity of milk products (Chawla *et al*., 1987) [1].

Conclusion

In conclusion, optimizing the coagulant and fat content in milk can enhance the sensory and chemical quality of paneer, providing valuable insights for the dairy industry to improve paneer production processes and product quality. Further research could explore additional coagulants and their potential benefits, as well as consumer preferences for paneer with different sensory and nutritional profiles.

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