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Paneer Prepared from Standard Milk using Different Coagulants, and Its Effects on Sensory Quality (Acceptability)

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Abstract
Paneer, a fresh cheese widely consumed in India, is traditionally prepared by coagulating hot milk with food-grade acids such as lemon juice, vinegar, or curd. This study investigates the effects of different coagulants—specifically lactic acid and calcium lactate—at varying concentrations (1%, 2%) and coagulation temperatures (70 °C, 75 °C, 80 °C, 85 °C) on the sensory quality of paneer. Standardized milk with fat levels of 4.0% and 4.5% was used for paneer preparation. The samples were stored at 5 °C and evaluated over 0, 5, 10, and 15 days for overall acceptability.

Keywords: Paneer, coagulants, temperature, fat, acceptability

1. Introduction
Paneer is traditionally prepared by adding a food grade acid such as lemon juice, vinegar, citric acid, or fermented curd (dahi) to hot milk, which induces coagulation of milk proteins and separates the curds from the whey. Once coagulation occurs, the curdled mass is collected using a fine muslin or cheesecloth to facilitate the drainage of whey and to retain the solids. The coagulated mass is then pressed to remove excess moisture, forming a compact block of paneer. To enhance its texture, firmness, and visual appeal, the freshly formed paneer is immersed in chilled water for 2-3 hours, which helps tighten its structure. Owing to its high moisture content and absence of preservatives, paneer is highly perishable and requires refrigeration to maintain its freshness and prevent microbial spoilage. It was reported that the freshness of Paneer remains intact only for 3 days at refrigeration temperature (Bhattacharya *et al.*1971) [5].

At room temperature, paneer typically spoils within a day. To enhance its shelf life, several studies have recommended various approaches, including the use of suitable additives, modifications in the manufacturing process, application of surface treatments, and the adoption of advanced packaging materials. Singh *et al.* (1988) [14] dipped paneer blocks of 1.5 kg each in 5% brine, chilled water and acidified water (pH 5.0) to enhance their shelf life (up to 12 days at refrigeration temperature). Singh *et al.* (1989) [13] found that addition of 0.15% sorbic acid to milk for paneer preparation or wrapping the paneer in sorbic acid-coated butter paper (2 g/m^2) extended its shelf life to 30 days at ambient temperature.

Paneer is produced by coagulating milk proteins to form curd. During coagulation, large protein aggregates are created, entrapping fat along with other colloidal and dissolved solids. Milk coagulation occurs when its pH drops to 4.6, the isoelectric point of casein, the principal milk protein. The type and concentration of acid used, as well as the method of its addition to hot milk, significantly affect the moisture content and yield of the final product. Moreover, the concentration of the coagulant plays a crucial role in determining the body and texture of paneer. Low acid strength produces paneer with a soft body and smooth texture, whereas high acid strength leads to a firm and hard body. Various coagulants have been explored for paneer preparation, including lemon juice, citric acid, tartaric acid, lactic acid, malic acid, hydrochloric acid, phosphoric acid, acetic acid, fermented milk, sour or cultured whey, yoghurt, and lactic cultures. In addition, calcium lactate has also been employed as a coagulant (Sachdeva and Singh 1987; Deshmukh *et al.*, 2009) [11, 7].

To enhance the flavour, body, texture, digestibility, and calcium content of paneer, it is essential to identify suitable alternatives to conventional coagulants. With this objective, the present study was undertaken to examine the effects of different coagulants—specifically

lactic acid and calcium lactate—along with coagulation temperature, on the quality characteristics of paneer.

Materials and Methods

This investigation was carried out in the department of Animal Husbandry and Dairying, Janta Mahavidyalaya, Ajitmal (Auraiya), and Department of Dairy science and Technology, CCR PG College, Muzaffarnagar UP. The standardized milk (4.0%, 4.5% milk fat with SNF level of 8.5%) was subjected to four different heat treatments of 70^0, 75^0, 80^0 and 85^0 C and lactic acid (1%, 2%), Calcium Lactate (1%, 2%) used as coagulant for preparation of Paneer. The paneer samples were stored under refrigeration at 5°C for four different durations: 0, 5, 10, and 15 days. The influence of various factors on the physico-chemical characteristics of paneer was evaluated based on its sensory quality, particularly overall acceptability.

Plan of work

Factor of the study

Temperatures of final heating of milk

(i) 70 ^{0}C (ii) 75 ^{0}C (iii) 80 ^{0}C (iii) 85 ^{0}C

Use of coagulants

(i) lactic acid (1%, 2%),
(ii) Calcium Lactate (1%, 2%)

Fat level of Milk

(i) 4.0% (ii) 4.5%

Storage periods

(i) 0 day (ii) 5 days (iii)10 days (iv) 15 days

Parameters of the study

(i) Overall acceptability

Results

Overall acceptability

The overall acceptability score of paneer was found to be highly significantly influenced by the coagulation temperature. The highest score (7.09) was obtained for paneer prepared at 80 °C, while the lowest score (6.45) was recorded for samples coagulated at 70 °C. Thus, paneer produced at 80 °C exhibited superior overall acceptability compared to that prepared at 70 °C.

The overall acceptability score of paneer was significantly affected at the 0.1% level by the type and concentration of coagulants used. The highest score (7.45) was obtained for paneer prepared using 1% lactic acid, whereas the lowest score (6.21) was recorded for samples prepared with 2% calcium lactate. Thus, lactic acid produced the most acceptable paneer, while calcium lactate resulted in comparatively lower acceptability.

Furthermore, the overall acceptability was highly significantly influenced by the fat percentage used in paneer preparation. The highest score (7.11) was observed in paneer made with 4.5% fat, while the lowest score (6.52) was obtained in samples prepared with 4.0% fat.The overall acceptability score of paneer was found to be highly significantly influenced by the duration of storage. The highest mean score (7.38) was recorded for fresh samples, while the lowest score (6.20) was noted for paneer stored for 15 days at 5 °C. Overall, the acceptability of paneer decreased progressively with an increase in storage time.

The overall acceptability score of paneer was significantly influenced at the 0.1% level by coagulation temperature, type and concentration of coagulant, milk fat percentage, and storage period. The highest score (8.35) was achieved for paneer prepared using 1% lactic acid as the coagulant, coagulated at 80 °C, with 4.5% milk fat. In contrast, the lowest score (5.08) was recorded for paneer produced at a coagulation temperature of 75 °C, using 1% calcium lactate as the coagulant, with 4.0% milk fat, and stored for 15 days. These results clearly demonstrate that optimal combinations of processing parameters and fresh storage contribute substantially to superior sensory quality, whereas less optimal conditions and prolonged storage markedly reduce product acceptability.

Table 1: Overall acceptability score of Paneer prepared with various coagulants, temperatures treatments and Fat levels.

Combination	B1	B2	B3	B4	C1	C2	D1	D2	D3	D4	MEAN
A1	6.78	6.84	6.18	6.00	6.23	6.67	6.98	6.70	6.27	5.85	6.45
A2	7.10	7.28	6.27	5.97	6.32	6.99	7.26	6.84	6.44	6.08	6.66
A3	7.70	7.89	6.40	6.36	6.75	7.43	7.66	7.41	6.94	6.39	7.09
A4	7.40	7.78	6.57	6.52	6.78	7.37	7.63	7.25	6.90	6.50	7.07
B1					7.27	7.63	8.05	7.67	7.32	6.76	7.45
B2					7.04	7.45	7.76	7.47	7.03	6.72	7.25
B3					5.95	6.76	7.08	6.66	6.08	5.60	6.35
B4					5.82	6.61	6.64	6.40	6.08	5.74	6.21
C1							7.09	6.72	6.39	5.88	6.52
C2							7.67	7.38	6.87	6.53	7.11
Mean							7.38	7.05	6.63	6.20	

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