

Impact of milk fat content on the physico-chemical, and sensory characteristics of paneer

Pravin Kumar and P.K. Singh*

U.P. Pandit Deen Dayal Upadhyaya pashu Chikitsa Vigyan Vishwavidyalaya Evam Go Anusandhan Sansthan (DUVASU), Mathura-281001 (Uttar Pradesh), India

*Raja Balwant Singh College, Bichpuri-283105, Agra (Uttar Pradesh), India

Corresponding author: pravinmthr@gmail.com

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Abstract

The present investigation was conducted to find out the impact of milk fat content on the physico-chemical and sensory characteristics of paneer. Fresh cow and buffalo milk from nearby dairies was collected and separated in the laboratory. Cow and buffalo skim milk and creams were also used to standardize milk at various fat levels according to the needs of the experiments, i.e., buffalo milk testing 6.0 and cow milk testing 5.0, 4.5, 3.5, and 2.5% fat. As a coagulating agent, a 2.0% (w/v) concentration of synthetic citric acid was employed. The temperature of 80°C was reached after the coagulation process was finished. To make each batch of paneer, many three-liter batches of homogenized milk were prepared. The standard process was used to make the paneer, and yields were noted. Yield, moisture, titratable acidity, pH, fat, FDM, protein, lactose, ash, calcium, and phosphorus were among the chemical parameters examined for the paneer samples. Suitable methods of statistical analysis were applied to the data collected during the current study. The conclusion was that the decrease in the fat content of the milk used to prepare paneer declined in appearance, body and texture, color, taste, flavor, and overall acceptability; however, the variations in milk fat levels had no effect on the moisture absorption properties of paneer or the quantity of coagulants needed for milk coagulation.

Keywords: cow milk, dairy milk, paneer, physico-chemical characteristics, sensory characteristics.

Introduction

Paneer is a type of fresh, soft, unripened cheese made by the acid-heat coagulation

of milk. It is quite popular in the Indian sub-continent and is used to prepare various culinary dishes and snacks. Paneer is highly nutritious and is rich in proteins, fats,

vitamins, and minerals like calcium and phosphorous (Rai et al., 2014). Over the past few years, there has been a continuous attempt to produce paneer in various forms such as long-life paneer, low-fat paneer, UF paneer, and paneer-like products through the utilization of various vegetable proteins and fats. There is a constant urge for the development of low-fat paneer preferably from cow milk as cow milk contains low fat compared to buffalo milk. Such type of paneer will not only fulfil the increasing demand for paneer especially to the fat-conscious consumer but also utilizes a significant part of surplus skim milk. The development of paneer from low-fat milk results in the formation of paneer having a hard body, rubbery, coarse, bland flavor, poor mouthfeel, chewy texture, mottled color, and appearance (Kant et al., 2024).

The level of fat in milk had a significant ($P < 0.01$) effect on yield, and nutrients recovered. Paneer yield and recovery of fat, protein, and total solids decreased with the decrease in the level of fat in milk used for preparing paneer. A decrease in the level of fat in milk increased the contents of moisture, fat, calcium, and phosphorus; decreased FDM, and could not affect pH, protein lactose, and ash in manufactured paneer (Kumar and Singh, 2013).

Present investigation was conducted to study the impact of milk fat content on the physico-chemical, and sensory characteristics of paneer.

Materials and Methods

In order to prepare paneer, a coagulated milk product, fresh cow and buffalo milk from nearby dairies were separated in the laboratory for the current investigation. Cow and buffalo skim milk and creams were also used to standardize milk at

various fat levels according to the needs of the experiments, i.e., buffalo milk testing 6 (control) and cow milk testing 5.0, 4.5, 3.5, and 2.5% fat. As a coagulating agent, a 2.0% (w/v) concentration of synthetic citric acid was employed. The temperature of 80°C was reached after the coagulation process was finished. To make each batch of paneer, many three-liter batches of homogenized milk were prepared. The process of Bhattacharya et al. (1971), as modified by Sachdeva (1983), was used to make the milk product from standardized milk, and yields were noted. Yield, moisture, titratable acidity, pH, fat, FDM, protein, lactose, ash, calcium, and phosphorus were among the chemical parameters examined for the paneer samples (AOAC 1980, ISI 1973, ISI 1977, and ISI 1981). Snedecor and Cochran (1994) methods of statistical analysis were applied to the data collected during the current study.

Results and discussion

Physico-chemical properties of paneer

For paneer prepared from milk, the moisture absorption (% green weight) was 11.91 ± 0.97 , 11.98 ± 0.63 , 11.9 ± 0.27 , 11.66 ± 0.01 , and $11.81 \pm 0.59\%$, with corresponding fat percentages of 6.0, 5%, 4.5, 3.5, and 2.5% in raw milk (Table 1). The final product generated from milk with different levels of milk fat did not differ significantly in terms of moisture absorption. The consistent moisture absorption value seen in all samples may be the result of paneer being saturated with water, which could explain this phenomenon. When the amount of fat in the milk used to make paneer decreases, there is no discernible trend in the moisture absorption (% green weight) of the product. The results regarding paneer's ability to

absorb moisture were in line with previous reports (Arora and Gupta, 1980; Parmar et al., 1989; Gupta et al., 1992; Agnihotri and Pal, 1996; Pal and Kapoor, 2000; Farooquei et al., 2008; Kumar et al., 2008; Das and Das, 2009; Harjai et al., 2009; Nalkar et al., 2009a; Nalkar et al., 2009b; Pawar et al., 2011). Regarding low-fat paneer, the results of this investigation corroborated the

findings previously published in this regard (Pal et al., 1991; Sanyal and Yadav, 2000a; Kumar et al., 2007; Kandeepan and Sangma, 2011). All the milk varieties used to make paneer had similar coagulation temperatures and times, which may have contributed to the nearly identical moisture absorption in the final product.

Table 1: Effect of Fat Levels in Milk on Physico-Chemical Properties of Paneer

Parameters	6.0% fat	5% fat	4.5% fat	3.5% fat	2.5% fat
Moisture absorption (%)	11.91±0.97	11.98±0.63	11.90±0.27	11.66±0.01	11.81±0.59
Coagulant (ml)	70.00±0.17	73.00±0.41	75.00±0.71	78.00±0.73	80.00±0.69
Appearance scores	4.89±0.13 ^C	4.29±0.08 ^{B,C}	4.05±0.12 ^B	2.38±0.03 ^A	2.46±0.09 ^A

^{A,B,C} Values bearing different superscripts within the row differed significantly ($P < 0.05$).

For paneer that was made from milk, the amounts of coagulant needed for optimal coagulation were 70.00±0.17, 73.00±0.41, 75.00±0.71, 78.00±0.76, and 80.00±0.69 ml, testing 6.0, 5.0, 4.5, 3.5, and 2.5% fat, respectively. The amount of coagulant needed to coagulate the milk was not significantly affected by the fat content of the milk. However, throughout the current experiment, the trend of data for this very measure showed a negative relationship with the amount of fat in milk. As a result, it was observed that the amount of coagulant (ml) needed seemed to grow as raw milk's fat content decreased. According to some theories, casein, acid phosphate, citrates, and other minerals contribute to milk's natural acidity, which is thought to be higher in milk that has been standardized to include up to 3.5% fat than in milk with lower fat content. This could be the cause of the greater coagulant (mL) required in low-fat therapy regimens that are standardized. These results are consistent with those of Pal et al. (1991), who similarly observed a comparatively higher

amount of coagulant need with a drop in milk fat levels, despite the paucity of literature to support and validate this theory. All the varieties of milk used to make paneer had similar coagulant types and extents, as well as coagulation temperatures and times, which is why the study's results were nearly identical. The paneer manufactured from milk with 6.0, 5.0, 4.5, 3.5, and 2.5% fat, respectively, had appearance scores of 4.89±0.13, 4.29±0.08, 4.05±0.12, 2.38±0.03, and 2.46±0.09. There were notable differences in the amount of fat in milk ($P < 0.01$). When paneers were tested at 6% fat, the greatest appearance ratings were obtained; when paneers were tested at 2.5% fat, the lowest appearance scores were obtained. When paneer manufactured from milk was tested at 2.5 and 3.5%, 4.5 and 5%, and 5 and 6% fat, the results did not differ significantly from one another. The results described before (Arora and Gupta, 1980; Agnihotri and Pal, 1996; Bhadekar et al., 2008; Kumar et al., 2008; Rupnar et al., 2009) are supported by the current findings about the

appearance of paneer. Regarding low-fat paneer, the results of this investigation corroborated the findings published previously (Sanyal and Yadav, 2000a; Kumar et al., 2007). When paneer was made with low-fat milk, its appearance scores dropped. It might be because there isn't much of this nutrient in the final product.

Sensory Attributes of Paneer

A product's sensory qualities are extremely important since they draw customers in and, in some cases, safeguard their interests. Customers typically assess a product's quality based on its look, smell, body, texture, and taste, among other physical characteristics. A high-quality paneer is distinguished by its white hue, characteristic acidic flavor with a hint of sweetness, firm, cohesive, and spongy body, and smooth, densely knit texture. During the current experiment, paneer made from milk with different fat contents was not only evaluated sensory using a 5-point hedonic scale that ranged from outstanding (scoring 5) to fair (score 1). The following headings give a summary of the findings thus far in this regard. In paneer made from milk containing 6.0, 5.0, 4.5, 3.5, and 2.5% fat, respectively, the body and texture ratings were 4.02 ± 0.11 , 3.66 ± 0.07 , 3.29 ± 0.1 , 2 ± 0.03 , and 2.31 ± 0.08 (Table 2). According to the findings in this area, the amount of fat in the milk had a noteworthy ($P < 0.05$) impact on the paneer's body and texture characteristics. Moreover, it is evident that raising the fat content of milk significantly enhances the body and texture of paneer. However, it seems that reducing the fat content of milk by up to 3.5% resulted in a product with decent body and texture. However, the further decrease in milk fat produced paneer with a fair body and

texture. This proved that the fat content of the raw milk added to the paneer's richness. The decrease in fat content in the milk used to make paneers indicates a downward trend in the body and texture scores of these milk products. The current research on the body and texture scores of paneers supported the findings published in previous studies (Arora and Gupta, 1980; Mistry et al., 1990; Gupta et al., 1992; Sharma et al., 1998; Sharma et al., 1999; Uprit and Mishra, 2004; Jayaraj Rao and Patil, 2006; Bhadekar et al., 2008; Kumar et al., 2008; Deshmukh et al., 2009; Mathare et al., 2009; Karadbhajne and Bhoyarkar, 2010; Pawar et al., 2011). The results of this investigation confirmed previous findings for low-fat paneer (Chawla et al., 1985; Desai et al., 1991; Pal et al., 1991; Sanyal and Yadav, 2000a; Sanyal and Yadav, 2000b; Kandeepan and Sangma, 2011).

The paneer samples that tested at 6.0, 5.0, 4.5, 3.5, and 2.5% fat had color scores of 4.25 ± 0.11 , 3.53 ± 0.06 , 3.5 ± 0.11 , 2.73 ± 0.04 , and 2.24 ± 0.08 , respectively. Creamy white is the typical color of freshly cooked paneer derived from whole fat milk. As the fat content of the milk used to make paneer fell and became much closer to white, the color ratings decreased as well. One possible explanation is that the presence of fat-soluble vitamin A precursor in milk fat gives paneer its creamy white color. The amounts of fat in milk varied considerably ($P < 0.05$) from the color ratings of paneer. The paneer prepared from milk with 6% fat had the highest color score, while milk with 2.5% fat had the lowest. As the amount of fat in the milk used to make this milk product decreased, so did the paneer's color scores. The results validated those previously published (Agnihotri and Pal, 1996; Bhadekar et al., 2008; Kumar et al., 2008) findings. Regarding low-fat paneer, the current study's results corroborated

previously published research (Rupnar et al., 2009).

In paneer prepared from milk with fat levels of 6.0, 5.0, 4.5, 3.5, and 2.5 percent, the taste scores were 4.61 ± 0.12 , 4.4 ± 0.08 , 3.87 ± 0.12 , 2.62 ± 0.04 , and 1.81 ± 0.06 , in that order. Freshly cooked paneer made with whole milk typically has a little sweeter, less sour flavor. As the amount of fat in the milk used to make paneer fell, so did the scores. The explanation could be that paneer made from low-fat milk has less of the lactose and milk fat that give it a nice, sweet taste, which could lead to the product receiving low marks. The amount of fat in milk had a substantial ($P<0.05$) difference in the taste of paneer. The paneers prepared from milk that tested at 6% fat had the highest flavor ratings, while the sample made from milk that tested at 2.5% fat had the lowest. The flavor of paneer manufactured with milk that tested at 5 and 6% fat levels did not differ significantly from one another. Figure 4.4 shows that when the amount of fat in the milk used to make this milk product reduced, so did the paneers' taste scores. The results shown before (Agnihotri and Pal, 1996; Bhadekar et al., 2008; Karadbhajne and Bhoyarkar, 2010; Nawaz et al., 2011) were supported by the current research on paneer flavor. Regarding low-fat paneer, the results of this investigation corroborated the findings published previously (Pal et al., 1991).

When paneer made from milk with 6.0, 5.0, 4.5, 3.5, and 2.5% fat was tested, the flavor score was 4.75 ± 0.25 , 4.75 ± 0.25 , 4.25 ± 0.48 , 3 ± 0.58 , and 2.5 ± 0.65 . Because diacetyl is present, newly cooked paneer made from full fat milk has a pleasant flavor. As the amount of fat in the milk used to make paneer fell, so did the flavor scores. The final product may have received low ratings because the amount of diacetyl was

decreased in paneer made from low-fat milk. The amount of fat in milk had a significant difference ($P<0.05$) in the flavor of paneer. The paneer prepared from milk tested at 6% fat had the highest flavor, whereas milk tested at 2.5% fat yielded the lowest. In tests involving 2.5, 3.5, and 4.5% fat, 5% fat, and 4.5, 5 and 6% fat, the flavor of paneer manufactured from milk did not differ significantly from one another. As the amount of fat in the milk used to make this milk product reduced, so did the flavor of paneer. The current research on paneer flavor validated previously published research in this area (Arora and Gupta, 1980; Mistry et al., 1990; Pandya and Ghodke, 2007; Kumar et al., 2008; Yadav and Grover, 2009; Karadbhajne and Bhoyarkar, 2010; Nawaz et al., 2011). Regarding low-fat paneer, the current study's results corroborated previously published research (Chawla et al., 1985; Sanyal and Yadava, 2000a; Sanyal and Yadav, 2000b).

The paneer made from milk that tested at 6.0, 5.0, 4.5, 3.5, and 2.5 percent fat had overall acceptability values of 4.57 ± 0.12 , 4.07 ± 0.07 , 3.76 ± 0.11 , 2.49 ± 0.03 , and 2.26 ± 0.08 , in that order. Fresh paneer made with whole milk is suitable due to the combination of its flavor, body, texture, and taste. As the amount of fat in the milk used to make paneer fell, so did the paneer's overall acceptability scores. The cause might be the decreased milk fat in paneer made from low-fat milk, which could result in a low-scoring final product. The amount of fat in milk varied considerably ($P<0.05$) from the paneer's overall acceptability scores. The paneer made with 6% fat in milk had the highest overall acceptability scores, whereas the paneer created with 2.5% fat had the lowest. The paneer prepared from milk was tested at 2.5 and 3.5%, 4.5 and 5%, and 6% fat did not

significantly differ from one another in terms of overall acceptability scores. As the amount of fat in the milk used to make this milk product fell, so did the paneer's overall acceptability scores. The overall acceptance

scores supported findings of (Kumar et al., 2008; Rupnar et al., 2009). Regarding low-fat paneer, the results of this investigation corroborated the findings published previously (Pal et al., 1991).

Table 2: Sensory Characteristics of Paneer as Influenced by Varying Milk Fat Levels.

Physical properties	6.0% fat	5% fat	4.5% fat	3.5% fat	2.5% fat
Body and texture	4.02±0.11 ^C	3.66±0.07 ^{B,C}	3.29±0.10 ^B	2.00±0.03 ^A	2.31±0.08 ^A
Colour	4.25±0.11 ^D	3.53±0.06 ^C	3.50±0.11 ^C	2.73±0.04 ^B	2.24±0.08 ^A
Taste	4.61±0.12 ^D	4.40±0.08 ^{C,D}	3.87±0.12 ^C	2.62±0.04 ^B	1.81±0.06 ^A
Flavour	4.75±0.25 ^B	4.75±0.25 ^B	4.25±0.48 ^{A,B}	3.00±0.58 ^A	2.50±0.65 ^A
Overall Acceptability	4.57±0.12 ^C	4.07±0.07 ^{B,C}	3.76±0.11 ^B	2.49±0.03 ^A	2.26±0.08 ^A

^{A,B,C,D} Values bearing different superscripts within the row differed significantly, ($P < 0.05$)

Conclusion

The findings thus led to the conclusion that decreasing the fat content of the milk used to prepare paneer resulted in a decline in appearance, body and texture, color, taste, flavor, and overall acceptability; on the other hand, the variations in milk fat levels had no effect on the moisture absorption properties of paneer or the quantity of coagulants needed for milk coagulation.

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