Effect of Coagulants on Paneer Quality Prepared from Market Milk

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Abstract
Paneer was prepared from market milk containing 5% fat and 8.1% solid-not-fat (SNF). The hot milk (70 °C) was coagulated with citric, tartaric and lactic acids at 1, 2 and 3% each and filtered the whey pressed the curd at a pressure of $8 \times 10^5$ Pa for 20 minutes. Then it was stored under refrigerated condition at 6±2 °C for 12 hours and analysed. The moisture, fat, protein and lactose content in paneer was slightly affected by different coagulant concentrations. The yield of paneer obtained from 1% citric acid was highest (14.2%) than other coagulant concentrations. The sensory evaluation results indicated that the product prepared from citric, tartaric and lactic acids at 1% each could be considered the best product.

Keywords: Coagulants Concentrations, Product quality, Product yield, Total solid recovery, Total solids in whey

Introduction
Paneer is a popular indigenous milk product obtained by acid coagulation of milk. It contains almost all fat and casein along with part of the whey proteins, minerals and vitamins present in milk. It is also low in sugar content. The mild acidic flavour and slightly sweetish taste of paneer makes it suitable as a base material for many culinary dishes and sweet meats (Tiwari 1991) and also used as an ingredient for cooked vegetables in Northern India (Bhattacharya et al. 1971).

Conventionally, buffalo milk has been in use for the production of Paneer. In order to achieve the desirable characteristics of Paneer such as firm, cohesive and compact body and closely knit smooth texture and to meet the PFAI requirements, it is necessary to use buffalo milk having more than 5% fat (Bhattacharya et al. 1971, Sachdeva & Singh 1988). It is obtained by acid precipitation of high temperature milk (70°C) often called as acid precipitated soft cheese. Precipitation involves the formation of large structural aggregates of proteins in which milk and other colloidal and soluble solids are entrained with whey (Sachdeva & Singh 1988, Babje et al. 1991).

According to Prevention of Food Act rules (1983) Paneer means a product obtained from cow or buffalo milk or a combination thereof by precipitation with sour milk, lactic acid, or citric acid. It should not contain more than 70% moisture and the fat content shall not be less than 50% of the dry matter basis (De 1996).

The ratio of fat and solid-not-fat (SNF) in milk for Paneer preparation should be 1:1.65. Higher fat content in milk results in lower moisture retention in Paneer and therefore, a loss in terms of yield. Paneer of good quality could never hold moisture beyond 60% (Sachdeva & Singh 1988).

Paneer can be prepared by precipitating milk with the help of suitable coagulant and separation of curd from whey. The curd is subsequently pressed for increasing the cohesion and the removal of excess moisture (Kulshrestha et al. 1987). It is white in appearance with spongy body and close texture.

The present work is to study the product qualities of Paneer prepared by using different coagulants on market milk.

Methodology
Milk was collected from Dairy Development Corporation (DDC), Milk Supply Scheme, Biratnagar. The coagulating agents such as citric acid, lactic acid and tartaric acid were used. The standardised milk (fat: SNF ratio = 1:1.62) was taken and then heated to 35-40 °C and filtered through muslin cloth. This standardised and filtered milk was reheated to 90 °C for 5 minutes and then cooled down to 70 °C. The milk was coagulated with citric, lactic and tartaric acid at 1, 2 and 3% each. Continuous stirring was done
until the coagulum formed and clear whey was obtained. The temperature of coagulants during coagulation was around 25±2 °C. The coagulum so obtained was allowed to settle for 5 minutes and then filtered through muslin cloth. The coagulum was wrapped in muslin cloth and pressed in a wooden box (hoop) at a pressure of 8-10^3 Pa for 20 minutes. The mass was cut into rectangular pieces and stored in refrigerated condition (6±2 °C for 12 hrs) and analysed.

Nine samples of Paneer were subjected to 15 panelists for sensory evaluation. The parameters for evaluation were colour and appearance, body and texture, taste, flavour and overall acceptability. The scoring data so obtained from different panelists were statistically analysed.

The chemical analyses of the products were made by standard methods mentioned here. Fat in milk was estimated by Gerber method (DDC 1981). Fat in paneer was determined by Gerber method (Egan 1981). Solid-not-fat in milk was determined by the standard method given in milk and milk products (Clarence et al. 1997).

Acidity of milk and paneer was estimated by the method adopted in DDC (1981). pH of milk was determined by pH meter directly by dipping the bulb in the sample. pH of Paneer was determined by the standard method described in AOAC (1990).

The protein content in paneer was estimated by the Kjeldahl method and the conversion factor used is 6.38 (Rangana 1994). The moisture and ash contents of Paneer were estimated by the methods described in Pearson's chemical analysis of foods (Egan et al. 1981). The lactose content in paneer was estimated by Lane and Enyon method (Egan et al. 1981).

Results and Discussion

The chemical composition of standardised milk used for Paneer preparation is as follows: moisture 86.9%, fat 5.0%, SNF 8.1%, acidity 0.14-0.15% and pH 6.4-6.6.

Milk having acidity within the range of 0.14-0.16% should be accepted for paneer manufacture. As a result of bacterial action on milk lactose there is increase in acidity in milk. Animal udder infection (mastitis) results in higher pH values for fresh milk whereas lower values show bacterial action. The bacterial action disturbs salt balance i.e., causes progressive removal of calcium and phosphates from caseinate phosphate micelle due to which coagulation is faster simply on heating or on addition of small amount of coagulant which directly affects the quality of the final product (De 1996).

The flavour of paneer has a direct relationship with fat content of milk. The paneer made from milk containing fat up to 3.0% is fairly acceptable, but reduction in fat percent from this level, the Paneer is unacceptable (Chawla et al. 1987). Fat level in milk is also affected on body and texture of paneer.

The mean pH and titrable acidity of different concentration of coagulants used ranged from 1.40-2.50 and 1.56-3.95%, respectively. The amount of acids (citric, tartaric and lactic acid) required for coagulation decreased with increasing their concentrations.

The yield of Paneer/Chhena mainly depends upon the type of milk used, heat treatment prior to acidification of the milk, coagulants and their concentrations, coagulation temperature, acidity of the milk, acid mixture, residence time of the coagulum prior to separation (Jonkman & Das 1993) and pressing conditions. In general, the yield decreases with increase in the strength of coagulant, coagulation temperature and lowering the pH of coagulation in case of buffalo milk (Sachdeva & Singh 1988) and it increases with increase in the coagulation temperature in cow milk. Paneeq prepared by using 2% each of lactic and tartaric acid solution was slightly higher i.e. 13.0% and 11.8% respectively, than the yield of sample prepared by using other two concentrations of the coagulant, whereas in case of citric acid (1%) it was higher (14.2%) than others.

The total solid loss in whey increases as there is an increase in concentration of coagulants. Sachdeva and Singh (1988) reported that loss of total solid in whey was 5.8%, 6.4% and 6.8% on coagulating milk with 1, 2 and 3% citric acid, respectively. The total solid loss in whey is also affected by pH of coagulation. As the pH (5.30-5.35%) of coagulation was kept for all cases, the effect may only be due to concentration difference of coagulants. The total solid recovery was decreased as concentration of coagulant increased. Greater the solid loss in whey, lesser is the total solid recovery in Paneer as it is inversely related (Table 1).

Protein, the most essential component of Paneeq, varied slightly with concentration of coagulants (Table 2). The protein content obtained from citric acid (1%) was highest (17.7 %). The lactose content (2.7 %) was highest for lactic acid (3%) and fat content for citric acid (1%) was highest (22.6 %).

Paneer contains entire milk casein, part of denatured whey protein, almost all fat, colloidal salts and soluble milk solids in proportion to the moisture content.
Table 1. Effect of different coagulants on yield and total solid (TS) recovery in paneer.

<table>
<thead>
<tr>
<th>Coagulants</th>
<th>Concentration % (w/v)</th>
<th>pH</th>
<th>Titrable acidity (%</th>
<th>Amount of coagulant used (ml/100ml milk)</th>
<th>Yield (%)</th>
<th>Total solid recovery (%)</th>
<th>TS in whey (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citric Acid</td>
<td>1</td>
<td>2.50</td>
<td>1.56</td>
<td>22.0</td>
<td>14.2</td>
<td>68.6</td>
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<td></td>
<td>2</td>
<td>2.50</td>
<td>1.56</td>
<td>15.0</td>
<td>13.7</td>
<td>67.3</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.80</td>
<td>3.90</td>
<td>13.0</td>
<td>13.0</td>
<td>67.2</td>
<td>7.6</td>
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<tr>
<td>Tartaric Acid</td>
<td>1</td>
<td>2.50</td>
<td>1.56</td>
<td>24.0</td>
<td>11.7</td>
<td>66.4</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2.20</td>
<td>2.25</td>
<td>13.0</td>
<td>11.8</td>
<td>65.2</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1.50</td>
<td>3.24</td>
<td>9.0</td>
<td>11.0</td>
<td>64.7</td>
<td>7.9</td>
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<td>Lactic Acid</td>
<td>1</td>
<td>2.45</td>
<td>2.72</td>
<td>20.0</td>
<td>12.6</td>
<td>68.3</td>
<td>6.7</td>
</tr>
<tr>
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<td>2</td>
<td>2.25</td>
<td>2.72</td>
<td>18.0</td>
<td>13.0</td>
<td>66.5</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2.40</td>
<td>3.95</td>
<td>8.0</td>
<td>11.9</td>
<td>64.8</td>
<td>7.6</td>
</tr>
</tbody>
</table>

*Values are means of three replicates.

Table 2. Chemical composition of Paneer in percent wet basis.

<table>
<thead>
<tr>
<th>Coagulants</th>
<th>Concentration</th>
<th>Moisture</th>
<th>Fat</th>
<th>Protein</th>
<th>Lactose</th>
<th>Ash</th>
<th>Acidity</th>
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<tbody>
<tr>
<td>Citric Acid</td>
<td>1</td>
<td>54.2</td>
<td>22.6</td>
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<td>2.4</td>
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<td>3</td>
<td>55.0</td>
<td>21.9</td>
<td>17.0</td>
<td>2.9</td>
<td>2.9</td>
<td>0.50</td>
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<tr>
<td>Tartaric Acid</td>
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<td>54.9</td>
<td>22.2</td>
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<td>2.7</td>
<td>2.6</td>
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<td>0.51</td>
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<td>17.0</td>
<td>3.0</td>
<td>2.8</td>
<td>0.57</td>
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<td>Lactic Acid</td>
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<td>54.6</td>
<td>22.5</td>
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<td>2.7</td>
<td>2.6</td>
<td>0.45</td>
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<td>17.2</td>
<td>2.5</td>
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<tr>
<td></td>
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<td>55.0</td>
<td>21.9</td>
<td>17.2</td>
<td>2.7</td>
<td>2.9</td>
<td>0.52</td>
</tr>
</tbody>
</table>

*Values are means of three replicates.

content retained (Chawla et al. 1984). The acidity for Paneer obtained from tartaric acid (3%) was 0.57, which is very high. This may be due to retention of higher amount of acid used or may be due to development of acidity during processing or as a result of change of lactose to lactic acid.

The moisture content in paneer made by using different coagulants in different concentrations (Table 1) did not vary much. The retention of the moisture in paneer is due to the moisture present in the structure of protein, in contact with curd particles and free moisture present in paneer (Scott 1985). The moisture content in paneer varied inversely with the fat level in milk (Sachdeva & Singh 1998).

The ash content of paneer is increased with the increase in concentration of coagulants (Table 2). The ash content of product depends upon the mineral content in the raw material. The mineral content may vary from species to species, breeds, feed (De 1996).

From the sensory evaluation, it was found that the colour and appearance, body and texture, flavour and overall acceptability of the paneer prepared by using citric, tartaric and lactic acid were observed significant (p<0.05) difference. On carrying out Duncan's multiple test (DMT) for above five parameters for all samples, it was found that there were significant (p<0.05) difference between 1% and 3%, 2% and 3% and 1% and 2% for colour and appearance, body and texture but no significant difference were observed between 1% and 2% for flavour, taste and overall acceptability.

The sensory score were maximum for paneer made with each coagulant of 1% solution and decreased with increase in concentration, stronger solutions resulted in paneer with slightly acidic taste and harder body. Solutions lower than 1 percent concentration would increase the bulk of the contents posing problems in handling (Sachdeva & Singh 1988).
Conclusion
Paneer is an acid precipitated milk products often called soft cheese, can be prepared by using locally available raw material by means of simple method. The best quality product can be obtained by using the milk having acidity 0.14-0.16. The percent yield obtained from 1% citric acid was 14.2%, which is higher than 2% and 3% solution whereas in case of tartaric acid and lactic acid, 2% solution was optimised. The chemical composition of paneer did not much affected by the coagulant concentration. The Total Solid recovery decreased with the increase in concentration of coagulant in all cases whereas total solid loss in whey increased with the increase in concentration of coagulants. Paneer prepared by using 1% solution of citric acid was the best product than 2 and 3% solution in terms of sensory quality.

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References


