Standardization of technology for the preparation of goat milk paneer

Lokendra Singh, Umesh S Suradkar, Dinesh M Chavhan, Praveen Kumar, Karishma Rathore, Narendra Singh Rathore and Mukesh Sharma

Abstract

The present investigation was undertaken to standardize a technology for the preparation of a good quality goat milk paneer using calcium chloride. Different levels of calcium chloride were used like C1 (0.08%), C2 (0.10%) and C3 (0.12%). Paneer prepared with 0.10 percent calcium chloride had moderately acceptable general appearance, body and texture taste and flavour and overall acceptability. Hence, a level of 0.10 percent calcium chloride was selected for preparation of goat milk paneer. In the development of a modified method different coagulation temperature were used like T1 (75 °C), T2 (80 °C) and T3 (85 °C) and different strength of citric acid solution as coagulant were used like S1 (1%), S2 (2%) and S3 (3%). Based on preliminary trials, it was found that a coagulation temperature of 85°C and use of 1.0 percent citric acid solution as coagulant was most suitable for preparation of goat milk paneer. In the standardized technology, 5.0 percent fat milk added with 0.10 percent calcium chloride was subjected to heating at 90 °C with no holding followed by cooling to 85 °C and adding 1 percent citric acid solution as coagulant.

Keywords: Goat milk, calcium chloride, coagulation temperature, citric acid

Introduction

Livestock sector plays an important role in India economy. Goats are important part of livestock industry and play a crucial role in the socio-economic structure of marginal farmers in India. India possess 148.88 million goats and is ranked second in the world in terms of goat population (Basic Animal Husbandry Statistics, 2019) [2]. Total milk production in India is 187.7 million tone and goat milk contribution is 3 percent of total milk production in India (Basic Animal Husbandry Statistics, 2019) [3].

In recent years goat milk and it’s product are receiving a real alterations in many countries of the world. Goat milk are useful for health of children especially who have allergy to cow milk (Playford et al., 2000) [4]. Goat milk can be used to prepare a wide variety of dairy products as paneer, cheese, butter, ice-cream, butter milk, condensed milk, yoghurt, flavoured milk, sweets and candy (Fazilah et al., 2018) [5].

According to Chandan (2007) [4] an estimate about 5 percent of milk produced in India is converted into paneer. Good quality paneer is characterized by a marble white color, sweetish, mildly acidic taste, nutty flavour, spongy body and closely knit smooth texture (Patel,1991) [6].

High grade paneer has pleasing, mild acidic, slightly sweet and nutty flavour, firm cohesive and spongy body and compact (close-knit), smooth and velvety texture (Patil and Gupta, 1986) [9].

The present research work was carried out as an attempt to utilize goat milk for the preparation of paneer, a value added product. In order to improve the quality characteristics of paneer from goat milk, different level of calcium chloride, different coagulation temperature & different concentration of coagulant (citric acid) are used for its preparation and better suited level of calcium chloride, coagulation temperature and coagulant (citric acid) are selected for paneer preparation from goat milk.

Materials and Methods

Experimental design

Procurement of milk: Goat milk was procured from livestock research station, Bojunda, Chittorgarh and standardized to 5 percent fat for preparation of paneer.
Additives used: Different levels of calcium chloride were used as additives like C₁ (0.08%), C₂ (0.10%) and C₃ (0.12%). For selection of best suited level of calcium chloride, each level of calcium chloride were added in goat milk for paneer production using 1 percent citric acid solution as coagulant at 85 °C coagulation temperature.

Coagulation temperature used: After selection of best suited level of calcium chloride, different coagulation temperature were used like T₁ (75 °C), T₂ (80 °C) and T₃ (85 °C). For selection of best suited coagulation temperature, each coagulation temperature were used for paneer production from goat milk added with best suited level of calcium chloride using 1 percent citric acid solution as coagulant.

Coagulant used: After selection of best suited coagulation temperature, different strength of citric acid solution as coagulant were used like S₁ (1%), S₂ (2%) and S₃ (3%). For selection of best suited strength of citric acid solution, each strength of citric acid solution as coagulant at best suited coagulation temperature were used for paneer production from goat milk added with best suited level of calcium chloride. The product was prepared by the process suggested by Sachadeva and Singh (1988) [12]. The standardized goat milk was added with various level of calcium chloride and heated to 90 °C and subsequently cooled to 75 °C or 80 °C or 85 °C. Various strength of citric acid solution as coagulant were added slowly with continuous agitation till clear whey separated out. The curd was left for 5-10 minutes in the whey and then drained through muslin cloth and pressed in a hoof at 2-3 kg/cm² pressure. Paneer block was dipped in chilled water for 5-10 minute and packaged in pre-sterilized LDPE pouches and stored at 5 °C.

Sensory analysis of paneer
The paneer prepared under different treatments during the course of the investigation was subjected to the sensory evaluation by a panel of five judges from the Department of Livestock Products Technology and Department of Veterinary Public Health by using the procedure described in IS 6273 (Part II) (1971) [6]. The product was judged for different quality attributes by 9 point Hedonic scale (Amerine et al., 1967) [1] with suitable modifications.

Table 1: The Effect of various levels of calcium chloride on sensory quality of goat milk paneer

<table>
<thead>
<tr>
<th>Parameter</th>
<th>General appearance</th>
<th>Taste and flavor</th>
<th>Body and texture</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₀</td>
<td>6.23±0.16</td>
<td>6.00±0.16</td>
<td>6.00±0.28</td>
<td>6.00±0.15</td>
</tr>
<tr>
<td>C₁</td>
<td>6.70±0.02</td>
<td>6.70±0.08</td>
<td>7.03±0.13</td>
<td>7.06±0.07</td>
</tr>
<tr>
<td>C₂</td>
<td>7.93±0.04</td>
<td>7.50±0.10</td>
<td>7.70±0.06</td>
<td>7.76±0.05</td>
</tr>
<tr>
<td>C₃</td>
<td>7.33±0.15</td>
<td>6.86±0.16</td>
<td>7.30±0.20</td>
<td>7.23±0.22</td>
</tr>
</tbody>
</table>

Each observation is a mean ± SE of three replicate experiment (n=3)
Mean in column bearing a common superscripts do not differ significantly (p<0.05).
Control (C₀): Without calcium chloride
C₁: With 0.08 % calcium chloride
C₂: With 0.10 % calcium chloride
C₃: With 0.12 % calcium chloride.

The mean value for general appearance for control (C₀) was 6.23±0.16 and for treatments group C₁, C₂ and C₃ were 7.00±0.02, 7.93±0.04 and 7.33±0.15 respectively. It is revealed that the score for general appearance with different level of calcium chloride differed significantly (p<0.05). The general appearance score for C₂ group was observed to be significantly higher than C₁ and C₀, while C₂ and C₃ were non-significant to each other.

The mean value for taste and flavor for control (C₀) was 6.00±0.16 and for treatments group C₁, C₂ and C₃ were 6.70±0.08, 7.50±0.01 and 6.86±0.16 respectively. It is revealed that the score for taste and flavour with different level of calcium chloride differed significantly (p<0.05). The taste and flavor score for C₂ group was observed to be significantly higher than all groups while group C₁ and C₃ were non-significant to each other and group C₀ and C₁ were non-significant to each other.

The mean value for overall acceptability for control (C₀) was 6.00±0.28 and for treatments group C₁, C₂ and C₃ were 7.03±0.13, 7.70±0.06 and 7.30±0.20 respectively. The mean value for overall acceptability for control (C₀) was 6.00±0.15 and for treatments group C₁, C₂ and C₃ were 7.06±0.07, 7.76±0.05 and 7.23±0.22 respectively. The score for body and texture and overall acceptability of a goat milk paneer treated with calcium chloride levels differed significantly (p<0.05). It is further noticed that values for body and texture and overall acceptability of all treatment significantly higher than C₀ but other levels i.e C₁, C₂, C₃ were non-significant to each other. These above findings for general appearance, taste and flavor, body and texture and overall acceptability are in accordance with the observations of Singh and Kanawjia (1988) [13] for the use of 0.10 percent calcium chloride in the manufacture of paneer from cow milk.

On the basis of above study, it can be seen that C₂ was preferred the most with respect to all the attributes studied from amongst all the experimental samples. A level of calcium chloride 0.10 percent was found to be best suited, because it resulted in good quality goat milk paneer (Table 1) and was employed in the second part of the study.

Second part: In this part of study paneer was prepared from goat milk added with 0.10 percent calcium chloride using 1 percent citric acid solution as coagulant at 85 °C coagulation temperature and subsequently cooled to 75 °C. The standardized goat milk quality attributes by 9 point Hedonic scale (Amerine et al., 1967) [1] and was employed in the second part of the study.
percent citric acid solution as coagulant at different coagulation temperature like T₁ (75 °C), T₂ (80 °C) and T₃ (85 °C) 85 °C coagulation temperature. The results on General appearance, Taste and flavour, Body and texture and Overall acceptability of paneer have been recorded in Table 2.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sensory attributes</th>
<th>General Appearance</th>
<th>Taste and Flavour</th>
<th>Body and texture</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>6.20 ±0.13</td>
<td>5.96 ±0.07</td>
<td>6.06 ±0.07</td>
<td>6.10 ±0.08</td>
<td></td>
</tr>
<tr>
<td>T₂</td>
<td>6.86 ±0.04</td>
<td>7.00 ±0.06</td>
<td>7.00 ±0.13</td>
<td>6.90 ±0.12</td>
<td></td>
</tr>
<tr>
<td>T₃</td>
<td>7.13 ±0.04</td>
<td>7.06 ±0.04</td>
<td>7.06 ±0.01</td>
<td>7.08 ±0.11</td>
<td></td>
</tr>
</tbody>
</table>

Each observation is a mean ± SE of three replicate experiment (n=3)
Mean in column bearing a common superscripts do not differ significantly (p<0.05).

T₁-Coagulation temperature of 75 °C
T₂-Coagulation temperature of 80 °C
T₃-Coagulation temperature of 85 °C

The significant difference (p<0.05) were observed in the mean values for appearance but treatment T₂ and T₃ were non-significant to each other and they were differed significantly higher than T₁. The average values of taste and flavor, body and texture and overall acceptability for treatment T₁, T₂ and T₃ differed significantly (p<0.05). The values for T₂ and T₃ for taste and flavour, Body and texture and overall acceptability were non-significant each other but significantly higher than T₁. Similar finding made by Singh and Kanawjia (1988) [13] for sensory score of a cow milk paneer improved with increase in coagulation temperature (i.e. 75 to 90 °C). Rao et al. (1984) [11] also reported that paneer samples obtained with heat treatment of 85 °C scored highest due to the superior flavour, body and texture and colour and appearance.

On the basis of above study, it can be seen that T₃ was preferred the most with respect to all the attributes studied from amongst all the experimental samples. A coagulation temperature of 85 °C was found to be satisfactory, because it resulted in good quality goat milk paneer (Table 2) and was employed in the third part of the study.

Third part: In this part of the study paneer was prepared from goat milk added with 0.10 percent calcium chloride using different strength of citric acid solution as coagulant like S₁ (1%), S₂ (2%) and S₃ (3%) at 85 °C coagulation temperature. The results on General appearance, Taste and flavour, Body and texture and Overall acceptability of paneer have been recorded in table 3.

<table>
<thead>
<tr>
<th>Sensory attributes</th>
<th>General Appearance</th>
<th>Taste and Flavour</th>
<th>Body and texture</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>S₁</td>
<td>7.53 ±0.07</td>
<td>7.46 ±0.10</td>
<td>8.13 ±0.13</td>
<td>7.53 ±0.05</td>
</tr>
<tr>
<td>S₂</td>
<td>7.16 ±0.05</td>
<td>7.00±0.06</td>
<td>7.40 ±0.13</td>
<td>7.03 ±0.08</td>
</tr>
<tr>
<td>S₃</td>
<td>6.73 ±0.10</td>
<td>6.93 ±0.04</td>
<td>6.73 ±0.20</td>
<td>6.70 ±0.08</td>
</tr>
</tbody>
</table>

Each observation is a mean ± SE of three replicate experiment (n=3)
Mean in column bearing a common superscripts do not differ significantly (p<0.05).

S₁- 1% citric acid solution
S₂- 2% citric acid solution
S₃- 3% citric acid solution

The average value for general appearance of a treatment S₁, S₂ and S₃ were 7.53±0.07, 7.16±0.05 and 6.73±0.10 respectively. The score of appearance for S₁ treatment was significantly (p<0.05) higher than S₁ but non-significant to S₂ treatment. The mean values for taste and flavor and overall acceptability of S₁ treatment significantly (p<0.05) higher than S₂ and S₃ treatments while S₁ and S₃ treatments for taste and flavor and overall acceptability were non-significant to each other. The average value for body and texture of a treatment S₁, S₂ and S₃ were 8.13±0.13, 7.40±0.08 and 6.73±0.20 respectively. The score of body and texture for S₁ treatment was significantly (p<0.05) higher than S₁ but non-significant to S₂ treatment. The present findings are in close agreement with that of Bankar et al. (2014) [3] who reported 1 percent citric acid solution scored maximum for all sensory attributes than 2 percent and 3 percent concentration of citric acid solution. Khan et al. (2014) [7] also observed that the body and texture score exhibited decrease in score with the increase in concentration of coagulant.

From this study, it is evident that amongst all the levels tried S₁ (1.0 percent citric acid solution) when used as coagulant resulted in product having superior quality with respect to all the attributes studied. Hence a level of 1.0 percent citric acid solution was selected and was employed in the standardized process.

This investigation was conducted to arrive at a modified method in developing an acceptable quality goat milk paneer. From the results obtained in the study the method of preparing goat milk paneer was modified to obtain paneer with desirable overall quality characteristics. In the modified method, 5.0 percent fat milk with addition of 0.10 percent calcium chloride was subjected to heating at 90 °C with no holding followed by cooling to 85 °C and using 1 percent citric acid solution as coagulant.

**Conclusion**

On the basis of the results obtained in the experiment, it is concluded that all the study parameters such as addition of calcium chloride, coagulation temperature and strength of coagulant play a significant role in obtaining goat milk paneer with high acceptability and consistent quality. The good quality goat milk paneer could be prepared by addition of 0.10 percent of calcium chloride using 1 percent solution of citric acid as a coagulant at coagulation temperature of 85 °C.
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References