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Effect of different coagulation temperature on the preparation of paneer from goat milk

Lokendra Singh and Karishma Rathore

Abstract
The present study was conducted on goat milk paneer to estimate the effect of different coagulation temperature in term of quantity of coagulant used and quantity of whey received during preparation of goat milk paneer and on sensory quality (General appearance, Taste and flavour, Body and texture and Overall acceptability) and yield of goat milk paneer. Different coagulation temperature for preparation of paneer from a goat milk were used like T_1 (75 °C), T_2 (80 °C) and T_3 (85 °C). The statistical analysis of data revealed that the values for quantity of whey received during preparation of paneer and yield for T_1, T_2 and T_3 were non-significant to each other but in case of T_3 found higher value than T_2 and T_1. The mean values for quantity of coagulant for T_3 and T_2 were non-significant to each other but differed significantly ($p<0.05$) with T_1. The values for T_2 and T_3 for General appearance, taste and flavour, Body and texture and overall acceptability were non-significant each other but significantly higher than T_1. A coagulation temperature of 85 °C was found to be best suited, because it resulted in good quality goat milk paneer.

Keywords: Goat milk, coagulation temperature, paneer, yield, sensory quality

1. 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) [5]. Total milk production in India is187.7 million tone and goat milk contribution is 3 percent of total milk production in India (Basic Animal Husbandry Statistics, 2019) [5]. Goat milk has been recommended as an ideal substitute for cow and human milk (Zenebe *et al*., 2014) [11]. 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) [4]. The growing consumer interest in goat's milk and its dairy products is related to the nutritional benefits offered by these products (Clark & Gacia, 2017) [3]. 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) [7]. The temperature and pH of coagulation have a significant effect on the body and texture, total solid recovery and yield of paneer. The optimum temperature of coagulation differs for different types of milk and their composition, including fat. 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 estimate the effect of coagulation temperature in term of quantity of coagulant used and quantity of whey received during preparation of goat milk paneer and on sensory quality and yield of goat milk paneer, different coagulation temperature were used for its preparation.

2. Materials and Methods
2.1 Procurement of milk: Goat milk was procured from livestock research station, Bojunda, Chittorgarh and standardized to 5 percent fat for preparation of paneer.

2.2 Preparation of paneer: Different coagulation temperature for preparation of paneer from goat milk were used like T_1 (75 °C), T_2 (80 °C) and T_3 (85 °C) to preparation of paneer. The product was prepared by the process suggested by Sachadeva and Singh (1988) [8]. The standardized goat milk was added with 0.10 percent calcium chloride and heated to 90 °C than subsequently cooled to coagulation temperature and add 1 percent citric acid solution as coagulant 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.

2.3 Yield of goat milk paneer: The yield of goat milk paneer obtained was weighed and recorded as per cent yield of the milk used for preparation of goat milk paneer in each treatment.

2.4 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.

2.5 Statistical analysis: Data were statistically analyzed by using the method described by Snedecor and Cochran (1989) [10].

3. Results and Discussion

To study the effect of different coagulation temperature, paneer was prepared from goat milk added with 0.1 percent calcium chloride using 1 percent of citric acid solution as coagulant at coagulation temperature.

3.1 Effect of different coagulation temperature on various parameters like, the quantity of coagulant (1% citric acid solution) used and quantity of whey received during preparation of paneer and yield of goat milk paneer.

The results of mean values of effect of different coagulation temperature on various parameters like, the quantity of coagulant (1% citric acid solution) used and quantity of whey received during preparation of paneer and yield of goat milk paneer are presented in Table 1.

The mean values for quantity of citric acid solution (ml/L milk) used were T_1 (104.00±4.8), T_2 (61.33±1.53) and T_3 (46.66±3.84). The mean values for quantity of citric acid solution for T_3 and T_2 were non-significant to each other but differed significantly ($p<0.05$) with T_1. Chawla *et al*. (1987) [2] also reported that amount of a coagulant required decrease with increase in coagulation temperature.

The average values for quantity of whey (ml/L milk) received were T_1 (682.66±20.77), T_2 (702.66±35.68) and T_3 (710.66±25.65). The values for quantity of whey received for T_1, T_2 and T_3 were non-significant to each other but in case of T_3 found higher value than T_2 and T_1. The average values of effect of different coagulation temperature on yield of paneer were T_1 (14.58±0.58), T_2 (16.50±0.84) and T_3 (16.96±0.91). It is seen that the values did not differ significantly from each other. The mean value of a yield of T_3 was observed higher than T_2 and T_1. Singh and Kanawjia (1988) [9] also reported that increase in yield of a cow milk paneer with increase in coagulation temperature.

Table 1: Effect of different coagulation temperature on various parameters like, the quantity of coagulant (1% citric acid solution) used and quantity of whey received during preparation of paneer and yield of goat milk paneer.

Parameter	Quantity of citric acid used (ml/L milk)	Quantity of whey received (ml/L milk)	Yield (%)
T_1	104.00 a ±4.8	682.66±20.77	14.58±0.58
T_2	61.33 ^{b} ±1.53	702.66±35.68	16.50±0.84
T_3	46.66 ^{b} ±3.84	710.66±25.65	16.96±0.91

Each observation is a mean ± SE of three replicate experiment (n=3)
Mean in column bearing a common superscripts do not differ significantly ($p<0.05$).
T_1-Coagulation temperature of 75 °C
T_2 -Coagulation temperature of 80 °C
T_3-Coagulation temperature of 85 °C

3.2 Effect of different coagulation temperature on sensory quality of goat milk paneer

The results of effect of different coagulation temperature on sensory quality (general appearance, taste and flavour, body and texture, and overall acceptability) of goat milk paneer are presented in Table 2.

3.2.1 General appearance: The average value for general appearance of a treatment T_1, T_2 and T_3 were 6.20 ±0.13, 6.86 ±0.04 and 7.13 ±0.04 respectively. The significant difference ($p<0.05$) were observed in the mean values for appearance but treatment T_2 and T_3 were non-significant to each other and they were differed significantly higher than T_1.

3.2.2 Taste and flavor, body and texture and overall acceptability: The average values of taste and flavor, body and texture and overall acceptability for treatment T_1, T_2 and T_3 differed significantly ($p<0.05$). The values for T_2 and T_3 for taste and flavour, Body and texture and overall acceptability were non-significant each other but significantly higher than T_1. Similar finding made by Singh and Kanawjia (1988) [9] for sensory score of a cow milk paneer improved with increase in coagulation temperature (*i.e.* 75- 90 °C).

On the basis of current study, it can be seen that T_3 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 best suited, because it resulted in good quality goat milk paneer.

Table 2: Effect of different coagulation temperature on sensory quality of goat milk paneer

	Sensory attributes			
Parameter	General Appearance	Taste and Flavour	Body and texture	Overall Acceptability
T_1	6.20 ^{b} ±0.13	5.96 ^{b} ±0.07	6.06 ^{b} ±0.07	6.10 ^{b} ±0.08
T_2	6.86 ^{a} ±0.04	7.00 ^{a} ±0.06	7.00 ^{a} ±0.13	6.90 ^{a} ±0.12
T_3	7.13 ^{a} ±0.04	7.06 ^{a} ±0.04	7.06 ^{a} ±0.01	7.08 ^{a} ±0.11

Each observation is a mean ± SE of three replicate experiment (n=3)
Mean in column bearing a common superscripts do not differ significantly ($p<0.05$).
T_1-Coagulation temperature of 75 °C
T_2- Coagulation temperature of 80 °C
T_3-Coagulation temperature of 85 °C

4. Conclusion

On the basis of the results obtained in the experiment, it is concluded that quantity of whey received during preparation of paneer and yield of paneer (P>0.05) were not affected by coagulation temperature. Quantity of coagulant used during

preparation of paneer and sensory quality of paneer were significantly ($P<0.05$) affected by coagulation temperature. A coagulation temperature 85 °C was found to be best suited, because it resulted in good quality goat milk paneer**.**

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