



# Effect of goat milk fortification on chemical, microbial and sensorial quality characteristics of *Paneer*

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**ABSTRACT :** The present investigation was carried out to assess the suitability of goat milk incorporation in preparation of *Paneer* on the basis of sensorial properties and to observe the effect of goat milk addition of nutritional and microbial quality of *Paneer*. Different proportions of goat milk (*viz.*, 25, 50 and 75%) were used as replacement of buffalo milk and effect of different proportions on sensorial quality characteristics, chemical composition and microbial profile was evaluated. The Results showed that increasing proportion of goat milk incorporation reduced sensorial, nutritional and microbial quality of *Paneer*. However, results of overall acceptability showed that sample containing 25 per cent goat milk observed to be under very much liked sample among the other treatments without significantly affecting the sensory quality profile of *Paneer*.

**KEY WORDS :** *Paneer*, Goat milk incorporation, Nutritional quality, Microbial quality

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## INTRODUCTION

India is an agrarian country in which major proportion of population is vegetarian. Milk plays an important role in the diet of such persons as a source of animal proteins.

*Paneer* is a South Asian variety of soft cheese obtained by acid and heat coagulation of milk. It is non-fermentative, non-renneted, non-melting and unripened type of cheese. The production of *Paneer* is now spreading throughout the world. It is one of the popular indigenous dairy product in which the technique of acid coagulation of milk at high temperature is

used to conserve wholesome and unique nutrients of milk. *Paneer* is extensively used as base material in preparation of large number of culinary dishes and snacks. An estimated 5 per cent of milk produced in India is converted into *Paneer* (ICMR, 2000; Chandan, 2007). Good quality *Paneer* is characterized by marble white colour, sweetish, mildly acidic taste, nutty flavour, spongy body and closely knit, smooth texture and generally prepared from buffalo milk (Patel, 1991). According to specifications, *Paneer* shall contain not more than 70 per cent moisture and the fat content should not be less than 50 per cent expressed on dry matter basis (PFA, 2010). The ability of *Paneer* to be deep fried is one feature that has led to its wider acceptance and a favorite for making snakes, *pakors* or fried *Paneer* chunks (Aneja, 2007). Due to the ever growing demand of the *Paneer*, by varied health conscious consumers, researchers were encouraged to develop new types and varieties of *Paneer viz.*, skim milk *Paneer*, low fat *Paneer*, fibre enriched low fat *Paneer*, soy *Paneer*, filled *Paneer*, *Paneer* from mixed milk etc.

Goats are important component of livestock industry and play vital role in the socio-economic structure of economically weak, rural community. India ranks first in world goat milk production with the production of around 48,50,000 MT of

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milk (FAOSTAT, 2012). Goat milk differs from cow or buffalo milk is having better digestibility, alkalinity, buffering capacity and certain therapeutic values in medicines and human nutrition (Haenlein and Caccese, 1984).

Goat milk is naturally homogenized it forms soft curd when compared to cow milk and hence helps in easy digestion and absorption (Roy and Vadodaria, 2006). In India goat milk is generally considered as inferior as compared to cow and buffalo milk because of strong goaty flavour and having low utility for direct consumption.

There are limited references available for utilization of goat milk in production of *Paneer* as the *Paneer* produced from whole goat milk having some limitation due to its goaty flavour. The use of goat milk along with the buffalo milk for preparation of *Paneer* may attribute the nutritional as well as medicinal properties of *Paneer*. Therefore considering the above facts the attempt was made to explore the possibility of utilization of goat milk in combination with buffalo milk in preparation of *Paneer*.

## MATERIAL AND METHODS

The present investigation was carried out in the Department of Animal Husbandry and Dairy Science, College of Agriculture, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani during academic year 2013-14.

### Material :

The whole, fresh clean buffalo and goat milk was obtained from Dairy Unit, Department of Animal Husbandry and Dairy Science, College of Agriculture, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani. All the other equipments for preparation of *Paneer* were available in the department. All chemicals used during present investigation were of analytical grade.

### Treatments for development of *Paneer* :

For preparation of *Paneer* from buffalo milk blended with goat milk following treatment combination were studied

- $T_0$  = 100 parts of buffalo milk + 0 parts of goat milk (control sample)  
 $T_1$  = 75 parts of buffalo milk + 25 parts of goat milk  
 $T_2$  = 50 parts of buffalo milk + 50 parts of goat milk  
 $T_3$  = 25 parts of buffalo milk + 75 parts of goat milk.

### Preparation of *Paneer* :

*Paneer* was prepared as per the method described by Bhattacharya *et al.* (1971) with slight modifications. Buffalo milk was first filtered through double layered muslin cloth in order to remove dust and dirt particles. Milk was separated by centrifugal cream separator for standardization purpose. Buffalo milk was standardized to 6 per cent fat and 9 per cent SNF using buffalo skim milk with standardized buffalo milk was done.

The mixed milk was added slowly continuous stirring till complete coagulation occurred and clear whey was seen. After coagulation of milk, the whey and coagulant was separated by draining with the help of muslin cloth. The hot coagulant was transferred into a circular stainless steel hoop for hoping purpose and pressing was done by applying the weight of 3.0 kg/cm<sup>2</sup> for 15 minutes for texturization of coagulated mass. Cut the coagulated mass into pieces (6'' × 6'') and dropped in chilled water at 5°C for 2 to 3 hours, the chilled *Paneer* was then to drain out. Finally the *Paneer* blocks were wrapped in parchment paper and stored in refrigerator.

### Preparation of *Paneer* from buffalo milk blended with goat milk :

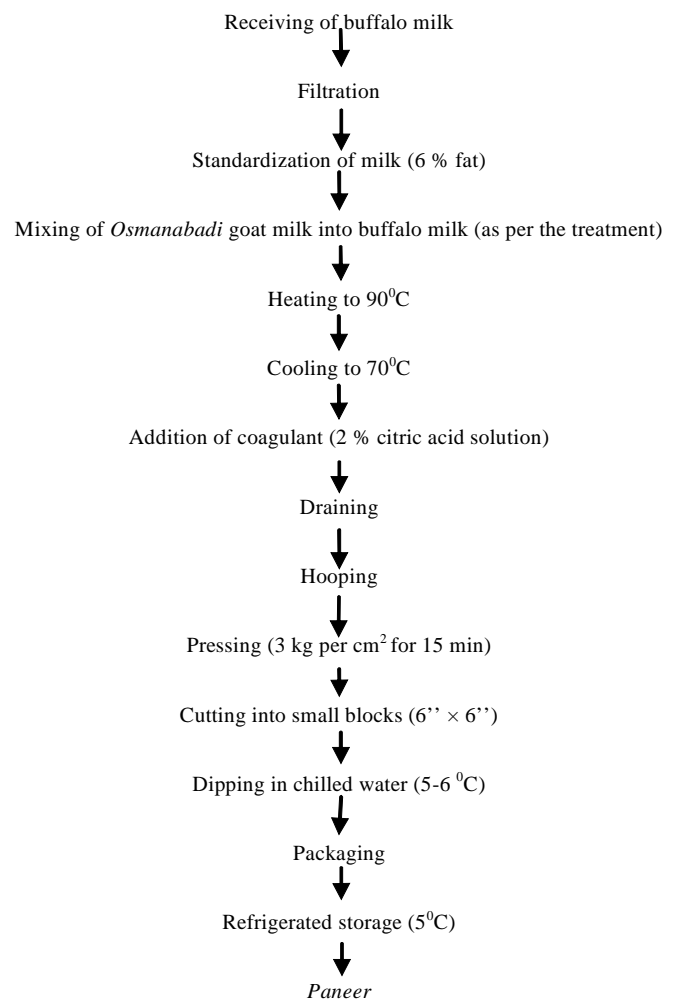


Fig. A : Flow chart for preparation of *Paneer* from buffalo milk blended with goat milk

### Sensory evaluation of *Paneer* :

Sensory evaluation of *Paneer* was carried out by standardized method using 9 point hedonic scale. The scores

given by the panel of judges were then statistically analyzed (Gupta, 1976).

#### Chemical analysis of *Paneer* :

The moisture content was determined Atherton and Newlander (1987). Fat content was determined by IS:1223 (1977). Crude protein content, total solids and ash content were determined by AOAC method (1975). Carbohydrate was calculated by subtraction method.

#### Microbial examination :

The microbial examination of soup samples was carried out as per the method cited in Indian standard institute (ISI) 1969. The results obtained for each count was recorded as colony forming unit per gram of sample *i.e.* CFU/gm.

#### Standard plate count :

It was determined by the method cited in ISI (IS: 5402) 1969 by using tryptone dextrose agar medium.

#### Yeast and mould count :

Yeast and mould counts were determined by the method cited in ISI. (IS: 5403) 1969 using potato glucose agar

#### Coliform count :

The presumptive coliform test was determined by the method recommended by (Chalmers, 1955) by using McConkey's broth.

#### Statistical analysis :

The experiment laid in Completely Randomized Design was carried out the method as per Panse and Sukhatme (1967). In all there were four treatment combinations, which were replicated six times.

#### Cost of production of *Paneer* :

The various constituents or chemicals required for manufacture of *Paneer* was rated as per prevailing market price and cost per kg of *Paneer* was worked out.

## RESULTS AND DISCUSSION

The present investigation entitled "Preparation of *Paneer* from buffalo milk blended with goat milk" was carried out for optimization of concentration of goat milk in preparation of

*Paneer* from blended milk on the basis of its sensory quality characteristics. The obtained results were reported and discussed under following suitable headings.

#### Effect of goat milk incorporation on chemical composition of *Paneer* :

The *Paneer* prepared from buffalo milk blended with goat milk with various treatments were subjected to analysis *viz.*, moisture, fat, protein, ash, lactose, total solids. The results are presented in the Table 1.

#### Moisture content of *Paneer* :

It was observed that the mean moisture content in T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> were 50.10, 53.20, 54.60 and 57.10 per cent, respectively. It was also observed that as the goat milk in the blend increased the moisture content in *Paneer* decreased due to total solids content and higher amount of moisture content in goat milk. These values are agreement with reported by Rajorhia *et al.* (1984).

#### Fat content of *Paneer* :

It was observed that the mean fat content in *Paneer* was 26.07, 24.74, 24.10 and 22.72 for treatment T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively. It was also observed that highest fat content was obtained for the *Paneer* prepared from buffalo milk T<sub>0</sub> followed by T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>. This might be due to the less fat per cent in goat milk.

The highest fat content in control sample can be attributed to the higher fat content of buffalo milk than other treatments. However within treatments T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> it was progressively decreasing trend in fat content due to the low fat content of goat milk, the values were within the range prescribed by ISI (1983) and PFA (2010) and closer to the values obtained by Rajorhia *et al.* (1984).

#### Protein content of *Paneer* :

It was observed that the protein content of the finished product ranged from 19.00 to 16.00 per cent. It was also observed that as the proportion of goat milk in the blend increased the protein content of *Paneer* decreased. This might be due to less amount of protein in goat milk as compared to buffalo milk. The results in *Paneer* from barberi goat milk were some what closer to the values reported by Pal and Agnihotri (1997).

**Table 1 : Chemical composition of *Paneer* prepared with different concentrations of goat milk**

Treatments	Moisture (%)	Fat (%)	Protein (%)	Lactose (%)	Ash (%)	Total solids
T <sub>0</sub>	50.10	26.07	19.00	2.50	2.33	49.90
T <sub>1</sub>	53.20	24.74	17.70	2.38	1.98	46.80
T <sub>2</sub>	54.60	24.10	17.20	2.24	1.86	45.40
T <sub>3</sub>	57.10	22.72	16.00	2.20	1.78	42.70
S.E. ±	0.044	0.255	0.045	0.015	0.005	---
C.D. (P=0.05)	0.140	0.760	0.142	0.048	0.023	---

**Ash content of Paneer :**

Ash content in *Paneer* of treatment T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> were 2.33, 1.98, 1.86 and 1.78 respectively. As the goat milk level increases the ash content level of the product decreases. This may be due to lower ash content of goat milk. This may also be due to decreased content of total solids and increased content of moisture in the *Paneer* prepared from the higher blend of goat milk. Above findings are in agreement with Biradar *et al.* (2012). Khan *et al.* (2012) reported that decreased per cent of total solids and increased per cent of moisture decreases the ash content in the *Paneer*.

**Lactose content of Paneer :**

It can be observed from Table 1 that addition of goat milk in the blend decreased lactose content. This might be due to the low lactose content in goat milk.

**Total solids content of Paneer :**

Average total solids content of finished product were found to be 49.90, 46.80, 45.40 and 42.70 for treatment T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively. The highest total solids content was recorded for the *Paneer* (49.90 %) entirely prepared from buffalo milk T<sub>0</sub> followed by T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>. The lowest total solids content was observed for *Paneer* prepared from T<sub>3</sub> (25:75). This might be due to the less total solids content of goat milk. The decreased total solids content due to increased level of goat milk in the blend observed in study is also confirmed by the report made by Biradar *et al.* (2012) in preparation of *Paneer*.

**Effect of goat milk incorporation on sensory evaluation of Paneer :**

*Paneer* samples prepared from buffalo milk blended with goat milk were judged for its sensory quality with respect to colour and appearance, flavour, body and texture and overall acceptability by a panel of judges using 9- point hedonic scale. The results obtained for organoleptic evaluation of *Paneer* are

presented in Table 2.

**Colour and appearance :**

Colour and appearance score for different blends of *Paneer* varied from 7.25 to 8.58. The *Paneer* prepared from 100 parts of buffalo milk (control) had maximum score 8.58 followed by T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>. White coloured *Paneer* is desired by consumer while wholesome and uniform appearance is preferred. It could be observed that as the proportion of goat milk in the blend increased the colour and appearance score of *Paneer* decreases significantly. This may be due to dull colour of goat milk which affected the colour properties.

**Flavour score of Paneer :**

Flavour score of *Paneer* ranged from 6.00 to 8.41. The *Paneer* prepared entirely from buffalo milk (T<sub>0</sub>) had maximum score of 8.41 followed by treatments T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>. This might be due to the goaty flavour and salty taste of goat milk.

**Body and texture :**

Body and texture score of *Paneer* prepared from different blends of buffalo milk and goat milk ranged from 5.91 to 8.50. The maximum score 8.50 was obtained for the *Paneer* prepared entirely from buffalo milk T<sub>0</sub> (control), and minimum score 5.91 was obtained for *Paneer* prepared from 25 parts of buffalo milk and 75 parts of goat milk. From the table it is also clear that increasing proportion of goat milk linearly decreases the body and texture score of *Paneer*. Biradar *et al.* (2012) reported that increase in level of soy milk decreased the score for body and texture of *Paneer*.

**Overall acceptability :**

It was observed that the overall acceptability score of *Paneer* prepared from different blends of buffalo milk and goat milk ranged from 6.38 to 8.49. The maximum score 8.49 was obtained for *Paneer* prepared entirely from buffalo milk (T<sub>0</sub>).

**Table 2 : Sensorial evaluation of Paneer prepared with different proportions of goat milk**

Treatments	Colour and appearance	Flavour	Body and texture	Overall acceptability
T <sub>0</sub>	8.58	8.41	8.50	8.49
T <sub>1</sub>	8.16	8.00	8.08	8.10
T <sub>2</sub>	7.75	7.58	7.58	7.63
T <sub>3</sub>	7.25	6.00	5.91	6.38
S.E. ±	0.119	0.151	0.171	0.085
C.D. (P=0.05)	0.364	0.459	0.517	0.263

**Table 3 : Microbial quality of Paneer prepared with different proportion of goat milk**

Treatments	Standard plate count (cfu × 10 <sup>3</sup> /g)	Yeast and mould count (cfu × 10 <sup>3</sup> /g)
T <sub>0</sub>	2.33	1.33
T <sub>1</sub>	2.70	1.50
T <sub>2</sub>	3.16	1.66
T <sub>3</sub>	3.50	1.83

The minimum score 6.38 was obtained for *Paneer* prepared from 25 parts of buffalo milk and 75 parts of goat milk ( $T_3$ ). This might be due to goaty flavour, salty taste, loose texture and dull whitish colour of goat milk.

The above results for the decreasing colour and appearance, body and texture, flavour and overall acceptability due to increasing levels of goat milk are in confirmation with Bhadekar (2008) and Biradar *et al.* (2012) where they used different concentrations of sago powder and soy milk incorporation in preparation of *Paneer*.

#### Effect of goat milk incorporation on microbial quality of fresh *Paneer* :

The fresh product prepared was subjected to microbial analysis with respect to standard plate count, yeast and mould count and coliform count.

#### Standard plate count of *Paneer* :

It was observed that the standard plate count of fresh sample was ranged in between 2.33 to 3.50 cfu x  $10^3$  per g for treatment  $T_0$  to  $T_3$ . There is non-significant difference observed in between treatments. As the goat milk increased in *Paneer* the SPC count in *Paneer* was increased. This might be due to increased level of moisture in goat milk. Pal and Agnihotri (1997) observed the SPC count of goat milk *Paneer*, the average SPC of fresh goat milk *Paneer* sample was  $3.94 \times 10^3$  cfu/g.

#### Yeast and mould count of *Paneer* :

The yeast and mould count of *Paneer* ranged between 1.33 to 1.83 cfu per g for treatment  $T_0$  to  $T_3$ . The highest count was observed in  $T_3$  followed by  $T_2$ ,  $T_1$  and  $T_0$ . It also observed that, non-significant difference between the various treatments. As the goat milk increased in *Paneer* the yeast and mould count in *Paneer* was increased. This might be due to increased level of moisture in goat milk. Srivastava (2004) observed the yeast and mould count of buffalo milk *Paneer*, the average yeast and mould count was  $\log 1.338 \times 10^3$  cfu per g. Pal and Agnihotri (1997) observed the yeast and mould count of goat milk *Paneer*, the average yeast and mould count of fresh goat milk *Paneer* sample was  $\leq 1.0 \log_{10}$  cfu/g<sup>-1</sup>.

#### Conclusion :

It could be concluded that goat milk at the level of 25 per cent could be successfully used for blending with buffalo milk in preparation of *Paneer* without significantly affecting the sensorial, textural and microbial quality of *Paneer*.

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