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**SE Kangare**  
 Department of Animal  
 Husbandry and Dairy Science,  
 College of Agriculture, Latur,  
 Maharashtra, India

**PV Padghan**  
 Senior Scientist Cattle Cross  
 Breeding Project, VNMKV,  
 Parbhani, Maharashtra, India

**RB Kurumkar**  
 Department of Animal  
 Husbandry and Dairy Science,  
 College of Agriculture, Latur,  
 Maharashtra, India

**Corresponding Author:**  
**SE Kangare**  
 Department of Animal  
 Husbandry and Dairy Science,  
 College of Agriculture, Latur,  
 Maharashtra, India

## Physico-chemical properties of Paneer prepared from cow milk blended with buffalo colostrum

**SE Kangare, PV Padghan and RB Kurumkar**

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### Abstract

In the present investigation the attempt was made to study the Physico-chemical properties of Paneer prepared from cow milk blended with buffalo colostrum. The Paneer was prepared by considering treatment combination of cow milk and buffalo colostrum as 95%, 90% and 85% of cow milk and 5%, 10% and 15% of buffalo colostrum in treatments T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> whereas treatment T<sub>1</sub> was taken as control. The Physico-chemical properties (pH, acidity, fat, protein, ash, moisture and total solid) for the Paneer prepared from cow milk blended with buffalo colostrum were analyzed. The treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> contained score for acidity 0.30, 0.37, 0.46 and 0.54 percent, pH 6.87, 6.68, 6.51 and 6.42 percent, fat 23.76, 24.38, 24.98 and 25.10 percent, protein 16.99, 17.13, 17.24 and 18.03 percent, moisture 55.61, 54.62, 53.97 and 52.65 percent, total solid 44.64, 44.78, 45.06 and 46.18 percent, ash 0.84, 1.66, 1.54 and 1.58 percent, respectively. On the basis of result it was revealed that as the concentration of buffalo colostrum in Paneer increased there was increase in acidity, protein, fat, ash, total solid, while pH and moisture percentage decreased.

**Keywords:** Paneer, cow milk, buffalo colostrum

### Introduction

India is leading as a global milk producer. India's fluid milk production in market year 2023 is 207 million metric tons, up to 2 percent from the earlier revised MY 2022 estimates of 202.5 MMT and milk consumption in MY 2023 at 86.5 MMT up somewhat compared to the MY 2022 consumption of 85 MMT. (Anonymous 2022-23) [5]. According to Prevention of Food Adulteration Rules (PFA 2010) [14], Paneer means the product obtained from cow or buffalo milk or a combination thereof by precipitation with sour milk, lactic acid or citric acid. It shall not contain more than 70 percent moisture and the milk fat content shall not be less than 50% of the dry matter. Colostrum contains major nutrients (fatty acids, proteins, carbohydrates, vitamins (A, B6, B12, C etc.), minerals (Ca, Na, Mg, P, Cl, K etc.), immunological compounds (immunoglobulines - IgG and IgM, hormones and enzymes. Besides providing immune support colostrum has remarkable musculoskeletal repair and growth capabilities. In addition, it seems that colostrum is the only natural source of four major growth factors namely transforming growth factors alpha (TGF- $\alpha$ ) and beta (TGF-B), and insulin-like growth factors 1 (IGF-1) and 2 (IGF-2). Colostrum in addition is also a protecting agent against various disease (Coroian *et al.* 2013) [1]. The present investigation was carried out to study the physico-chemical properties of Paneer prepared from cow milk blended with buffalo colostrum.

### Materials and Methods

**Cow milk and Buffalo colostrum:** The fresh Cow milk was purchased from local market of Latur city, having 3.5 percent fat and 8.5 percent SNF. The Buffalo colostrum was purchased from farmer of Sonvati village of Latur.

### Chemicals

Analytical reagents (AR), or Guaranteed reagents (GR), were used in chemical analysis.

### Packaging material

A polythene bag of 200 gauge were used for packing of Paneer.

### Equipment and accessories

The equipment includes stainless steel vessels of requisite capacity, knives, mixture, milkometer (fat, lactose, solid not fat and protein of milk), standard weight balance, thermometer, gas shegadi, muslin cloth, Paneer press machine, etc used for the preparation of Paneer. All the equipment was properly cleaned and washed with the detergent solution before using and all the precautionary measures were considered during the conduction of trials to avoid contamination.

### Preparation of Paneer from cow milk blended with buffalo colostrum

The cow milk with 3.5 percent fat and 8.5 percent SNF was heated to 90°C and cooled up to temperature 78°C. After cooling buffalo colostrum was added than citric acid was added @ 1 percent at 76°C with stirring. After complete coagulation the stirring was stopped and allow the curd to sink to the bottom. The whey was then drained through a stainless steel container. The curd was collected and filled in stainless steel Paneer hoop. The hoop used was of circular blocks with holes on its side to facilitate the expulsion of whey. Paneer was pressed 10-15 minutes @ 3 kg/sq em. The pressed block of curd was removed from the hoop, cut into pieces and immersed in chilled water (4 °C) for 2 to 3 hours. The chilled Paneer was then removed from water to drain out and packed in polythene bag and finally was stored in refrigerator (5 °C).

### Treatment combinations

The Paneer was prepared from cow milk blended with buffalo colostrum as per the following treatments.

T<sub>1</sub>= Paneer from Cow milk (control)

T<sub>2</sub>= Paneer with 5 percent of Buffalo colostrum (On a wt. basis of milk)

T<sub>3</sub>=Paneer with 10 percent of Buffalo colostrum (On a wt. basis of milk)

T<sub>4</sub>= Paneer with 15 percent of Buffalo colostrum (On a wt. basis of milk)

### Evaluation of physico-chemical properties of Paneer

Paneer samples of different treatments were subjected for analysis for pH {digital pH meter}, titrable acidity {IS: 1479 (1960) [91 Part-1]}, fat {IS: 1224 (part II) (1977)} [81, protein {A.O.A.C. (Official method of Analysis. (1965))} [11, moisture/total solid/ash {IS: SP (Part XI) 1981} [101]. The data were analyzed statistically by using Completely Randomized Design (CRD) as per Panse and Sukhatme (1985) [13].

## Results and Discussion

### Physico-chemical analysis of Paneer

The requisite Paneer samples prepared from cow milk blended with buffalo colostrum were subjected for the proximate analysis of physico-chemical properties such as pH, acidity, fat, protein, moisture, ash and total solids.

### pH of Paneer prepared from buffalo milk blended with cow colostrum

The pH of Paneer refers to the level of acidity or alkalinity in the cheese. The pH content in the finished product prepared under different treatments combinations had been determined in table no. 1.

**Table 1:** pH of buffalo colostrum blended cow milk Paneer

Treatment \ Replication	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	Mean
T <sub>1</sub>	6.86	6.85	6.87	6.90	6.87 <sup>a</sup>
T <sub>2</sub>	6.60	6.63	6.69	6.78	6.68 <sup>b</sup>
T <sub>3</sub>	6.54	6.52	6.50	6.49	6.51 <sup>c</sup>
T <sub>4</sub>	6.43	6.48	6.41	6.39	6.42 <sup>d</sup>
SE± 0.0246, CD at 5% 0.0759					

The values with different superscripts differ significantly at 5 percent level of significance.

From Table no. 1 it was revealed that the average scores for pH of developed Paneer was continuously decreased. The highest value of pH was shown by treatment T<sub>1</sub> i.e. 6.87. and the lowest had shown by treatment T<sub>4</sub> i.e. 6.42. The pH of the Paneer declined as the amount of buffalo colostrum in Paneer increased and average scores for pH declined from 6.87 to 6.68, 6.51 and 6.42. The reduced values in pH of all treatments of developed Paneer was due to increase in its acidity due to addition of buffalo colostrum.

The results of the Paneer generated were similar to those found in the following research investigations.

Anamika (2013) [4] observed that with increase in bovine colostrum level, there was significant decrease ( $p>0.05$ ) in pH of bovine colostrum supplemented ice cream. The pH values of R<sub>1</sub> and R<sub>2</sub> were found to be 6.52 and 6.48 respectively. Saleh *et al.* (2019) [15] stated that the pH values of all the produced ice cream with buffalo colostrum took an opposite trend to that of the acidity and decreased compared to control from (6.49) to (6.41) for T<sub>1</sub>, (6.38) T<sub>2</sub>, (6.34) T<sub>3</sub> and (6.32) T<sub>4</sub> respectively.

### Percent acidity percentage of buffalo colostrum blended cow milk Paneer

The data on acidity content in buffalo colostrum blended cow milk Paneer is presented in Table no. 2.

It was observed that the average acidity (percent) of Paneer prepared under each treatment was increased as buffalo colostrum quantity increased.

**Table 2:** Percent acidity of buffalo colostrum blended cow milk Paneer

Treatment \ Replication	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	Mean
T <sub>1</sub>	0.29	0.32	0.27	0.30	0.30 <sup>d</sup>
T <sub>2</sub>	0.35	0.38	0.36	0.40	0.37 <sup>c</sup>
T <sub>3</sub>	0.42	0.43	0.45	0.52	0.46 <sup>b</sup>
T <sub>4</sub>	0.46	0.58	0.50	0.62	0.54 <sup>a</sup>
SE± 0.0227, CD at 5% 0.0701					

The values with different superscripts differ significantly at 5 percent level of significance.

The overall acid content of a food is indicated by its titrable acidity. From Table 2, indicates that the mean average scores for acidity of Paneer were 0.30, 0.37, 0.46 and 0.54 percent for treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>, respectively. It was observed that buffalo colostrum increased the acidity of the developed product. The highest value for acidity had shown by treatment T<sub>4</sub> (0.54) and lowest value for acidity had shown by treatment T<sub>1</sub> (0.30). All the treatment shown significant differed between each other.

The results of the Paneer generated were similar to those found in the following research investigations.

Neupane (2018) [11] showed that the results on acidity percent in control and experimental Paneer using cow milk

and soymilk sample of various treatments. It was discovered that the soy Paneer was found to be slightly acidic than control sample from  $0.507 \pm 0.01$  to  $0.41 \pm 0.005$ .

Saleh *et al.* (2019) [15] showed that the acidity of ice cream without colostrum compared to ice cream with buffalo colostrum had slightly higher acidity than control as 0.24, 0.28, 0.31, 0.36 respectively.

### Fat percentage of buffalo colostrum blended cow milk Paneer

Gerber's fat determination device was used to determine the fat content of the created product. The average ratings for fat produced Paneer are shown in Table no. 3.

**Table 3:** Fat percentage of buffalo colostrum blended cow milk Paneer

Treatment \ Replication	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	Mean
T <sub>1</sub>	23.04	24.02	23.98	24.01	23.76 <sup>c</sup>
T <sub>2</sub>	24.30	24.80	24.02	24.41	24.38 <sup>b</sup>
T <sub>3</sub>	25.06	25.00	24.80	25.06	24.98 <sup>a</sup>
T <sub>4</sub>	25.09	25.07	25.07	25.18	25.10 <sup>a</sup>
SE $\pm$ 0.1488, CD at 5% 0.4587					

The values with different superscripts differ significantly at 5 percent level of significance.

From Table no. 3 it was concluded that the mean fat percentage score of the manufactured Paneer continued to rise from treatment T<sub>1</sub> (23.76), T<sub>2</sub> (24.38), T<sub>3</sub> (24.98) to T<sub>4</sub> (25.10) concerning the percentage of buffalo colostrum. The treatments T<sub>3</sub> as (24.98) and T<sub>4</sub> as (25.10) at par with each other but significantly different from treatment T<sub>1</sub> as (23.76) and T<sub>2</sub> as (24.38). According to the current study, the fat percentage of Paneer rose as the amount of buffalo colostrum in Paneer increased.

The results of the Paneer generated were comparable to those found in the following research investigations.

Nivedita and Prajakta. (2015) [12] studied on fat values of experimental recipes like kalakand, palak Paneer, chocolate split, and vegetable pizza prepared using bovine colostrum and found to be higher than control recipes from 4.48 to 23.64, 9.77 to 10.82, 24.09 to 25.29 and 5.78 to 9.92.

Alshymaa *et al.* (2022) [2] studied on functional stirred yoghurt fortified with buffalo colostrum and found increasing values of fat when compared with control 6.52 to 6.75.

### Protein percentage of buffalo colostrum blended cow milk Paneer

Protein in milk refers to essential macronutrient found in milk and dairy products. The protein percentage of the developed product was determined using Kjeldahl's distillation flask method. The recorded protein values under different treatment combinations are presented. in Table No.4.

**Table 4:** Protein percentage of buffalo colostrum blended cow milk Paneer

Treatment \ Replication	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	Mean
T <sub>1</sub>	16.98	16.96	17.03	16.99	16.99 <sup>b</sup>
T <sub>2</sub>	17.11	17.15	17.13	17.12	17.13 <sup>b</sup>
T <sub>3</sub>	17.26	17.24	17.22	17.24	17.24 <sup>b</sup>
T <sub>4</sub>	18.15	18.13	18.39	17.43	18.03 <sup>a</sup>
SE $\pm$ 0.1039 CD at 5% 0.3201					

The values with different superscripts differ significantly at 5 percent level of significance.

From Table no. 4, the protein percentage in buffalo colostrum added cow milk Paneer rose as the amount of buffalo colostrum percent increased. The mean average protein score of buffalo colostrum blended cow milk Paneer was (16.99), (17.13), and (17.24) for treatments T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively. Were significantly different from treatment T<sub>4</sub>. T<sub>4</sub> had the highest percentage of protein whereas T<sub>1</sub> had the lowest protein percentage. The protein increased in each treatment was due to the higher protein in buffalo colostrum.

The results of the Paneer generated were comparable to those found in the following research investigations.

Nivedita and Prajakta. (2015) [12] revealed protein values of experimental recipes like Kalakand, Palak Paneer, chocolate split, and vegetable pizza prepared using bovine colostrum was found to be two or three folds higher than control recipes from 3.22 to 57.15, 5.82 to 16.57, 14.02 to 26.50 and 4.55 to 8.31.

Saleh *et al.* (2019) [15] recorded the protein content average values of ice cream were the lowest ( $p < 0.01$ ) in the control compared with treatments T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>. However, the protein content gradually increased in all treatments with an increase in the added percentage of buffalo's colostrum. The measured average values were 4.90, 4.95, 5.10, 5.18 and 5.37 percent for control, T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>, respectively.

### Moisture percentage of buffalo colostrum blended cow milk Paneer

The moisture of Paneer refers to the amount of water content present in Paneer. The moisture content of the produced Paneer was determined by placing the sample in a hot air oven. The recorded moisture values of the developed product are presented. in Table No.5.

**Table 5:** Moisture percentage of buffalo colostrum blended cow milk Paneer

T	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	Mean
T <sub>1</sub>	55.05	55.77	55.60	56.00	55.61 <sup>a</sup>
T <sub>2</sub>	54.70	54.18	54.16	55.45	54.62 <sup>b</sup>
T <sub>3</sub>	54.25	53.78	53.65	54.21	53.97 <sup>b</sup>
T <sub>4</sub>	53.12	52.38	52.09	53.00	52.65 <sup>c</sup>
SE $\pm$ 0.2325, CD at 5% 0.7166					

The values with different superscripts differ significantly at 5 percent level of significance.

From the above Table no.5, it is clear that the moisture content of the control (T<sub>1</sub>) Paneer was 55.61 percent. As the proportion of buffalo colostrum increased the moisture percent of developed Paneer decreased. The decreasing trends of moisture started from T<sub>2</sub> to T<sub>4</sub> because of increase in level of buffalo colostrum. The treatments T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> were differed significantly over each other. The decline in moisture was due to the fact that colostrum had high total solid as compared to normal milk.

The results of the Paneer generated were comparable to those found in the following research investigations.

Amrita and Dabur (2015) [3] studied on moisture content of cow and buffalo colostrum Paneer and found higher value of moisture was seen in control Paneer as  $53.00 \pm 1.66$  and decreased in milk: buffalo colostrum Paneer as  $51.00 \pm 1.00$  for buffalo colostrum Paneer.

Simon *et al.* (2022) [16] prepared fresh cheese using the colostrum surplus and reported that the fresh colostrum based cheese contained  $67.98 \pm 1.16$  percent moisture.

**Ash percentage of buffalo colostrum blended cow milk Paneer**

The ash content in developed Paneer as influenced by different proportions of buffalo colostrum blended in cow milk has been presented in Table no. 6.

**Table 6:** Ash percent of buffalo colostrum blended cow milk Paneer

Treatment \ Replication	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	Mean
T <sub>1</sub>	0.70	0.79	0.86	0.99	0.84 <sup>b</sup>
T <sub>2</sub>	1.62	1.64	1.61	1.78	1.66 <sup>a</sup>
T <sub>3</sub>	1.56	1.58	1.57	1.46	1.54 <sup>a</sup>
T <sub>4</sub>	1.33	1.42	1.38	1.39	1.58 <sup>a</sup>
SE± 0.0401, CD at 5% 0.1236					

The values with different superscripts differ significantly at 5 percent level of significance.

Table no. 6, revealed that the mean ash score of buffalo colostrum blended cow milk Paneer with treatments T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> had a score of (1.66), (1.54) and (1.58) respectively. These treatment values were at par with each other but significantly different than T<sub>1</sub>. Which had a score of (0.84). From the above treatment score, it was clear that ash percent of developed Paneer rose with the amount of buffalo colostrum was added in Paneer. Treatment T<sub>4</sub> with a score of 1.58 which was the highest ash percentage score of all of the treatments. This might be due to high content of mineral as compared to milk and their binding ability to milk components.

The values recorded in ash content in the present investigation were comparable with below mentioned research.

Saleh *et al.* (2019) [15] revealed the increase of ash contents in treatments T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> as (0.90), (1.07), (1.08) and (1.09) of ice cream contained buffalo colostrum compared to the control sample scoring (0.88) percent ash.

Alshymaa *et al.* (2022) [2] estimated the ash percentage of stirred yoghurt fortified with buffalo colostrum which

increased from control 0.78 to 0.95 with the addition of buffalo colostrum.

**Total solid percentage of buffalo colostrum blended cow milk Paneer:**

The data obtained in respect of total solids content of the finished product are presented in Table. no. 7.

**Table 7:** Total solid percent of buffalo colostrum blended cow milk Paneer

Treatment \ Replication	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	Mean
T <sub>1</sub>	44.66	44.75	44.45	44.68	44.64 <sup>d</sup>
T <sub>2</sub>	44.78	44.83	44.69	44.81	44.78 <sup>c</sup>
T <sub>3</sub>	45.05	45.06	45.04	45.09	45.06 <sup>b</sup>
T <sub>4</sub>	46.18	46.21	46.14	46.19	46.18 <sup>a</sup>
SE± 0.0369, CD at 5% 0.1138					

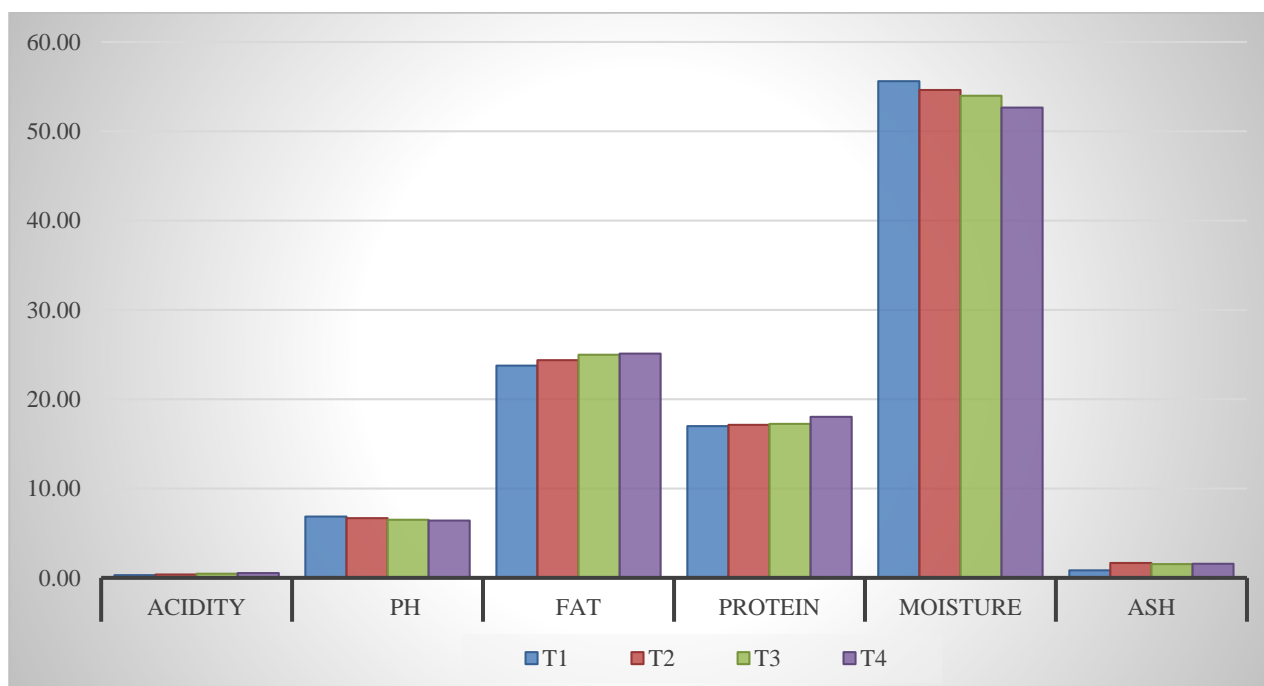
The values with different superscripts differ significantly at 5 percent level of significance.

From the Table no 7, it was revealed that the control (T<sub>1</sub>) has total solids content as 44.64 percent and other treatments i.e. T<sub>2</sub> (44.78), T<sub>3</sub> (45.06) and T<sub>4</sub> (46.18) percent. It was observed that the total solid content increased with increased in level of buffalo colostrum from T<sub>1</sub> to T<sub>4</sub>. A total solid of product is the counter part of the moisture content parameter of the product and hence moisture content directly influenced the total solid percent, decreased in moisture content of the product increased the total solid content.

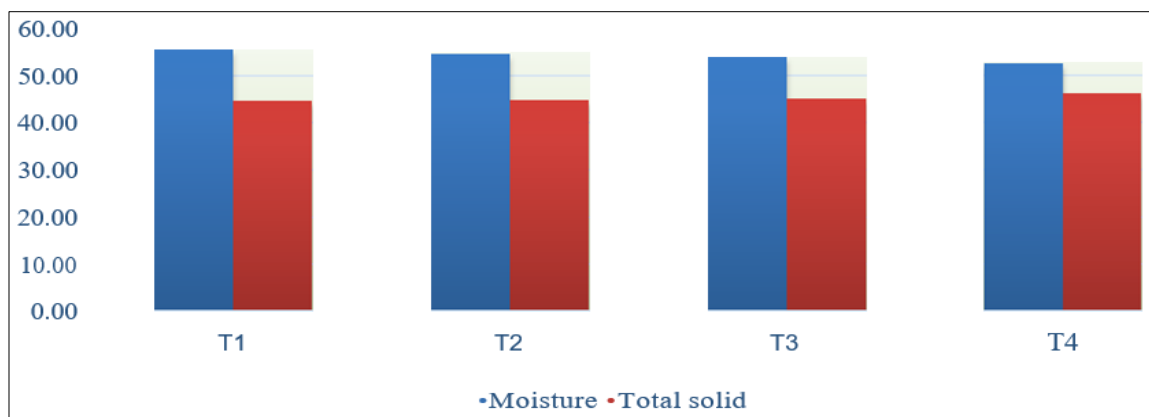
The results of the Paneer generated were comparable to those found in the following research investigations.

Bhandekar *et al.* (2018) [6] studied that the total solid content of Paneer marketed in Nagpur city was 45.51, 48.08, 47.44, and 47.21 percent of various samples.

Saleh *et al.* (2019) [15] reported that Total solids (TS) content was significantly affected by adding buffalo's colostrum. The recorded value in ice cream (36.29 percent) was significantly higher (*p*< 0.01) in treatment T<sub>4</sub> compared to the control, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> (34.20, 35.56, 35.90 and 36.12 percent respectively).







**Fig 1:** Physico-chemical analysis of Paneer prepared from cow milk blended with buffalo colostrum

### Conclusion

From present investigation it can be concluded that the buffalo colostrum can be very well utilized for preparation of medicinal and nutritional Paneer. All the physico-chemical properties i.e., pH, acidity, fat, protein, ash, moisture and total solid these values were found to be significantly differed over control and between each other. There was increased in acidity, protein, fat, ash, total solid, whereas, decrease in pH and moisture percentage of Paneer.

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