www.ajlifesciences.com / ISSN: 2663-1040 *AJ Life Sci. 2019, 2 (2): 56-65* **Original Research Article**

Abasyn Journal of Life Sciences

Open Access

DOI: 10.34091/AJLS.2.2.3

Quantitative studies on chhana (soft cheese) prepared from cow and buffalo milk

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Abstract

Quantitative studies on chhana (soft cheese) were carried out to evaluate the chemical characteristics by using two milk sources and three coagulants in the department of Animal Product Technology Sindh Agriculture University Tandojam, Pakistan. Chhana was prepared from cow and buffalo milk coagulated with acetic acid, citric acid, and lactic acid at 0.5, 1, 2 and 4% concentration level. Chhana prepared with citric acid indicated remarkable variation (P< 0.05) among the ash content of cow milk chhana and buffalo milk chhana. On the basis of present finding it was concluded that Moisture content, protein content, fat content and yield of chhana in buffalo milk chhana coagulated with acetic acid, citric acid and lactic acid was comparatively higher as compared with cow milk chhana. In this study, buffalo milk chhana was found better in all aspects compared to that of cow milk.

Keywords: Acetic Acid, buffalo Milk, Chhana, Citric Acid, Cow Milk, Lactic Acid

Article Info:
Received:
February 06, 2019
Received Revised:
July 25, 2019
Accepted:
August 25, 2019
Available online:
October 1, 2019

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How to cite:
Menghwar DR, Bhutto SA, Ahmed T . Quantitative studies on chhana (soft cheese) prepared from cow and buffalo milk. *Abasyn Journal of Life Sciences 2019; 2(2): 56-65.*

1. INTRODUCTION

Chhana or Chhena is an Indian counter part of soft cheese is a heat-acid coagulated milk product. It is prepared by precipitating the whole milk of cow or buffalo or a combination thereof by boiling and adding of lactic acid, citric acid or any other suitable coagulating agent, and subsequent drainage of whey[1]. Traditionally, the chhana is prepared by heating milk to its boiling point in open pan and allowed to cool in between 75 to 80^{0}C by constant stirring. Thereafter 1 to 2% of acid coagulant has been added to it. During the coagulation process, the milk and acid solution is stirred slowly with the help of ladle, and continued until the milk gets precipitated and settled down at the bottom of the pan. The clear whey floating on the top is filtered through a muslin cloth and semi-solid curd is collected for the consumption. Chhana being a rich source of fat and protein, fat-soluble vitamins A and D, and low sugar content is highly recommended for the diabetic patients[2]. It has been reported that factors like type of milk, heat treatment given to milk prior to acidification, coagulation temperature, acidity of milk-acid mixture and residence time of the coagulated chhana-whey mixture before separation of milk solids from whey may influence the yield and chemical composition of

chhana. While the compositional factors like calcium content, fat level, presence of colostrum and adulteration of milk with water or starch may affect the texture of chhana[3].

Moreover, chhana from cow and buffalo milk had acceptable flavor whereas, that from goat's milk was slightly acidic. While the chhana made from cow milk had higher moisture, protein and ash contents but lower fat and lactose contents than the chhana from buffalo milk[4]. It has been found that the production of chhana in desirable quality from buffalo milk was produced with modified processing parameters, for example, the chhana blended with cream has perceived the mild acidic flavor, soft body and smooth texture and suitable for manufacture of spreads or spreads with desirable spreadability at refrigeration temperature and of high nutritional quality by using functional ingredients[5]. Since chhana is one of the base materials for production of a variety of milk products like Paneer, Rasgolla (a type of sweet), Sandesh and Gulab jaman in Asian countries, has not been well studied in the (remove this word Province) of Sindh or even in Pakistan; thus an approach was hypothesized to produce and evaluate the quality and yield of chhana by using two different milk sources (milk of cow & buffalo).

2. MATERIALS AND METHODS

Milk (cow or buffalo) obtained from Livestock Experiment Station, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam, was used during the production of chhana. Food grade citric acid, acetic acid and/or lactic acid were used to coagulate the milk during chhana-making. Electrical weighing balance (Mettler PJ 300, Mettler Instrument AG Switzerland) was used to take weight of chhana samples as well as of chemical during analysis. pH meter (Model HI, Hanna Instruments, Italy) was used to determine the pH value of chhana sample. Pestle and mortar was used to grind the chhana samples for analysis. Micro Kjeldhal digestion (LABCONCO Mod 60300-01) and distillation unit were used during the determination of nitrogen/protein content of chhana.

Whole milk of cow or buffalo was collected in clean milk cans and brought to Dairy Products and Processing Laboratory, Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, Pakistan. After receiving of milk, it was first strained through muslin cloth and sample (250ml) was taken for analysis purpose, while rest of the milk was processed for chhana-making. Experiment was arranged in a Randomized complete block (RCB) design with 2 X 3 factorial treatment combinations of two milk sources i.e. cow milk (CM) and buffalo milk (BM) and three coagulants i.e. citric acid (CA), lactic acid (LA) and acetic acid (AA). In each experiment six batches were prepared according to the method as reported by[5] and replicated four times as per following treatment combinations. Milk of cow or buffalo was heated to its boiling point (100.15^{0}C) in large pan and allowed to cool at 70^{0}C under running tap water. It was then added a coagulant i.e. (CA, LA or AA, 0.5%) and stirred slowly until complete coagulation occurred. The coagulated mass was kept undisturbed for 2 min and then transferred to muslin cloth for drainage of whey without applying pressure to obtained chhana.

2.1. Chemical analysis of Chhana

Moisture Content: Moisture content was determined by evaporation method as described by[6]. The washed aluminum dishes encoded with an appropriate code were dried in a hot air oven at 100^{0}C for 1hr and kept in desiccator for cooling. Chhana sample (3 g) was taken in pre-weight empty and placed in hot air oven at 101^{0}C for approximately 3hrs. Ashed sample was transferred to desiccator having silica gel as desiccant and after 1hr, the weight was taken. The drying and desiccating was repeated till constant weight. The result was calculated by applying a following formula:

$$\text{Moisture content \%} = (W_2 - W_3 / W_2 - W_1) \times 100$$

Where,

W_1 = weight of empty dish.

W_2 = weight of dish + sample.

W_3 = weight of dish + dried sample.

Total Protein Content: Protein content was determined according to the method of British Standards Institute[7]. Sample (5 g) was digested using Micro-Kjeldhal digester in the presence of catalyst (0.2 g copper sulfate and 2 g sodium sulfate), where sulfuric acid (30 ml) was used as an oxidizing agent. The digested sample was diluted with distilled water (250 ml) and 5ml portion was distilled with 40% NaOH (5 ml) using Micro-Kjeldhal distillation unit where steam was distilled over into 2% boric acid (5 ml) containing an indicator for 3 min. The ammonia trapped in boric acid was determined by titration with 0.1N HCL. The nitrogen percentage was calculated using following formula:

$$N\ \% = (1.4\ (V_1-V_2) \times \text{normality of Hcl} / \text{Weight of sample taken} \times \text{sample used for distillation}) \times 250$$

Where,

V_1 = titrated value of sample

V_2 = blank value of sample

While protein percentage was determined by conversion of nitrogen percentage to protein, assuming that all the nitrogen in chhana was present as protein i.e. Protein percentage = Nitrogen (N)% x Conversion factor. Where conversion factor = 100/N% in protein of dairy products (i.e. 15.66).

Fat Content: Fat content of chhana was determined by Gerber method as described by James[8] for milk with minor modifications. Chhana sample (10 g) was taken into a beaker to which 1N NaOH solution (20 ml) was added and mixed thoroughly. Sample (11 ml) was transferred to butyrometer having 90% sulfuric acid (10 ml) and then amyl alcohol (1 ml) was added. After plugging the butyrometer, the sample was mixed thoroughly and placed in water bath at 65 ± 1^0C for approximately 50 min. It was then placed in Gerber centrifuge machine and centrifuged (5 min) at 1100 rpm. The fat percentage was noted on the butyrometer scale.

Solids-Not-Fat and Lactose Content: The Solids-not-fat and lactose contents were

determined by difference using the following formula:

SNF content = TS% – Fat%

Lactose content% = TS% - (Fat + Protein + Ash %)

Ash Content: Ash content was determined by Gravimetric method as described by[6] using Muffle furnace. Chhana sample (5 g) was measured in pre-weighed crucible, and transferred to muffle furnace (550°C) for 5 hrs. Ashed sample was transferred to desicator having silica gel as desiccant and after 1hr, the weight was taken. The concentration of ash was calculated by applying the following formula:

Ash % = (Weight of ashed sample / Weight of sample taken) × 100

Chloride Content: Chloride content was determined by Mohr method as described by[6]. Chhana sample (10 g) was taken in a beaker, and 20 ml of warm ($40\text{-}50^0$C) distilled water was added and mixed well, until the mixture was dissolved completely. Sample was transferred in to volumetric flask (100 ml) and made up to mark (100 ml). After mixing and filtering through the filter paper, the filtrate (25 ml) was taken into conical flask and 1 ml of potassium dichromate indicator (10% aqueous solution) was added. It was then titrated with silver nitrate (0.1N) till pale-red-brown color appears. The result was calculated as under:

Total chloride % = (ml Ag NO_3 x Normality of Ag NO_3 x 0.0355 / Weight of sample taken) × 100

2.2 Statistical Analysis: The data so obtained was edited, tabulated and analyzed according to statistical procedures like descriptive statistics and analysis of variance (ANOVA). In case of significant differences exists, the means were further computed using least significant difference (LSD) at 5% level of probability through computerized statistical package i.e. Student Edition of Statistic (SXW), Version 8.1 (Copyright 2005 Analytical Software, U.S.A).

3. RESULTS AND DISCUSSIONS

3.1 Influence of milk source on chemical characteristics of chhana

It has been observed from preliminary studies that cow milk chhana among the different concentration level of coagulants (0.5, 1, 2 and 4%), 0.5 and 1% level perceived the highest score. Thus in strategic studies, lower concentration i.e. 0.5% level of coagulant was included to observe the influence of milk source on chemical characteristics of chhana.

3.2 Moisture content

Moisture content of cow and buffalo milk chhana was analyzed, and results are shown in Table 1. It was observed that there was significant influence of milk source on moisture content of chhana product. Moisture content in buffalo milk chhana prepared with either acetic acid, citric acid or lactic acid was significantly (P< 0.05) higher (i.e. 55.60±0.52, 54.53±0.25 and 54.51±0.15%, respectively) compared to that of cow milk chhana (i.e. 51.73±0.47, 51.88±0.23 and 51.55±0.14%, respectively). The overall mean moisture content (54.88±0.18%) of buffalo milk chhana prepared with different acidulants (**Acidulants** are additives that give a sharp taste to foods) was comparatively higher (P< 0.05) from that of cow milk chhana (51.72±0.24%). It was further noticed that there was significant influence of coagulant on moisture content of chhana. Chhana prepared with acetic acid showed significantly higher moisture content (53.66±0.33%) compared to that of prepared with lactic acid (53.03±0.14%). Whilst there were no any significant (P> 0.05) variation among chhana prepared with acetic acid and citric acid or among citric acid and lactic acid.

Table 1. Moisture content (%) in chhana prepared from cow and buffalo milk

Coagulant (0.5%)	Source of milk *		Mean ± SE % **
	Cow (Mean±SE %)	Buffalo(Mean±SE %)	
Acetic acid	13.86±0.14 [b]	14.51±0.16 [a]	**14.18±0.11** [b]
Citric acid	14.94±0.16 [a]	14.50±0.15 [a]	**14.72±0.13** [a]
Lactic acid	14.79±0.32 [a]	15.05±0.22 [a]	**14.92±0.27** [a]
Mean ± SE	**14.53±0.15** [b]	**14.69±0.07** [a]	**14.61±0.11**

LSD (0.05) = **0.92±0.47** Means with similar superscript within the same row or column are not significantly different.

** LSD (0.05) = **0.61±0.30** Means with similar superscript within the same column are not significantly different.

3.3 Protein content

Protein content in cow and buffalo milk chhana was analyzed, and results are shown in Table 2. A significant influence (P< 0.05) of milk source on protein content of chhana prepared with acetic acid was observed. The buffalo milk chhana prepared with acetic acid revealed significantly (P< 0.05) higher (14.51±0.16%) protein content compared to that of cow milk chhana prepared with similar acid (13.86±0.14%). The overall mean protein content of buffalo milk chhana prepared with different coagulants was comparatively (P< 0.05) higher (14.69±0.07%) from that of cow milk chhana (14.53±0.15%). It was further found that there was no significant influence of coagulant or milk source on protein content of chhana prepared from cow or buffalo milk coagulated with citric acid or lactic acid. However, the overall mean concentration indicated significant influence of coagulant on protein content of chhana. Milk coagulated with lactic acid showed highest protein content (14.92±0.27%) followed by with citric acid (14.72±0.13%) and acetic acid (14.18±0.11%). Although variation was found in protein content of chhana prepared with lactic acid or citric acid, the differences were statistically non-significant (P> 0.05). But both of these products were significantly (P< 0.05) varied from chhana prepared with acetic acid.

Table 2. Protein content (%) in chhana prepared from cow and buffalo milk

Coagulant (0.5%)	Source of milk *		Mean±SE % **
	Cow (Mean±SE %)	Buffalo (Mean±SE%)	
Acetic acid	51.73±0.47 ^{c}	55.60±0.52 ^{a}	**53.66±0.33** ^{a}
Citric acid	51.88±0.23 ^{c}	54.53±0.25 ^{b}	**53.20±0.11** ^{ab}
Lactic acid	51.55±0.14 ^{c}	54.51±0.15 ^{b}	**53.03±0.14** ^{b}
Mean ± SE	**51.72±0.24** ^{b}	**54.88±0.18** ^{a}	**53.30±0.11**

LSD (0.05) = **0.57±0.29** Means with similar superscript within the same row or column are not significantly different.

** LSD (0.05) = **0.52±0.26** Means with similar superscript within the same column are not significantly different.

3.4 Fat content

The results of fat content of cow and buffalo milk chhana shown in Table 3 reveals significant influence of milk source on fat content of chhana product. Fat content in buffalo milk chhana prepared with either citric acid or lactic acid was significantly (P< 0.05) higher (i.e. 15.00±0.15 or 14.75±0.17%, respectively) compared to that of cow milk chhana (13.50±0.23 or 13.58±0.30%, respectively). Regardless, fat content varied among the chhana prepared from cow milk and buffalo milk coagulated with acetic acid (i.e. 14.50±0.43% and 15.08±0.13%, respectively), the differences were statistically non-significant (P> 0.05). The overall mean fat content of buffalo milk chhana (14.94± 0.07%) prepared with different coagulants was comparatively higher (P< 0.05) from that of cow milk chhana (13.86±0.27%). It was further observed that there was significant influence of coagulant on fat content of chhana. Chhana prepared with acetic acid showed significantly higher fat content (14.79±0.25%) compared to that of prepared with lactic acid (14.16±0.17%). While there were no any significant (P> 0.05) variation among chhana prepared with lactic acid and citric acid.

3.5 Ash content

Cow and buffalo milk chhana was examined for ash content, and results are present in Table 04 a significant (P< 0.05) influence of milk source was observed on ash content of chhana prepared with citric acid, but not significant (P> 0.05) when prepared with either acetic acid or lactic acid. Cow milk chhana coagulated with citric acid was comparatively higher in ash content (2.24±0.01%) from that of prepared from buffalo milk (2.16±0.01%). The overall mean ash content of cow milk chhana

(2.16±0.005%) was seems to be slightly higher from that of buffalo milk chhana (2.15±0.005%) but it indicated statistically non-significant (P> 0.05), them. Regardless, chhana prepared with acetic acid showed lower ash content (2.09±0.009%) compared to that of prepared with citric acid (2.20±0.007%) and lactic acid (2.16±0.02%), the differences among them were statistically significant (P< 0.05).

Table 3. Fat content (%) in chhana prepared from cow and buffalo milk

Coagulant (0.5%)	Source of milk *		Mean±SE % **
	Cow (Mean±SE %)	Buffalo (Mean±SE %)	
Acetic acid	14.50±0.43 [a]	15.08±0.13 [a]	**14.79±0.25** [a]
Citric acid	13.50±0.23 [b]	15.00±0.15 [a]	**14.25±0.17** [ab]
Lactic acid	13.58±0.30 [b]	14.75±0.17 [a]	**14.16±0.17** [b]
Mean ± SE	**13.86±0.27** [b]	**14.94±0.07** [a]	**14.40±0.16**

* LSD (0.05) = **0.72±0.36** Means with similar superscript within the same row or column are not significantly different.
** LSD (0.05) = **0.57±0.29** Means with similar superscript within the same column are not significantly different.

Table 4. Ash content (%) in chhana prepared from cow and buffalo milk

Coagulant (0.5%)	Source of milk *		Mean±SE % **
	Cow (Mean±SE %)	Buffalo (Mean±SE %)	
Acetic acid	2.08±0.01 [c]	2.11±0.01 [c]	**2.09±0.009** [c]
Citric acid	2.24±0.01 [a]	2.16±0.01 [b]	**2.20±0.007** [a]
Lactic acid	2.15±0.01 [b]	2.18±0.02 [b]	**2.16±0.02** [b]
Mean ± SE	**2.16±0.005** [a]	**2.15±0.005** [a]	**2.16±0.006**

* LSD (0.05) = **0.04±0.02** Means with similar superscript within the same row or column are not significantly different.
** LSD (0.05) = **1.25±0.63** Means with similar superscript within the same column are not significantly different.

Table 5. Chloride content (%) in chhana prepared from cow and buffalo milk

Coagulant (0.5%)	Source of milk *		Mean±SE % **
	Cow (Mean±SE %)	Buffalo (Mean±SE %)	
Acetic acid	0.06±0.006 [a]	0.05±0.005 [a]	**0.05±0.005** [a]
Citric acid	0.05±0.005 [ab]	0.04±0.003 [ab]	**0.05±0.003** [a]
Lactic acid	0.04±0.005 [bc]	0.02±0.001 [c]	**0.03±0.003** [b]
Mean ± SE	**0.05±0.003** [a]	**0.04±0.002** [a]	**0.04±0.003**

* LSD (0.05) = **0.01±0.006** Means with similar superscript within the same row or column are not significantly different.
** LSD (0.05) = **0.01±0.006** Means with similar superscript within the same column are not significantly different.

3.6 Chloride content

Chloride content of cow and buffalo milk chhana was analyzed, and results are shown in Table 5. It was observed that chloride content in cow milk chhana prepared with acetic acid was significantly (P< 0.05) higher (0.06±0.006%) compared to that of prepared with lactic acid (0.04±0.005%). Regardless, chloride content varied among chhana prepared from cow and buffalo milk coagulated with acetic acid (i.e. 0.06±0.006 and 0.05±0.005%, respectively), the differences among them were statistically non-significant (P> 0.05). The overall mean chloride content of cow milk chhana (0.05±0.003%) prepared with different coagulants was relatively similar (P> 0.05) to that of buffalo milk chhana (0.04±0.002%). It was further observed that of chhana prepared with acetic acid showed remarkably (P< 0.05) higher chloride content (0.05±0.005%) compared to that of prepared with lactic acid (0.03±0.003%). While there were no any significant (P> 0.05) variation among chhana prepared with citric acid and acetic acid.

3.7 Influence of milk source on the yield of chhana

Yield of cow and buffalo milk chhana was analyzed, and results are shown in Table 6. It was observed that there was significant influence (P< 0.05) of milk source on the yield of chhana product. The yield of buffalo milk chhana prepared with either acetic acid, citric acid or lactic acid was significantly (P< 0.05) higher (i.e. 153.54±4.19, 173.71±3.71 and 148.79±5.84 g/kg, respectively) compared to that of cow milk chhana (i.e. 130.13±4.98, 128.88±4.76 and 122.23±9.09 g/kg, respectively). The overall mean (158.68±2.25 g/kg) of buffalo milk chhana prepared with different acidulant was comparatively higher (P< 0.05) from that of cow milk chhana (127.08±6.20 g/kg). It was further noticed that there was no any significant influence of coagulant among the yield of chhana prepared from cow milk or buffalo milk except from buffalo milk with citric acid.

Table 6. Yield of chhana prepared from cow and buffalo milk

Coagulant (0.5%)	Source of milk *		Mean±SE g/kg **
	Cow (Mean±SE g/kg)	Buffalo (Mean±SE g/kg)	
Acetic acid	130.13±4.98 ^{c}	153.54±4.19 ^{b}	**141.83±2.60** ^{ab}
Citric acid	128.88±4.76 ^{c}	173.71±3.71 ^{a}	**151.29±2.73** ^{a}
Lactic acid	122.23±9.09 ^{c}	148.79±5.84 ^{b}	**135.51±5.96** ^{b}
Mean ± SE	**127.08±6.20** ^{b}	**158.68±2.25** ^{a}	**142.88±2.95**

LSD (0.05) = **16.96±8.07** Means with similar superscript within the same row or column are not significantly different.

****** LSD (0.05) = **13.02±5.76** Means with similar superscript within the same column are not significantly different.

Discussion

Chhana is an important traditional milk product used to be a base material for the preparation of variety of sweets i.e Rasgula, sendish, rasmalai, chhana-cham, chhana-murki[9]. Although it is a rich source of high quality of proteins, fat, minerals and vitamins, its chemical quality and yield varied greatly. It has been reported that the factors like type of milk, heat treatment, coagulation temperature, acidity of milk-acid mixture, calcium content, fat level, presence of colostrums, adulteration of milk with water or starch and straining methods might be responsible in the quantitative variability of chhana[3]. In the present study, influence of milk source on chemical characteristics and yield of chhana has been evaluated. Two milk sources (i.e. cow milk and buffalo milk) and three coagulants (i.e citric acid, lactic acid and acetic acid) were used during the study period. Preliminary the chhana was prepared from each of cow and buffalo milk coagulated with citric acid, acetic acid, and/or lactic acid each at 0.5, 1, 2 and 4% concentration level and among each coagulant, the chhana made with 0.5% concentration level of coagulants rated better acceptability score. Similar coagulants (i.e lactic acid and citric acid) and milk source were used in a study conducted

by[1]. Similarly better textural characteristics of chhana prepared with 0.5% concentration level, each of citric acid and lactic acid among five concentration levels (0.5, 1.0, 2.0, 4 and 8%) were reported by[10]. While among three concentration levels of citric acid (2, 3, and 5%), 2% level has been suggested to be better coagulant for chhana/paneer with most desirable characteristics[11]. Moreover, the type of milk, fat level, temperature of heating and coagulant had reported to be a significant influence on chemical composition of chhana[9]. In this regard in the present study chemical characteristics such as moisture, protein, fat, ash and chlorides analysis of chhana prepared with 0.5% level of each of citric acid, acetic acid and lactic acid were examined.

In the present study, average moisture content in buffalo milk chhana was comparatively ($P< 0.05$) higher than that of cow milk chhana. These results were not expected as buffalo milk contains lower moisture content than that of cow milk[12]. One of the reasons behind this could be attributed with pH condition, which was more acidic in buffalo milk chhana than that of cow milk chhana. It has been reported that under more acidic condition, more moisture could release from complex constituents of milk during acidification, and this had been found in the present findings. Present results are in line with that of reported by[9], who also observed the similar trend in moisture content of chhana prepared from buffalo milk and cow milk. The moisture content of cow milk chhana examined in the present study was relatively similar to that of reported by[9]and lower than that of reported by[13] with citric acid or with lactic acid. Present findings further indicated that there was no any significant effect of coagulants found to be on moisture content of chhana prepared from cow milk, but in case of chhana prepared from buffalo milk with acetic acid showed remarkably ($P< 0.05$) higher moisture content contrast to that of with citric acid and/or lactic acid. A remarkable variation in moisture content was also observed when cow milk was coagulated with citric acid, lactic acid and papaya extract[13]. In the present study no significant ($P> 0.05$) influence of milk source was observed on protein content of chhana when prepared with citric acid and/or lactic acid, while with acetic acid, it was comparatively higher in buffalo milk chhana than that of cow milk chhana. Further the overall mean protein content of chhana observed in the present study indicates significant influence of milk source. The protein content was recorded higher in buffalo milk chhana from that of cow milk chhana. Present findings are not in agreement with that of reported by[9] who observed opposite trend of protein content in chhana i.e higher in cow milk chhana and lower in buffalo milk chhana. Moreover, protein content of buffalo milk chhana found to be relatively similar. It was further noticed that acetic acid as coagulant in chhana-making has significant influence on protein content, as its recovery has been significantly reduced compared to that of chhana prepared with citric acid or lactic acid. This is probably due to interactive effect of coagulants, which has been pointed out by[10] in their study. It is of interest to note that the findings regarding the fat content of chhana were remarkably ($P< 0.05$) comparable among buffalo milk and cow milk either prepared with citric acid or with lactic acid, while not with acetic acid. However, the significant influence of milk source on fat content of chhana was observed. The buffalo milk chhana contained comparatively higher fat content than that of prepared from cow milk. These results were expected in the present study as buffalo milk contains higher fat content than that of cow milk[12]. Moreover, similar trend of fat concentration was reported in buffalo milk and cow milk chhana in different studies [1,9,14]. Nevertheless, the concentration of fat either in cow milk chhana or buffalo milk chhana reported by these workers are found to be higher and did not support the fat content of chhana examined in the present study.

Chhana prepared from cow milk or buffalo milk either with acetic acid or with lactic acid did not show any significant effect on ash content; but it was significantly ($P< 0.05$) affected with citric acid. These results indicate that type of milk had no influence on ash content of chhana. Moreover, it was significantly affected by type of coagulant as mean concentration of ash content of chhana resulted in the present study showed remarkable ($P< 0.05$) variation among them. It is of interest to note that ash content of cow milk chhana was in agreement with that of reported by[9]and of buffalo milk chhana, it disagreed with their results. Similarly, the type of milk had no significant influence on the chloride content of chhana either prepared with acetic acid, citric acid or lactic acid. While mean concentration of chlorides of chhana prepared with acetic acid or citric acid also not showed significant influence, but with lactic acid, a remarkable effect was observed among the coagulants.

It was noticed that the yield of chhana in buffalo milk either coagulated with acetic acid, citric acid or lactic acid was comparatively (P< 0.05) higher than that of cow milk chhana. These results indicate that type of milk had significant influence on the yield of chhana. Moreover, the yield of chhana did not match with that of reported by[15] who observed the higher yield of chhana prepared with 1.0% each of citric acid, tartaric acid, and lactic acid, and with 0.6% each of phosphoric acid, HCl and citric acid, respectively. While present results are relatively similar to that of observed by[14] who reported average yield of paneer/chhana from buffalo milk 16.66% and cow 14.10%. [16] also obtained 14.2% yield of paneer from cow milk, standardized to 4% fat. These differences among the chhana from cow milk and buffalo milk could be attributed with difference in the chemical composition of milk base as buffalo milk is rich in chemical components compared to that of cow milk[17].

4. CONCLUSIONS

On the basis of present finding it was concluded:

Milk source had significant influence on the quality characteristics and yield of chhana. Cow milk chhana was found to be more acidic than buffalo milk chhana, but still under acceptability acidic condition. Moisture content was comparatively higher in buffalo milk chhana than that of cow milk chhana. Buffalo milk chhana was found to be rich in protein and fat content compared to that of cow milk chhana. Ash content was higher in cow milk chhana contrast to buffalo milk chhana. Buffalo milk yielded higher quantity of chhana than that of cow milk. In this study, buffalo milk chhana was found better in all aspects compared to that of cow milk.

CONFLICT OF INTEREST

All the authors claim that there is no conflict of interest regarding the publication of this paper.

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