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Effect of different levels of sugar on qualitative characteristics of lassi prepared from sour dahi

Muhammad Shah Moazzem[1], Md Nurul Islam[1], AKM Masum[1*], Md Rezwanul Habib[2]

[1]Department of Dairy Science, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh
[2]Bangladesh Livestock Research Institute Regional Station, Baghabari, Shahjadpur, Sirajganj 6770, Bangladesh

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Mohammad Ashiqul Islam

*Corresponding Author
AKM Masum
akmmasum.bd@gmail.com

ABSTRACT

An investigation was carried out to develop lassi from sour dahi using different levels of sugar (10, 15, 20 and 25%) and 15% water. Lassi quality was assayed through the study of physical, chemical and microbiological parameters. Results revealed that significant difference existed in overall physical score of lassi samples and the highest score was found in 15% sugar lassi whereas, the lowest score was found in 25% sugar lassi. Total solids, carbohydrate, fat, protein and ash contents differed significantly among various levels of sugar added lassi. From chemical test, it appears that, 15% sugar added lassi possess the highest fat and protein values whereas, the highest total solids and carbohydrate values posses in 25% sugar added lassi. No significant difference ($p>0.05$) revealed in terms of pH value and acidity percentage among lassi types. Lassi made from 10% sugar was most inferior than other levels of sugar added lassi in respect of microbiological quality-total viable count ($\times 10^4$ cfu/mL) content was 95.67±2.08 and coliform ($\times 10$ cfu/mL) content was 1.00±0.00. Considering above mentioned quality aspects, it might be resolved that lassi could be prepared successfully from sour dahi with 15% sugar keeping water level constant at 15%.

Keywords: Dahi, sugar, lassi, physical, chemical and microbiological

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1 Introduction

Dairy products are mainly classified into fermented and non-fermented. The fermented dairy products are dahi, yoghurt, lassi, cheese, kefir, acidophilus milk and the non-fermented dairy products are flavored milk and ice-cream etc. These fermented dairy products are well balanced food for human diet. Dahi or yoghurt is a popular dairy product to the consumers due to its typical flavour, characteristic semi-solid consistency, nutritive and therapeutic value. Different types of dahi such as sweet dahi, sour dahi and flavored dahi are usually found in the markets. Kaic and Antonic (1996) stated that the cultured dairy products have advantageous therapeutic effects such as in reducing lactose intolerance syndrome, preventing gastro-intestinal infections, cardiovascular disease and improving immune defenses. Fermented drinks are good source of probiotic bacteria which plays important roles in preventing irritable bowel syndrome and colon cancer. Also, probiotics plays a vital role in inhibiting *Helicobacter pylori* infections which causes ulcers (Santosa et al., 2006).

Lassi familiar in some Indian subcontinent as buttermilk (Dahal et al., 2005) and its prepared by churning dahi containing *Streptococcus thermophilus* and

Lactobacillus bulgaricus with or without addition of salt/sugar, spices, or flavoring agents for different taste and flavors (Vijayendra and Varadaraj, 2015). Preparation method of lassi differs from place to place and country to country. The traditional method of lassi preparation is cumbersome and time consuming as it requires fermentation of milk using lactic culture till the desired level is reached. Milk turns to curd requires 5-6 hours and lassi quality is influenced by type of dahi, type of culture, temperature of making dahi as well as duration of incubation and addition of sugar and/or salt (Shinde et al., 2015). The propagation and maintenance of bacterial cultures are the most important pre-requisites in preparation of good quality lassi.

As the quality of lassi depends upon manufacturing technology, few researchers were tried to improve the lassi quality using several ingredients like orange juice (Jadhav et al., 2014), carrot (Upadhyay et al., 2017), finger millet (Pardhi et al., 2014) and lassi from cow milk blended with sapota pulp (Shinde et al., 2015). Lassi could be prepared using both sweet and sour dahi. Dry matter (DM) content of dahi influences the lassi quality and water levels in lassi inversely related to DM content in dahi. Volume of milk reduction during dahi making is closely related to sugar requirement in lassi which indicates that sugar levels variation would also responsible in preparation of good quality lassi. Bagal et al. (2007) carried out lassi preparation using sweet dahi with different levels of sugar and water; and recommended 10% water and 15% sugar through organoleptic tests. Recently, Zohra et al. (2016) prepared lassi through reconstituted milk and sweet dahi but present study is quite different from Bagal et al. (2007) and Zohra et al. (2016) as sour dahi was prepared from whole milk and water level remains constant. The lassi prepared from sour dahi using various levels of sugar with keeping water constant has not come to the attention of the author.

Hence, this research work was undertaken to investigate the appropriate sugar level to be used in sour dahi for lassi preparation. For aforementioned aim, physical, chemical and microbiological parameters were monitored in all respects of the study.

2 Materials and Methods

2.1 Site of the experiment

Whole milk was collected from Bangladesh Agricultural University Dairy Farm and then it was taken in the Dairy Chemistry and Technology laboratory for chemical analysis. All the chemical parameters of milk were assayed using milk analyzer (Milkotronic Ltd., Narodni buditeli str., Nova Zagora, 8900, Bulgaria). The chemical composition of whole milk is shown in Table 1. Sour dahi was prepared at the Dairy Chemistry and Technology laboratory and then physical parameters were studied at the same laboratory. Only protein test of lassi was done at Animal Science Laboratory, Department of Animal Science, Bangladesh Agricultural University, Mymensingh. Other chemical parameters of lassi were assayed at Dairy Chemistry and Technology Laboratory, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh. Microbiological parameters of lassi were analyzed in Dairy Microbiology Laboratory, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Table 1. Chemical composition of whole milk

Paramter	value
Specific gravity	1.028
Total solids (g/kg)	127.53
Fat (g/kg)	44
SNF (g/kg)	83.53
Protein (g/kg)	34
Lactose (g/kg)	42.8
Ash (g/kg)	6.73
pH	6.7

2.2 Preparation of sour dahi and lassi

For making sour dahi, whole milk was heated to boiling temperature and then cooled to 40-45 °C. Thereafter, inoculated with 2-3% starter culture (*Streptococcus thermophilus*: *Lactobacillus bulgaricus* = 2:1) and maintained 37 °C in an oven [Serial: 0399752; J.P. Selecta; S.A. ctra. Nil km: 585.1, Abrera (Bercelona) Spain] which required 5-6 hours for coagulation. Four types of lassi were prepared keeping 15% water level constant using different levels of sugar like 10, 15, 20 and 25%. The coagulated mass (sour dahi) was broken by stirring with sugar and water for lassi preparation.

2.3 Physical, chemical and microbiological tests

Lassi quality was evaluated by a panel of six adept academic teachers from Department of Dary Science, Bangladesh Agricultural University, Mymensingh for flavour, color, mouthfeel, sweetness and overall physical score using a score card. Total solids content of lassi was estimated through oven [Serial: 0399752; J.P. Selecta; S.A. ctra. Nil km: 585.1, Abrera (Bercelona) Spain] drying at 105 °C for 24 hours. Then dried sample was transferred to the muffle furnace and ignited at 500-600 °C for 5 hours for detecting ash content. Fat was determined by Babcock method by using commercial sulphuric acid (Analytical Grade, Germany), ammonium hydroxide (Sigma-Aldrich, Inc., USA) and normal butyl alcohol (BDH,England). Crude protein estimation was performed by using Kjeldahl method and 6.38 was used as conversion

factor. pH was measured with the help of pH meter-215 (Ciba Corning Diagnostic Ltd. Sudhury, Suffolk, England Co. 106 XD) and acidity% was estimated by titration method by using 0.1N sodium hydroxide and phenolphthalein.
For total viable bacteria, tryptone glucose yeast extract agar media was used. Dilutions were made and the inoculated plates were incubated at 37 °C for 48 hours. The colonies were enumerated which plate having within 30-300 colonies. Violate red bile agar media was prepared and serial dilutions were made. Inoculated plates were incubated at 32 °C for 24 hours. Then coliform colonies (at least 0.5 mm in diameter) were enumerated.

2.4 Statistical analysis

Completely Randomized Design was ascertained to investigate the effect of different levels of sugar on physical, chemical and microbiological parameters of lassi. All the data were statistically analyzed using Statistical Package for the Social Science software (SPSS, IBM-20 Corporation, 2011). The least significant difference (LSD) test was also used when the F-ratio suggests rejection of the null hypothesis.

3 Results and Discussion

3.1 Physical parameters

3.1.1 Flavor

The flavor score of different types of lassi samples are given in Table 2 and it revealed that there was significant difference in flavor score among the lassi samples. The highest flavor score was recorded in lassi with 15% sugar whereas the lowest score was found in lassi with 10% sugar. This finding is contradicted with Zohra et al. (2016) who found highest flavor score in lassi when prepared with sweet dahi along with 20% sugar and water.

3.1.2 Color

The color score of various levels of sugar added lassi samples are shown in Table 2 and significant difference existed in color score among the lassi samples. The highest color score was recorded in lassi with 20% sugar and lassi color varies from slightly yellowish to white which might be due to without addition of sugar during dahi preparation. This color supported by Bagal et al. (2007) who reported that the normal color of lassi varies from yellow to whitish color and which gives good color score.

3.1.3 Sweetness

Sweetness score for lassi samples are given in Table 2 and results revealed that there existed significant difference among the lassi samples. Best sweetness score was recorded in lassi with 15% sugar and this sweetness might be due to higher moisture reduction during dahi making. Again, Zohra et al. (2016) reported higher sweetness score in lassi through preparing sweet dahi with 20% sugar and water.

3.1.4 Mouth feel

Statistical analysis showed that there was significant difference in mouth feel score content among the lassi samples. The highest mouth feel score was recorded in lassi with 15% sugar and the lowest score was seen in lassi with 10% sugar which quite similar with Zohra et al. (2016) who found the highest mouth feel score in lassi through preparing sweet dahi using constant sugar level (20%) with varying water levels. Again, that sweet dahi was prepared from reconstituted milk but present research work was carried out using sour dahi from whole milk.

3.1.5 Overall physical score

Results indicated that significant difference existed among the overall score of all lassi samples. The highest overall score was recorded in lassi with 15% sugar whereas the lowest score was found in lassi with 25% sugar. This result indicated that lassi prepared by using sour dahi with a combination of 15% water and 15% sugar would give a better quality lassi. This finding is contradicted with Zohra et al. (2016) who found better overall acceptability in lassi when prepared with 20% water and 20% sugar combination; present research work variation from previous may be due to sweet or sour dahi used in lassi preparation.

3.2 Chemical parameters

3.2.1 Acidity percentage

Acidity percentage of four types lassi samples are shown in Table 2 and non-significant difference existed among the lassi samples in terms of acidity percentages. This finding is similar to Zohra et al. (2016) who also found non-significant difference in lassi by prepring with sour dahi.

3.2.2 pH value

Statistical analysis revealed that no significant difference among the pH content of all lassi samples which contradicted with Zohra et al. (2016) who found significant difference using 20% sugar with different levels of water in lassi from sweet dahi.

3.2.3 Moisture content

Moisture content of four type's lassi samples are shown in Table 2 and result implied that significant

Table 2. Physical, chemical and microbiological attributes of lassi containing different levels of sugar

Parameter	% Sugar added to lassi				LSD‡	p-value
	10%	15%	20%	25%		
Physical attributes						
Flavor†	3.50±0.13 c	4.64±0.10 a	4.42±0.14 b	3.72±0.10 c	0.133	0.001
Color†	3.71±0.04 c	4.02±0.03 b	4.10±0.02 a	3.80±0.05 c	0.034	0.01
Sweetness†	3.11±0.05 d	4.68±0.08 a	4.57±0.08 b	3.75±0.15 c	0.103	0.01
Mouthfeel†	3.14±0.12 d	4.29±0.04 a	4.23±0.03 b	3.93±0.03 c	0.069	0.001
Overall physical score†	3.42±0.02 c	4.42±0.09 a	4.33±0.06 b	3.04±0.12 d	0.059	0.01
Chemical attributes						
Acidity (%)	0.49±0.02	0.48±0.01	0.48±0.01	0.48±0.01	–	0.28
pH	5.70±0.02	5.71±0.01	5.72±0.01	5.70±0.01	–	0.62
Moisture (g/kg)	860.67±1.39 a	849.58±1.74 b	838.75±2.09 c	828.96±1.66 d	1.67	0.001
Total solids (g/kg)	139.30±1.39 d	150.4±1.74 c	161.20±2.09 b	171.0±1.63 a	0.23	0.01
Fat (g/kg)	30.71±0.00 b	31.82±0.01 a	30.12±0.01 c	29.92±0.00 d	1.88	0.001
Protein (g/kg)	23.31±0.00 d	23.92±0.00 a	23.90±0.01 b	23.54±0.01 c	2.69	0.001
Carbohydrate (g/kg)	78.24±1.33 d	90.75±1.75 c	102.30±2.09 b	112.7±1.63 a	4.62	0.01
Ash (g/kg)	5.06±0.06 a	4.92±0.00 b	4.87±0.00 b	4.81±0.04 c	0.03	0.001
Microbiological attributes						
Total viable count ($\times 10^4$)	95.67±2.08 a	70.67±7.57 c	73.33±4.16 b	62.33±2.52 d	5.02	0.001
Coliform count ($\times 10$)	1.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	–	0.45

† The full score of this parameter is 5.0. Mean values within a row having different letter differ significantly.
‡ LSD = least significant difference at 5% level of significance.

difference existed in moisture content of all lassi samples. The highest moisture value was found for lassi with 10% sugar whereas the lowest value found in lassi with 25% sugar which might be due to increasing of sugar concentration during lassi preparation. Again, Zohra et al. (2016) found the highest moisture content in lassi when prepared with sweet dahi along with 30% water and 20% sugar level.

3.2.4 Total solids content

Significant difference existed in total solids contents among the lassi samples (Table 2). The highest total solids recorded in lassi with 25% sugar which may be due to increased sugar level in lassi and the lowest was found in lassi with 10% sugar. This finding quite similar with Soomro et al. (2002) and Zohra et al. (2016) that conducted an experiment on lassi preparation and stated total solids of lassi varied from 154.00 to 194.00 g/kg.

3.2.5 Fat content

Average fat content of lassi samples are shown in Table 2 and significant difference found in fat content among the lassi samples. The highest value was recorded in lassi with 15% sugar whereas the lowest value was found in lassi with 25% sugar. This finding supported by Zohra et al. (2016) who described that fat in lassi samples varied from 32.13 to 35.37 g/kg.

3.2.6 Carbohydrate content

Statistical analysis showed that there was significant difference existed in carbohydrate content of all lassi samples (Table 2). The carbohydrate content was higher in lassi with 25% sugar and the lowest in lassi with 10% sugar. Higher level of carbohydrate in lassi with 25% sugar sample was due to high total solids content of that sample which similar to Zohra et al. (2016) who found highest carbohydrate in lassi prepared from sweet dahi using 15% water and 20% sugar.

3.2.7 Protein content

Protein content of different levels of sugar added lassi types are given in Table 2 and there significant difference in terms of protein content among the lassi samples. The highest protein was recorded in lassi with 15% sugar followed by lassi with 20% sugar and lassi with 25% sugar whereas the lowest value was found in lassi with 10% sugar sample. This variation in protein content of lassi samples might be due to dahi preparation from whole milk and/or addition of sugar during lassi preparation. Again, Zohra et al. (2016) reported that protein in lassi samples varied from 22.20 to 24.70 g/kg when lassi prepared with 20% sugar.

3.2.8 Ash content

Ash content significantly differed among the lassi samples and found slightly lower ash in this study compared to Zohra et al. (2016). Ash content of this study varies from 4.81 to 5.06 g/kg which contradicted with Sayed (2008) who reported that ash content was 6.4 to 7.0 g/kg different fat levels dahi in yoghurt based drink.

3.3 Microbiological parameters

3.3.1 Total viable count

The total viable count of various levels of sugar added lassi types are shown in Table 2 and results revealed that significant difference among the different lassi samples. The highest total viable count was found in lassi prepared by using 10% sugar which may be due to less sugar concentration in lassi. Again, Ahmed (2004) found similar total viable bacteria in yoghurt drink samples and which quite similar with this finding.

3.3.2 Coliform count

The coliform bacterial count lassi types are shown in Table 2 which indicated that coliform bacterial count very low in all types of lassi samples. Result showed that there was non-significant difference existed among lassi samples. Lower coliform count indicated lassi quality maintained hygienically as well as sanitation condition was good. This finding was supported by Zohra et al. (2016) who reported that there were almost no coliform bacteria in lassi through prepared with sweet dahi.

4 Conclusion

It may be concluded that good quality and nutritionally enriched lassi with more acceptability could be prepared successfully from sour dahi using 15% sugar along with 15% water. Sour dahi was prepared from whole milk and successfully lassi making could be most suitable for homemakers as well as product manufacturers using suggested sugar and water levels.

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