

EFFECT OF VARIOUS INGREDIENTS ON THE PHYSICO CHEMICAL PROPERTIES OF ICE CREAM

T. F. Miano^{1*} and M. Imtiaz¹, A. Shamim² and S. G. Mohyuddin³

¹Institute of Food Sciences and Technology, Sindh Agriculture University, TandoJam 70060, Pakistan

²Department of Pathobiology, Faculty of Veterinary and Animal Science University of Poonch Rawalakot Azad Kashmir, Pakistan,

³Department of Veterinary Medicine Guangdong Ocean University, Zhanjiang, China

Corresponding author: Email: tahseenfm@yahoo.com

ABSTRACT: Ice cream is a dairy product prepared with the addition of various types of ingredients to make desirable quality liked by consumers of various ages. Ice cream industry at Pakistan is also concerned with preparation of new flavour. Therefore, the aim of this research was to evaluate the effect of various types of ingredients on the physicochemical properties of ice cream. The complete this study, randomized design was used. The three types of milk cow milk, buffalo milk and skimmed milk were used with the addition of table sugar and aspartame as sweetener whereas, the vegetable ghee and fresh milk cream were used to improve the quality of ice cream. The result observed shown statistically significant difference ($P < 0.05$) in each sample for °Brix, ash %, fat %, protein %, sucrose% and carbohydrate content respectively. Ice cream prepared with buffalo milk observed with higher Tss (°Brix) of 18.7% pH 6.71, ash% 0.81, total fat 9.03%, protein 8.34%, sucrose 11.18% and total carbohydrate 29.7% were recorded in ice cream samples. Whereas, ice cream prepared with cow milk observed low in Tss, fat, protein, sucrose and total carbohydrate while the ice cream prepared with skimmed milk power result in lower Tss of 15.92 less ash content 0.5 very low quantity of fat 1.75% protein 3.32% sucrose 7.87% and carbohydrates 20.93%. Therefore, it is concluded from this study that ice cream prepared with buffalo milk and cow milk is highly nutritious and appealing to the consumer.

(Received 14.04.2021

Accepted 01.06.2021)

INTRODUCTION

Ice cream is prepared by dairy milk and is termed as cream milk or custard which has been sweetened and flavoured with the addition of various ingredients. Ice cream is semisolid mixture which has been frozen by means of freezing mixture [1] (Harvey and Hill 2006). Therefore, a delicious and nutritious ice cream at industrial level and locally manufactured from pasteurized milk with addition of cream, sugar, egg and by addition of considerable quantity of butter fat to improve textural properties of the product [2].

Mostly, ice cream besides being extremely palatable contain all the vitamins and calorific value of whole milk and cream together, with those of the added ingredients like serum, solids of milk and the sucrose gives taste to the product. Therefore, ice cream eaten contains substantial solid content which is lower than that of milk, also use of butter and sucrose in ice cream also observed a valuable source of calcium and phosphorus [3]. Therefore, an average portion of a good quality ice cream contains twice the amount of vitamin A,

B₁, E and G found in milk, and four times more found in butter. Mostly, ice cream supply nutrients to body for repair, injury and building of new tissue [4]. Generally, a good nutritious ice cream gives 12% milk solid not fat, 11% sugar, 15% stabilizer and emulsifier 0.3% and total solids 38.3%. One serving of a good ice cream after average composition per 100 grams supplies approximately 200 g calcium, protein 4 g, calcium 0.13g, phosphorus 0.105 g, iron 0.1 g, vitamin A 490 Iu, thiamine 0.38 mg, and riboflavin 0.24 mg (Harvey and Hill 2006) [5].

Currently, three well-known ice cream producing industries in Pakistan are IGLOO, polka and yummy [4]. Lever brother and multinational company's also manufacturing world's famous ice cream Walls [6]. Keeping in view the increasing importance of ice cream production and increasing consumption of ice cream in Pakistan is very much high, all age peoples like the ice cream and enjoy more in summer season. Therefore, this research aims to evaluate the effect of different ingredient on physico-chemical property of ice cream prepared with three types of milk.

MATERIAL AND METHODS

Sample collection: Three different types of fresh raw buffalo milk, cow milk were collected from animal farm Hyderabad, and skim milk powder was purchased from commercial market of Hyderabad. Other ingredients table sugar, aspartame, vegetables ghee and fresh milk cream were purchased from commercial market of Hyderabad.

Experimental Design: The each treatment of ice cream was prepared according to complete randomized design. According to the experiment two batches of ice cream mixes were prepared with buffalo milk, cow milk and skimmed milk powder, respectively. Each batch of ice cream samples were observed to evaluate the effect of milk and sweetener sugar, aspartame and vegetables ghee and fresh milk cream.

Ice cream preparation: The ice cream was prepared by following the ingredients sugar 150 g, egg 1, ice cream powder 100 g, pectin 15 g, mango flavour 1 mL, and color 0.3 g were mixed properly and added in the 2 kg milk. The mixture was properly agitated to make a homogeneous mixture. The ice cream mixture was cooked for 15 min to make it concentrate. The ice cream mixture was kept at ambient temperature for cooling to bring it at 4 °C. The prepared mixture was poured into ice cream container in manual ice cream making machine. Before mixing flavour was added and mixing was started for 15-20 min continuously by manual mixing. Same procedure was used for each treatment. The prepared ice cream samples were safety packed and labelled in plastic containers for physico chemical analysis.

Physico chemical analysis: The each ice cream samples were determined by following the standard method of (AOAC, 2000). The total soluble solids (°Brix) was determined by using digital refractometer (ATAGO, Benchtop, Italy). The total acidity of ice cream was determined by volumetric-potentiometric titration test with NaOH 0.1 N alkali solution. The acidity was determined in terms of lactic acid standard value.

$$\text{Acidity \%} = \frac{\text{No. mL of NaOH} \times 0.009}{\text{Weight of sample taken}} \times 100$$

The pH value of ice cream sample was measured by a pH meter (Hanna Instruments, Italy). Protein content was determined according to the method described by the AOAC, 2000 [5]. The nitrogen conversion factor of 6.38 was used in the calculation of the protein content by fixing titration value in following formula:

$$N \% = 1.4 \frac{(V_2 - V_1) \times \text{Normality of HCl}}{\text{Weight of ice cream sample taken}} \times 250$$

Where as, V_1 = Titrated value, V_2 = Blank sample

Moisture % of ice cream was determined by drying the sample 5 g at 80 °C for 8 hrs in hot air oven. After evaporation of moisture the final weight of

sample was recorded. The following formula was used for moisture calculation.

$$\text{Moisture \%} = \frac{(\text{Final weight} - \text{Initial weight})}{\text{Weight of sample taken}} \times 100$$

Fat determination of ice cream was determined by using Gerber method (mazumder & majumder, 2003) method with some modification. The ice cream sample 5.5 g was diluted with same volume of 5.5 g distilled water. The mixture was diluted with 10 mL sulfuric acid 1 mL amyl alcohol were poured into the butyrometer tubes and closed with a rubber cork. The mixture was mixed and placed in Gerber centrifuge machine (Al-Madina engineering works and dairy equipment OKA) for 3-5 min at 1000 rpm. The fat % was recorded on the butyrometer scale. The ash of each sample was determined by following the method of (AOAC 2000). 5 g of each sample was weighed and placed in pre weighed crucible for dryness at 100 °C. The sample was kept in muffle furnace at 550 °C until ash was became carbon free, after ashing sample was transferred in to the dessicator for cooling about 1hr. The sample was re-weighed to record the final value was recorded and ash percentage was calculated by using following formula,

$$\text{Ash \%} = \frac{\text{Weight of ashed sample}}{\text{Weight of sample taken}} \times 100$$

The total carbohydrates were calculated by difference, by subtracting the percent of fat, protein and ash content from that of total solids content of ice cream according to the following formula.

$$\begin{aligned} \text{Total Carbohydrate} \\ &= \text{Total solid content} \\ &- (\text{Protein} + \text{fat} + \text{ash}) \end{aligned}$$

Total solids content of ice cream samples was observed by subtracting / calculate moisture content from 100 (TS content = 100 – moisture %).

$$\text{Total solids} = 100 - \text{moisture \%}$$

Specific gravity of ice cream was determined according to the method (AOAC, 2000) by pycnometer. Following formula was used to calculate specific gravity.

$$\text{Specific gravity} = \frac{\text{Weight of ice cream sample}}{\text{Weight of distilled water}}$$

Statistical Analysis: The data obtained regarding all parameters were tabulated and analysed according to statistical procedure of analysis of variance (ANOVA) and significant differences of the mean were further computed by the method as described by Gomez and Gomez, (1984) using least significant difference (LSD) at 0.05% level of probability.

RESULTS AND DISCUSSION

Physico chemical analysis of the ice cream sample showed statistically significant variation with

addition of various ingredients on fat content of ice cream, buffalo milk with fresh with fresh milk cream. The result showed highest content of 14.00 % as compared to other treatments. Whereas, cow milk with fresh milk cream ranked second in higher fat content of 11.83 % this was followed by ice cream prepared with cow milk and vegetable ghee which recorded fat content of 8.67 %. These results are accordance with the work done by Udabage and Augustin (2003)[6]. The lower fat content of 0.20 % was recorded in ice cream sweetened with aspartame. The results observed for ice cream formulated with skimmed milk powder and fresh milk cream was found higher 41.30 % in fat content were found statistically significant ($P < 0.05$). The result showed highest protein content of 8.34 % was found in sample prepared with buffalo milk followed by 7.18 % ice cream prepared in cow milk 3.02 % in skimmed milk

powder[1]. These results are supported by the research done by Jangju and Moosavi (2004). They worked on low fat ice cream with the replacement of fat by using stabilizer and emulsifier to improve the texture and mouth feel properties of ice cream. The result regarding effect of milk types and ingredient showed that all ingredients sugar, aspartame, vegetable ghee, and fresh milk cream added in ice cream prepared with buffalo milk is significant from each other [7]. The result are more or less similar with the work done by Harvey and Hill (2006), they worked on improvement of ice cream and found that good ice cream contains 10 % of milk fat, 10-12 % milk solids, 12-16% sweetness, 38.3 % of Brix. The low protein % 2.94 was recorded in skimmed milk with aspartame and fresh milk cream. The highest protein % was observed 3.23 when vegetable ghee was added in ice cream prepared with skimmed milk powder.

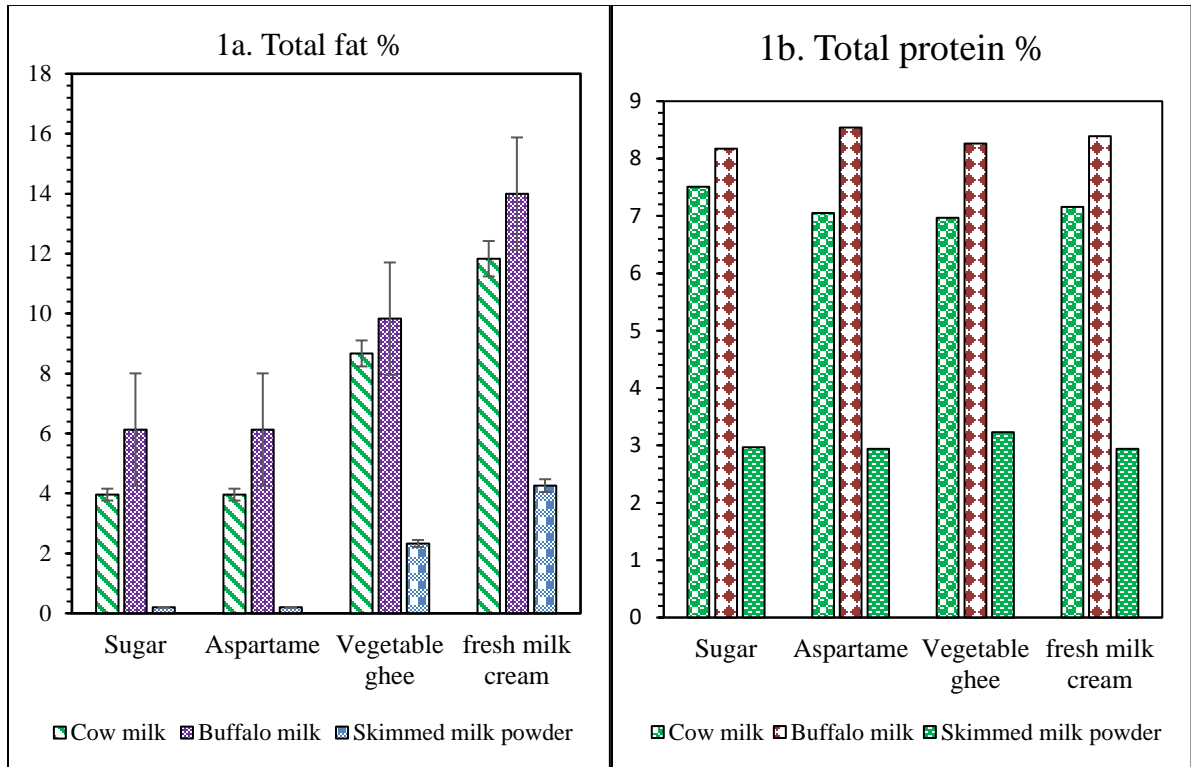


Fig. 1a. Total fat % of ice cream formulations (Fig. 1b) and total protein % of ice cream formulations.

The data revealed that higher percent of total carbohydrate 32.58 % was observed in ice cream prepared with buffalo milk and sugar, followed by ice cream prepared with buffalo milk and vegetable ghee results 32.57 % and lowest was found in ice cream prepared with cow milk and sugar 31.39 % was recorded[8]. The total carbohydrate of 29.33 and 28.18 was recorded in ice cream prepared with cow milk and fresh milk cream followed by addition of vegetable ghee, respectively. The lowest carbohydrate of 14.76 % was observed in ice cream made with skimmed milk powder

and aspartame as low calorie sweetening agents for diabetic[9]. The result pertaining to total carbohydrate are significant for type of milk ($P < 0.05$) ingredients ($P < 0.05$) and their interaction effect ($P > 0.05$).

The result further revealed that TSS of buffalo milk are not significantly different from skimmed milk TSS in cow buffalo milk are significantly different from each other[6][4]. The highest TSS of 18.67 was recorded in buffalo milk. The lowest TSS of 15.92 % was noted in skimmed milk. The result on effect of ingredients revealed that highest TSS in buffalo milk with fresh milk

cream followed by cow milk with fresh milk cream. The lowest TSS of 9.00 % was noted in buffalo milk with aspartame and skimmed milk with aspartame. The work done by [5] also more or less supporting the results. The interaction effect of three milk types and ingredients are statistically non significantly from each other. The result on sucrose percentage are significant for milk type, ($P<0.01$), ingredients ($P<0.01$), and their interaction effect ($P<0.01$). The result further showed that higher

sucrose percent of 11.82% was noted in buffalo milk followed by sucrose percentage of 10.39 cow milk. Skimmed milk ranked third in sucrose percent of 7.86, the interaction effect of milk type and ingredients showed that buffalo milk with fresh milk cream and sugar recorded higher sucrose percent of 14.61 and 41.3 respectively. The lowest sucrose percent of 2.90 and 31.2 was noted in skimmed milk with aspartame and cow milk with aspartame respectively[1].

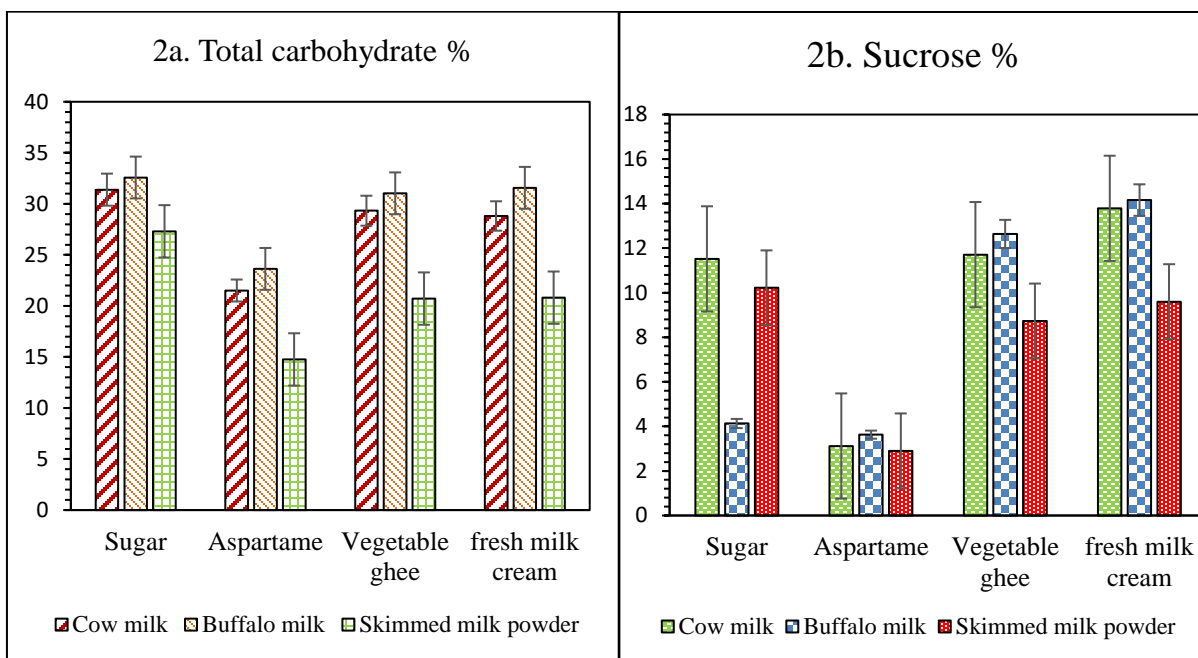


Fig.2a, 2b. Total carbohydrates (Fig. 2b) and sucrose % of ice cream formulations.

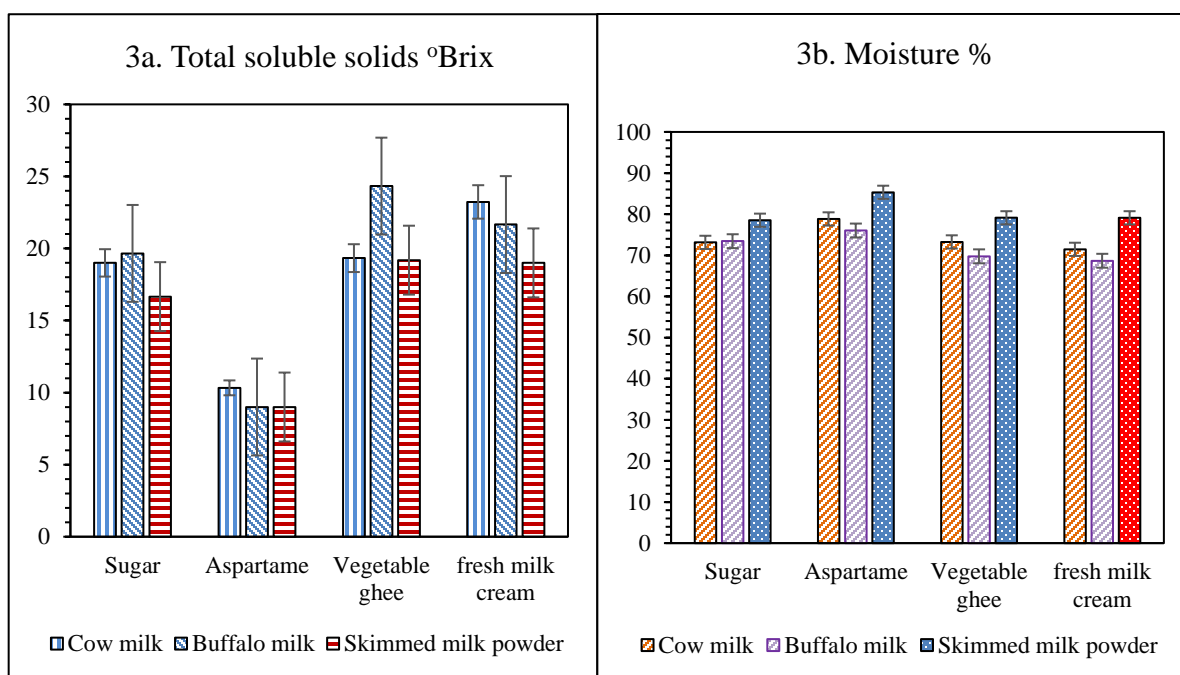


Fig.3a, 3b. Total soluble solids and moisture % of ice cream formulations.

The result of total soluble solids 24.33 °Brix was observed high in ice cream prepared with buffalo milk with addition of vegetable ghee, followed by lowest total soluble solids 9.00 (Brix) in ice cream prepared with skimmed milk powder. The result regarding moisture 85.32 % was observed high in ice cream prepared with skimmed milk powder with addition of aspartame, followed by lowest

moisture 73.43% found in ice cream prepared with buffalo milk.

The result regarding titratable acidity of ice cream formulation (Fig. 4) was recorded high 0.19 and lowest was observed 0.17 %, respectively. The result regarding pH of ice cream formulation (Fig. 4) was recorded 7.33 and lowest was observed 6.7 to 6.5, respectively.

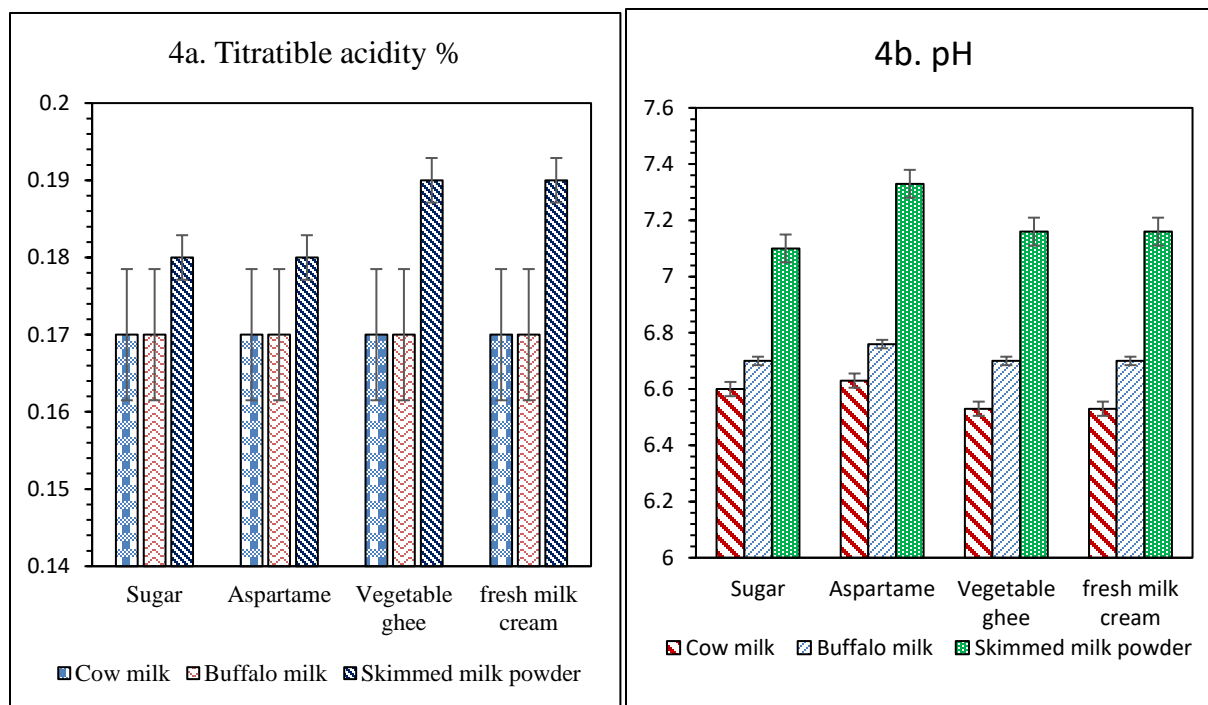


Fig.4a, 4b. Titratable acidity % and pH value of ice cream formulations.

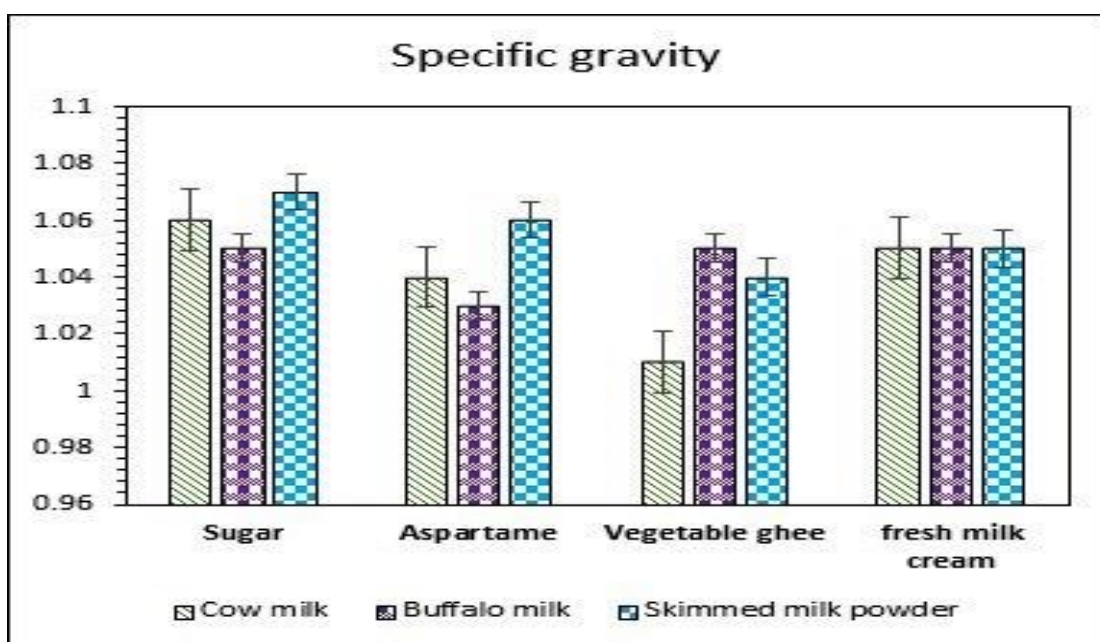


Fig.5. Specific gravity of ice cream formulations.

The ice cream formulations for specific gravity was recorded 1.07 to 1.01 result showed statistically significant difference among the ice cream samples (Fig. 5), respectively.

Conclusions: Results of the present study showed that ice cream prepared with different types of milk sweeteners and fat replacers have a significant effect on the physicochemical properties of ice cream. The development of ice cream with use of aspartame is health effective for the diabetic peoples of all ages as they can enjoy the taste of ice cream. However, the ice cream prepared with reconstitution of skimmed milk powder was observed with a significant amount of fats, proteins, and total carbohydrates. The use of fresh milk and other ingredients showed an appealing effect on ice cream quality. The use of aspartame as new sweetening ingredients with skimmed milk powder and other milk has proven an acceptable taste and texture of ice cream. This research is helpful for new diet ice cream formulation to the ice cream manufacturing industries at Pakistan and other countries. The cow and buffalo milk with addition of fresh milk cream and sugar resulted quality ice cream compared to aspartame and skimmed milk powder. The physio-chemical properties of types of milk, ingredients and sensory evaluation results were better for cow and buffalo milk.

Conflict of interest: The author declares no any conflict of interest.

REFERENCES

- A. P. Whelan, C. Vega, J. P. Kerry, and H. D. Goff, "Original article Physicochemical and sensory optimisation of a low glycemic index ice cream formulation," pp. 1520–1527, 2008.
- S. Junior, S. Caetano, and S. Lannes, "Effect of different sweetener blends and fat types on ice cream properties," vol. 31, no. 1, pp. 217–220, 2011.
- S. Banupriya, A. Elango, N. Karthikeyan, and C. Kathirvelan, "Physico Chemical Characteristics of Dietetic Ice Cream developed by with Sunflower Oil Rice Bran Wax Organogel," vol. 9, no. August, pp. 32–35, 2016.
- D. N. Bajad, S. D. Kalyankar, M. A. Dehmukh, P. R. Bachanti, and G. S. Bajad, "Impact of physico-chemical properties of mix on the final quality of ice-cream," vol. 35, no. 4, pp. 293–297, 2016.
- H. H. Patel and B. K. Amin, "Formulation and Standardization of Different Milk Ice-Cream Fortified with Pink Guava Pulp," *Int. J. Dairy Sci.*, vol. 10, no. 5, pp. 219–227, 2015.
- F. Science, H. Fung, and S. Lu, "Food Science and Technology International," no. June, 2014.
- E. Faculty, "Physicochemical , bioactive , and sensory properties of persimmon-based ice cream : Technique for order preference by similarity to ideal solution to determine optimum concentration," *J. Dairy Sci.*, vol. 97, no. 1, pp. 97–110, 2014.
- Q. A. Syed, S. Anwar, R. Shukat, and T. Zahoor, "Effects of different ingredients on texture of ice cream," vol. 8, no. 6, pp. 422–435, 2018.
- Acacia honey lime ice cream : physicochemical and sensory characterization as effected by different hydrocolloids," vol. 26, no. June, pp. 883–891, 2019.
- AOAC, 2000. Official method of analysis association and analytical chemists.
- Gomez, K.A. and A.A. Gomez 1984. Statistics of agriculture research 2nd edition, John wiley and sons, Newyork.
- Jangjou and M.A. Moosavi. 2004. A review of the methods to produce low fat ice cream. Ice cream II. Proceedings of the second IDF international symposium on ice cream. Thessaloniki, Greece. 412.
- Sharma. H.K., K. Parsad, S. Jindal, P.Sood and H. Pandey. 2003. Optimization of ingredients for the manufacture of soft serve ice cream by response surface methodology RSM. International j. of dairy technology 56, (1): 22-25.
- Udabage, P., M.A. Augustin. 2003. Dairy ingredients in ice cream. Austerilian journal of of dairy technology 58. (1): 21-25.