Research Article

Studies on Camel Milk Powder Supplemented Kulfi

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Abstract

The present study was aimed and conducted to develop camel milk powder supplemented kulfi using camel milk powder which was assessed for its physico-chemical properties, sensory attributes, therapeutic value and microbial quality. The kulfi prepared without any addition of camel milk powder was treated as control. The fat 14%, protein 8.37%, ash 1.91%, carbohydrate 26.71%, total solids 50.99%, acidity 0.31% LA, melt down time 24.37, anti-oxidant 4.50 mg ascorbic acid and whey nitrogen index 2.34% were observed in optimized kulfi. The chemical composition showed that the percentage of fat, protein, carbohydrate, ash and total solids increased by increasing the amount of camel milk powder with respect to physical properties, melting resistance and hardness in kulfi samples decreased with increasing level of camel milk powder.

Keywords: Camel milk powder, optimized kulfi, Buffalo milk, Sugar, Stabilizer

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Introduction

Kulfi is an Indian traditional frozen dairy product, is popular in many part of northern India. Traditionally it is prepared by evaporating sweetened and flavoured milk by slow heating with continuous stirring to keep milk from sticking to the bottom of the vessel until its volume is reduced by a half thus concentrating the milk [1]. Kulfi has in composition almost resembled in Ice-cream. Kulfi is a 500 years old popular frozen dessert of Indian origin and it occupies a privileged position amongst the traditional Indian dairy products. Kulfi is also known as kulfa, qulfi, kulphy etc [2]. The word 'kulfi' was derived from the Persian word for a covered cup. The dessert likely originated in the Mughal Empire in 16th century [3]. In recent years, the consumption of ice cream in India has increased considerably in big cities and town. Every north Indian city is selling frozen product to quench scorching heat of summer season [4]. In India about 0.7% of the total milk produced is converted into frozen desserts like ice-cream and kulfi [5]. Kulfi contains approximately 8.53 % fat, 34.18 % TS, 3.43 % protein, 11.02 % SNF, 6.17 % lactose, 0.84 % ash [6].

Addition of Camel milk powder with buffalo milk helps to increase the nutritive value of food and which also help to maintain good health and prevent from degenerative disease. Camel milk, generally opaque and white, has an acceptable taste [7]. Normally milk has a sweet and sharp taste, but sometimes milk can also have a salty taste due to the type of plants eaten in the desert area by the camels. The changes in taste are mainly caused by the type of fodder and availability of drinking water [8]. Camel milk and its products are a good nutritional source for human diet in several parts of the world as they contain all essential nutrients [9]. It has been reported that camel milk has potential therapeutic properties, such as anticarcinogenic, antidiabetic and antihypertensive and has been recommended to be consumed by children who are allergic to bovine milk [10]. Camel milk has higher unsaturated fatty acids, lower saturated and short chain fatty acids and also lower content of carotene than bovine milk [11]. Camel milk has been used to treat tuberculosis, dropsy, jaundice, and anaemia. It has high insulin content and it has traditionally been used to treat diabetes. Camel milk improved long-term glycaemic control and reduced insulin dose in patients with type-1 diabetes. It contains low amounts of κ-casein resulting in weak casein network which affects melting resistance and hardness of the developed product. The composition of camel milk is similar to the cow and goat milk (Morton, 1984) [12]. Camel milk has 11.7% total solids, 3.0% protein, 3.6% fat and 0.13% acidity [13]. This effect has been attributed of the presence of antimicrobial substances in camel milk, including lysozymes, hydrogen peroxide, lactoferrin, lactoperoxidase, and immunoglobulin's [14]. Studies on camel milk powder supplemented kulfi have not been reported. The present study aims at investigating the quality characteristics of kulfi supplemented with camel milk powder.

Materials and Methods

The present study was conducted for preparation of kulfi, fresh Ingredients like buffalo milk was collected from local dairy farm of Prayagraj for preparation of kulfi in this investigation. Fresh milk was standardized to 6% fat and 9% SNF. Good quality sugar was brought from the local market of Prayagraj. Camel milk powder was procured from Aadvik foods and Products limited. Sodium alginate was used as stabilizer @ 0.5%.

Preparation of kulfi

Kulfi was prepared in the laboratory using method described by Giri *et al*., (2012) [15] with slight modification. Firstly we will take fresh milk and standardized to 6.0% fat and 9.0% SNF and placed in a steel pan with a wooden ladle and heated by placing pan in a container containing water (double jacketed vat arrangement) over direct fire. The milk was condensed to (2:1) ratio kulfi mix was standardized by adding calculated amount of ingredients like, sugar, stabilizer and emulsifier to obtain total solids not less than 36% in the final mix. During holding 0.5%stabilizerand emulsifier was added. Then the mix was cooled immediately to 30ºC, and other ingredients such as camel milk Powder according to the required percentage were added and then heat kulfi mix at 72ºC for 15 Second. After addition of camel milk power 0.2% cardamom was added. The mix was subsequently frozen in a batch freezer and subsequently be transferred into kulfi moulds and hardened at -20ºC over night.

Treatment Combination

In the present study four treatments were formulated viz. T_0, T_1,T_2, and T_3,where in T_0 is control kulfi (100%), T_1 was prepared 95% concentrated milk with 5% Camel milk powder (95%CM + 5%CMP), T_2 was prepared 90% concentrated milk with 10% Camel milk powder (90% + 10%CMP), T_3 was prepared 85% concentrated milk with 15% Camel milk powder (85%CM + 15%CMP).

Physico-Chemical Analysis

Total carbohydrate percentage in kulfi was determination according to BIS, Hand book of food analysis. SP-18 Part XI: Dairy Products Indian standard Institution, New Delhi, 1981[16]. Fat percentage in kulfi was determination according to method of Rose Gottlieb of (AOAC Official Methods of Analysis of AOAC. International 17th edition; Gaithersburg, MD, USA. 2000 [17]. Protein content in kulfi was determination according to method of kjeldahl procedure for kulfi under IS: 1479, Part-2 (1961) [18]. Ash content in kulfi was determination as per the procedure laid down in IS: 10501, 1983 [19]. Total solid content of kulfi supplemented with camel milk powder was determined by gravimetrically as per the procedure for milk laid down in (IS:1479, Part -2 1961) [18]. Titratable acidity of kulfi was done as per the procedure laid down in IS: 1479, Part-1 (1960) [20]. Melting resistance of kulfi was done as per the procedure [15]. Hardness of kulfi supplemented with camel milk powder was done as per procedure IS: 1479, Part-2 (1961) [18]. Antioxidant activity of kulfi was done as per the procedure DPPH method [21]. Whey nitrogen index of kulfi was done as per the procedure Kjeldahl method laid down IS: 1479, Part-2 (1961) [18]. Measurement of colour of kulfi supplemented with camel milk powder was done as per the procedure [22].

Microbiological Attribute

Kulfi samples were analyzed for the standard plate count (SPC), yeast and mold (Y&M) and coliform count by the method as described in (APHA) standard method for the examination of Dairy products (1992) [23].

Sensory attribute

Each treatment of kulfi sample was prepared 30 ml of kulfi mould and evaluated for sensory attributes like flavour, colour and appearance, body and texture, melting resistance and overall acceptability by a sensory panel consisting 6 members of teacher and 6 members of students on a 9 point hedonic scale [24].

Statistical Analysis

Data was analyzed using Analysis of Variance (ANOVA) and Critical Difference (C.D.) at 5% in WASP and excel software.

Results and Discussion

The camel milk powder supplemented kulfi were analyzed for different parameters viz. Physico-Chemical analysis (Total carbohydrate, Fat, Protein, ash, Total solid, Moisture, Titratable Acidity, pH Hardness, Melting resistance, antioxidant Activity, whey nitrogen index, measurement of colour) was done for estimating its nutritional contents of kulfi sample.

Physical Properties of Kulfi Mix/Kulfi

In view of investigation physical properties of kulfi mix/kulfi are shown in **Table 1**. It was observed that the physico-chemical properties in control and other experimental in camel milk powder supplemented kulfi sample of different treatment. The mean value of total solid content of treatment viz. T_0, T_1, T_2 and T_3 was found to be 44.02, 47.60, 50.99, and 54.46% respectively. Total solid content of camel milk powder supplemented kulfi, highest mean was observed in T_3 and lowest was observed in T_0. The mean treatment values were increased form T_0 to T_3 experimental samples so the total solid of different treatment increased significantly ($P<0.05$). Similar observations were made by the Shiva *et al*., (2019) [25].

Table 1 Physico-Chemical properties of camel milk powder supplemented Kulfi

Parameters		**T_0**	**T_1**	**T_2**	**T_3**
Total Solid (%)		44.02±0.16	47.60±0.20	50.99±0.22	54.46±0.25
Moisture (%)		55.97±0.16	52.4±0.20	49.00±0.23	45.54±0.24
Fat (%)		11.89±0.13	12.95±0.08	14.00±0.09	15.07±0.09
Protein (%)		6.60±0.09	7.61±0.07	8.37±0.04	9.06±0.06
Total carbohydrate (%)		24.04±0.08	25.33±0.11	26.71±0.09	28.07±0.10
Ash (%)		1.49±0.06	1.69±0.04	1.91±0.05	2.24±0.03
Titratable Acidity (%)		0.26±0.02	0.29±0.01	0.311±0.01	0.33±0.02
pH		6.37±0.03	6.33±0.02	6.30±0.02	6.27±0.02
Hardness (N)		11.19±1.54	9.17±0.59	8.58±0.35	7.88±0.60
Melting Resistance (in Min)		26.16±2.34	25.06±1.28	25.37±1.67	22.89±1.00
Antioxidant Activity (expressed in terms of mg Ascorbic acid)		0.35±0.04	2.45±0.26	4.49±0.28	6.49±0.19
Whey nitrogen index		0.57±0.07	0.83±0.07	1.11±0.03	1.35±0.07
Colour measurement	Lightness	99.07±0.11	98.92±0.07	98.76±0.03	98.51±0.02
	Browning index	12.33±0.06	13.04±0.04	13.80±0.03	14.65±0.08

Note: Data represented as mean ± standard deviation of five replications. Values with significantly different ($p \leq 0.05$)

The results indicated that a gradual reduction of the mean moisture content was observed till it reached a maximum level after addition of camel milk powder. Moisture content of camel milk powder kulfi, highest mean was observed in T_0 and lowest was observed in T_3. The mean treatment values were decreased from T_0 to T_3 experimental samples so the moisture content of different significantly ($P<0.05$). Similar observation were made by Singh *et al.*, (2017) [26] on effect of stevia on the chemical composition of low herbal calorie kulfi.

The highest fat percentage was observed in T_3 treatment and lowest fat content was noted in treatment T_0. Level of camel milk powder in the kulfi increased, the fat content of kulfi from it also increased. The mean value of fat percentage in camel milk powder supplemented kulfi sample of different treatments T_0, T_1, T_2 and T_3 was found to be 11.89, 12.95, 14.00, and 15.07% respectively. It was observed that mean treatment values were increased from T_0 to T_3 experimental sample so the fat of different treatment also was increased significantly ($P<0.05$). Similar observation were made by Shiva *et al*., (2019) [25].

The mean value of protein content of treatment T_0, T_1, T_2 and T_3 was found to be 6.60, 7.61, 8.37, and 9.06 respectively. The presented data of camel milk powder kulfi highest mean protein percent was observed in T_3 followed T_2, T_1 and T_0. It can be observed from Table 1, that the values for protein increased with the increased in proportion of camel milk powder. Similar observation were made by Shiva *et al*., (2019) [25].

The mean value of total carbohydrate of four treatment viz. T_0, T_1, T_2 and T_3 was found in the range of 24.04 to 28.07 percent. Total carbohydrate content of camel milk powder kulfi highest mean carbohydrate percentage was observed in T_3 (28.076) followed by T_2 (26.712), T_1 (25.338) and T_0 (24.044). The total carbohydrate content of the camel milk powder kulfi was significantly higher than the control. It was observed that mean treatment values were increased from T_0 to T_3 experimental samples so that carbohydrate of different treatment increased significantly ($P<0.05$). The results are similar to the report of Shiva *et al.*, (2019) [25].

The data regarding Ash content in camel milk powder supplemented kulfi sample of different treatments are shown in Table 1. The mean value of Ash percentage of treatment T_0, T_1, T_2 and T_3 was found to be 1.49, 1.69, 1.91, and 2.2 respectively. The ash content of camel milk supplemented kulfi highest mean was observed in T_3 and lowest was observed in the sample of T_0. It indicates that increased the level of camel milk powder, the ash content was also increased. The results are similar to the report of Shiva *et al.,* (2019) [25].

The data regarding titratable acidity in camel milk powder supplemented kulfi sample of different treatments are shown in Table 1. The mean value of titratable acidity percent lactic acid of treatment T_0, T_1, T_2 and T_3 was found to be 0.26, 0.29, 0.31, and 0.33 respectively. The titratable acidity of camel milk supplemented kulfi highest mean was observed in T_3 and lowest was observed in the sample of T_0. It indicates that increased the level of camel milk powder, the titratable acidity was also increased. Similar observation were made by Shiva *et al.*, (2019) [25] on flaxseed powder kulfi.

The pH of control kulfi mix was observed 6.37 and experimental sample was observed in treatments T_1, T_2 and T_3 in 6.33, 6.30 and 6.27 respectively. The pH of camel milk powder kulfi highest mean was observed in $T_0$and lowest was observed in the sample of T_3. It indicates that increase the level of camel milk powder, the pH was decreased. The results are similar to the report of Vitthalrao W.M. (2011) [27] who observed that pH content of *Kulfi* ranged from 6.11 to 6.40, The control *Kulfi* (T_0) had higher pH value (6.40) than the *Kulfi* blended with custard apple pulp T_1(6.31), T_2(6.23) and T_3(6.11) respectively.

It was observed that the hardness of the kulfi prepared by addition of camel milk powder varied with respect to camel milk powder of the kulfi. The hardness of camel milk powder supplemented kulfi highest mean was observed in T_0 and lowest was observed in the sample of T_3. It indicates that increased the level of camel milk powder, then hardness was decreased. Similar observation were made by Shiva *et al.,* (2019) [25] for preparation of flaxseed powder kulfi.

The results indicated that a gradual reduction of the mean melting resistance was observed till it reached a maximum level after addition of camel milk powder. Melting resistance of camel milk powder kulfi highest mean in melting resistance was observed in T_0 and lowest was observed in T_3. The mean treatment values were increased form T_3 to T_0 experimental samples so the melting resistance of different treatment increased significantly ($P<0.05$). The results agreed with the report of Shiva *et al.,* (2019) [25].

The mean value of antioxidant activity of four treatment viz. T_0, T_1, T_2 and T_3 was found in the range of 0.35 to 6.49 expressed in mg ascorbic acid. Antioxidant activity of camel milk powder kulfi highest mean antioxidant was observed in T_3 (6.49) followed by T_2 (4.49), T_1 (2.45) and T_0 (0.35). It was observed that mean treatment values were increased from T_0 to T_3 experimental samples so the antioxidant of different treatments increased significantly ($P<0.05$). The similar results were found Shiva *et al.,* (2019)[25] for preparation of flaxseed powder kulfi.

The mean value of whey nitrogen index of treatment T_0, T_1, T_2 and T_3 was found to be 0.57, 0.836, 1.11, and 1.35 respectively. The presented data of camel milk powder kulfi highest mean whey nitrogen index was observed in T_3 followed by T_2, T_1 and T_0. It can be observed from Table 1, that the values for whey nitrogen increased with the increased in proportion of camel milk powder.

The measurement of colour of control and experimental sample kulfi mix was observed on basis of Lightness percentage and Browning index.

The mean value of lightness of treatment T_0, T_1, T_2 and T_3 was found to be 99.07, 98.92, 98.76 and 98.51 respectively. The presented data of camel milk powder kulfi highest mean lightness was observed in T_0 followed by T_1, T_2 and T_3. It can be observed from Table 1 that the values for lightness decreased with the increased in proportion of camel milk powder. Similar observation was made by Shuddhodhan (2012) [22] reported the similar trends in study wherein the authors worked iron and zinc fortification of neutri mix based on milk and pearl millet.

The highest browning colour of 14.65 percent was observed for treatment T_3 and lowest browning percent of 12.332 percent was noted for treatment T_0. Level of camel milk powder in the kulfi increased, the browning content of kulfi from it also increased. The mean value of browning percentage in camel milk powder supplemented kulfi sample if different treatment of T_0, T_1, T_2 and T_3 was found to be 12.33, 13.04, 13.80 and 14.65 respectively. It was observed that mean treatment values were increased from T_0 to T_3 experimental sample so the browning index of different treatment also increased significantly ($P<0.05$). But Shuddhodhan (2012) [22] reported the opposite trends in study wherein the authors worked on iron and zinc fortification of neutri mix based on milk and pearl millet. Browning index was increased as the proportion of added camel milk powder increased in the product.

Microbial Properties of kulfi mix/kulfi

The mean value of standard plate count of treatment T_0, T_1, T_2 and T_3 was found to be 27.80, 35.80, 36.00 and 45.00 respectively. The standard plate count of camel milk powder kulfi, highest mean standard plate count was recorded in

T_3 (45.00) followed by T_2 (36.00), T_1 (35.80) and T_0 (27.80). There are non-significant difference ($P<0.05$) between these treatments. The results agreed with the report of Shiva *et al.*, (2019) [25]

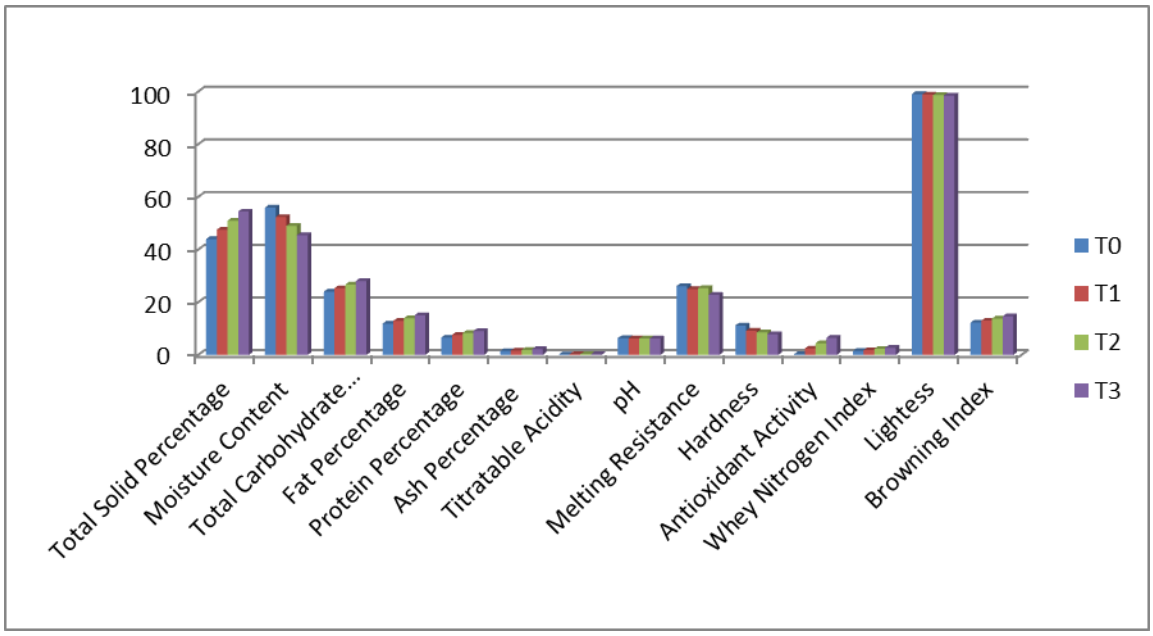

Figure 1 Graphical representation of physico-chemical properties of camel milk powder supplemented kulfi

The mean value of yeast and mold count in camel milk powder supplemented kulfi sample of different treatmentsT_0, T_1, T_2 and T_3 was found to be 2.00, 2.04, 2.94 and 4.48 respectively. The yeast and mold of camel milk powder kulfi, highest mean yeast and mold was recorded in T_3 (4.48) followed by T_2 (2.94), T_1 (2.046) and T_0 (2.00). There are non-significant difference ($P<0.05$) between these treatments.

Coliform was observed absent in all the kulfi samples which indicates that excellent hygienic condition were maintained during the preparation and while storage time gave an excellent results of the product.

Sensory characteristics of kulfi mix/kulfi

Organoleptic characteristic like (Flavour, colour and appearance, body texture, melting resistance and overall acceptability) was evaluated by sensory methods using in 9 point hedonic scale. Mean values of organoleptic characteristic was given in **Table 2**.

Table 2 Sensory evaluation of camel milk powder supplemented kulfi

Parameters	**T_0**	**T_1**	**T_2**	**T_3**
Flavour	7.78±0.24	7.48±0.33	7.82±0.24	7.08±0.19
Colour and Appearance	7.52±0.19	7.52±0.13	7.56±0.11	7.28±0.14
Body & Texture	7.78±0.17	7.74±0.20	7.82±0.19	7.42±0.14
Melting Resistance	7.64±0.16	7.32±0.30	7.60±0.31	7.06±0.42
Overall Acceptability	7.67±0.07	7.51±0.18	7.69±0.12	7.20±0.13

Note: Data represented as mean ± standard deviation of five replications.
Values with significantly different ($p \leq 0.05$)

In view of investigation organoleptic characteristics of kulfi mix/kulfi are shown in Table 2. The kulfi samples prepared by addition of different level of camel milk powder were cited to sensory evaluation using 9- hedonic scale which was conducted by trained panelists. The kulfi samples are rated flavour, colour and appearance, body and texture, melting resistance, overall acceptability. The data revealed that the sensory scores of camel milk powder supplemented kulfi, the sample T_2 got highest score for flavour, colour and appearance, body and texture and overall acceptability as 7.82, 7.56, 7.82 and 7.69 respectively and T_0 was highest score of melting resistance (7.64).

The Table 2 reveals that the mean score for flavour of camel milk powder kulfi was found to be in the range of 7.08 to 7.82.

Figure 2 Camel milk powder supplemented kulfi (Control T0, T1, T2 and T3)

The colour and appearance score of camel milk powder of the mean value of T_0, T_1, T_2 and T_3 was found to be 7.52, 7.52, 7.56 and 7.28 respectively. The highest mean colour and appearance score was recorded in $T_2$and lowest was in T_3.

Similarly, the mean scores of body and texture of camel milk powder supplemented kulfi of different treatments was found in the range of 7.42 to 7.82. The highest mean of body and texture was recorded in T_2 and lowest was recorded in T_3. The different treatments were observed to be significantly different ($P<0.05$).

The melting resistance score of camel milk powder kulfi of T_0, T_1, T_2 and T_3 was found to be 7.64, 7.32, 7.60 and 7.06 respectively. The highest mean of melting resistance score was recorded in T_0 followed by T_2, T_1 and T_3. The different parameters were also observed to be significantly different ($P<0.05$).

Table 2 also reveals that for overall acceptability score of camel milk powder kulfi ranged from 7.20 to 7.69. The result obtained in the study indicates that the variation amongst sensory scores for different treatments were found to be significant difference ($P<0.05$).

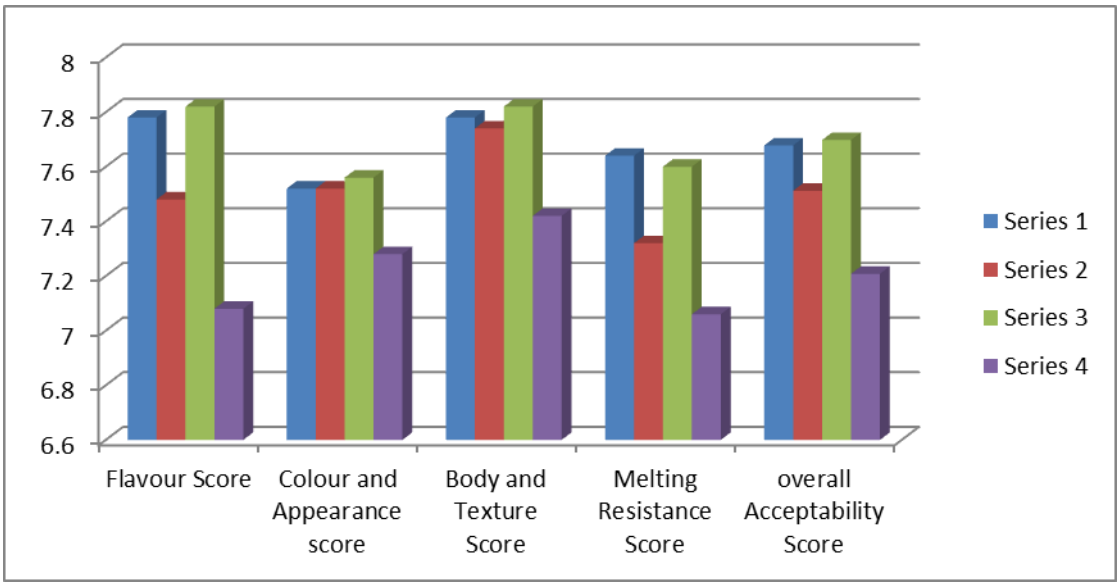

Figure 3 Graphical representation of Sensory evaluation of camel milk powder supplemented kulfi

Conclusion

In this present study physico-chemical characterization, microbiological attributes and sensory evaluation of camel milk powder supplemented kulfi was carried out and it was found that frozen dessert. The demand of kulfi is increasing in recent years, as it is a rich source of high quality animal protein, fat, minerals and vitamins. The

utilization of camel milk powder in kulfi will be of great importance as it imparts therapeutic health benefits like antimicrobial, anti-inflammatory, anti-diabetic, anti-cancerous. It may be stated that value addition of kulfi incorporated with camel milk powder can be commercialized on a large scale in future.

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