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Physicochemical analysis of probiotic functional Kulfi by using Indian blackberry (*Syzygium cumini* L.)

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Abstract
Kulfi is an indigenous product that looks like ice cream or milk ice. Kulfi is India's most famous frozen dessert, which aids in the development of small-scale manufacturing while also providing significant employment and money. Its origin is unknown, but it is possible that it only became popular after artificial ice became available. Kulfi is a nut ice cream that is frozen in little conical pots. After chilling, sweetened milk with 20-25 percent additional sugar is concentrated to about half its volume, then malai, crushed almonds, pistachio, and flavoring components such as vanilla and rose essence are added. The goal of this research was to create a probiotic-functional kulfi using Indian blackberry (*Syzygium cumini* L.). Studied for its physicochemical analysis such as carbohydrate, protein, fat, TS and moisture. In the present investigation treatment K_0 is the control kulfi that doesn't contain any probiotic culture and powder of Indian blackberry and treatments K_a to K_r are the experimental kulfi which contain various proportion of sugar (10%, 15% and 20%), Indian blackberry powder (2%, 4% and 6%) and probiotic culture (1%., *Lactobacillus acidophilus* and *Bifidobacterium bifidus*). After physicochemical analysis it was found that the probiotic functional kulfi (K_a to K_r) has high amount of protein and low amount of fat than control kulfi (K_0). Because the experimental kulfi was prepared by using Indian blackberry powder with 1% probiotic culture.

Keywords: *Lactobacillus acidophilus*, *Bifidobacterium bifidum*, Jamun, Indian dairy product, functional foods, probiotic culture, physicochemical analysis

Introduction
Indian frozen dairy products are liked the most by most of the consumers, as it is quite cheap, palatable and nutritious. It is widely accepted and its demand is increasing day by day next to ice-cream. It is a typical frozen dessert sold by small milk vendors, halwais, sweet makers etc, in many parts of our country, specially in the summer season. Kulfi is the foremost Indian frozen desert which helps to develop small scale industry and generate sizeable employment and income. According to Warner (1976) [21] Kulfi is defined as an indigenous product which resembles ice-cream or milk ice. It' s origin is uncertain, but it could have become widely used only after artificial ice became available. Kulfi is a nut ice-cream, frozen in small containers of conical shape. Sweetened milk, containing 20-25 percent added sugar is concentrated to about half of its volume and malai, crushed almonds, pistachio and flavouring materials such as vanilla and essence of rose are added after cooling (Parikh, 1977) [14]. In recent years, growing health consciousness has led to the development of novel dairy products, having therapeutic and nutritive value. Given this, Indian kulfi, the most commonly consumed Indian frozen dairy product, if enriched with probiotic culture and Indian blackberry (*Syzygium cumini* L.) powder, could result in increased acceptability, value addition and therapeutic value of the product.

Indian Blackberry (*Syzygium cumini* L.)
Indian Blackberry is the most common fruit in India. The fruit is also called as black plum or Java plum, Jamun and jambolan. The family of this tree is Myrtaceae. Its native range includes the Indian Subcontinent, Southeast Asia, China, and Queensland. It is mostly used for traditional treatment for diabetes mellitus, inflammation, ulcers and diarrhoea. It has pharmaceuticals properties and it is a good source of anthocyanin and the fruit is effective against the analgesic properties. It also has chemopreventive, radio protective and antineoplastic properties.

Medicinal Properties of Indian Blackberry (*Syzygium cumini* L.)
Srivastava *et al.*, (1983) [16] noted that the Jamun fruits have stomachic, astringent, carminative, antiscorbutic and diuretic activities. Fruits have also antimicrobial and cytotoxic activities.

Indian blackberry is also an excellent source of antioxidant substances, including as phenolics, carotenoids, vitamins, and flavonoids, are useful for reducing oxidative stress and inhibiting macromolecular oxidation, which helps to manage degenerative illnesses (Kubola *et al.*, 2011) [12].

Health Benefits of Indian Blackberries

Indian blackberries are delicious fruits which have been tremendously beneficial to maintain excellent health. They are useful resource for combating and preventing various conditions of disease (1:1).

Use of powder of Indian blackberry in Kulfi

Various fruit powder is used in kulfi to prepare functional kulfi with high potential health benefits. Indian blackberry powder contains high amount of dietary fibre and vitamin C and because of their antiproliferative, antiinflammatory activities and antioxidant. The coloured fruits, specially berries, are highly chemoprotective, so kulfi with Indian blackberry powder is good for human health (Aqil *et al.*, 2012) [4].

Use of Buffalo Milk in Kulfi

In India, buffalo's milk is very popular to prepare various dairy products. Buffalo's milk is a wealthy source of total solids and casein to make extreamly worthy to process different types of milk products with creamy textures yet rich flavour profiles (Han *et al.*, 2012) [7].

Buffalo's milk contributes to significant energy saving in conducting the process manufacturing (Ahmad *et al.*, 2013) [1].

Probiotics

Probiotics in simple terms can be defined as living microorganisms which are consumed and have potent health benefits, these microbes include LAB (lacticacid bacteria), *Saccharomyces boulardii* etc.

Probiotics are safe to consume and promote good microbial building in our body. They generally increases gut health and also increases vitamin synthesis.

Collins and Gibson, (1999) [6] noted that Probiotics, specially *Lactobacillus* and *Bifidobacteria*, are one of the most common methods for improving the balance of the intestinal microflora. Probiotic microorganism also helps to increase blood metabolic activities, they create healthy microbial (bacterial) balances and helps to boost immunity as well.

Use of probiotics in Kulfi

Parker (1974) Introduced the term "Probiotic" to describe "organisms and substances contributing to intestinal microbial balance." In addition to this, they perform beneficial role against severe diseases such as constipation, hypertension, colitis, inflammatory bowel disease, cancer and food allergies etc. (Ashwell, 2002; Teitlbaum, 2005 and Thomsen, 2006) [5, 18, 19]. The following microorganisms are used in food.

Table 1: List of probiotics used in the food industry (source: www.probioticswikepedia.com)

***Lactobacillus* Species**	***Bifidobacterium* Species**	**Yeast**	**Others**
L. acidophilus	*B. bifidum*	*S. bulardii*	*B. cereus*
L. plantarum	*B. breve*	*S. cerevisiae*	*E. feacium*
L. bulgaricus	*B. infantis*		*C. butyricum*
L. lactis	*B. longum*		*S. Thermophilus*
L. rhamnosus	*B. adolescentis*		*E. faecalis*
L. gasseri	*B. lactis*		
L. reuteri			
L. casei			
L. salivarius			
L. johnsonii			
L. paracasei			

Vijayageetha *et al.*, (2011) [20] noted that the feasibility of dispensing ice-cream with live probiotic species has been discussed the freeze-dried cultures of *Lactobacillus bulgaricus*, *Bifidobacterium bifidum*, *Lactobacillus acidophilus*, and *Lactobacillus delbrueckii* were added to the mix at levels of 1% and 2% before freezing with various crop combinations (8 treatments) in the current study. Chemical and sensory physical examinations were performed on the treatment. All of the following qualities were determined to be acceptable and superior in the 1 percent ice cream containing *Lactobacillus acidophilus* + *Bifidobacterium bifidum*. Furthermore, the viability of the above-mentioned treatment culture might be greatly sustained in the ice cream even after freezing, which could be healpful to customers. Depending on the examination of the above features, it may be able to make probiotic ice cream successfully with different starter cultures.

The ice cream containing *L. A+ B. B.* at 1% level culture, on the other hand, demonstrated superior acceptability by the Judges with less acidity and higher scores for all sensory qualities than the control ice cream for all the samples determined to be adequate.

Levels of viable probiotic organisms required to provide therapeutic effect have been suggested as greater than 1 x 106 CFU/g of product (Tamine *et al.*, 1995) [17]. These bacteria are preventive, free of undesirable effects and non-invasive over antibiotics. In recent year awareness and popularity of probiotic among the global population is increasing day by day (Sanders, 1999) [15].

Kulfi is traditionally prepared by evaporating sweetened and flavoured milk via slow cooking, it is a milk product which is widely consumed in India. The Indian blackberry is also known as jamun, jambul, jamblang, jambolan, black plum, Damson plum, Duhat plum, Jambolan plum, or Portuguese plum. The botanical name is *Syzygium cumini* L. Jamun, also known as black plum, is a popular summer fruit with numerous health and medical benefits. The Indian black plum is a carminative, anti-scorbutic, and diuretic that helps to ease stomach pain.

Jamun is beneficial for reducing spleen enlargement, diarrhea, and urinary retention. Jamum's ployphenolic chemicals have been shown to be useful in the treatment of cancer, heart disease, diabetes, asthma, and arthritis. Jamun is used to treat a variety of digestive issues such as gas, bowel spasms,

stomach ailments, and dysentery. Probiotic culture (*lactobacillus acidophilus* and *bifidobacterium bifidum*) is also beneficial to intestinal health in humans. The main objective of this study is to evaluate the physicochemical properties of optimized kulfi.

Materials and methods

The research, entitled "Process optimization for manufacturing probiotic functional kulfi by using Indian blackberry (*Syzygium cumini* L.)" was carried out in the laboratory of Warner College of Dairy Technology (WCDT), Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS), Allahabad, U.P., India.

Procurement and collection of ingredients

For preparation of probiotic kulfi, the raw ingredients like Buffalo's milk, sugar, Indian blackberry were bought from local shop of Allahabad, U.P., India.

Buffalo's milk

Buffalo's milk was bought from local shop of Allahabad. 8.5 per cent SNF, 13.00 per cent total solids and 0.13 per cent acidity.

Sugar

Commercial grade clean, white crystalline sugar was obtained from the local shop of Allahabad.

Stabilizers and emulsifier

Soy Lecithin and Soy Alginate was bought from local shop of Allahabad.

Indian blackberry

Natural Indian blackberry powder was procured from the local shop of Allahabad, U.P., India.

Probiotic cultures

Freeze-dried cultures *viz., Lactobacillus acidophilus (14)* and *Bifidobacterium bifidus* (232) were procured from The National Collection of Dairy Cultures, NDRI, Karnal (Haryana). These were subcultured and maintained in the laboratory of Microbiology, WCDT, SHUATS, Allahabad. The working cultures, maintained in plain skim milk were subculture once in a week.

Physicochemical analysis of final prepared functional kulf

1. Total Solids content (%) was estimated as per the procedure laid down in IS: 12333, (1997) [10].
2. Fat (%) was estimated as per procedure laid down in IS: 1166, (1973) [9].
3. Protein (%) was estimated as per the procedure suggested by Maneffee and Overman (1940) [13].
4. Carbohydrates (%) was estimated as per the procedure (By Lane Eynon method, SP: 18, Part XI, 1981) [8].
5. Ash (%) was estimated as per the procedure laid down in IS: 5962 (1970) [11].
6. Total Fibre (%) was estimated by standard AOAC 2000 [2, 3] method.

Treatment combination of probiotic functional kulfi

Control or normal Kulfi (k_0)

K_0 – Buffalo milk + 10% sugar and without Indian blackberry powder and culture (Normal kulfi)
Experimental kulfi (k_a to k_r)
K_a – Buffalo milk + 10% sugar +2% Indian blackberry powder +1% *Bifidobacterium bifidus*
K_b – Buffalo milk + 10% sugar +4% Indian blackberry powder +1% *Bifidobacterium bifidus*
K_c – Buffalo milk + 10% sugar +6% Indian blackberry powder +1% *Bifidobacterium bifidus*
K_d – Buffalo milk + 10% sugar +2% Indian blackberry powder +1% *Lactobacillus acidophilus*
K_e – Buffalo milk + 10% sugar +4% Indian blackberry powder +1% *Lactobacillus acidophilus*
K_f – Buffalo milk + 10% sugar +6% Indian blackberry powder +1% *Lactobacillus acidophilus*
K_g – Buffalo milk + 15% sugar +2% Indian blackberry powder +1% *Bifidobacterium bifidus*
K_h– Buffalo milk + 15% sugar +4% Indian blackberry powder +1% *Bifidobacterium bifidus*
K_i – Buffalo milk + 15% sugar +6% Indian blackberry powder +1% *Bifidobacterium bifidus*
K_j – Buffalo milk + 15% sugar +2% Indian blackberry powder +1% *Lactobacillus acidophilus*
k_K – Buffalo milk + 15% sugar +4% Indian blackberry powder +1% *Lactobacillus acidophilus*
K_l– Buffalo milk + 15% sugar +6% Indian blackberry powder +1% *Lactobacillus acidophilus*
K_m– Buffalo milk + 20% sugar +2% Indian blackberry powder +1% *Bifidobacterium bifidus*
K_n – Buffalo milk + 20% sugar +4% Indian blackberry powder +1% *Bifidobacterium bifidus*
K_o – Buffalo milk + 20% sugar +6% Indian blackberry powder +1% *Bifidobacterium bifidus*
K_p – Buffalo milk + 20% sugar +2% Indian blackberry powder +1% *Lactobacillus acidophilus*
K_q – Buffalo milk + 20% sugar +4% Indian blackberry powder +1% *Lactobacillus acidophilus*
K_r– Buffalo milk + 20% sugar +6% Indian blackberry powder +1% *Lactobacillus acidophilus*

No of treatment – 18+1
No of replications: 5
Total no of trials: 95

Flow chart for manufacturing probiotic functional kulfi

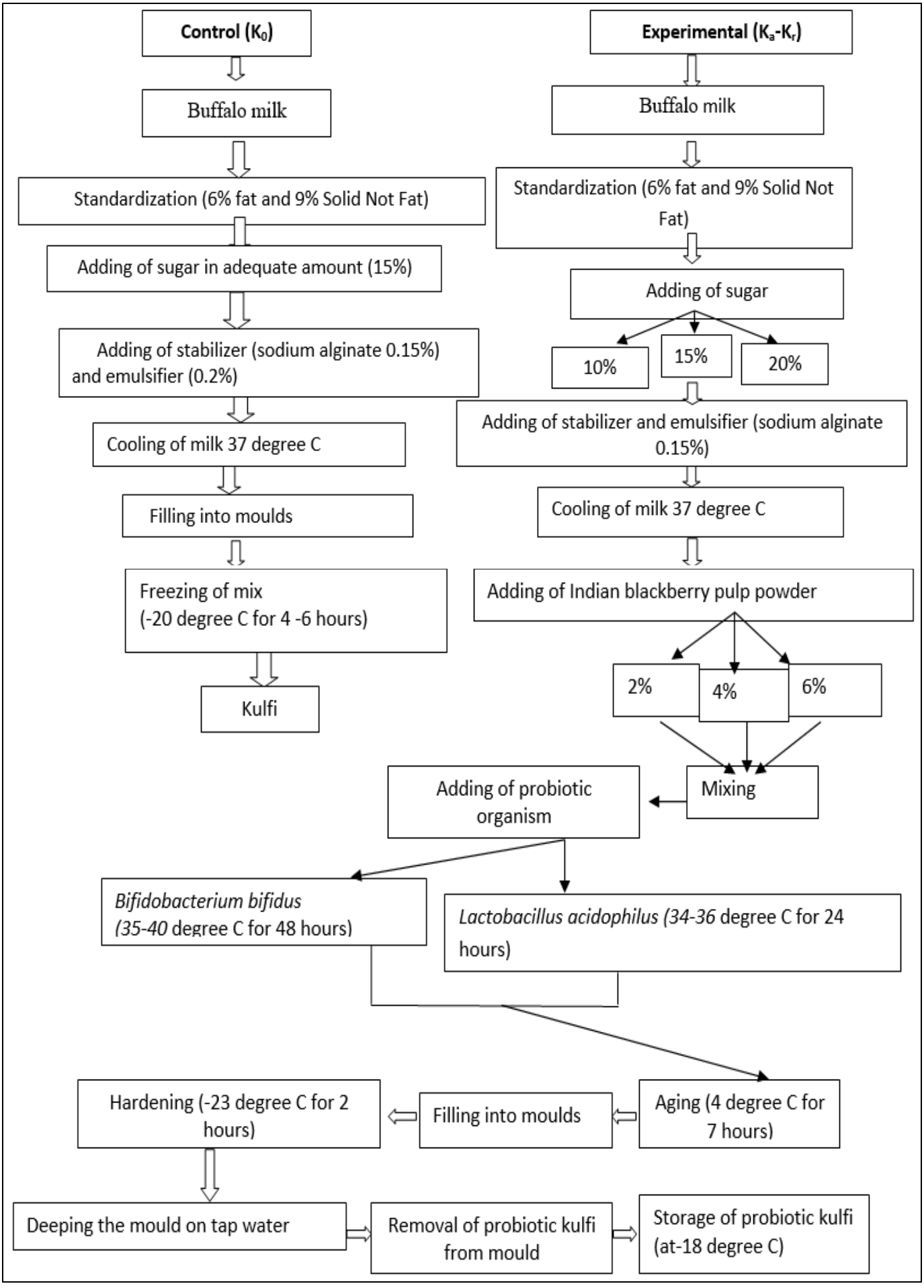

Fig 1: Flow chart for manufacturing probiotic functional kulfi

Results and Discussion

The present studies were carried out on "Process optimization for manufacturing probiotic functional kulfi by using Indian blackberry (*Syzygium cumini* L.)" were done in the laboratories of WCDT, SHUATS, Allahabad, U.P., India. The results of the observations for all of the parameters of the various goals were reported and statistically analyzed.

Table 2: Table showing the mean value of physico-chemical analysis of final prepared probiotic functional kulf

Treatment combination	Carbohydrate (%)	Protein (%)	Fat (%)	TS (%)	Moisture (%)
K_0	24.00	3.92	10.2	39.80	60.20
K_a	24.13	3.94	9.87	39.75	60.25
K_b	24.02	3.94	9.86	39.84	60.16
K_c	24.03	3.96	9.85	39.98	60.02
K_d	23.72	4.04	10.00	39.44	60.56
K_e	23.52	4.14	9.89	39.47	60.53
K_f	23.50	4.14	9.88	39.58	60.42
K_g	26.71	3.93	10.00	40.16	59.84
K_h	26.68	3.94	9.89	40.25	59.75
K_i	26.30	4.14	9.87	40.39	59.61
K_j	25.01	3.95	9.89	40.03	59.97
K_k	25.92	4.04	9.88	40.08	59.92
K_l	25.71	4.13	9.86	40.10	59.90
K_m	28.84	4.04	10.00	41.38	58.62
K_n	28.51	4.14	9.89	41.58	58.42
K_o	28.35	4.17	9.86	41.79	58.10
K_p	27.75	3.96	10.01	40.59	59.41
K_q	27.71	4.11	9.89	40.78	59.22
K_r	27.29	4.19	9.87	40.97	59.03

Physico-chemical analysis of final prepared Kulfi

Carbohydrate percentage in final prepared kulfi

Table 3: Table showing carbohydrate content of final prepared kulfi

Treatments	R_1	R_2	R_3	R_4	R_5	Mean
K_0	23.99	24.01	24.00	24.00	24.00	24.00
K_a	24.10	24.16	24.12	24.14	24.13	24.13
K_b	24.03	24.02	24.02	24.01	24.02	24.02
K_c	24.03	24.04	24.02	24.01	24.04	24.03
K_d	23.72	23.72	23.70	23.74	23.72	23.72
K_e	23.50	23.52	23.52	23.52	23.54	23.52
K_f	23.50	23.49	23.51	23.50	23.50	23.50
K_g	26.71	26.71	26.70	26.72	26.71	26.71
K_h	26.68	26.69	26.67	26.69	26.67	26.68
K_i	26.30	26.31	26.29	26.30	26.30	26.30
K_j	25.01	25.02	25.00	25.01	25.01	25.01
K_k	25.92	25.92	25.90	25.94	25.92	25.92
K_l	25.71	25.71	25.70	25.72	25.71	25.71
K_m	28.84	28.83	28.85	28.84	28.84	28.84
K_n	28.51	28.50	28.52	28.51	28.51	28.51
K_o	28.33	28.37	28.35	28.35	28.35	28.35
K_p	27.33	27.37	27.35	27.35	27.35	27.35
K_q	27.70	27.72	27.71	27.71	27.71	27.71
K_r	27.30	27.28	27.29	27.29	27.29	27.29
Mean	25.85	25.86	25.85	25.86	25.86	25.86
Minimum	23.50	23.49	23.51	23.50	23.50	23.50
Maximum	28.84	28.83	28.85	28.84	28.84	28.84
F test				S		
S. Ed. (±)				0.007		
C. D. (P = 0.05)				0.013		

Table 4: Table showing ANOVA for carbohydrate percentage in final prepared kulfi

ANOVA						
Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Treatment	18	304.7332	16.9296	153538.318	1.75	S
Replication	4	0.0010	0.0002	1.041	2.50	NS
Error	72	0.0079	0.0001			
TOTAL	94	304.7421				

The above table (Table 3) showing that the values of F (Cal. Value) are more than the value of F (Tab. Value) at 5 % significant level on their respective d.f. The above table also showing significant difference ($P<0.05$) between 18 different treatments.

Inoculating probiotics and use of Indian blackberry powder in kulfi had a significant effect on carbohydrate content, as seen in Table 4 and Fig. 2. The control kulfi contain carbohydrate percentage (24.00 %) and at 1% inoculation levels of probiotic culture (*Lactobacillus acidophilus* and *Bifidobacterium bifidus*), the carbohydrate content in kulfi of different treatments was ranges from 23.50 % to 28.84 %. It was discovered that the carbohydrate content of the probiotic kulfi was decreased as the amount of Indian blackberry powder was increased with 1% probiotic culture.

The findings of this study are close to those of Acharya *et al.*, (1999). They investigated the chemical consistency of mango pulp available in Anand city (5 samples each of loose and tinned mango pulp). Carbohydrate 18.88 percent is the average chemical composition of the loose mango pulp. For tinned mango pulp, the carbohydrate percentage was 24.19.

Susngi *et al.*, (2019) make a peach pulp supplemented kulfi by adding different levels of peach pulp (5 percent, 10%, 15%, and 20%) to the kulfi and then studying the effect of adding peach pulp supplemented kulfi. The final optimized product, which contains 15% peach pulp, was found to be highly appropriate among the other combinations based on physico-chemical and sensory evaluations, 24.55 percent carbohydrate content make up the optimized product.

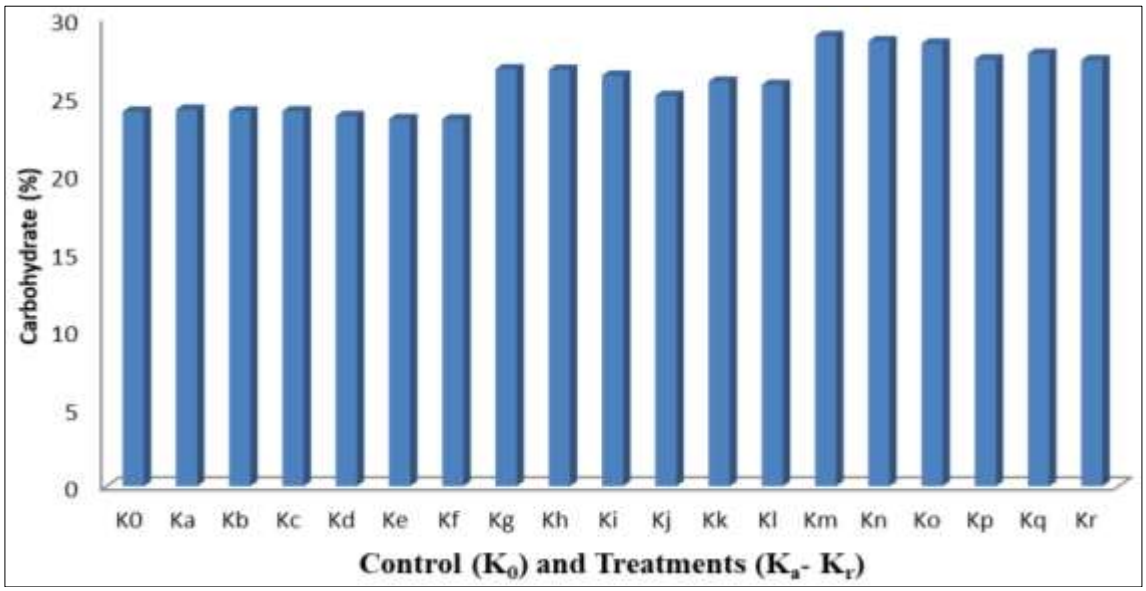

Fig 2: Graphical representation of carbohydrate content (%) of final prepared kulfi

Protein Percentage in Final Prepared Kulfi

Table 5: Table showing protein content (%) of final prepared kulfi

Treatments	R_1	R_2	R_3	R_4	R_5	Mean
K_0	3.91	3.90	3.92	3.96	3.92	3.92
K_a	3.92	3.93	3.94	3.98	3.91	3.94
K_b	3.94	3.95	3.96	3.93	3.94	3.94
K_c	3.96	3.98	3.92	3.94	3.99	3.96
K_d	4.00	4.01	4.06	4.08	4.05	4.04
K_e	4.10	4.12	4.17	4.16	4.13	4.14
K_f	4.12	4.13	4.15	4.18	4.14	4.14
K_g	3.92	3.93	3.94	3.96	3.92	3.93
K_h	3.93	3.94	3.96	3.94	3.92	3.94
K_i	4.10	4.12	4.18	4.19	4.12	4.14
K_j	3.93	3.94	3.95	3.98	3.93	3.95
K_k	4.00	4.01	4.06	4.08	4.05	4.04
K_l	4.10	4.13	4.14	4.16	4.14	4.13
K_m	4.00	4.02	4.06	4.08	4.02	4.04
K_n	4.10	4.13	4.17	4.16	4.14	4.14
K_o	4.15	4.17	4.16	4.17	4.22	4.17
K_p	3.98	3.96	3.98	3.96	3.94	3.96
K_q	4.00	4.10	4.15	4.18	4.12	4.11
K_r	4.10	4.22	4.26	4.17	4.22	4.19
Mean	4.01	4.04	4.06	4.07	4.04	4.04
Minimum	3.91	3.90	3.92	3.93	3.91	3.92
Maximum	4.15	4.22	4.26	4.19	4.22	4.19
F- test				S		
S. Ed. (±)				0.016		
C. D. (P = 0.05)				0.033		

Table 6: Table showing ANOVA for protein content (%) in final prepared kulfi

ANOVA						
Source of variation	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Treatment	18	0.0626	0.0079	1.532	1.75	S
Replication	4	0.0326	0.0082	2.167	2.50	NS
Error	72	0.0482	0.0007	-	-	-
TOTAL	94	0.1434	-			-

The above table (Table 5) showing that the values of F (Cal. Value) are more than the value of F (Tab. Value) at 5 % significant level on their respective d.f. The above table also showing significant difference ($P<0.05$) between 18 different treatments.

Inoculating probiotics and use of Indian blackberry powder in kulfi had a significant effect on protein content, as seen in Table 6 and Fig. 3. The control kulfi contain protein percentage (3.92 %) and at 1% inoculation levels of probiotic culture (*Lactobacillus acidophilus* and *Bifidobacterium bifidus*), the protein content in kulfi of different treatments was increased with the increase of Indian blackberry powder ewith 1% probiotic culture, which was range from 3.93 % to 4.19 %.

Nalkar (2012) prepared probiotic kulfi with incorporation of mango *(Mangifera indica* L.) pulp cv. Alphonso and revealed that the protein content of the control group (T2a-non-probiotic) was 4.45 percent protein, while it was 4.40, 4.37, and 4.34 percent protein for the T2b, T2c, and T2d treatments, respectively.

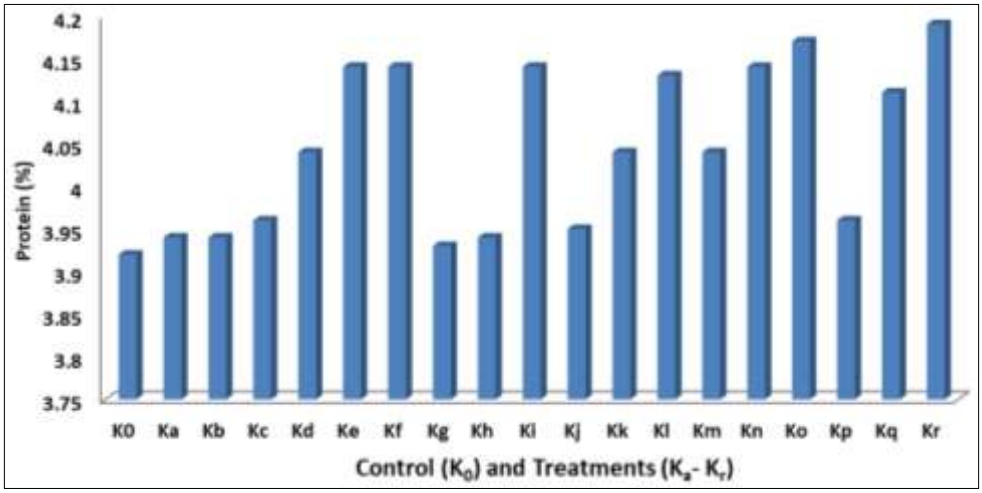

Fig 3: Graphical representation of protein content (%) of final prepared kulfi

Fat Percentage in Final Prepared Kulfi

Table 7: Table showing fat content (%) of final prepared kulfi

Treatments	R_1	R_2	R_3	R_4	R_5	Mean
K_0	10.20	10.22	10.18	10.20	10.20	10.20
K_a	9.87	9.86	9.88	9.87	9.87	9.87
K_b	9.86	9.86	9.87	9.85	9.86	9.86
K_c	9.85	9.87	9.85	9.83	9.85	9.85
K_d	10.00	10.02	10.04	9.90	10.03	10.00
K_e	9.89	9.88	9.90	9.88	9.90	9.89
K_f	9.88	9.86	9.90	9.88	9.88	9.88
K_g	10.00	9.90	10.10	10.00	10.00	10.00
K_h	9.89	9.90	9.88	9.91	9.87	9.89
K_i	9.87	9.88	9.86	9.86	9.88	9.87
K_j	9.89	9.87	9.89	9.91	9.89	9.89
K_k	9.89	9.87	9.88	9.87	9.89	9.88
K_l	9.86	9.86	9.87	9.85	9.86	9.86
K_m	10.00	9.91	10.01	9.90	10.02	9.97
K_n	9.89	9.90	9.88	9.89	9.89	9.89
K_o	9.86	9.86	9.87	9.85	9.86	9.86
K_p	10.02	10.00	10.02	10.00	10.01	10.01
K_q	9.89	9.89	9.88	9.90	9.89	9.89
K_r	9.87	9.88	9.86	9.86	9.88	9.87
Mean	9.92	9.91	9.93	9.91	9.92	9.92
Minimum	9.85	9.86	9.85	9.83	9.85	9.85
Maximum	10.20	10.22	10.18	10.20	10.20	10.20
F test				S		
S. Ed. (±)				0.016		
C. D. (P = 0.05)				0.032		

Table 8: Table showing ANOVA for fat content (%) in final prepared kulfi

ANOVA						
Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Treatment	18	0.6602	0.0367	55.445	1.75	S
Replication	4	0.0061	0.0015	2.318	2.50	NS
Error	72	0.0476	0.0007			
TOTAL	94	0.7139				

The above table (Table 7) showing that the values of F (Cal. Value) are more than the value of F (Tab. Value) at 5 % significant level on their respective d.f. The above table also showing significant difference ($P<0.05$) between 18 different treatment.

Inoculating probiotics and use of Indian blackberry powder in kulfi had a significant effect on fat content. Table 8 and Fig. 4 show that inoculating probiotics in functional kulfi had a major impact on fat content. The control kulfi contain high fat percentage

(10.20%) and at 1% inoculation levels of probiotic culture (*Lactobacillus acidophilus* and *Bifidobacterium bifidus*), the fat content in kulfi of different treatments was decreased with the increase of Indian blackberry powder with 1% probiotic culture, which was range from 9.85 % to 10.01 %.

It was discovered that as the amount of Indian blackberry powder with 1 % probiotic culture was increased, the fat content of the probiotic kulfi was decreased. According to the current findings the control sample (no probiotic culture) had slightly more fat (10.20 %) than the other 18 treatments of probiotic functional kulfi. It's possible that probiotic culture affects the variations in fat content in kulfi.

Treatment-induced variations in fat content of probiotic kulfi were statistically significant. According to Salooja and Balchandran (1982), the above findings are right.

Ghosh and Rajorhia, (1992) looked at the most famous Kulfi shop samples from Karnal and Delhi. The fat content of the kulfi samples ranged from 6.59 to 13.87 percent. They also came to the conclusion that the kulfi mix should contain at least 11% fat for industrial output.

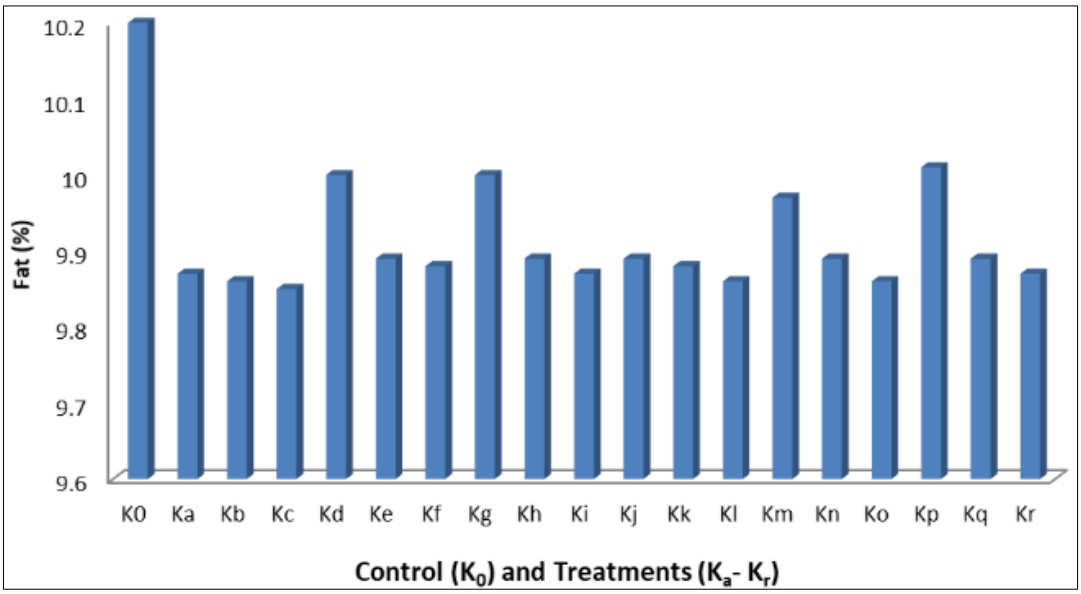

Fig 4: Graphical representation of fat content (%) of final prepared kulfi

TS Content in Final Prepared Kulfi

Table 9: Table showing TS content (%) of final prepared kulfi

Treatments	R_1	R_2	R_3	R_4	R_5	Mean
K_0	39.01	38.99	39.00	39.00	39.00	39.00
K_a	39.75	39.74	39.76	39.75	39.75	39.75
K_b	39.84	39.83	39.85	39.84	39.84	39.84
K_c	39.98	39.97	39.99	39.98	39.98	39.98
K_d	39.44	39.44	39.45	39.43	39.44	39.44
K_e	39.47	39.45	39.49	39.47	39.47	39.47
K_f	39.58	39.58	39.58	39.57	39.59	39.58
K_g	40.16	40.15	40.17	40.16	40.16	40.16
K_h	40.25	40.23	40.27	40.27	40.23	40.25
K_i	40.39	40.38	40.40	40.39	40.39	40.39
K_j	40.03	40.03	40.03	40.02	40.04	40.03
K_k	40.08	40.07	40.09	40.08	40.08	40.08
K_l	40.10	40.10	40.09	40.11	40.10	40.10
K_m	41.38	41.39	41.37	41.40	41.36	41.38
K_n	41.58	41.58	41.58	41.57	41.59	41.58
K_o	41.78	41.80	41.79	41.79	41.79	41.79

K_p	40.58	40.60	40.59	40.59	40.59	40.59
K_q	40.78	40.77	40.79	40.80	40.76	40.78
K_r	40.97	40.98	40.97	40.96	40.97	40.97
Mean	40.27	40.26	40.27	40.27	40.27	40.27
Minimum	39.44	39.44	39.45	39.43	39.44	39.00
Maximum	41.78	41.80	41.79	41.79	41.79	41.79
F test				S		
S. Ed. (±)				0.006		
C. D. (P = 0.05)				0.013		

Table 10: Table showing ANOVA for TS content in final prepared kulfi

ANOVA						
Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Treatment	18	43.9482	2.4416	23259.499	1.75	S
Replication	4	0.0006	0.0002	1.529	2.50	NS
Error	72	0.0076	0.0001			
TOTAL	94	43.9564				

The above table (Table 9) showing that the values of F (Cal. Value) are more than the value of F (Tab. Value) at 5 % significant level on their respective d.f. The above table also showing significant difference (P<0.05) between 18 different treatments.

Inoculating probiotics and use of Indian blackberry powder in kulfi had a significant effect on TS content, as seen in Table 10 and Fig. 5. The control kulfi contain low TS (39.00 %) and at 1% inoculation levels of probiotic culture (*Lactobacillus acidophilus* and *Bifidobacterium bifidus*), the TS content in kulfi of different treatments was increased with the increase of Indian blackberry powder with 1% probiotic culture, which was range from 39.44 % to 41.79 %.

It was discovered that as the amount of probiotic culture in the mix increased, the total solids content of the probiotic kulfi decreased, which may be attributed to losses in sugars and other volatile substances from the mix during gravimetric total solids estimation. The findings of this study are close to those of Salooja and Balchandran (1982) and Nalkar (2012).

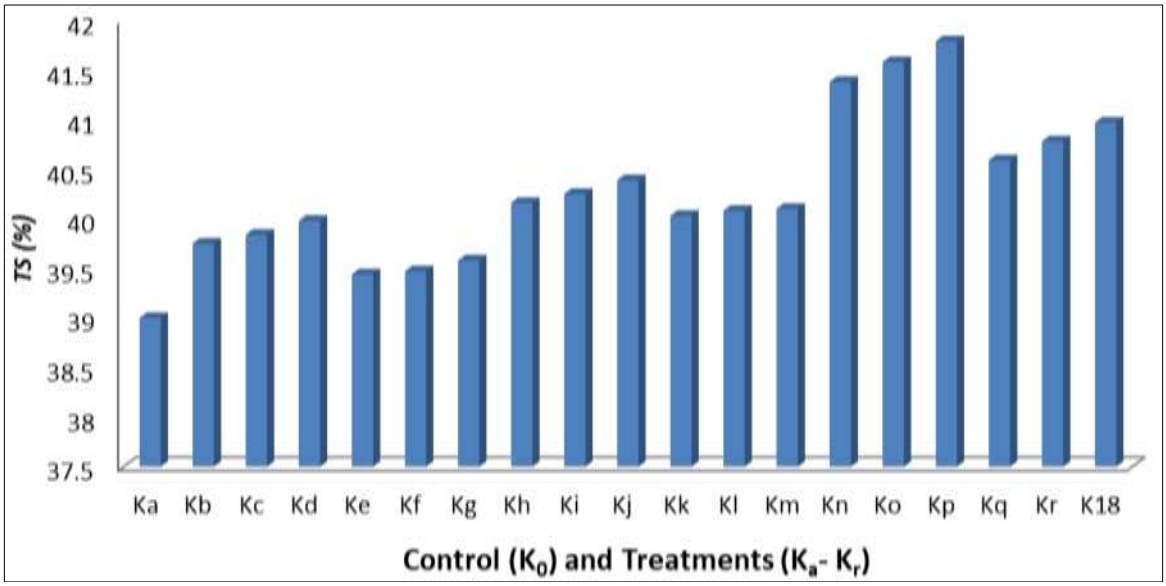

Fig 5: Graphical representation of TS content (%) of final prepared kulfi

Moisture Content in Final Prepared Kulfi

Table 11: Table showing moisture content (%) of final prepared kulfi

Treatments	R_1	R_2	R_3	R_4	R_5	Mean
K_0	60.18	60.20	60.20	60.22	60.20	60.20
K_a	60.25	60.23	60.27	60.25	60.25	60.25
K_b	60.16	60.16	60.16	60.15	60.17	60.16
K_c	60.02	60.01	60.03	60.02	60.02	60.02
K_d	60.56	60.55	60.57	60.56	60.56	60.56
K_e	60.55	60.51	60.50	60.56	60.53	60.53
K_f	60.42	60.42	60.43	60.42	60.41	60.42
K_g	59.84	59.83	59.85	59.84	59.84	59.84
K_h	59.75	59.75	59.75	59.73	59.77	59.75
K_i	59.61	59.60	59.62	59.61	59.61	59.61
K_j	59.98	59.97	59.96	59.97	59.97	59.97

K_k	59.92	59.90	59.94	59.92	59.92	59.92
K_l	59.90	59.91	59.89	59.90	59.90	59.90
K_m	58.60	58.62	58.64	58.62	58.62	58.62
K_n	58.42	58.40	58.44	58.42	58.42	58.42
K_o	58.10	58.10	58.10	58.11	58.09	58.10
K_p	59.41	59.40	59.41	59.42	59.41	59.41
K_q	59.22	59.21	59.23	59.22	59.22	59.22
K_r	59.03	59.02	59.03	59.04	59.03	59.03
Mean	59.68	59.67	59.69	59.68	59.68	59.68
Minimum	58.10	58.10	58.10	58.11	58.09	58.10
Maximum	60.56	60.55	60.57	60.56	60.56	60.56
F test				S		
S. Ed. (±)				0.007		
C. D. (P = 0.05)				0.013		

Table 12: Table showing ANOVA for moisture content (%) in final prepared kulfi

ANOVA						
Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Treatment	18	45.6295	2.5350	22258.279	1.75	S
Replication	4	0.0010	0.0001	1.512	2.50	NS
Error	72	0.0082	0.0001			
TOTAL	94	45.6383				

The above table (Table 11) showing that the values of F (Cal. Value) are more than the value of F (Tab. Value) at 5 % significant level on their respective d.f. The above table also showing significant difference ($P<0.05$) between 18 different treatments. Inoculating probiotics and use of Indian blackberry powder in kulfi had a significant effect on moisture content. Table: 12 and Fig: 6 showing the moisture content of final prepared kulfi. Control kulfi contain 60.20 % moisture and at 1% inoculation levels of probiotic culture (*Lactobacillus acidophilus* and *Bifidobacterium bifidus*), the moisture content in kulfi of different treatments was ranges from 59.50 % to 60.84 %.

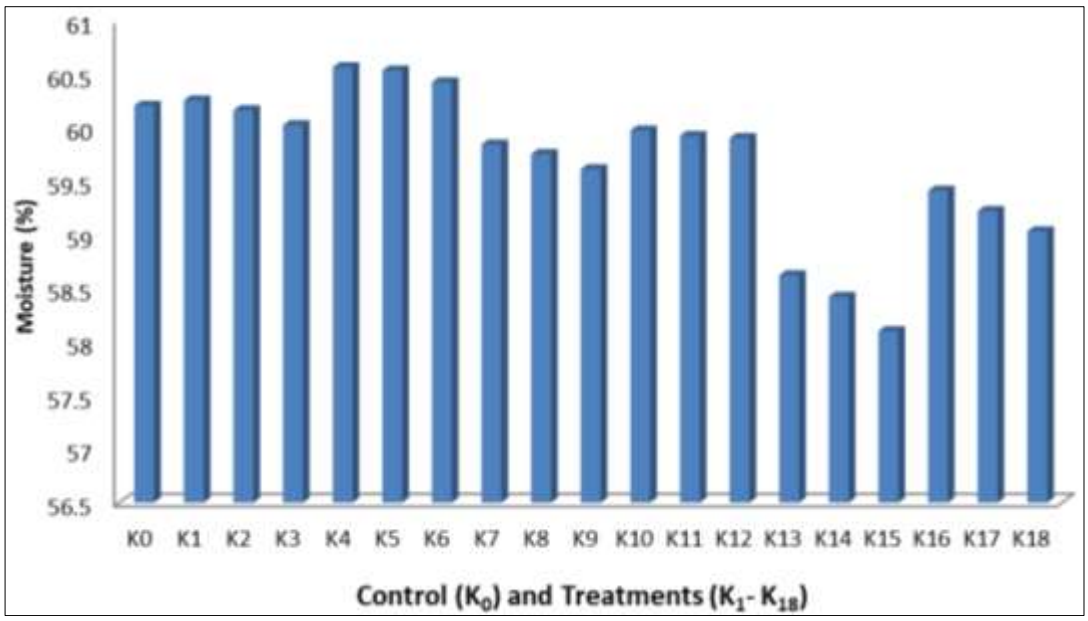

Fig 6: Graphical representation of moisture content (%) of final prepared kulfi

Conclusion

The control kulfi contain carbohydrate percentage (24.00 %) and at 1% inoculation levels of probiotic culture (*Lactobacillus acidophilus* and *Bifidobacterium bifidus*), the carbohydrate content in kulfi of different treatments was ranges from 23.50 % to 28.84 %. It was discovered that the carbohydrate content of the probiotic kulfi was decreased as the amount of Indian blackberry powder was increased with 1% probiotic culture. The control kulfi contain protein percentage (3.92 %) and at 1% inoculation levels of probiotic culture (*Lactobacillus acidophilus* and *Bifidobacterium bifidus*), the protein content in kulfi of different treatments was increased with the increase of Indian blackberry powder ewith 1% probiotic culture, which was range from 3.93 % to 4.19 %. The control kulfi contain high fat percentage (10.20%) and at 1% inoculation levels of probiotic culture (*Lactobacillus acidophilus* and *Bifidobacterium bifidus*), the fat content in kulfi of different treatments was decreased with the increase of Indian blackberry powder with 1% probiotic culture, which was range from 9.85 % to 10.01 %. It was discovered that as the amount of Indian blackberry powder with 1 % probiotic culture was increased, the fat content of the probiotic kulfi was decreased. According to the current findings the control sample (no probiotic culture) had slightly

more fat (10.20 %) than the other 18 treatments of probiotic functional kulfi. It's possible that probiotic culture affects the variations in fat content in kulfi. The control kulfi contain low TS (39.00 %) and at 1% inoculation levels of probiotic culture (*Lactobacillus acidophilus* and *Bifidobacterium bifidus*), the TS content in kulfi of different treatments was increased with the increase of Indian blackberry powder ewith 1% probiotic culture, which was range from 39.44 % to 41.79 %. The Control kulfi contain 60.20 % moisture and at 1% inoculation levels of probiotic culture (*Lactobacillus acidophilus* and *Bifidobacterium bifidus*), the moisture content in kulfi of different treatments was ranges from 59.50 % to 60.84 %.

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