

Preparation of Fibre Fortified *Basundi* Using Date Fruit (*Phoenix dactylifera*)

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Abstract

Fibre fortified *basundi* was prepared using different levels of dried crushed date fruit (*Phoenix dactylifera*) with a view to optimize the process for its manufacture and to study its chemical, sensory and microbiological qualities. Initially the preliminary trials were conducted by blending of different levels of date fruit crush viz; 0, 2, 4, 6, 8, 10 and 12% in the *basundi* with 5% sugar to finalize the experimental treatments.

The experimental treatments viz; no addition of date fruit crush (T₀), addition of 2% date fruit crush (T₁), 4% date fruit crush (T₂), 6% date fruit crush (T₃), 8% date fruit crush (T₄) and addition of 10% date fruit crush (T₅) with 5% sugar level. Experimental *basundi* samples were analyzed for sensory, chemical and microbiological qualities.

The mean sensory score for colour and appearance, body and texture, flavour and overall acceptability showed significant (p<0.05) differences. The mean sensory score for colour and appearance, body and texture, flavour and overall acceptability ranged from 6.15 to 8.88, 6.15 to 8.38, 6.15 to 8.25 and 6.13 to 8.00, respectively.

It was observed that *basundi* samples under different treatments showed significant differences (P<0.05) for fat, protein, total sugar, total solids, acidity, ash and total fibre content. The values were ranged from 9.05 to 10.28, 8.76 to 9.54, 24.56 to 29.24, 44.78 to 49.37%, 0.31 to 0.42% L. A., 1.18 to 1.54 and 0.00 to 0.15%, respectively.

The *basundi* samples under different experimental treatments significantly (P<0.05) influenced the standard plate count (SPC) due to addition of different levels of date fruit crush in the *basundi*. The mean SPC counts ranged from 6.50 cfu x 10³ (T₀) to 23 cfu x 10³ (T₅) per gm.

There was no growth of yeast and mould counts (YMC) and colliform counts observed in the *basundi*.

Keywords: *Basundi*; Date fruit; Chemical quality; Sensory quality; Microbiological quality

Introduction

Utilization of milk and milk products in human diet is common from the beginning of the human civilization. This is because of the fact that milk and milk products which originate from animals are in position to supply the nutrients in balanced proportion to them. The digestibility coefficient of milk nutrients is also very high and hence they are considered indispensable in balancing the dairy food. Hence, supply of milk in one form or the other is a must throughout the year. However, the milk is a perishable commodity and therefore, is required to be converted into the products having long shelf life. The production of milk is not constant throughout the year. It leans down during the summer season while production is boosted up from monsoon to the end of flush season. The scientists have, therefore, tried to preserve the invaluable constituents from milk in 'flush' season either by concentration or dehydration. Preservation of milk constituents by concentration has been advantageous than the other ones, particularly, under the tropical climate. Hence, concentrated milk products possess an important place in the Indian dairy industry [1].

Basundi is one of the heat desiccated indigenous milk products popular in western part of India, mostly Maharashtra and Gujarat. It has been termed as '*Basundi*' in the "First Indian Dairy Year Book" and is defined as a preparation of boiled and sugared milk, used mostly in western India. *Basundi* can be classified in the condensed milk group along with *Rabri*, *Khoa-Mithai*, and *Kheer* and can be considered similar to sweetened condensed whole milk [2-4].

Basundi is an important indigenous desiccated whole milk product prepared by partial dehydration of the milk with sugar. The dehydration of the milk is done in a *karahi* on direct fire. The original volume of milk is reduced to about 40 to 50 per cent. *Basundi*

is mostly served on ceremonial occasions at feasts and festivals. The market value of product depends upon a relative thick creamy consistency, white to light brown colour, sweetish caramel aroma and soft textured flakes uniformly distributed throughout the product mass [5].

The aroma and flavour of any food or drink, if they are enticing and satisfy the consumer, makes it for eating or drinking more pleasurable. *Basundi* is a desiccated product, like much by most of the people but those who do not like to consume as such, they like to consume, if it is flavoured with some appealing natural fruit flavours. Thus, there is considerable scope for research work on fortification of *basundi* with fruit pulp to improve its nutritional and sensory quality and also popularity among the consumers for improving its market value.

The date fruit is a "drupe" in which outer fleshy part (exocarp and mesocarp) surrounds a shell (the pit or stone) of hardened endocarp with a seed inside. The fruit is oval to cylindrical in shape, 3–7 cms long, and 2–3 cms diameter, and when ripe, range from bright red to depending on the variety. The ripe date fruit has high nutritive value as well as a delectable taste. The pulp contains 0.15% fat, 1.81% protein and 74.81% carbohydrates/100g. It is also rich in vitamins and mineral matter. However, available literature indicates that no work has been so far carried out on utilization of date fruit crush for value addition of *basundi*. It is, therefore, decided to explore the possibility to utilize date fruit crush in the preparation of *basundi*.

Materials and Methods

The present study entitled "Preparation of fibre fortified *basundi* using date fruit (*Phoenix dactylifera*)", was undertaken in the laboratory of Dairy Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) during the year 2014 -15 [6].

Materials

Incubator: Digital temperature controlled B.O.D. incubator manufactured by M/S. Neutronic, Bombay was used for microbiological works.

Electrical balance: Electronic precision balance (BT 2245, Sartorius ISO 9001) was used for weighing.

Autoclave: Autoclave manufactured by M/S. Modern Industrial Corporation (MIC) Bombay was used for sterilization of microbiological media and glasswares.

Hot air oven: Hot air oven manufactured by Yorko Company was used for sterilization of glasswares and drying purpose.

Muffle furnace: Tempo make muffle furnace was used for determination of the ash content in *basundi* samples.

Food processor: Food processor was used for crushing dried date pulp.

Karahi: Iron karahi along with stainless steel ladle was used for preparation of *basundi*.

Colony counter: A colony counter with magnifying lens was used for counting the colonies developed by microorganisms on experimental *basundi* samples.

Laminar Air Flow: An instrument manufactured by Kirloskar Electronic Ltd. was used for microbiological work.

pH meter: pH meter was used to determine pH of buffer solution for microbiological work.

Milk: Composite samples of crossbred cow milk were obtained from the herd maintained at the Research Cum Development Project (RCDP) on cattle, MPKV, Rahuri, Dist, Ahmednagar (MS).

Ingredients: The ingredients like sugar, dried date fruit were purchased from the local market.

Method for preparation of *basundi*

Standardization of milk: The milk samples were standardized to 4 per cent fat.

The *basundi* samples were prepared as per the procedure given by Patel and Upadhyay (2003b) with slight modifications (Figure 1) [7,8].

Pre-experimental trials were conducted to decide the levels of addition of date fruit crush in the *basundi* using 0, 2, 4, 6, 8, 10 and 12 percent date fruit crush with 5% sugar. The prepared samples of *basundi* were subjected to sensory evaluation by panel of six trained judges. On the basis of the results of sensory evaluation of pre-experimental trials 0, 2, 4, 6, 8 and 10% i.e. T₀ : Without Date fruit crush *Basundi*, T₁ : 2% Date fruit crush, T₂ : 4% Date fruit crush, T₃ : 6% Date fruit crush, T₄ : 8% Date fruit crush and T₅ : 10% Date fruit crush in the *basundi*. Levels / Treatments were finalized for the experimental trials.

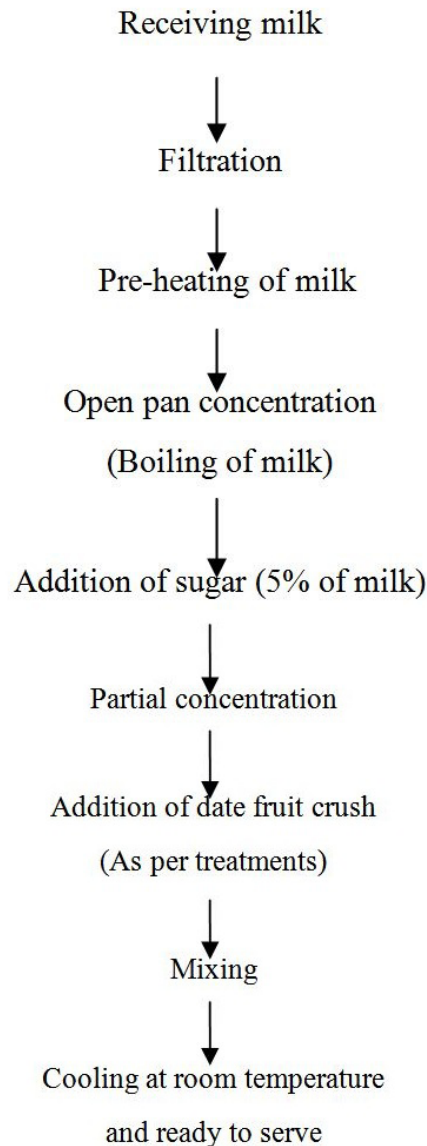


Figure 1: Flow diagram for preparation of *basundi*

Chemical analysis of Milk

Fat: The fat content was determined by Gerber method as per procedure described in BIS (1981) [9]

Total Solids: The total solids content was determined by gravimetric method as per BIS (1981).

Titrateable Acidity (%LA): The titrateable acidity was determined as per the procedure described in BIS (1981).

Protein: The protein content was determined by Micro-Kjeldahl method as described in BIS (1981).

Lactose: The lactose content was determined by Lane - Eynon volumetric method described in BIS (1981).

Chemical analysis of date fruit crush

Fat: Fat content was determined as per the method described by Ranganna [10].

Protein: Protein content was determined as per the method described by Ranganna [10].

Total sugar: The total sugar content was determined as per the method described by Ranganna [10].

Total solids: The total solids content was determined by using the refractometer. (A.O.A.C., 1975) [11].

Ash: Ash content was determined as per the method given by Ranganna [10].

Total fibre: Total fibre content was estimated by using the procedure given in the BIS.

Sensory evaluation of *basundi*

Basundi samples prepared under different pre- experimental and experimental treatments were subjected to sensory evaluation using the method described in the IS: 6273, Part-I and Part- II (1971) adopting 9 point Hedonic scale [12]. A panel of six trained judges was formulated for this purpose. The samples were coded every time to conceal their identity and were offered to the judges for evaluation of the quality attributes [13].

Chemical analysis of *Basundi*

Fat: The fat content was determined by Gerber method as described in IS: 1224, Part I [14].

Protein: Protein content was determined by Micro -Kjeldahl method as described by Chaudhari [15].

Total sugar: The total sugar content was determined as per procedure of Lane - Eynon in BIS (1981).

Total Solids (TS): The TS was determined as per method given in IS: 1479, Part II (1961) [16].

Lactic Acidity (%LA): The lactic acidity was determined as per procedure given in BIS (1981).

Ash: Ash content was estimated as per the procedure given in BIS (1981).

Total fibre: Total fibre content was determined as per the method given in BIS (1981).

Microbiological analysis

Enumeration of microorganisms: The pour plate method was adopted for enumeration of different groups of microorganisms.

Standard Plate Counts (SPC): Standard Plate Counts was determined by adopting standard procedure using Standard Plate Count Agar (SPCA) media as mentioned by Amin [17].

Yeast and Mould Counts (YMC): Yeast and Mould Counts (YMC) was determined as per the procedure described in IS: 5403 (1999) using Potato Dextrose Agar (PDA) [18].

Coliform Counts: Coliform Counts of *basundi* samples was determined as per the procedure described in IS: 5550 (1970) using McConkey's Agar [19].

Statistical analysis

Experiment was laid out in completely randomized design (CRD) with four replications. The data was tabulated and analyzed according to Snedecor and Cochran [20].

Results and Discussion

Chemical composition of Milk (Table 1)

Constituent	Percent
Fat	4.0
Protein	3.43
Lactose	4.45
Total solids	12.53
Ash	0.65
Acidity(% LA)	0.13

The average cow milk contained 4.0, 3.43, 4.45, 12.53, 0.65, 0.13 percent fat, protein, lactose, total solids, ash and acidity (%LA), respectively

Table 1: Chemical composition of milk (Means of 4 replications)

Chemical composition of date fruit crush (Table 2)

Constituent	Per cent
Total solids	74.20
Fat	0.40
Protein	2.70
Ash	1.60
Total fibre	6.50
Total sugar	63.00

The average dried date fruit crush contents were 74.20, 0.40, 2.70, 1.60, 6.50 and 63.00 percent total solids, fat, protein, ash, total fibre and total sugar, respectively

Table 2: Chemical composition of date fruit crush (Mean of 4 replication)

Chemical composition of *basundi*

Fat: It was observed (Table 3) that the mean fat content in T₀, T₁, T₂, T₃, T₄ and T₅ were 10.28, 10.10, 9.80, 9.55, 9.30 and 9.05 per cent respectively. All the treatments showed the significant (P<0.05) differences for fat contents due to addition of date fruit crush in the *basundi*.

Treatment	% Fat content	% protein	% total sugar	% total solids	% LA	% LA	Ash	% Total fibre
T ₀	10.28 ^a	8.76 ^f	24.56 ^a	44.78 ^a	0.42 ^f	0.42 ^f	1.18 ^a	0.00 ^f
T ₂	9.80 ^c	9.04 ^d	26.04 ^c	46.16 ^c	0.38 ^d	0.38 ^d	1.33 ^c	0.40 ^d
T ₃	9.55 ^d	9.16 ^c	26.96 ^d	47.08 ^d	0.36 ^c	0.36 ^c	1.40 ^d	0.70 ^c
T ₄	9.30 ^e	9.36 ^b	27.94 ^e	48.08 ^e	0.33 ^b	0.33 ^b	1.48 ^e	1.10 ^b
T ₅	9.05 ^f	9.54 ^a	29.24 ^f	49.37 ^f	0.31 ^a	0.31 ^a	1.54 ^f	1.50 ^a
SE(+)	0.023	0.011	0.033	0.043	0.004	0.004	0.000234	0.017
CD @5%	0.071	0.032	0.101	0.131	0.011	0.011	0.001	0.050

S.E: Standard Error; CD: Critical Difference; Letters in lower case indicates Significant difference among the treatments

Table 3: Influence of addition of different levels of date fruit crush on chemical composition of *basundi*

It was observed that fat content in treatment samples of *basundi* decreased with increase in levels of date fruit crush. It is due to low fat (0.4%) content in date fruit. Treatment T₀ (without addition of date fruit crush) showed highest fat content (10.28%) whereas treatment T₅ (10% date fruit crush level) had lowest fat content (9.05%).

The values of fat content in the *basundi* prepared in present study are at par with the reports made by Patel and Upadhyay, Aneja, *et al.* and Pathode [19-22].

Sharma mentioned Indian Standard Specifications (vide IS1966, 1973) for condensed milk as fat percentage in *basundi* should not be less than 9. The present results are comparable with the reports of Bureau of Indian Standards (BIS) [23].

Protein: The influence of experimental treatments on protein content in the *basundi* samples was significant (P<0.05). The mean values for protein in T₀, T₁, T₂, T₃, T₄ and T₅ were 8.76, 8.89, 9.04, 9.16, 9.36 and 9.54 per cent respectively (Table 3). The highest value for protein content was 9.54% in the treatment T₅ (10% date fruit crush). All the treatments significantly (P<0.05) differed among themselves. Aneja, *et al.* studied protein content of laboratory made *basundi* samples and reported 9.86% protein content. Patel and Upadhyay standardized compositional recipe of *basundi* with of 5% sugar and they observed 9.55% protein in the *basundi* samples [19,24]. Pathode concentrated the cow milk with 4.5 per cent fat upto 40 per cent and reported that the finished product was of good quality containing 8.0 per cent protein [22]. There was increase in protein content as the level of date fruit increase in the *basundi*. It is due to protein content in the date fruit.

Total sugar: From the results presented in the Table 3, it is revealed that the mean total sugar content in T₀, T₁, T₂, T₃, T₄ and T₅ were 24.56, 25.18, 26.04, 26.96, 27.94 and 29.24 per cent respectively. The influence of addition of date fruit crush in the *basundi* was significant (P<0.05). All experimental treatments differed significantly among themselves due to addition of date fruit crush in the *basundi* samples. It was noticed that as the level of addition of date fruit crush in the *basundi* increases, the total sugar in the sample treatments also increased. It is obviously due to sugar content in the date fruit crush. The treatment T₅ had the highest mean total sugar content (29.24). The results are in agreement with Patel and Upadhyay who reported the values for total sugar of market samples as 21.9 to 27.76% [18].

Aneja, *et al.* reported 24.26% total sugar content of laboratory made *basundi* samples and it is comparable with the values observed in the present study [19].

Total Solids (TS): The influence of addition of date fruit crush in the *basundi* was significant (P<0.05). The mean values of total solids in different samples ranged from 44.78 (T₀) to 49.37 (T₅) % (Table 3). All the experimental treatments differed significantly among themselves. Treatment T₅ showed the highest total solid content (49.37%) whereas treatment T₀ showed lowest value (44.78%) [25].

Patel and Upadhyay and Aneja, *et al.* reported total solids content of *basundi* as 49.57 and 47.35 per cent, respectively [19,24]. These values are in close agreement with the values observed in the present investigation.

Acidity (% LA): The influence of experimental treatments on lactic acidity content of *basundi* was significant (P<0.05). It was observed (Table 3) that the mean lactic acidity content in T₀, T₁, T₂, T₃, T₄ and T₅ were 0.42, 0.39, 0.38, 0.36, 0.33 and 0.31 per cent respectively. All the sample treatments differed significantly among themselves. The titratable acidity was ranged from 0.31% (T₅) to 0.42% (T₀). The control sample T₀ had significantly (P<0.05) higher acidity (0.42%) over the rest of the treatments, while the treatment T₅ had lowest acidity content (0.31%). The titratable acidity levels in the various samples might be related to the total solids content in the date fruit crush admixed in the *basundi* [26-28].

Aneja, *et al.* studied the chemical composition of laboratory made *basundi* and they observed average 0.47% acidity content in the *basundi* which is in close agreement with the values of acidity observed in the present investigation [19].

Ash: The ash content (Table 3) in the *basundi* samples under different experimental treatments due to addition of date fruit crush showed significant ($P < 0.05$) differences. The mean ash content ranged from 1.18 (T_0) to 1.54 (T_5) percent. The sample of the treatments T_5 had significantly higher ash content (1.54%) over the rest of the treatments whereas the treatment T_0 had significantly lower value (1.18%). It was seen that with increase in the level of addition of date fruit crush in the *basundi*, there was increase in the ash content in the *basundi* sample. The influence of different levels of date fruit crush on the total fibre content is depicted in Table 3. There was significant ($P < 0.05$) increase in the total fibre content of the experimental *basundi* samples. It is revealed that the mean total fibre content in the *basundi* samples of T_0 , T_1 , T_2 , T_3 , T_4 and T_5 were 0.0, 0.2, 0.4, 0.7, 1.1 and 1.5 per cent respectively. All the experimental samples differed significantly ($P < 0.05$) among themselves. It was noticed that as the level of addition of date fruit crush in the *basundi* increases, the total fibre content in the sample treatment also increased. Obviously, it is due to the fibre content in the date fruit. Treatment T_5 had highest total fibre content (1.5 per cent).

Microbiological Quality of fresh *basundi* samples

The samples of fresh date fruit *basundi* were subjected to microbial analysis viz., Standard Plate Counts (SPC), Yeast and Mould counts (YMC) and Coliform counts. The microbial counts of respective group are presented in the following Tables.

Standard Plate count

The *basundi* samples prepared with addition of different levels of date fruit crush showed variation in the standard plate counts of the product.

Treatment	Standard plate count (cfu x10 ³ per gm)
T_0	6.50 ^a
T_1	9.00 ^b
T_2	12.00 ^c
T_3	15.00 ^d
T_4	19.00 ^e
T_5	23.00 ^f
SE (+)	0.46
CD @ 5%	1.40

S.E: Standard Error; CD: Critical Difference; Letters in lower case indicates Significant difference among the treatments

Table 4: Influence of different levels of date fruit crush on SPC content of *basundi*

The changes in the SPC of *basundi* samples due to addition of date fruit crush are presented in Table 4. The mean SPC counts of the different experimental *basundi* sample treatments T_0 , T_1 , T_2 , T_3 , T_4 and T_5 were 6.50×10^3 , 9.00×10^3 , 12.00×10^3 , 15.00×10^3 , 19.00×10^3 and 23.00×10^3 cfu per gram, respectively. It was revealed that there was a significant increase ($P < 0.05$) in SPC of the sample as influenced by addition of date fruit crush in the *basundi* samples. The SPC of the control sample (T_0) were significantly lower ($P < 0.05$) than the counts observed in the rest of experimental *basundi* samples. This might be attributed the effect of addition of date fruit crush in the *basundi* samples.

Gaikwad and Hembade evaluated the microbiological quality of Ujani *basundi* manufactured traditionally in Ujani and neighboring villages by traditional manufacturers [29,30]. The SPC counts reported in the range of 16,800 to 2,60,000.

Yeast and mould count (YMC)

The *basundi* sample T_0 , T_1 , T_2 , T_3 , T_4 and T_5 were evaluated for yeast and mould count by pour plate technique. There was no growth of yeast and moulds observed in the *basundi* samples. It indicates that proper pasteurization of the product had been done due to heating process while manufacturing of the *basundi* and there is no post pasteurization contamination in the product. Heating process during manufacturing of *basundi* resulted in complete destruction of undesirable microflora e.g. yeast and moulds.

Coliform counts

The *basundi* sample T_0 , T_1 , T_2 , T_3 , T_4 and T_5 were evaluated for coliform counts by pour plate technique. There was no growth of coliform observed in the *basundi* samples. It indicates that proper pasteurization of the product had been done due to heating process while manufacturing of the *basundi* and there is no post pasteurization contamination in the product. Heating process during manufacturing of *basundi* resulted in complete destruction of undesirable microflora e.g. coliform.

Sensory evaluation

Immediately after preparation of *basundi*, the samples were subjected to sensory evaluation for testing their sensory parameters. From the consumer point of view, the sensory quality of the product holds highest position in marketability, therefore it was intended to study this aspect of sensory qualities.

Colour and appearance

The colour and appearance score of the *basundi* as influenced by different levels of date fruit crush depicted in Table 5.

Treatment	Colour & Appearance	Body & Texture	Body & Texture	Score
T ₀	8.00 ^e	7.63 ^c	7.63 ^c	7.50 ^f
T ₁	7.50 ^c	6.50 ^b	6.50 ^b	6.50 ^b
T ₂	7.63 ^d	7.38 ^d	7.38 ^d	7.38 ^d
T ₃	8.88 ^f	8.38 ^f	8.38 ^f	8.25 ^e
T ₄	6.88 ^b	6.75 ^c	6.75 ^c	7.00 ^c
T ₅	6.15 ^a	6.15 ^a	6.15 ^a	6.15 ^a
SE (+)	0.21	0.26	0.26	0.25
CD @ 5%	0.63	0.80	0.80	0.76

S.E: Standard Error; CD: Critical Difference; Letters in lower case indicates Significant difference among the treatments

Table 5: Influence of different levels of date fruit crush on sensory quality of *basundi* (Mean Sensory Score out of 9)

It is revealed that the mean sensory scores for colour and appearance of the product under different treatments were significant ($P < 0.05$). It means that the addition of different levels of date fruit crush in the *basundi* samples affected the colour and appearance over plain *basundi*.

It was observed that mean colour and appearance score for the experimental treatments T₀, T₁, T₂, T₃, T₄ and T₅ were 8.00, 7.50, 7.63, 8.88, 6.88 and 6.15 respectively. The treatment T₃ had the highest score (8.88) for colour and appearance and the treatment T₅ had lowest score (6.15). All the samples under experimental treatments differed significantly among themselves.

Body and texture

In this case too, the treatment differences in the mean scores were found to be significant ($P < 0.05$) due to addition of date fruit crush in the *basundi* (Table 5).

The mean scores ranged from 6.15 (T₅) to 8.38 (T₃). The sample treatment T₃ scored highest (8.38) among all the treatments studied, whereas T₅ exhibited lowest score (6.15). All experimental treatments differed significantly among themselves.

Flavour

The flavour is the most important component of sensory quality. The mean flavour scores for the treatment samples T₀, T₁, T₂, T₃, T₄ and T₅ were 7.50, 6.50, 7.38, 8.25, 7.00 and 6.15 respectively (Table 5).

The highest score (8.25) was received by the *basundi* sample T₃ prepared from 6 percent date fruit crush followed by T₀ (0%), T₂ (4%), T₄ (8%), T₁ (2%) and T₅ (10%) samples. However there was significant difference among the all treatment. The addition of date fruit crush in the *basundi* significantly ($P < 0.05$) affected the flavour of the product.

Overall acceptability

From the Table 5, it is observed that the addition of different levels of date fruit crush in the *basundi* samples significantly ($P < 0.05$) influenced the overall acceptability of the product. The mean sensory score of experimental *basundi* samples under different treatments were ranged from 6.13 (T₅) to 8.00 (T₃). The highest overall acceptability score (8.00) was observed in treatment T₃ with addition of 6% date fruit crush in the *basundi* over rest of the sample treatment. All the sample treatments significantly differed among themselves.

Conclusion

The best quality fibre enriched *basundi* can be prepared by incorporation of 6 date fruit crush and 5% sugar.

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