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Physico-chemical properties of low-calories and low-sugar *kalam*

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Abstract
The low-calories and low-sugar *kalam* was prepared by using maltodextrin, sugar and aspartame in suitable combination after optimization in the laboratory of Department of Animal Husbandry and Dairy Science, College of Agriculture, Latur, VNMKV, Parbhani during the year 2016-17. The developed product was analyzed for sensory evaluation by serving the product to 100 consumers. The selections of consumers were done purposefully among diabetic, heart disease, obesity and normal consumers with considering their age profile. The formulation of buffalo milk with 3 per cent fat, 1 per cent maltodextrin (on the basis of milk) and 10 per cent sugar & 0.10 per cent aspartame (on the basis of *khoa)* were found suitable for preparation of low-calories and low-sugar *kalam*. The developed *kalam* samples were tasted for 100 consumers selected at randomly on the basis of age, sex and health groups. It is concluded that 55 consumers suffering from diabetic, heart diseases and obesity, 33 consumers liked the developed *kalam* extremely and liked very much. The composition profile of a food product determines its nutritional content, the physico-chemical attributes. Hence, compositional characteristics viz., moisture, fat, protein, total sugar, total solid and ash content of the low-calories and low-sugar *kalam* were determined.

Keywords: *Kalam*, low-calories, low-sugar, physico-chemical properties

Introduction
In India most of traditional dairy product contains high fat and also high sugar (Pal & Raju, 2007) [6]. *Peda* and *Burfi* are the two major *khoa* based sweets, which are highly popular among Indians, mainly because of their delicious taste and high nutritional value. It has been reported that the quantity of *peda* produced in India exceeds any other indigenous milk based sweet (Mahadevan, 1991) [4]. Fat replacers sometimes referred as fat substitutes or fat replacements are ingredients that mimic some of the roles of fat in food processing. The ideal fat replacer is a safe compound consumed with no health risk. It has all the functional and organoleptic properties of fat (Taste and appearance characteristics such as richness, flakiness and sheen) with significantly fewer calories than fat (Hope Warshaw and Marion Franze, 1996) [3].
It can serve as an excellent carrier product for extra nutrient and if enriched or fortified it can satisfy the nutritional needs of the people. In India most of traditional dairy food contains high fat and also high sugar (Pal & Raju, 2007) [6].

Kalam
Kalam is a popular heat desiccated traditional dairy delicacy of Maharashtra specially Parbhani district in Gangakhed talukas. It is prepared by blending of *khoa* and sugar followed by heat desiccation until characteristic light brown colour appears. It is a nutritive, palatable and a very good source of energy.

Material and Methods
The materials used and methods employed for this investigation, are as under Low-calories and low sugar *kalam* was prepared in the Department of Animal Husbandry & Dairy science, Latur.

Buffalo milk
Buffalo Milk was standardized to 3 % fat & 9 % SNF.

Artificial sweetener
Artificial sweeteners i.e. Aspartame was purchased from College of Agriculture, Latur.

Sugar
Good quality sugar was obtained from the local market of Latur.

Bulking agents
High quality bulking agents i.e. Maltodextrin was purchased from College of Agriculture, Latur.

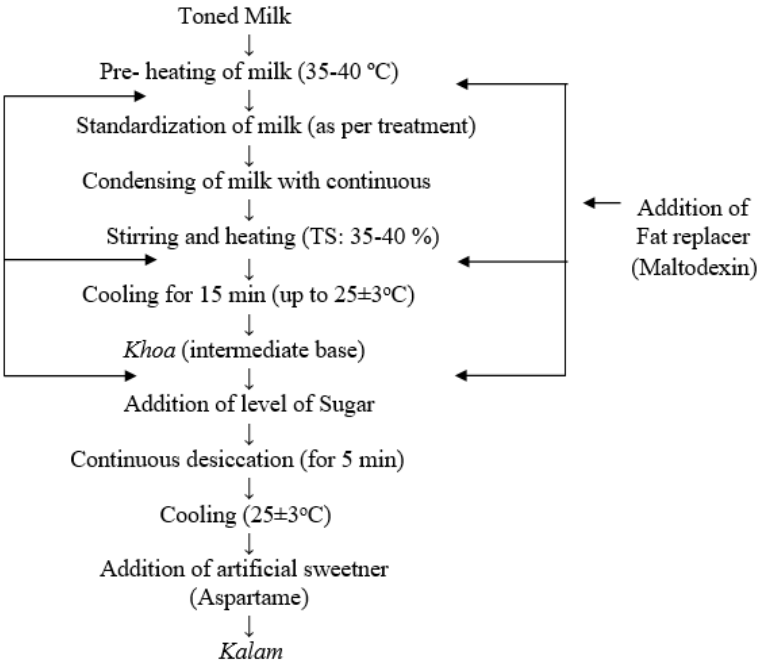
Methodology
Experiment details and treatment details
1. Optimization of stage of addition of fat replacer on the basis of milk for preparation of low calorie *Kalam*.
2. For optimization of stage of addition of fat replacer, Maltodextrin will be tried at 1 % level on the basis of milk to prepare low calorie *Khoa* from toned milk.
3. Trials three were conducted to decide the stage of addition of Maltodextrin
   - At milk stage
   - At pat formation stage
   - After pat formation stage

The stage of addition of maltodextrin will be selected by comparing with full fat *Khoa*, prepared from 6 % fat on the basis of sensory evaluation for next study.

Optimization of levels of Maltodextrin
1. Maltodextrin will be tried to prepare low calorie *Khoa*.
2. Levels of Maltodextrin will be selected by comparing with full fat *Khoa* on the basis of sensory evaluation.

Sugar replacement in *Kalam*
1. The previously developed low calorie *Khoa* with Maltodextrin will be tried for preparation of *Kalam*.
2. Artificial sweetener Aspartame will be tried at different levels with sugar. Levels of aspartame and sugar will be selected on the basis of sensory evaluation.
3. *Kalam* prepared from low fat *Khoa* using aspartame and sugar will be compared with *Kalam* prepared from standardized sugar with full fat *Kalam*.
4. Suitable level of Aspartame and sugar will be selected on the basis of sensory evaluation.

Procedure for preparation of *Kalam* by using Artificial sweet ner and Fat replacer Proposed process diagram for the manufacture of *Kalam* added with artificial sweetener and bulking agents from Toned milk



Statistical analysis
The results obtained during the course of investigation were subjected to statistical analysis using Randomized block design (RBD) as described by Panse and Sukhatme (1967).

Results and Discussion
The composition profile of a food product determines its nutritional content, the physico-chemical attributes. Hence, compositional characteristics viz., moisture, fat, protein, total sugar, total solid and ash content of the low-calories and low-sugar *kalam* were determined.

Table 1: Chemical composition of buffalo milk

Species	Water	Fat	Protein	Lactose	Ash
Buffalo	84.2	6.6	3.9	5.2	0.8

(**Source:** Outlines of dairy technology, Sukumar De)

Table 2: Physico-chemical properties of aspartame

Chemical formula	C14H18N2O5
Mol. Weight.	294.301 g/mol
Melting point	246-247 C
Heat of sol. @ 25 ^{0}C (Cal/g)	-28
Solubility in water at 25^{0}C (g/100 g of water)	235
Caloric value/g (Kcal/g)	4
Sweetness (sucrose = 1)	0.6
Taste	Cool, sweet
Resistance to high temp.	Unstable
Hygroscopicity	Medium

1. Moisture content of aspartame and maltodextrin utilized *kalam*
Moisture content in maltodextrin and aspartame utilized *kalam* varied due to incorporation of different levels of aspartame and presented in table 4.6.

Table 3: Moisture content of *kalam* influenced by different levels of aspartame and maltodextrin

Treatments	Moisture (%)				
Replications	R-I	R-II	R-III	R-IV	Mean
T_1	14.26	13.45	14.38	14.60	14.17[a]
T_2	28.34	29.36	28.93	28.36	28.74[b]
T_3	28.62	29.14	28.45	28.46	28.66[c]
T_4	28.59	29.62	28.88	28.38	28.86[d]
SE ± 0.219				CD at 1% = 0.99	

It was revealed from above table 3 the average moisture content in T_1, T_2, T_3 and T_4 were 14.17, 28.74, 28.66 and 28.86 per cent respectively. Whereas significant differences were observed between T_1 and T_2, T_3, T_4. Also between T_2 and T_3, T_4. As the maltodextrin and aspartame level increased in *kalam*, the moisture content in *kalam* was increased.

2. Fat content of aspartame and maltodextrin utilized *kalam*

The fat content of aspartame and maltodextrin utilized *kalam* under different treatment combinations was determined. The results obtained are presented in table 4.

Table 4: Fat content of *kalam* influenced by different levels of aspartame and maltodextrin

Treatments	Fat (%)				
Replications	R-I	R-II	R-III	R-IV	Mean
T_1	19.28	18.60	18.50	19.40	18.94[a]
T_2	9.60	8.30	9.20	9.10	9.05[b]
T_3	8.80	9.60	9.50	9.50	9.35[c]
T_4	9.60	9.20	8.40	9.20	9.1[d]
SE ± 0.237		CD at 1 % = 1.02			

From the table 4 it was observed that, the mean fat content of aspartame utilized *kalam* was 18.94, 9.05, 9.35 and 9.1 for treatment T_1, T_2, T_3 and T_4 respectively. It was also observed that maximum fat content was observed in T_1 while minimum fat content observed in T_4. Statistically significant differences were observed among all treatments.

3. Protein content of aspartame utilized *kalam*

The protein content in the finished product was determined and the results obtained are presented in table 5.

Table 5: Protein content of *kalam* influenced by different levels of aspartame

Treatments	Protein (%)				
Replications	R-I	R-II	R-III	R-IV	Mean
T_1	15.40	14.38	15.35	14.40	14.88[a]
T_2	14.56	14.28	13.42	14.64	14.22[b]
T_3	14.40	13.38	14.56	13.74	14.02[c]
T_4	14.56	14.13	13.38	14.28	14.08[d]
SE ± 0.2661, CD at 1 % = 1.149					

From table 5 it was observed the protein content of *kalam* was 14.88, 14.22, 14.02 and 14.08. For treatment T_1, T_2, T_3 and T_4 respectively. T_3 showed lowest protein content i.e. 14.02 and while T_1 showed highest protein content i.e. 14.88. Statistically significant difference was observed among the treatments T_1, T_2 and T_3. Also between T_3 and T_4.

4. Ash content of aspartame and maltodextrin utilized *kalam*

The ash content of aspartame utilized *kalam* under different treatment combinations was determined. The results obtained are presented in table 6.

Table 6: Ash content of *kalam* influenced by different levels of aspartame and maltodextrin

Treatments	Ash (%)				
Replications	R-I	R-II	R-III	R-IV	Mean
T_1	2.94	2.90	2.92	2.90	2.92[a]
T_2	2.96	2.94	2.92	2.94	2.94[b]
T_3	2.98	2.97	2.95	2.94	2.96[c]
T_4	2.99	2.98	2.96	2.98	2.98[d]
SE ± 0.0083, CD at 1 % = 0.03					

The data presented in table 6 indicate that, the ash content in treatment T_1, T_2, T_3 and T_4 were 2.92, 2.94, 2.96 and 2.98 respectively. The differences observed were statistically significant among all treatments. As the aspartame and maltodextrin level increase the ash content level of the *kalam* was increased. This happened due to the increased level of total solid content in *kalam.*

5. Total solids content of aspartame and maltodextrin utilized *kalam*

The total solids content of aspartame utilized *kalam* under different treatment combinations were determined. The results obtained are presented in table 7.

Table 7: Total solids content of *kalam* influenced by different levels of maltodextrin and aspartame

Treatments	Total solids (%)				
Replications	R-I	R-II	R-III	R-IV	Mean
T_1	85.74	86.55	85.62	85.40	85.82[a]
T_2	71.66	70.64	71.07	71.40	71.19[b]
T_3	71.38	70.86	71.55	71.54	71.33[c]
T_4	71.41	70.38	71.12	71.62	71.13[d]
SE ± 0.230, CD at 1% =0.995					

From the table 7 it was observed the average total solids content of *kalam* were found 85.82, 71.19, 71.33 and 71.13, for treatment T_1, T_2, T_3 and T_4 respectively.

6. Total sugar content of aspartame and maltodextrin utilized *kalam*.

The total sugar content of aspartame utilized *kalam* varied due to utilization of different levels of Aspartame is presented in table 8.

Table 8: Total sugar content of *kalam* influenced by different levels of aspartame

Treatments	Total sugar (%)				
Replications	R-I	R-II	R-III	R-IV	Mean
T_1	33.28	30.84	32.44	33.14	32.42a
T_2	30.26	31.44	32.12	32.14	31.45[b]
T_3	33.14	32.92	32.18	31.94	32.54[c]
T_4	30.28	31.92	32.18	31.44	31.45[d]
SE ±0.437, CD at 1 % = 1.888					

It is revealed from Table 8 that, total sugar content in treatment T_1, T_2, T_3 and T_4 was found 32.42, 31.45, 32.54 and 31.45 per cent respectively. All the treatment was found statistically significant among each other. As Aspartame level was increased total sugar content of the *kalam* was also increased. It is worthwhile to explain that the initial total sugar content in T1 control *kalam*, 32.42 per cent, it was due

to the presence of sucrose (Sugar), lactose and their inversion products including glucose and galactose. And from treatment T3 there was increased pattern of total sugar content was observed. This might be due to the utilization of different levels of Aspartame in *kalam* and increased bulk volume of sweeteners in further treatments.

7. Mean chemical composition of maltodextrin and aspartame utilized *kalam*

The data obtained for mean chemical composition of treatments T_1, T_2, T_3 and T_4 is tabulated in Table 9.

Table 9: Mean chemical composition of maltodextrin and aspartame utilized *kalam*

Sr. No.	Chemical constituents (%)	T_1	T_2	T_3	T_4
1	Moisture	14.17	28.74	28.66	28.86
2	Fat	18.94	9.05	9.35	9.1
3	Protein	14.88	14.22	14.02	14.08
4	Ash	2.92	2.94	2.96	2.98
5	Total solids	85.82	71.19	71.33	71.13
6	Total sugar	32.42	31.45	32.54	31.45

It was observed from table 9 the mean chemical composition of Maltodextrin and Aspartame utilized *kalam* was varied treatment wise. It was happened due to chemical nature of the Aspartame and its sweetness as compare to normal sugar. The table showed values of different chemical parameters viz., moisture, fat, protein, ash, total solids and total sugar. Moisture contents of *kalam* were 14.17, 28.74. 28.66 and 28.86 for treatments T1, T2, T3 and T4 respectively. Fat content of *kalam* were 18.94, 9.05, 9.35 and 9.1 for treatments T1, T2, T3 and T4 respectively. Protein contents of *kalam* were 14.88, 14.22, 14.02 and 14.08 for treatments T1, T2, T3 and T4 respectively. Ash contents of *kalam* were 2.92, 2.94, 2.96 and 2.98 for treatment T1, T2, T3 and T4 respectively. Total solids contents of *kalam* were 85.82, 71.19, 71.33 and 71.13 for treatments T1, T2, T3 and T4 respectively. Total sugar contents of *kalam* were 32.42, 31.45, 32.54 and 31, 45 for treatments T1, T2, T3 and T4 respectively.

Conclusion

As regard to physico-chemical properties, the highest moisture content in T4 (28.86 %) and low in T1 (14.17 %), highest fat T1 (18.94%) and low T2 (9.05%), highest protein T1 (14.88%) and low T3 (14.03%), highest total solid T1 (85.82 %) and low in T4 (71.13 %) and highest total suagr in T1 (32.42%) and lowest in T4 (31.45%).

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