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# Development and sensory evaluation of flaxseed incorporated camel and buffalo milk nuggets

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**Abstract**
Milk is rich in vital nutrients and health enhancing components. It is required by all age group people. As majority of Indian population is lacto-vegetarian who consume food from vegetarian origin except the milk and milk products In view of low consumption of animal source based protein by the Indian population, the supply of milk protein as a source of animal protein in the form of nuggets has a great potential to fulfill the animal protein deficiency in the diet. Milk protein based nugget is one such Ready-to-Cook type new product having scope for commercial exploitation. Formation of milk nuggets was done by using different ratio (90:10, 80:20, 70:30, 60:40) of camel and buffalo milk coagulum. Best result obtained on the basis of yield and consistency of milk coagulum by combination of 70% camel milk and 30% buffalo milk. On the basis of sensory scores, that 4% flaxseed incorporation level, were scored maximum for almost all sensory quality parameters such as appearance, color, flavor, taste and overall acceptability compared to control and other levels of flaxseed (2%, 6%, 8%).

**Keywords:** Development, sensory evaluation, flaxseed incorporated camel, buffalo milk nuggets

## Introduction
Milk is a nutrient rich and widely accepted livestock product in worldwide food culture. It is known for its nutritional and therapeutic values and other health benefits. In India, most of the processed milk products are traditional products. It is liked by most of the people without any social or religious restrictions. Product diversification is the key for long term sustainability of food sector like any sector and it caters the changing need of market.

Buffalo milk is the preferred for preparing milk and dairy products and are nutritionally superior. Buffalo milk contains less cholesterol (total cholesterol 275 mg and free cholesterol 212 mg per 100 g of fat) compared to cow milk (total cholesterol 330 mg and free cholesterol 280 mg per 100 g of fat) and more tocopherol (334.21 µg per kg for buffalo and 312.3µg per kg of cow milk). It contains more calcium and better calcium: phosphorous ratio and less sodium and potassium than in cow milk.

Camel milk has a similar composition to cow milk but is slightly saltier. Camel milk represents a vital source of vitamin C for people living in arid and semi-arid areas, who often cannot obtain vitamin C from fruits and vegetables. Camel milk is also rich in unsaturated fatty acids and B vitamins and having low fat (1.5-3%), low protein (2.5%), longer shelf life, higher ratio of ß-casein to k-casein, absence of Lysozyme-C and ß-lactoglobulin. It has antibacterial and other therapeutic properties, fresh and fermented camel milk is an important nutritional and functional source. The taste of camel milk is usually sweet, when camels are fed on green fodder, but sometimes salty, due to feeding on certain shrubs and herbs in the arid regions (El – Agamy, 1983 & 1994; Indra and Erdenebaatar, 1998) [2, 3, 5].

Flaxseed is emerging as an important functional food ingredient because of its rich nutrient contents and potential health benefits such as in reduction of cardiovascular disease, atherosclerosis, diabetes, cancer, arthritis, osteoporosis, autoimmune and neurological disorders the incorporation of flaxseed was done to prepare a value added functional milk product that will prove to have an excellent nutritional properties and will be more popular in near future.

Milk nugget is a cooked and ready to eat milk based functional product suitable as a snack food as well as an adjunct to the routine meals. It is a ready to eat healthy vegetarian food with reasonably good shelf life under refrigerated and frozen storage conditions. It would be one of the better choices to cater the need to commercial lines. Incorporation of Flaxseed as a source of nutraceuticals and functional food in the preparation of camel and buffalo milk nuggets

would be more beneficial for the health conscious people and the people demanding variety of healthy products. Looking towards the product diversification and demand for newer products by the industry for milk utilization and value addition one such new product having scope for application is milk protein based nugget. Which can be effectively used by vegetarian people to meet their animal protein deficiency In view of the above facts, the present research study was conducted with an aim of development and quality evaluation of flaxseed incorporated camel and buffalo milk nuggets as flaxseed is emerging as an important functional food ingredient because of its rich nutrient contents and potential health benefits such as in reduction of cardiovascular disease, atherosclerosis, diabetes, cancer, arthritis, osteoporosis, autoimmune and neurological disorders the incorporation of flaxseed was done to prepare a value added functional milk product that will prove to have an excellent nutritional properties and will be more popular in near future. The available literature over viewing the composition, physico-chemical. An attempt has also been made by Jain (2003) [6], Sharma (2005) [9], Mohapatra (2013) [7] Shahi *et al*., (2014) [8] and Das *et al*., (2015) [1] to prepare milk nuggets.

## Materials and Methods

### Formation and Accessibility of Milk nuggets with Incorporation of Flaxseed

Formation of milk nuggets was done by using different ratio of camel and buffalo milk coagulum with incorporation of flaxseed.

For formation of milk nuggets, first the milk coagulum was prepared form a ratio of 70% of camel milk and 30% of buffalo milk was taken in a neat and clean utensil made up of stainless steel and was heated to 90 ºC and cooled to 75 ºC. Meanwhile, 2 per cent citric acid solution was prepared and heated to 75 ºC. The hot milk was coagulated using citric acid solution till clear whey was obtained. The whey was drained from coagulum by using clean muslin cloth and thus the coagulum obtained was cooled at room temperature and then 4% flaxseed powder, Spice mix, Condiment mix and other ingredients in the required ratio was mixed as shown in table to form soft textured dough. Thus the prepared soft textured dough placed in aluminum mould, packed compactly, covered and cooked in steam without pressure for 30 minutes. The internal temperature of cooked block was 72°C, measured using a probe type thermometer (HTA Instrumentation Pvt. Ltd., Bangalore). The block was cooled to room temperature, chilled overnight at 4 °C and cut into nuggets of 4 x 2 x 2 $cm^3$.

Flaxseed incorporated camel and buffalo milk nuggets were prepared as shown in flow chart whereas the control nuggets were prepared without incorporation of flaxseed powder but rest all the ingredients were same as that used in preparation of Flaxseed incorporated camel and buffalo milk nuggets (treatment nuggets).

### Spice mix formulation

The spices and their composition used in this study have been given. Cleaned spices without extraneous material were ground to powder, sieved to obtain a fine powder, which was stored for subsequent use.

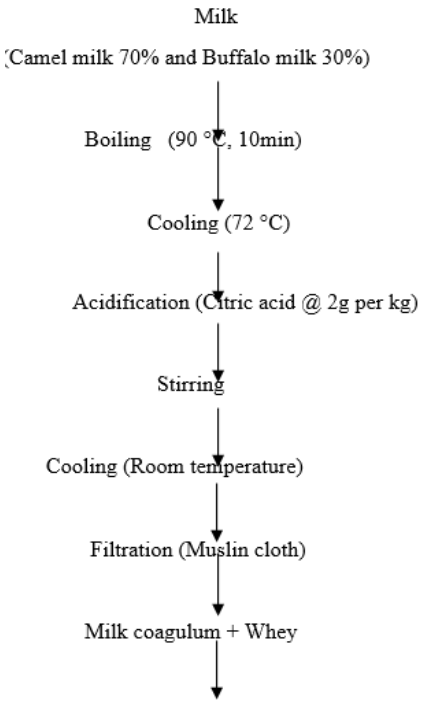
**Table 1:** Spice mix formulation

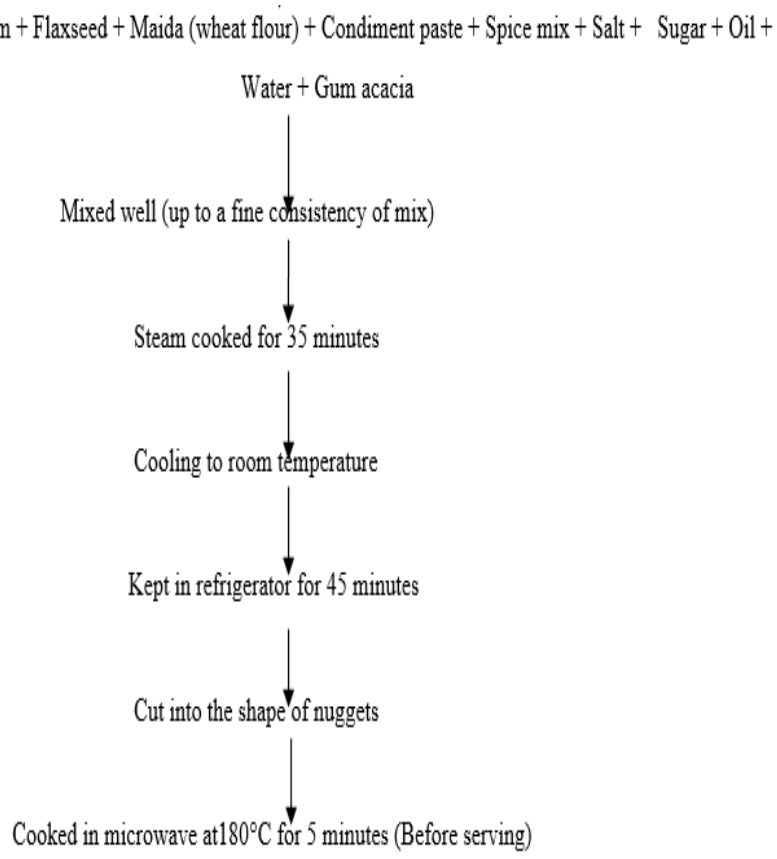
| S. No. | Ingradients | Presentage |
|---|---|---|
| 1 | Cinnamon powder | 4.5 |
| 2 | Coriander powder | 20 |
| 3 | Red chili powder | 40 |
| 4 | Turmeric powder | 5 |
| 5 | Cumin | 5 |
| 6 | Cloves powder | 5 |
| 7 | Black pepper powder | 7 |
| 8 | Souf | 10 |
| 9 | Salt | 3.5 |
| 10 | Total | 100 |

### Condiment mix

Condiments used in this study were onion and garlic in the ratio of 3:1.The external covering of the onion and garlic were peeled off and made into small pieces. The cut pieces were ground in a grinder to the consistency of fine paste.

### Formation of flaxseed incorporated camel and buffalo milk nuggets






**Formation, accessibility and quality evaluation of flaxseed incorporated camel and buffalo milk nuggets**

For formation of milk nuggets to obtain the coagulum different ratio of camel and buffalo milk were tried but the best results were obtained on the basis of yield and consistency of milk coagulum by using combination of 70% camel milk and 30% buffalo milk. Increasing the proportion of camel milk above 70% resulted in inappropriate consistency of the nuggets and caused decrease in the yield of milk coagulum. Whereas by decreasing the ratio of camel milk results in diminishing its properties in the product. Camel milk is often mixed with fresh or other cultured milk of species (cows, goats and sheep) particularly when intended to make products such as butter and cheese (Eyassu, 2008) [4]. The formulation of flaxseed incorporated camel and buffalo milk nuggets in various combinations of flaxseed (2%, 4%, 6% and 8%) and milk coagulum were tried by keeping other ingredients constant in all the combination and presented in table.

**Table 2:** Formulation of different combinations of flaxseed incorporated camel and buffalo milk nuggets

| S. NO | Ingredients | Control | Treatment ($t_1$) | Treatment ($t_2$) | Treatment ($t_3$) | Treatment ($t_4$) |
|---|---|---|---|---|---|---|
| 1 | Milk coagulum | 84% | 82% | 80% | 78% | 76% |
| 2 | Flaxseed | 0% | 2% | 4% | 6% | 8% |
| 3 | Maida (wheat flour) | 4% | 4% | 4% | 4% | 4% |
| 4 | Condiment paste | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% |
| 5 | Spice mix | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% |
| 6 | Salt | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% |
| 7 | Sugar | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% |
| 8 | Oil | 1% | 1% | 1% | 1% | 1% |
| 9 | Water | 6.5% | 6.5% | 6.5% | 6.5% | 6.5% |
| 10 | Gum acacia | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% |
| | Total | 100 | 100 | 100 | 100 | 100 |

**Sensory evaluation of flaxseed incorporated camel and buffalo milk nuggets**

The sensory evaluations of prepared camel and buffalo milk nuggets were performed by using 8-point hedonic scale to know the sensory characteristics such as appearance/color, flavor, binding, texture/consistency and overall acceptability. Eight semi- trained panelists consisting of academic staff and students were included in sensory evaluation. Control nuggets and all the preparations of flaxseed incorporated camel and buffalo milk nuggets were presented in transparent plastic cups under fluorescent light. All samples were marked with digital code, and the order of presentation of samples was randomized for each panelist.

**Table 3:** Sensory attributes of flaxseed incorporated camel and buffalo milk nuggets

| Treatment | Appearance / colour | Flavour | Binding | Texture/ consistency | Overall acceptability |
|---|---|---|---|---|---|
| $t_0$ | 6.58 ± 0.06 | 6.16 ± 0.03 | 6.96 ± 0.05 | 6.89 ± 0.03 | 6.65 ± 0.03 |
| $t_1$ | 6.70 ±0.04 | 7.05 ± 0.05 | 7.01 ± 0.06 | 6.95 ± 0.12 | 6.93 ± 0.12 |
| $t_2$ | 7.19 ± 0.02 | 7.23 ± 0.04 | 7.17 ± 0.02 | 7.01 ± 0.04 | 7.60 ± 0.04 |
| $t_3$ | 6.24 ±0.01 | 6.51 ± 0.01 | 7.14 ± 0.02 | 6.97 ± 0.03 | 6.84 ± 0.03 |
| $t_4$ | 6.01 ± 0.03 | 6.51 ± 0.01 | 6.80 ± 0.04 | 6.85 ± 0.08 | 6.54 ± 0.08 |

On the basis of sensory attributes like appearance /colour, flavor, binding, texture/ consistency the milk nuggets incorporated with 4% flaxseed ($t^2$) had obtained maximum overall acceptability (7.60 ± 0.04). Thus on the basis of sensory evaluation or overall acceptability the preparation of milk nuggets incorporated with 4% flaxseed were further selected as flaxseed incorporated camel and buffalo milk nuggets for storage study whereas plain nuggets was considered as control ($T_0$), and $t_2$ was considered as Treatment (T) or flaxseed incorporated camel and buffalo milk nuggets. Eyassu (2008) [4] reported that Camel milk is often mixed with fresh or other cultured milk of species (cows, goats and sheep) particularly when intended to make products such as butter and cheese.

**Appearance/ colour of Milk nuggets**

The mean ± S.E value of Appearance/ colour of camel and buffalo milk nuggets of control group during 0, 3, 6, 9, 16 and 12 days of refrigerated (4±1°C) storage were 7.08 ± 0.06, 6.89 ± 0.06, 6.78 ± 0.04, 6.76 ± 0.01 and6.69 ± 0.02 respectively and for treatment group of same storage periods were 7.19 ± 0.02, 6.85 ± 0.04, 6.79 ± 0.04, 6.69 ± 0.02 and 6.48 ± 0.04 respectively.

Similar results were obtained by Shahi *et al.,* (2014) [8] who find mean score for appearance of low fat milk nuggets were ranged from 6.95±0.11 for the product with 15% FMF to 7.89 ± 0.11 for control product. Scores of T1 (7%FMF) and control product were comparable to each other and those of T2 (11% FMF) and T3 (15% FMF) were further comparable. A decreasing trend in appearance scores was observed with increase in the level of FMF incorporation in formulation. Further, scores of control and T1 were significantly ($P$<0.05) higher than T2 and T3 products.

**Table 4:** Appearance/ colour of Milk nugget

| Storage period | Control | Treatment |
|---|---|---|
| 0 day | 7.08 ± 0.06 | 7.19 ± 0.02 |
| 3 day | 6.89 ± 0.06 | 6.85 ± 0.04 |
| 6 day | 6.78 ± 0.04 | 6.79 ± 0.04 |
| 9 day | 6.76 ± 0.01 | 6.69 ± 0.02 |
| 12 day | 6.69 ± 0.02 | 6.48 ± 0.04 |

**Flavor of Milk nuggets**

The mean ± S.E of flavor scores of camel and buffalo milk nuggets of control group during 0, 3, 6, 9, 16 and 12 days of refrigerated (4 ±1°C) storage were7.16 ± 0.03, 7.01 ± 0.03, 6.37 ± 0.05, 5.85 ± 0.06, and 5.04 ± 0.09 respectively and for treatment group of same storage periods 7.23 ± 0.04, 6.90 ± 0.05, 6.34 ± 0.07, 5.75 ± 0.03 and 5.01 ± 0.04 respectively. Similar results were obtained by Shahi *et al.,* (2014) [8] who find mean scores for flavour were ranged from 7.03±0.11 for product with 15% FMF to 7.82±0.11 for control product. Mean score of T1 was significantly ($P$<0.05) higher than T2 and T3 and lower than control. Further, there was no significant (p>0.05) difference between the flavour scores of nuggets with 11% and 15% FMF. The results depict that increase in level of incorporation of FMF showed a decreasing trend in the flavor of the product.

**Table 5:** Flavor of Milk nuggets

| Storage period | Control | Treatment |
|---|---|---|
| 0 day | 7.16 ± 0.03 | 7.23 ± 0.04 |
| 3 day | 7.01 ± 0.03 | 6.90 ± 0.05 |
| 6 day | 6.37 ± 0.05 | 6.34 ± 0.07 |
| 9 day | 5.85 ± 0.06 | 5.75 ± 0.03 |
| 12 day | 5.04 ± 0.09 | 5.01 ± 0.04 |

**Juiciness of Milk nuggets**

The mean ± S.E value of juiciness of camel and buffalo milk nuggets of control group during 0, 3, 6, 9, 16 and 12 days of refrigerated (4 ±1°C) storage were 6.96 ± 0.05, 6.78 ± 0.04, 6.46 ± 0.04, 6.37 ± 0.05 and 6.20 ± 0.02 respectively and for treatment group of same storage periods 7.17 ± 0.02, 7.01 ± 0.04, 6.86 ± 0.06, 6.64 ± 0.02 and 6.23 ± 0.02 respectively. Similar results were obtained by Shahi *et al.,* (2014) [8] who find mean score for juiciness was lowest for T3 product (6.80±0.08) and highest for the product with 7% level of FMF i.e. T1 (7.71±0.11). No significant difference (p>0.05) was observed in the juiciness score of milk nuggets among control, T1 and T2, however the score of T3 was significantly ($P$<0.05) lower than the other three products including the control. Control and T1 were significantly ($P$<0.05) higher than T2 and T3 products.

**Table 6:** Juiciness of Milk nuggets

| Storage period | Control | Treatment |
|---|---|---|
| 0 day | 6.96 ± 0.05 | 7.17 ± 0.02 |
| 3 day | 6.78 ± 0.04 | 7.01 ± 0.04 |
| 6 day | 6.46 ± 0.04 | 6.86 ± 0.06 |
| 9 day | 6.37 ± 0.05 | 6.64 ± 0.02 |
| 12 day | 6.20 ± 0.02 | 6.23 ± 0.02 |

**Texture of Milk nuggets**

The mean ± S.E of texture scores of camel and buffalo milk nuggets of control group during 0, 3, 6, 9, 16 and 12 days of refrigerated (4 ±1 °C) storage were 6.98 ± 0.03, 6.86 ± 0.06, 6.71 ± 0.04, 6.59 ± 0.01 and 6.23 ± 0.02 respectively and for treatment group of same storage periods 7.01 ± 0.04, 6.93 ± 0.04, 6.78 ± 0.04, 6.64 ± 0.02, and 6.46 ± 0.04 respectively. Similar results were obtained by Shahi *et al.,* (2014) [8] who find mean scores for body and texture were ranged from 6.95±0.11 for nuggets with 15% FMF (T3) to 7.65±0.10 for nuggets with 7% FMF. Mean scores for control and nuggets with 7% FMF (T1) and 11% FMF (T2) were comparable to each other and were significantly ($P$<0.05) higher than the product with 15% FMF.

**Table 7:** Texture of Milk nuggets

| Storage period | Control | Treatment |
|---|---|---|
| 0 day | 6.98 ± 0.03 | 7.01 ± 0.04 |
| 3 day | 6.86 ± 0.06 | 6.93 ± 0.04 |
| 6 day | 6.71 ± 0.04 | 6.78 ± 0.04 |
| 9 day | 6.59 ± 0.01 | 6.64 ± 0.02 |
| 12 day | 6.23 ± 0.02 | 6.46 ± 0.04 |

**Overall acceptability of Milk nuggets**

The mean ± S.E of scores of Overall acceptability of camel and buffalo milk nuggets of control group during 0, 3, 6, 9, 16 and 12 days of refrigerated (4 ±1°C) storage were 7.50 ± 0.03, 7.22 ± 0.11, 6.13 ± 0.07, 5.85 ± 0.16 and 5.65 ± 0.06 respectively and for treatment group of same storage periods were 7.60 ± 0.04, 7.24 ± 0.10, 6.12 ± 0.08, 5.79 ± 0.04 and 5.42 ± 0.05 respectively. Similar results were obtained by Shahi *et al.*, (2014) [8] who find mean scores for overall acceptability was highest (7.69±0.12) for nuggets with 7% FMF (T1) and lowest (6.88 ± 0.13) for nuggets with 15% FMF (T3). Mean scores for control and nuggets with 7% FMF (T1) and 11% FMF (T2) were comparable to each other and were significantly ($P$<0.05) higher than the product with 15% FMF.

**Table 8:** Overall acceptability of Milk nuggets

| Storage period | Control | Treatment |
|---|---|---|
| 0 day | 7.50 ± 0.03 | 7.60 ± 0.04 |
| 3 day | 7.22 ± 0.11 | 7.24 ± 0.10 |
| 6 day | 6.13 ± 0.07 | 6.12 ± 0.08 |
| 9 day | 5.85 ± 0.16 | 5.79 ± 0.04 |
| 12 day | 5.65 ± 0.06 | 5.42 ± 0.05 |

**Conclusion**

1. On the basis of sensory evaluation the optimum level of flax seed incorporation was adjudged to be 4% without affecting the sensory properties.
2. Though the scores for all the sensory attributes declined significantly with the progress of storage but the products were acceptable up to 6th day of storage.

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