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Microbial Quality Evaluation of Flaxseed incorporated Camel and Buffalo Milk Nuggets

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A B S T R A C T

The milk products and by products may be contaminated intentionally/unintentionally at different level at the time of production, processing, and storage. Therefore, the present study was conducted with an objective to assess Microbial Quality Evaluation of Flaxseed incorporated Camel and Buffalo Milk Nuggets. The samples were collected hygienically and subjected to microbiological analysis. The control and treatment milk nuggets were examined for the standard plate count (SPC), coliform count, yeast, and mould count during storage for 12 days at refrigeration temperature for interval of 0, 3, 6, 9 and 12 days. The initial microbial load was nil up to 3rd day of storage then standard plate count value, coli form count and yeast and mould count of milk nuggets were increased significantly ($P<0.05$) in both control and treatment milk nuggets during the refrigerated (4±1°C) storage period. Therefore, it is concluded that the milk nuggets based on Flaxseed Incorporation prepared from Camel and Buffalo Milk were highly safe to consume from fresh condition till three days of storage period. The microbiological quality of these nuggets was showing a declining pattern after three days of storage period. After nine days of storage, it should not be recommended for consumption as it is almost deteriorated by yeast and mould.

Introduction

Milk has a high nutritive value and supplies body building proteins, bone forming minerals, healthful vitamins and provides energy giving lactose and milk fat. Milk provides essential nutrients and is an important source of dietary energy, high-quality proteins, and fats. Milk can make a significant contribution to the required nutrient intakes for calcium, magnesium, selenium, riboflavin, vitamin B12. Buffalo milk has a remarkably high fat content, which is on average twice as high as that of cow

milk. The fat-to-protein ratio in buffalo milk is about 2:1. Compared with cattle milk, buffalo milk also has a higher casein-to-protein ratio. The high calcium content of casein facilitates cheese making. Buffalo milk contains less cholesterol compared to cow milk and more tocopherol. Due to high peroxidase activity, buffalo milk can be preserved naturally for a longer period. Buffalo milk 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 can be three times as rich in vitamin C as cow milk and represents a vital source of this vitamin 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. Milk from Bactrian camels has a higher percentage of fat than milk from dromedaries, but levels of proteins and lactose are similar. Normal camel milk has a very white color and is foamy (El – Agamy, 1983). 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 and 1994; Indra and Erdenebaatar, 1998). The one-humped camels (*Camelus dromedarius*) are well-known producers of milk which differs from bovine milk in the composition and structure of its protein content and thus has different functional and medicinal properties. Caseins (CNs) are the major proteins in camel milk, and α-, β- and κ- CN constitutes about 65, 21 and 3.47% respectively, of total caseins (Kappeler *et al.*, 2003).

Milk protein-based nugget is one such Ready-to-Cook type new product having scope for commercial exploitation. However, in case of nuggets preparation, protein texturization takes places in mechanical process in presences of heat and pressure, which sometimes improves the digestibility of the protein. Nuggets from milk protein may also give an alternative to utilize milk protein for food preparation and can be effectively used as replacer of meat or animal protein. 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 healthy vegetarian food with reasonably good shelf life under refrigerated and frozen storage conditions.

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.

Materials and Methods

Development of flaxseed incorporated camel and buffalo milk nuggets

Milk nuggets under study were formulated by using 70% camel milk and 30 % buffalo milk coagulum. The coagulum thus obtained was cooled at room temperature and then 4% flaxseed powder, 1.5% Spice mix, 1.5% Condiment mix (paste of onion and garlic in the ratio of 3:1) and other ingredients in the required ratio was mixed as shown in Table 1 to form soft textured dough. The prepared soft textured dough placed in aluminium 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 cm3. Flaxseed incorporated camel and buffalo milk nuggets were prepared as shown in Fig.1 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).

Microbial study of flaxseed incorporated camel and buffalo milk nuggets

Microbial count was determined by using pour plate method. Standard plate count (SPC) was determined on plate count agar medium, and the plates of different dilutions were incubated at 30°C for 24 hours. The total number of colonies per gram (CFU/g) was determined. Violet Red Bile (VRB) Agar medium was used for determination of coli form bacteria and the plates of different dilutions were incubated at 30°C for 24 hours by pour plate method, and the number of dark red colonies was calculated. Yeast molds (Y-M) count take place by Potato dextrose agar (PDA) medium by pour plate method and the plates of different dilutions were incubated at 30°C for 24 hours, for yeast and mold count. The microbial count of each sample was measured at day 0, 3, 6, 9 and 12 from preparation.

Results and Discussion

Microbial analysis of flaxseed incorporated camel and buffalo milk nuggets

All the microbial counts done in the present study (standard plate count, coliform count, yeast, and mould count) has been shown in table 2 and depicted in Fig. 2, 3 and 4 under refrigerated storage condition (0, 3, 6, 9 and 12 days).

Standard plate count (SPC) flaxseed incorporated camel and buffalo milk nuggets

The mean ± S.E values of total plate counts of milk nuggets with incorporation of 4% flaxseed and storage periods has been presented in the table 2. The overall mean ± S.E values of total plate counts of milk nuggets for control and treatment product on 12 day of storage were observed to be 5.212 ± 0.04 and 5.297 ± 0.018, respectively. The initial microbial load was observed nil and then standard plate count values of milk nuggets were found significantly ($P<0.01$) higher on the 6th, 9th, and 12th day of refrigerated storage.

The mean ± S.E values of total plate counts of milk nuggets of control during for 6, 9, and 12 days of refrigeration (4 ± 1°C) storage were found to be 4.963 ± 0.043, 5.292 ± 0.018 and 5.382 0.019 respectively and for treatment group of same storage periods were 4.917 ± 0.041, 5.302± 0.034 and 5.421 ± 0.013 respectively for 6, 9, and 12 days of refrigerated storage (4 ± 1°C).

Coli form count of flaxseed incorporated camel and buffalo milk nuggets

The overall mean ± S.E values of yeast and mould counts of milk nuggets of control and treatment were 2.37 ± 2.46 and 2.46 ±0.12, respectively. The mean ± S.E values of coli form counts of milk nuggets of control during 0, 3, 6, 9, and 12 days of refrigerated (4 ± 1°C) storage was 0, 0, 1.97 ± 1.95, 2.51 ± 2.66, and 2.62 ± 2.77 respectively and for treatment group of same storage periods were 0, 0, 1.95 ± 0.39, 2.66 ± 0.01 and 2.77 ±0.01, respectively.

Yeast and mould count of flaxseed incorporated camel and buffalo milk nuggets

The overall mean ± S. E values of yeast and mould counts of milk nuggets of control and treatment were 2.26A ±0.06 and 2.29B ±0.04, respectively. The yeast and mould count was not observed from day 0 to day 3rd of storage study in both the products.

Table.1 Formulation of flaxseed incorporated camel and buffalo milk nuggets

S. No.	Ingredients	Control (T0)	Treatment (T2)
1.	Mil coagulum	84%	80%
2.	Flaxseed	0%	4%
3.	Maida (wheat flour)	4%	4%
4.	Condiment paste	1.5%	1.5%
5.	Spice mix*	1.5%	1.5%
6.	Salt	0.5%	0.5%
7.	Sugar	0.5%	0.5%
8.	Oil	1%	1%
9.	Water	6.5%	6.5%
10.	Gum acacia	0.5%	0.5%
	Total	**100**	**100**

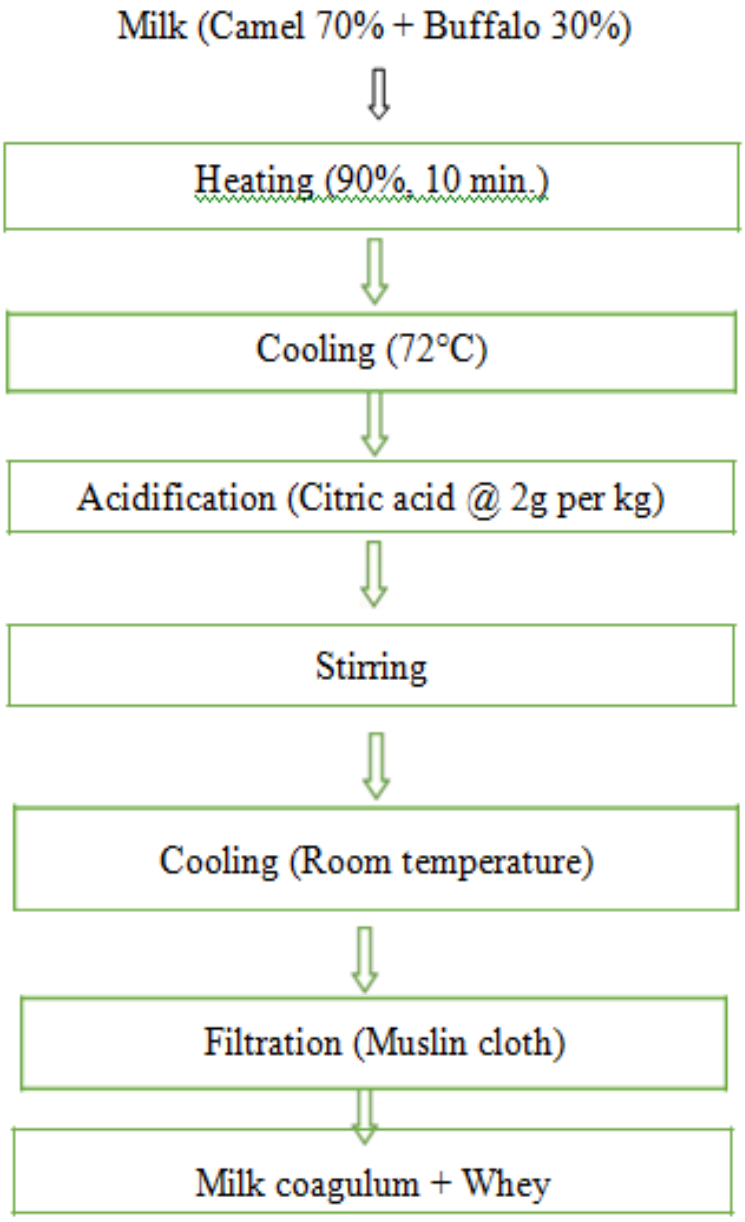
(*Cinnamon powder 4.5%, Coriander powder20%, Red chili powder 40%, Turmeric powder 5%, Cumin5%, Clove's powder 5%, Black pepper powder 7%, salt 3.5%, Sounf 10%)

Table.2 Standard plate count log (CFU/g) (mean ± SE), Coli form count (CFU/ml), Yeast and mould count (CFU/ml) of flaxseed incorporated camel and buffalo milk nuggets

Parameter	Storage period (days)	Samples		
		Control (T_0)	Treatment (T)	Overall
**Standard plate count log	Day 0 to 3	Nil	Nil	
	Day 6	4.963 ± 0.043	4.917 ± 0.041	4.940^{a} ± 0.029
	Day 9	5.292 ± 0.018	5.302 ± 0.034	5.297^{b} ± 0.018
	Day 12	5.382 ± 0.019	5.421 ± 0.013	5.402^{c} ± 0.012
	Overall	5.212 ± 0.046	5.297 ± 0.018	
**Coli form count (CFU/ml)	Day 0 to 3	Nil	Nil	Nil
	Day 6	1.97 ± 1.95	1.95 ±0.39	1.96^{A} ± 0.342
	Day 9	2.51 ± 2.66	2.66 ±0.01	2.59^{B} ± 0.024
	Day 12	2.62 ± 2.77	2.77 ±0.01	2.69^{B} ± 0.012
	Overall	2.37 ± 2.46	2.46 ±0.12	
**Yeast and mould count (CFU/ml)	Day 0 to 3	Nil	Nil	Nil
	Day 6	2.01^{aA} ± 0.00	2.03^{aA} ± 0.01	2.02^{a} ± 0.007 2
	Day9	2.15^{bA} ± 0.03	2.43^{bB} ± 0.02	2.29^{b} ± 0.046
	Day 12	2.61^{cA} ± 0.02	2.77^{cB} ± 0.02	2.69^{c} ± 0.029
	Overall	2.26^{A} ± 0.06	2.29^{B} ± 0.04	

Note: - ** = Highly Significant (P<0.01), Means bearing different superscripts in a column (small letter) and in a row (capital letter) differ significantly

Fig.1 Flow diagram for preparation of flaxseed incorporated camel and buffalo milk nuggets



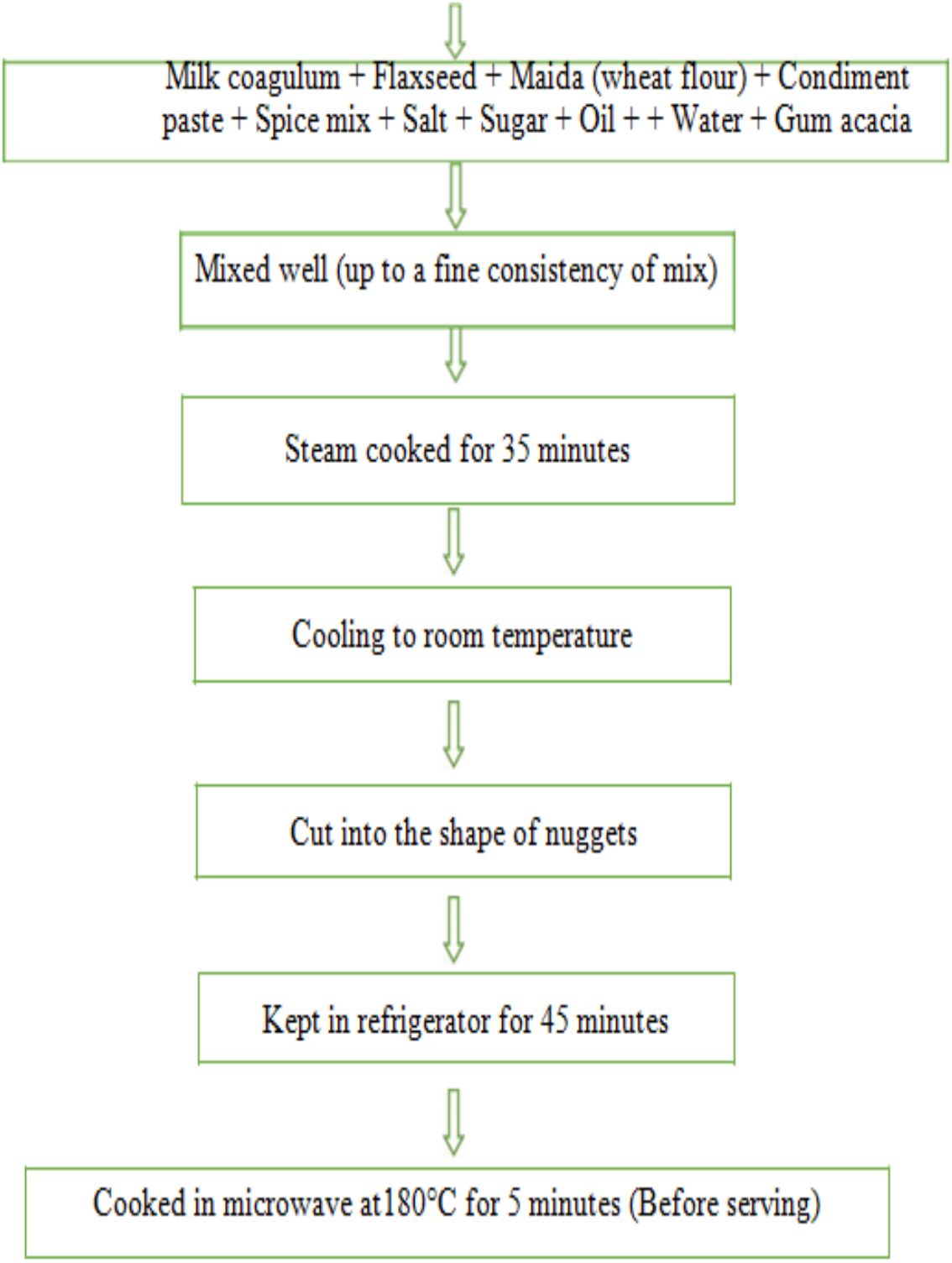

Milk coagulum + Flaxseed + Maida (wheat flour) + Condiment paste + Spice mix + Salt + Sugar + Oil + + Water + Gum acacia
Mixed well (up to a fine consistency of mix)
Steam cooked for 35 minutes
Cooling to room temperature
Cut into the shape of nuggets
Kept in refrigerator for 45 minutes
Cooked in microwave at180°C for 5 minutes (Before serving)

Fig.2 Standard Plate Count (SPC) of flaxseed incorporated camel and buffalo milk nuggets

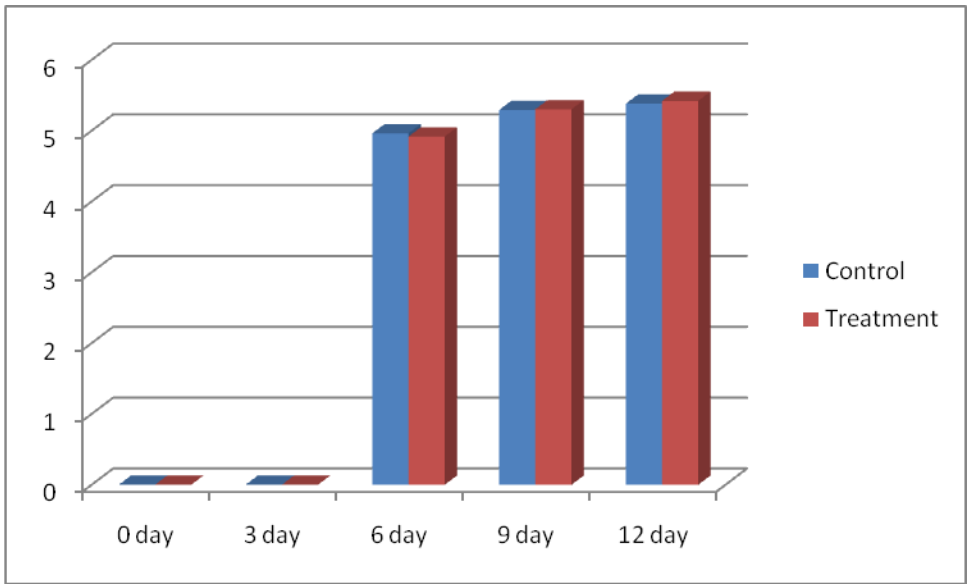


Fig.3 Coli form count of flaxseed incorporated camel and buffalo milk nuggets

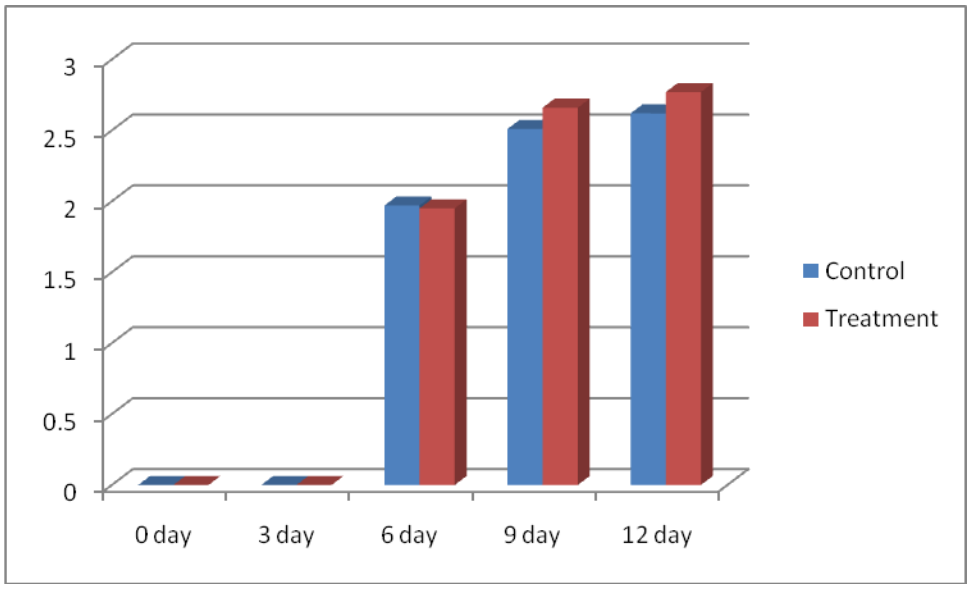
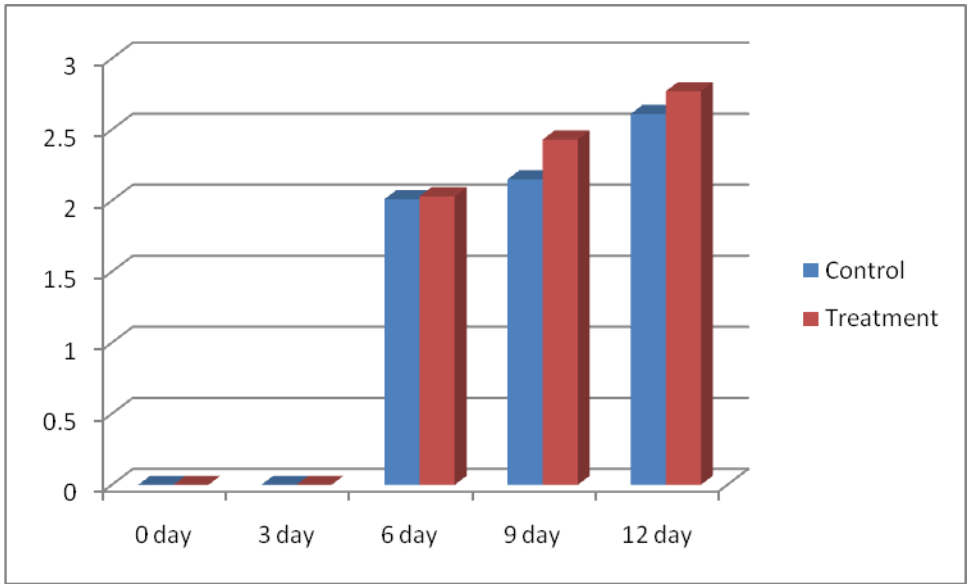


Fig.4 Yeast and mould count of flaxseed incorporated camel and buffalo milk nuggets



Yeast and mould count was first observed on day 6th of storage. The mean ± S.E values of yeast and mould counts of milk nuggets of control during 6, 9, and 12 days of refrigerated (4 ± 1°C) storage were 2.01aA ± 0.00, 2.15bA ±0.03 and 2.61cA ± 0.02 respectively and for treatment group of same storage periods were 2.03aA ±0.01, 2.43bB ±0.02 and 2.77cB ±0.02, respectively. The results of the present study are in close agreement with the Ismail *et al.*, (2011), Yonis *et al.*, (2014), Tak (2017) and Singh (2017).

From present study, it may be concluded that the Flaxseed incorporated Camel, and Buffalo Milk Nuggets are hygienic and microbiologically safe to consume in fresh condition till three days of storage period under refrigeration and consumption of flax seeds as an adjunct in milk nuggets will positively benefit the consumers.

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