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Effect of Storage Temperature on Microbiological Quality of Optimized Almond Supplemented Paneer Kheer

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ABSTRACT

Background: The present research entitled Effect of Storage Temperature on Microbiological Quality of Optimized Almond Supplemented Paneer Kheer was conducted to detect the relationship between storage temperature and storage period.

Methods: The research took place in the laboratory of Department of Animal Husbandry and Dairying, Banaras Hindu University, Varanasi from October 2019 to December 2019. Three different aspects of Microbiological Parameters were studied *viz*. Standard Plate Count (SPC), Coliform Count (CFC) and Yeast and Mold Count (YMC) from the sample taken under study as control and optimized. All the samples were studied at distinguish storage temperatures like. 5°C, 25°C and 37°C. The CRD was used to find out the appropriate data obtained from research work.

Result: Microbiological parameters have been the major influencer in determination of shelf life of any product. Milk possesses the characteristics to be refrigerated soon otherwise it starts degrading in its quality which is true also for milk products. It has been found that maximum mean scores of SPC of control sample (5.54) and of optimized sample (5.42) were obtained on 3rd day of storage at 37°C. But for YMC maximum mean score of control (1.32) and of optimized (1.25) were obtained on 18th days of storage at 5°C whereas CFC remained nil at every count regardless of storage temperature and period. Thus, the result revealed that with the elevation in the storage temperature along with storage period the life of product deteriorates at a faster rate showing directly proportional relation.

Key words: Coliform count, Paneer kheer, Standard plate count, Temperature, Yeast and mold count.

INTRODUCTION

Milk and milk-based products are gaining popularity these days as milk is taken as almost complete food and referred as “Bank of Nutrients”. Most of the portion of milk produced in India is used in the preparation of traditional dairy products like Khoa, Chhana *etc* (Shivakumar *et al*., 2014). Kheer, which is one of them is a cereal based particulate dairy dessert prepared by partial dehydration of whole milk.It is a semi solid cereal-based dairy dessert prepared by cooking rice with sugar or jaggery in milk till the point when rice starch gets gelatinized. Major ingredients include rice, milk, sugar, dry nuts and other flavourings. Milk being perishable commodity should be converted to products that have longer shelf life.

When rice is cooked in presence of milk, a reaction occurs between starch-milk which results in a thickened product, known as Kheer. Kheer which contains creamy sweetened concentrated milk is renowned all-over South-east Asia. There is no large scale of its production because of its poor shelf life (Jha *et al*., 2011). It has been the premier milk delicacy associated with festive and celebration from the time immemorial and it has the status of a royal treat. No feast is considered complete without kheer. Kheer evolved itself to suit regional and personal preferences (Kadam *et al*., 2011). Kheer is known by different name across India. A variety of *kheer* type products are prevalent in different parts of the country in different forms like *firni* that is made by using rice flour instead of granular rice, *Payasam* is based on rice flour, *Makhana based kheer* and *Sabudana* based *kheer etc*.

Paneer kheer is the base material for incorporating many types of dry fruits and different medicinal materials. Almond based *paneer kheer* is qualitatively highly nutritious and more favourable for body health. Most importantly almond have an antioxidant quality. Almonds are a source of vitamin E, copper, magnesium, manganese, zinc and high-quality protein; they also contain high levels of healthy unsaturated fatty acids along with high levels of bioactive molecules (such as fibre, phytosterols, vitamins, other

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minerals and antioxidants), which may help in preventing cardiovascular disease (Karan Gill, 2017). Traditional kheer was not supposed to cater all the essential nutrients to our body. So, blending of kheer with paneer and almond was kept into consideration which obviously will provide nutrients from almond, paneer as well as from rice and milk.

Paneer contain all the milk constituents except for the loss of soluble whey protein lactose and minerals (Singh and Kanawajia, 1988). Paneer has a fairly high level of fat (22-25%) and protein (16-18%) and low level of lactose (2-2.7%) (Kanawajia and Singh, 1996). Paneer is preferably made from buffalo milk as it has firm and spongy body and a close texture while *chhana* made from cow milk which is soft-spongy in body and open in texture and is used to manufacture *channa* based sweets. (Sindhu 1996). Usually paneer keeps well for about a day at ambient temperature while for about a week under refrigeration (7°C). Usually, it is kept dipped in chilled water at low temperature when unpacked. The spoilage of paneer is mainly due to bacterial action. Successful attempts have been made to enhance the shelf life of paneer (Kumar *et al.*, 2017).

Shelf life is the number of days a product can be stored at a certain temperature and can be consumed safely, without deterioration of sensory characteristics of taste, color, texture and flavor. Microbiological and organoleptic quality are must for maintaining shelf life. Refrigeration of the product helps to lengthen the shelf life. Researchers like Landge (2007), Navjeevan and Rao (2005) have been working on packaging materials to increase the shelf life of indigenous dairy products at room temperature these days. In the present study, attempt was made to develop relation between temperature and storage period of protein rich paneer kheer with incorporation of Almonds in the milks. Hence, the study entitled, "Effect of Storage Temperature on Microbiological Quality of Optimized Almond Supplemented Paneer Kheer" was undertaken with the following objectives:

- To detect the storage life of ASPK at varying degree of storage temperature.
- To find out the reason of short shelf life of traditional dairy product.
- To determine which storage temperature best suits the storing of ASPK.

MATERIALS AND METHODS

This research was performed in the laboratory of Department of Animal Husbandry and Dairying, Banaras Hindu University, Varanasi from October 2019 to December 2019. CRD test was used to enumerate the data obtained from research. Almond supplemented paneer kheer was prepared after the milk gets boiled and then lowering the flame which was then followed by adding the ingredients keeping the maximum temperature of kheer 75. Kheer was packed inside the lab which was sterilized by applying spirit and other sterilizing agents a day before. Inorder to keep the kheer, LDPE plastic glass were used that were ordered from online source. After packing the glass were stored in different temperature as per study specification. Three different parameters were studied namely Standard plate count (SPC), coli form count (CFC) and Yeasts and mold count (YMC). SPC and CFC test in almond supplemented paneer kheer were determined using plate count agar (Hi media, Mumbai, India) and violet red bile agar (Hi media, Mumbai, India), respectively, after incubation for 48 hrs at 5°C. YMC test in almond supplemented paneer kheer was estimated with the help of potato dextrose agar (PDA, Hi media, Mumbai, India) after incubation at 30°C for 4-5 days. All the media used in this study were prepared according to manufacturer's instructions.

RESULTS AND DISCUSSION

The result obtained from the research was analysed and discussed below:

Microbiological study

Shelf life of a product depends on its chemical composition and microbiological condition. The products can remain safe for number of days at refrigerator temperature but it is costly method of preservation. The microbiological study on three characteristics *viz.* standard plate count, yeast and mold count and coli form count on three specific temperatures *i.e.*, 5°C, 25°C and 37°C

Effect of storage period on standard plate count (SPC) microbiological quality of control and optimized almond supplemented *paneer kheer* at 5°C

The results pertaining to standard plate count (SPC) for control and optimized almond supplemented *paneer kheer* (ASPK) are presented in Table 1. On 0th days, the SPC was found higher in control sample while optimized sample has lower value. On 3rd and 6th days, both of the products SPC rate changes slightly during these storage days. The value was found to be statistically significant ($p<0.05$). On 9th and 12th days, control value was found higher as compared to optimized ASPK. The bacterial infestation gradually increases after 6th days in both of the products. But data was found significant ($p<0.05$) on these storage days. On 15th days, the SPC of control sample crossed the permissible limit of consumption as given by FSSAI (2006) and it was not considered for further study while optimized sample of same day was found acceptable. The control *paneer kheer* was found highly susceptible and proved as a good nutrient medium for bacterial growth. Bacterial growth was found to be increased at a higher rate on 18th days in ASPK. The value of the both products was found to be non-significant at this storage period. It is evident from the results that the SPC of the both samples increase consistently with increase in the storage period. Approximately similar findings were noticed by Gaikwad and Hembade, (2012) which shows that such dairy product can be kept for about 20 days at similar temperature regime without any deterioration in quality. Also, the findings concur with that of Ghodekar *et al.* (1978) and Hossain *et al.* (2000).

Effect of storage period on yeast and mold count (YMC) of control and optimized almond supplemented *paneer kheer* at 5°C

The outcomes related to yeast and mold count (YMC) of control and optimized ASPK during storage is presented in Table 2. On 0th days, the optimized ASPK has lower value while control sample has higher one. On 3rd and 6th days, the value of optimized YMC was slightly increased. The value of YMC remains significant ($p<0.05$) on this day. The rapid increase of YMC on 9th and 12th days was due to the biochemical changes brought about by moisture content which hasten the growth of yeast and mold, still the data was found statistically significant ($p<0.05$). On 15th day, control *paneer kheer* value was found to be highly bacterial loaded from the permissible limit of FSSAI (2006), therefore not considered for further references meanwhile, the optimized value was found within limit of FSSAI (2006). On 18th days, both of the product control (1.32) and optimized ASPK (1.25) were found with maximum bacterial load from the permissible limit. It is evident from the results that the rate of growth of YMC was directly proportional with the increasing number of storage days for *paneer kheer*. Changade *et al.* (2012), also observe similar data of bottle guard and pumpkin *kheer*.

Effect of storage period on coliform count (CFC) of control and optimized almond supplemented *paneer kheer* at 5°C

Table 3 depicts the information of CFC for control and optimized ASPK. During the entire study period from 0th days to 18th days, there was absence of coliform bacteria in both the samples.

Effect of storage temperature on Standard Plate Count (SPC) of control and optimized almond supplemented *paneer kheer* at 25±1°C

The value of SPC is presented in Table 4. The 0th and 3rd days, both the value of control (2.62 and 5.12) and optimized ASPK (2.27 and 3.81) showed increasing number of bacteria. The value of SPC of control sample obtained on 3rd day was beyond the permissible limit of FSSAI (2011) and this sample was then discarded in further study whereas data was found statistically significant ($p<0.05$). On 6th days, all the samples of control (5.28) and optimized (5.08) were found deteriorated due to increase in microbial load with respect to increase in storage period. The value of both products was found non-significant on this day.

Effect of storage temperature on yeast and mold count (YMC) of control and optimized almond supplemented *paneer kheer* at 25±1°C

Table 5 represent value of yeast and mold count. On 0th days, the value on both samples control (0.51) and optimized (0.41) were found to be significant ($p<0.05$). On 3rd day, the value of control (1.08) and optimized (0.58) sample consistently increases as increase storage period. The control *paneer kheer* value was found to higher from the

Table 1: Effect of storage period on Standard Plate Count (SPC) microbiological quality of control and optimized almond supplemented *paneer kheer* at 5°C.

	Standard plate count (SPC) value in log10 cfu/g													
	Number of days of storage at 5±1°C													
	0 day		3 day			6 day		9 day		12 day		15 day		18 day
Sample	Mean+SE	P value	Mean+SE	P Value		Mean+SE	P value	Mean+SE	P value	Mean+SE	P value	Mean+SE	P Value	Mean+SE	P value
Control	2.54±.028		2.62±.017			2.68±.020		2.83±.017		2.90±.014		5.08±.017		5.21±.034	
Optimized	2.17±.034	0.001	2.27±.040	0.001		2.41±.028	0.001	2.64±.028	0.005	2.75±.034	0.016	3.89±.023	0.003	5.15±.040	0.301

Table 2: Effect of storage period on yeast and mold count (YMC) of control and optimized almond supplemented *paneer kheer* at 5°C.

Yeast and mold count (YMC) value in log10 cfu/g												
	Number of days of storage at 5±1°C											
	0 day		3 day		6 day		9 day		12 day		15 day		18 day	
Sample	Mean+SE	P value	Mean+SE	P value	Mean+SE	P value	Mean+SE	P value	Mean+SE	P value	Mean+SE	P value	Mean+SE	P value
Control	0.49±.031		0.56±.017		0.64±.017		0.73±.020		0.81±.011		1.09±.008		1.32±.034	
Optimized	0.31±.017	0.036	0.40±.023	0.047	0.48±.026	0.008	0.54±0.23	0.001	0.65±.023	0.003	0.82±.011	0.002	1.25±.054	0.384

Table 3: Effect of storage period on coliform count (CFC) of control and optimized almond supplemented *paneer kheer* at 5°C.

Coli form count value in log10cfu/g												
	Number of days of storage at 5±1°C											
	0 day		3 day		6 day		9 day		12 day		15 day		18 day	
Sample	Mean+SE	P value	Mean+SE	P value	Mean+SE	P value	Mean+SE	P value	Mean+SE	P value	Mean+SE	P value	Mean+SE	P value
Control					Nil		Nil		Nil		Nil		Nil	
Optimized	nil	0.00	Nil	0.00	nil	0.00	Nil	0.00	Nil	0.00	Nil	0.00	nil	0.00

Table 4: Effect of storage temperature on standard plate count (SPC) of control and optimized almond supplemented *paneer kheer* at 25±1°C.

Standard plate count (SPC) value in log 10 cfu/g			
	Sample		
Storage days	Control	Optimized ASPK	P value
0 day	2.62±.017	2.27±.040	0.001
3 day	5.12±.020	3.81±.028	0.001
6 day	5.28.014	5.08±.037	0.311

Table 5: Effect of storage temperature on yeast and mold count (YMC) of control and optimized almond supplemented *paneer kheer* at 25±1°C.

Yeast and mold count (YMC) Value in log 10 cfu/g			
	Sample		
Storage days	Control	Optimized ASPK	P value
0 day	0.51±.023	0.41±0.17	0.026
3 day	1.08±.008	0.58.011	0.001
6day	1.26±.017	1.21±.040	0.319

Table 6: Effect of storage temperature on Coliform Count (CFC) of control and optimized almond supplemented *paneer kheer* at 25±1°C.

Coli form count value log10 cfu/g			
	Sample		
Storage days	Control	Optimized ASPK	P value
0 day	Nil	Nil	0.00
3 day	Nil	Nil	0.00
6 day	Nil	Nil	0.00

Note: All the values are average of three determinations.
Mean+SE ASPK- Almond Supplemented *Paneer kheer*.

permissible limit from match of FSSAI (2011). Therefore, not regarded for further analysis. On 6th day optimized sample was found at deteriorated condition.

Effect of storage temperature on Coliform Count (CFC) of control and optimized almond supplemented *paneer kheer* at 25±1°C

The data of coliform is presented in Table 6. On 0th days, 3rd day and 6th days, the value of the coli form bacterial was found to be nil. Data of the products found also the same. The coli form value lower in these products from the acceptable limit of FSSAI (2011).

Effect of storage temperature on Standard Plate Count (SPC), Yeast and Mold Count (YMC) and Coliform Count (CFC) of control and optimized almond supplemented *paneer kheer* at 37±1°C

Table 7 and 8 depicts the information on SPC and YMC respectively. On 0th day, the SPC (2.52) and YMC (0.76) value of control *paneer kheer* was found higher as compared

Table 7: Effect of storage temperature on standard plate count (SPC) of control and optimized almond supplemented *paneer kheer* at 37±1°C.

Standard plate count (SPC) value in log 10 cfu/g			
	Sample		
Storage days	Control	Optimized ASPK	P value
0 day	2.52±.075	2.11±.052	0.012
3 day	5.54±.046	5.42±.034	0.106

Table 8: Effect of storage temperature on yeast and mold count (YMC) of control and optimized almond supplemented *paneer kheer* at 37±1°C.

Yeast and mold count (YMC) value in log 10 cfu/g			
	Sample		
Storage Days	Control	Optimized ASPK	P value
0day	0.76±.026	0.59±.034	0.005
3 day	1.26±.017	1.19±.028	0.102

Table 9: Effect of storage temperature on Coliform Count (CFC) of control and optimized almond supplemented *paneer kheer* at 37±1°C.

Coli form count at log10 cfu/g			
	Sample		
Storage days	Control	Optimized ASPK	P value
0 day	-	-	-
3 day	-	-	-

to SPC (2.11) and YMC (0.59) in optimized ASPK. Both the samples were found statistically significant ($p<0.05$). On 3rd day, both of the samples and microbial attributes were found deteriorated and also their value was found above the permissible limit. Besides Table 9 showed that the coliform bacteria was found nil in 0th and 3rd days. These findings are in accordance with that of Gaikwad and Humbade (2012) who reported that due to lipolysis ujjani basundi has a very short life and Satish *et al.* (2017) who reported that prolonged storage of the treated product above 30°C for 10th days periods, gave off- flavour and discoloration.

SUMMARY AND CONCLUSION

The shelf life of products mostly depends upon the microbiological aspects which is must for safety and good quality. The quality of good food is checked by microbiological status. The microbiological quality of foods on three different types of microbiological parameters: Standard Plate Count, (SPC), Yeast and Mold Count (YMC) and Coliform Count (CFC) were studied in this research. These are the mostly used parameters to check the food quality so far. The growth of microbiological bacteria mostly depends on temperature and nutrient medium present in food.

The results obtained from study revealed that each of the parameter tested has statistically significant relation during the initial few days of storage. But as the storing period elevates some parameters at the end of storage period has shown non-significant result as well. SPC has slightly changed when the temperature of storage is 5°C. The control sample used at this temperature crossed the given permissible limit of consumption by FSSAI (2006) on 18th days. The maximum number of SPC (5.21), YMC (1.32) were recorded on control sample at 5°C on 18th day whereas for optimized sample, maximum SPC (5.15) and YMC (1.25) were recorded on same day. The data of 25°C shows that for control sample maximum SPC (5.28), YMC (1.26) were recorded on 6th day while SPC (5.08), YMC (1.21) were maximum values for optimized sample of ASPK on same day. Highest temperature of storage was maintained at 37°C of which control sample with maximum SPC (5.54), YMC (1.26) were obtained on 3rd day and for optimized sample maximum SPC (5.42), YMC (1.19) were recorded on same day at same temperature. Coliform bacteria mostly enter into the food products *via* water or when the polluted water is used in the preparation of food products. As this present research study is only based on milk and its products, coliform bacteria is not encountered in it. That is why the value of CFC was nil at almost all counts irrespective of storage period and temperature.

So, from this research it can be concluded that with the rise of storage period and temperature, the growth of microbes that deteriorate the products are likely to increase.

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Conflict of interest

All authors declare that they have no conflict of interest.

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