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Effect of metabolized polyethylene terephthalate, vacuum packaging and storage temperature on shelf life of papaya pulp Kalakand (Indian cookie)

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Abstract: The dairy plants are looking for newer products for diversification and value addition. There is scope for the dairy industry to introduce newer products as healthy, convenience and ready to eat foods for capacity utilization and value addition, but because of complex biochemical composition and high water content, milk and milk products act as an excellent culture medium for growth and multiplication of varieties of microorganisms. Vacuum packaging reduces product shrinkage, trim losses by eliminating oxidation and freezer burn resulting it can enhance product quality. Now a day metabolized polyethylene terephthalate (MET PET) with vacuum packaging have a promising role in storage of various value added milk product. The developed value added Kalakand product (Indian cookie) could be stored successfully for 5 days in MET PET packaging material at 4±1°C and when the product was packaged under vacuum the shelf life increased up to 10 days at 4±1°C.

Keywords: Indian cookie, Kalakand, Metabolized polyethylene terephthalate, Microbiological analysis, Vacuum packaging

INTRODUCTION

A strong and effective food processing sector plays a significant role in diversification of agricultural activities, improving value addition opportunities and creating a surplus for export of agro-food products. Keeping in view, the market trend in western dairy market, incorporation of fruits in to traditional milk product would generate a great demand for processed milk products. Kalakand is a partially desiccated milk product with caramelized flavour and granular texture prepared from acidified milk (Suresh and Jha, 1994) and found to be an attractive product amongst all the classes of consumers. It is a very popular sweet in North and East India, including Jharkhand, Orissa and Bengal states. The product is reputed for its exquisite taste (Sawant *et al.,* 2006).

Due to complex biochemical composition and high water content, milk and milk products act as an excellent culture medium for growth and multiplication of varieties of microorganisms particularly under unhygienic production and storage at ambient temperature. The quality and safety of milk and milk products largely depends on controlling entry and growth of microorganisms from source of milk to consumer. Since last two decades as a part of market demand many methods has been developed for increase shelf life of various milk products of Indian cookies. Potassium sorbate (0.3%) was found to be effective in preventing the growth of fungus on *Sandesh* for a period up to 10 days at room temperature (Natarajan, 2007). Further mozzarella cheese was stored up to 9 to 11 week by Modified Atmosphere Packaging (MAP) i.e. air, vacuum, CO2 (50 % &100%) and N2(50 % &100%) (Alam and Goyal, 2007). In *peda* preparation addition of BHA (0.02%) and the combination of BHA (0.01%) + potassium sorbate (0.1%) along with vacuum packaged in preformed LLD/BA/Nylon-6/BA/LDPE pouches can increased shelf life range from 30 to 40 days (Londhe and Pal, 2007). Vacuum packaging reduces product shrinkage, trim losses by eliminating oxidation and freezer burn resulting it can enhance product quality. Vacuum packaging allows more efficient use of time. Food can be prepared in advance without loss of fresh-

ness, so slack times are more productive and busy times are more manageable. Now a days metabolized polyethylene terephthalate (MET PET) with vacuum packaging have a promising role in storage of various value added milk product (Kuczenski and Geyer, 2010). Therefore, the present study designs to know the effect of these type of storage method on value added kalakand.

MATERIALS AND METHODS

In the present study, Kalakand prepared from whole buffalo milk (100 %) was served as control (C). The new value added Kalakand products were prepared by using 5 (T_1) and 20 (T_2) per cent replacement of buffalo milk by papaya pulp. These two products along with control were studied for the sensory, proximate and microbiological evaluation at different storage periods when using metabolized polyethylene terephthalate (MET PET) as a packing material with and without vacuum packaging.

Storage Study: The prepared samples (control, T_1 and T_2) were stored at 4±1°C with and without vacuum using metabolized polyethylene terephthalate (MET PET) for 0 day, 5 days and 10 days. These samples were tested for sensory, chemical and microbiological analysis at every storage period.

Sensory evaluation: The Kalakand samples were evaluated organolaptically for different quality attributes like flavour (odour and test), body and texture, colour and appearance and overall acceptability by semi trained panel of six judges. The score card based on classical nine point hedonic scale was used for evaluation suggested by Amerine *et al.* (1965). All the samples were appropriately coded before subjecting for sensory evaluation.

Chemical evaluation (proximate analysis): The samples were also analyzed for chemical composition, namely total solids using method as per Indian standards (ISI, 1961), moisture by standard gravimetric method (ISI, 1961), fat by Gerber method (IS: 1223, Part II, 1970), protein by following micro Kjeldahl method (AOAC, 1995). Ash content and Titaratable acidity of Kalakand samples were determined by the method described in ISI (1961) and BIS (1960) respectively.

Carbohydrate content was measured as percentage by difference from the data obtained in compositional analysis by using the following formula.

Carbohydrate (% by difference) = Total Solid % - (Fat % + Protein %+ Ash %)

Microbial analysis: The control as well as value added (T_1 and T_2) Kalakand samples analysed for microbial qualities. The total numbers of viable bacteria in Kalakand were enumerated by the method described in BIS, 1977), yeast and mould count was done according to the procedure recommended by BIS, (1969) and coliform counts was performed according to the procedure specified by the method explained in BIS (1977). Results were analyzed using complete randomized design to test the statistical significance (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

Sensory evaluation of papaya fruit Kalakand during storage: It was observed from table 1 that at 0, 5 and 10 days of storage flavour, body and texture and colour and appearance score was significantly higher in vacuum packaged Control, T_1 (5 per cent papaya pulp and 95 per cent buffalo milk) and T_2 (20 per cent papaya pulp and 80 per cent buffalo milk) samples as compare to without vacuum packaged sample. So, overall acceptability was highest in vacuum packaged sample. There after it was decreased with increase storage period. Further, it was observed that without vacuum packaged sample acceptable up to 5 days where as in case of vacuum packaged sample the acceptability was upto 10 days. Deterioration of kalakand during storage may be attributed to reduction of moisture and increase microbial activity. Venkatesh *et al.* (2005) observed loss of moisture was greater in vegetable parchment paper and low-density polyethylene film compared to aluminium foil and suggested the maximum shelf life of Kalakand was achieved using aluminium foil as packaging material up to 14 days at 30 ± 0.5°C and 21 days at 5 ± 0.5°C.

Proximate analysis of papaya fruit Kalakand during storage: The effect of storage period on proximate composition of control, T_1 and T_2 samples are presented in table 2. The moisture loss was significantly highest in without vacuum packaged samples as compare to vacuum package. The fat, protein, total solid and acidity content significantly increased with increased in the period of storage at different level of papaya pulp. This may be due to loss of moisture during storage. Almost similar changes in proximate analysis of Kalakand were reported by Magadum *et al.* (1989) and stated that product was not acceptable after 21 days of storage at room temperature. The storage period did not affect either ash or carbohydrate content of the control, T_1 and T_2 samples.

Microbial quality of papaya fruit Kalakand during storage: The standard plate count, yeast and mould count and coliform counts of control, T_1 and T_2 samples stored in with/without vacuum packaging at 4±1° C for various time intervals (Table 3) revealed that both with and without vacuum packaged product had significant effects on microbial scores of all the treatments. Tabulated result shows that there was a significantly higher microbial count in without vacuum packaged sample as compare to vacuum package. Almost comparable findings were also reported by Venkatesh *et al.* (2005) and Elango and Doraisamy (2008) in Kalakand. Further, Venkatesh *et al.* (2005) observed the total viable count (TVC) and yeast and mould counts was higher in samples packed using vegetable parchment paper and low-density polyethylene film

Table 1. Sensory evaluation of papaya fruit Kalakand (Indian cookie) during storage with and without vacuum packaging.

Sensory Attributes	C					T_1					T_2				
		5 day		10 day			5 day		10 day			5 day		10 day	
	0 day	With	Without	With	Without	0 Day	With	Without	With	Without	0 day	With	Without	With	Without
Flavour	8±0.00	7.5±0.28^a	6.16±0.16^b	6.33±0.16^a	Not Accepted	7.5±0.00	7.16±0.16^a	6±0.00^b	6.16±0.16^a	Not Accepted	7±0.00	6.5±0.16^a	5.83±0.16^b	5.83±0.16^a	Not Accepted
Colour and Appearance	8±0.00	7.33±0.16^a	6.33±0.16^b	6.16±0.16^a	Not Accepted	8.66±0.16	8±0.00^a	7.33±0.16^b	6.66±0.33^a	Not Accepted	7±0.00	6.16±0.16^a	5.33±0.16^b	5.16±0.16^a	Not Accepted
Body and Texture	8.16±0.16	7.83±0.16^a	7.16±0.16^b	7.16±0.16^a	Not Accepted	7.33±0.16	7±0.00^a	6.33±0.16^b	6.16±0.16^a	Not Accepted	6.83±0.16	6.33±0.16^a	5.16±0.16^b	6.16±0.16^a	Not Accepted
Overall Acceptability	8±0.00	7.33±0.16^a	6.66±0.16^b	6.16±0.16^a	Not Accepted	7.83±0.16	6.83±0.16^a	6.16±0.16^b	5.83±0.16^a	Not Accepted	7.16±0.16	6.16±0.16^a	5.33±0.16^b	5.66±0.16^a	Not Accepted

* Superscripts are to be read raw wise for mean comparison; * Mean with similar superscripts in raw do not differ significantly (P<0.05); C= Control; T_1= 5 per cent replacement of buffalo milk by papaya pulp and T_2 = 20 per cent replacement of buffalo milk by papaya pulp

Table 2. Proximate analysis of papaya fruit Kalakand (Indian cookie) in percent during storage with and without vacuum packaging.

Parameters	Control					T_1					T_2				
	0 day	5 day		10 day		0 day	5 day		10 day		0 day	5 day		10 day	
		With	Without	With	Without		With	Without	With	Without		With	Without	With	Without
Moisture	25±0.57	23±0.57^a	20±0.57^b	21±0.57^a	17±0.57^b	25.44±0.57	23.44±0.57^a	20.44±0.57^b	21.44±0.57^a	17.44±0.57^b	28.88±0.57	26.88±0.57^a	23.88±0.57^b	24.88±0.57^a	20.88±0.57^b
Total Solid	75±0.57	77±0.57^b	80±0.57^a	79±0.57^b	83±0.57^a	74.56±0.57	76.56±0.57^b	79.56±0.57^a	78.56±0.57^b	82.56±0.57^a	71.12±0.57	73.12±0.57^b	76.12±0.57^a	75.12±0.57^b	79.12±0.57^a
Fat	26.2±0.57	27.2±0.57^b	29.2±0.57^a	28.2±0.57^b	30.2±0.57^a	23.8±0.57	24.8±0.57^b	26.8±0.57^a	26.3±0.57^b	28.8±0.57^a	16.8±0.57	17.8±0.57^b	19.8±0.57^a	18.8±0.57^b	21.8±0.57^a
Protein	16.05±0.00	17.05±0.00^b	18.05±0.00^a	18.05±0.00^b	20.05±0.00^a	14.9±0.00	15.9±0.00^b	16.9±0.00^a	16.4±0.00^b	17.9±0.00^a	9.02±0.00	10.02±0.00^b	11.02±0.00^a	11.02±0.00^b	12.02±0.00^a
Ash	2.26±0.00	2.26±0.00^a	2.26±0.00^a	2.26±0.00^a	2.26±0.00^a	2.15±0.00	2.15±0.00^a	2.15±0.00^a	2.15±0.00^a	2.15±0.00^a	2±0.00	2±0.00^a	2±0.00^a	2±0.00^a	2±0.00^a
Carbohydrate	30.49±0.00	30.49±0.00^a	30.49±0.00^a	30.49±0.00^a	30.49±0.00^a	33.71±0.00	33.71±0.00^a	33.71±0.00^a	33.71±0.00^a	33.71±0.00^a	43.3±0.00	43.3±0.00^a	43.3±0.00^a	43.3±0.00^a	43.3±0.00^a
Acidity	0.44±0.012	0.54±0.011^b	0.60±0.011^a	0.64±0.011^b	0.70±0.011^a	0.32±0.012	0.48±0.011^b	0.52±0.011^a	0.58±0.011^b	0.60±0.011^a	0.15±0.012	0.25±0.011^b	0.31±0.011^a	0.35±0.011^b	0.41±0.011^a

* Superscripts are to be read raw wise for mean comparison; * Mean with similar superscripts in raw do not differ significantly (P<0.05); C= Control; T_1= 5 per cent replacement of buffalo milk by papaya pulp and T_2 = 20 per cent replacement of buffalo milk by papaya pulp

Table 3. Microbial quality of papaya fruit Kalakand (Indian cookie) during Storage with and without vacuum packaging.

Microbial Counts (log 10 cfu/g)	C					T_1					T_2				
	0 day	5 day		10 day		0 day	5 Day		10 day		0 day	5 day		10 day	
		With	Without	With	Without		With	Without	With	Without		With	Without	With	Without
SPC	0±0.00	2±0.57^b	4.33±0.33^a	5±0.57^b	7.33±0.33^a	0±0.00	2.33±0.33^b	3.66±0.33^a	4.33±0.33^b	6.33±0.33^a	0±0.00	2.66±0.33^b	4±0.00^a	5.66±0.33^b	7.66±0.33^a
Y&M	0±0.00	1.66±0.33^b	3.66±0.33^a	3.66±0.33^b	5.66±0.33^a	0±0.00	2±0.00^b	3.66±0.33^a	3±0.00^b	4.66±0.33^a	0±0.00	2.33±0.33^b	3.66±0.33^a	4.33±0.88^b	7±0.00^a
Coliform	0±0.00	0.33±0.33^b	1.66±0.33^a	0.66±0.33^b	3.33±0.66^a	0±0.00	0.66±0.33^b	2.33±0.33^a	1±0.00^b	2.33±0.33^a	0±0.00	0.66±0.33^b	2±0.00^a	1.33±0.33^b	3.33±0.33^a

* Superscripts are to be read raw wise for mean comparison; * Mean with similar superscripts in raw do not differ significantly ($P<0.05$)
C= Control; T_1= 5 per cent replacement of buffalo milk by papaya pulp and T_2 = 20 per cent replacement of buffalo milk by papaya pulp

compared to aluminium foil at both at 30 ± 0.5°C and 5 ± 0.5°C temperature. However, Coliform bacteria were absent in all packed materials.

Metabolized polyethylene terephthalate (MET PET) provide barrier and antimicrobial properties. These advances are oriented to obtain improved Kalakand quality and safety during storage period. Use of MET PET with vacuum packaged kalakand inhibits growth of bacteria, mould and yeast, because these and other spoilage microorganisms need oxygen to grow. Since, moisture loss was significantly lower in vacuum packaged samples in comparison to without vacuum packaged samples. Once moist air is removed and the pouch is sealed, oxygen levels continue to drop where carbon dioxide levels increased. The low oxygen, high carbon dioxide environment significantly reduces the growth of normal spoilage organisms, allowing longer shelf life of kalakand.

Conclusion

The developed product could be stored successfully for 10 days under vaccum packaging with Metabolized polyethylene terephthalate (MET PET) as a packaging material at 4±1°C.

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