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Effect of active packaging on sensory attributes of low sugar, low calorie and fibre enriched *Lal Peda*

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ABSTRACT : Varanasi,the city of gallis and ghats is not only famous for its *Banarasi saree* and *Banarasi paan*, but also famous for the *Lal Peda* loaded with higher amount of sugar and loaded with *Ghee*, the *Peda* is shaped by hand and dusted with semolina and pistachios as a finishing touch. *Lal Peda* is a popular heat desiccated traditional dairy delicacy of eastern India specially Uttar Pradesh. It is prepared by blending of *Khoa* and sugar followed by heat desiccation until characteristic reddish brown colour appears. The *Lal Peda* is deficit in fibre so the developed *Lal Peda* was prepared with addition of oat. This product is manufactured since long time yet not glamorized as other *Khoa* based sweet products like *Burfi, Peda* etc. The main reason behind this is, these products centered into specific areas and have not proper focused by research scientists and extension workers. So the experiment was carried out on low calorie, low sugar and fibre enriched *Lal Peda*. The *Lal Peda* samples packed in polythene bags coated with nisin as a bio-preservative to check the preservation ability of the developed *Lal Peda.* The *Lal Peda* samples were packed in commercial Nasco sampling polyethylene bags using MAP equipment Reepack® and MAP mix 9000 Gas mixer, manufactured by PBI DAN5SENSOR A/S, Ringstead, Denmark. Three different combinations of gases *i.e.* 75 per cent CO_2:25 per cent N_2,50 per cent CO_2:50 per cent N_2 and 25 per cent CO_2:75 per cent N_2were used to pack the *Lal Peda* samples. The samples packed under air were kept as control. The samples were stored in a BOD incubator (Remi Elektrotechnik Ltd., New Delhi, India) at 20 and 37^{0}C and were analyzed for sensory attributes at an interval of 10 days. The sensory evaluation was carried out by 10 semi expert judges.

KEY WORDS : Low sugar, Low calorie, Fibre, *Lal Peda*, Active packaging

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INTRODUCTION

In India most of traditional dairy product contains high fat and also high sugar (Pal and Raju, 2007). *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). 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).

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 (Krupa *et al*., 2011). In India most of traditional dairy food contains high fat and also high sugar (Pal and Raju, 2007).

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Oat :

Oats are generally, considered 'healthful', or a health food, being touted commercially as nutritious. The discovery of their cholesterol-lowering properties has led to wider appreciation of oats as human food.

Soluble fibre in oat:

Consumption of oat is believed to lower LDL (bad) cholesterol and possibly to reduce the risk of heart disease. Oats contain more soluble fibre than any other grain, resulting in slower digestion and an extended sensation of fullness. Oat protein is nearly equivalent in quality to soy protein, which World Health Organization research has shown to be equal to meat, milk and egg protein.

***Lal Peda* :**

Varanasi, the city of gallis and ghats is not only famous for its *Banarasi saree* and *Banarasi paan*, but also famous for the *Lal Peda* loaded with high sugar and loaded with *Ghee*. *LalPeda* is a popular heat desiccated traditional dairy delicacy of eastern India specially Uttar Pradesh. Very little attention is paid to packaging and sanitary handling practices (Patil, 2003). On the commercial scale, the low shelf of products is big challenge faced by the manufacturer (Mishra, 2000; Aneja *et al.*,2002 and Patil 2003). *Lal Peda* is produced and marketed has limited shelf-life of 5-7 days and consumed fresh. For making it popular outside the traditional manufacturing region, there is a need to have its higher shelf-life.

MATERIAL AND METHODS

Low sugar, low calorie and fibre enriched *Lal Peda* was prepared in the Laboratory of Animal Husbandry and Dairying and Centre of Food Science amd Technology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi.

Buffalo milk :

Buffalo milk was standardized to 3 per cent fat and 9 per cent SNF.

Artificial sweetener :

Artificial sweeteners *i.e*. aspartame was purchased from market, Varanasi, U.P.

Sugar :

Good quality sugar was obtained from the local market of Varanasi, Uttar Pradesh.

Bulking agents :

High quality bulking agents *i.e*. Maltodextrin and Sorbitol were purchased from the local market of Varanasi, Uttar Pradesh.

Oat :

High quality oat was purchased from the local market of Varanasi, Uttar Pradesh.

Statistical analysis :

All the data were expressed as mean ± standard deviation of mean and was calculated from three independent experiments. One-way analysis of variance (ANOVA) was applied and Duncan multiple range test was performed to measure the test of significance by post hoc test using SPSS 16.0 software (SPSS Italia, Bologna, Italy).

RESULTS AND DISCUSSION

The results of the present study as well as relevant discussions have been presented under following sub heads:

Effect of modified atmosphere packaging and nisin on sensory score of *Lal Peda* stored at 20^0C and 37^0 C :

The sensory evaluations of experimented *Lal Peda* samples were evaluated on the basis of flavour, colour and appearance, body and texture and overall acceptability. Table 1 shows the data for sensory evaluation of experimented *Peda* packed under air and modified atmospheric packaging at 20^0 C.

Effect on flavour score :

Changes in flavour score of low sugar, low calorie fibre enriched *Lal Peda* stored at 20^O C have been presented in Table 1. The average flavour score for low sugar, low calorie fibre enriched *Lal Peda* was 9.00 out of 10 at initial stage *i.e.* at 0 day. During storage period of 40 days, the flavour score decreases as progress in storage period. In air (control) samples, the flavour score decreased to 9.00, 7.14 and 6.71 on 0 day, 10 days and 20 days of storage. With advancement in storage period the flavour score exhibited a rapid significant decrease. The average flavour score for all samples decreased

significantly (P<0.05) with storage period. The maximum flavour score was obtained at initial day (9 out of 10). As concerned to the samples stored in air discarded after 20 days due to visible mold growth. The samples stored in MAP also showed decrease in flavour score but the rate of decrease was slow as compared to control sample. It can also be seen from table that the Lal *Peda* samples packed under 50 per cent CO_2:50 per cent N_2 scored the maximum flavour score among all samples at their respective storage periods. The flavour score of samples stored under gas combination of 50 per cent CO_2:50 per cent N_2were 9.00, 8.71, 8.51, 8.00 and 7.14 at 0 day, 10 days, 20 days, 30 days and 40 days of storage period. There was not much flavour score change in samples stored in 50 per cent CO_2:50 per cent N_2 gas composition upto 20 days. Nonetheless, the samples stored at 20^{O}C packed under 50 per cent CO_2:50 per cent N_2 showed the best preservation and flavour score of *Lal Peda* samples and rated higher flavour score than rest followed by samples stored under 75 per cent CO_2:25 per cent N_2 and 25 per cent CO_2:75 per cent N_2.None of the judges reported the presence of any objectionable off flavour such as rancid, oxidized or acidic during entire storage period of 40 days. The findings of the present study are in accordance with the report of Biradar *et al.* (1985) and Sharma *et al.* (2003) also reported the decrease in mean flavour scores of the control and MAP packaged *Malai Peda* samples in flexible packaging material at room temperature. Londhe and Pal (2007) and Jain *et al*. (2014) also reported decrease in flavour scores irrespective of temperature and storage.

Effect on body and texture :

The average body and texture score for low sugar, low calorie fibre enriched *Lal Peda* was 8.86 out of 10 at initial stage *i.e.* at 0 day. During storage period of 40 days the body and texture score decreases as progress in storage period. In air (control) samples, the flavour score decreased to 8.86, 7.14 and 7.00 on 0 day, 10 days and 20 days of storage. With advancement in storage period the body and texture score exhibited a rapid significant decrease. The average flavour score for all samples decreased significantly (P<0.05)with progression in storage period. The maximum body and texture score was obtained at initial day (8.86 out of 10). The samples stored in MAP also showed decrease in flavour score but the rate of decrease was very slow as compared to control sample. It can also be seen from table that the

Table 1 : Effect of modified atmosphere packaging and nisin on sensory score of *Lal Peda* at 20^{0}C

Days	Atmosphere	Flavour (10)	Body and texture (15)	Colour and appearance (5)	Overall acceptability (25)
0 Day		9.00±0.38	8.86±.048	5.00±.048	22.86±0.53
(10 days)					
T_0	Air (Control)	7.14± 0.38	7.14±0.8	4.14±0.38	18.43±0.38
T_1	25%CO_2:75%N_2	8.29±0.49	8.29±0.49	4.43±0.53	21.00±0.53
T_2	50%CO_2:50%N_2	8.71±0.49	8.43±0.53	4.71±0.49	21.86±0.49
T_3	75%CO_2:25%N_2	8.43±0.54	8.29±0.49	4.57±0.53	21.29±0.53
20 days					
T_0	Air (Control)	6.71±0.49	7.00±0.0	4.00±0.00	17.71±0.0
T_1	25%CO_2:75%N_2	8.00±0.00	8.00±0.0	4.43±0.53	20.43±0.53
T_2	50%CO_2:50%N_2	8.71±0.49	8.29±0.49	4.71±0.49	21.71±0.49
T_3	75%CO_2:25%N_2	8.29±0.49	8.14±0.38	4.57±0.53	21.00±0.53
30 days					
T_1	25%CO_2:75%N_2	7.00±0.0	7.14±0.38	3.86±0.38	18.00±0.38
T_2	50%CO_2:50%N_2	8.00±0.0	7.86±0.38	4.14±0.38	20.00±0.38
T_3	75%CO_2:25%N_2	7.57±0.53	7.43±0.53	4.00±0.0	19.00±0.0
40 days					
T_1	25%CO_2:75%N_2	6.43±0.53	6.43±0.53	3.43±0.53	16.29±0.53
T_2	50%CO_2:50%N_2	7.14±0.38	7.00±0.0	3.86±0.00	18.00±0.0
T_3	75%CO_2:25%N_2	6.71±0.49	6.71±0.49	3.71±0.48	17.14±0.48

Lal Peda samples packed under 50 per cent CO_2:50 per cent N_2 scored the maximum body and texture score among all samples at their respective storage periods. The body and texture score of samples stored under gas combination of 50 per cent CO_2:50 per cent N_2 were 8.86, 8.43, 8.29, 7.86 and 7.00 at 0 day, 10 days, 20 days, 30 days and 40 days of storage period, respectively. There was not much body and texture score change in samples stored in 50 per cent CO_2:50 per cent N_2 gas composition upto 30 days. Nonetheless, the samples stored at 20^{O}C packed under 50 per cent CO_2:50 per cent N_2 showed the best preservation and body and texture score of *Lal Peda* samples and rated higher body and texture score than rest followed by samples stored under 75 per cent CO_2:25 per cent N_2 and 25 per cent CO_2:75 per cent N_2. The body and texture score of experimented *Lal Peda* stored at 20^{O}C was found to be acceptable upto 40 days as compared to *Lal Peda* samples stored at 37^O C. The findings of the present study are in accordance with the report of Biradar *et al.* (1985); Sharma *et al.* (2003) also reported the decrease in mean body and texture scores of the control and MAP packaged *Malai Peda* samples in flexible packaging material at room temperature. Londhe and Pal (2007) and Jain *et al*. (2014) also reported decrease in body and texture scores irrespective of temperature and storage. The decrease in body and texture scores may be due to loss of moisture during entire storage period.

Effect on colour and appearance :

The average colour and appearance score for low sugar, low calorie fibre enriched *Lal Peda* was 5.0 out of 5.0 at 0 day *i.e.* on initial stage. During storage period of 40 days the colour and appearance score decreases as progress in storage period. In air (control) samples, the colour and appearance score decreased to 5.0, 4.14 and 4.00 on 0 day, 10 days and 20 days of storage. With advancement in storage period the colour and appearance score exhibited a rapid significant decrease. The average colour and appearance score for all samples decreased significantly ($P<0.05$) with progression in storage period. The samples stored in MAP also showed decrease in colour and appearance score but the rate of decrease was very slow as compared to control sample. It can also be seen from table that the *Lal Peda* samples packed under 50 per cent CO_2:50 per cent N_2 scored the maximum colour and appearance score among all samples at their respective storage periods. The colour and appearance score of samples stored under gas combination of 50 per cent CO_2:50 per cent N_2 were 5.0, 4.71, 4.51, 4.14 and 3.86 at 0 day, 10 days, 20 days, 30 days and 40 days of storage period, respectively. There was not much colour and appearance score change in samples stored in 50 per cent CO_2:50 per cent N_2 gas composition upto 30 days. Nonetheless, the samples stored at 20^{O}C packed under 50 per cent CO_2: 50 per cent N_2 showed the best preservation and colour and appearance score of *Lal Peda* samples and rated higher colour and appearance score than rest followed by samples stored under 75 per cent CO_2:25 per cent N_2 and 25 per cent CO_2:75 per cent N_2. The body and texture score of experimented *Lal Peda* stored at 20^{O}C was found to be acceptable upto 40 days as compared to Lal *Peda* samples stored at 37^O C. The findings of the present study are in accordance with the report of Biradar *et al.* (1985) and Sharma *et al.* (2003) also reported the decrease in mean colour and appearance scores of the control and MAP packaged *Malai Peda* samples in flexible packaging material at room temperature. Londhe and Pal (2007) and Jain *et al*. (2014) also reported decrease in colour and appearance scores irrespective of temperature and storage.

Effect on overall acceptability :

The average overall acceptability score for low sugar, low calorie fibre enriched *Lal Peda* was 22.86 out of 25.0 on first day. With advancement in storage period the overall acceptability score exhibited a significant decrease. The average overall acceptability score for all samples decreased significantly ($P<0.05$) with progression in storage period. The samples stored in MAP also showed decrease in overall acceptability score but the rate of decrease was very slow as in samples stored in MAP compared to control sample. It can also be seen from table that the *Lal Peda* samples packed under 50 per cent CO_2:50 per cent N_2 scored the maximum overall acceptability score among all samples at their respective storage periods. The samples stored at 20^O C packed under 50 per cent CO_2:50 per cent N_2 showed the best preservation and overall acceptability score of *Lal Peda* samples and rated higher overall acceptability score than rest followed by samples stored under 75 per cent CO_2:25 per cent N_2 and 25 per cent CO_2:75 per cent N_2. The findings of the present study are in accordance with the

report of Biradar *et al.* (1985) and Sharma *et al.* (2003) also reported the decrease in mean colour and appearance scores of the control and MAP packaged *Malai Peda* samples in flexible packaging material at room temperature. Londhe and Pal (2007) and Jain *et al.* (2014) also reported decrease in overall acceptability scores irrespective of temperature and storage.

Effect of modified atmosphere packaging and nisin on sensory score of *Lal Peda* at 37^{0}C :

The sensory evaluations of experimented *Peda* samples were evaluated on the basis of flavour, colour and appearance, body and texture and overall acceptability. Table 2 shows the data for sensory evaluation of experimented *Peda* packed under air and modified atmospheric packaging at 37^{0}C.

Effect on flavour score :

Changes in flavour score of low sugar, low calorie fibre enriched *Lal Peda* stored at 37^{O}C have been presented in Table 2. The average flavour score for low sugar, low calorie fibre enriched *Lal Peda* was 9.00 out of 10 on initial day. During storage period of 20 days, the flavour score decreases as progress in storage period. In air (control) samples, the flavour score decreased rapidly from 9.00 to 7.14 on 10th day of storage. With advancement in storage period the flavour score exhibited a rapid significant decrease. The average flavour score for all samples decreased significantly ($P<0.05$) with progression in storage period. The maximum flavour score was obtained at initial day (9 out of 10). The samples stored in MAP also showed decrease in flavor score but the rate of decrease was slow as compared to control sample. It can also be seen from table that the *Lal Peda* samples packed under 50 per cent CO_2:50 per cent N_2 scored the maximum flavour score among all samples at their respective storage periods. The flavour score of samples stored under gas combination of 50 per cent CO_2:50 per cent N_2were 9.00, 8.29 and 7.14 at 0 day, 10 days and 20 days of storage period. There was much flavour score change in samples stored in 50 per cent CO_2:50 per cent N_2 gas composition upto 20 days. Nonetheless, the samples stored at 20^{O}C packed under 50 per cent CO_2:50 per cent N_2 showed the best preservation and flavour score of *Lal Peda* samples and rated higher flavour score than rest followed by samples stored under 75 per cent CO_2:25 per cent N_2 and 25 per cent CO_2:75 per cent N_2.None of the judges reported the presence of any objectionable off flavour such as rancid, oxidized or acidic during entire storage period of 20 days. The findings of the present study are in accordance with the report of Biradar *et al.* (1985) and Sharma *et al.* (2003) also reported the decrease in mean flavour scores of the control and MAP packaged *Malai Peda* samples in flexible packaging material at room temperature. Londhe *et al.* (2007) and Jain *et al.* (2014) also reported decrease in flavour scores irrespective of temperature and storage.

Effect on body and texture :

Changes in body and texture score of low sugar, low calorie fibre enriched *Lal Peda* stored at 37^{0}C have been presented in Table 2. The average body and texture score for low sugar, low calorie fibre enriched *Lal Peda* was 8.86 out of 10 at initial stage *i.e.* at 0 day. During storage period of 20 days the body and texture score

Table 2: Effect of modified atmosphere packaging and nisin on sensory score of *Lal Peda* at 37^{0}C

Days	Atmosphere	Flavour (10)	Body and texture (10)	Colour and appearance (5)	Overall acceptability (25)
0 Day		9.00±0.49	8.86±0.38	5.00±0.00	22.86±0.53
10 days					
T_0	Air (Control)	7.14±0.38	7.00±0.0	3.86±0.38	18.00±0.38
T_1	25%CO_2:75%N_2	8.00±0.0	7.86±0.38	4.00±0.00	19.86±0.0
T_2	50%CO_2:50%N_2	8.29±0.49	8.14±0.38	4.43±0.53	20.86±0.53
T_3	75%CO_2:25%N_2	8.14±0.38	7.86±0.38	4.29±0.49	20.29±0.49
20 days					
T_1	25%CO_2:75%N_2	6.71±0.49	6.29±0.48	3.43±0.53	16.43±0.53
T_2	50%CO_2:50%N_2	7.14±0.38	7.00±0.0	3.71±0.49	17.86±0.49
T_3	75%CO_2:25%N_2	6.86±0.38	6.57±0.53	3.57±0.53	17.00±0.53

decreases as progress in storage period. In air (control) samples, the flavour score decreased to 8.86 to 7.00 on 10th day of storage. With advancement in storage period the body and texture score exhibited a rapid significant decrease. The average flavour score for all samples decreased significantly (P<0.05) with progression in storage period. The maximum body and texture score was obtained at initial day (8.86 out of 10). The samples stored in MAP also showed decrease in flavor score but the rate of decrease was slow as compared to control sample. It can also be seen from table that the *Lal Peda* samples packed under 50 per cent CO_2:50 per cent N_2 scored the maximum body and texture score among all samples at their respective storage periods. There was very much body and texture score change in samples stored in 50 per cent CO_2:50 per cent N_2 gas composition within 20 days. Nonetheless, the samples stored at 37^{O}C packed under 50 per cent CO_2:50 per cent N_2 showed the better preservation and body and texture score of *Lal Peda* samples and rated slight higher body and texture score than rest followed by samples stored under 75 per cent CO_2:25 per cent N_2 and 25 per cent CO_2:75 per cent N_2. The body and texture score of experimented *Lal Peda* stored at 37^{O}C was found to be acceptable upto 20 days as compared to *Lal Peda* control samples. The findings of the present study are in accordance with the report of Biradar *et al.* (1985) and Sharma *et al.* (2003) also reported the decrease in mean body and texture scores of the control and MAP packaged *Malai Peda* samples in flexible packaging material at room temperature. Londhe and Pal (2007) and Jain *et al.* (2014) also reported decrease in body and texture scores irrespective of temperature and storage. The decrease in body and texture scores may be due to loss of moisture during entire storage period.

Effect on colour and appearance :

The average colour and appearance score for low sugar, low calorie fibre enriched *Lal Peda* was 5.0 out of 5.0 on first stage. During storage period of 20 days the colour and appearance score decreases as progress in storage period. In air (control) samples, the colour and appearance score decreased 5.0 to 3.86 on 10th day of storage. With advancement in storage period the colour and appearance score exhibited a rapid significant decrease. The average flavour score for all samples decreased significantly (P<0.05) with progression in storage period. The maximum colour and appearance score was obtained at initial day (5.0 out of 5). The samples stored in MAP also showed decrease in colour and appearance score but the rate of decrease was slow as compared to control sample. It can also be seen from table that the *Lal Peda* samples packed under 50 per cent CO_2:50 per cent N_2 scored the maximum colour and appearance score among all samples at their respective storage periods. There was much colour and appearance score change in samples stored in 50 per cent CO_2:50 per cent N_2 gas composition upto 20 days. Nonetheless, the samples stored at 37^{O}C packed under 50 per cent CO_2:50 per cent N_2 showed the good preservation and colour and appearance score of *Lal Peda* samples and rated higher colour and appearance score than rest followed by samples stored under 75 per cent CO_2:25 per cent N_2 and 25 per cent CO_2:75 per cent N_2. The body and texture score of experimented *Lal Peda* stored at 37^{0}C was found to be acceptable upto 20 days. The findings of the present study are in accordance with the report of Biradar *et al.* (1985) and Sharma *et al.* (2003) also reported the decrease in mean colour and appearance scores of the control and MAP packaged *Malai Peda* samples in flexible packaging material at room temperature. Londhe and Pal (2007) and Jain *et al.* (2014) also reported decrease in colour and appearance scores irrespective of temperature and storage.

Effect on overall acceptability :

The average overall acceptability score for experimented *Lal Peda* was 22.86 out of 25.0 on initial day. During storage period of 20 days the overall acceptability score decreases as progress in storage period. With advancement in storage period the overall acceptability score exhibited a significant decrease. The average overall acceptability score for all samples decreased significantly (P<0.05) with progression in storage period. The samples stored in MAP also showed decrease in overall acceptability score but the rate of decrease was very slow as in samples stored in MAP compared to control sample. It can also be seen from table that the *Lal Peda* samples packed under 50 per cent CO_2:50 per cent N_2 scored the maximum overall acceptability score among all samples at their respective storage periods. The samples stored at 37^{0}C packed under 50 per cent CO_2:50 per cent N_2 showed the good

preservation and overall acceptability score of *Lal Peda* samples and rated higher overall acceptability score than rest followed by samples stored under 75 per cent CO_2:25 per cent N_2 and 25 per cent CO_2:75 per cent N_2. The findings of the present study are in accordance with the report of Biradar *et al.* (1985) and Sharma *et al.* (2003) also reported the decrease in mean colour and appearance scores of the control and MAP packaged *Malai Peda* samples in flexible packaging material at room temperature. Londhe and Pal (2007) and Jain *et al.* (2014) also reported decrease in overall acceptability scores irrespective of temperature and storage.

Conclusion :

The optimized *Lal Peda* was subjected to storage at an interval of 10 days at two various temperature combinations *i.e.* 20^0C and 37^0C. During storage period, the developed *Lal Peda* was evaluated sensory changes at an interval of 10 days interval. The sensory evaluation of experimented *Peda* samples were evaluated on the basis of flavour, colour and appearance, body and texture and overall acceptability packed under air and modified atmospheric packaging at 20^0C and 37^0C. It was observed that the flavour, colour and appearance, body and texture and overall acceptability score decreased rapidly as increasing in storage period. But the rate of decrease was slower in samples packed under MAP. It can conclude that samples stored under 50 per cent CO_2: 50 per cent N_2 were lower decrease in sensory properties as compared to other MAP combinations.

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