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Effect of packaging on sensory quality of microwaved ready-to-eat mutton based snacks during storage

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ABSTRACT

Packaging plays significant role to extend shelf life and preserving the quality of food product. Rising trends in the snack food and ready-to-eat food market industry has given wide scope for development of a variety of novel packaging materials and methods to ensure the safety and quality. Laminates and Nitrogen gas flushing are the most popular choice as a packaging material and method respectively. Hence this study was conducted to evaluate the effect of nitrogen gas and laminate on sensory quality of ready-to-eat mutton based snack. Irrespective of packaging method, sensory attributes gradually decreased during the storage, however MAPS had higher scores than APS on any particular days of storage. ANOVA showed a highly significant ($P<0.01$) difference in flavour in between treatments (APS and MAPS), days of storage and their interaction was also significant. Statistically there was highly significant ($P<0.01$) difference in texture and crispness score between days of storage Sensory attributes of both of the APS and MAPS did not decrease much up to 60^{th} days of storage at 30±2°C. All

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these scores were very well within acceptable limits during whole storage period but scores of MAPS are much better.

Key words: Mutton based snacks, nitrogen gas flushing, laminate packaging, sensory quality and storage.

1. INTRODUCTION

Owing to the fast changing pace of life, urbanization and changing socio-economic conditions, snack foods are gaining their popularity today. The reported growth of the market of meat snacks is due to their low carbohydrate, fat content and diverse flavor selection (Bosse and Boland, 2008). It has become an integral part of the eating habits of the majority of the world's population. Pszczola (2002) identified innovation in 'meat snacks' as an area with high potential. Thus it is of the essence to develop good quality, healthful and shelf stable meat products containing high protein, low calorie, low sodium, low cholesterol and scientific packaging for extend the shelf life of product so that it can be utilized for long time.

The Indian snacks market worth around US$ 3.5 billion is one of the largest snack markets in the Asia-Pacific region, with the organised segment taking half the market share and growing at around 20% per annum. The organized sector of the snack food market is growing at 15-20 percent a year while the growth rate of the unorganized sector of US$ 1.56 billion is 7-8 per cent (SSTI, 2011).

Modified atmosphere packaging (MAP) is the removal and/or replacement of the atmosphere surrounding the product before sealing in vapor-barrier materials (McMillin *et al.*, 1999). Nitrogen is colorless, odorless, tasteless, non-toxic and doesn't react with any other compound. By excluding oxygen and moisture, gas flushing with nitrogen prevents oxidation and

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rancidity within the food product and, as a result, helps improve shelf life and product quality. N_2-flushing treatment constitutes a promising option to extend the shelf life (Lloyd *et al.*, 2009)

During storage sensory quality of many snack food products are mostly affected by moisture, light and oxygen. The moisture content of snack is very low, and any increase due to the hygroscopic nature of the product may lead to loss of crispness, rendering the product unacceptable to the consumers. Moreover, added moisture also accelerates other biochemical changes such as oxidative rancidity and lead to change in flavour. In order to protect against moisture, light and oxygen in gas-flushed packs, a metalized high-barrier packaging film should be used. Plastic laminates and films provide properties such as high barrier to oxygen, moisture aroma/flavour or sealability to a package even when its surface is contaminated with product. Thus a scientific packaging which prevents moisture and gas transfer is the key to preserve the sensory quality, shelf life, brand image and marketability of confectionery products.

In present study efforts were apply to resists the change in sensory quality of meat based snack foods by suitable packaging. Nitrogen gas replacing the air of packaged snacks which in turn prevent oxidation, bacterial growth and detrimental effect on sensory quality while laminates resist the change in sensory quality by providing high barrier to oxygen, moisture or sealability to a package.

2. MATERIALS AND METHODS

2.1 Source of raw materials

2.1.1 Spices, condiments and other ingredient

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Spices, condiments, flours, Salt, Vegetable oil, Sugar and Monosodium glutamate were procured from the local market of Bareilly. Starch used in experiment was obtained from SRL Pvt. Ltd., Mumbai (India).

2.1.2 Chemicals

Chemicals were of analytical grade and obtained from standard firms (Qualigens, Hi Media, Polypharm, SRL etc.).

2.1.3 Packaging material

Low density polyethylene (LDPE) films (250 gauge) in natural colour were procured from the manufacturer, M/s Hitkari Industries Ltd., New Delhi for packing of the materials for storage studies. Aluminium foil-LDPE laminate packaging covers were purchased from local market of Bareilly.

2.2 Mutton based snacks

Meat from the leg portion of sheep was obtained from experimental abattoir of Livestock Products Technology Division, IVRI or from local market of Bareilly, Uttar Pradesh (India). All separable fat, fascia and connective tissue, were trimmed off and meat was packed in low density polyethylene (150 gauge) bags, and frozen at -18 to -20°C till further use. The meat was thawed before it was processed for preparing meat based snacks. Mutton based snacks are developed by microwaving the dry batter.

2.3 Analytical Procedures

2.3.1 Sensory evaluation

Sensory evaluation of meat based snacks was conducted using an eight point scale (Keeton, 1983) with slight modifications, where 8 = excellent and 1 = extremely poor. Trained

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taste panel consisting of scientists, post graduate and PhD scholars of the LPT Division obliged in conducting the sensory evaluation of the product. Taste panel were organized around 3.30-4.00 pm every time. The panelists were explained about the nature of experiment without disclosing the identity of the samples. The panelists evaluated the samples for attributes such as appearance/colour, flavour, texture/crispness, after taste, meat flavour intensity, and overall acceptability.

2.3.2 Statistical analysis

The data generated from various trials under experiment were analyzed by statistical method of one way-ANOVA using SPSS software package as per the procedure of Snedecor and Cochran (1995) and the significant differences ($P<0.05$) in the means were compared by using Duncan's Multiple Comparison Test (Duncan, 1955).

2.4 Experimental Design

The experiment was designed to evaluate the change in sensory quality of shelf stable microwaved ready-to-eat mutton based snacks during 60 days of storage and compare the sensory quality of snacks packaged in aluminium foil-LDPE laminate with nitrogen gas flushing (MAPS—modified atmosphere packaged snacks) and in low density polythylene (LDPE) films (250 gauge) without nitrogen gas flushing (APS — aerobically packaged snacks).

3. RESULTS AND DISCUSSION

The results of comparison of sensory quality of APS and MAPS are given in table 1 in which appearance/colour, flavour, texture/crispness, after taste, meat flavour intensity, and overall acceptability are analysed.

3.1 Appearance and colour

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Scores of appearance and colour decreased significantly throughout the storage in both type of the packaged snacks. Statistically there was highly significant ($P<0.01$) difference in appearance and colour scores between different days of storage. There was no significant ($P>0.05$) difference between treatments at particular periods of storage but on 60^{th} day scores of APS was quite low as compared to MAPS. Singh *et al.* (2002) also reported similar decreasing trend of appearance and colour in chicken snacks. Sharma and Nanda (2002) had reported no significant difference in the colour and appearance scores of four different formulations of chicken meat chips.

Kalara *et al.* (1987) also observed slight decrease in the scores for colour and texture of snacks packaged in Low Density Polyethylene (LDPE) bags of 100 and 150 gauge thickness as well as in friction top tins during storage at room temperature up to 6 months. Decline in colour and appearance scores during storage could be due to dilution of meat pigments. These findings are also supported by Zyl and Zayas (1996), Kumar and Sharma (2006) and Bhat and Pathak (2009).

Karthikeyan *et al.* (2000) also reported a reduction in colour scores during ambient temperature storage of vacuum packaged hurdle treated caprine *keema* and attributed it to the lipid oxidation and the oxidised compounds reacting with amino acids causing non-enzymatic browning.

3.2 Flavour and Meat flavour intensity

ANOVA showed a highly significant ($P<0.01$) difference in flavour in between treatments (APS and MAPS), days of storage and their interaction was also significant. There was significantly ($P<0.01$) lower scores for APS on 45^{th} and 60^{th} days than MAPS. This might be

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due to presence of nitrogen in MAPS that prevented the microbial, enzymatic and oxidation reaction by creating the inert environment around product.

Scores for APS decreased significantly throughout the storage, however in MAPS scores decreased gradually up to 60th day. ANOVA showed a highly significant ($P<0.01$) difference in meat flavour intensity of treatments (APS and MAPS), days of storage. Sharma and Nanda (2002) also reported significant decrease in meat flavour intensity during vacuum-packaged storage of chicken chips at ambient temperature.

Lipids oxidation is also responsible for reduction in nutritional quality as well as changes in flavor (Aguirrezábal *et al.*, 2000). The decrease in flavour and meat flavour scores with the advancement of the storage period might be due to dilution in meaty flavour. Similar reports were published by Padda *et al.* (1989), Kumar and Sharma (2005, 2006) and Bhat and Pathak (2009) for various meat products.

3.3 Texture and crispness

On 60th days score of texture and crispness was significantly lower in APS as compared to MAPS. Singh *et al.* (2002) also reported similar decreasing trend of texture and crispness in aerobically and vacuum packaged chicken snacks during 30th days of storage.

The crispness intensity and overall hedonic texture of dry snack food products are a function of water activity (Katz and Labuza, 1981). According to Mckee *et al.* (1995) crispness in snacks food is one of the critical factors which is affected during storage under moist conditions. For crispy products, the crispness loss due to the adsorption of ambient moisture or due to the water mass transfer from neighboring components is a major cause of rejection by the consumers (Piazza *et al.*, 2007).

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Table 1. Changes in the sensory qualities of aerobically packaged and modified atmosphere packaged snacks during storage at ambient temperature (Mean± S.E)

Particulars	Days of storage				
	0	15	30	45	60
	Appearance and Colour				
APS	7.38±0.05 ^{a}	7.12±0.05 ^{b}	7.08±0.05 ^{b}	7.00±0.04 ^{b}	6.74±0.06 ^{cB}
MAPS	7.38±0.05 ^{a}	7.17±0.05 ^{b}	7.13±0.07 ^{b}	7.10±0.09 ^{b}	6.91±0.07 ^{cA}
	Flavour				
APS	7.33±0.05 ^{a}	7.21±0.05 ^{a}	7.19±0.05 ^{a}	6.80±0.07 ^{bB}	5.83±0.09 ^{cB}
MAPS	7.33±0.05 ^{a}	7.21±0.06 ^{a}	7.23±0.06 ^{a}	7.17±0.06 ^{abA}	7.00±0.07 ^{bA}
	Texture and crispness				
APS	7.17±0.13 ^{a}	7.12±0.15 ^{a}	7.10±0.14 ^{a}	6.91±0.15 ^{a}	6.24±0.16 ^{bB}
MAPS	7.17±0.13	7.14±0.13	7.13±0.15	7.10±0.15	7.05±0.11 ^{A}
	After-taste				
APS	7.29±0.15 ^{a}	7.17±0.17 ^{ab}	7.17±0.14 ^{ab}	6.79±0.14 ^{b}	5.93±0.14 ^{cB}
MAPS	7.29±0.15	7.26±0.17	7.24±0.18	7.11±0.16	7.07±0.17 ^{A}
	Meat flavour intensity				
APS	7.36±0.05 ^{a}	7.20±0.09 ^{ab}	7.06±0.08 ^{b}	6.77±0.07 ^{cB}	6.05±0.08 ^{dB}
MAPS	7.36±0.05 ^{a}	7.26±0.06 ^{a}	7.26±0.07 ^{a}	7.21±0.06 ^{aA}	7.00±0.07 ^{bA}
	Overall acceptability				
APS	7.36±0.05 ^{a}	7.27±0.08 ^{a}	7.19±0.05 ^{a}	6.85±0.06 ^{bB}	6.11±0.09 ^{cB}
MAPS	7.36±0.05 ^{a}	7.35±0.08 ^{a}	7.31±0.04 ^{a}	7.27±0.05 ^{aA}	6.93±0.05 ^{bA}

*Mean±S.E. with different superscripts row wise (small letter) and column wise (capital letter) differ significantly ($P<0.05$).
APS – aerobically packaged snacks, MAPS – modified atmosphere packaged snacks

3.4 After-taste

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Scores of after-taste decreased significantly throughout the storage period in APS. This could be due to the microbial and enzymatic reaction or oxidation of lipid and protein, in the product, during storage.

3.5 Overall acceptability

The decline in overall acceptability scores could be reflective of changes in scores of flavour, colour, texture and other sensory attributes. Scores of 45^{th} and 60^{th} day were significantly lower for APS as compared to MAPS, this might be due to some biochemical changes in the APS. Das and Jayaraman (2003) had observed a significant decrease in colour, flavor and overall acceptability of dehydrated chicken *pulav* during ambient temperature storage.

4. CONCLUSION

Modified atmosphere packaging and aerobic packaging were compared and analysed by package the shelf stable microwaved ready-to-eat mutton based snack. Modified atmosphere packaging results better flavour, texture and crispness, after-taste, meat flavour intensity and overall acceptability than aerobic packaging. Flushing of nitrogen in Modified atmosphere packaging preserves sensory quality by lowering the oxygen content and chance of lipids oxidation. Aluminium foil-LDPE laminate shows more resistant to moisture absorption and gas transmission leads to low sensory quality changes as compare to LDPE. Modified atmosphere packaging and laminate is better than aerobic packaging and LDPE respectively to package the shelf stable microwaved ready-to-eat mutton based snack.

5. REFERENCES

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Aguirrezábal MM, Mateo J, Domínguez MC and Zumalacárregui JM (2000). The effect of paprika, garlic and salt on rancidity in dry sausages. *Meat Science*, 54: 77-81.

Bhatt ZF and Pathak V (2009). Effect of mung bean (*Vigna radiate*) on quality characteristics of oven roasted chicken seekh kababs. *Fleischwirtschaft International*, 6: 58-60.

Bosse A and Boland M (2008). Dried beef industry profile. Available at http://www.agmrc.org/agmrc/commodity/livestock/beef/driedbeefindustryprofile.htm.

Das H and Jayaraman S (2003). A Study on quality and stability of convenience dehydrated chicken pulav. *Journal of Food Science and Technology*, 40(1): 97-101.

Duncan DB (1955) Multiple Range and Multiple F Test. *Biometrics*, 11: 1-42.

Kalra CL, Kaur S, Sharma TC, Kulkarni S C and Berry SK (1987). Studies on the preparation, packaging and storage of potato snacks from cold stored potatoes. *Indian Food Packer*, 45: 30-39.

Karthikeyan J, Kumar S, Anjaneyulu ASR and Rao KH (2000). Application of hurdle technology for the development of caprine keema and its stability at ambient temperature. *Meat Science*, 54(1): 9-15.

Katz EE and Labuza TP (1981). Effect of water activity on the sensory crispness and mechanical deformation of snack food products. *Journal of Food Science*, 46: 403-409.

Keeton JT (1983). Effect of fat and NaCl/phosphate levels on the chemical and sensory properties of pork patties. *Journal of Food Science*, 48: 878-881.

ISSN 2278-7763

Kumar RR and Sharma BD (2005). Evaluation of the efficacy of pressed rice flour as extender in chicken patties. *Indian Journal of Poultry Science,* 40(2): 165-168.

Kumar RR and Sharma BD (2006). Efficacy of barley flour as extender in chicken patties from spent hen meat. *Journal of Applied Animal Research*, 30: 53-55.

Llyod MA, Hess, SJ and Drake MA (2009). Effect of nitrogen flushing and storage temperature on flavor and shelf-life of whole milk powder. *Journal of Dairy Science,* 92(6): 2409-2422.

Mckee LH, Ray EE, Remmenga M and Christopher J (1995). Quality evaluation of chile flavoured, jerky type extruded products from meat and potato flavour. *Journal of Food Science,* 60: 587-591.

McMillin KW, Huang NY, Ho CP and Smith BS (1999). Quality and shelf-life of meat in case-ready modified atmosphere packaging. In: Quality in muscle foods, Y. L. Xiong, F. Shahidi, & C. T. Ho (Ed.), New York: ACS Symposium Series, Plenum Publishing Corporation. pp. 73-93.

Padda GS, Sharma N and Bisht GS (1989). Effect of some vegetative extenders on organoleptic and physico-chemical properties of goat meat balls. *Indian Journal of Meat Science and Technology*, 2: 116-122.

Piazza L, Gigli J and Ballabio D (2007). On the application of chemometrics for the study of acoustic-mechanical properties of crispy bakery products. *Chemometrics and Intelligent Laboratory System*, 86(1): 52-59.

Pszczola D (2002). Snack food: ingredient concept to munch on. *Food technology*, 56(4): 82-96.

ISSN 2278-7763

Sharma BD and Nanda PK (2002). Studies on the development and storage stability of chicken chips. *Indian Journal of Poultry Science,* 37: 155-158.

Singh VP, Sanyal MK and Dubey PC (2002). Quality of chicken snack containing broiler spent hen meat, rice flour and sodium caseinate. *Journal of Food Science Technol*ogy, 39: 442-444.

Snedecor GW and Cochran WG (1995). Statistical methods, 8th Ed. IOWA State University Press, Ames, IOWA.

SSTI (2011) International Exhibition on Sweet & Snack Processing & Packaging Technology, Equipment & Supplies December 6-8, 2011. Hall No.6, Bombay Exhibition Centre, Goregaon(E), Mumbai, India. www.sweetandsnacktecindia.com.

Zyl HV and Zayas JF (1996). Effect of three levels of sorghum flour on the quality characteristics of frankfurters. IFT Annual Meeting: Book of abstracts, ISSN 1082-1236, pp. 64.

