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Full Length Research Paper

Chicken snacks as affected by storage conditions under aerobic and vacuum packaging at 30±2ºC

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Chicken snacks prepared by utilizing spent hen meat and other necessary ingredients were packaged aerobically as well as under vacuum in laminated (polyethylene/aluminium foil) pouches (size 25 × 20 cm). They were stored at 30±2°C and analysed for physico-chemical, microbiological and sensory characteristics at a regular interval of 0, 6, 12, 18, 24 and 30 days. Chicken snacks indicated none significant effect of storage and packaging systems on contents of moisture, fat, protein, ash, texture, crispness and meat flavour intensity. However, significant (P<0.05) difference was observed in thiobarbituric acid (TBA) value, shear force value, pH, total plate count (TPC), enterobacteriacae (EC) yeast and mould counts (YMC). Overall storage in vacuum packaging revealed better quality with respect to its physico-chemical, microbiological and sensory qualities. On the basis of present study, we can say that chicken snacks can be very well preserved at ambient (30±2°C) temperature for a month under aerobically as well as under vacuum packaging.

Key words: Chicken snacks, vacuum packaging, aerobic packaging, qualities.

INTRODUCTION

The market of snack food industry including semi-processed/cooked and ready to eat foods was around Rs 82.9 billion in 2004 to 2005 and is rising rapidly with a growth rate of 20%. With the changing life styles and the busy schedules of working peoples, high mobility groups, change in eating habits of children, the demand for semi-processed cooked/ready to eat food has increased tremendously. According to the report of Euromonitor International, a market research company, the amount of money Indians spend on meals outside the home is more than doubled in the past decade, to about US$ 5 billion a year and is expected to double again in coming few years.

The industry is estimated to grow at 9 to 12%, on the basis of an estimated GDP growth rate of 6 to 8%, during the tenth five-year plan period in India. Value addition of food products is expected to increase from the current 8 to 35% by the end of 2025.

The snacks available in the markets are mainly of cereals based which are high in carbohydrates and low in protein contents. So, to impart nutritive value to these snacks particularly protein, addition of meat is a revolutionary step. Feeding of such snacks may provide a balanced food in terms of nutritive value and much liked by the children as well because they are crispy, tasty and provides variety of options to satisfied satiety centre.

The spent hens are the poultry birds which can surpass their productive life in primary field and are not preferred by the most of the consumers for direct consumption. So the problem of poor utilization can be resolved by development of convenience meat products (Kondaiah, 1990; Choudhury et al., 1992). For these product developments, various extenders like rice starch and milk proteins (Chung et al., 1989; Tarte et al., 1989). Non-meat proteins from a variety of plant sources can be utilized in different meat products in various ways (Gujral et al., 2002; Dzudie et al., 2002; Bhat and Pathak, 2009; Serdarouglu and Degirmencioglu, 2004).

In present study, meat from spent hens was

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incorporated in the rice flour and other necessary ingredients were also added to provide the better quality and stability. Their storage characteristics were studied to know the changes occurred in the storage time of 30 days at 30±2°C under aerobic and vacuum packaging.

MATERIALS AND METHODS

Broiler spent hen's meat

Fifty weeks old broiler spent hens were procured from Central Avian Research Institute, Izatnagar. The birds were slaughtered and dressed in the abattoir of Institute by humane method of slaughter. The body fat was removed and deboning of dressed chicken was done manually removing all tendons and separable connective tissues. The lean meat was packed in low density polyethylene bags and frozen at -20°C until use.

Condiments and rice flour

Onion, garlic and ginger in the ratio of 3:1:1 were ground in a mixture to the consistency of fine paste. Rice flour used in the study was procured from the standard flour mill of Izatnagar, Bareilly.

Spice mixture

The spice mix formula shown in Table 2 was formulated on the basis of the trials conducted among the scientists and students of the Livestock Products Technology division of the Institute. The ingredients used in this formulation were purchased from local market. After removal of extraneous matter, all spices were dried in an oven at 80°C for 3 h and then ground in grinder to powder. The course particles were removed using a sieve of 100 mesh and fine powdered spices were mixed in required proportion to obtain spice mixture for chicken and control snacks preparation. The spice mix was stored in plastic airtight container for subsequent use.

Sodium caseinate, common salt, baking powder and phosphate

Sodium caseinate was procured from Central Drug House (P) ltd., Mumbai, India. Common salt of the brand Tata and baking powder of the brand Rex were purchased from local market. Sodium phosphate of food grade was procured from the local market.

Packaging materials

Two layered laminated pouches (aluminium foil/polyethylene) of food grade quality (size 25 × 20 cm) were procured from Sadar Bazaar, Delhi for packaging of chicken snack as well as control snack.

Chicken snacks preparation

Fifty weeks old spent hens were procured from Central Avian Research Institute, Izatnagar, India and sacrificed in the abattoir. Chicken snacks were prepared as per the formulation given in Table 1. Dressed and deboned meat was cut into small cubes and minced twice through the mincer (Electrolux, Sweden). Minced chicken meat was blended with ice water (5% of calculated amount of water), common salt and sodium hexametaphosphate and chopped in a bowl chopper (Seydelmann, Germany) for 1 min.

Table 1. Formulations for chicken snacks preparations.

Ingredients	Percent (%)
Broiler spent hen meat	50.0
Rice flour	41.0
Sodium caseinate	2.5
Common salt	2.0
Condiments	2.5
Spice mix	1.5
Baking powder	0.5

Phosphate: 0.3% of meat used (on weight basis). Ice water: 100% of flour used (on weight basis).

Table 2. Composition of spice mixture.

Ingredients	Percent (%)
Coriander powder	15.0
Cumin seeds	15 .0
Red chilli powder	20.0
Black pepper	15.0
Cloves	5.0
Cardamom	5.0
Turmeric	10.0
Cinnamon	5.0
Aniseed	10.0

Condiment mixture was prepared by grinding small pieces of peeled and washed onion, ginger and garlic in ratio of 3:1:1 (by weight) with small quantity of chilled water in a grinder. Condiment mixture was added to the emulsion and chopped again for 30 s and added with sodium caseinate (Central drug house (p) Ltd., Mumbai) and rechopped for 1 min. Spice mix powder prepared by grinding dried (80°C for 3 h) ingredients (coriander powder 15%, cumin seeds 15%, red chili powder 20%, black pepper 15%, cloves 5%, cardamom 5%, turmeric 10%, cinnamon 5% and aniseed 10%, by weight) to a fine powder, rice flour and rest (95%) of the water were added to the mixture and chopped again for 1 min. The emulsion was extruded through a manually operated stainless steel extruder into the shape of chips (size 20 × 2.5 × 0.3 cm) which were later cooked in a microwave oven (T 37, Kelvinator, India) for about 8 to 10 min to prepare chicken snacks.

Procedures for physico-chemical assessment

The physico-chemical characteristics such as moisture, fat, protein and ash content of chicken snacks were analysed as per the method described in AOAC (1995). Objective texture measurement was done by the procedure of Smith et al. (1991) with suitable modifications. Chicken snacks in the form of strip (20 × 2.5 cm) were taken for measuring shear force value using Warner-Bratzler shear press. Each strip of the product was placed in the shear press and shear force required to break the snack was recorded. Three readings of shear force were taken from each strip of snack and average shear force in kg/cm^2 was calculated on the basis of 15 readings for each sample.

The storage stability of chicken snacks packaged aerobically as well as under vacuum in low density polyethylene (LDPE) was evaluated at ambient temperature up to 30 days at regular intervals

of 0, 6, 12, 18, 24 and 30 days for physico-chemical, microbiological and sensory characteristics. The pH was determined by the method of Strange et al. (1977), whereas TBA value was estimated as per the procedure of Witte et al. (1970).

Microbiological profile evaluation

Total plate count (TPC), enterobacteriaceae count (EC), yeast and mould count (YMC) in chicken snacks were determined by the method as described by APHA (1984).

Sensory evaluation procedure

Sensory evaluation was done by member of experienced laboratory panel using 8 point hedonic scale (where 1 indicates most disliked and 8 indicate most liked).

Statistical analyses

Data were analysed statistically by one-way analysis of varience using SPSS software package as per the procedure of Snedecor and Cochran (1994) and the significant differences ($P<0.05$) in the means were separated by Tukey Multiple Comparison Test.

RESULTS

Physico-chemical characteristics

The physico-chemical characteristics of chicken snacks packaged aerobically as well as under vacuum in laminated pouches and stored at 30±2°C (Table 2) for storage period of 30 days is given in Table 3. They showed none significant differences ($P>0.05$) in the contents of moisture, fat, protein and ash in both of the packaging systems. The contents of shear force value (kg/cm^2) and pH were found in increasing order with advancement of the days of storage. TBA value of chicken snacks initially decreased up to 18 days in vacuum packaging and upto 24^{th} day in aerobic packaging and thereafter increased. Among both treatments TBA (mg malonaldehyde/kg) values of vacuum packaged chicken snacks were none significantly different in entire storage period while aerobically packaged products of 0, 6^{th} and 30^{th} day was significantly ($P<0.05$) different from the product of 12^{th}, 18^{th} and 24^{th} day. The values of shear force on day 0 and 6^{th} were significantly ($P<0.05$) lower from rest of the storage values, while pH value of day 0 was also significantly ($P<0.05$) lower from the products from rest of storage periods.

Microbiological profile

TPC, EC and YMC at different intervals during storage of aerobically and vacuum packaged chicken snacks are presented in Table 4. The TPC (cfu/g) of the products, irrespective of its packaging type indicated an increasing trend during storage after 6^{th} day of storage and increased significantly ($P<0.05$) after every 6 days till 30^{th} day of storage. EC (cfu/g) of the products in both the packaging system was not detected till 18^{th} day, after that it indicated an increasing trend. EC in the products during storage differed significantly ($P<0.05$) to each other from 24^{th} to 30^{th} day. YMC (cfu/g) in chicken snacks was also not detected till 18^{th} day; after that an increasing trend in YMC was noticed during the entire period of storage. Like EC, YMC of the product in both packaging systems increased significantly ($P<0.05$) after 24^{th} day. Higher count for TPC, EC and YMC were noticed in aerobically packaged products as compared to vacuum packaged products.

Sensory profile

The sensory attributes of chicken snacks packaged aerobically as well as under vacuum at different intervals during storage are given in Table 5. In general, all the sensory attributes that is, colour and appearance, flavour, texture, crispness, aftertaste, meat flavour intensity and overall acceptability indicated decreasing trend during entire storage period at ambient temperature. Overall sensory attributes of vacuum packaged products were higher than aerobically packaged products. The score for colour and appearance of the product did not change significantly upto 24^{th} days but score for colour and appearance obtained by the product on 30^{th} day were significantly ($p<0.05$) different from rest of the storage period in aerobically packaged products. However, none significant difference was observed in colour and appearance in vacuum packaged products during whole storage period.

The flavour score of the products did not change significantly upto 24^{th} day in vacuum packaging but changed significantly ($P<0.05$) on 30^{th} day from rest of the storage days. However, in aerobic packaging, score for flavour on days 0 and 6^{th} were significantly ($P<0.05$) different from rest storage period. Scores for texture crispness and meat flavour intensity in both of the packaging systems did not differ significantly in whole of the storage period. Irrespective of the packaging systems total scores of aftertaste and overall acceptability on day 0 were significantly ($P<0.05$) different from day 30^{th} during storage at ambient temperature while these scores on day 6^{th}, 12^{th}, 18^{th} and 24^{th} were found none significantly different.

DISCUSSION

Physico-chemical characteristics

Chicken snack are convenient food items which can satisfy the consumers demand and can provide the nutrition. So the qualities of products are very important

Table 3. Physico-chemical properties of chicken snacks as affected by the packaging under aerobic and vacuum packaging during storage at 30 ± 2°C (Mean* ± SE).

Particulars	Days of storage					
	0	6	12	18	24	30
			Moisture (%)			
APCS	8.80±0.08	8.73±0.12	8.70±0.13	8.65±0.18	8.64±0.21	8.59±0.25
VPCS	8.80±0.08	8.74±0.12	8.73±0.17	8.70±0.17	8.68±0.16	8.61±0.14
			Fat (%)			
APCS	3.54±0.14	3.50±0.12	3.50±0.18	3.50±0.07	3.48±0.18	3.47±0.06
VPCS	3.54±0.65	3.50±0.12	3.48±0.30	3.44±0.36	3.41±0.05	3.39±0.08
			Protein (%)			
APCS	22.01±0.65	22.0±0.72	22.0±0.35	21.9±0.36	21.9±0.09	21.8±0.05
VPCS	22.01±1.13	22.1±0.20	22.0±0.52	22.0±0.62	21.9±0.09	21.9±0.14
			Ash (%)			
APCS	2.60±0.10	2.57±0.13	2.55±0.13	2.52±0.12	2.5±0.15	2.46±0.13
VPCS	2.60±0.10	2.58±0.13	2.54±0.14	2.51±0.06	2.48±0.06	2.47±0.13
			Thiobarbituric acid value (mg malonaldehyde/kg)			
APCS	0.89^{ab}±0.01	0.81^{bcd}±0.02	078^{cd}±0.02	0.73^{d}±0.02	0.80^{bcd}±0.03	0.91^{a}±0.02
VPCS	0.89^{ab}±0.01	0.87^{abc}±0.02	0.84^{abc}±0.02	0.87^{abc}±0.03	0.89^{ab}±0.02	0.91^{a}±0.01
			Shear force value (Kg/cm^2)			
APCS	4.61^{b}±0.10	4.45^{b}±0.08	5.50^{a}±0.13	5.55^{a}± 0.13	5.60^{a}±0.05	5.64^{a}±0.15
VPCS	4.61^{b}±0.18	4.43^{b}±0.05	5.46^{a}±0.09	5.52^{a}±0.14	5.58^{a}± 0.16	5.61^{a}±0.17
			pH			
APCS	5.50^{b}±0.12	6.03^{ab}±0.22	6.28^{a}±0.19	6.36^{a}±0.14	6.33^{a}±0.15	6.29^{a}±0.15
VPCS	5.50^{b}±0.12	6.13^{a}±0.27	6.38^{a}±0.13	6.41^{a}±0.18	6.36^{a}±0.21	6.30^{a}±0.20

* Means with different superscript in a row differ significantly (P<0.05). APCS: Aerobically packaged chicken snacks. VPCS: Vacuum packaged chicken snacks.

aspect to be assessed before going to develop and store any food product. In the present study contents of moisture, fat, proteins and ash under the whole 30 days of storage in both of the packaging systems were found in slightly reduced quantity with respect to the progression of the days of storage. The reductions in contents were less in vacuum packaged chicken snacks as compared to the aerobically packaged chicken snacks except in fat contents. Present findings do not agree with the results of Kalra et al. (1987) which might be due to variation in packaging and storage conditions.

The contents of shear force value (kg/cm^2) and pH were found in increasing order with advancement of the days of storage. TBA value of chicken snacks initially decreased up to 18 days in vacuum packaging and upto 24th day in aerobic packaging and thereafter increased which may be due to low fat content and good storage conditions. These findings were very well agreed with the observations of Park et al. (1993) in which he found rapid decrease in TBA value in beef snacks upto 15 days at 37°C but little change thereafter. These values of TBA were also in the similar fashion as reported by Smith et al. (1991), decreased TBA value of partially defatted chopped beef snacks with increase in storage during 0, 30, 60 and 90 days at 24°C.

The physico-chemical characteristics of the present study were very well in agreed with the findings of Mills et al. (2007) and Maretzki and Mills (2003) on the extruded strips made from rabbit meat with potatoes.

Microbiological profile

In the study of microbiological profile TPC, EC and YMC counts were low and there were under the limit of snack foods. But these counts were more than the findings of Hobbs and Greene (1976). They reported very low TPC, *Escherichia coli* and yeast and mould counts in beef snack stored at 37°C for 150 days. These higher counts in the chicken snacks could be due to post manufacture contamination which might have taken place in spite of best efforts to maintain hygienic conditions.

Table 4. Microbiological profile of chicken snacks as affected by aerobic and vacuum packaging during storage at 30 ± 2°C (Mean* ± SE).

Particulars	Days of storage					
	0	6	12	18	24	30
Total plate count (cfu/g)						
APCS	NDS	$30.6x10^{1g}$±0.313	$43x10^{1fgh}$±1.55	$68x10^{1e}$±0.57	$19x10^{2c}$±1.15	$58x10^{2a}$±5.77
VPCS	NDS	$22x10^{1gh}$±0.57	$34x10^{1fg}$±1.73	$58x10^{1fg}$±1.15	$13x10^{2d}$±1.15	$42x10^{2b}$±5.77
Enterobacteriaceae count (cfu/g)						
APCS	NDS	NDS	NDS	NDS	$20x10^{1c}$±0.57	$53x10^{1a}$±1.15
VPCS	NDS	NDS	NDS	NDS	$15x10^{1d}$±0.57	$48x10^{1b}$±1.15
Yeast and Mould count (cfu/g)						
APCS	NDS	NDS	NDS	NDS	$18x10^{1b}$±2.30	$35x10^{1a}$±1.73
VPCS	NDS	NDS	NDS	NDS	$15x10^{1b}$±2.30	$30x10^{1a}$±1.15

*Means with different superscript in a row differ significantly (P<0.05). NDS- not detected significantly. APCS-aerobically packaged chicken snacks. VPCS- vacuum packaged chicken snacks.

Table 5. Sensory attributes of chicken snacks as affected by aerobic and vacuum packaging during storage at 30 ± 2°C (Mean* ± SE).

Particulars	Days of storage					
	0	6	12	18	24	30
Colour and appearance						
APCS	7.29^{a}±0.04	7.24^{ab}±0.04	7.25^{ab}±0.05	7.18^{ab}±0.04	7.12^{ab}±0.04	7.07^{b}±0.05
VPCS	7.29^{a}±0.04	7.26^{ab}±0.04	7.21^{ab}±0.04	7.20^{ab}±0.03	7.16^{ab}±0.04	7.09^{ab}±0.05
Flavour						
APCS	7.17^{a}±0.03	7.12^{ab}±0.03	7.03^{abcd}±0.02	6.95^{bcd}±0.05	6.91^{cd}±0.05	6.87^{d}±0.05
VPCS	7.17^{a}±0.03	7.15^{a}±0.03	7.09^{abc}±0.03	7.02^{abcd}±0.03	7.00^{abcd}±0.04	6.95^{bcd}±0.05
Texture						
APCS	7.34±0.05	7.28±0.06	7.21±0.06	7.16±0.06	7.15±0.06	7.12±0.06
VPCS	7.34±0.05	7.31±0.05	7.29±0.05	7.25±0.04	7.21±0.04	7.19±0.04
Crispness						
APCS	7.03^{a}±0.05	7.00^{a}±0.05	6.94^{ab}±0.05	6.85^{ab}±0.04	6.83^{ab}±0.04	6.87^{ab}±0.04
VPCS	7.03^{a}±0.05	7.00^{a}±0.04	6.96^{ab}±0.04	6.92^{ab}±0.04	6.90^{ab}±0.04	6.84^{ab}±0.04
Aftertaste						
APCS	7.13^{a}±0.03	7.06^{abc}±0.03	7.00^{abc}±0.05	6.98^{abc}±0.05	6.95^{abc}±0.05	6.89^{c}±0.05
VPCS	7.13^{a}±0.03	7.10^{ab}±0.03	7.06^{abc}±0.03	7.02^{abc}±0.03	7.00^{abc}±0.04	6.94^{bc}±0.03
Meat flavour intensity						
APCS	6.27±0.03	6.19±0.03	6.25±0.03	6.23±0.04	6.18±0.04	6.13±0.04
VPCS	6.27±0.03	6.25±0.03	6.23±0.03	6.20±0.03	6.18±0.04	6.20±0.04
Overall acceptability						
APCS	7.20^{a}±0.03	7.15^{abc}±0.03	7.11^{abc}±0.03	7.05^{abc}±0.04	7.02^{bc}±0.04	6.98^{c}±0.03
VPCS	7.20^{a}±0.03	7.17^{ab}±0.03	7.15^{abc}±0.03	7.10^{abc}±0.04	7.09^{abc}±0.04	7.03^{abc}±0.03

Sensory profile

According to McKee et al. (1995), crispness in snack foods is one of the critical factors which are affected during storage under moist conditions. The crispness of the chicken snacks was reported very well that might be

due to increase in emulsion stability with increase of extension level. It is attributed to gelatinizing property of increasing starch component on heating, which stabilized the emulsion (Comer, 1979; Bond et al., 2001; Kumar and Sharma, 2006; Bhatt and Pathak, 2009). Smith et al. (1991) did not notice any difference in mouth feel, taste and texture of beef snack during storage at room temperature (24ºC) for about 30 days. Kalra et al. (1987) reported slight decrease in the score for colour and texture of laboratory prepared as well as traditionally prepared potato snacks packaged in LDPE bags of 100 and 150 gauge thicknesses as well as in the friction top tins during their storage at room temperature upto 6 months. In present study, sensory attributes of both of the aerobically and vacuum packaged chickens snacks did not decrease much during storage period of 30 days at 30±2°C. All these scores were very well in acceptable and demanding limits during whole of the storage period and confirm the similar findings as discussed in the foregoing. Thereafter, the products were not evaluated, hence can not be commented upon regarding their shelf life. Data on sensory evaluation and microbiological quality of chicken snacks were accurate in the vicinity of snacks prepared by Macros and Simon (2007) and Furtaw (2006).

Based on results, it could be concluded that chicken snacks packaged aerobically and under vacuum remained in good condition for 30 days at 30±2°C. During the storage period of 30 days, the values/scores for physico-chemical constituents as well as sensory attributes of the products indicated little change from those of the fresh product. However, microbiological quality of the product indicated significant ($P<0.05$) increase in counts during storage of 30 days nevertheless these counts were very well within acceptable limit during the entire period of storage. The comparative study of the packaging systems for chicken snacks did not showed any significant difference in all the physico-chemical, microbiological and sensory scores. However, values/scores of the chicken snacks stored under vacuum were found better than the products packaged aerobically.

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