Current Research in
Poultry Science

ISSN 2152-2111

Academic
Journals Inc.

www.academicjournals.com

Current Research in Poultry Science 1 (2): 66-76, 2011
ISSN 2152-2111 / DOI: 10.3923/crps.2011.66.76

Quality Assessment of Vacuum Packaged Chicken Snacks Stored at Room Temperature

V.P. Singh, M.K. Sanyal, P.C. Dubey and S.K. Mendirtta
Division of Livestock Products Technology, Indian Veterinary Research Institute, Izatnagar-243122, India

Corresponding Author: V.P. Singh, Department of Livestock Products Technology, DUVASU, Mathura, India Tel: +91-9412190865

ABSTRACT

The aim of the study was to assess the suitability of vacuum packaging in the storage of chicken snacks developed with the incorporation of meat. In this study chicken snacks were prepared by utilizing spent hen meat, sodium caseinate and rice flour, spice mix, condiments, common salt, phosphate and baking powder. The control was prepared in a similar manner except that spent hen meat was substituted by equal quantity of rice flour. Chicken snack and control were packaged under vacuum in laminated (polyethylene/aluminium foil) pouches (size 25×20 cm), stored at 30±2°C. The changes in physico-chemical characteristics, sensory attributes and microbiological profile of vacuum packaged chicken snacks as well as control were analyzed during the storage at room temperature (30±2°C) for 30 days with the regular intervals of six days. Both chicken snacks and control indicated non-significant effect of treatment on days of storage with respect to the contents of fat, protein, ash, pH, Total Plate Count (TPC), Yeast and Mould Counts (YMC). However, shear force value in treated products were significantly ($p<0.05$) different on day 0 and 6 from rest of the storage days. The Thiobarbituric Acid Value (TBA)values for control on day 0, 6, 12 were found significantly different from rest of the storage days. Sensory attributes for both control and treated products were found little effected with the days of storage in whole of the storage period. Overall comparison of physico-chemical, microbiological and sensory profiles of control and treated products found highly significantly ($p<0.01$) different except some values of moisture, shear force and pH. The study revealed that both products can be stored under vacuum in very good condition up to 30 days at room temperature.

Key words: Chicken snack, spent hen meat, rice flour, sodium caseinate, vacuum

INTRODUCTION

Fast food is one of the world's largest growing food. India's fast food industry was grown by 40% and generated a billion dollars in sales by 2005 (MFPI, 2005). In last 6 years, foreign investment in this sector stood at Rs. 3600 million which is about one-fourth of total investment made in this sector. Because of the availability of raw material for fast food, global chains are flooding into the country (Euromonitor International, 2010). Among the fast foods, snacks are convenient fast food and their consumption is increasing day by day due to rapid urbanization and sociological changes. It is a food of choice for school going children, adolescent girls and high mobility groups. The world market of snack food industry including semi-processed/cooked and ready to eat foods was around Rs 82.9 billion in 2004-05 and is rising rapidly with a growth rate of 20% (MFPI, 2005). The food

industry size has been estimated at US$ 70 billion by the Ministry of Food Processing, Government of India. The food processing industry contributed 6.3% to India's GDP in 2003 and had a share of 6% in total industrial production. During the period of 2002 to 2007 the industry was grown at the rate of 9-12% (MFPI, 2004).

As per capita incomes rise and urban families live in smaller units, the demand for processed meat products, which can be quickly cooked, has been rising. Most of the production of meat and meat products continues to be in the unorganised sector. Some branded products like Venky's and Godrej's and Real Chicken are, however, becoming popular in the domestic market. Fast food industry segment comprises bakery products, ready-to-eat snacks, chips, namkeens (salted snacks and savouries) and other processed foods/snack foods. The market size of confectioneries are estimated at US$ 484.3 million growing at the rate of 5.7% per annum. Biscuits have a market of US$ 373.4 million, growing at 7.5% per annum. Other products like bread, chocolates are also growing at a significant rate (AFTPAI, 2010).

Indian snack food market has reached a value of Rs 1530 crore. It is one of the largest snack markets in the world. Potato chips are by far the largest product category within snacks, with 85% of the total market share. Snack nuts and savory snacks also add to the market. At present, popcorn has yet to break into the Indian market. There is a demand for Indian snack food (Ready-To-eat) in overseas markets. The exports market is estimated at US$ 33.4 million and is growing at around 20% annually (Diamond and Oppenheim, 2004). The Bakery and Cereals market in Asia-Pacific will be worth $68.5 bn, with an expected CAGR of 6.4% between 2008 and 2013 according to Datamonitor's new Market Databook titled "Bakery and Cereals in Asia Pacific to 2013", (Datamonitor 2010). According to the report of Euromonitor International, a market research company, the amount of money Indians spend on meals outside the home has more than doubled in the past decade, to about US$ 5 billion a year and is expected to double again in coming few years (Euromonitor International, 2010).

The most the snacks available in the market are mainly based of cereals which are high in calorie and low in protein contents. So the incorporation of meat in these snacks is a good alteration in its nutritional value particularly high value animal protein. By incorporation of spent hen meat we can enhance nutritive value, palatability and can help in utilizing this poultry industry by-product. The spent hens are old and culled chickens, which have completed their productive and reproductive phase of life (Fletcher, 2002). The meat of such birds is tougher, less juicy due to high collagen contents (Lee *et al*., 2003) and high degree of cross linkages (Nowsad *et al*., 2000; Lee *et al*., 2003; Li, 2006) as compared to broiler meat. These shortcomings of using spent hens meat in different products can be overcome with suitable food additives or extenders like flours, starch and milk proteins (Devadason *et al*., 2010). 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; Serdaroglu and Degirmencioglu, 2004; Kamaljit *et al*., 2010).

The packaging of poultry meat and meat based products has always been challenging because of their perishable nature due to high sensitivity to spoilage and pathogenic organisms (Yavas and Bilgin, 2010; Fontes *et al*., 2011). Super markets and consumers ask for long shelf life as well as good quality throughout the entire shelf life period (Balev *et al*., 2011) and the predominant reason for meat shelf life is microbial spoilage activity (Koch *et al*., 2009).Very few workers have attempted the still inconclusive study of chicken snacks from spent hens particularly from broiler spent hens meat. Thus the study was conducted and chicken snacks prepared were envisaged to evaluate the effect of vacuum packaging to know the suitability of its storage at ambient temperature.

MATERIALS AND METHODS

The study was primarily conducted at Indian Veterinary Research Institute, Izatnagar, Bareilly in the year 1999 but its realistic data and trials were finalized in the year 2008 at Pt. Deen Dayal Upadhyay Veterinary University and Go Anusandhan Sansthan, Mathura, U.P.

Sources of chicken 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.

Preparation of chicken and control snacks: For the preparation of chicken snack and control standardized formulation (Table 1) on the basis of several trials was used. Dressed and deboned meat was cut into small cubes and minced twice through the mincer (Electrolux, Sweden) after microwave thawing of the stored chicken meat. 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. Condiment mixture was added to the emulsion and chopped again for 30 sec followed by mixing of sodium caseinate and rechopped for 1 min. Spice mix powder, rice flour and rest 95% of the water were added to the mixture and chopped again for 1 min. Thus the emulsion was prepared for chicken snacks. 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 cooked in a microwave oven (Kelvinator, India) for about 8-10 min to prepare crisp snacks. Control snacks were prepared following the procedure mentioned earlier except that no spent hen meat was used in its preparation.

Table 1: Formulations for chicken snacks preparations

Ingredients (w/w)	Chicken snack	Control snack
Broiler spent hen meat	50.0	0.0
Rice flour	41.0	91.0
Sodium caseinate	2.5	2.5
Common salt	2.0	2.0
Condiments	2.5	2.5
Spice mix	1.5	1.5
Baking powder	0.5	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

Analytical techniques for physico-chemical characteristics: Moisture, fat, protein and ash of treated as well as control samples were analyzed as per the method described by AOAC (1995). The pH was determined following the method of Strange *et al.* (1977), whereas, Thiobarbituric Acid (TBA) value by the procedure of Witte *et al.* (1970). The procedure of Smith *et al.* (1991) was followed with suitable modifications for determining the shear force value of chicken and control snacks using Bratzler shear press.

Sensory evaluation: Chicken snacks as well as control snacks were subjected to sensory evaluation by a panel of seven judges comprising of scientists of the institute by using 8-point Hedonic scale (Keeton, 1983).

Micro-biological quality assessment: The Total Plate Count (TPC), Enterobacteriaceae Count (EC), Yeast and Mould Count (YMC) in chicken snack as well as control were determined following the methods of APHA (1984). The experiment was repeated three times for each and every parameter.

Statistical analysis: Data collected in study were analyzed statistically following the procedure of Snedecor and Cochran (1980) in the computer center of the Institute. Means and standards errors were calculated for different parameters. The data were subjected to analysis of variance and paired comparison test. In significant effects, least significant differences were calculated at appropriate level of significance.

RESULTS

Physico-chemical characteristics of chicken and control snacks: The values for physico-chemical characteristics are presented in Table 3. These values for chicken snacks and control

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

	Days of storage					
Particulars	0	6	12	18	24	30
Moisture (%)						
Control	8.27±0.28	8.20±0.29	8.18±0.12	8.16±0.16	8.13±0.07	8.10±0.13
Treated	8.80±0.14	8.73±0.21	8.70±0.29	8.68±0.30	8.64±0.27	8.61±0.24
Fat (%)						
Control	0.65±0.08	0.63±0.06	0.62±0.07	0.60±0.13	0.56±0.04	0.52±0.09
Treated	3.54±0.25	3.50±0.25	3.48±0.11	3.44±0.12	3.41±0.26	3.39±0.09
Protein (%)						
Control	9.08±0.71	9.03±0.12	8.98±0.36	8.92±0.09	8.87±0.07	8.82±0.17
Treated	22.10±1.13	22.05±0.20	22.01±0.52	21.96±0.62	21.89±0.09	21.86±0.14
Ash (%)						
Control	1.50±0.14	1.48±0.26	1.45±0.26	1.42±0.08	1.41±0.22	1.39±0.10
Treated	2.60±0.18	2.58±0.23	2.54±0.25	2.51±0.10	2.48±0.11	2.47±0.22
Thiobarbituric acid value (mg malonaldehyde kg^{-1})						
Control	$0.25±0.03^{abc}$	$0.23±0.02^{bcd}$	$0.24±0.01^{cd}$	0.21±0.02	0.26±0.01	0.27±0.02
Treated	$0.89±0.02^{ab}$	$0.87±0.03^{abc}$	$0.84±0.03^{abc}$	$0.87±0.04^{abc}$	$0.89±0.02^{ab}$	$0.90±0.02^{a}$
Shear force value (kg cm^{-2})						
Control	5.30±0.21	5.38±0.08	5.40±0.20	5.43± 0.16	5.48±0.08	5.51±0.06
Treated	$4.40±0.31^{b}$	$4.43±0.09^{b}$	5.46^{a} ±0.15	$5.52 ±0.24^{a}$	$5.58± 0.28^{a}$	$5.61±0.29^{a}$
pH						
Control	6.22±0.14	6.47±0.22	6.57±0.19	6.59±0.14	6.40±0.15	6.35±0.15
Treated	5.50 ±0.20	6.13±0.27	6.38±0.13	6.53±0.18	6.36±0.21	6.30±0.20

*Means with different superscript in a row differ significantly ($p<0.05$)

under storage period of 30 days showed none significant differences ($p>0.05$) in the contents of moisture, fat, protein, ash and pH in both of the treatments. During entire storage time the values for moisture, fat, protein, ash and pH were in the range of 8.10± 0.13 to 8.27±0.28, 0.52±0.09 to 0.65±0.08, 8.82±0.17 to 9.08±0.71, 1.39±0.10 to 1.50±0.14 and 6.22±0.14 to 6.59±0.14 in control snacks while these values in chickens snacks ranges 8.61± 0.24 to 8.80±0.14, 3.39±0.09 to 3.54±0.25, 21.86±0.14 to 22.10±1.13, 2.47±0.22 to 2.60±0.18 and 6.13±0.27 to 6.53±0.18, respectively. Similarly, the values for TBA (mg malonaldehyde kg^{-1}) and Shear force (kg cm^{-2}) in control were varied from 0.21±0.02 to 0.27±0.02 and 5.30±0.21 to 5.51±0.06 but these values in chicken snacks were in between 0.84±0.03 to $0.90±0.02^{a}$ and 4.40 ±0.31 to 5.61±0.29, respectively. The contents of shear force value (kg cm^{-2}) and pH were found in increasing order with advancement of the days of storage while moisture, fat, protein and ash showed decreasing trend in whole of the storage period of 30 days. TBA value of chicken snacks initially decreased up to 12th days in and up to 18th day in control snacks and thereafter increased. TBA (mg malonaldehyde kg^{-1}) values of chicken snacks were none significantly different in entire storage period while control snacks of 0, 6th and 12th day was significantly ($p<0.05$) different from the product of 18th, 24th and 30th day. The values of shear force on day 0 and 6th were significantly ($p<0.05$) different from rest of the storage values in chicken snacks while non significant difference was observed on control snacks during whole of the storage period. On comparative assessment of chicken snacks and control snacks, we found highly significant difference ($p<0.01$) in the contents of fat, proteins, ash and TBA value during whole of the storage period and in moisture contents and shear force value on day 6th and in pH on day 0 and 6th both.

However, significant difference ($p<0.05$) in the contents of moisture was observed in rest of the storage time and shear force value on day 0, in pH on day 12th among the treated and control snacks. There were non-significant differences also observed in shear force value in between the days of 12th to 30th, in pH on last three studied days (Table 3).

Microbiological profile: Microbiological profile of chicken snacks as well as control is given in Table 4. The TPC in both of the products were negligible on day 0 however in rest of the storage period they were ranges from $14.7\times10^{1}\pm0.09^{a}$ to $31\times10^{2}\pm 2.08^{e}$ in control and from $22\times10^{1}\pm1.15^{a}$ to $42\times10^{2}\pm1.53$ in chicken snacks, respectively. The counts for Enterobacteriaceae and yeast and mould were also not detected significantly upto day 18th but in rest of the storage period they were ranges from $10.9\times10^{1}\pm0.15$ to $32.4\times10^{1}\pm0.87$ and $12.7\times10^{1}\pm3.60$ to $25.3\times10^{1}\pm17.57$ in control and $14.6\times10^{1}\pm1.03$ to $47.5\times10\pm1.61$ and $15.0\times10\pm1¼.42$ to $29.7\times10\pm22.¾1$ in chicken snacks, respectively. In general, TPC, EC and YMC profiles of chicken snacks and control snacks at different intervals during storage were in increasing trend. The TPC (cfu g^{-1}) of the products, irrespective of its product type indicated an increasing trend during storage after 6th day of storage and increased significantly ($p<0.05$) after every 6 days till 30th day of storage. EC (cfu g^{-1}) of the products in both the treatments was not detected significantly till 18th day, after that it indicated an increasing trend. EC in the products during storage differed significantly ($p<0.05$) to each other from 24th to 30th day. YMC (cfu g^{-1}) in chicken snacks was also not significantly detected till 18th day; after that it showed increasing trend during the entire period of storage. Like EC, YMC of both the products increased significantly ($p<0.05$) after 24th day. Higher count for TPC, EC and YMC were noticed in chicken snacks as compared to control snacks which might be due to presence of meat and higher moisture content. Comparative study of chicken and control snacks revealed significant differences during whole of the period in whole of the microbiological profile (Table 4).

Sensory attributes: The scores for different sensory attributes obtained in study are presented in Table 5. Colour and appearance, flavour, texture, crispness, aftertaste and overall acceptability ranged from 6.30±0.08 to 6.47±0.07, 6.15±0.07 to 6.23±0.06, 5.87±0.05 to 6.03±0.05, 5.88±0.06 to 6.00±0.06, 6.22±0.06 to 6.33±0.07 and 6.00±0.06 to 6.13±0.07 in control, respectively. However, same scores in chicken snacks were in the vicinity of 7.09±0.06 to 7.29±0.07, 6.95±0.07 to 7.17±0.06, 7.19±0.07 to 7.34±0.08, 6.84±0.07 to 7.03±0.08, 6.94±0.05 to 7.13±0.05 and 7.03±0.06 to 7.06±0.15, respectively. Though, meat was not added in control so meat flavour intensity score was found only in chicken snacks which was in the range of 6.18±0.06 to 6.27±0.06. In general, all the sensory attributes i.e., colour and appearance, flavour, texture, crispness, aftertaste, meat flavour intensity and overall acceptability indicated decreasing trend during entire storage period at ambient temperature in both chicken and control snacks. However, this statement is reverse on day 12th and 30th for flavour score of control snack, day 30th for flavour and meat flavour intensity of chicken snacks and on 0 day of chicken snack for overall acceptability. The scores for colour and appearance of the product did not change significantly during whole of the storage period for both treatments. This statement is also true for flavour scores of control snacks but flavour scores of chicken snack on day 0 and 6th were significantly ($p<0.05$) different from other scores during storage. Texture scores of both products were non- significantly different during whole storage except the scores of day 6th as compared to 0 and 30th scores for control. The scores for crispness on day 6th for control were significantly ($p<0.05$) different from the scores of control on day 24th and 30th while rest scores for crispness in all days were non-significantly different. The scores for aftertaste, meat flavour intensity and overall acceptability were none significantly

Table 4: Microbiological profile of chicken snacks packaged under vacuum in laminated pouches during storage at 30±2°C (Mean±SE)*

	Days of storage					
Particulars	0	6	12	18	24	30
Total plate count (cfu g^{-1})						
Control	NDS	$14.7\times10^{1}\pm0.09^{a}$	$28\times10^{1}\pm1.53^{b}$	$60\times10^{1}\pm1.73^{c}$	$9.8\times10^{2}\pm0.14^{d}$	$31\times10^{2}\pm 2.08^{e}$
Treated	NDS	$22\times10^{1}\pm1.15^{a}$	$34\times10^{1}\pm3.18^{b}$	$58\times10^{1}\pm2.08^{c}$	$13\times10^{2}\pm1.73^{d}$	$42\times10^{2}\pm1.53^{e}$
Enterobacteriaceae count (cfu g^{-1})						
Control	NDS	NDS	NDS	NDS	$10.9\times10^{1}\pm0.15^{a}$	$32.4\times10^{1}\pm0.87^{b}$
Treated	NDS	NDS	NDS	NDS	$14.6\times10^{1}\pm1.03^{a}$	$47.5\times310^{1}\pm1.61^{b}$
Yeast and mould count (cfu g^{-1})						
Control	NDS	NDS	NDS	NDS	$12.7\times10^{1}\pm3.60^{a}$	$25.3\times10^{1}\pm17.57^{b}$
Treated	NDS	NDS	NDS	NDS	$15.0\times10^{1}\pm14.42^{a}$	$29.7\times10^{1}\pm22.11^{b}$

*Means with different superscript row-wise differ significantly ($p<0.05$). NDS: Not detected significantly

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

	Days of storage					
Particulars	0	6	12	18	24	30
Colour and appearance						
Control	6.47±0.07	6.45±0.07	6.42±0.07	6.34±0.08	6.30±0.08	6.30±0.08
Treated	7.29 ± 0.07^{a}	7.26 ± 0.07^{ab}	7.21 ± 0.07^{ab}	7.20 ± 0.07^{ab}	7.16 ± 0.07^{ab}	7.09 ± 0.06^{ab}
Flavour						
Control	6.20 ± 0.06^{ab}	6.15 ± 0.07^{ab}	6.21 ± 0.07^{ab}	6.16 ± 0.07^{ab}	6.10 ± 0.07^{ab}	6.23 ± 0.06^{b}
Treated	$7.17^{a}\pm0.06$	7.09 ± 0.06^{a}	7.02 ± 0.06^{abc}	7.00 ± 0.07^{abcd}	$6.95^{abcd}\pm0.07$	7.15 ± 0.06^{bcd}
Texture						
Control	6.03 ± 0.05^{bc}	6.00 ± 0.05^{a}	5.97 ± 0.05^{ab}	5.92 ± 0.05^{abc}	5.88 ± 0.05^{ab}	5.87 ± 0.05^{bcd}
Treated	7.34±0.08	7.31±0.08	7.29±0.08	7.25±0.07	7.21±0.07	7.19±0.07
Crispness						
Control	6.00 ± 0.06^{ab}	5.98 ± 0.06^{a}	5.95 ± 0.06^{ab}	5.97 ± 0.06^{ab}	5.92 ± 0.06^{b}	5.88 ± 0.06^{b}
Treated	7.03 ± 0.08^{a}	7.00 ± 0.07^{a}	6.96 ± 0.07^{ab}	6.92 ± 0.07^{ab}	6.90 ± 0.07^{ab}	6.84 ± 0.07^{ab}
Aftertaste						
Control	6.33 ± 0.07^{a}	6.31 ± 0.07^{abc}	6.28 ± 0.07^{abc}	6.30 ± 0.07^{abc}	6.28 ± 0.07^{abc}	6.22 ± 0.06^{c}
Treated	7.13 ± 0.05^{a}	7.10 ± 0.05^{ab}	7.06 ± 0.05^{abc}	7.02 ± 0.05^{abc}	7.00 ± 0.05^{abc}	6.94 ± 0.05^{bc}
Meat flavour intensity						
Treated	6.27±0.06	6.25±0.06	6.23±0.06	6.20±0.06	6.18±0.06	6.20±0.05
Overall acceptability						
Control	6.13±0.07	6.11±0.06	6.10±0.06	6.07±0.06	6.05±0.06	6.00±0.06
Treated	7.06 ± 0.15^{a}	7.17 ± 0.06^{ab}	7.15 ± 0.06^{abc}	7.10 ± 0.06^{abc}	7.09 ± 0.06^{abc}	7.03 ± 0.06^{abc}

*Means with different superscript in a row differ significantly ($p<0.05$)

different during whole of the storage except the aftertaste scores on day 0 which was significantly ($p<0.05$) different from day 30th in both of the treatment. Comparative study between control and treated snacks revealed overall highly significant difference irrespective of the days of storage with some exceptions in the scores of flavour and overall acceptability. Flavour score of day 0 and overall scores for whole storage period except 0 day were found non-significantly different. Though, meat flavour intensity scores was not observed in control snacks so the comparative study was not conducted for meat flavour intensity score (Table 5).

DISCUSSION

Physico-chemical characteristics of chicken and control snacks: A non-significant difference in contents of moisture, fat, protein and ash was noticed in the products but quantative

trend was decreasing in order during the entire period of storage. This trend was very well in the range of the findings of Kalara *et al.* (1987) but the qualitative trend for moisture in his study was in increasing order rather than in decreasing. The findings related to moisture contents were quantitatively similar as reported by Kalara *et al.* (1987) but they were qualitatively in contrast. Values for TBA were also similar to the findings of Park *et al.* (1993) for beef snacks and Huda *et al.* (2010) for beef meat balls. The trend of gradual increase in pH with the advancement of the storage time is very well agreed according to the findings of Huang *et al.* (1996), Reddy and Rao (2000), Kumar and Sharma (2006) and Bhat and Pathak (2009) for different meat products. The increasing trend of shear force value during entire storage period in both of the products might be due to gradual decline in moisture content with the advancement of the storage period.

Microbiological profile: TPC (cfu g^{-1}) was not detected significantly on day 0 as the total colony count was less than 30 so we did not considered it as significant. Thereafter, it showed increasing trend from day 6 to 30th days of storage. Enterobacteriaceae count, yeast and mould count were also not detected significantly till the day 18th of the storage and then showed increasing trend. The counts for all three parameters were greater than the values obtained by Hobbs and Greene (1976) and Singh and Pandey (2011) for beef snacks stored at 37°C for 5 months which might be due to post processing contaminations. However, the values obtained in this study were very well in the standards microbiological limits for meat products. Higher TPC, enterobacteriaceae count, yeast and mould count were noticed in treated products as compare to control during the entire storage period. It could be due to the incorporation of meat which is a good medium for the growth of micro-organisms.

Sensory attributes: In general, sensory attributes showed insignificant decreasing trend during whole of the storage period irrespective of the product type. 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 upto 6 months. Decline in colour and appearance scores during storage could be due to dilution of meat pigments. These findings are also supported by Van Zyl and Zayas (1996), Kumar and Sharma (2006) and Bhat and Pathak (2009). 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. The decline in overall acceptability scores could be reflective of changes in scores of flavour, colour, texture and other sensory attributes. Similar findings were reported by the Nag *et al.* (1998) and other workers. 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 scores for crispness were in lower range as compared to the findings of Mckee *et al.* (1995) which might be due to the differences in storage and packaging conditions.

CONCLUSION

Chicken snacks prepared by utilizing 50% broiler spent hen meat, sodium caseinate and rice starch as well as control snacks kept well for 30 days at ambient temperature (30±2°C) under vacuum in laminated pouches. During entire storage chicken as well as control snacks did not showed much change in their physico-chemical characteristics, microbiological profile and sensory attributes. Although, they all were in decreasing trend but their values were very well under the

acceptable limit. So we can say that vacuum packaging for such type of self sustained meat snacks may be the good alternative of packaging. Though, the study was only for 30 days storage so we can not definitely comment on the shelf life of the product.

REFERENCES

AFTPAI., 2010. Report of agro and food processing technology and equipment providers association of India. Published in International Foodtech, India.

AOAC, 1995. Official Methods of Analysis. 16th Edn., Association of Official Analytical Chemists, Washington, DC., USA.

APHA, 1984. Compendium of Methods for the Microbiological Examination of Foods. 2nd Edn., American Public Health Association, Washington, DC. USA.

Balev, D.K., A.S. Staykov, G.Y. Ivanov, S.G. Dragoev and E.H. Filizov, 2011. Color stability improvement of chilled beef by natural antioxidant treatment and modified atmosphere packaging. Am. J. Food Technol., 6: 117-128.

Bhat, Z.F. and V. Pathak, 2009. Effect of mung bean (*Vigna radiata*) on the quality characteristics of oven roasted chicken seekh kababs Fleischwirtschaft Int., 6: 58-60.

Datamonitor, 2010. Bakery and Cereals in Asia Pacific to 2013. Datamonitor, Market Research Reports, http://marketpublishers.com/report/consumers_goods/food_beverage/bakery_n_cereals_in_asia_pacific_to_2013.html

Devadason, I.P., A.S. Anjaneyulu and Y. Babji, 2010. Supplementation effect of different extenders in meat nuggets. J. Food Sci., 75: 777-783.

Diamond, W. and M.R. Oppenheim, 2004. Marketing Information: A Strategic Guide for Business and Finance Libraries. Haworth Press, Binghamton, ISBN: 9780789060068, pp: 342.

Dzudie, T., J. Scher and J. Hardy, 2002. Common bean flour as an extender in beef sausages. J. Food Eng., 52: 143-147.

Euromonitor International, 2010. Briefing: The Euromonitor International 2010 industry outlook from just-food. http://www.just-food.com/management-briefing/the-euromonitor-international-2010-industry-outlook-from-just-food_id110369.aspx.

Fletcher, D.L., 2002. Poultry meat quality. World's Poult. Sci. J., 58: 131-145.

Fontes, L.C.B., K.K. Ramos, T.C. Sivi and F.P.C. Queiroz, 2011. Biodegradable edible films from renewable sources-potential for their application In fried foods. Am. J. Food Technol., 6: 555-567.

Gujral, H.S., A. Kaur, N. Singh and N.S. Sodhi, 2002. Effect of liquid whole egg, fat and textured soy protein on the textural and cooking properties of raw and baked patties from goat meat. J. Food Eng., 53: 377-385.

Hobbs, W.E. and V.W. Greene, 1976. Cereal and Cereal Products. In: Compendium of Methods for the Microbiological Examination of Foods, Speck, M.L. (Edn.). American Public Health Association, Washington, DC., USA., pp: 559.

Huang, J.C., J.F. Zayas and J. Bowers, 1996. Functional Properties of Sorghum Flour as an Extender in Ground Beef Patties. Association of Official Analytical Chemists, IFT, UK., pp: 100.

Huda, N., Y.H. Shen, Y.L. Huey, R. Ahmad and A. Mardiah, 2010. Evaluation of physico-chemical properties of Malaysian commercial beef meatballs. Am. J. Food Technol., 5: 13-21.

Kalara, C.L., S. Kaur, T.C. Sharma, S.C. Kulkarni and S.K. Berry, 1987. Studies on the preparation, packaging and storage of potato snacks from cold stored potatoes. Indian Food Packer, 45: 30-39.

Kamaljit, K., S. Baljeet and K. Amarjeet, 2010. Preparation of bakery products by incorporating pea flour as a functional ingredient. Am. J. Food Technol., 5: 130-135.

Keeton, J.T., 1983. Organoleptic quality assessment methods for foods of animal origin. J. Food Sci., 48: 878-878.

Koch, A.G., H. Christensen, P.E. Sorensen and L. Meinert, 2009. Requirement to shelf life of fresh meat and meat products. Proceedings of the 55th Congress of Meat Science and Technology, Aug.16-21, Copenhagen, Denmark, pp: 1273-1276.

Kumar, R.R. and B.D. Sharma, 2005. Evaluation of the efficacy of pressed rice flour as extender in Chicken Patties. Indian J. Poult. Sci., 40: 165-168.

Kumar, R.R. and B.D. Sharma, 2006. Efficacy of barley flour as extender in chicken patties from spent hen meat. J. Applied Anim. Res., 30: 53-55.

Lee, S.O., J.S. Min, I.S. Kim and M. Lee, 2003. Physical evaluation of popped cereal snacks with spent hen meat. Meat Sci., 64: 383-390.

Li, C.T., 2006. Myofibrillar protein extracts from spent hen meat to improve whole muscle processed meats. Meat Sci., 72: 581-583.

MFPI., 2004. A report on Indian food processing industry. Annual Report of Ministry of Food Processing India.

MFPI., 2005. A report on Indian food processing industry. Annual Report of Ministry of Food Processing India.

Mckee, L.H., E.E. Ray, M. Remmenga and J. Christopher, 1995. Quality evaluation of chile-flavoured, jerky- type extruded products from meat and potato flavour. J. Food Sci., 60: 587-591.

Nag, S., B.D. Sharma and S. Kumar, 1998. Quality attributes and shelf life of chicken nuggets extended with rice flour. Indian J. Poult. Sci., 33: 182-186.

Nowsad, A.A., S. Kanoh and E. Niwa, 2000. Thermal gelation properties of spent hen mince and surimi. Poult. Sci., 79: 117-125.

Padda, G.S., N. Sharma and G.S. Bisht, 1989. Effect of some vegetative extenders on organoleptic and physico-chemical properties of goat meat balls. Indian J. Meat Sci. Technol., 2: 116-122.

Park, J., K.S. Rhee, B.K. Kim and K.C. Rhee, 1993. High protein texturized products of defatted soy flour, corn starch and beef: Shelf life, physical and sensory properties. J. Food Sci., 58: 21-27.

Reddy, P.K. and B.J. Rao, 2000. Effect of binders and precooking meat on quality of chicken loaves. J. Food Sci. Technol., 37: 551-553.

Serdaroglu, M. and O. Degirmencioglu, 2004. Effects of fat level (5%, 10%, 20%) and corn flour (0%, 2%, 4%) on some properties of Turkish type meatballs (koefte). Meat Sci., 68: 291-296.

Singh, N.J. and R.K. Pandey, 2011. Rehydration characteristics and structural changes of sweet potato cubes after dehydration. Am. J. Food Technol., 6: 709-716.

Smith, G.L., J.W. Stadler, J.T. Keeton and L.S. Papadopoulos, 1991. Evaluation of partially defatted chopped beef in fermented beef snack sausage. J. Food Sci., 56: 348-351.

Snedecor, G.W. and W.G. Cochran, 1980. Statistical Methods. 7th Edn., Iowa State University Press, Iowa, USA., ISBN-10: 0-81381560-6, pp: 507.

Strange, E.D., R.C. Benedit, J.L. Smith and C.E. Swift, 1977. Evaluation of rapid test for monitoring alterations in meat quality during storage. J. Food Protect., 40: 843-847.

Van Zyl, H. and J.F. Zayas, 1996. Effect of three levels of sorghum flour on the quality characteristics of frankfurters. IFT Annual Meeting: Book of Abstracts, pp: 64.

Witte, V.C., G.F. Krause and M.E. Bailey, 1970. A new extraction method for determining 2-thibarbituric acid values of pork and beef during storage. J. Food. Sci., 35: 582-585.

Yavas, E. and B. Bilgin, 2010. Effect of calcium lactate, sodium diacetate and sodium chloride mixture on the microbiological, chemical and sensory properties of chicken nuggets stored in refrigerated and under modified atmospheres. Int. J. Poult. Sci., 9: 66-71.