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EFFECT OF VACUUM PACKAGING ON NOVEL CHICKEN SAUSAGE INCORPORATED WITH PANEER AND OATS

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Novel chicken sausage with the incorporation of paneer and oats that had good sensory appeal and health promoting properties was developed. The quality characteristics of the novel sausages were studied under both aerobic and vacuum packaging in chiller conditions (4±1 °C) on days 0, 3, 5, 7 and 10 and compared with control sausages. The samples were analyzed for proximate principles, physical, physico-chemical, microbiological characteristics and sensory attributes. Results of the study revealed that sausages incorporated with paneer and oats showed significantly lower dimension shrinkage and cooking gain was observed when compared to control. Proximate principles like protein, fat and ash were similar in both control and treatment sausages. Dietary fibre level was ten times higher in treatment sausages than control. Vacuum packaging was found to be effective in reducing thiobarbituric acid reactive substances and tyrosine values and aerobic plate counts in both sausages. Treatment sausages had similar sensory scores as control sausages. Aerobically packed control and treatment sausages were spoiled on day 10, whereas the vacuum packed sausages maintained their quality on day 10. Vacuum packed novel chicken sausage containing paneer and oats can be considered as a novel functional meat product which can be manufactured and marketed commercially.

Keywords: Novel chicken sausage, Vacuum packaging, Dietary fibre, Proximate principles

INTRODUCTION

Meat has become an integral part of our diet not only due to its unmatched flavour, palatability and satiety value, but also because of its high protein, mineral and vitamin levels which invariably add to its unmatched importance. Among the different meats, poultry meat, especially, chicken meat is the most commonly consumed and widely accepted meat. Chicken meat production in India in 2013 was 2.328 million MT (FAOSTAT, 2013). Chicken meat is low in calories with high levels of unsaturated fatty acids and is beneficial to health, especially to children, elderly and convalescent people. It has neutral flavour, good texture and light colour and is most suitable for processing of products (Barbut, 2012; and Petraccia *et al.*, 2013). Demerits of this highly nutritious meat is the lack of dietary fibre and low levels of calcium and vitamin C. Sausage is one of the popular meat products in western countries and is now slowly becoming popular in India. It is a comminuted product in which minced/chopped meat is mixed with fat, binders, salt and seasonings and stuffed in containers called casings. It is considered as a convenient ready-to-eat or ready-to-fry meat product.

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In current scenario, due to the population demographics and consumer preference of diets which are healthy, nutritious and with novel sensory appeal, many foods have evolved which are functional or fortified. Fortified meat products or functional meat products are those meat products which are enriched with omega-3 fatty acids, dietary fibre, minerals like calcium, etc. The term 'functional foods' was coined by Japanese scientists in the 1970's and the term was introduced to the European scientific community in the 1980's (Guo, 2009). Present day consumers are seeking certain additional health benefits in the foods they consume. Dietary fibre is considered as a healthy ingredient of foods which has several health promoting functions like reducing serum cholesterol and glucose levels and regulating bowel movements (Rodrguez *et al.*, 2006). Dietary fibres are carbohydrates from edible plants like polysaccharides, oligosaccharides, and lignin which are resistant to digestion and assimilation in intestine of human beings. Incorporation of dietary fibre in meat products improve the functional property of the products adding health promoting benefits to them.

Paneer is an acid and heat coagulated milk product very popular in India. It is highly nutritious, rich in protein, fat and minerals like calcium. Paneer can be added to meat products to give a novel sensory appeal and to add variety. Packaging is a method to reduce the contamination of product and to enhance the shelf life. Vacuum packaging can extend the shelf life of food products by reducing the growth of aerobic organisms and inhibiting lipid oxidation, thereby maintaining the keeping quality for a longer time.

A study was conducted to develop a chicken sausage with a novel sensory appeal and with the functional properties of added dietary fibre by incorporation of paneer and oats to the batter. Also the effect of vacuum packaging on the quality characteristics of the sausage was studied.

MATERIALS AND METHODS

Broiler chicken of the same age group was procured from the local markets in Vythiri, Wayanad district, Kerala and were brought to the Department of Livestock Products Technology, College of Veterinary and Animal Sciences, Pookode. The birds were provided *adlibitum* water and proper rest. They were slaughtered, dressed under hygienic conditions and the carcasses were washed and chilled overnight. On the next day, chicken carcasses were deboned and meat was harvested. For the manufacture of novel chicken sausages, paneer was prepared in the department using cow milk.

Preparation of Sausage

Control and treatment (novel) chicken sausages were prepared as follows. Meat was minced in a meat mincer (Sirman, Italy) and chopped with salt, ice, refined wheat flour, refined sunflower oil, spices and condiments in a bowl chopper (Talsa-TC12E, Spain). Finely cut paneer and powdered oats were added to the treatment batter and mixed manually. The treatment and control batters were stuffed into edible sheep casings (16-18 mm diameter) using a sausage filling machine (SIRMAN – V15, Italy) then linked, tied and steam cooked separately for 10 minutes. The batches of cooked sausage samples after cooling to ambient temperature were subjected to aerobic and vacuum packaging using high density polyethylene (HDPE > 50 µ) pouches and polyethylene/polyester pouches, respectively. The pouches (CA–Control Aerobically packed, CV-Control Vacuum packed, TA-treatment aerobically packed, TV-treatment vacuum packed) were stored under chiller conditions (4±1 °C) in a refrigerator for shelf life studies on days 0, 3, 5, 7 and 10, or till spoilage, whichever is earlier. The sausages were subjected to analysis of physical, physico-chemical, microbiological and sensory characteristics.

Physical characteristics of control and treatment sausages like dimension shrinkage and cooking loss were analyzed on day of preparation.

Physico-chemical characteristics like proximate composition, pH, tyrosine value and TBARS (Thiobarbituric acid reactive substances) value were assessed on all days of storage.

Proximate principles were assessed by the method of AOAC (1990). Moisture content of sausages was measured on all days of storage by gravimetric method in a hot air oven (101±1 °C for 16 h). Crude lipid content of moisture free sample was analyzed by extracting the lipid with ether in a Soxhlet extractor for 2.5 h. Crude protein was measured by the Kjeldhal method and ash content of the sample was measured by gravimetric method. Carbohydrate content was assessed by subtracting the total values of moisture, fat, protein and ash from 100. Energy values of the samples were calculated by the procedure of FAO (2002). Sausages were analysed for dietary fibre at Care Keralam Laboratory, KINFRA, Koratty, Thrissur, Kerala.

pH of the cooked sausages was measured after homogenization with distilled water by using a digital pH meter (AOAC, 1990). Thiobarbituric acid reactive substance (TBARS) value was analysed by the procedure of Witte *et al*. (1970) and Tyrosine Value (TV) by the procedure of Pearson (1968) on all the storage days.

Microbiological parameters like aerobic plate count (Morton, 2001), psychrotrophic count (Cousin *et al.,* 2001) and yeast and mold count (Beuchat and Cousin, 2001) were assessed on all days of storage

Sensory attributes of control and treatment sausages were evaluated on all the days of storage by semi-trained panelists in the Department of Livestock Products Technology using a nine-point Hedonic scale (9 = like extremely and 1 = dislike extremely) following the procedure of Badr (2004). The sensory attributes like appearance, texture, juiciness, flavour and overall acceptability were assessed.

Data were analyzed using one-way ANOVA, Duncan's new multiple range test and repeated measures-ANOVA (Snedecor and Cochran, 1994) using the SPSS 21.0 version.

RESULTS

Dimension shrinkage and cooking loss of treatment sausages incorporated with paneer and oats were significantly (P<0.01) lower when compared to control sausages.

Among the proximate principles, moisture content of treatment sausage (55.93±0.37) was significantly lower when compared to that of control sausages (58.13±0.59). Protein and fat percentages of both control and treatment sausages were similar, 11.32±0.22 and 10.74±0.27 and 11.92±0.17 and 10.28±0.16, respectively. The ash content did not differ significantly between control and treatment sausages. Carbohydrate content was significantly (P<0.01) higher in treatment sausages (19.72±0.26) when compared to control sausages (17.84±0.32). However, energy values calculated did not vary significantly between control and treatment sausages. Treatment sausages showed a significantly higher dietary fibre content (2.0 g/100 g of sausage) which was ten times higher than that (0.2 g/100 g of sausage) of control sausages.

pH, TBARS and tyrosine values were analysed on 0, 3, 5, 7 and 10 days of storage. pH did not show any significant difference between the storage days and also between the chiller stored sausages. Changes in thiobarbituric acid reactive substances values and tyrosine values of the sausages during storage are expressed in Figures 1 and 2.

TBARS and tyrosine values showed a progressive and significant increase from day 0 to day 10 and also in between the sausages on all the storage days. However vacuum packed control and treatment sausages showed significantly (P<0.01) lower TBARS values (0.31±0.012 and 0.23±0.004) when compared to aerobically packed sausages (0.38±0.015 and 0.27±0.014). Tyrosine values were also lower for vacuum packed control and treatment sausages (2.08±0.04 and 1.89±0.02) when compared to aerobically packed sausages (2.15±0.001 and 2.03±0.04). No significant difference of TBARS and tyrosine values was observed between control and treatment sausages.

Figure 1: TBARS Values of Control and Treatment Sausages on Different Storage Days Under Chiller Condition

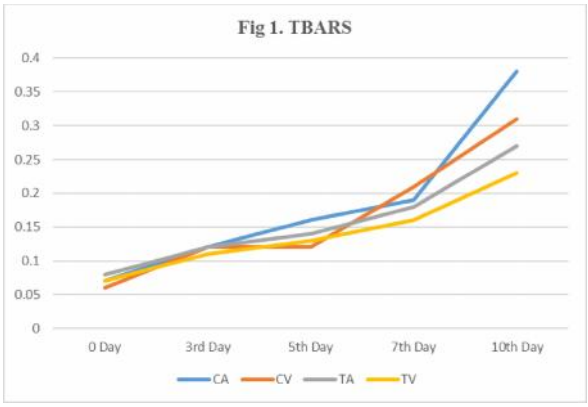

Figure 2: Tyrosine Values of Control and Treatment Sausages on Different Storage Days Under Chiller Condition

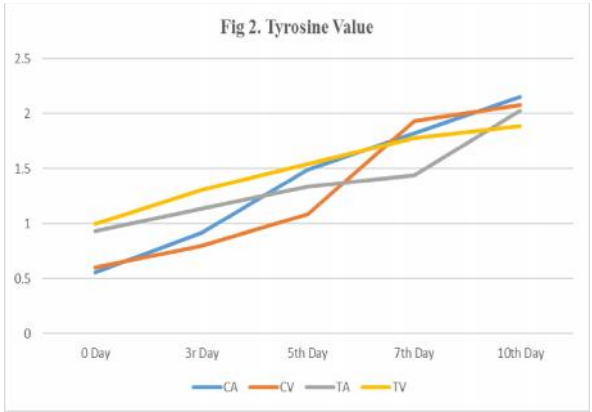

Table 1: Aerobic Plate Counts of Control and Treatment Sausages on Different Storage Days Under Chiller Condition

Sausages	0 Day$^{(NS)}$	3rd Day	5th Day	7th Day	10th Day	P=
CA	3.59 ± 0.04^{E}	3.97 ± 0.02^{bD}	4.31 ± 0.03^{bC}	4.48 ± 0.01^{bB}	4.85 ± 0.01^{aA}	0.01
CV	3.58 ± 0.04^{E}	3.83 ± 0.01^{dD}	3.95 ± 0.01^{cdC}	4.37 ± 0.02^{cB}	4.65 ± 0.01^{cA}	0.01
TA	3.69 ± 0.06^{E}	4.29 ± 0.01^{aD}	4.44 ± 0.01^{aC}	4.57 ± 0.01^{aB}	4.70 ± 0.01^{bA}	0.01
TV	3.69 ± 0.06^{E}	3.92 ± 0.01^{cD}	3.98 ± 0.01^{cC}	4.17 ± 0.02^{dB}	4.44 ± 0.03^{dA}	0.01
P=	0.32	0.01	0.01	0.01	0.01	

Note: Means bearing same small alphabets as superscripts are homogeneous within column. Means bearing same capital alphabets as superscripts are homogeneous within row.

Microbiological parameters like Aerobic Plate Count (APC), psychrotrophic count and yeast and mold count were assessed on all the days of storage. Aerobic plate counts (log 10 cfu/g) of CA, CV, TA and TV are shown in Table 1.

Among the microbiological parameters, APC showed a significant difference ($P<0.01$) in between the storage days and between the sausages. The counts significantly ($P<0.01$) increased during storage in all sausages. Aerobically packed sausages, CA and TA showed significantly ($P<0.01$) higher counts when compared to vacuum packed sausages on all days of storage except day zero. Yeast and mold counts in both control and treatment sausages showed a significant increase during storage. Psychrotrophic counts were not observed in any of the sausages on days 0, 3 and 5. However, on 7th day all the sausages showed psychrotrophic growth which significantly ($p<0.01$) increased on day 10 and the counts were similar in both aerobic and vacuum packed samples.

Sensory attributes were evaluated by using a nine point hedonic scale by the semi-trained panelists in the Department of Livestock Products Technology. Sensory attributes like colour, flavour, juiciness, texture and overall acceptability of both control and treatment sausages were in the range of 7 to 7.5 on all storage days and did not significantly ($P<0.01$) decrease on storage. However, aerobically packed sausages, CA and TA showed physical signs of spoilage like sliminess and sour odour on day 10. Vacuum packed sausages, CV and TV maintained their freshness on day 10 and had good sensory scores for all attributes.

DISCUSSION

Treatment (novel) sausages showed lower dimension shrinkage and higher cooking yield when compared to control sausages. This might be due to the gelling effect and stabilization of soluble fibres of oats and is in agreement with the findings of Kurt and Kilincceker (2012) and Govind *et al.* (2013) in oats incorporated buffalo meat patties and chicken sausages, respectively. From the results it is clear that treatment sausages had similar protein, fat and ash contents and higher carbohydrate and energy values when compared to control sausages. Dietary fibre content of treatment sausages was ten times higher than control sausages which contributed to the functional property of the novel sausage. This might be due to the oats added to these sausages which has high levels of dietary fibre, especially the soluble fibre. Alakhrash *et al.* (2015) reported that oat surimi gel fortified with oat bran had lower cooking loss and improved functional properties when compared to control.

pH of the sausages did not show any significant increase from 0 to 10th day and these observations are contrary to the findings of Ruban *et al.* (2008) who reported an increase in pH from zero day to 20th day and 25th day in tapioca starch and potato flour incorporated pork sausages respectively. TBARS values in all the sausages increased significantly during storage and the present observations are in agreement with the findings of Biswas *et al.* (2011) who observed a similar increase of TBARS values in chiller stored duck patties. Vacuum packed sausages showed a significantly lower TBARS values compared to aerobically packed samples and the findings were similar to the observations made by Nam and Ahn (2003) who reported reduced lipid oxidation and lower TBARS values in vacuum packed chiller stored turkey breast patties. This could be due to the absence of oxygen and effect of vacuum which would have inhibited lipid oxidation. Tyrosine value which

indicate protein degradation significantly increased from day 0 day 10 in all sausages and the results are in agreement with the findings of Dushyanthan (2001) who observed that vacuum packaging could effectively reduce tyrosine values in mutton stored under chiller conditions.

Aerobic plate count, psychrotrophic and yeast and mold counts increased significantly on storage in all samples. Lowered APC of vacuum packed sausages, CV and TV when compared to those of CA and TA could be due to the effect of vacuum which suppressed the growth of aerobic organisms. Similar observations were reported by Dushyanthan *et al*. (2005) in vacuum packed mutton stored under chiller an dfreezer conditions. No effect of vacuum packaging was observed in the counts of psychrotrophs and yeast and molds from 10th day, irrespective of method of packaging when stored under chiller conditions. Similar findings were made by Biswas *et al*. (2011) who observed a significant increase in psychrotropic count in duck patties from 7th day and Bhattacharyya *et al*. (2013) in duck sausages.

The sensory attributes assessed with the help of nine point hedonic scale revealed that the novel chicken sausages had high scores of colour, flavour, juiciness, tenderness and overall acceptability, similar to those of control sausages. The freshness of both control and treatment chicken sausages were maintained thought the storage period effectively by vacuum packaging. All aerobically packed sausages showed physical signs of spoilage on the 10th day and were not subjected for sensory evaluation.

CONCLUSION

Novel chicken sausage incorporated with paneer and oats had a novel sensory appeal for the consumers and also has various health beneficial properties like high levels of dietary fiber. Vacuum packaging was effective in maintaining the shelf life of sausages beyond the 10th day and also preserving the freshness of a product by reducing the lipid peroxidation and suppressing the aerobic bacteria. Considering the extended shelf life, wholesomeness of the product, new sensory appeal and health beneficial property, vacuum packed novel chicken sausage containing paneer and oats can be considered as a novel functional meat product which can be manufactured and marketed commercially.

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