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Effect of Frozen Storage on the Physico-chemical, Microbiological and Sensory Quality of Low Fat Restructured Chicken Block Incorporated with Gizzard

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ABSTRACT

This study was planned to study the quality of low fat restructured chicken block incorporated with gizzards during frozen storage. The partially thawed meat was minced through 8 mm plate and mixed with curing ingredients and water, then filled in stainless steel mould and kept overnight in refrigerator for curing. Next day the filled moulds were cooked in water at 90°C for 45 min then cooled and stored overnight in refrigerator. The next day chicken blocks were obtained from the moulds and sliced (3 mm). This standardized recipe was used as control and over that 40% gizzard and 3% fat was found to be best suited and these two products were studied under frozen (-18°C) storage for 60 days. pH of the product reduced significantly ($p<0.05$) in the test product on day 40 and 60 and it was higher in the test product in comparison to the control up to 40 day. TBARS and tyrosine values increased significantly ($p<0.05$) in both test and control product throughout the storage period studied. Standard Plate Count (SPC) and Psychrophillic count (PPC) in test and control product increased significantly ($p<0.05$), however, coliform and yeast and mould counts were not detected in both the products. In general sensory scores were significantly ($p<0.05$) higher in the test product than the control. Sensory scores reduced significantly ($p<0.05$) during the storage period in both the products but remained well above the acceptable range. Based on physicochemical, microbiological and sensory quality it is concluded that the low fat restructured chicken block incorporated with 40% gizzard and 3% fat replacing lean meat could be stored safely at frozen temperature (-18±1°C) for 60 days without any deterioration in quality.

Key words: Chicken gizzard, restructured, chicken block, low fat, quality, frozen storage

INTRODUCTION

The demand for low fat meat products is rapidly increasing since today's consumers have become more health conscious. The ground meat products continue to command a major share of meat consumption and generally contain 20-30% fat. It is essential that the meat industry develop low fat ground meat products tailored to meet the need of these diet conscious consumers. The need for fat reduction in our diets has been further emphasized by the recommendations of the American Cancer Society, American Heart Association and the US department of Health and Human services to limit dietary fat to 30% of calories (Middleton, 2000). Low fat meat products have constituted a growing segment of the food industry and demand for such products has

contributed to the production of low fat meat, poultry and fish products. For meat product to be labeled as low fat meat product, the fat content should not exceed 10% in the final product (Heinz and Hautzinger, 2007). There is a great interest regarding demand for foods with health enhancing properties as low-fat meat products due to the human health and nutrition correlation (Tokusoglu and Kemal Unal, 2003).

In its broadest sense, any meat product that is partially or completely disassembled and then reformed into the same or a different form is called restructured product. Production of improved quality processed product such as restructured product has been indicated as a good end product from low value cuts. Restructured products have characteristics somewhere between ground meats and intact muscle steaks (Morin *et al*., 2009). By restructuring product characteristics such as shape, colour, texture, juiciness and flavour can be improved.

With the growing poultry production and processing activities, there would be an increased availability of edible byproducts. The principal edible byproducts of poultry include heart, liver and gizzard, which are being marketed as variety meats along with dressed chicken. Among the edible byproducts gizzard forms about 1.6-2.3% of live broiler chicken (Mountney and Parkhurst, 2001) and is not generally preferred by the consumers due to its toughness (Maiti and Ahlawat, 2010). The proximate composition and amino acid profile of gizzard is nearly same as of chicken. Gizzard contains approximately 20% proteins besides possessing unique textural and flavour characteristics (Rao *et al*., 1994).

Studies on storage stability of fried chicken gizzards has been reported (Pangas *et al*., 1998). Recently efforts are made to use this byproduct after tenderizing with natural plant enzymes (Grover *et al*., 2005; Maiti and Ahlawat, 2010). Gizzard has the potential for being used in the development of cost effective, convenient ready to eat chicken products. Cured products are very popular throughout the world. Cured meat products have the advantages of higher cooking yield, uniform color, easy slicing, better fat control and salability (NIIR, 2005).

Therefore, we developed a restructured chicken block incorporating 40% gizzard and 3% fat and in the present paper we report the shelf life of the product in comparison to control during frozen (-18°C) storage.

MATERIALS AND METHODS

Chicken meat: Fifty spent broiler chickens of about 16 weeks of age were obtained from the Instructional Farm of Rajiv Gandhi College of Veterinary and Animal Sciences (RAGACOVAS), Pondicherry and slaughtered under hygienic conditions using semi automatic poultry dressing unit (RND Practical Engineers, Pune) in the Department of Livestock Products Technology (LPT) adopting standard procedures in 2008. The dressed carcasses were chilled and deboned manually and the meat obtained was packed in low-density polyethylene (LDPE) bags (200 gauge) and stored in the freezer (-18±1°C) till further use.

Gizzard and fat: Gizzard and fat obtained during slaughter of broiler chicken were collected hygienically, cleaned and packed separately in LDPE bags (200 gauge) and stored in frozen condition (-18±1°C) for incorporation in the experimental product. They were thawed and minced with 8 mm plate in a meat mincer (Mado Shop Mincer Junior, Germany) before use.

Product preparation: Several preliminary trials were conducted to standardize the procedure (Fig. 1) to develop restructured chicken block following the recipe of Mandal *et al*. (2002). The

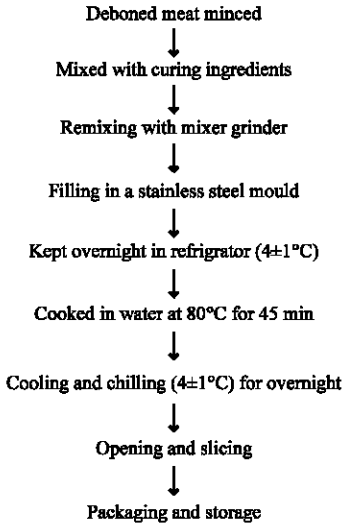

Fig. 1: Flow chart for preparing low fat restructured chicken block

Table 1: Recipe for low fat restructured chicken block

Ingredients	Control (%)	Test (%)
Meat	100.0	60.0
Gizzard	0.0	40.0
Fat	0.0	3.0
Salt	2.0	2.0
Sugar	1.0	1.0
Phosphate	0.4	0.4
Nitrate (ppm)	150.0	150.0
Water	10.0	10.0

standardized recipe of the product is given in Table 1. The frozen deboned meat was thawed overnight in the refrigerator (4±1°C). The thawed meat was minced using 8 mm plate in a meat mincer (Mado Shop Mincer Junior, Germany). The minced meat was mixed manually with curing ingredients and water, then further mixed uniformly using home mixer grinder for 30 sec (Sumeet Machines Ltd., Mumbai) for better extraction of proteins. Thus obtained meat mix was filled in clean stainless steel moulds lined with food grade aluminum foil. Finally the moulds were covered with lid and kept overnight in refrigerator (4±1°C) for curing. Next day the moulds were cooked in water at 90°C for 45 minutes followed by cooling under potable tap water and chilled overnight in refrigerator (4±1°C) for setting. The next day chicken blocks were obtained by opening the moulds. Product was sliced using food slicer (Sirmon SPA, Italy) into 3 mm thickness and considered as control product. This product was taken as the control. In the test product 40% gizzard was added replacing lean and 3 % fat was added over that to prepare the low fat restructured chicken block. The frozen storage life of the new product was studied in comparison to the control.

Frozen storage studies: The restructured chicken block containing 40% gizzard and 3% fat and control product (without gizzard and fat) were packed in LDPE bags and stored under frozen (-18±1°C) conditions. Samples were evaluated for their quality at 20 days interval for a period of

60 days (0, 20, 40 and 60 days) during frozen storage. Different quality parameters like pH, TBARS number, tyrosine value, microbiological and sensory quality were studied. Details for analysis of samples on, physico-chemical microbiological and sensory quality are mentioned below.

Physico-chemical analysis: The pH of chicken block was determined by adopting the method of AOAC (1995). Five gram of the product was homogenized with 45 mL of distilled water using waring blender at 3000 rpm for 15 sec then pH of the homogenate was recorded by immersing combined glass electrode of the pH meter (ELICO Model LI-120). The distillation method described by Taraldgis *et al.* (1960) was followed for the determination of TBARS value expressing as mg malonaldehyde kg^{-1} of sample. Tyrosine value of restructured chicken block was estimated adopting the procedure of Strange *et al.* (1977).

Microbiological analysis: All the microbiological parameters viz, standard plate count, psychrophilic count, coliform and yeast and mound count were determined following procedures recommended by APHA (1984). Readymade media (Hi-Media, Mumbai) were used for the analysis.

Sensory analysis: The product was evaluated organoleptically using semi-trained panelists consisting of faculty and post-graduate students using eight-point hedonic scale (Keeton, 1983). The panelists were explained about the nature of experiment without disclosing the identity of the samples. They were requested to record their preferences on an 8 point hedonic scale (8: like extremely, 1: dislike extremely) for appearance, colour, flavour, juiciness, texture and overall acceptability as given in the score sheet. Taste panel was conducted around 3-4 pm every time. Plain water was provided to each panelist to rinse the mouth in between the samples.

Statistical analysis: Three trials were conducted for each experiment and samples were analyzed in duplicate. The data recorded were analyzed using SPSS version 10.0 of windows (SPSS, Chicago, USA). The data on all parameters were analyzed using 2-way ANOVA. The significant differences between means were tested using the Least Significant Difference (LSD) test (Snedecor and Cochran, 1986).

RESULTS

The results of physicochemical and microbiological quality are presented in Table 2, there was a significant ($p<0.05$) decrease in pH of test product and control as the storage period progressed up to 60 days. The pH of control and the test product ranged between 6.47-6.33 and 6.54-6.37, respectively. The TBARS values of test product as well as control increased significantly ($p<0.05$) throughout the storage period up to 60 days. The values of TBARS ranged between 0.20-0.56 and 0.29-0.72 in control and test product, respectively. The tyrosine value of the test product and control increased significantly ($p<0.05$) throughout the frozen storage period. The tyrosine values of control and test product ranged between 19.93-31.06 and 20.54-29.42.

The SPC and PPC (Table 2) of the test product and control in the present study increased significantly ($p<0.05$) throughout the storage period. The SPC ranged between 2.44-4.19 and 2.46-4.17 log cfu g^{-1} in control and test products, respectively. The PPC ranged between 1.36-3.5 and 1.45-3.56 log cfu g^{-1} in control and test products, respectively. The coliforms as well as yeast and mould were not detected in both test product and control throughout the storage period.

Table 2: Effect of frozen (-18±1°C) storage on physiochemical and microbial quality of restructured chicken block with 40% gizzard and 3% fat

	Storage period (days)			
Parameters	0	20	40	60
pH				
C	6.47±0.03^{Aa}	6.38±0.01^{Ab}	6.39±0.005^{Ab}	6.33±0.01^{b}
T	6.54±0.06^{Ba}	6.51±0.02^{Ba}	6.45±0.01^{Bb}	6.37±0.01^{c}
TBA (mg malonaldehyde kg^{-1} sample)				
C	0.20±0.02^{Aa}	0.23±0.03^{Ab}	0.31±0.02^{Ac}	0.56±0.02^{Ad}
T	0.29± 0.01^{Ba}	0.32±0.01^{Bb}	0.37±0.03^{Bc}	0.72±0.05^{Bd}
Tyrosine value (mg 100 g^{-1})				
C	19.93±0.18^{a}	23.88±0.36^{Ab}	28.24±0.23^{Ac}	31.06±0.27^{Ad}
T	20.54±0.10^{a}	22.07±0.40^{Bb}	26.56±0.14^{Bc}	29.42±0.31^{Bd}
SPC (log_{10} CFU g^{-1})				
C	2.44±0.04^{a}	2.97±0.04^{b}	3.21±0.07^{Ac}	4.19±0.04^{d}
T	2.46±0.03^{a}	3.07±0.10^{b}	3.45±0.06^{Bc}	4.17±0.07^{d}
Psychrophiles (log_{10} CFU g^{-1})				
C	1.36±0.03^{Aa}	2.61±0.06^{b}	2.76±0.04^{Ac}	3.50±0.06^{d}
T	1.45±0.03^{Ba}	2.69±0.07^{b}	3.04±0.05^{Bc}	3.56±0.08^{d}

C: Control; T-test product. *Means with different superscripts (capital letter(s) in same column and small letters in the same row) differ significantly ($p<0.05$)

Table 3: Effect of frozen (-18±1°C) storage on sensory quality of low fat restructured chicken block with 40% gizzard and 3% fat

	Storage period (days)			
Parameters	0	20	40	60
Appearance and color				
C	6.03±0.13^{Aa}	6.40±0.11^{Ab}	5.93±0.13^{Ac}	5.50±0.09^{Ac}
T	7.13±0.32^{Ba}	7.20±0.10^{Ba}	7.30±0.09^{Ba}	6.26±0.08^{Bb}
Flavour				
C	5.96±0.14^{A}	6.06±0.14^{A}	5.83±0.10^{A}	5.63±0.11^{A}
T	7.03± 0.11^{Ba}	7.03±0.12^{Ba}	6.76±0.11^{Bb}	6.76±0.11^{Bb}
Juiciness				
C	5.76±0.13^{Aa}	6.10±0.12^{Ab}	5.93±0.10^{Ab}	5.03±0.12^{Ac}
T	6.86±0.09^{Ba}	7.26±0.09^{Bb}	7.03±0.11^{Bb}	6.23±0.11^{Bc}
Texture				
C	6.26±0.15^{Aa}	5.20±0.12^{Ab}	5.33±0.12^{Ab}	5.23±0.11^{Ab}
T	7.00±0.11^{Ba}	6.33±0.09^{Bb}	6.93±0.10^{Bc}	6.60±0.10^{Bd}
Overall acceptability				
C	6.76±0.13^{Aa}	6.46±0.14^{Ab}	6.26±0.06^{Ab}	6.00±0.11^{Ac}
T	7.20±0.11^{Ba}	7.23±0.10^{Ba}	6.96±0.07^{Bb}	6.36±0.09^{Bc}

C: Control; T-test product. *Means with different superscripts (capital letter(s) in same column and small letters in the same row) differ significantly ($p<0.05$)

The result of the sensory quality during storage is presented in Table 3, the colour and appearance scores were significantly ($p<0.05$) higher in test product (7.13-6.23) than in control (6.03-5.50). The scores of the test product was not affected up to 40 day of storage, however, the scores reduced significantly ($p<0.05$) from 20 day onwards in control product.

The flavor scores were significantly ($p<0.05$) higher in test product (7.03-6.76) than the control (5.96-5.63) throughout the storage period. The scores reduced significantly ($p<0.05$) from 40th day in test product, however, there was no significant difference in the scores of control throughout the storage period.

The juiciness scores were significantly ($p<0.05$) higher in test product (6.86-6.23) than the control (5.76-5.03) throughout the storage period. Both in control and test product the scores reduced significantly ($p<0.05$) on 20th day and then further reduced significantly ($p<0.05$) on 60th day.

The texture scores were significantly ($p<0.05$) higher in test product (7.00-6.60) than the control (6.26-5.23) throughout the storage period. The texture scores reduced significantly ($p<0.05$) on 20th day but no significant changes till 60day. In test product the scores reduced significantly ($p<0.05$) on 20th, 40th and 60th day of storage.

The overall acceptability scores were significantly ($p<0.05$) higher in test product (7.20-6.36) than the control (6.76-6.00) throughout the storage period. The scores for control reduced significantly ($p<0.05$) on day 20 and then on day 60, however, in test product the scores reduced significantly ($p<0.05$) on day 40 and day 60.

DISCUSSION

Decrease in pH might be due to accumulation fatty acids and development of oxidation products which is also indicated by increase in TBARS values. Similarly, Nath *et al.* (1995) and Pandey *et al.* (1998) reported a decrease in pH values during frozen storage in chicken patties and low fat egg patties throughout the storage period of 60 days.

Increase in the TBARS values indicating an increase in the lipid oxidation by the prooxidant effect of haeme iron. However, the values were far below the threshold value of 1-2 mg kg^{-1} for spoilage as reported by Watts (1962). The results reported on TBA values of low fat restructured chicken block in the present study were in agreement with the findings of Nath *et al.* (1995) and Bhoyar *et al.* (1997) who reported an increase in the TBA values as the storage period progressed up to 60 days in chicken patties and restructured chicken steaks. Similarly, Hollander *et al.* (1987) also reported increasing TBA values during frozen storage of restructured patties from spent layer meat.

Increase in tyrosine value might be attributed to proteolytic activity as evident from increased microbial counts on 60th day of storage. Similarly, Muthulakshmi *et al.* (2009) reported a significant increase in the tyrosine values of buffalo meat sausages incorporated with offal meats during storage.

An increase in SPC and psychrophilic counts throughout the storage period up to 60 days in chicken patties was reported by Nath *et al.* (1995). Contrary to the present findings Bhoyar *et al.* (1997) and Pandey *et al.* (1998) reported a decrease in aerobic and psychrophilic counts throughout the storage period of 60-90 days in restructured chicken steaks and low fat egg patties. The absence of coliforms indicated good hygienic practices which were in conformity with the findings of Nath *et al.* (1995) in chicken patties.

In general the sensory scores for all attributes were higher in test product in comparison to the control throughout the storage period which might be due to the addition of gizzard and fat. It is well known that the added fat improves the flavor of the meat product which is also reflected in the present study. The reduction of sensory scores in respect of different attributes also seems normal pattern during storage of any meat product. The reductions in sensory scores are mainly due to dehydration, loss of flavor components and microbial activity. Nath *et al.* (1995), Bhoyar *et al.* (1997) and Pandey *et al.* (1998) recorded a decrease in sensory scores of chicken patties, restructured chicken steaks and low fat egg patties throughout the storage period of 60 days. Similarly Jacobson and Koehler (1970) observed that flavor deteriorated progressively in chicken meat during frozen storage mainly due to increase in the rancidity.

CONCLUSION

Based on physicochemical, microbiological and sensory quality it is concluded that the low fat restructured chicken block incorporated with 40% gizzard and 3% fat replacing lean meat could be stored safely at frozen temperature (-18±1°C) for 60 days without any deterioration in quality.

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