Effects of Incorporating Chicken's Gizzards on quality characteristics and total bacterial count of beef sausages

Maha .M.M, Hassan .E.H

Department of Meat science and Technology, College of Animal Production Science and Technology, Sudan University of Science and Technology, Street 61, Khartoum, Sudan

Department of Pathology, College of Veterinary Medicine, Sudan University of Science and Technology, Street 61, Khartoum, Sudan

Abstract: The present study was aimed to develop an acceptable quality beef sausage with incorporation of poultry by product viz. gizzard. Different levels of poultry gizzard (0, 25 and 50%) were incorporated in three formulations of sausages. It was observed that, the sensory evaluation results showed no significant differences (P>0.05) among the treatments in color, texture, flavor, juiciness, and overall acceptance. On the other hand the physical characteristics results cleared a significant difference(P ≤ 0.05) in water holding capacity, in reverse to shrinkage, cooking loss and total bacterial count that were not significantly different(P >0.05).

Keywords: Poultry gizzard, Sensory evaluation, Total bacterial count

I. Introduction

Sudan has largest population of animals in Africa and among Arabic countries. Recently Ministry of Animal Resources, Fisheries and Ranges (MARFR, 2010) estimated animal population to be around 104 million heads. Although Sudan is rich in animal resources, it confronts many problems which lead to continuous increase, in animal and meat prices. These include poor natural pastures, high cost of feed ingredients and processed feed, diseases, inefficient management of stocks and high transportation costs.

According to Ministry of Animal Resources Sudan(MAR,2008) the production of chicken broilers was increased from 15×103 kg to 35×103 kg in 2007, and the consumption of poultry meat had been increased from 0.8 kg per capita per year in 2000 to one kg per capita per year in 2007, and according to the Sudan quarter century comprehensive national strategy it will increased from 1 kg per capita per year to 5.5 kg per capita per year in 2012.

Throughout the world, consumption of poultry meat continues to rise in both developed and developing countries. In 1999, global production of broiler chickens reached 40 billion for the first time and, by 2020, poultry is predicted to become the overall meat of choice (Bilgilis,2002).

It is estimated that during slaughtering of birds, about 10 to 13% live poultry weight is wasted in the form of skin, gizzard, heart and other by-products (Sharma, 1999). The nutritive value of these edible by-products in respect of protein and fat is as good as lean meat. It is more advisable to incorporate chicken giblets (Heart and gizzard) in the preparation of processed meat products if the consumer is looking for low calorie diet having high protein and polyunsaturated fatty acids. Effective utilization of these by-products for production of value added meat products is one way to realize maximum returns from poultry sector (Subhash Kumar et al. 2009).

With the growing poultry production and processing activities, there would be an increased availability of the edible byproducts. Gizzard is one of the principal edible byproducts of poultry processing which is being marketed as variety meats along with dressed chicken. It forms nearly 3% of dressed chicken (Charonpong and Chen 1980) and as such it is less preferred by the consumer due to its peculiar flavour and texture. Gizzard contains approximately 20% proteins (Kondaiah and Panda 1987; Rao et al. 1994) and has potential for using in cost effective, convenient ready to eat chicken products. Studies on development of fried chicken gizzard and its storage stability has been reported (Pangas et al. 1998). Further, utilization of this byproduct would increase the profitability of broiler industry.

Most sausages are made from only skeletal muscles that are taken off the bones. A few varieties of sausage can also be made with variety of meats, such as liver or tongue (Food Safety and Inspection Service / United States Department of Agriculture FSIS/USDA. 1995). Meat quality, especially in relation to its bacteriological load, is of special importance in the production of fresh sausages. Beef sausage is also manufactured from cheaper cuts of forequarters such as clod (Savic, 1985). For desirable color, meat from older animals which contains more myoglobin is preferred (Toldra, 2002).

Increasing costs of conventional animal protein foods, have encouraged researchers to study alternative protein sources, particularly chicken gizzards that are commonly used in direct consumption without processing. The objectives of this study are to study the effect of addition of chicken gizzards in beef sausages on physical,
organoleptic properties and total bacterial count of sausages product. Also to access a new type of meat product in meat industry.

II. Materials and methods

The experiment of the study was conducted at the laboratory of Meat Science and Technology Faculty of Animal Production Science and Technology, Sudan University of Science and Technology.

Meat and gizzards preparation

Fresh deboned beef meat was obtained from the local market, and was ground through 0.25 in. plate of an electrical meat grinder. The whole bulk of mixed meat was thoroughly hand mixed to give a homogeneous sample. Then, it was divided into three patches (One batch for each treatment). Fresh Chicken Gizzards were obtained from Khartoum meat market, were washed, cleaned and ground through 0.25 inch plate of an electrical meat grinder, then the bulk was divided into two batches to obtain, one treatment contained (0.25 kg) Chicken Gizzard and the other treatment contained (0.5 kg) Chicken Gizzard While the third treatment was formulated without chicken gizzard (control), (three replications were prepared for each treatment).

Table 1: Ingredients based on total mixed base

<table>
<thead>
<tr>
<th>No</th>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Salt</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Coriander</td>
<td>0.4</td>
</tr>
<tr>
<td>3</td>
<td>Black pepper</td>
<td>0.3</td>
</tr>
<tr>
<td>4</td>
<td>Sugar</td>
<td>0.4</td>
</tr>
<tr>
<td>5</td>
<td>Cinnamon</td>
<td>0.1</td>
</tr>
<tr>
<td>6</td>
<td>Garlic</td>
<td>0.3</td>
</tr>
<tr>
<td>7</td>
<td>Skimmed milk powder</td>
<td>0.3</td>
</tr>
<tr>
<td>8</td>
<td>Potatoes</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>Ice water</td>
<td>20</td>
</tr>
</tbody>
</table>

Preparation of sausage

Three patches of sausage formulation were made, 0% chicken gizzard (control) ,25% chicken gizzard and 50% chicken gizzard. Each patch was chopped separately, after formulation using the ingredients in table (1). The chopper was started after the minced meat was introduced. Salt and half of the recommended ice water were added together and uniformly dispersed. Then, the binder and seasoning were added together, with the remainder of the recommended ice water. The entire mass for each batch was chopped about 5 minutes. The batter for each patch was then stuffed into natural casings and linked at length about7cm.The sausages were packed in polyethylene bags and stored in freezer waiting tests.

Sensory evaluation

Ten (10) semi-trained panelists were asked individually to evaluate the treatments effect on color, tenderness, juiciness, flavor, and overall acceptability. Samples in each treatment were taken after being cooked at (90 ºc) for five minutes and then placed in a dish which was divided into 3 portions. Every treatment was given a random of three code numbers which were changed in each session. Every panelist had one dish to evaluate in each session under natural light. Using 8-points (hedonic scale) card (Keeton , 1983), in which the highest score of 8 being extremely desirable and 1 being extremely undesirable, plain water was provided to each panelist to rinse the mouth in between the samples.

Cooking loss

The frozen sausage samples were thawed in a refrigerator for overnight. The sample were cooked in a pan using vegetable oil at constant temperature (90ºc) for 5 minutes with continuous turning of the samples. The cooked samples were dried of the oil using absorbent kitchen paper and allowed to cool, weighed and kept for sensory evaluation. The difference in weight of samples before and after cooking was recorded as the total cooking loss and expressed as a percentage of weight before cooking .( Nour 2003 ).

    Cooking loss% = \frac{\text{wt. before cooking} - \text{wt. After cooking}}{\text{wt. before cooking}}

Shrinkage determination

The frozen sausage sample of almost the same diameter was thawed in a refrigerator overnight. The length of the samples were measured using a measuring tape then cooked in a pan using vegetable oil at constant temperature (90ºc) for 5 minutes with continuous turning of the samples. The cooked samples were dried of the oil using absorbent kitchen paper and allowed to cool and were re measured. The difference in the total length of samples before and after cooking was recorded as the shrinkage and expressed as a percentage of length before cooking. (Nour 2003).

    Shrinkage = \frac{\text{Length Before Cooking} - \text{Length After Cooking}}{\text{Length Before Cooking}}
Water Holding Capacity (WHC)

Water holding capacity was calculated according to Alaswad (1984). The samples from each batch of sausages about 0.3 g were placed on a humidified filter paper (what man no 40) of known weight then the samples were pressed between two Plexiglas plates for 10 min at 1 kg load. Each filter paper was reweighed and the difference between the two weights was obtained. The water holding capacity then calculated using the following equation:

\[ \text{WHC (\%)} = \frac{\text{Actual moisture (\%)} - \text{free water in sample (\%)}}{\text{Actual moisture (\%)}} \]

Statistical Analysis

Statistical analysis was performed on all data of the various experiments using SPSS and was subjected to analysis of variance (ANOVA). Least significant difference (LSD) was used for mean separation (Gomez & Gomez, 1984).

III. Results and Discussion

Sensory evaluation

It is clear from table (2) and figure (1) that, there was no significant difference among the treatments in Color, texture, flavor, juiciness, and Overall acceptability that agree with Mohamed Elkhatim et al. (2013) who did not find any significant difference in sensory attributes such as appearance, tenderness and overall acceptance among the different types of sausage formulations. and also agree with Raut et al. (2015) who found that, the incorporation of heart and gizzard up to 10% level had no significant effect on flavor and texture compared to control. On the other hand the sensory scores in the present study did not agree with Sudheer et al. (2011) who reported that the sensory scores of the product increased significantly (p<0.05) for all the parameters up to 40% level of gizzard incorporation and also the results disagree with the findings of Malik and Panda (1994) and Reddy and Vijayalakshmi (1998) who reported higher acceptability scores of mutton blocks incorporated with 25% gizzard and 5% heart and chicken sausages incorporated with skin, heart, gizzard and yolk at levels of 15 and 18%, respectively.

The results showed that the scores for the juiciness and flavor were decreased with increasing the poultry gizzard percentage which was nearly agree with Raut et al., (2015) who reported in their study, since there was further increase in heart and gizzard level, scores for flavor, texture and juiciness declined significantly. Similar trend was reported by Subhash Kumar et al. (2009) for sausage made with incorporation of 4% heart and gizzard.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Parameters</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Significant level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Color</td>
<td>6.67±0.92</td>
<td>6.67±0.88</td>
<td>6.60±1.04</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Texture</td>
<td>6.50±1.07</td>
<td>6.63±0.96</td>
<td>6.57±1.10</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Flavor</td>
<td>6.60±0.81</td>
<td>6.57±1.01</td>
<td>6.43±1.01</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Juiciness</td>
<td>6.67±0.76</td>
<td>6.50±1.07</td>
<td>6.33±1.06</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>Overall acceptance</td>
<td>6.70±0.84</td>
<td>6.70±0.99</td>
<td>6.57±1.07</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS: Not significant
A: Control (100% beef).
B: (25% chicken gizzards + 75% beef).
C: (50% chicken gizzards + 50% beef).

Figure (1) Panel test of experimental samples

(A) Control (100% beef).
(B) (25% chicken gizzards + 75% beef).
(C) (50% chicken gizzards + 50% beef).
Physical Properties and total count of bacteria

Table (3) and Figure (2) showed that, there were significant differences (p≤ 0.05 ) among the treatments in water holding capacity . The sausage sample (A) had a higher percentage (23.33%) followed by sausage sample (C) which recorded (21.11), and sausage (B) which recorded (20).

As shown in table (3) Figure (2)  With regard to shrinkage , the results revealed that, the samples were not significantly different, and the results of Cooking loss were also not significantly different (p≤ 0.05 among the treatments, the sausage sample (B) recorded higher score (23.81) followed by the sausage sample (A) which recorded ( 23.68) and at last the sausage sample (C) which recorded ( 21.91) which indicated decrease in cooking loss (increase in cooking yield) with increase of incorporated gizzards.

Sudheer et al. (2011) who reported  in their study of the physicochemical properties of restructured chicken block, that cooking yield decreased significantly (P < 0.05) on incorporation of gizzards at 40% level (97.8%), similar to the findings of Kondaiah et al. (1993) who reported the yield of 96 to 97.6% in mutton nuggets incorporated with chicken skin, heart and gizzard at 15% and 25% levels. Whereas, Reddy and Vijayalakshmi (1998) reported much lower cooking yield of chicken sausages (75.13–79.39%) containing skin, gizzard, heart and yolk at levels of 15 and 18%.So the results in the present study were not agree with the previous studies,that may be due to the difference in formulations and cooking methods.

As for the W.H.C the results in table (3) figure (2) showed significant different among the treatments . However the sample A, 100% beef (control) recorded the highest value 23.33% compared to the other two samples B and C (20.0,21.3)% respectively.

**Total Bacterial Count**

From the microbiological point of view, there was no significant difference among the treatments in Total Bacterial Count (TBC). Total bacterial Count slightly increased with increase of chicken gizzard added to the sausage sample as shown in table (3) figure(2), beef sausage (control) was lower in total bacterial count (log 6.25 log10 CFUg⁻¹) compared to (chicken Gizzard with beef) sausage samples (B) and sample (C) with (6.41 log10 CFUg⁻¹), (6.47 log10 CFUg⁻¹) respectively, that may be attributed to a previous contamination of chicken gizzard which seems to agree with Smith and Berranq (2006), who found crop and gizzard would increase over all bacterial count of pen chill broilers carcasses.

**Table 3: Mean values and their standard deviation SD for some physical properties and total bacterial count (TBC) of sausage**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Significant level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water holding capacity %</td>
<td>23.33±0a</td>
<td>20±0b</td>
<td>21.11±1.92b</td>
<td>*</td>
</tr>
<tr>
<td>Shrinkage %</td>
<td>20.73±1.27</td>
<td>21.95±0.46</td>
<td>20.48±0.83</td>
<td>NS</td>
</tr>
<tr>
<td>Cooking loss %</td>
<td>23.68±2.28</td>
<td>23.81±2.06</td>
<td>21.91±0.96</td>
<td>NS</td>
</tr>
<tr>
<td>TBC CFU/log-1</td>
<td>1.93±0.81</td>
<td>2.87±1.45</td>
<td>3.07±0.95</td>
<td>NS</td>
</tr>
<tr>
<td>TBC CFU/10-5ml-1</td>
<td>6.25±0.22</td>
<td>6.41±0.28</td>
<td>6.47±0.15</td>
<td>NS</td>
</tr>
</tbody>
</table>

TBC= Total Bacterial Count
*: significant at P<0.05
NS: Not significant

Different letters within the same row means significant different at P<0.05
A=Control (100% beef ),
B=(25% chicken gizzards +75% beef),
C=(50% chicken gizzards +50% beef).

**Figure2: Physical properties and total bacterial count of beef and chicken gizzard sausages**
IV. Conclusion

A: Control (100% beef).
B: (25% gizzard + 75% beef).
C: (50% gizzard+50% beef)

Conclusion

The study has concluded that Chicken gizzard sausages are nearly similar, in physical properties and sensory evaluation to beef sausage. The contamination level was generally higher in chicken gizzard-beef sausage in comparison with beef sausage.

Recommendations

This study has recommended encouraging the researchers to investigate other chicken meat alternatives for beef in sausage processing and continue to research in this issue to explore more about chicken gizzard and other chicken by-products such as liver and heart.

Acknowledgements

Thanks are extended to the staff members, technicians and students for the provision of facilities and help.

References