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Effect of Incorporating Chicken Giblets on Some Quality Attributes of Beef Sausage

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Abstract

The present study was conducted to investigate the effect of substituting of chicken giblets on the chemical and physical properties of beef sausage production. Four sausage formulations were processed as follows: A- control (0% giblets), B -30% gizzards, C -30% livers) and D -15% gizzards and 15% livers, The proximate analysis of the sausage showed significant differences (P<0.01) among the sausage treatments in protein, fat, moisture, and ash contents. Also the physical characteristics results revealed that, there were significant differences (P<0.01) among the sausage treatments for water holding capacity, and cooking loss.

Keywords: Chicken Giblets, Beef Sausage, Water Holding Capacity, Cooking Loss

Introduction

Meat ranks among one of the most significant, nutritious and energy-rich natural food product, utilized by humans to fulfill their regular body requirements. It is considered quite important in maintaining a healthy and balanced diet, which is essential in accomplishing optimum human growth and development (Pereira, 2013) [19].

Increasing consumer demand for quality meat products results in the development of meat products by incorporating health enhancing ingredients.

The long standing positive consumer perception that meat and meat products are the best sources of minerals, vitamins and complete proteins which contains all of the amino acids that our body needs to function properly (Verbeke *et al*., 2010).

The word sausage was derived from the Latin word *salsus* which means salted or preserved by salting, which dates back thousands of years ago (USDA/FSIS, 1999) [26]. Sausages are meat products that are salted and usually seasoned. The name is derived from the Latin term salsus meaning salt. From ancient times to the present day sausages mixture has been encased assuming cylindrical form which become traditionally the sausage shape, and in most instances, is one of the characteristics that differentiate sausage form other meat products (Karmlich *et al*., 1973).

There have been very few studies on the use of giblets as ingredients in sausage production. Blackshear *et al*. (1966) [6] prepared frankfurters with broiler neck meat, gizzards, and hearts, also Tarver *et al*. (1978) [25] prepared a pate with broiler hearts and livers. Lyon *et al.* (1982) [15] studied thigh meat patty products incorporating broiler giblets as to sensory evaluation, proximate composition analysis, and Texture Profile Analysis.

Consumer demand healthier meat products that are low in fat, salt, cholesterol, nitrates and calories in general and contain in addition health- promoting bioactive components such as carotenoids, unsaturated fatty acids, sterols and fibers on the other hand; furthermore, consumer accept these level meat products with altered formulations to taste, look and smell the same way as they are traditionally formulated and processed counterparts. At the same time competition is forcing the meat processing industry to use the increasingly expensive raw material i.e. meat more efficiently and produce products at lower costs (Jochen *et al*., 2010) [13].

The non-meat ingredients are used in meat products to improve the quality and reduce the cost of the products. These ingredients of very wide sources such as dairy, eggs, plants and microbial including probiotics are incorporated in these meat products (Xiong, 2012; Yadav *et al*., 2013) [28, 29] These additives able to increase nutritional value, consumer acceptability and benefits to human health.

The consumption of processed meat is more difficult to estimate than that of red meat, as it is a heterogeneous food group with different definitions across countries. According to the per capita data collected by FAOSTAT, the total processed meat

consumption was between 0 and 33 g/day (FAO/WHO, 2015) [9]. While the intake of processed meat in countries of the Middle East and north Africa was estimated in 2010 to range from 2.5 g/day (Palestine) to 6.7 g/day (United Arab Emirates) (Afshin *et al*., 2015) [1].

Increasing cost of conventional animal protein food have encouraged researchers to study alternative protein sources, particularly chicken gizzards and livers that are commonly used without processing. Chicken gizzards and livers are widely available throughout Sudan and their price is lower compared to other meat, so they could be processed to improve sensory characteristics, enhance nutritive content.

There were no more previous researches carried out about this subject. The reason which guide to this study is the continuous increase in red meat price. The objectives of this study were: To evaluate the effects of incorporating broiler giblets (hearts, livers, or gizzards) on physical and chemical properties of beef sausage and, creation of good recipe and marketing for chicken gizzards and livers.

Materials and Methods

This study was conducted at the laboratory of Meat Science and Technology, College of Animal Production Science and Technology Sudan University of Science and Technology.

Beef meat preparation

A total of 9.30kg fresh deboned beef meat was obtained from Meat Technology Department in Kuku Animal Production Research Center. The beef meat was ground through 0.25 in plate of an electrical meat grinder. The whole bulk of the mixed meat was thoroughly hand mixed and divided into four batches a 1 kg, 0.70kg, 0.70kg, and 0.70kg each treatment had one batch.

Chicken liver and gizzard preparation

A total of 1.35kg fresh chicken liver and 1.35kg fresh chicken gizzard were obtained from North Khartoum meat market. They were washed cleaned and ground through 0.25 in. plate of an electrical meat grinder then the bulk was divided as well as 0.3kg chicken livers, 0.15kg chicken livers, 0.30kg chicken gizzard and 0.15 chicken gizzard.

Ingredients

All ingredients were added equally to all treatments.

Table 1: Ingredients based on total mixed base

No	Ingredient	Percent %
1	Salt	2
2	Coriander	0.3
3	Cinnamon	0.3
4	Garlic	0.3
5	Sugar	0.4
6	Skimmed milk powder	4
7	Potatoes	10
8	Ice water	20
9	Dry bread	10
10	Fat	10

All ingredients are percentage from the formulated products.

Casings

Natural casings from (sheep intestines) were obtained from the local market at Khartoum north in clean scraped ready form. They were salted and kept in a freezer at (-18C^{o}).

Treatments formulation

Ground chicken liver and chicken gizzard were added to the ground beef meat to formulate four treatments:

A. 100% beef (control), 0% chicken liver and gizzard.
B. 70% beef, 30% chicken liver.
C. 70% beef, 30% chicken gizzard.
D. 70% beef, 15% chicken liver and 15% chicken gizzard.

Preparation of sausage

All ingredients shown in Table 1 were added equally to all treatments. Each batch was chopped separately, after formulation using the ingredients in Table 1, the chopper was started after the minced meat was introduced, half the recommended ice water was 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 batch was then stuffed into natural casing and linked at length about 7cm.The sausage were packed in polyethylene bags and stored in freezer waiting different tests.

Proximate analyses

Four sausage samples were taken at randomly from each treatment and then approximately 50 grams portions were taken from different places and mixed well to assure a representative samples for proximate analyses, and were sent to the laboratory of Khartoum University Faculty of Animal Production for the Proximate chemical analysis, moisture, crude protein (CP), ether extract (EE) and ash of the sausage samples were determined according to Association of Official Analytical Chemists (AOAC, 1995) [4] methods.

Moisture determination

Moisture content determination was based on weight loss of 2.5gm sample, dried overnight in a drying oven at 102◦C. The sample was cooled in a desiccator, weighed and moisture loss was calculated as percentage of fresh sample weight.

$$\text{Moisture\%} = \frac{\text{Weight loss} \times 100}{\text{Original weight}}$$

$$\text{Dry matter\%} = 100 - \text{moisture\%}$$

Ash determination

Samples were placed in crucibles and dried overnight in a drying oven at 102◦c, then a shed in muffle furnace at 550◦c for 18 hrs. Samples were cooled in a desiccator and weighed.

$$\text{Ash\%} = \frac{\text{wt. of ash} \times 100}{\text{wt. of sample}}$$

Fat determination

Fat was determined by ether extract method. Two gms from the sample were taken to Soxhlet apparatus. The sample was subjected to continuous extract with ether for 6 hours. The sample then removed from the extractor and allowed to dry for 2 hours at 100co in a drying oven till on traces of ether remained.

The sample was then cooled and weighed for the extraction percentage was calculated as follows:

$$\text{Fat\%} = \frac{\text{Fat weight} \times 100}{\text{Sample weight}}$$

Crude protein determination

The Kjeldahl method was used to determine the total nitrogen. Crude protein was calculated 6.25 times Kjeldahl nitrogen. 0.2gm sample was weighed in Kjeldahl flask. Half tablet of catalyst mixture (10 part of K_2SO_4 to 1 part of $CuSO_4$) was added. Ten ml conc. H_2SO_4 was added. The content of the flask was digested under boiling at maximum heat for about 2 hours. The flask was cooled and transferred to the distillation unit. The sample was distilled using 40% Na OH solution and received in 4% boric acid. The content titrated against 0.1N HCL.

$$\text{Crude protein\%} = \frac{\text{ml HCL for sample} - \text{ml HCL for blank})0.1 \times 6.25}{\text{Wt. of sample} \times 1000}$$

Cooking loss

The frozen sausage samples were thawed in a refrigerator for overnight then cooked in a pan using vegetable oil at constant temperature (90°C) for 5 minutes with continues turning of the samples. The cooked samples were dried of the oil using absorbent kitchen paper and allowed to cool and weighed. The difference in weight of samples before and after cooked was recorded as the total cooking loss and expressed as a percentage of weight before cooking.

$$\text{Cooking loss\%} = \frac{\text{Wt. before cooking} - \text{wt. after cooking} \times 100}{\text{Weight before cooking}}$$

Water holding capacity

Water holding capacity was calculated according to Alaswad (1984) [3]. The meat samples from each rib section about 0.3g were ground and 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 1kg 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:

WHC (%) = Actual moisture (%) - Free water in sample (%)

Statistical analysis

Complete randomized design was used in this study. Data of chemical composition, physical properties, were analyzed using one-way ANOVA followed by Duncan (multiple range test) at 0.05 level of significant using IBM Corp., version 21.

Results and Discussion

Proximate Analysis

The addition of different levels of giblets to beef sausage affected significantly on chemical composition Table 2 for all studied chemical parameters (P<0.01). Group D showed the highest percentages in CP, Fat and Ash (18.30, 7.85and 1.91) followed by group C (18.09, 7.32 and 1.56) respectively, while group A was the highest in moisture content (66.88%) followed by group B (65.90%)that it decreased with addition of gizzard and liver. The moisture content results agree with those of Agnihotri and Pal (2000) [2] who reported that the average of moisture content in sausage was 66.7%, also, Mohamed Elkhatim *et al*. (2013) [18] found it 65.30% in his study the effects of incorporating 25% chicken's gizzards on the fresh and stored Sausage and also observed decrease in moisture content with increased percentage of chicken gizzard incorporated in sausage. Similar trend was reported by Raute, *et al* (2015) who incorporated heart and gizzard in chicken pickle., Maha and Hassan, (2015) [16] found different results ranged from 77.50% in beef sausage and 80.67% in 25% inclusion rate of gizzard in beef sausage.

As for crude protein percentage of sausage the results disagreed with Mohammed Elkhatimm *et al* (2013) 19.25%, and that reported by Dharmaveer *et al.,* (2007) [8] who found it 18.36%,however it was lowest than those found by Pereira *et al*., (2011) [20] as 26%, which may be due to the difference in sausage formulations.

Grover *et al*., (2005) [11] mentioned that, fat values of raw gizzard was 2.02% and 2.3%, respectively. Also Mohamed Elkhatim, *et al* (2013) [18] reported that, there were no significant differences (p≤0.05) in fat content among the different samples in their study of the effect of incorporation of chicken gizzard on the fresh and stored sausage, On the other hand, Sudheer., *et al* (2011) [24] mentioned that, the protein increased significantly, whereas, the fat content decreased significantly.

Ash content results agreed with that reported with Mohammed Elkhatim (2013) [18] who found no significance difference among treatments and it was in the range with those of Maha and Hassan, (2015) [16], but was differing from that of Hussein (2006) [12] and Maiti & Ahawat (2011) [17].

Table 2: Effect of incorporation different levels of giblets on chemical composition of beef sausage

Parameters	Sausage types				
	A	B	C	D	Significant
Moisture	66.88±0.47^{a}	65.90±0.67^{a}	63.62±1.22^{b}	62.24±0.12^{b}	**
CP	17.22±0.11^{c}	17.69±0.33^{b}	18.09±0.13^{a}	18.30±0.13^{a}	**
Fat	5.96±0.18^{d}	6.57±0.30^{c}	7.32±0.35^{b}	7.85±0.07^{a}	**
Ash	1.39±0.08^{b}	1.50±0.10^{b}	1.56±0.15^{b}	1.91±0.04^{a}	**

A=100% beef, B=70% beef+30% gizzard, C=70% beef+30% liver and D=70% beef+ 15% gizzard+15% liver
N=3/treatment, **=Significant differences at P<0.01
Different superscript letters within the same row means significant differences at P<0.05

Physical Properties

From Table 3 the effect of added different levels of giblets (gizzard and liver) was significantly affected cooking loss percentage and water holding capacity (P<0.01), type A beef sausage recorded the highest value of cooking loss and WHC followed by type B, these findings were in agree with those of Samaa *et al*., (2018) [22] who found that cooking loss was the highest in manufactured non- added giblets beef sausage, however it was in contrary in WHC results in non-added giblets beef sausage where it was increased by giblets

portions. Berker, (2023) [5] found that, chicken liver as chicken meat replacer at more than 50% significantly decreased WHC, and increased the cooking loss of the emulsion ($p<0.05$).

Table 3: Effect of incorporation different levels of giblets on studied physical traits of beef sausage

	A	B	C	D	Sig.
Cooking loss %	30.81±0.60^{a}	29.68±0.55^{b}	28.07±0.13^{c}	27.14±0.10^{d}	**
W.H.C	2.23±0.22^{a}	1.66±0.33^{b}	1.26±0.07^{c}	0.82±0.09^{d}	**

A=100% beef, B=70% beef+30% gizzard, C=70% beef+30% liver and D=70% beef+ 15% gizzard+15% liver, W.H.C=water holding capacity

N=3/treatment, **=Significant differences at P<0.01

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