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Effect of Chicken Giblets Incorporation on Sensory Properties, Microbial Count and Economic Cost of Beef Sausages

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Abstract

This study was conducted to evaluate the effect of partial substitution of beef meat with chicken giblets on some quality attributes of beef sausage, four sausage formulations were processed as A -control with 0% giblets, B -30% gizzards, C- 30% livers and D -15% gizzards +15% livers. The sausages were analyzed for sensory attributes, total bacterial count and production cost. The sensory evaluation results showed no significant differences ($P>0.05$) among the sausage types in color, texture, flavor, juiciness, and

overall acceptability. Similarly there was no significance difference ($P>0.05$) in total bacterial count among all treatments. Financial analysis revealed that, beef sausage incorporated with chicken gizzards and chicken livers had lower production cost compared to control beef sausages. It can be concluded that, substitution of up to 30% chicken giblets in sausage formulation is feasible without negatively affecting sensory and microbiological quality, while also reducing production cost.

Keywords: Chicken Giblets, Beef Sausage, Sensory Evaluation, Bacterial Count

Introduction

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) [20]. Selection of meat for sausage production is important in achieving good quality products.

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 from 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) [4] prepared frankfurters with broiler neck meat, gizzards, and hearts, also Tarver *et al.* (1978) [18] prepared a pate with broiler hearts and livers. Lyon *et al.* (1982) [12] studied thigh meat patty products incorporating broiler giblets as to sensory evaluation, proximate composition analysis, and Texture Profile Analysis.

Chicken by-products are widely consumed due to their low cost, their low content in fat and the short period of time needed in preparation (Alvarez-Astorga *et al.*, 2002). In the last few decades, the amount of available meat byproducts from slaughterhouses, meat processors and wholesalers has increased considerably (Darine *et al.*, 2010) [6].

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) [10].

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) [21, 22] 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) [7]. 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.

The objectives of this study were: To evaluate the effects of incorporating broiler giblets (hearts, livers, or gizzards) on total bacterial count, sensory attributes and financial cost of sausage in addition to create good recipe and marketing for chicken gizzards and livers through sausage processing.

Materials and Methods

This experiment 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°).

Treatments formulation

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

- 100% beef (control), 0% chicken liver and gizzard.
- 70% beef, 30% chicken liver.
- 70% beef, 30% chicken gizzard.
- 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.

Sensory Evaluation

Ten (10) semi-trained panelists were asked to evaluate the treatments effect on color, tenderness, juiciness, flavor, and overall acceptability.

Samples in each treatment were taken after they had been cooked in a pan using vegetable oil at (90c) for 5minutes then placed in a dish which was divided into four portions Every treatment was given random four 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 (Cross *et al.*, 1975), in which the highest score of 8 being extremely desirable and 1 being extremely undesirable, tap water was available for use between testing samples for washing hands and mouth cleaning.

Total bacterial count

Standard plate count agar media was used to determine the total bacterial count. Samples were prepared according to the technique described by (ICMSF, 1978) [9]. Briefly, 1g from each sample was transferred under aseptic condition to glass tube containing 9ml of sterile normal saline. The content of the tube was homogenized by dipping and shaking the sample to have a dilution of 10^{-1} .

About 10^{-15} ml of plate count agar media poured aseptically into sterile petri- dishes. One ml from dilutions added to each petri – dish, and they were transferred to an incubator at 37c° for 48 hours. A colony count was used for counting colonies grown in the incubated petri – dishes. Such homogenate was used for all bacterial investigation. Further, 5 fold serial dilutions were prepared up to 10^{-5} .

Financial cost determination

To determine the financial cost of each treatment we calculated the price of all additives and materials involved in each treatment. Table 2 which represents the (A) treatment (control 100% beef meat) the financial cost of 1.573kg from sausage processed reached (346 SDG) this mean (1kg cost 219.96 Sudanese pound). Treatment (B) (Table 3) 70% beef meat with 30% chicken liver, the financial cost of 1.573kg from sausage processed recorded (286 SDG) this mean (1kg cost 181.81 Sudanese pound). In the treatment (C) (Table 4)

70% beef meat with 30% chicken gizzard, the financial cost of 1.573 kg from sausage processed recorded (286 SDG) this mean (1kg cost 181.81 Sudanese pound). In the treatment (D) (Table 5) 70% beef meat with 15% chicken liver and 15% chicken gizzard, the financial cost of 1.573 kg from sausage processed recorded (286 SDG) this means (1kg cost 181.81 Sudanese pound).

Table 2: Financial cost of sausage processed from (100% beef + 0% chicken liver and gizzard)

No	Ingredient	Quantity/ gram	Price/ pound
1	Additives	573	46
2	Meat	1000	300
3	Liver	-	-
4	Gizzard	-	-
Total		1573	346

Table 3: Financial cost of sausage processed from (70% beef + 30% chicken liver)

No	Ingredient	Quantity/ gram	Price/ pound
1	Additives	573	46
2	Meat	700	210
3	Liver	300	30
4	Gizzard	-	-
Total		1573	286

Table 4: Financial cost of sausage processed from (70% beef + 30% chicken gizzard)

No	Ingredient	Quantity/ gram	Price/ pound
1	Additives	573	46
2	Meat	700	210
3	Liver	-	-
4	Gizzard	300	30
Total		1573	286

Table 5: Financial cost of sausage processed from (70% beef + 15% liver + 15% gizzard)

No	Ingredient	Quantity/ gram	Price/ pound
1	Additives	573	46
2	Meat	700	210
3	Liver	150	15
4	Gizzard	150	15
Total		1573	286

Statistical analysis

Complete randomized design was used in this study. Data of sensory evaluation and total bacterial count 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

Sensory Evaluation

Sensory evaluation results of the studied sausage types (Table 6) revealed no significant differences ($P>0.05$) among treatments, but type A(100%beef) showed the highest score in color, texture and flavor whereas type B(70%beef+30%liver) was the highest in tenderness and type D was the highest score in juiciness and overall acceptance. These results agreed with Mohammed Elkhathim *et al.*, (2013) [13] who revealed in their study of five types of sausage with different level of gizzards meat (100%, 75%, 50%, 25%, and 0%) that, there was no significant difference ($p \leq 0.05$) in sensory attributes such as appearance,

tenderness and overall acceptance. Sensory evaluation showed that gizzards and liver sausage was very acceptable from the standpoint of color, taste, odor, juiciness, tenderness and overall acceptability, (Samma *et al.*, 2018) [16]. Also the results in agreement with Mohammed Elkhathim *et al.*, (2014) [14] who reported that, there was non-significant difference ($P \leq 0.05$) between gizzards and beef burger in their appearance, tenderness, firmness, taste and overall acceptance and Harapin Hafid *et al* who indicated that, the addition of giblets to beef meatballs did not have a significant effect ($P>0.05$) on the organoleptic test of beef meatballs, especially on the variables of shape, aroma, texture, taste, and general acceptance.

Table 6: Effect of incorporation of chicken giblets on sensory evaluation of beef sausage

Parameters	Sausage type				Sig.
	A	B	C	D	
Color	6.60±0.50	6.60±0.50	6.57±0.50	6.53±0.51	NS
Texture	6.60±0.50	6.53±0.51	6.53±0.57	6.53±0.51	NS
Flavor	6.57±0.50	6.57±0.50	6.53±0.51	6.53±0.51	NS
Tenderness	6.50±0.51	6.60±0.50	6.47±0.51	6.53±0.51	NS
Juiciness	6.50±0.51	6.50±0.51	6.53±0.51	6.60±0.50	NS
Overall acceptance	6.52±0.29	6.55±0.29	6.54±0.31	6.58±0.27	NS

A=100% beef, B=70% beef+30% gizzard, C=70% beef+30% liver and D=70% beef+ 15% gizzard+15% liver

N=3/treatment NS=No significant differences at $P<0.01$

Total Bacterial Count

The total bacterial count in different studied sausage types (Table 7) were insignificant differences ($P>0.05$). these results were meanwhile similar to those of Ali, (2014) [3] who found the addition of chicken gizzard slightly increased total bacterial count of the sausage sample. Mohammed Alkhathim (2014), *et al* reported that, fresh gizzards contained 1.3×10^3 cfu/g total viable count, while both gizzard burger and beef burger contained $\leq 10^2$ beef 25% GS, beef, and gizzards, no bacteria was detected, but they were 10^3 - 10^4 cfu/g. These results were acceptable as they fall within the confidence limits (10^7 cfu/g) of total viable counts of (chilled and unfrozen) fresh meat products like burger, sausage equired by the Sudanese Standardization Metrology Organization (SSMO). Alalla (1990) [2] reported that, the aerobic plate count of fresh meat before processing was (10^2 - 10^3 cfu/g) and after processing was (10^7 - 10^8 cfu/g).

Table 7: Total bacterial count (TBC) for studied sausage types

Sausage Formulation	TBC (log CFU/ml)
A	7.56±0.04
B	7.56±0.10
C	7.51±0.15
D	7.59±0.05
Significant	NS

N=3/sausage type, NS=no significant difference, CFU= coli forming unit

A=100% beef, B=70% beef+30% gizzard, C=70% beef+30% liver and D=70% beef+ 15% gizzard+15% liver

Recipe Cost

As it shown in (Table 8) the economic cost for the four samples (A), (B), (C), and (D) is 346, 286, 286, and 286 SDG respectively. The additive costs are equal in all treatments.

The calculation of the financial cost of sample (A) (1kg) is 219.96 SDG, sample (B) (1kg) is 181.81 SDG, sample (C)

(1kg) is 181.81 SDG, and sample (D) (1kg) is 181.81 SDG. That reflects the lower price of chicken gizzards and livers compared with prevalent market prices of sausage to reveal the possible market value of the product.

Incorporation of skin, gizzard and heart resulted in better overall acceptability of mutton nuggets. Gizzard contains approximately 20% proteins as reported by Rao *et al.*, (1997) ^[19] and also it is cost effective according to Mohamed *et al.*, (2014).

Table 8: Recipe cost of beef sausage treatments

No	Samples	Quantity/ kg	Cost/ SDG
1	A	1573 1	346 219.96
2	B	1573 1	286 181.81
3	C	1573 1	286 181.81
4	D	1573 1	286 181.81

SDG: Sudanese Pound

A: Control (100% beef + 0% gizzards and livers) B: (70% beef + 30% chicken gizzards)

C: (70% beef + 30% chicken livers)

D: (70% beef + 15% chicken gizzards + 15% chicken livers)

Conclusion

Gizzards and livers of poultry as a low cost alternative source of protein can be incorporated into sausages with a percentage 30% which can produce a product with acceptable quality and safe for consumption. Further studies should be done to high light the problem associated with broiler chickens offal especially gizzards, heart and livers.

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