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Effects of Incorporating Chicken's Gizzards and Abdominal Fat in the Quality of Burger Meat Product

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Abstract The present study aimed to incorporate broiler chicken's gizzard and abdominal fat in production of burger. The effect of sex and weight of chicken on gizzards weight was determined. Two types of burger were processed, gizzard burger (GB) and beef burger (BB) and compared with Looli commercial burger (LCB). The quality of burger products was assessed using chemical and microbiological analyses as well as sensory evaluation. The results showed non-significant difference ($P \leq 0.05$) between the two sexes on gizzards weight, while there was a significant difference ($P \geq 0.05$) due to the birds weight. Salmonella was not detected in the gizzards, while *E.coli* and Salmonella were present with high counts in beef fat. There was non- significant difference ($P \leq 0.05$) between gizzards and beef burger in their appearance, tenderness, firmness, taste and overall acceptance. Storage of meat and meat products lead to a significant increase in the total viable bacterial count. Storage increased moisture, ash, and pH, but decrease fat and protein. The study recommends utilization of gizzards and abdominal fat in burger production after proper and quick cleaning.

Keywords Gizzard, Abdominal fat, Microbial analysis, Sensory evaluation

1. Introduction

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 [1].

According to Ministry of Animal Recourses [2], the production of chicken broilers was increased from 15×10^3 kg in 2×10^3 to 35×10^3 kg at 2007, and the consumption of poultry meat had been increased from 0.8 kg per capita per year 2000 to I kg per capita per year in year 2007, and according to the Sudan quarter century comprehensive national Strategy it will increase from1 kg per capita per year to 5.5 kg per capita per year at year 2012.

The increasing in the production of broilers followed by increasing in the quantities of offal's especially gizzards with high percentages of proteins and fats, can contribute for human consumption. However, the high contents percent of fat makes gizzards tasty with pleasant flavor and popular to the consumer. Depending on the cultural context, offal's may be considered as waste materials that is thrown away, or as delicacies that command a high price.

The gizzards are muscular organ used for grinding and mixing of the food materials in preparation for digestion, thus replacing the mastication function of the teeth. The strength of the gizzard muscle and tough leather-like lining allow utilization of grit as well as the feed particles producing much friction in the grinding process. The physical breakdown of large feed particles increases their surface area, allowing more complete enzymatic digestion [3].

Gizzards are consumed in several countries especially Asian countries. Many products were processed from gizzards, for example, in China, fermented sausage, and dried gizzrards are produced, in Jordon sandwiches were prepared from gizzards.

The Sudanese utilize gizzards traditionally in various ways, one of these ways is to be fried with its own fat, or using the abdominal fat of chicken, after addition of some herbs. They also use another method in which gizzards are cooked with other giblets of chicken like livers, hearts, and neck, abdominal fat of chicken, plus onions, garlic, and and several types of herbs added (personal communication). The main objectives of the present study were to assess the effect of incorporating gizzards and abdominal fat of the chickens in burger processing and to evaluate the quality aspects of the product.

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2. Materials and Methods

2.1. Materials

Gizzards were collected from slaughtered broiler chickens at Albashair farm, Wad Medani city, Sudan. Meat from one beef carcass was used for all treatments to minimize variation in meat source. Fat used in the sausage was obtained from the chicken abdominal fat pad. The gizzards, meat of beef, abdominal fat pad of chicken, onion, and garlic, were ground separately to pass through 44 mm sieve using an electric type grinder mill. Chick peas was soaked overnight and then ground to pass through 44 mm sieve using electric grinder. White rice was also soaked overnight, dried and then minced using an electric mincing machine.

2.2. Burger Processing

Two types of burger were processed in the laboratory using two types of meat (gizzards and beef), with the same ingredients (chicken abdominal fat 10%, chick peas 10%, rice 10%, water 5%, salt 1%, onion 1.7%, garlic 1%, and seasoning mixture 1.3%). All ingredients were mixed together in a silent cutter and then formed using a burger machine. The average weight of the burger piece was 70g.

2.3. The Effect of the Birds Sex and Weight on the Gizzards Weight

The effect of the birds sex and weight on the gizzards weight was assessed by weighing selected birds males and female as well as gizzards of the same birds, was measured using a digital balance.

2.4. Proximate Chemical Analysis

The proximate chemical composition of samples was determined according to AOAC [4] methods, these analyses included: the contents of moisture, ash, proteins, fat and crude fibre, the carbohydrates contents were determined by difference.

2.5. Determination of Free Fatty Acids

Free fatty acids content was determined according to the method of (AOCS [5]. Samples of beef fat and abdominal fat of chicken was mixed separately until become entirely liquid before weighing and heated at 8˚C. Then 3.525g of each type of fat was weighed in an oil sample bottle, then 100 ml s of ethanol were added and 2ml of methyl violet was also added, then titrated with standard sodium hydroxide, and shake vigorously until the appearance of fires permanent pink color of the same intensity as that of the neutralized ethanol before the addition of the sample, free fatty acid percentage was calculated as follows:

$$\text{Free fatty acids as palmitic \%} = \frac{\text{ML of alkali} \times \text{N} \times 25.6}{\text{Mass, g of sample}}$$

2.6. Microbial Analysis

Microbial load on the gizzards, beef, and burger samples were determined for all burger samples. The total viable, Coliforms, yeast and mould counts were determined using plate count agar, Mac-Conkey agar and potato dextrose agar, respectively. The presence of *E. coli* was confirmed using the positive tubes for Coliforms test which were sub cultured into *E. coli* broth medium and then incubated at 44.5° for 24 hour.

The salmonella was detected using the following method: Ten grams sample were weighed aseptically and mixed well with 100 mls sterile distilled water, and incubated at 37℃ for 24 hours. Then 10 ml were drawn aseptically and added to 100 ml selenite broth. The broth was incubated at 37℃ for 24 hours. Then with a loop full streaking was done on Salmonella and Shigella agar plates. Plates were incubated at 37^0C for 72 hours. Black metallic sheen discrete colonies indicated the presence of salmonella.

2.7. Sensory Evaluation

To assess eating quality, the burger types were shallow fried in vegetable oil for 5 – 10 min and served to a panel of 15 panelists, samples were randomly presented to panelists. The panelists were asked to evaluate the quality in judges in terms of appearance, tenderness, firmness, taste and over all acceptability on four grades scale (4: excellent, 3 very good, 2: good, 1: bad).

2.8. Statistical Analysis

Statistical analysis of the data was performed using SPSS (13.0) program. All parameters studied were analyzed by one–way analysis of variance. Means were compared by using LSD test with significance level of 0.05.

3. Results and Discussion

3.1. The Effect of the Birds Sex and Weight on the Gizzards Weight

Table 1. The effect of the birds sex and weight on the gizzards weight

Sex	Weight	Body weight(kg)	Gizzards weight(g)
Female	Light	2.20^{d}	41.71^{c}
	Heavy	2.73^{b}	43.15^{bc}
Male	Light	2.51^{c}	43.67^{b}
	Heavy	2.91^{a}	47.43^{a}
	S.E±	3.090	

* For each parameter in a column followed with a different letter are differ significantly at level 5%

The effect of the birds sex and weight on the gizzards weight is indicated in Table (1) which shows that shows that there was non-significant difference ($P \leq 0.05$) between the gizzards weight of the light and heavy females and between the heavy females and the light males, but there was a significant difference at ($P \geq 0.05$) between heavy males and the light females, heavy females, and the light males. However, the highest weight of the gizzards was related to the heavy males (47.43g) and the lowest weight of the

gizzards was related to the light females. These results were in agreement with (Mohammed [6] who reported that there was no significant difference (P≤0.05) between gizzards weight of males and females.

3.2. Proximate Composition

The proximate composition of various burger samples are shown in Table (1). The moisture and crude fibre contents were relatively similar in the various burger samplers and non-significant differences existed between those samples. However, the contents of proteins, ash and fat differed between the various burger samples, with the greatest values recorded for beef burger (BB), and followed by Looli Commercial Burger (LCB) and finally Gizzards Burger (GB). The lower protein content of GB is probably due to substitution with non meat components (gizzard). Fat content did not exceed 30% (maximum amount stipulated in the FAO [7] in all tested burger samples. On the other hand, the carbohydrates contents differed significantly in the various burger samples, with the LBC contained the highest value (9.86%) followed by GB (7.57%) and finally BB which contained the least value (5.63%). Generally, beef burgers had higher protein (14.76%) and fat (22.62%) contents, while the higher moisture and carbohydrates contents were found in Looli commercial burger which was 54.61% and 9.86%, respectively. The proximate analyses of locally processed beef burgers have been reported by many investigators [8, 9, 10, 11 and 12].

Table 2. Proximate composition of various burger samples

Parameters	Treatments		
	Gizzards Burger (GB)	Looli Commercial Burger (LCB)	Beef Burger (BB)
Moisture	54.23 [a]	54.61 [a]	53.92 [a]
Ash	1.86 [b]	2.28 [a]	2.52 [a]
Protein	12.64 [b]	14.24 [b]	14.76 [a]
Fat	19.84 [b]	18.66 [c]	22.62 [a]
Crude Fibre	0.86 [a]	0.88 [a]	0.82 [a]
Carbohydrates	7.57 [b]	9.86 [a]	5.63 [c]

Table (3) shows the free fatty acids (FFA) content in the abdominal fat of broiler chickens and the cow fat. The table shows that there was no significant difference (P ≤ 0.05) between the two types of fat in the content of FFA. The higher value of FFA was found in the broiler chicken abdominal fat (9.61 ±1.02), and the lower value of free fatty acids was found in the cow fat (9.02 ±2.13%).

Table (3). Fee fatty acids content of chickens abdominal fat and cow fat

Type of fat	Means	S.E.
Chicken abdominal fat	9.61 [a]	1.02
cow fat	9.02 [a]	2.14

3.3. Microbial Load

Table (4) shows the microbial analysis of various samples of burger. Harmful bacteria such as salmonella, coliforms, *E. coli* as well as yeast and moulds were devoid in all tested samples. However, fresh gizzards contained $1.3x10^3$ cfu/g total viable count, while both gizzard burger and beef burger contained ≤ 10^2 beef 25% GS, beef, and gizzards, no bacteria was detected, but they were 10^3x10^4 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, etc.) Required by the Sudanese Standardization Metrology Organization (SSMO) [13]. Alalla [14] 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). There was no growth of Salmonella, Shigella, *E. coli*, and yeast and molds in the samples. The (SSMO) [13] requires presence of the less than 6.0 cfu/g mould in processing meat.

As for coliforms, there was no growth in all samples with exception to fresh gizzards which contained few cells (≤ 10^2). On the other hand, the SSMO [13] reported acceptable microbiological limits (50.0 cfu/g), and the level of maximum count as (5×10^2 cfu/g). However, there was a mixed growth (cocci+bacilli) in the gizzard sample. Coliforms are group of microorganisms which include *E. coli* an organism that causes bacteria dysentery and food infection.

Table 4. Microbial load (cfu/g) of fresh gizzards, gizzard burger (GB) and beef burger (BB)

Sample	Total viable count	*Salmonell a shigella*	*E coli*	Coliforms	Yeast
Fresh gizzard	$1.3x10^3$	Nil	Nil	≤ 10^2	Nil
Gizzard burger	≤ 10^2	Nil	Nil	Nil	Nil
Beef gizzard	≤ 10^2	Nil	Nil	Nil	Nil

Table (5) shows the sensory evaluation results of the gizzards burger (GB) and beef burger (BB) as well as Looli Commercial Brand (LCB). The appearance (Table (4) of LCB and GB differed significantly (P≥0.05), while there was non-significant difference (P≤0.05) between BB and LCB. The highest mean of appearance was recorded for LCB(3.50) followed by BB 100% (3.00), and the lowest was recorded in the GB (2.57).

As for the tenderness (Table 5), there were a significant difference (P≥0.05) among the different types of burger LCB, GB and BB, and there was non- significant difference when comparing GB and LCB. The highest level of tenderness was given to BB (3.57) followed by the LCB (3.14), and the lowest level of tenderness was given to GB 100% (2.93).

Table (5) indicate that there was a significant difference (P ≥0.05) among the various tested burger samples as regards as the firmness. However, there was non-significant difference (P≤0.05) when comparing the BB and the GB. The highest degree of firmness was found in LCB (3.64) and the lowest was that of GB (2.64).

As for the taste, the results indicate a significant difference (P≥0.05) between LCB and that at GB, and BB, however, there was non- significant difference (P ≤ 0.05) between GB

and BB. The highest scores of taste were given to LCB (3.71).

Table (5) also shows that there was a significant difference (P≥0.05) between LCB and GB in overall acceptance, but there was non-significant difference (P≤0.05) between LCB and BB, and between GB and BB. The highest scores of overall acceptance was found in LCB (3.71), while the lowest was given to the GB (2.93).

Table 5. Sensory evaluation of gizzards burger (GB), beef burger (BB) and Looli commercial burger (LCB)

Parameters	Treatments		
	Gizzards Burger (GB)	Looli Commercial Burger (LCB)	Beef Burger (BB)
Appearance	2.57 [b]	3.00 [ab]	3.50 [a]
Tenderness	2.93 [b]	3.14 [b]	3.57 [a]
Firmness	2.64 [b]	3.07 [b]	3.64 [a]
Taste	3.07 [b]	3.07 [b]	3.71 [a]
Overall acceptance	2.93 [b]	3.29 [ab]	3.71 [a]

GB = Gizzards sausage; BB = Beef burger; LCB= Looli commercial burger
*For each parameter means in a row followed by different letter differ significantly at 5% level

4. Conclusions

Based on the results, the use of chicken gizzards regardless of sex and/or weight of the chicken is encouraged to produce meat products such as burger, at commercial scale. As the broiler chickens gizzards cost less than 50% of the beef price, and since the results of the present study indicate that the burger products made from gizzards are safe microbiologically and acceptable by the panelists. Therefore, it is highly recommended to incorporate chicken gizzards in burger production as this will reduce the cost of the production, and will reduce the sale price of his product which lead to an increase of the sales and thus end increasing the producers's income.

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