



Effect of Fish Species on Physical, Chemical, and Organoleptic Properties of Fish Sausages

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Abstract – This research was conducted to investigate the chemical, physical, and organoleptic properties of fish sausages from two fish species. *Tetrodonfahaka* (A), and *Clariasgariiepinus* (B), were used in the experiment, and they were collected from three fish markets of Khartoum.

The protein values showed no significant differences ($p \geq 0.05$) between the samples (A) and (B), the upper value (20.7%) attained by the sample (A) *Tetrodonfahaka*. The upper value of moisture (77.6%) clarified within (A). The upper mean of fat (2.43%) attained by (B). The ash values had no significant differences ($P \geq 0.05$), and the upper mean of ash (3.33%) clarified within (B). The pH values showed no significant differences ($P \geq 0.05$) and the upper value (6%) attained by (B). Also the values of cooking loss showed no significant differences ($p \geq 0.05$) and upper mean of cooking loss (34.8%) clarified within (A).

Sensory evaluation was executed for color, texture, flavor, and juiciness. The results clarified good acceptability and there were no significant differences ($p \geq 0.05$) in color, texture, flavor and juiciness.

Keywords – Physical, Chemical, Organoleptic Properties, Sausages, *Tetrodonfahaka* and *Clariasgariiepinus*.

I. INTRODUCTION

Fish are aquatic vertebrae animals that are typically ectothermic (previously cold-blooded), some covered with scales, and equipped with two sets of paired fins and unpaired fins. Fish are abundant in the sea and in fresh water, with species known from mountain streams as well as in the deepest depths of the ocean. Fish are of importance as food for people around the world, either collected from the wild or farmed. Also they are exploited for recreation, through angling and fish keeping exhibited in public aquaria (FAO, 2002). They have an important role in many cultures through the ages, ranging as widely as deities and religious symbols to subjects of books and popular movies in various culture (Ackman., 1998).

The term fish processing refers to the processes associated with fish and fish products between the time fish are caught or harvested, and the time the final product is delivered to the customer. Although the term refers specifically to fish, in practice it is extended to cover any aquatic organisms harvested for commercial purposes, whether caught in wild fisheries or harvested from aquaculture or fish farming. It also involves primarily the application of preservation techniques in order to retain quality and increase shelf life. It may also mean adding value to produce a wide variety of products (Suzuki et al., 1991). A number of methods are used to preserve fish. There are various techniques based on temperature control, using ice, refrigeration or freezing; others on the

control of water activity that includes drying, salting, smoking and freeze-drying (Rehbein et al., 1998).

Sudan has important fisheries resources within its inland waters especially along the River Nile and in the marine sub-sector along the Red Sea coast. Estimates suggest that fish production could double and still be short of the full potential. Whilst techniques and vessels used in the inland fishery remain artisanal in nature, participants in the fisheries are becoming increasingly commercialized and investors are now operating fleets of simple vessels. Sudan is, however, imports a limited quality of fish from other areas of the Great Lakes region of Africa like Uganda, Nigeria (Braekkan et al., 1994).

Fish processing carried out in Sudan by traditional methods and the processed samples are relatively few with short shelf life and consumed locally. It is of prime importance to encourage upgrading of fish industry and to increase the investment in this sector, and to make use of stored fishes commercially via methods of preservation and processing of fishes (Suliman et al., 2012).

Sea food is being used as the dish of choice owing to its healthy image and delicious taste. The fishery industry has been developing, processed or minced fish products such as fish burgers, fish fingers and sausages which add cooking convenience and value to nutritional benefits (Mohammed & Alamalhodaa (2008). Fish flesh can be used as raw material for sausage production because its muscle protein can form gel and act as an emulsifying agent (Yeoman et al., 2009). Fish sausage paste has decisive influence on quality factors of the final product, such as texture, flavor, appearance and nutritive value (Simopoulos et al., 1991).

The main objective of this study is to investigate the suitability of sausages from (*Clariasgariiepinus*) and (*Tetrodonfahaka*) and their quality evaluations by physical, chemical, and organoleptic tests.

II. MATERIALS AND METHODS

The laboratory work was executed in the College of Animal Production Science and technology, in the department of Meat Science and Technology. Two species of fish (*Clariasgariiepinus*) and (*Tetrodonfahaka*) were used in processing of sausages. Their physical, chemical, and organoleptic properties were assessed.

2.1. Sausage Formulation

2.1.1. Fish Meat Preparation

Fish samples were collected from three markets. (Three replicates for each species). During transportation, the fresh lean meat was maintained as quickly as possible in



an insulated box using crushed ice at 5°C. Then fish meat (9 kgs) was thoroughly washed with chilled water prior to processing under hygienic conditions. The meat was ground through 0.25 in. Plate of electrical meat grinder.

2.1.2. Sausage Preparation

The ground fish meat (1.5kg) was formulated using the ingredients in table (1). Each patch was chopped separately. The chopper was started after the minced meat was introduced with salt and ice water were added and uniformly dispersed. Then the binder (skim milk) and seasoning (Cinnamon, Mace, Black pepper, Coriander and garlic) were added together ice water.

The batter of each batch was then stuffed into intestinal casing of 22 mm in diameter and linked at length about 8 cm. After that the product was immediately stored in refrigerator (4°C) waiting different tests.

Table 1. Ingredients of sausage and their percentage quantities

Ingredients	Quantities	Percent %
Fish meats	1500kg	% 63.8
Potato	300g	% 12.7
Coriander	4.5g	%. 2
Cinnamon	4.5g	%. 2
Mace	1.5g	%. 06
Garlic	1.5g	%. 06
Skim milk	4.5g	% 1.9
Ice-water	300ml	% 12.7
Bread crumbs	150g	% 6.3
Common salt	30g	% 1.15

2.2. The Chemical Analysis

Three sausage links were taken randomly from each treatment sample and then approximately 50 gms portion were taken, from different places of each link for the raw sausage. Chemical composition was determined as described by (AOAC, 2000) and all procedures of approximate analysis for the Protein, Fat, Moisture, Ash were executed in Khartoum University, Lab of Nutrition.

2.2.1. Crude Protein Content

The protein content determined by (kjeldhal) method (AOAC):

In (kjeldhal) flask ,1 gm of sample (flesh) was placed. Two (kjeldhal) tabs (1mg Na₂SO₄) equivalent of 1 mg Hg) were added; 25ml of conc. Sulphuric acid were added to the flask. The mixture was then digested on heater until clean solution obtained, and the flask were removed and left to cool.

The digested sample was poured in a volumetric flask (100ml) and diluted to 100ml with distilled water. 5ml of the dilution was taken and poured in a Markham still.

The distillation was received in a conical flask containing 25ml of 2% boric acid, plus three drops of indicator (methyl red). The distillation was continued until the volume in flask was 75ml. The flask was then removed from the distiller. The distillate was then titrated against 0.1 NHCL until the end point was obtained (red color). Protein content was then calculated as follows:

Nitrogen (%) = $N \times 0.1 \times 0.014 \times 20 \div \text{Weight of sample} \times 100$
Crude protein = $N \times 6.25 = \text{CP}\%$

2.2.2. Moisture Determination

Moisture was determined by, weighing of 5gm of the sample (flesh) into a weighted tarred silica or porcelain dish. Sample then dried in the oven at 105°C for 24 hrs, cooled in a desiccator and weightless, in weight (represents moisture). The moisture % was calculated as :
Moisture % = $(\text{Fresh weight} - \text{Dry matter} \div \text{Fresh weight}) \times 100$

2.2.3. 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 was then removed from the extractor and allowed to dry for 2 hours at 100°C in a drying oven, till no traces of ether remained. The sample was then cooled and weighted for the extraction percentage. Fat percentage was calculated as follows:

Fat% = $(\text{fat weight} \div \text{sample weight}) \times 100$

2.2.4. Ash Determination

Total ash determined by weighing out 5g of sample into silica dish, which has been previously ignited and cooled before weighing. Then the dish and contents were ignited, first gently and then at 550°C, until the ash got grey / white color. The dish was cooled at room temperature and by subtracting the weight before and after ashing, the ash was determined.

Ash = $(\text{Fresh weight} - \text{Ash weight} \div \text{Fresh weight}) \times 100$

2.3. Physical Analysis

2.3.1. PH Measurement

Ten grams of the sample were placed in a blender jar, and 100ml of distilled water were added. The mixture was blended at high speed for one minute. The PH of the mixture was measured, using a PH meter (model L pusl Munchen 15) which had been calibrated with two standard buffers (7 and 4).

2.3.2. Cooking Loss Measurement

Weighted 26 gram from each sample, were separately placed in nylon bag in thermal bath at 100°C for about one hour, then cooled and dried with clean papers. (Honikel 1998).

2.4. Sensory Evaluation of Sausages

The sensory evaluation was conducted in the sensory evaluation facilities Meat science and Technology Department. Ten (10) semi trained panelists were asked to evaluate the treatments effects on color, flavor, tenderness, and juiciness and over all acceptability after cooking each sample in oven (240°C) for 30 minutes and placed in a dish divided into 6 portions. Every treatment was given a random three code numbers which were changed in each test. Every panelist had one dish to evaluate in each session under natural light. Six points hedonic scale were used. Where (1) was moderately undesirable and (6) extremely desirable. Tap water was available for use between testing of samples.

2.5. Statistical Analysis

Statistical analysis was performed on all data of the various experiments using SPSS and was subjected to analysis of one way (ANOVA) test, least significant difference (LSD), (Gomez et al, 1984).



III. RESULTS

The obtained results from this study which studied Chemical Physical and organoleptic properties of fish sausages of the two species: *Tetrodonfahaka* & *Clariasgariepinus*; which were used in sausage preparation, and they were collected from three markets (Almorada' Almarkazi' Jabelawlia).

3.1. The Chemical Analysis

3.1.1. Protein

There were no significant differences ($P \geq 0.05$) in protein percentages between the two species (A) and (B), as shown in table (2). By using one way (ANOVA) test.

The upper mean of protein (20.7%) clarified with (A) species, and (16.7%) clarified with (B) species.

Table 2. The chemical analysis of protein, moisture, fat, ash for the (A) and (B) species:

Parameter Species	Protein	Moisture	Fat	Ash
<i>Tetrodonfahaka</i> (A)	20.7±4.10	77.60±0.15	1.05±0.66	2.76±0.23
<i>Clariasgariepinus</i> (B)	16.70±1.10	71.6±0.85	2.43±0.53	3.33±0.55
Significant	NS	NS	NS	NS

4.1.2. Moisture

There were no significant differences ($P \geq 0.05$) in moisture percentages between the two species (A) and (B), as shown in table (3). The upper mean of moisture value (77.6%) clarified with (A) species and (71.6%) clarified with (B) species.

4.1.3. Fat

There were no significant differences ($P \geq 0.05$) in fat percentages between the two species (A) and (B), as shown in table (2). The upper mean of fat (2.43%) clarified with (B) species and (1.15%) clarified with (A) species.

4.1.1. Ash

There were no significant differences ($P \geq 0.05$) in ash percentages between the two species (A) and (B), as shown in table (2). The upper mean of ash (3.33%) clarified with (B) species and (2.76%) clarified with (A) species.

3.2. The Physical Analysis

3.2.1. PH

There were no significant differences ($P \geq 0.05$) in PH values between the two species (A) and (B), as shown in table (3). By using one way (ANOVA) test. The upper mean of pH (6%) clarified with (B) species and (5.9%) clarified with (A) species.

Table 3. The analysis of pH, and cooking loss for the (A) and (B) species:

Parameter Species	pH	Cooking loss
<i>Tetrodonfahaka</i> (A)	5.96±0.96	34.8±7.41
<i>Clariasgariepinus</i> (B)	6.06±0.46	25.7±5.92
Significant	NS	NS

3.2.2. Cooking Loss

There were no significant differences ($P \geq 0.05$) in cooking loss percentages between the two species (A) and

(B), as shown in table (3). The upper mean of cooking loss (34.8%) clarified with (A) species and (25.7%) clarified with (B) species.

3.3. The Sensory Evaluation

Sensory evaluation attributes of the various sausages from the two species as assessed by panelists:

4.3.1. Color

The color values for all samples of fish sausages reveal that, there were no significant differences ($P \geq 0.05$) between the sample (A) and (B) as shown in table (4). By using one way (ANOVA) test.

3.3.2. Flavor

The flavor values for the fish sausages reveal that, there were no significant differences ($P \geq 0.05$) between the sample (A) and (B), as shown in table (4).

3.3.3. Texture

The texture values for all samples of fish sausages reveal that, there were no significant differences ($P \geq 0.05$) between the sample (A) and (B) as shown in table (4).

4.3.4. Juiciness

The juiciness values for the fish sausages reveal that, there were significant differences ($P \geq 0.05$) between the sample (A) and (B) as shown in table (4).

Table 4. The sensory evaluation for the species (A) and (B):

Parameter Species	Color	Texture	Flavor	Juiciness
<i>Tetrodonfahaka</i> (A)	3.33±0.57	3.33±2.08	3.33±3.21	4.33±0.57
<i>Clariasgariepinu</i> s (B)	3.33±1.52	3.33±2.51	3.33±2.30	3.33±1.15
Significant	NS	NS	NS	*

IV. DISCUSSION

From all the results obtained from this study, it is evident that fish sausages are excellent and rich meal. They can be obtained by easy ways and low costs; specially commercial species such as those used in this experiment. Noticeable, although the costs are low, the commercial shops that practice this activity in Sudan are very few, for these reasons I executed the experiment specially from those two species and the analysis give present good and accepted results.

The result of the chemical composition of protein, moisture, fat, and ash clarified that:

There were no significant differences in protein, the sample (A) had the greatest value in protein (20.7%) was shown in (table 4), this result agree with the study which was conducted by (Rafiaa, 2008) who studied the chemical composition of sausage *Tetrodonfahaka* and found the protein range was 18-28%.

The high value of moisture (77.6%) attained by (A) agreed with (Selma, 2003) who studied the chemical composition of *Tetrodonfahaka* and found the moisture value (77.6 %).

The greatest value of fat contents (2.43%) attained by (A) in agreement with (FAO, 1976), report about approximate chemical properties of the fresh fishes (range



of the fat contents 2-10%).

There were no significant differences ($p \geq 0.05$) in ash values, and the greatest value of ash (3.3%) attained by *Clarias gariepinus* agreed with (FAO., 1976) range of the ash contents (2-4%). Also these results were in agreement with (Ahmed. 2006) ash content of the fresh fish which ranged between 2-4.

While these results were different from the finding of (Hecht et al. 1988) who reported feed conversion ratios (FCR) and cost efficiency of *Clarias gariepinus* used in South Africa and he found 2-6 the range of ash content.

There were no significant differences in pH, the sample (A) had the greatest value in PH (5.9%).

There were no significant differences in cooking loss. Sample (A) had the greatest value in cooking loss (34.8%) which refers to their high content of moisture and juiciness.

Also this study was conducted to determine the levels of acceptability of all sausage samples regarding color, flavor, texture, and juiciness.

The color values for the fish sausages reveal that, there were no significant differences ($P \geq 0.05$) between the sample (A) and (B).

The flavor values for the fish sausages showed no significant differences ($P \geq 0.05$) between the samples (A) and (B).

The texture values for the fish sausages showed no significant differences ($P \geq 0.05$) between the samples (A) and (B).

The juiciness values for the fish sausages revealed significant differences ($P \geq 0.05$) between the samples (A) and (B), this result agreed with Judge et al. (1990), who said the degree of shrinkage on cooking, is directly correlated with loss of juiciness. There are some suggestions that juiciness reaches a minimum when the PH level of the meat is about 6.0 (Howard et al., 1956).

These results indicate that the panelists could pick significant differences difference between the two species. Just in juiciness which refers to many reasons such as, the environments variations of the fish sample, that were collected from them and seasons, ages, sexes.

V. CONCLUSION

This study clarified the high nutritive value of fish sausage and their beneficially characteristics such as, easy way to process, cheap raw materials (specially the third class species, not attractive to consumers such as *Clarias gariepinus* and *Tetrodon fahaka* which were used in the experiment).

Some factors (environment, seasonage and sex of the fish), had effects on the chemical, physical and organoleptic properties of fish meat and effect on the quality of the sausages.

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