بسم الله الرحمن الرحيم

Sudan University of Sciences and Technology
College of Graduate Studies

Effect of Fish Specie on Chemical, Physical and Organoleptic Properties of Fish Sausages Khartoum state

تاثير نوع الاسماك على الخصائص الكيميائية والفيزيائية والحسية للسجق المصنع من للحوم السمك بولاية الخرطوم

A dissertation submitted in Partial Fulfillment of the Requirement for the Degree of Master of Science (M.S.c) in Fish Science and Technology

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الإستهلال

قَالَ تَعَالَىٰ:

﴿ وَيَسۡـَٔلُونَكَ عَنِ ٱلرُّوحِۖ قُلِ ٱلرُّوحُ مِنۡ أَمۡرِ رَبِّي وَمَآ أُوتِيتُم مِّنَ ٱلۡعِلۡمِ إِلَّا قَلِيلٗا ٨٥ ﴾:

صدق الله العظيم

سورة الإسراء (85)

Dedication

To all my family

Mother

Sister

Brother

Acknowledgements

Firstly I say praise is to Allah, the cherisher and sustainer of the words, to give me knowledge and power to complete this research.

Who gave me patience with to accomplish this research.

I would like thanks and deep gratitude my supervisor dm Mohammed abed salaam for her guidance during all stage this research.

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Abstract

The research was conducted to determine the chemical, physical and organoleptic properties of fish sausage made from meat of *Mormyrus Niloticus* and {B} *Bagrus Bayad*. The samples{3kg from each species} of study were collected from the Almurada market. In the chemical analysis, the results showed that there were no significant difference in moisture {p≥0.05} between the sample A{66.4±1} and B{68.3±1.01}. in protein in sample A{23.6±0.15} and B{23.±047}.But there were significant difference in fat {p≤0.05} In sample A{3±0.36} and B{2.4±0.17}, highest in Ash {2.3%} . there were no significant difference in Ash {p≥0.05} in sample A{2.1±0.22} and B{2.3±0.26}. there were significant difference in carbohydrate {p≤0.05}in sample A {4.6±1.09} and B {3.7±0.76}.there were no significant difference between in total volatile base nitrogen {p≥0.05} . In the physical analysis, the results showed that there were no significant differences in the sample for PH. In sensory of degree of the products ability in terms of color, texture, flavor and juice, the result showed that there was good acceptance, as there were no significant differences in color and texture; but there was significant difference in flavor and juice.

ملخص البحث

تم اجراء هذا البحث لتحديد الخصائص الكيميائية ، الفيزيائية والحسية للسجق المصنع من للحوم اسماك خشم البنات *Mormyrus Niloticus* وسمك البياض *Bagrus Bayad*. و تم جمع العينات الدراسه{ 3كليوجرام لكل نوع} من سوق الموردة.

عند التحليل الكيميائى اظهرت النتائج ان ليس هنالك فروق معنوية فى الرطوبة وكانت في العينةA {66.4±1} و B {68.3±1.01} . وليست هنالك فروق معنوية في البروتين وكانت في العينة A {23.6±0.15} وفي العينة B {23.±0.47}، بينما كانت هنالك فروق معنوية في الدهون في العينة{ 3±0.36} وكان في العينة {2.4±0.17}. و ليست هنالك فروق معنوية في الرماد عالية} في العينة A {2.1±0.22} وفي العينة B {2.3±26}. بينما هنالك فروف معنوية في الكربوهيدريت وكان في العينة A {4.6±1.09} وفي العينة B {3.7±0.76}.اما بالنسبة للمواد النتروجينية المتطايرة ليست هنالك فروق معنوية بين العينات اما التحليل الفيزيائى اظهرت النتائج ان ليس هنالك فروق معنوية عند قياس درجة PH. التقيم الحسي الذي اجري لمعرفة درجة قابلية المنتج من حيث الون ، الملمس ، النكهة و العصيرية. اظهرت النتائج ان هنالك قبولا جيدا حيث لم يكن هنالك فروقا معنوية في الون والملمس، ولكن اظهرت النتائج ان هنالك فروقا معنوية في النكهة والعصيرية.

Introduction

Fish are classified as any of cold-blood aquatic vertebrates of the super class pieces typically, Fish also refer to the flesh of such animals used as food. This supper class of vertebrates includes all the bony and cartilaginous finfish and mollusks and crustacean.

Fish are an important part of a healthy diet since they contain high quality protein, but typically present a low fat when compared to other meat; most fish contain omega-3 fatty acids and other essential nutrients, {Arias. 2009}.

There is considerable scope for increasing the production and consumption of fish in many developing countries. Global production from capture fisheries as well as aquaculture and fish food supply is current and the highest on record and remains highly significant for global food security, providing more than 15% of total animal protein supply, {Melaku,(2007)}. Consumer around the world increasing consumption of fish and fish product in recent years due recognition of their nutritional value {Tingman *et al*.,(2010)}.

Fish meal could be a major protein source in food diets, there are essential amino and fatty acids that are present in fish meal but not present in tissue from plants or animals. Well balanced regime that includes a variety of fish and fish production can considerate to heart health children for proper growth, {Mahmud *et al*.,(2010)}.

Fishery products constitute an important part international trade, currently worth more than US$ 5o billion, indicating increasing consumer interest in the commodity,{Samakupa. 2003}.

Sudan has important fisheries resources within its inland water especially along the river Nile and the sea red sub-sector along the red sea coast.

Fish processing carried out in Sudan by traditional methods, so the amounts of the processed samples are relatively few with a short shelf life and

consumed locally, therefore 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 {Suleiman . 2012}. The principle fish processing methods in Sudan are smocking, salting, sun-drying, fermentation, grilling and frying.

The predominant type of fishery product in any particular country is closely related to the food habits and purchasing power of the population, specific types of fishery product are best, suited as the local staple food, furthermore ,due to the lock of a good transport infrastructure for the transportation of fresh fish to towns and villages, and lock modern preservation techniques{Ali.1994)}.

Objectives:-

1- To investigate the chemical and physical properties of fish meat in sausages.

2- To evaluate the sensory properties of fish meat in sausages.

Chapter one

Literature Review

Meat industry is in continuous updating to improve eating quality characteristic, desirability acceptance and preference in this respect many efforts have been made to improve the quality, to meet the consumer demands, the demand for heather alternative diets and ingredients is increasing{Wang and Danu.2006}. Meat products are concentrated sources of high quality protein their essential amino acids contents usually compensate for deficiencies in diets made mainly of cereal and other vegetable protein.{Bender.1992}. Meat products are highly perishable and spoil easily, and soon become unfit to eat and possibly dangerous to heath through microbial growth, chemical changes and breakdown by endogenous enzymes. There are many factor effecting the shelf life of meat products, that include extrinsic factors such as temperature, relative humidity, the availability of oxygen, and physical state of meat, the other intrinsic factor such as water activity (Wa), pH, oxygen-reduction potential, the presence or absence of inhibitory substances and protective tissues, and nutritive value of meat{Judge *et al*.,(1990)}. Preservation of meat products usually is accomplished by different preservative methods such as chilling, freezing, use of irradiation and drying. {Frazier and West off. 1978}.

1-1-Nutritional Value of Meat:-

Meat is very good source of essential amino acids and lesser extent to certain minerals, vitamins and essential fatty acids are also present, meat is not usually relied upon for these components in a well balanced diet.{Judge, *et al*.,(1990)}. Also meat provides calories from protein, fat and limited quantities of carbohydrate present. People eat meat because of traditional, nutritional value, availability, wholesomeness variety and

social or religious customs. Meat in fact is desired food which is internal item of most meals in many countries, ultimately meat value is based on its degree on acceptability by consumers, satisfaction derived from meat consumption depends on psychological and sensory responses unique among individuals, such factors as appearance, purchase price ,aroma during cooking losses, ease of preparation and serving, edible portion, tenderness, juiciness, flavor and perceived nutritive value govern composite reactions of individual, among individual, there are wide variations importance attributed to such factors. Most fish are low in fat and cholesterol and a good source of protein, which make them a good choice for healthy diet, human bodies require a certain amount of protein daily and the body does not store protein so need replenish it in daily diet. All fish are a good source of B vitamins and oil-rich fish are a good source of vitamins A and D {Simopoulos *et al*., (1991)}. Many fish also provide a good source of calcium, oil-rich Fish, such also salmon, trout, mackerel, herring and Sardine, are an excellent source of omega-3 fatty acids, which are essential to our diet { Suleiman *et al*., (2012)}. Omega-3 fatty acids cannot be produced by the body so it is important to bring them into human diet and eating oil-rich fish provides the omega-3 fatty acids human need, some of the benefits of omega-3 oil in fish are below, reduces the risks of heart attacks, makes the blood flow easier through the body, reducing blood pressure it is felt that it help the heart beat steadier and reduces the chances of suffering from a stroke, some experts think that it can helping preventing cancer cells from developing to the tumor stage, it is also thought to reduce inflammation in rheumatoid arthritis patients. Omega-3 fatty acids can also help in development of the brain, nerves and eyesight. Fish is a good food for a low fat diet, it is low in calories and many types of fish not contain any unsaturated fat { Kiessling and John. 1992}.

1-2-Composition of meat Fish:-

1-2-1-Protein:-

The protein in fish muscle tissue can be divided into following three groups, structural protein are myosin, actin,tropromyosin and actomyosin, which constitute 70-80% of the total protein content (compared with 40% in mammals). These proteins are soluble in neutral salt solution of fairly high ionic strength (0.5m), sarcoplasmic proteins (myoalbumin, globulin and enzymes) which are soluble in neutral salt solution of low ionic strength (0.15m).this fraction constitutes 25-30% of protein connective tissue protein (collagen), which constitute approximately 3% of the protein . The amino acids composition is approximately the same as for the corresponding protein in mammalian muscle, and about 10% in elasmobranchi compared with 17% in mammals {Suzuki *et al*.,(1991)}. The structural protein make up although the properties may be slightly different, the corresponding PH values the protein have their lower solubility, the conformational structure of fish proteins is easily changed by changing the physical environment and how the solubility characteristics of the myofiberillar protein changed after freeze-drying treatment with high salt concentration or heat may lead to denaturation, after which the native protein structure has been irreversibly changed, when the protein denatured under controlled condition their properties may be utilize for technological purposes, {Rehbein, *et al.*, (1997)}.

The majority of the sarcoplasmic proteins are enzymes participating in the cell metabolism, such as the anaerobic energy conversion from glycogen to ATP if the organelles within the muscle cells are broken, this protein fraction may also contain the metabolic enzymes localized inside the endoplasmatic reticulum, mitochondria and lysosomes. The fact that this composition of the sarcoplasmic protein fraction changes when the organelles are broken was suggested as a method for different fresh from

frozen fish, under the assumption as a organelles were intact until freezing, {Rehbein et al., (1998)}. However it was later stated that methods should be used with great caution, as some of the enzymes are liberated from the organelles also during iced storage of fish, {Rehbein *et al.*,(1997)}.

The chemical and physical properties of collagen protein are different in tissues, such skin, swim bladder and the myocommata in muscle{Molhur.2000}.

In general collagen fibrils from delicate network structure with varying complexity in the different connective tissues in a pattern similar to that found in mammals, however the collagen in fish is much more thermolabile and contains fewer but more labile cross-links than collagen from warm-blood vertebrates the hydroxyprolin content is in general lower in fish than in mammals, although a total variation between 4.7-10% of the collagen has been observed, {*Sato et al.*, (1999)}.Different fish species contain varying amounts of collagen in the body tissues, this has led to a theory that the distribution of collagen may reflect the swimming behavior of the species,{Yoshinaka. *et al.*,(1998)}.Further the varying amount and varying types of collagen in different fishes may also have an influence on the textural properties of fish muscle {*Montero et al.*,(1998)}.

1-2-2-Lipids:-

The lipids present in teleoste fish species may be divided into two major groups, the phospholipids and triglyceridees. The phospholipids make up the integral structure of the unit membranes in the cell; they are often called structure lipids. The triglycerides are lipids used for storage of energy in fat depots, usually within special fat cell surrounded by a phospholipids member and a rather weak collagen network {Simopouloe *et al.*, (1991)}.

The triglycerides are often termed depot fat, few fish have esters as part of their depot fats, the white muscle of a typical lean fish such as cod contains less than 1% lipids, the phospholipids make up about 90% {Ackman *et al*.,(1998)}. The phospholipids fraction in a lean fish muscle consists of about 69% phosphatidyl-choline19%phosphatidyl-ethanolamine and 5% phosphatidyl-serine, in addition there several other phospholipids occurring in minor quantities, the phospholipids are all contained in membrane structure, including the outer cell membrane, the endoplasmic reticulum and other intracellular tubule systems, as well as membranes of the organelles like mitochondria, in addition to phospholipids the membranes also contain cholesterol, contributing to the membrane rigidity, in lean fish muscle cholesterol may be found in quantity of about 6% of the total lipids, this level is similar to that found in mammalian muscle {*Takama et al*.,(1995). As already explained fish species may be categorized as lean or fatty depending on how they store lipids for energy, lean fish use the liver as their energy depot, and the fatty species store lipids in fat cells throughout the body, the fat cells making up the lipid depots in fatty species are typically located in subcutaneous tissue, in the belly flap muscle and in the muscle moving the fins and tail, in some species which store extraordinarily high amount of lipids the fat may be deposited in the bell cavity, depending on amount of polyunsaturated fatty acids, most fish fats are more or less liquid at temperature {Ando. 1999}.

Finally fat depots are also typically found spread throughout the muscles, the concentration of fat cells appears to be highest close to the myocommata and in the region between the light and dark muscle {*Kiessling et al*.,(1992)}. The dark muscle contains some triglyceride inside the muscle cells even in lean fish, as this muscle is able to metabolize lipids directly as energy, the corresponding light cells are

dependent on glycogen as a source of energy for the anaerobic metabolism {*Takama et al*.,(1995)}.

In dark muscle the energy reserves are completely catabolized to co^2 and water, whereas in light muscle lactic acids is formed, the mobilization of energy is much faster in light muscle than in dark muscle, but the formation of lactic acids creates fatigue, leaving the muscle unable to work for long periods at maximum speed, thus the dark muscle is used for continuous swimming activities and the light muscle for quick bursts such as when the fish is about to catch a prey or to escape a predator {*Ando et al*.,(1999)}.

1-2-3 Carbohydrate:-

Fish muscle normally contains only carbohydrates, in from of sugar phosphates and glycogen, some other tissue such as liver contain large amounts as glycogen, and most molluscan shellfish also contain a fair amount of glycogen {*Atike et al*.,(2011)}.

1-2-4 Vitamins and Minerals:-

The amount of fish vitamins and minerals is species specific and can furthermore vary with season. In general fish meat is a good source of B vitamins, in the case of fatty species, also of the A and D vitamins, some fresh water species such as carp have high thiaminase activity so thiamine content in these species is usually low. As for minerals, fish meat is regarded as a valuable source of calcium and phosphorus in particular but also iron, copper and selenium, while salt water fish have a high content of iodine, {Kossel *et al*.,(1999)}.

1-2-5-Water Holding Capacity:-

The water holding capacity(WHC) is the ability of meat to retain its water or added water during application of external forces such as eating, heating, grinding or pressing, many of the physical properties of meat(include color, texture, tenderness and juiciness of cooked meat)

are partially dependent on WHC { *judge* et al.,(1990)}. Water exists in the from of bound, immobilized and free water molecules are not electrically neutral, but have positively and negatively charged ends. Thus they are associated with electrically charged reactive groups of muscle protein. Of the total water in muscle 4-5 percent at the end known as bound water. Other water molecules are termed immobilized water which is weaker as the distance from the reactive groups on protein becomes greater and water held only by weak surface forces is known free water. The number of reactive groups on the protein and their availability for binding water are dependent on the production of lactic acids, loss of ATP, onset of rigor mortis and changes of cell structure associated with photolytic enzyme {Judge *et al*.,(1990)}.

The water holding capacity of meat is affected by several factors such as species, age and muscular function, muscles having high content of intramuscular fat tend to have a high WHC {Saffle and Brazler.1959}.

The water holding capacity is strongly dependent on the PH of the meat, at PH corresponding to the isoelectric point of actomyosin WHC of meat at its minimum{Thomsen and Zeuthen. 1988}.

1-3-History of sausages:

The term sausage is derived from the Latin word "salsas" meaning salt or literally translated refers to chopped or minced meat preserved by salting {person and Tauber. 1984}.

It had reported that sausages were used by Babylonians and the Chinese about 1500 B.c, although most of these population groups living in the same neighborhood frequented developed a taste of these characteristic products {Person and Tauber. 1984}.

1.4. Types of Sausage:-

Europeans had produced many kinds of sausage, particular types in specific areas in conformation to climatic condition for example in

Germany and northern European countries characterized by periods of cold weather, fresh sausages were developed. While the Mediterranean climate in Italy and southern France encourages the preparation of dry sausage that kept well {Shewan.1999}.Sausages came in many shapes and different combinations of meat and spices in some countries there are classified by the degree combination, coarse grind or grind sausages which add only to confusion {Mohammed. *el al*., (2008)}.

According to the combination at the sausage can be classified to:-

1-Fish sausage:-

In which the production is popular in countries such as the Philippines, Thailand, Malaysia, Japan and China. The products are often made into fermented fish paste and fish sauce which were used for general cooking.

2-Sasuage fish-rice:-

Is used as filler and the source of carbohydrates for fermentation.

3-Sasuage chicken.

4-Sasuage beef. {Person *et al*, (1984)}.

1-5-Organoleptic Properties Sausages:-

Many of physical properties have an effect on fish sausage such color, texture, flavor and juiciness, which have a direct effect on the of meat during storage and loss of moisture, the loss weight during storage is great {Judge *et al*., (1990)}.

1-5-1-Color:-

Color is one of the primary attributes affecting the acceptability

Of meat products by consumers {Trout.1991}. Color is important factor particularly for the buying consumer dependent upon the quantity and oxidation states of muscle, there is no fish muscle and the color is white or grayish color {Hood and Riordan. 1971}.

1-5-2-Flavor:-

The flavor is involves oder and taste or cooking meat. It originates from water or fat soluble precursors and from the release of volatile substances pre-existent in meat. The flavor development is an important result of cooking the nature and intensity of meat flavor depend in part on the type, length and time and temperature of cooking {Price *et al*., (1970)}.

Two important points must be considered in meat flavor, the first is that each kind of meat has characteristics flavor, and second is that the flavor can modified by change in condition of cooking {Herrick son *et al*, (1978)}.

{Angelo. 2001} reported that components of meat responsible for flavor had not completely identified, it is likely many constituent of muscle connective and adipose tissues became flavor compounds upon being heated.

1-5-3-Texture:-

Food texture defined the composite food of these properties which arise from the structural and the manner in which it register with the physiological sense { Kumer *et al*. ,(1974)}.

Resulting from the application of pressure and for surface by sense of, while consumer develops some idea of texture.

1-5-4-Juiciness:-

The degree of shrinkage on cooking is directly correlated with loss of juiciness; the principal source in meat as detected by consumer, is the intramuscular lipids and the water content {Judge *et al.*, (1990)}.

Good quality meat is more juicy than that of poor quality, the difference at least partly attributable to higher content of intramuscular fat in the consumer, on the other hand there are some suggestions that juiciness reaches minimum when the PH the meat is about 6.0 {*Howard et*

al.,(1956)}. There is relation between organoleptic, chemical and characteristic in types of sausages, the study concluded that chemical and organoleptic characteristic are not always corrected and that quality of sausage are best based on organoleptic assessment, the chemical composition serving as a guide to their biological value {Fiems *et al*.,(1991)}.

Chapter Two

Materials and Methods

2.1. Place of Laboratory:-

The process of sausage was applied in the laboratory Sudan University Science and Technology, College of Animal Production Science and Technology, the Department of Meat Science and Technology, in East Nile.

2.2. Sausage Formulation:-

2.2.1. Fish meat:-

The flesh of fresh fishes approximately 6Kg was colected The samples of study were from a single market {Almurada market}.

The flesh of fresh of fishes cleaned and washed very well, and put into box of crushed ice during transportation, for the processing.

2.2.2. Sausage Processing:-

The process started by minceding fish meat from the { 3kg from each one}, then Salt and Spices were added {table 1}.

Also was added ice water and the mixture very well.

The mixture was packaged into sheep intestinal casing about 22 mm in diameter and sausages were stored at 4 □ c.

Table (1): Percentage of the quantities of ingredients in processed sausage .

Ingredients	Quantities	Percent%
Fish meat	1500 kg	%63
Skim milk	4.5 g	1.9%
Bread crumbs	150 g	6.3%
Potato	30 g	12.7%
Common salt	30 g	1.15%
Cinnamon	4.5 g	0.2%
Ginger	4.5 g	0.2%
White pepper	1.5 g	0.06%
garlic	1.5 g	0.06%
Coconut tiyyp	4.5 g	0.2%
Ice water	30 ml	12.7%

2.3. The chemical analysis:-

2.3.1. Moisture determination:-

Moisture was determined by weight 5g from the sample in silica dish and recorded. The sample was dried in the oven at 105 □ c for 3-6 hours and allowed to cool and weight again and recoded as the dry weight of sample.

Moisture calculation:

Percentage of moisture%

((Weight of sample before dry-weight of sample after dry)\weight of sample before dry) ×100

2.3.2. Crude protein content:-

The protein content determined with kjeldhal method AOAO(2006)

In kjeldhal flask 1g of sample, two kjeldhal tabs

(1mg Hg, equivalent of 1mg Na2so4) and 25ml of sulphuric ,then to the flask, than the mixture placed on heater until clear solution obtained. The flask was removed and cooling.

Digested sample poured in a volumetric flask (1ooml) and diluted to 200ml with distilled water and 5ml of dilution was taken and poured in Markham still. The distillation received in conical flask containing 25ml of %2 boric and acid three drops of methyl red were added. Distilled water was added to the mixture until the volume 75ml in the flask. The mixture was titrated {0.1NHCL} until protein content was obtained.

Protein calculation:

Nitrogen (%) = N ×0.1×0.014×20)\weight of sample) ×100

Crude protein%= N×6.25

2.3.3. Fat determination:-

Fat was determined by ether extract method. 2g from sample were taken to soxhlet apparatus, the sample subjected to continuous extractor with ether for 6hours, then removed from the extractor and allowed to dry for 2hours at 100□ c in dried oven till no traces of ether of ether removed, then cooled and weighte.

Fat%= (fat weight\sample weight) ×100

2.3.4. Ash determination:-

For determination of ash 5g was weighted from the sample all ingeneration at 550□ c until become gray, than it is cooled.

Ash calculation:

Ash%= (Fresh weight-ash weight)\fresh weight) ×100

2.3.5 Carbohydrate count:-

The count of carbohydrate by summation of the values of moisture, protein, fat, ash, and subtraction from 100.

CHO calculation:

CHO= 100- (moisture +protein +fat+ ash)

2.3.6 Total volatile base nitrogen TVBN determination:-

Total volatile base nitrogen was determined using kjeldhal apparatus. Addition of 10g from the sample to 2g magnesium, 25ml of 2% boric acid and to 300ml distilled water, than 3 drops of methyl red was added as indicator. The mixture was heated for 10 minutes and then titrated {0.1sulfuric acid}. Reading of the liquid was multiplied by 14 to obtained TVBN as gN/100 flesh.

Total volatile nitrogen calculation:

TVN%= (V×N×14)\W) ×100

2.4. Physical Analysis:-

2.4.1 PH determination:-

10g of the samples was placed in the blender jar and 100ml distilled water was added. The mixture was blinded at high speed for one minute and the pH of the mixture was measured.

2.5. Sensory Evaluation of Sausage:-

Twenty (20) semi trained panelists asked to evaluate the treatment effects on texture, color, flavor, juiciness and overall acceptability after cooked. Each sample roasting in vegetable oil about 10 minutes and placed in plate, divided into two (2) portion .Every samples give two codes A and B.

2.6. Statistical Analysis:-

Statistical analysis performed on all data obtained using t.test chemical, physical analysis and total volatile nitrogen, organoleptic properties used Anova test.

Chapter Three

Results

The results obtained from fish flesh of this *Mormyrus Niloticus and Bagrus Bayed* after application of chemical, physical and organoleptic properties .

3.1. Chemical Analysis:-

3.1.1. Moisture:-

There were no significant differences {p≥0.o5} in moisture percentage between the two samples {A} and {B}.

The higher value was moisture {68.4%} in sample B with sample A was {table 2}.

Table {2} values of chemical analysis of sausages from fish flesh..

Sample	A	B
Moisture	66.4±1	68.3±1.01
Protein	23.6±0.15	23±0.47
Fat	3±0.36	2.4±0.17
Ash	2.1±0.22	2.3±0.26
Carbohydrate	4.6±1.09	3.7±0.76

Data presented as mean± stander deviation were significantly different (P≥o.o5)

3.1.2. Protein:-

There were no significant differences {p≥0.05} in protein percentage between two samples {A} and {B}.

The higher value was protein {23.6%} in sample A with sample B {23.%} { table 2}.

3.1.3. Fat:-

There were significant differences {p≤0.05} in fat percentages between two samples {A} and {B}.

The higher value was fat {3.%} in sample A with sample B {2.4%} { table 2}.

3.1.4. Ash:-

There was no significant difference {P≥0.05} in ash percentage between two samples {A} and {B}{table 2}.

3.1.5. CH:-

There were significant differences {p≤0.05} in CHO percentage between two samples {A} and {B}{table 2}.

3.1.6. Total Volatile Nitrogen:-

There were no significant differences {p≥0.05} in total volatile nitrogen between samples {A} and {B}. showed in table (3).

Table {3}values of total volatile base nitrogen from processed sausage from fish flesh.

Storage period	A	B
1	3.7±0.80	5.1±0.80
4	7.9±1.61	8.8±0.80
7	13.5±1.61	17±1.61
10	23.8±1.40	21.4±1.61
13	35.4±1.61	35.9±2.13

Data presented as mean± stander deviation are significantly different (P≥0.05)

3.2. Physical Analysis:-

3.2.1 PH:-

There were no significant differences {p≥0.05} in PH percentage between two samples {A} and {B}.

The higher value was PH {6.4%} in sample A with sample B {6.2%} { tableh 4}.

Table {4} values of physical analysis of sausage from fish flesh.

sample	A	B
PH	6.4±0.25	6.2±1.28

Data presented as mean± stander deviation are significantly different (P≥0.O5).

3.3. Sensory Evaluation:-

In evaluation of color and texture good acceptable but difference in acceptable in flavor and juiciness

.

Chapter Four

Discussion

The purpose of this study to measure effect chemical, physical and organoleptic properties of fish sausage.

The results of chemical composition analysis moisture, protein, fat, ash and carbohydrate of sausage were showed in table (2), and total volatile base nitrogen was showed in table(3).

The fish sausage showed significant difference ($p \geq 0.05$) in the chemical composition among the samples.

The chemical composition was in range 66.4-68.3% for moisture, 23-23.6% for protein, 2.4-3% for fat, 2.1-2.3% for ash and 3.7-4.6% for carbohydrate. Higher moisture contents { 68.3%} in sample B was similar to fish sausage evaluated by Raju *et al.*{2003} {68.6%}.

The protein content higher {23.6%} in sample A, this in greater with Rafida. {2013} the composition of sausage {28%} also similar was Bruna *et al*,{2013} in smoked sausage {19.3%}.

The fat contents higher {3%} in sample A this approximately similar Nural. {2013} and Olaa, {2013} found fat contents {3%}. The fat composition fish and its products depends on the species, age, size, and processing.

The higher value in ash {2.3%} in sample while Burna *et al*,{2013} {2.9} in raw sausage, but similar to that reported by Raju et al,{2003} {2.6}. The addition of condiments, mainly salt was responsible in the ash content in sausage *Verugopal*.2006.

The higher value in carbohydrate {4.6%} in sample {A}, this result was similar by Bruna et al,{2013] {4.7%}. Also addition of starch and sugar contributed to the carbohydrate contents *Venugopal*. 2006, reported the concentrations of sugar and starch added during fish sausage preparation, also corroborating results observed by Souza et al, {2004}.

Other ingredients such as starch, accounted for an increase in the carbohydrate content.

There TVB-N of fish is an indicator of the freshness of raw material Zhou *et al*, 2011. There were no significant difference (p≥o.o5) in total volatile base nitrogen in this study. The initial TVB-N value was range 7-9.8mg/100g in sample A and 8.8-9.8mg/100g in sample B the results were the same as reported by Fijelu *et al*, 2013. After 3 days of storage the TVB-N value was range 13.5-15.4mg/100g in sample A and 17-19.6mg/100g in sample B. TVB-N value are unacceptable and are associated with unpleasant smell in the meat Limo *et al*.2009. this is because of the impact of the various treatments of TVB-N, which primarily includes nitrogen from ammonia and dimethylamine which reflects the extent of degradation of protein and non-protein nitrogenous compound which can be explained by proteolysis, due to enzymatic and microbial activities in the samples *al* on storage(Erkan and Ozden.2008).

The result of physical analysis that there were no significant difference in PH between the species {A} and {B}.

The high value in PH {6.4%} in sample A was similar with *Paulo et*, 2010.

These studied determine the levels of all sausage of fish samples, concerning to color and texture there were no significant difference (p≥0.05) between the samples A and B, there were significant difference (p≤0.05) in flavor and juiciness between the samples A and B.

The suggestion for significant difference in flavor and juiciness the reason was species of fish used in experiment.

Conclusion and Recommendations

Conclusion:-

In this study of high nutritive values from fish sausage and their beneficially characteristic such easy to process and attractive to consumers to *Mormyrus Niloticus* and *Bayad Bagrus*, which were used in the experiment.

Recommendations:-

- Measurement the length, ages and six of fish to use in sausage of fish.
- Qualitative hygienic and heath full of fish species with product from sausage of fish.
- Cleanness and sterilizer the equipment to use in processing.
- The handling circulation of product must be controlled carefully by avoidance micro-organism and suitable temperature.
- Sausage products in local market must be in safe and good quality.
- More research in sausage to in fish enhance and development the quality.

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APPENIDX {1}

Tables

Table (10) chemical and physical analysis values for (A) and (B).

sample	moisture	protein	fat	ash	CHO	Energy	PH
A	67.48	23.61	3.48	1.97	81.8	453.1	6.20
	66.39	23.48	2.98	2.08	81.5	447	6.41
	65.48	23.79	2.76	2.41	81.3	445.5	6.71
B	68.39	22.48	2.41	2.48	82.4	441.2	6.21
	67.38	23.41	2.38	2.67	81.6	441.6	6.14
	69.41	23.14	2.41	2.17	81.4	440	6.39

Table {11} chemical analysis of total volatile nitrogen

Days	**(TVN)** ***Mormyrus Niloticus***		
	Read(1)	**Read(2)**	**Read(2)**
1	2.8	4.2	4.2
4	7	7	9.8
7	12.6	12.6	15.4
10	25.2	22.4	23.8
13	36.4	33.6	36.4
Days	**(TVN)*Bagrus Bayad***		
	Read(1)	**Read(2)**	**Read(3)**
1	4.2	5.6	5.6
4	8.4	9.8	8.4
7	16.8	19.6	16.8
10	22.4	19.6	22.4
13	36.4	33.6	37.8

APPENIDX {2}

Questionnaire for sensory evaluation

The values of these samples for color, flavor, texture and juiciness, each sample on the side with use of numbers attached below by gradient

When you have a problem, ask

-**name**:

-**data**:

-**product type**:

-**connoisseur:**

Number of sample	**color**	**texture**	**flavor**	**juiciness**	**comments**
( )					
( )					

color	**texture**	**flavor**	**juiciness**
8-Excellent in acceptance **7**-Good in acceptance **6**-Medium in acceptance **5**-Little acceptance **4**-Few do not accept **3**-Medium in not accepting **2**-Unacceptable	**8**-Excellent in acceptance **7**-Good in acceptance **6**-Medium in acceptance **5**-Little acceptance **4**-Few do not accept **3**-Medium in not accepting 2-Unacceptable	**8**-Excellent in acceptance **7**-Good in acceptance **6**-Medium in acceptance **5**-Little acceptance **4**-Few do not accept **3**-Medium in not accepting **2**-Unacceptable	**8**-Excellent in acceptance **7**-Good in acceptance **6**-Medium in acceptance **5**-Little acceptance **4**-Few do not accept **3**-Medium in not accepting **2**-Unacceptable