

**EFFECT OF SOME SELECTED PROCESSING METHODS ON THE
NUTRITIONAL QUALITY OF FRESH WATER APPLE SNAIL (*Lanistes libycus*)**

BY

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**DEPARTMENT OF AQUACULTURE AND
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FACULTY OF AGRICULTURE
UNIVERSITY OF BENIN
BENIN CITY**

JULY, 2021

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**A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF
AQUACULTURE AND FISHERIES MANAGEMENT, FACULTY OF
AGRICULTURE, UNIVERSITY OF BENIN, BENIN CITY IN PARTIAL
FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF
BACHELOR OF AGRICULTURE DEGREE B. AGRIC (FISHERIES)**

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CERTIFICATION

This is to certify that this research was carried out by **Emmanuel Onyemekihian OMOREGIE** in the Department of Aquaculture and Fisheries Management, Faculty of Agriculture, University of Benin, Benin City.

Dr. K. Omoruyi
Project supervisor

Dr. O.M. Wangboje
Ag. Head of Department

Date

Date

DEDICATION

To my Lord God Almighty whose mercy has no end and love no bound, I dedicate this work, for by his grace, love and mercies have brought me this far and not by my strength.

With deep sense of gratitude, I also dedicate this work to my loving parents Mr. and Mrs. M. O. Igunbor and my Lovely sister, Miss Joy Ndidi Omoregie for their support and love throughout my study years.

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ABSTRACT

The study is aimed at determining the effects of some selected drying method on the nutritional quality of Apple Watersnail (*Lanistis libycus*) purchased at Ikpoba hill market

One hundred and Fifty (150) Apple snail (*Lanistis libycus*) specimen was obtained from a fish seller and taken to the Faculty of Agriculture processing unit where processing was carried out using some selected methods. They were slaughtered, removed from the shell to collect the meat and discard the shell. They were weighed before been spiced and then dried using the different processing method (sun drying, smoked drying and oven drying). They were then taken to the lab for analysis. Statistical analysis using Genstat computer software was used to compute the result for proximate composition.

The result from this study will assist in determining the most appropriate method of processing with regards to nutrient availability and amount of moisture content hence the method that has the best rate of preservation.

CHAPTER ONE

1.0 INTRODUCTION

Fish is a good source of animal protein and minerals (Tidwell and Allan, 2001). Fish is widely consumed in many parts of the world because it has high protein content. The quality of fish protein is very high because of its low saturated fat, its richness with essential amino acids and also it's containing ω -3 and ω -6 fatty acids that is known to support good health. According to FAO, (2008) and Gandotra *et al.* (2012), fish provides 20% of animal protein intake to about 2.6 billion people globally and at least 50% of animal protein intake for over 400 million in Asia and Africa. In developing countries, it provides only 13% of animal protein intake. Fish constitute the major source of animal protein intake in Bangladesh due to its availability and low cost. Although, fish production is steadily increasing, preservation of the commodity still remains a challenging problem. Susceptibility of fish to rapid spoilage has been attributed to its intrinsic characteristics and to possibilities of microbial contamination from a variety of sources (Venugopal *et al.*, 1997). Preservation of fish can be achieved by various methods, which include, refrigeration, freezing, salting, canning (wet salting), icing, smoking, glazing, drying, frying, and so on. Therefore, the quality of fish processed by the various methods cannot be the same and hence its subsequent effect on the fish's shelf life also varies. It has been observed that different processing methods have different effects on the nutritional compositions of fish.

Shell fish is a term for all exoskeleton bearing aquatic invertebrate mostly used as food. They include various species of mollusc, crustaceans, and echinoderms, and include

various families, order, genera and species of fresh water animals and a few terrestrial representatives (Ramzy, 2009).

Snail belongs to the class Gastropoda which is the largest group of Molluscs and has more animal group after Antropoda. They are enclosed in calcareous shell and they possess un-segmented bodies (Barker, 2001; Ramzy, 2009).

The snails are alternative and non- conventional animal protein source in Nigeria and some other part of Africa. Snails are processed by different methods for consumption. The processing methods include roasting, frying, drying among others. Fish and shell fishes are good sources of not only fatty acid, but a source of easily digestible protein, and its amino acid profile usually contain most of the essential amino acid which is required for balance diet. They are also rich source of fat soluble and B group vitamins (Erkans and Bilen, 2009). Not only are they good source of nutrient, other economic importance of shell fish includes provision of employment, income and foreign exchange (Ezeama 2000). They occur abundantly in brackish and fresh waters (Tayo *et al*, 2008).

Various method of processing (roasting, grilling, oven drying, sun drying among others) greatly affect the proximate composition/ level of nutrient of food, in this case freshwater snail (Onyeika and Oguike, 2003). The energy required to drive the moisture from the surface of fish and aquatic snail can be obtained from a variety of sources including wood smoke, sun drying, solar drier, electrical and mechanical drier (Davies *et al.*, 2008; Tawari and Abowei, 2011). Processing of fish either through smoking or drying is widely used in fish preservation. In the process moisture content present in the fish is extracted through heating, thus inhibiting the action of microbes and increasing shelf life

(Oyeleye, 2003; Amoo *et al.*, 2007; Singh and Heldman 2013). However, Onyeike and Oguike, *et al.*, (2010), reported that different processing method including boiling and roasting, influences the proximate, mineral and toxicant composition of food.

1.1 Justification of study

Snail which is proven to be one of the highly nutritious food in terms of crude protein and other vital nutrient, Fresh water snail species which is domicile in our aquatic environment in abundance quantity but less utilized for nutritional purposes and as part of delicacies as regards to its terrestrial counterpart. Though consumed by indigenous communities, it is less utilized when compared to its abundance and probably wastage s a result of neglect.

Hence the need to study the nutritive value of the fresh water snail specie cannot be over emphasized using selected processing method as practiced in this part of the world with emphasis on nutrient availability and probably shelf life

Processing (smoking, sun drying, oven drying) of shell fishes is not regularly carried out in this part of the world, therefore the study is aimed at revealing the effect of sun drying, oven drying, smoke drying) on the nutritional quality.

1.2 Aim and Objectives

The aim of this study is to determine the effect of processing methods (smoke, sun, and oven dry) on the nutritional quality of fresh water shellfishes in Edo state

The specific objectives are to:

1. determine the proximate composition of fresh water snail sample processed using selected processing method

2. compare the proximate composition of the different processing method of fish processing
3. bi-weekly effect of selected drying method on the nutritional value of fresh water snails

CHAPTER TWO

LITERATURE REVIEW

2.1 Fish Quality

The quality of fish and fishery products has become a priority concern to fish industries globally (Huss *et al.*, 2003). Quality as a term in food have diverse meaning, it may not only be termed as the sensory attribute of a product which may be in form of its physical appearance, chemical appearance in terms of its flavor and texture and also its aroma, which refers to its odour, but also show nutritional value, safety and other characteristics. Before the purchase of any food commodity or product for the first time by a consumer, these characteristics are used to ascertain the quality of these food commodities or product (Hughes and Koplán, 2005) . The goal of any food industry including fisheries globally is to provide a well acceptable product to the consumer considering the fact that fish is a highly perishable food product (Hughes and Koplán, 2005). The size, sex and species of fish, distance from fishing ground to port, diet effect (how the fish feed and what the fish feed on), fishing ground, spawning activities, fish habitat (fresh water, brackish or estuarine water and salt or marine water), parasites, water pollution among others. One or a combination of the following attribute plays a key role in the quality outcome of aquatic products and these attributes are variable. Therefore, a great deal of work is carried out to ensure that quality and acceptability of fish and fisheries product is maintained.

Fish having a relatively short shelf life is seen as being highly perishable. Shelf life is defined as the length of time from the moment of capture to the time a fresh fish can be in

these Market place unspoiled (Regenstein and Regenstein, 1991). Therefore proper fish handling and preservation is required to retain its quality and nutritional attributes and increase its shelf life.

2.2 Fish Processing and Preservation

the term fish processing refers to the processes associated with fish and fish products between the time of capture or harvest as the case may be to the time the final products is delivered to the final consumer/ customer (Wikipedia, 2020). The processing and preservation of fish is a priority concern since fish is prone to spoilage after harvest and to prevent economic loss (Okonta and Ekelemu, 2005). Preservation method should be applied if fish is not sold fresh to extend its shelf life. Fish preservation is the removal of moisture such that enzymatic and microbial activities which can cause fast deterioration are inhibited in a long run to keep fish in stable condition for a longer period of time (Eyo, 2001). The principle of chemistry, engineering and other aspect of sciences are employed in other to improve the quality of the products to attain a longer shelf life (Adedeji and Adetunji, 2004; Adedeji, 2012). The effect of preservation is due to the activities of microbial properties of phenolic compounds and antioxidants. Some of the important reason for food preservation may include: (a) To take care of excess produce (b) Distribution to areas where food items is unavailable (c) preserving food at home (Adedeji and Adetunji, 2004; Adedeji, 2012). Fish processing not only facilitate a change in texture and taste but also leads to change of state of fish (Abolagba and Aigbe 2013). Processing means handling, storing, preparation, heading, eviscerating, shucking, freezing, form changing for marketing purposes, production, preservation, labeling, dockside/ holding fish/fishery products (Russel, 2004). Though fishing is done in a

continuous basis with a significant harvest witnessed from July to September annually. Hence the availability of fish throughout the year, especially during the lean season, it is very essential to process the fish to preserve it in appreciable quantities in good condition without the loss of its significant nutrients until its use is required (FAO, 2001).

Local consumers of fish have come to accept fishery products preserved by the method of curing and over 80% of fishes harvested in Nigeria are preserved by curing (Felicia and Patterson, 2003), while over 25%-30% of the world's fish caught are consumed dried, salted, smoked or in combination of the three processes (Aliya *et al.*, 2012). These cured fish are preserved due to the process of partial removal (reduction) of moisture or addition of some chemical preservatives which may include salt, vinegar or application of dry heat. Examples may include smoke (Whittle, 2002). Curing may be defined as the methods employed in preservation processes of fish by various means which may include salting, drying, smoking and pickling. Cleaning, sealing and eviscerating are the first steps undertaken when curing fish. Medium-sized fishes are split through the backbone and top of the head, with the two halves going by the stomach skin, butterfly style (Adedeji and Adetunji, 2004; Adedeji, 2012). Curing is the cheapest and easiest way of preservation as it requires the least technical expertise. It plays a much greater significance and relevance in the socio-economic system of local farmers which include the small-scale fish farmers (Felicia and Patterson, 2003). In the fermentation of food, salt usually plays a pivotal role.

2.3 Salting

Salting is a popular way of preserving fish and other food items especially fresh food stock. Salt has a preservative effect on food by simply reducing the water or moisture content thereby causing a decrease in water activities, reduction of attack of food material by microbes, and enhancement of functional properties, leading to sustainability and an increase in shelf- life (Santiago and Maurizio, 2002). In the fermentation of food, salt play a very vital role. Fermentation as a common way of food preservation is a process in which fresh food are transformed into desirable and sometimes acceptable food which can stay for a longer time and has a longer shelf life than when it is kept fresh which may lead to increased activities of microbes which can cause spoilage(Potter and Hotchkiss, 1995). Salt favor's the growth of salt- tolerable and useful/ beneficial organisms. Length of salting period and its concentration goes a long way to predict the final product (Bellagha *et al.*, 2007). The simplicity of salting processes, the low cost of production, the ease in which it combines with other preservative methods such as drying, smoking has resulted in making it to be well- known and in long time use (Erhumpon *et al.*, 1990). Salting is done by the use of different method with may include

Brine salting this has to do with the immersion of fillets into a solution of salt and water (Andreas *et al.*, 2002)

Kench salting: this method is done by simply rubbing the entire surface of the split fish with a well granulated salt

Pickle salting: in this type of salting, the fish is stacked with alternating layer of dried salt. The uptake of salt is initiated by extraction of liquid from the muscle if the fish and solubilization of the salt saturated brine is produced in a surface layer on the fillets which

continuously extract moisture from the muscle, where-as water moves to the surrounding solution while salt moves from the interior of the muscle.

2.4 Drying

The energy needed to drive the moisture from the surface of fish can be obtained from a variety of sources including wood smoke, sun-drying, solar drier, electricity and mechanical driers (Davies *et al.*, 2008). During drying, water is removed from the surface of the fish. This water removed is then replaced by water drawn up from the tissue, which leaves the fish surface. The rate of drying consequently, the removal of water depends on the speed, relative humidity and temperature of the surrounding air (Delgade *et al.*, 2003). Drying which usually reduces moisture content, involves drying in the sun or oven. When sufficient water has been removed, fish will be preserved because water is essential for enzymic and bacteria growth which works to spoil the fish. Drying is also used in combination with salting and smoking for additional preservation. Although the method of drying used depend on the species of fish and consumers preference. The drying process has effect on the protein quality and composition of fish which is in the specie. This method is a cheap method. Although the oven drying method is faster than the sun drying method (Aberoumand *et al.*, 2015).

The oven drying method is also safer than the sun-drying method. Fish drying in the sun maybe cheap but it's limitation to its use are significant losses in product, lowers quality of fish because of contamination by foreign materials, insects and microorganisms as well as discoloration by ultra violet light (Aberoumand *et al.*, 2015). The most common

form of fish drying practiced in Nigeria is the sun drying due to its simplicity and it been the cheapest method of air drying process used for food. It can also be done as open sun drying or Sola tent drying. Effective open sun-drying depends mainly on the environment condition, relative humidity and wind speed.

2.5 Smoking

Smoking is one of the traditional processing of fish preservation aimed at reducing post-harvest losses, Its aim is preservation of the product. The preservation processes is largely due to anti-oxidant and antimicrobial properties of phenolic compounds (Kjallstrand and Peterson, 2001). In preservation of fish be it smoking, water activities are greatly reduced to the point where microbial activities which lead to spoilage is inhibited (Ighodaro and Abolagba, 2010). Smoking of fish as a preservation methods dates back to civilization as the most accepted form of fish preservation in the rural areas due to insufficient power supply. Fish smoking is traditional method of processing globally; it accounts for about 3% of the world's catch and also increases the shelf life (Gupta and Gupta, 2006). The flesh if smoked fish is succulent, delicate and delicious and can be readily consumed without further processing (Eyo, 2001). In Nigeria, drying and smoking especially hot smoking is preferred by consumers (Abolagba and Osifo, 2004). Length of time/ period of smoking will determine the length of preservation and shelf life (Abolagba *et al*, 2002; Arthur and Osei-somuah, 2004).

Smoking as a preservative process combine the effect of drying, heating and smoking, coupled with salting. Before smoking can be carried some preliminary processes are

carried on the fish which may include gutting, splitting, Kench salting, brining and/or drying, depending on the consumers choice and smoking method adopted.

2.6 Methods of Fish Smoking

Hot smoking: This is the most used method of preparation adopted by many countries of the world which involves the application of heat and smoke which is a traditional method of preservation in tropics. The result is to attain an extended shelf life when food is smoked until cooked. The main purpose of heat smoking is to preserve the product flavor and colour arising as a result of preservation function.

There are different type of smoking kiln and oven used in Nigeria and the type used is dependent on the location where it is been used. Among the many reasons why fishes are smoked may include; to enhance the flavor; to reduce waste in time of harvest; for future use; to increase the protein intake of consumers; and to make it easier to package it for the purpose of transportation to other areas

Cold smoking: This process requires smoke of not more than 30 degrees centigrade; it is mostly practiced in developed countries of the world where alternative means of preservation of fish are available. This method of smoking is primarily adopted in other to preserve the flavor of the fish and retain its nutritive value (Olokoe *et al.*, 2007). This method applies to products at temperature less that 90 degrees Fahrenheit this causing a non-coagulation of the protein in the fish (FAO, 2007)

2.7 Smoke Agent

Wood smoke: Wood smoke is produced by smoldering chips or sawdust or firm wood below the fish in the smoke house (Visciano *et al.*, 2008). The taste of the final product is

affected by the composition of the wood. The smoke quality depends on the type of wood used, whether hard or soft wood this, impacting on the color, flavor and aroma. Some vital factors that affect Wood smoke composition and absorption during smoking include; the type of wood, moisture content of the wood, the combustion temperature, the humidity and air flow. Smoke from wood is said to be highly complex with the mixture of chemicals which include; organic acids, alcohols, phenols benzene (Abolagba *et al.*, 2002). Smoke produced is as a result of the incomplete combustion if the wood followed by pyrolysis (thermal disintegration), lignin (20-30%), yielding cellulose (40-60%) and hemicelluloses (20-30%) (Olokoe *et al.*, 2007).

Smoke flavourings have been used for preservation and aromatization of meat and fish (Hattula *et al.*, 2007). This is made by distilling dry-wood which is then concentrated to a specific degree of concentration (Season *et al.*, 2014).

2.8 Proximate Analysis

Proximate analysis for is used to estimate the relative amounts of lipid, water, ash, and Carbohydrates in an organism. Ash contribute to the mass of an organism while the rest contribute to the total energy content of the organism. Energy content is usually used as an expression of fish's condition or health status. In response to the fish specific life history demands, the relative contribution of lipid, protein and carbohydrates to a fish total energy vary (National Marine Fisheries Service, NMFS, 2014).

2.8.1 Moisture content

Water is the major constituent of fish's flesh. This usually accounts for over 80% of fresh fish while the average water content of fatty fresh fish is about 70%. At time certain specimen containing about 30%-90% of moisture may be found (FAO, 2005).

2.8.2 Protein

Protein are large biomolecules or macromolecules consisting of one or more long chains amino acid residue. These amino acids are bonded together by peptide linkages. Protein provides the essential amino acid necessary for tissue synthesis and they consist of tissue protein. (Young 2001). Protein is the most abundant substance in the human body after water. It's the building block for growth, maintenance and repair of body tissue. The average crude protein content of fresh water fresh fish ranges from 0.8%-18.3% depending on the specie (schreckenbach, 2008).

2.8.3 Fatty acid

The nutritional relevance of fish consumption is a great deal is associated with its advantageous fatty acid profile (Sidhu, 2003). Moreover, lipids are vital components to fish and human diet both as energy and fatty acid sources (Sargent *et al.*, 2002). Fish are often classified on the basis of their fat contents.

2.8.4 Carbohydrate content

Fish do not have a specific dietary requirement for carbohydrates, but including these compounds in diets is an inexpensive source of energy. The ability of fish to utilise dietary carbohydrate for energy varies considerably; many carnivorous species use it less efficiently than do herbivorous and omnivorous species (Wilson, 1994). Generally Fish are found to possess very low levels of carbohydrates with an average content of about

0.04%-0.36%. This small value could be attributed to the fact that glycogen contribution little of no value to the reserves in the fish body tissue.

2.8.5 Ash Content

Ash refers to the inorganic residue remaining after either ignition or complete oxidation of organic matter in a food sample (Ismail B.P, 2017). It is a measure of the mineral content of any food, the average ash content of fish species ranges between 1% and 3.92%. Majority of fish contains about less than 2% ash content. The concentration of minerals and trace elements that contribute to the total ash Content are known to vary in fish depending on their feeding behavior, environmental factor, ecosystem as well as migration (Palani *et al.*, 2014)

CHAPTER THREE

MATERIALS AND METHODS

3.1 Collection of Samples

One hundred and fifty (200) apple water snails (*Lanistes libycus*) were obtained from Ikpoba hill market at Ikpoba Okha local Government area of Edo State.

Ikpoba Okha is a local Government Area in Edo state, Nigeria. Its headquarters are in the town of Idogbo. It has an area of 826km² square and a population of 371, 106 at the last census conducted in 2006.

3.2 Sample Size

The water apple snails (*Lanistes libycus*) were obtained and weighed. Through removal from the shell, they were eviscerated with a knife and the average weight was taken. Then the snail samples were washed with clean water and alum to remove the slime as practiced by the local consumers. The snail samples were rinsed thoroughly to remove any trace of the alum. Thereafter the samples were divided into batches of 50 per samples. Each batch was labeled A, B, C, D. Batch D was kept fresh (without drying), batch B was smoked dried, batch C was sun dried while batch A was oven dried

3.3 Description of Processing Method

The Magbon-alade Kiln was used in the smoking of the snails. The kiln was constructed with steel, with different partitions which includes the smoking chamber, charcoal chamber and the chimney. The charcoal chamber supplied heat to the snail sample, the

chimney remove excess smoke from the kiln while the smoking chamber has trays where the snail would be place during smoking.

3.4 The Smoke-drying Process

The samples were placed for drying in the Magbon-alade smoking kiln in the fisheries Department, University of Benin. The smoke- drying process was carried out for a specific duration at a certain temperature and the average weight was taken after the smoke drying process.

3.5 The Sun drying Process

The samples were placed on a clean tray and placed under the sun for it to dry until it gain the same weight as that of the smoked dried snail specie, to avoid bias and the average weight was taken as well.

3.6 Oven drying process

The samples were placed inside an oven to dry and an average weight was taken and duration noted.

3.7 Experimental Materials and Equipment

Hand gloves, sample collection jar, petri dish, Bunsen burner, aluminum foil, autoclave, measuring cylinder, beakers, conical flask, weighing balance, spatula, glass slide, marker pens, masking tape, test tube, were used for the experiment.

3.8 Proximate Analysis (Methodology)

Flesh of the fresh water snail sample (*Lanistes libycus*) would be taken for analysis. They would be pulverized to ensure homogeneity. Then the moisture, Ash, crude fibre, protein, fat content and Nitrogen free extract would be obtained.

3.8.1 Determination of moisture content

This is a measure of the percentage moisture lost due to drying at a temperature of 105°C degree centigrade. 2g of the fresh water apple snail (*Lanistes libycus*) sample was weighed (W_1) into a pre weighed beaker (W_0) and placed in a hot drying oven at 105°C degree centigrade for hours. The crucible were removed, cooled in a desiccator and weighed. The process of drying, cooling, and weighing will be repeated until a constant weight (W_2) was obtained. The weight loss to moisture was obtained by the equation

Calculation of moisture content

Calculate the moisture content on a wet-weight basis using the following formula:

$$\text{Moisture content (\%)} = \frac{W_1 - W_2}{W_1 - W_0} \times 100$$

where:

W_0 = weight of container with lid;

W_1 = weight of container with lid and sample before drying; and

W_2 = weight of container with lid and sample after drying.

3.8.2 Determination of ash content

This is a measure of the residue after combustion of the dry apple snail sample. Accurately weight ca 5g of sample in a crucible which has been ignited and tired (use 2.5

g of sample in the case of products which have a tendency to swell). Place crucible in drying oven at 100°C for 24 hours. Transfer to cool muffle furnace and increase the temperature step wise to 550°C ± 5°C. Maintain temperature for 8 hours or until a white ash is obtained. If white ash is not obtained after 8 hours, moisten ash with distilled water, slowly dry on a hot plate, and re-ash at 550°C to constant weight. Repeat if necessary. Remove crucible to a desiccator and weight soon after cool. Calculate the percentage ash content (wet weight basis) as follows:

$$\% \text{Ash} = \frac{W_2 - W_1}{W_1 - W_0} \times 100$$

Where;

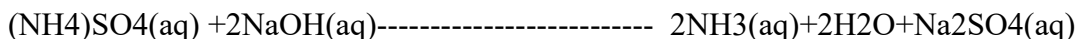
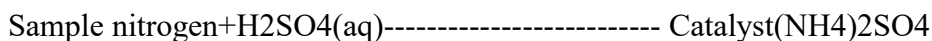
W_0 = weight of empty crucible

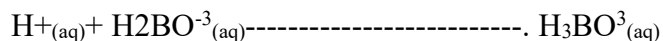
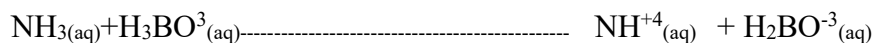
W_1 = Weight of crucible + powdered sample (g)

W_2 = Weight of crucible + ash sample (g)

3.8.3 Determination of crude protein content

This Kjeldahl method of nitrogen analysis is the standard method used worldwide for estimation of the protein content in a variety of materials ranging from human and animal food, fertilizer and waste crude. The crude protein of the snail sample will be determined using the Kjeldahl method described by AOAC (1990). The principle of this method is based on the transformation of protein and that of the other Nitrogen containing organic compounds, other than nitrates into ammonium sulphate by acid digestion.





Place 15 g of potassium sulphate and 0.5 g of copper (II) sulphate in an 800 ml Kjeldahl flask. Weigh accurately about 2 g of the prepared sample (1.5 g if rich in fat, 0.5 g if fish meal) on a filter paper and transfer both to the flask. Add carefully 25 ml of concentrated sulphuric acid and mix by swirling the flask. Place the flask in an inclined position on a suitable heating device in a fume cupboard. Heat carefully until foaming has ceased and the contents have become liquefied. Digest by boiling gently, occasionally rotating the flask, until the liquid is completely clear and of a light blue colour; boil gently for a further 1½ hours. Total digestion time should be not less than 2 hours. Cool the contents of the flask to about 40°C and cautiously add 50 ml of distilled water. Mix and allow to cool. Transfer the contents of the flask to a 250 ml standard flask, rinsing several times, and make up to 250 ml. Transfer 50 ml to a suitable steam distillation apparatus. Put 25 ml of 4 per cent boric acid solution in a conical flask and place under the condenser so that the outlet dips into the liquid. Add 35 ml of 33 per cent sodium hydroxide solution to the distillation flask. Steam distil for 4 minutes after the first drop of distillate, or until the distillate is no longer alkaline. Lower the conical flask so that the condenser outlet is above the liquid level and distil for a further minute. Add to the flask 4 drops of indicator (0.2 g methyl red and 0.1 g methylene blue in 100 ml ethanol) and titrate to a grey colour with exactly 0.1 M hydrochloric acid. Repeat the analysis with a second 50 ml portion of digest. A complete blank determination using only a piece of filter paper instead of the

fish should be carried through regularly. Nitrogen content is calculated by:

$$\frac{T_v \times N_a \times 0.014 \times V_1 \times 100}{G \times V_2}$$

Where

Tv = Titre value of acid (cm³)

Na = Concentration or normality of acid (0.1N HCl)

V1 = Volume of distilled water used for distilling the digest (100cm³).

V2 = Volume of aliquot used for distillation (10cm³)

G = Original weight of sample used, g

0.014 = milliequivalent of Nitrogen

100 = percentage

Nitrogen is finally converted to crude protein by multiplying by 6.25.

% crude protein = %N x 6.25

3.8.4 Determination of fat content

Most methods of measuring fat content depend on extracting the fat by dissolving it in a suitable solvent. In the method given below the fat is recovered from the solution by evaporating the solvent and is then weighed. The crude lipid content in the sample was extracted using a soxhlet extraction procedure. The ground sample (2g) was weighed W_0 into a porous thimble and covered with a clean white cotton wool. Petroleum ether (600cm³) was poured into a 100cm³ extracted flask, which was previously dried in the oven at 105°C and weighed W_2 , the porous thimble was placed into the soxhlet and the rest of the apparatus was assembled. Extraction was done for 5 hours. The thimble was carefully removed and the extracted flask was placed in a water bath so as to evaporate

the petroleum ether and then dried in the oven at a temperature of 105°C to completely free the solvent and moisture. It was then cooled in a desiccator and re weighed W_1 . The percentage crude fat was calculated as follows; $\% \text{crude fat} = \frac{W_1 - W_2 \times 100}{W_0}$

Where;

W_0 = Weight of sample (g)

W_1 = Weight of flask + oil (g)

W_2 = Weight of flask (g)

3.8.5 Determination of nitrogen free extract

The method of James (1995) was adopted where the total proportion of carbohydrates in the fish sample was obtained by calculations using the percentage weight method. The NFE was obtained by subtracting the amount of all four fractions above from 100%. There, to calculate for NFE;

$$100\% = (\% \text{moisture} + \% \text{crude protein} + \% \text{ash} + \% \text{fat content} + \% \text{crude fibre}).$$

3.9 Statistical Analysis

The data obtained was analyzed using computer software (Genstat version 8.1, 2005). Significant treatment means will be separated using the New Duncan Multiple Range Test



Plate 1: Fresh Water Apple Snail (*Lanistes libycus*)

CHAPTER FOUR

4.0 RESULTS

Table 1 shows the weight changes during the various drying method time and percentage moisture loss in the snail samples. The weight loss for the smoked dried sample was 91.7%, for the sun-dried sample was 92.2%, while that of the oven dried sample was 90%. According to the table, weight loss was obtained by the removal of the value gotten from the initial weight after shucking (shell + liquid waste removed) and final value of weight gotten after drying each sample. While the percentage loss is the weight loss multiplied by 100 and divided by the initial weight after the viscera were removed and an average weight will be obtained

Table 1: Average weight change during various smoking time (smoke-drying process) and percentage moisture loss of *Lanistes libycus*

TREATMENT	INITIAL WEIGHT(g)	WEIGHT AFTER 3hrs(g)	WEIGHT AFTER 6hrs(g)	FINAL WEIGHT(g)	WEIGHT LOSS(g)	% WEIGHT LOSS
OVEN DRY	128	68	37.9	38	(initial wt -final wt) 90	70.3
SMOKED	130	75	38.5	38.3	91.7	70.5
DRY						
SUN DRY	132	79	39.7	39.8	92.2	69.8

Table 2 summarizes the result obtained during the study of the proximate analysis of smoked-dried *lanistes libycus* obtained from Oregbeni market on dry matter basis.

The percentage moisture content of oven dried sample (10.87%) was lower than that of smoked dried sample (11.36%) and sun dried sample (13.86%). The percentage crude protein for smoked dried sample (71.65%) was higher than that of oven dried (69.07%) and sun-dried (68.16%) which was a little bit less than oven dried sample. The percentage crude fat content of oven dried sample (5.030%) was quite higher than that of smoked dried sample (4.725%) and sun dried sample (4.625%). The percentage crude fibre for oven dried, smoked dried and sun-dried sample were $p < 0.01\%$ which shows an insignificant value since aquatic snail contains little or no crude fibre residue. The percentage ash for oven dried sample (17.25%) was so slightly higher than that of smoked dried sample (17.14%) but higher than sun-dried sample (16.76%) which has the lowest ash content. The percentage NFE for oven dried, smoked dried, and sun dried samples were 8.648%, 6.565% and 10.357% respectively.

Table 2: Proximate result for *Lanistes libycus* immediately after drying

	OVEN DRY (%)	SMOKE DRY (%)	SUN DRY (%)	SED
MOISTURE	10.87 ^a	11.36 ^b	13.86 ^c	0.00432
CRUDE PROTEIN	69.07 ^b	71.65 ^c	68.16 ^a	0.01273
CRUDE FAT	5.030 ^c	4.725 ^b	4.625 ^a	0.02003
CRUDE FIBRE	<0.10	<0.10	<0.10	<0.10
ASH	17.25 ^c	17.14 ^b	16.76 ^a	0.01212
NFE	8.648 ^b	6.565 ^a	10.357 ^c	0.01939

(Value/ figure with the same superscript are not significantly different) (p<0.10)
(S.E.D: Standard error of the difference of mean)

Table 3: The Weekly Proximate Composition of Smoke-dried, sun-dried and oven-dried fresh water apple snail

Parameters	Sample A				Sample B				Sample C			
	Wk 0	Wk 2	Wk 4	Wk 6	Wk 0	Wk 2	Wk 4	Wk 6	Wk 0	Wk 2	Wk 4	Wk 6
Moisture content	6.84 ^A	10.13 ^C	12.52 ^F	13.98 ^I	7.74 ^B	10.91 ^E	13.04 ^G	13.76 ^H	8.35 ^C	14.30 ^J	15.29 ^K	17.50 ^L
Crude protein	69.30 ^F	69.05 ^D	69.11 ^E	68.83 ^C	72.12 ^J	71.89 ^I	71.62 ^H	70.98 ^G	68.88 ^C	68.43 ^B	68.39 ^B	66.94 ^A
Crude Fat	5.200 ^G	5.100 ^F	4.900 ^E	4.920 ^E	4.200 ^A	4.720 ^{CD}	4.690 ^{BC}	4.890 ^E	4.800 ^D	4.730 ^{CD}	4.740 ^{CD}	4.630 ^B
Crude Fibre	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Ash

Content	17.90 ^I	17.09 ^F	17.18 ^G	16.83 ^C	17.30 ^H	17.16 ^G	17.09 ^F	17.00 ^E	4.6000 ^B	4.9200 ^C	5.6800 ^D	5.2200 ^{DE}
Nitrogen free extract	7.600 ^D	8.760 ^E	8.810 ^E	9.420 ^F	6.300 ^A	6.230 ^A	6.600 ^B	7.130 ^C	9.570 ^G	10.140 ^I	9.970 ^H	11.750 ^J

Table 3 gives the weekly nutrient value of the different samples during a period of 6 weeks with two weeks interval for analysis. From the result it can be seen that there is an decrease in crude protein, crude fat, NFE content of the snail sample processed with selected drying method and an increase in moisture content but crude fibre was less than <0.001% which was in significant

CHAPTER FIVE

5.0 DISCUSSION

The proximate analysis results had shown that *Lynistics lybiscus* bought from Oregbeni market in Ikpoba Okha local government area of Edo state to be nutritionally rich. The fat, Fibre, and moisture content are constituents in the Shell fish which provide an energy source to the consumers. Shell fishes have been reported to be a good source of protein according to Rnvichandran *et al.*, (2012), which helps to repair worn out tissue and body building.

Previous similar analysis carried out by researchers such as Mohammed and Effiong (2008), Mumba and Jose (2005) and Abdullahi (2001). The level of moisture content in the fresh *Lanistes lybicus* (77.32%) agrees with that which was reported by Ajayi *et al.* (1978), who discovered that fresh snail had a high moisture content which is also comparable to raw beef and other meat product (Lawrie, 1991). Oven dried, smoked dried, and sun-dried sample had moisture content of 10.87%, 11.36% and 13.86% respectively. This decrease in the amount of moisture is as a result of the different processing method the samples have undergone to reduce spoilage and also coincidentally led to the increase in the number of fat and crude protein content (Maria's and Erasmus, 1997). Hence making the Oven drying method more preferable for preservation due to its low moisture content

Ninawe and Rathnakinar, (2008) reported that increase In protein can be attributed to the dehydration of the molecules present between protein, thereby resulting in increased protein percentage content in smoked dried snail as seen in the smoked dried snail sample which show a higher percentage of crude protein(71.65%) than oven dried (69.07%) and

sun dried(68.16%)sample respectively. This shows that though smoke dried losses more less water than oven dried sample and more than sun drying, it still retains its protein content, nutritionally. It can be adjudged the best form of preservation.

The oven dried snail sample has the highest amount of fat (5.030) as compared with its counterpart, smoke dried snail (4.725% and sun dried snail (4.625%). The low percentage fat in sun dried snail may be due to its high moisture content (Marias and Erasmus, 1997).

The ash content for sun dried snail (16.76) appears to be slightly lower than the smoked dried snail (17.14%) and oven dried (17.25%). This shows that the *Libistes libycus* is a good source of minerals such as calcium, potassium, Zinc, iron and maganese (Andrew, 2001).

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The different processing method outlined as a result of this project has shed more light on the different ways of processing and which is best in terms of Preservation and shelf life. They are commonly used in households in Nigeria and their product are appreciated by consumers. This study revealed the best method of processing for Preservation nutritionally and health wise. The proximate analysis was also enhanced by virtue of the different processing method adopted.

6.2 Recommendations

It is therefore recommended that to acquire more nutrition from processing

- Precaution should be taken to prevent water contamination during harvesting as well as post- harvest handling snail
- Improved sanitary in Edo metropolis by the provision of public toilet and enactment of effective policy for the collection and disposal of municipal solid waste as these drastically reduces pollution of rivers with human and domestic wastes
- Processors should observe strict hygienic measures during processing
- Proper use of drying devices with well controlled temperature

- Brown paper should be used in wrapping the snails during storage; the brown paper reduces atmospheric humidity hence reducing moisture absorption and hence increased shelf life

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APPENDIX

1.0 MOISTURE

TREATMENT				
WEEKS	OVEN DRY	SMOKE DRY	SUN DRY	S.E.D
0	6.85 ^A	7.74 ^B	8.35 ^C	
1	10.13 ^D	10.91 ^E	14.30 ^J	
2	12.52 ^F	13.04 ^G	15.29 ^K	0.00864
3	13.98 ^I	13.76 ^H	17.50 ^L	

*Values with the same superscripts are not significantly different ($P < 0.001$)
S.E.D: standard Error of the differences of mean*

2.0 CRUDE PROTEIN

TREATMENT				
WEEKS	OVEN DRY	SMOKE DRY	SUN DRY	S.E.D
0	69.30 ^F	72.12 ^J	68.88 ^C	
1	69.05 ^D	71.89 ^I	68.43 ^B	
2	69.11 ^E	71.62 ^H	68.39 ^B	0.02546
3	68.83 ^C	70.98 ^G	66.94 ^A	

Values with the same superscripts are not significantly different ($P < 0.001$)
S.E.D: standard Error of the differences of mean

3.0 CRUDE FIBRE

TREATMENT				
WEEKS	OVEN DRY	SMOKE DRY	SUN DRY	S.E.D
0	0.1	0.1	0.1	
1	0.1	0.1	0.1	0
2	0.1	0.1	0.1	
3	0.1	0.1	0.1	

S.E.D: standard Error of the differences of mean

4.0 CRUDE FAT

TREATMENT				
WEEKS	OVEN DRY	SMOKE DRY	SUN DRY	S.E.D
0	5.200 ^G	4.200 ^A	4.800 ^D	
1	5.100 ^F	4.720 ^{CD}	4.730 ^{CD}	
2	4.900 ^E	4.690 ^{BC}	4.740 ^{CD}	0.04007
3	4.920 ^E	4.890 ^E	4.630 ^B	

Values with the same superscripts are not significantly different ($P > 0.001$)

S.E.D: standard Error of the differences of mean

5.0 ASH

TREATMENT				
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WEEKS	OVEN DRY	SMOKE DRY	SUN DRY	S.E.D
0	17.90 ^I	17.30 ^H	16.75 ^B	
1	17.09 ^F	17.16 ^G	16.70 ^{AB}	
2	17.18 ^G	17.09 ^F	16.90 ^D	0.02424
3	16.83 ^C	17.00 ^E	16.68 ^A	

*Values with the same superscripts across rows are not significantly different ($P < 0.001$)
S.E.D: standard Error of the differences of mean*

6.0 NFE

TREATMENT				
WEEKS	OVEN DRY	SMOKE DRY	SUN DRY	S.E.D
0	7.600 ^D	6.300 ^A	9.570 ^G	
1	8.760 ^E	6.230 ^A	10.140 ^I	
2	8.810 ^E	6.600 ^B	9.970 ^H	0.03879
3	9.420 ^F	7.130 ^C	11.750 ^J	

Values with the same superscripts across rows are not significantly different ($P < 0.001$)

S.E.D: standard Error of the differences of mean