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Garba AA
Department of Fisheries and Aquaculture, Bayero University, PMB 3011, Kano, Kano State, Nigeria

MO Adadu
Federal College of Freshwater Fisheries Technology, Baga, PMB 1060, Maiduguri, Borno State, Nigeria

BI Usman
Department of Fisheries and Aquaculture, Bayero University, PMB 3011, Kano, Kano State, Nigeria

Corresponding Author:
Garba AA
Department of Fisheries and Aquaculture, Bayero University, PMB 3011, Kano, Kano State, Nigeria

Comparative study on effects of castor oil and groundnut oil on the appearance and acceptability of *Clarias gariepinus* treated with sodium chloride

Garba AA, MO Adadu and BI Usman

Abstract
This study was carried out to have a critical overview on effect of castor oil and groundnut oil on appearance and acceptability of smoked *Clarias gariepinus* treated with sodium chloride. 6 kg of *Clarias gariepinus* (with average weight of 350g) were obtained from federal college of freshwater fisheries technology Baga fish farm and were divided into three (3). The samples were dressed and samples 2 and 3 treated with sodium chloride, smoked and castor oil and groundnut oil applied respectively and air to dry. Fish sample 1 was processed without oil and sodium chloride therefore served as control. The fish labeled sample 2, was treated with 50g of sodium chloride and 30ml of castor oil applied while the fish sample 3 was treated with 50g of sodium chloride and 30ml of groundnut oil was applied. Organoleptic test was carried out on both the treated samples and the control for taste, texture, appearance and odour. Sample 2 showed highest in terms of acceptability by members of organoleptic panel, followed by sample 3 and lastly sample 1.
It was concluded that apart from the medical implication of castor oil, it can be used to enhance appearance of smoked fish to attract consumers.

Keywords: *Clarias gariepinus*, castor oil, groundnut oil, appearance, acceptability

Introduction
Fish is an important source of food and income to many people in the developing world. In Africa, over 50% of the population depends wholly or partly on the fisheries sub-sector, mostly artisanal fish for their livelihood. Nigeria is the highest fish consumer in Africa with a total animal consumption of 1.2 metric tons (FDF, 2005) [14]. In Nigeria, fish production through aquaculture has risen steadily from a few hundred kilograms in the 1950s to over 45,000 metric tons in 2004 (FAO, 2007) [12]. In recent time aquaculture is the fastest growing among livestock production sector in Nigeria with growth of about 29% in 2006 and with prospect to continue growing because demand for fish is on the increase in line with population growth, while catches from fisheries are on the decrease, even globally (Delgalo *et al*., 2003) [8]. Only about 50% of the demand for fish is currently being met by head supply (Olayemi *et al*., 2011). The fisheries sector is estimated to contribute 3.5% of Gross Domestics product (GDP) and provides direct and indirect employment to millions of people (FDF 2005) [14].

Fish is considered as a cheap source of protein and that gives it advantage over pork or beef. Fish is an important source of cheap first class protein, providing essential amino acids (Paul and Southgate, 1978) [26]. Fish is low in fat and cholesterol. It is also rich in calcium, phosphorus and vitamin A and D (Osuji, 1977) [25]. According to Mayhew and Panny (1988), fish is quicker to cook and is more easily digestible than meat of other animals.
African cat fish typical air-breathing with a scale-less bony elongated body with long dorsal and anal fins, is widely tolerant to many different habitats; even the upper reaches of estuaries but is considered to be freshwater species. The native range of *C. gariepinus* covers most of the African continent, with the exception of Maghreb, upper and Lower-Guinea and the cape-provinces of South Africa (Picker and Griffiths, 2011) [27]. It can tolerate waters of high turbidity and low in dissolved oxygen and is often the last or only fish species found in remnant pools of drying rivers (Van der waal, 1998) [29]. It is considered to be omnivorous displaying both scavenging and predatory behaviors (Bruton, 1979) [6].

Groundnut oil is the organic oil derived from peanuts. 40-50% of the weight of the nut is oil and the major fatty acids in the oil are palmitic, oleic and linoleic acids. 51% of the oil in peanut oil is monosaturated oil, 30% polyunsaturated and 19% saturated oil (The American heritages, 2007). It is also very abundant and available in Nigeria (Sogbesan *et al.*, 2006) [28]. The groundnut (*Arachis hypogaea*) is a native of South Africa. It was probably brought to Africa from Brazil by Portuguese in the early sixteen century, when they established regular communication with Indian subcontinent and with Ceylon and further Asia by way of the West or South Africa.

Taxonomical Classification of Castor oil *(Ricinus communis)* includes:

Kingdom: Plantae
Plylum: Magnoliophyta
Class: Magnoliopside
Order: Malpighiales
Family: Euphorbiaceae
Subfamily: Acalyphoideae
Genus: Ricinus
Species: *Ricinus communis*
(Marta Amelia Vattuone *et al*., 1983) [21]

The use of castor bean oil in India has been documented since 2000 BC for lighting lamps and in local medicine as a laxative, and cathartic in Unani, Ayurvedic and other ethnomedical systems. Traditional Ayurvedic medicine considers castor oil the king of medicines for curing arthritic diseases apart from brightening the appearance of processed fish products. Marta Amelia Vattuone *et al*. (1983) [21] studied the localization of invertase activities in *Ricinus communis* leaves. Leaf tissue from *Ricinus communis* possesses cell wall and soluble invertases. These activities may be distinguished on the basis of their optimum pH and Michaelis constant (Km) and the action of various inhibitors. They studied the hepatoprotective activity of *Ricinus communis* leaves in albino rats. An ethanol extract of the leaves showed significant protection against galactosamine-induced hepatic damage. It also showed dose-dependent choleretic and anti cholestatic activity as judged by hepatocytes isolated from paracetamol-treated rats. On fraction of the alcohol extract, maximum activity was localized in the butanol fraction. Subsequent chromatographic fractionation and testing in the galactosamine model led to the isolation of two active fractions which in turn yielded two important compounds: ricinine and N-demethl-ricinine. N-demethl-ricinine was found to be more active relatively.

Marta Amelia Vattuone *et al*. (1983) [21] also studied the protective effect of *Ricinus communis* leaves in experimental liver injury caused by carbon tetrachloride in albino rats. They reported the pharmacological effects of the whole leaves, cold aqueous extract and a glycoside extracted from the leaves. The whole leaves provided protection against liver necrosis as well as changes induced by it while the cold aqueous extract provided protection only against fatty changes. The glycoside protected the liver from cell necrosis. *Ricinus communis* leaves had significant parasympathetic activity and parasympathetic predominance can be expected to cause an increase in blood supply to the liver and protection against hepatoxic agents.

Similarly, Kumolu *et al*. (2015) [19] revealed that smoked fish samples treated with ginger oil had lower mould count, hence enhanced acceptability of the product over time.

Sodium chloride is the most used food additive in the fish processing industry, mainly for preserving but also for improving the taste of the product. In fact, the current demand for salted fish is driven more by the aroma and flavour of the product than for preservation purposes (Majaffar and Sankat, 2006) [20]. Sodium chloride in smoked fish not only contributes to increasing its shelf-life, but also influences its Water Holding Capacity (WHC), fat binding, colour, flavour and texture. Therefore, total or partial substitution of NaCl might lead to changes in these attributes (Hermansen, 2000) [16].

Fish is highly susceptible to deterioration without any preservation or processing measure and requires proper handling and preservation to increase its shelf life, quality and nutritional value (Okonta and Epelemu, 2005) [22]. Fish is one of the protein foods therefore, there is need to handle it carefully because fish spoils easily after capture due to the high tropical temperature which accelerates the activities of bacteria, enzymes and chemical oxidation of fat in the fish (Wood *et al.*, 1987) [30]. Due to poor handling, about 30-50% of fish harvested are wasted in Nigeria (Davies and Davies 2009) [7]. These losses could be minimized by the application of proper handling, processing and preservation techniques. Once spoilage set in, the odour, flavor, texture, colour and sometimes the chemical composition change (Gupta and Gupta, 2006) [15]. It is estimated that postharvest losses of fish is often more than 50% in developing countries which exceed any other food commodity (Olatunde, 1996) [23]. Some factors responsible for this include the prevailing temperature and the facilities for processing, storing and distribution. There is therefore enormous waste through spoilage of both fresh and dried fish.

Fish can be consumed in many forms but when it comes to smoking, it is most widely practiced method in countries like Nigeria, Ghana, Ivory Coast, Togo, Benin, Senegal, Sierra Leone, Liberia, Kenya, Uganda, Tanzania etc. Practically, all species of fish available in the country can be smoked and it has been estimated that 70-80% of the domestic marine and freshwater catch is consumed in smoked form (ECA 1984) [9]. The fish industry despite its importance, suffer from environment post-harvest losses, which are estimated at 35-40% of landed weight (FAO 1981) [11]. FAO 1994 estimated that post-harvest losses remain about 25% of the world catch annually. Fish is one of the most important foods on the planet. Its flesh is of top quality protein and for many in less developed parts of the world, it represents a significant proportion of the animal protein in their diet, either as fresh or cured in a variety of ways such as smoking, salting, drying, charring, icing and chilling (Eyo 2001) [10]. Appropriate processing of fish enables maximal use of raw material and production of value-added products which is obviously the basis of processing profitability (Ito, 2005; Davies and Davies, 2009) [7, 17].

Foods are usually classified as less perishable, moderately perishable and highly perishable. In order to understand their nature, groundnuts and grains are handled as less perishable food items while sea foods as highly perishable food are less stable because of their high moisture content and availability of nutrients for the growth of micro-organisms. Ambient temperature plays crucial role to affect the stability of the product.

Spoilage and freshness are the two qualities that have to be dearly defined which help in appearance/acceptability. A fresh product is defined as the one whose original characters

remain unchanged. Spoilage therefore is the inchoative of post-harvest change. This change may be graded as the change from absolute freshness to limits of acceptability to unacceptability. Spoilage is usually accompanied by change in physical character either change in colour, odour, texture, colour of eye, colour of gill area, softness of the muscle. These are some of the characteristics observed in spoiled fish. Spoilage is caused by the action of enzymes, bacterial and chemical present in the fish. The following factors contribute to spoilage of fish:

- High moisture content
- High fat content
- High protein content
- Weak muscle tissue
- Ambient temperature
- Unhygienic handling

The main components of fish are water, protein and fat. The spoilage of fish is a complicated process brought about by actions of enzymes, bacterial and chemical constituents. The spoilage process starts immediately after the death of fish. The process involves three stages:

- Regormoties
- Autolysis
- Bacterial invasion and putrefaction.

Fish is a low acid food therefore highly susceptible to pathogen and enzymatic spoilage. Fish are the most perishable of all stable commodities especially in the tropical climatic regions of the world; if not consumed within a day of capture, it becomes unfit for human consumption except subjected to some forms of processing (Bustid, 1988) The principal processing methods are smoking, salting, fermentation, roasting, boiling and frying or any combination of these processes (Eyo 2001) [10].

The fish quality largely depends on its appearance, texture, colour, and odour which could be altered by micro-organisms. Spoilage starts soon after death, due to enzymatic and micro-organism action, resulting in disagreeable taste, smell, and texture; therefore reducing consumers' acceptability (Davies and Davies, 2009) [7]. These authors asserted that high ambient temperature of the tropics is a major environmental factor promoting rapid spoilage of fish.

Given that about 40% of fish lost to post harvest spoilage is due to poor preservation technology (Akande, 1997; Ayuba and Omeji, 2006) [2, 4], it is imperative that adequate preservation method is used. Kloshmanesh, 2006 [18] suggested that refrigeration is the best means of preventing the fast rate of deterioration in fish. They also cited careful handling and rapid processing or essential steps to overcome the problem of rapid fish spoilage. Also the presence of salt retards bacterial action and in addition, it aids the removal of water by osmosis (Kloshmanesh, 2006) [18].

Deterioration of the fish starts immediately fish dies. It is due to complex process of degradation of protein with subsequent formation of hypoxanthine trimethyl amine and other product that result to formations of odour and flavour, softening of flesh and loss of cellular lipid. The major pest of fish includes *Crysmyis marginalis* (FAO, 2014) [13].

Freshwater fish processing, like the processing of the other food raw materials should: assure best possible market quality, provide a proper form of semi – processed final product, reduce wastes to the barest possible extent (Akinneye *et al.,* 2007) [3]. According to Eyo (2001) [10], during hot smoking, the fish is cooked and dried, the temperature of about 80 ^{0}C on the surface while at the centre the fish may be above 40 ^{0}C. The aim of hot smoking is to preserve the product's flavor and colour to avoid charred or bitter products in an attempt to produce product safe from mould, fragmentation and bacterial infection during storage (Azam *et al.,* 2004) [5].

Thus, the aims of this investigation are: to determine the effects of castor oil and groundnut oil on the appearance/acceptability of smoked *Clarias gariepinus* treated with sodium chloride and; to assess consumers' preference among the methods of processing adopted.

There was dearth of information on the use of castor oil (*Ricinus communis*) and groundnut oil (peanut oil) on the appearance and acceptability of smoked fish products especially *Clarias gariepinus.* Hence this research was conducted to fill the gap.

Materials and Methods

The study area

The study was carried out in the processing unit of the department of fisheries technology, Federal College of Freshwater Fisheries Technology Baga, Borno State, Nigeria. Borno State is located at latitude 11º 15N and longitude 13º 15E. The state occupied a land area of 70,898 Km^2 (27, 37459 miles) making it the second largest state in Nigeria in terms of land mass after Niger state with a population of 4,151,193 people (Census 2006) and with high ambient temperature. The sahelial climate is characterized with their distinct seasons: rainy and dry seasons. The rainy season starts from June to October, with mean annual rainfall ranging from 200mm to 500mm while dry season starts from November to April/May which is a period of very low temperature and dry harmattan wind. The dry hot season starts from March to June with temperature ranging from 27ºC to 40ºC making it the driest period with intense heat (Adadu and Ochogwu, 2020) [1]. The state is mainly dominated by the Kanuri, Babur, other minority tribes are Shuwa Arabs ethnic group, Margi and Gwoza. Borno is a habitable state with many other tribes living for business and other purposes.

Materials used

About 18 pieces of live *Clarias gariepinus* with average weight of 350g and total weight of 6kg were used. Also used were plastic containers (bowls), sensitive weighing scale, Knife, smoking Kiln and charcoal. The fresh castor oil, groundnut oil and sodium chloride were also used as treatments in the experiment.

Procedure

The fish samples were stunned and washed with clean water. The fish samples were randomly chosen, divided into 3 groups with a total weight of each group as 2kg and were subjected to treatments. The treatments were as follows: (1) control (untreated sample); (2) and (3) treated with 5% sodium chloride (table salt) for 5 minutes. Before smoking, the fish were labeled as samples 1, 2, and 3 to avoid error. Samples from each group were separated from each other and smoked according to the method described by Omojowo and Ibitoye (2005) [24]. The fish sample 1 was smoked without oil and sodium chloride therefore served as control. The smoking was carried out with improved smoking Kiln using charcoal for about 24 – 36 hours. The fish were weighed again after smoking and the changes in weight recorded.

After smoking, both castor oil and groundnut oil were applied to samples 2 and 3 respectively, allowed to air for temperature reduction and to enable the oil penetrate into the smoked fish. Thereafter, the samples were subjected to organoleptic test.

Organoleptic assessment

Sensory evaluation was carried out on the smoked fish samples by a 10 man panel which consists of five (5) staff and five (5) students of Federal College of Freshwater Fisheries Technology Baga on a scale of 7: Excellent, 6: Very good, 5: Good, 4: Fair, 3: Poor, 2: Very poor, and 1: Extremely poor, for taste, appearance, odour and texture and the results recorded in the questionnaire given to the panelists. Procedure for sensory assessment was strictly followed with reference to Eyo (2001) [10].

Data analysis

All data collected were subjected to the analysis of variance and a significance test for difference among sample variance using the least significance difference (LSD) in the mean comparison of means at $P<0.05$ level of significance in appearance, texture, taste and odour.

Results

Results of organoleptic assessment carried out on *C. gariepinus* treated with castor oil and groundnut oil are presented in Table 1.

The highest mean value of appearance (5.50 ± 0.32) was obtained from fish sample treated with 50g of sodium chloride and 30ml of castor oil while the lowest (4.90 ± 0.39) was obtained in sample 1 (the control) with P. value of 0.928

The highest mean value of taste (5.60 ± 0.25) was obtained from fish sample treated with 50g of sodium chloride and 30ml of castor oil while the lowest (4.90 ± 0.41) was obtained in sample 1 (the control) with P. value of 0.745

Also, the highest mean value of texture (5.30 ± 0.29) was obtained from fish sample treated with 50g of sodium chloride and 30ml of castor oil while the lowest (4.50 ± 0.35) was obtained in sample 1 (control) with P. value of 0.335

While the highest mean value of odour (5.50 ± 0.31^{a}) was obtained from fish sample treated with 50g of sodium chloride and 30ml of castor oil and the lowest (4.90 ± 0.29^{b}) was obtained in sample 1 (control) with P. value of 0.030

Table 1: Organoleptic attributes of smoked C. *gariepinus* (Treated and untreated)

	Sample 1	Sample 2	Sample 3	p-value
Appearance	4.90 ± 0.39	5.50 ± 0.32	5.20 ± 0.47	0.928
Taste	4.90 ± 0.41	5.60 ± 0.25	5.30 ± 0.31	0.745
Texture	4.50 ± 0.35	5.30 ± 0.29	4.90 ± 0.28	0.335
Odour	4.90 ± 0.29^{b}	5.50 ± 0.31^{a}	5.40 ± 0.15^{b}	0.030

Mean in the same row with different superscripts differ significantly ($P<0.05$)

Discussion

The organoleptic properties of the smoked *Clarias gariepinus* were assessed, and the fish sample that had the highest (best) result in appearance, texture, taste and odour were the fish treated with 50g of sodium chloride and 30ml of castor oil followed by sample treated with 50g of sodium chloride and 30ml of groundnut oil. The untreated smoked fish (which served as control) had the lowest score in all the assessments, probably due to the absence of salt and oil on them. This shows that application of oil on smoked fish improves quality and this is in agreement with Kumolu *et al*. (2015) [19] who revealed that smoked fish samples treated with ginger oil had lower mould count and improved quality. The viscosity of castor oil is high and it shines brighter than so many oils. This could be what informed the success seen in this experiment. It was also observed that sample treated with castor oil has highest level of acceptance (67%) than those treated with groundnut oil (33%) and the control (0%).

Castor oil can be seen to be all round in application. The leaves can be used for medical purposes as reported by Marta Amelia Vattuone *et al*. (1983) [21] who studied the hepatoprotective activity of *Ricinus communis* leaves in albino rats; Natu *et al*. (1977) also studied the protective effect of *Ricinus communis* leaves in experimental liver injury caused by carbon tetrachloride in albino rats.

Conclusion

The various treatments were found to have different effects on appearance and taste since there was significant difference ($p>0.05$) between samples treated with castor oil and groundnut oil. It was also observed that sample treated with castor oil has highest level of acceptance than those treated with groundnut oil and the control.

Recommendation

Quality standards should be adopted for the application of castor oil and groundnut oil in smoking of fish especially *Clarias gariepinus* to enhance good quality product and to ensure that fish reach the consumer in wholesome state. Castor oil, though more expensive than groundnut oil, shines brighter. Little quantity of castor oil should be applied so as not to reduce the profit margin on smoked fish. Also further studies need to be conducted on effect of castor oil on proximate composition and storage of smoked fish.

References

1. Adadu MO**,** Ochogwu J. Acute toxicity of detergent on juveniles of African catfish (*Clarias gariepinus*). International Journal of Fisheries and Aquatic Studies 2020;8(5):38-43.
2. Akande GR. Technical and economic dry kilns, a consultancy report commission 1997, 21.
3. Akinneye JO, Amao IA, Arannilewa ST. Evaluation of Traditional and solar drying systems towards enhancing fish storage and preservation in Nigeria (Abeokuta Local Government as a case study). Journal of Fisheries International 2007;2(1):99103.
4. Ayuba VO, Omeji S. Effect of insect infestation on the shelf life of smoked dried fish. Proceeding of the 21st Annual conference of the Fisheries Society of Nigeria (FISON), Calabar 2006, 357-359.
5. Azam K, Ali Asaduzzaman MY, Basher MZ, Hossain MM. Biochemical assessment of selected fresh fish, Journal of Biological science 2004, 4-910.
6. Bruton. The breeding biology and early development of *Clarias gariepnus (*Pisces: *Claridae* in Lake Sibaya, South Africa, with a review of breeding in species of the subgenus Clarias 1979.
7. Davies RM, Davies OA. Traditional and Improved Fish Processing Technologies in Bayelsa State, Nigeria. European journal of scientific research 2000;26(4):539-548.
8. Delgado CLN, Wada MW, Rosegrant SM, Ahmed M. Supply and demand in changing global markets.

International Food Policy Research Institute, Washington, DC and World Fish Centre, Penang, Malaysia.
9. ECA statistical activities 1982-1983 and work programme 1984-1987 with projections to 1989 1984.
10. Eyo AA. Text book on fish processing technology in the tropics. Published by National Institute for Freshwater Fisheries Research, New Bussa. University of Ilori Press, Nigerian 2001, 403.
11. FAO. The prevention of losses in cured fish. FAO Fisheries Tech 1981, 219.
12. FAO. The State of World Fisheries and Aquaculture 2006. FAO Fisheries and Aquaculture Department. Food and Agriculture Organization of the United Nations Rome 2007, 5-22.
13. FAO. CWP Handbook of fishery statistical standards. Section G: Fishing Areas-General. Rome, Italy 2014.
14. FDF. Fisheries statistic of Nigeria (1985-1994) 3rd edition published by Federal Department of Fisheries Abuja 2005, 51.
15. Gupta SK, Gupta RC. General and Applied ichthyology (Fish and Fisheries) S. Chand and 8 Company Ltd. Ranm Nagar, New Delhi 2006, 1330.
16. Hermansen K. Diet blood pressure and hypertension. Br. J Nutr 2000;83(1):133-119.
17. Ito S. The distribution effect of compliance with food safety and Agricultural health standards on small producers in developing countries. Proceedings for the Japan society for international development 2005, 113-116.
18. Kloshmanesh S. Design of solar dehydrator, coupled with energy storage in rock bed reservoir for fish drying process. International conference on energy and environment (ICEE). University Tenaga National, Bangi, Selangor, Malaysia 2006, 1-8.
19. Kumolu CA, Johnson PE, Ndimele AO, Ayorinde O, Ojikutu TI. The anti-oxidative and antifungal effects of ginger oil on the shelf life of hot smoked fish. American Journal of Food Technology 2015;10(2):78-84.
20. Majaffar S, Sankat CK. The mathematical modeling of the osmotic dehydration of shark 2006.
21. Marta AV, Olga LF, Fernnado EP, Alberty LV, Antonio RS. Localization of invertase activities in Rleinuseommunis leaves 1983.
22. Okonta A, Ekelemu J. A preliminary study of micro-organisms associated with fish spoilage in Asaba, Southern Nigeria. Proceedings of the 20th Annual Conference of the Fisheries Society of Nigeria (FISON) 2005, 557-560.
23. Olatunde AA. Approaches to the study of fisheries biology in Nigeria inland waters in Kainji. Proc National cont. two decades of research on Lake Kainji 1996, 538.
24. Omojowo FS, Ibitoye A. comparison of the microbial quantities of smoked *Clarias gariepinus* using four different kilns. In FISON proceeding, Port Harcourt 2005.
25. Osuji FNC. The influence of traditional handling method on the quality of processed fish in Nigeria. In proceeding of conference of handling, processing and marketing of tropical fish. London 1977, 312-322.
26. Paul AA, Southgate DAT. McCance and Widdowson's composition of foods. MRC special reprt no. 297 Elsevier/North. Biomedical Press. Amsterdam London 1978.
27. Picker MD, Griffiths CI. Alien and Invasive Animals- A South African Perspective Randomhouse/Struik. Cape Town, South Africa 2011, 240.
28. Sogbesan AO, Ugwumba AA, Madu CT. nutritive potentials and utilization of garden snail (*Limicolaria aurora*) meat meal in the diet of *Clarias gariepinus* fingerlings. I Hitech 2006;5(20):1999-2003.
29. Van der Wal S, Smith NJ, Hadfield KA. Review of the fish parasitic genus *Elthusa schioes.* Meinert 1884. (Crustacean, Isopoda, Cymothoidae) from South Africa including description of three new species. Zookeys 1998;841:17.
30. Wood CD, Evans NJ, Walker JD. The effect of salt on the susceptibility of clarias waiting to be attacked by dermestid beetles. Trop Sci 1987;27:223-228.