Insecticidal Effects of Natural Preservatives on Insect Pests of Smoked African Mud Catfish, *Clarias gariepinus* (Burchell, 1822)

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Abstract

The insecticidal affects some of natural preservatives: ginger, garlic, pepper, garlic-ginger and homogenate of garlic-ginger-pepper on insect pests of smoked cat fish (*Dermestes maculatus* and *Necrobia rufipes*) were investigated. Twenty each of *Necrobia rufipes*, *Dermestes maculatus* and larvae of these insects were introduced into each smoked fish product with the various natural insecticides, screened with mosquito net after which the mortality were observed and counted at every 3 days interval for a period of 7 weeks (49 days). The mortality of different species of insect pests and larvae were counted, sensory attributes of the products were evaluated using hedonic scale and ranking method. The entomological data as well as sensory data obtained by ranking the products were converted to percentage while the data obtained using the hedonic scale was subjected to kruscal wallis (H) analysis. The study revealed garlic had the highest insecticidal effect against *Necrobia rufipes*. However, garlic, pepper and garlic-ginger-pepper are very effective against *Dermestes maculatus*. The Kruskal wallis analysis of the hedonic scale indicated that there was no significant difference (p>0.05) in the taste panelist perception of the odour, flavour and texture of the various smoked catfish products during the period of study. The study established these natural preservatives are species selective which should be considered when they are intended to be used as insecticide as garlic-ginger-pepper homogenate had more potency against *Dermestes maculatus* (1.7%) while ginger had more potency against *Necrobia rufipes* (0.2% mortality). However, the odour, flavour and of unpreserved smoked catfish was ranked as the best by the taste panelist during the period of this study.

Keywords: Insecticidal effect; Natural preservatives; Insect pests; Smoked catfish

Introduction

Fish is highly perishable especially in the tropics where high temperature and humidity accelerate spoilage of fish immediately after catch as a result of which efforts are primarily directed towards the preservation of fish for human consumption [1,2]. However, poor handling, inadequate processing facilities, lack of ice or storage facilities, remoteness of the fishing villages to urban market centers, poor transportation system and poor distribution channels have drastically reduced fish utilization in the tropics [3]. A number of simple high temperature preservation techniques suitable for small scale preservation in the tropics such as sun drying, frying and smoking have been reviewed [4,5]. However, smoking is the most common method of fish preservation employed in the tropics; it increases fish shelf life, gives the product a desirable taste and odour, it also provides antibacterial and oxidative effects, lowers pH, impacts coloration as well as accelerating the drying process and acting as antagonist to spoilage agents [6]. In spite of the desirable effects of smoke on fish quality, high incidence of insect pest infestation has been reported to cause substantial losses in the nutritious value of fish during storage [5]. Insect pests such as *Dermestes maculatus* and *Necrobia rufipes* are insect pests that destroy smoked fish during storage just as microbes, enzymes and fat oxidation accelerates rates of spoilage [7]. Akpotu and Adebote [8] also stated that dermestis beetle, *Dermestes maculatus*, is a very important pest of smoke-dried fish as it destroys the flesh of stored fish. However, efforts to reduce losses through insect infestation by the use of synthetic insecticides and pesticides have not been fully adopted due to the hazardous nature of these chemicals to health and toxicity at high doses to users [9]. In order to eliminate much of these problems, many researchers are now working on plant based insecticides which are biodegradable, environment friendly, cheap, available and affordable to fish processors thereby justifying the use of plant based insecticide in this study.

Materials and Methods

Two hundred and fifty (250) live catfish (*Clarias gariepinus*) were collected from a concrete pond of PRO square Fish Farm Odo-Onaewele, Orita Challenge, Ibadan, Oyo state Nigeria with an average weight of the fish was 150 ± 10g, and transported by road to the fish processing unit of the Federal College of Animal Health and Production Technology (FCAH & PT) Moor Plantation Ibadan where they were slaughtered immediately and prepared in the sequence described by Ayeloja [2] which is presented in Figure 1. The fish were smoked using NIOMR (Nigeria Institute for Oceanography and Marine Research) smoking kiln installed in the fish processing unit of FCAH and PT Moor Plantation Ibadan Oyo State Nigeria at temperature of 90°C ± 10°C for 72 hours using charcoal as source of fuel. After smoking, the fish allowed to cool 12 hours in the smoking kiln after which they were stored at ambient temperatures (27°C ± 3°C) in the fish processing laboratory of FCAH and PT. Three replicate of each smoked catfish fish products were kept inside transparent polyethylene terephthalates (plastics) covered with mosquito net with rubber bound to prevent insects from escaping. Thereafter, twenty *Necrobia rufipes*, *Dermestes maculatus* and insect larvae each were introduced into each fish product with the various natural insecticides, screened with mosquito net after which the mortality were observed and counted at every 3 days.

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interval for a period of 7 weeks (49 days). The insects and larvae present were identified with the aid of hand lens while forceps were used to extract the insect pests.

Counting and identification of insect pest and larvae

The identification of the insect pests and insect larvae was based on the morphological features of the insects; hand lens was also employed for the proper view in order to clearly identify their features. The mortality of different species of insect pests and larvae were counted and recorded.

Collection of fish samples for organoleptic assessment

The fish samples were collected at every week (7 days) for organoleptic assessment for a period of 7 weeks. The sensory quality attributes that were evaluated was based on 5-point hedonic scale modified. Odour, flavour and texture were examined, the following grades were allotted depending on their qualities: 5 = Excellent, 4 = Very good, 3 = Good, 2 = Fair, and 1 = Bad. Ranks between 1 to 6 were also allotted to the various products for odour, flavor, texture and colour acceptance by semi trained taste panelists from Federal College of Animal Health and Production Technology Ibadan. The hedonic scale used for the study is presented on Table 1.

Statistical analysis

The entomological data as well as sensory data obtained by ranking the products were converted to percentage while the subjective sensory evaluation data obtained by using the hedonic scale was subjected to kruscal wallis (H) analysis.

Results and Discussion

The result in Tables 3-5 which shows the panelist perception of the odour, flavor and texture of the differently spiced catfish products during the period of the experiment indicated that the taste panelists observed no significant difference (p>0.05) in the odour, flavor and texture of the various smoked catfish products. This implies

![Figure 1: Step by step preparation of smoked fish products [2].](image)

### Table 1: The percentage mortality of the various insect pests in smoked catfish products.

| Preservatives | Dermestes maculatus % | Necrobia rufipes % | Insect larvae |
|---------------|------------------------|--------------------|--------------|
| Ginger        | 0.09%                  | 0.20%              | 99.70%       |
| Garlic        | 0.60%                  | 0.20%              | 99.30%       |
| Pepper        | 0.50%                  | 0.10%              | 99.50%       |
| Garlic-Ginger | 1.30%                  | 0%                 | 98.80%       |
| Garlic-Ginger-Pepper | 1.70% | 0% | 98.30% |
| Control       | 0.40%                  | 0%                 | 99.60%       |

**Percentage presented across the row.**

| Preservatives | Dermestes maculatus % | Necrobia rufipes % | Larvae % |
|---------------|------------------------|--------------------|----------|
| Ginger        | 0.09%                  | 0.20%              | 99.70%   |
| Garlic        | 0.60%                  | 0.20%              | 99.30%   |
| Pepper        | 0.50%                  | 0.10%              | 99.50%   |
| Garlic-Ginger | 1.30%                  | 0%                 | 98.80%   |
| Garlic-Ginger-Pepper | 1.70% | 0% | 98.30% |
| Control       | 0.40%                  | 0%                 | 99.60%   |

**Percentage presented across the row.**

### Table 2: The potency of the preservatives against each insect pest during ambient storage.

| Week | Ginger | Garlic | Pepper | Garlic-Ginger | Garlic-Ginger-Pepper | Control | H-value | P-value |
|------|--------|--------|--------|---------------|----------------------|---------|---------|---------|
| 1    | 35.79  | 32.92  | 35.58  | 41.29         | 41.04                | 32.38   | 0.814   | 2.25    |
| 2    | 28.33  | 36.58  | 29.21  | 42.13         | 41.46                | 42.29   | 0.284   | 6.233   |
| 3    | 36.63  | 34.88  | 31.79  | 31.54         | 43.96                | 34.21   | 0.772   | 2.527   |
| 4    | 42.92  | 34.63  | 25     | 34.29         | 41.21                | 40.96   | 0.266   | 6.438   |
| 5    | 41.42  | 23.13  | 45.96  | 31.71         | 42.5                 | 34.29   | 0.069   | 10.226  |
| 6    | 41.88  | 35.42  | 31.13  | 31.46         | 29.04                | 42.08   | 0.515   | 4.24    |
| 7    | 32.17  | 31     | 50.17  | 32.17         | 39.04                | 34.42   | 0.167   | 7.814   |

**Table 3: Panellist perception of the odour of differently spiced catfish preserved with different preservatives for seven weeks.**
Table 4: Panellist perception of the texture of differently spiced catfish preserved with different preservations for seven weeks.

| Week | Ginger | Garlic | Pepper | Garlic-Ginger | Pepper-Garlic | Control | H-value | P-value |
|------|--------|--------|--------|-------------|-------------|---------|---------|---------|
| 1    | 43.29  | 28.63  | 9.33   | 44.79       | 36.04       | 36.92   | 0.648   | 6.655   |
| 2    | 34.83  | 31.46  | 29.63  | 44.17       | 36.58       | 42.38   | 0.432   | 4.866   |
| 3    | 31.33  | 37.46  | 46.29  | 25.71       | 32.42       | 45.71   | 0.074   | 10.047  |
| 4    | 36.5   | 39     | 25.96  | 33.88       | 35.33       | 48.33   | 0.169   | 7.77    |
| 5    | 23.92  | 37.71  | 47.54  | 32.13       | 31.67       | 46.04   | 0.035   | 11.963  |
| 6    | 34.08  | 36.58  | 36.54  | 25.92       | 36.42       | 49.46   | 0.146   | 8.197   |
| 7    | 41.67  | 31.33  | 35.42  | 39.33       | 27.37       | 43.88   | 0.318   | 5.877   |

Table 5: Panellists perception on the flavour of differently preserved smoked catfish product.

| Preservatives | 1st (%) | 2nd (%) | 3rd (%) | 4th (%) | 5th (%) | 6th (%) |
|---------------|---------|---------|---------|---------|---------|---------|
| P0            | 8.33    | 33.33   | 66.67   | -       | -       | -       |
| P1            | 25     | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P2            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P3            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P4            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P5            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P6            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |

Table 6: Panellist perception of odour for week 1.

| Preservatives | 1st (%) | 2nd (%) | 3rd (%) | 4th (%) | 5th (%) | 6th (%) |
|---------------|---------|---------|---------|---------|---------|---------|
| P0            | 8.33    | 33.33   | 66.67   | -       | -       | -       |
| P1            | 25     | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P2            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P3            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P4            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P5            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P6            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |

Table 7: Panellist perception of odour for week 2.

| Preservatives | 1st (%) | 2nd (%) | 3rd (%) | 4th (%) | 5th (%) | 6th (%) |
|---------------|---------|---------|---------|---------|---------|---------|
| P0            | 8.33    | 33.33   | 66.67   | -       | -       | -       |
| P1            | 25     | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P2            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P3            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P4            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P5            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |
| P6            | 25.00  | 25.00   | 25.00   | 25.00   | 25.00   | 25.00   |

Table 8: Shows the panelist perception of odour for week 3.

that the type of preservative used have no significant effect (p>0.05) on the odour, flavor and texture of smoked catfish.

Tables 6-12 show the panelists ranking of the odour of the various smoked fish products during the period of the experiment. At the onset of the experiment, most of the panelists (33%) ranked the odor of smoked C. gariepinus preserved with ginger as the best, Fasakin and Aberejo [7] gave similar report in their study of the anti-oxidative and antifungal effects of fresh ginger (Zingiber officinalis) treatment on the shelf life of hot-smoked catfish (Clarias gariepinus, Burchell, 1822). However, taste panel preferred the odor of unspiced smoked C. gariepinus more than other products during 2nd, 3rd and the 6th weeks of storage (50.00%, 33.33% and 41.67% respectively). The result of the study is similar to the report of Ayeloja [1] where it was reported that consumers had more preference for un-spiced smoked catfish, an attitude that was attributed to non-familiarity of the spiced products by the consumers.

Tables 13-19 show the panelists ranking of the texture of the various smoked fish products during the period of the experiment. At the onset of the experiment, most of the panelists (50%) ranked the texture of smoked C. gariepinus preserved with ginger as the best, Fasakin and...
Aberejo [7] gave similar report in their study of the anti-oxidative and antifungal effects of fresh ginger (*Zingiber officinale*) treatment on the shelf life of hot-smoked catfish. Similar result as observed in the 1st week was also observed at the 6th week of the storage. However, taste panel preferred the texture of unpreserved smoked *C. gariepinus* more than other products during the period of this study as it was ranked to be the best by most of the taste panel during the 2nd, 3rd, 4th, 5th and the 6th weeks of storage (50.00%, 41.67%, 33.33%, 33.33% and 33.33% respectively). The result of the study is similar to the report of Ayeloja [1] where it was reported that consumers had more preference for unspiced smoked catfish, an attitude that was attributed to non-familiarity of the spiced products by the consumers.

Tables 20-26 show the panelists ranking of the flavour of the various smoked fish products during the period of the experiment. The result of this study indicated that pepper preserved smoked *C. gariepinus* was best preferred by the taste panel during the 4th and 7th week of storage (50.00% and 41.67% respectively). However, similar trend as observed for the odour and texture of these products were observed by the taste panel during the 2nd, 3rd, 4th, 5th and 6th weeks of storage (50.00%, 41.67%, 33.33%, 33.33% and 33.33% respectively).
panel for the flavour as the result indicated that the taste panel preferred the flavour of unpreserved smoked *C. gariepinus* more than other products during 1st, 2nd, 3rd, 5th and the 6th weeks of storage (41.67%, 41.67%, 33.33%, 50.00%, and 33.33% respectively). This is similar to the report of Ayeloja [1] where it was reported that consumers had more preference for un-spiced smoked catfish, an attitude that was attributed to non-familiarity of the spiced products by the consumers.

**Conclusion**

This study revealed that all the preservatives have high potency against insect larvae, while ginger had the highest insecticidal effect against *Necrobia rufipes*. However, garlic, pepper and garlic-ginger-pepper are very active against *Dermestes maculatus*. The Kruskal wallis analysis of the hedonic scale indicated that there was no significant difference (p>0.05) in the taste panelist perception of the odour, flavour and texture of the various smoked catfish products during the period of study. The preservatives are specie selective; this should be considered when they are intended to be used as insecticide as garlic-ginger-pepper homogenate had more potency against *Dermestes maculatus* (1.7%) while ginger had more potency against *Necrobia rufipes* (0.2% mortality). However, the odour, flavour and of unpreserved smoked catfish was ranked as the best by the taste panelist during the period of this study.

**References**

1. Ayeloja AA, George FOA, Awobifa OM, Sodeeq AE, Jimoh WA, et al. (2015) Effect of insect infestation on the economic value of smoked fish sold in selected markets within Oyo State, South West Nigeria. Delta State University, Asaba Campus, Delta State, Nigeria.
2. Ayeloja AA, George FOA, Akinyemi AA, Atanda OO (2015) Proximate and mineral composition of spiced, smoked catfish *Clarias gariepinus* (Burchell, 1822). J Agri Sci Environ 15: 68-74.
3. Fasakin EA (2003) Use of some plant oil extracts as surface protectant against storage insect pest, *Dermestes maculatus* Degeer, on smoked fish. UNAAB Journal 3 :1-6.
4. Ames GR (1992) Traditional and modern post-harvest technologies for increased food and supply from inland fisheries in Africa. Proceedings of the symposium of post-harvest fish technology, Cairo, Egypt. FAA-CIFA Technical Paper 19: 11-17.
5. Ikenweivec NB, Bolaji BO, Bola GA (2010) Fabrication and performance assessment of a locally developed fish smoking kiln. Ocean J Appl Sci 3: 1-12.
6. Akinwale AJ, Oyegoke OO, Lawal OS (2013) Medical implications of bio-deteriorating agents in stored fish samples in Nigeria. Africa J Microbiol Res 7: 3429-3434.
7. Fasakin EA, Abojoro O (2000) Effect of some pulverized plant materials on the developmental stages of fish beetle, *Dermestes maculatus Deger* in smoked catfish (*Clarias gariepinus*) during storage. Biore p Technol 85: 173-177.
8. Akpotu JO, Adebote DA (2013) Repellency effect of five plants extracts against the larvae of *Dermestes maculatus* larvae on smoke-dried *Clarias gariepinus* fish. Res J Chem Environ Sci 1: 1-4.
9. Balogun AM (1992) Fish handling and quality control: Aquaculture development in Africa, training and references manual for aquaculture extensionists. Commonwealth Secretariat, London.