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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 *Necrobial rufipes*) were investigated. Twenty each of *Necrobial 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 ginger 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 specie 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 nutritive 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-Onaelewe, 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 polyethelne terephtalates (plastics) covered with mosquitoes net with rubber bound to prevent insects from escaping. Thereafter, twenty *Necrobial 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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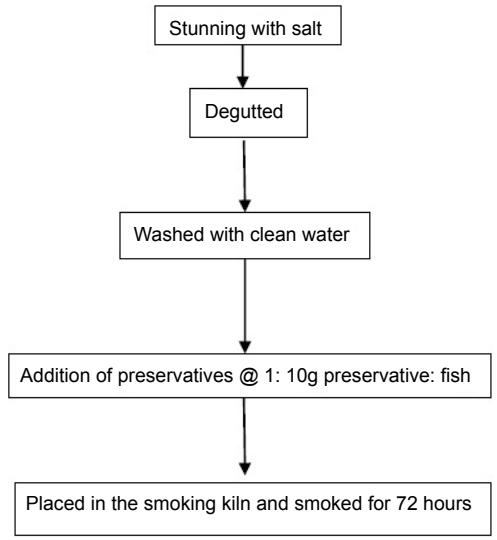

Figure 1: Step by step preparation of smoked fish products [2].

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: 8 ≤ 10 = Excellent, 6 ≤ 8 = Very good, 4 ≤ 6 = good, 2 ≤ 4 = bad and ≤ 2 = worst. Ranks between 1st to 6th 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 of the percentage mortality of the various insect pests in smoked catfish products (Table 1) indicated that garlic, pepper and garlic-ginger-pepper homogenate are very effective insecticide against *Dermestes maculatus* as 25% percent mortality were recorded for the insect (*Dermestes maculatus)* when preserved with these preservatives during 49days of storage while ginger had the lowest potency (5% mortality) against *Dermestes maculatus*. However, ginger had the highest potency against *Necrobia rufipes* where 50% mortality was recorded during the period of the experiment followed by garlic and pepper where 25% mortality were recorded, while garlic-ginger, garlic-ginger-pepper and control had the least percent mortality of *Necrobia rufipes*. All the preservatives added were able to kill insect larvae with the highest larvae mortality observed in pepper preserved smoked catfish (28.5%) followed by ginger preserved smoked catfish (25.9%), followed by garlic preserved smoked catfish (20.9%). The potency of the preservatives against each insect pest during ambient storage as presented in Table 2 indicated that the highest mortality of *Dermestes maculatus* was recorded in garlic-ginger-pepper homogenate (1.7%) while the lowest mortality of *Dermestes maculatus* was recorded in ginger (0.09% mortality). This indicates that garlic-ginger-pepper homogenate is the most effective preservative against *Dermestes maculatus* while ginger is the least effective. However, ginger and garlic are the most effective preservative against *Necrobia rufipes* (0.2% mortality) during the period of storage while garlic-ginger homogenate and garlic-ginger-pepper homogenate are the least effective against *Necrobia rufipes*. All the preservatives were however effective against insect larvae.

The result in Tables 3-5 which shows the panelist perception of the odour, flavor and texture of the differently preserved smoke 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

Preservatives	*Dermestes maculatus*	*Necrobia rufipes*	Insect larvae
Ginger	5%	50%	25.90%
Garlic	25%	25%	20.90%
Pepper	25%	25%	28.50%
Garlic-Ginger	10%	0%	4.20%
Garlic-Ginger-Pepper	25%	0%	7.30%
Control	10%	0%	13.10%
Percentage presented along the column.			

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

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	38.13	42.29	41.46	0.284	6.233
3	36.63	34.88	31.79	31.54	34.21	43.96	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	34.29	42.5	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	32.21	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.

Week	Ginger	Garlic	Pepper	Garlic-Ginger	Garlic-Ginger-Pepper	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 4: Panellist perception of the texture of differently spiced catfish preserved with different preservations for seven weeks.

Week	Ginger	Garlic	Pepper	Garlic-Ginger	Garlic-Ginger-Pepper	Control	*H*-value	P-value
1	37.63	31.21	43.79	43.29	31	32.08	0.401	5.127
2	38.58	35.46	29.83	30.71	41.17	43.25	0.502	4.335
3	44.38	23.96	42.96	43.63	26.29	37.79	0.03	12.408
4	40.46	30.33	39.46	33.83	35.25	49.67	0.06	10.614
5	35.58	40.42	41.54	29.96	30.83	40.67	0.578	3.8
6	40.96	23.67	34.58	57.58	30.96	41.25	0.062	10.507
7	32.79	33.88	31.38	40.67	30.88	43.42	0.604	3.63

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

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	8.33	16.67	25	25	-	25
P2	16.67	8.33		8.33	33.33	33.33
P3	16.67	41.67	25	8.33	8.33	-
P4		25	8.33	33.33	16.67	8.33
P5	8.33	8.33	41.67	16.67	25	-
P6	50				16.67	33.33

Table 6: Panellist perception of odour for week 1.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	33.33			25	25	16.67
P2	8.33	16.67	16.67	8.33	41.67	8.33
P3	25	16.67	8.33	16.67	8.33	25
P4	-	50	16.67	8.33	8.33	16.67
P5	16.67	8.33	33.33	16.67	16.67	8.33
P6	16.67	8.33	25	25	-	25

Table 7: Panellist perception of odour for week 2.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	16.67	25	16.67	16.67	16.67	8.33
P2	-	-	33.33	25	25	16.67
P3	25	25	16.67	33.33	-	-
P4	-	33.33	16.67	8.33	25	16.67
P5	25	8.33	16.67	8.33	25	16.67
P6	33.33	8.33	-	8.33	8.33	41.67

Table 8: Shows the panellist 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 odour 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 officnale*) treatment on the shelf life of hot-smoked catfish (*Clarias garieplinus*, Burchell, 1822). However, taste panel preferred the odour of unpreserved 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

Preservative	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	8.33	16.67	25	8.33	33.33	8.33
P2	-	8.33	8.33	33.33	16.67	33.33
P3	41.67	25	25	-	-	8.33
P4	16.67	25	-	25	33.33	-
P5	-	8.33	25	16.67	8.33	41.67
P6	33.33	16.67	16.67	16.67	8.33	8.33

Table 9: Shows the panellist perception of odour for week 4.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	16.67	25	16.67	16.67	16.67	8.33
P2	-	-	33.33	25	25	16.67
P3	25	25	16.67	33.33	-	-
P4	-	33.33	16.67	8.33	25	16.67
P5	25	8.33	16.67	8.33	25	16.67
P6	33.33	8.33	-	8.33	8.33	41.67

Table 10: Shows the panellist perception of odour for week 5.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	-	33.33	8.33	-	50	8.33
P2	16.67	25	33.33	-	-	16.67
P3	33.33	8.33	41.67	16.67	-	-
P4	-	16.67	-	41.67	8.33	33.33
P5	8.33	-	8.33	33.33	25	25
P6	41.67	16.67		8.33	16.67	16.67

Table 11: Shows the panellist perception of odour for week 6.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	25	16.67	33.33	-	16.67	8.33
P2	-	8.33	25	33.33	25	8.33
P3	50	-	16.67	8.33	8.33	25
P4	-	8.33	16.67	50	16.67	8.33
P5	8.33	25	8.33	8.33	8.33	33.33
P6	16.67	41.67	-	-	25	16.67

Table 12: Shows the panellist perception of odour for week 7.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	16.67	-	25	-	25	33.33
P2	-	33.33	8.33	8.33	16.67	33.33
P3	25	-	8.33	33.33	33.33	-
P4	8.33	25	41.67	16.33	-	8.33
P5	-	25	8.33	41.67	16.67	8.33
P6	50	25	-	-	8.33	16.67

Table 13: Shows the panellist perception of texture Week 1.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	50	25	8.33	8.33	8.33	-
P2	-	8.33	33.33	16.67	33.33	8.33
P3	-	25	25	16.67	16.67	16.67
P4	33.33	8.33	16.67	8.33	8.33	25
P5	8.33	16.67	8.33	33.33	8.33	25
P6	8.33	16.67	8.33	16.67	25	25

Table 14: Shows the panellist perception of texture for week 2.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	25	8.33	16.67	16.67	8.33	25
P2	8.33	16.67	16.67	16.67	25	16.67
P3	16.67	33.33	8.33	16.67	16.67	8.33
P4	-	16.67	33.33	33.33	8.33	8.33
P5	-	8.33	8.33	16.67	33.33	33.33
P6	41.67	16.67	16.67	-	8.33	8.33

Table 15: Shows the panellist perception of texture for week 3.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	16.67	8.33	16.67	16.67	33.33	8.33
P2	16.67	33.33	16.67	16.67	-	16.67
P3	8.33	8.33	25	33.33	16.67	8.33
P4	16.67	8.33	8.33	25	16.67	33.33
P5	16.67	25	16.67	-	25	16.67
P6	33.33	16.67	16.67	8.33	8.33	16.67

Table 16: Shows the panellist perception for texture week 4.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	-	16.67	16.67	8.33	16.67	41.67
P2	33.33	8.33	33.33	16.67	8.33	-
P3	16.67	33.33	16.67	33.33	-	-
P4	-	8.33	25	8.33	16.67	41.67
P5	8.33	8.33	-	25	33.33	8.33
P6	33.33	16.67	8.33	8.33	25	8.33

Table 17: Shows the panellist perception for texture week 5.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	33.33	16.67	33.33	8.33	-	8.33
P2	16.67	25	25	16.67	8.33	8.33
P3	8.33	33.33	8.33	41.67	8.33	-
P4	-	-	16.67	33.33	41.67	8.33
P5	8.33	-	8.33	-	33.33	50
P6	33.33	25	8.33	-	8.33	25

Table 18: Shows the panellist perception for texture week 6.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	16.67	8.33	25	8.33	25	33.33
P2	8.33	25	8.33	16.67	16.67	25
P3	41.67	16.67	16.67	25	-	-
P4	8.33	16.67	25	8.33	16.67	25
P5	8.33	8.33	8.33	33.33	25	16.67
P6	16.67	25	33.33	8.33	16.67	-

Table 19: Shows the panellist perception for texture week 7.

Aberejo [7] gave similar report in their study of the anti-oxidative and antifungal effects of fresh ginger (*Zingiber officnale*) 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 un-spiced 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

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	33.33	16.67	25	25	-	-
P2	16.67	8.33	8.33	16.67	41.67	8.33
P3	16.67	25	25	8.33	8.33	16.67
P4	-	16.67	16.67	33.33	16.67	16.67
P5	8.33	16.67	8.33	16.67	25	25
P6	33.33	16.67	16.67	8.33	8.33	16.67

Table 20: Shows the panellist perception for flavour week 1.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	25	25	41.67	-	8.33	-
P2	-	16.67	25	16.67	25	16.67
P3	25	8.33	8.33	33.33	8.33	16.67
P4	8.33	16.67	-	16.67	25	33.33
P5	8.33	16.67	-	33.33	16.67	25
P6	33.33	16.67	25	-	16.67	8.33

Table 21: Shows the panellist perception for flavour week 2.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	33.33	25	16.67	8.33	8.33	8.33
P2	8.33	8.33	41.67	8.33	16.67	16.67
P3	8.33	16.67	25	33.33	8.33	8.33
P4	-	8.33	16.67	41.67	8.33	25
P5	8.33	8.33	-	33.33	33.33	16.67
P6	41.67	33.33	-	-	-	25

Table 22: Shows the panellist perception for flavour week 3.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	16.67	25	25	-	8.33	25
P2	-	8.33	25	41.67	25	-
P3	16.67	16.67	8.33	25	16.67	16.67
P4	16.67	16.67	16.67	16.67	33.33	-
P5	-	8.33	16.67	16.67	8.33	50
P6	50	25	8.33		8.33	8.33

Table 23: Shows the panellist perception for flavour week 4.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	-	25	33.33	16.67	16.67	8.33
P2	8.33	33.33	25	8.33	-	25
P3	41.67	8.33	8.33	16.67	16.67	8.33
P4	-	8.33	8.33	25	50	8.33
P5	16.67	-	25	8.33	8.33	41.67
P6	33.33	16.67	-	33.33	8.33	8.33

Table 24: Shows the panellist perception for flavour week 5.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	16.67	25	25	-	8.33	25
P2	-	8.33	25	41.67	25	-
P3	16.67	16.67	8.33	25	16.67	16.67
P4	16.67	16.67	16.67	16.67	33.33	-
P5	-	8.33	16.67	16.67	8.33	50
P6	50	25	8.33	-	8.33	8.33

Table 25: Shows the panellist perception for flavour week 6.

Preservatives	1st (%)	2nd (%)	3rd (%)	4th (%)	5th (%)	6th (%)
P1	33.33	25	16.67	8.33	8.33	8.33
P2	8.33	8.33	41.67	8.33	16.67	16.67
P3	8.33	16.67	25	33.33	8.33	8.33
P4	-	8.33	16.67	41.67	8.33	25
P5	8.33	8.33	-	33.33	33.33	16.67
P6	41.67	33.33	-	-	-	25

Table 26: Shows the panellist perception for flavour week 7.

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.

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