(RESEARCH ARTICLE)

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Abundance and diversity of insects associated with dry fish spoilage in three (3) selected markets in Yenagoa, Bayelsa State

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Abstract

The insect vectors associated with spoilage of dried fish in Yenagoa were studied. This was done in order to identify the diversity and abundance of Insects implicated in fish spoilage in order to suggest alternate storage means. Insect infested dry fish samples were procured from Three (3) markets (Swali (A), Kpansia (B) and Tombia (C)) and put into clean transparent plastic containers covered with little nets. They were moistened every day with water sprinkled into the containers for 1 week for insects to emerge. Insect vectors were identified to species level using standard keys. Result of the investigation reveal that a total of eleven Taxa and 156 individuals were found: 12 Calliphorid larvae, 1 crane fly larvae, 46 *Musca domestica* larvae, 5 Phaenicia sericate, 20 *Piophilia casei*, 20 *Calliphorid* pupa, 3 *Tephritid* larvae, 6 *Necrobia fufipe* larvae, 10 *Dermestes maculatus* pupae, 30 *Phlorid pupa*, 3 scatopsidae larvae. The dominant taxon was *Musca domestica* larvae followed by *Phlorid* pupa, and the least abundant was crane fly larvae. From the eleven (11) taxa seen, the abundance of *Phlorid* pupa was observed in station C (30). Pio*philia casei* and *Musca domestica* larvae were the only taxa present in the three sample stations. The Shannon index gotten in station B varied from station A and C. Shannon diversity index for station B was observed to be 1.535 and A and C were observed to be 0.918 and 1.466 respectively. Species evenness was greatest at station A (0.835). The insect vector of the order coleoptera (Beetles) were present only in fish samples from Swali and Tombia markets and absent from fish samples from Kpansia market. This may be due to the storage methods for dry fish in these markets and also due to environmental factors prevalent in these markets. The dominance of *Musca domestica* is indicative of possible health hazards as the consumption of insect infested dried fish in Yenagoa without washing may result in cholera and diarrhea. The study concluded that insects are the major vector pathogens causing spoilage in dried fish in Yenagoa, as indicated in similar studies in the Niger Delta. Therefore, more effort should be taken in the preservation and storage of dry fish to ensure food safety and security.

Keywords: Abundance; Diversity; Insect; Dry fish; Spoilage; Markets; Bayelsa State

1. Introduction

There is a growing demand for fish protein in Nigeria due to the volatility of meat supplies due to issues of insecurity, banditry, cattle rustling and political instability. However, domestic production of fish from culture fisheries, capture fisheries and imports cannot meet local demand. This is further compounded by post- harvest fish losses due to spoilage. Fish preservation is therefore inevitable to preserve fish. Common methods of fish preservation include freezing, drying, salting, marinating etc. Fish drying is one of the most common methods of fish preservation and storage in Nigeria.

Sadly, fish drying does not guarantee the end to the problems of spoilage as proper storage and distribution of fish is cardinal to maintaining fish quality. Infestation of exposed dried fish by insects and mites can cause public health hazard

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as they are carriers of diseases causing pathogens to man that result to intestinal disorders and allergies [1, 2]. Spoilage occurring in dry fish due to flies and other insect vectors in the open markets as a result of poor storage are of great significance and a serious problem in Yenagoa, Bayelsa state.

In Yenagoa, dry fish are mostly displayed on tables in open trays without proper covering or protective shield to keep away dust and insects. They are further packed in open containers and left overnight for all sorts of crawling and flying insects to feast and forage upon.

As insects cause serious losses to stored dry fish and impact negatively on human health, this study is conducted to investigate the abundance and diversity of insect vectors of stored dry fish in three markets in Yenagoa, Bayelsa state. This will provide useful information for dealing with the problem of fish preservation, storage and help to ensure food safety and security.

2. Material and methods

2.1. Study Area

Swali, Kpansia, and Tombia markets are located in Yenagoa metropolis, Bayelsa State, Nigeria. Dry fish is supplied to these markets from various sources which include: Akassa, Nembe, Brass, Koluama, Otueke, Zarama, Ogbia, Sagbama, etc all from Bayelsa State.

2.1.1. Station A

(Swali market): This is one of the oldest markets in Yenagoa metropolis. This market opens every day where different goods, fish, fish products, meat and meat products are being sold.

2.1.2. Station B

(Kpansia market): It is situated at the heart of Yenagoa in Yenagoa local Government Area, Bayelsa State. The market is located along the express road.

2.1.3. Station C

(Tombia market): This market is located along the busy Tombia-Amassoma road roundabout.

2.2. Collection of samples

Insect infested dried fish samples of *Clarias gariepinus* sold in Swali, Kpansia and Tombia markets, were purchased from different fish stalls. Each fish sample was sealed in a polythene container and numbered serially and were transported to the laboratory in the Department of Biological Science, Niger Delta University. Fish samples were identified to generic level using keys provided by Olaosebikan and Raji [3].

2.3. Identification of Insects:

Each of the dried fish samples from the various markets were added into a plastic container containing little quantity of garri (Cassava flour) and was covered with a 0.05mm mesh size net and exposed to room temperature. The plastic containers containing the infested fishes were allowed to stand for 1 week to allow for insect larvae to develop and emerge. The dried fish samples were cracked to make sure that no maggot residing in the fish was left out. Raid ® aerosol home insecticide was then applied to kill all emerging insects. They were visually examined with the naked eyes and in turn with a microscope attached with a DC-2 camera. Collected insect larvae were examined thoroughly, counted and viewed and identified to species level according to taxonomic keys [1, 2, 4, 5, 6, 7].

2.4. Data Analysis

Species abundance and diversity of the insect vectors was determined virtually by manual enumeration and identification using standard keys, Shannon-Weiner diversity index, Evenness and Simpson's diversity were calculated using the following formula

Shannon-Weiner; $^s\Sigma = (^{ni}/_n) \ln (^{ni}/_n)$ where i=1

Evenness by E = $H^{ii}/_{lns}$

3. Results

The result of this study is presented in Table 1 and Figures 1 – 8.

Table 1 Insect Vectors of Dry fish in 3 Markets in Yenagoa

S/N	Order	Family	Taxa	Swali	Kpansia	Tombia
1	Diptera	Calliphoridae	Calliphorid larvae	0	2	10
2	Diptera	Tupulidae	Crane fly	0	1	0
3	Diptera	Muscidae	Musca domestica larvae	27	15	4
4	Diptera	Calliphoridae	Phaenicia sericate	0	5	0
5	Diptera	Piophillidae	Piophila casei	11	4	5
6	Diptera	Calliphoridae	Calliphorid pupa	0	20	0
7	Diptera	Tephritidae	Tephritid larvae	0	3	0
8	Coleoptera	Cleridae	Necrobia rufipe larvae	6	0	0
9	Coleoptera	Dermestidae	Dermestes masculatus	0	0	10
10	Diptera	Phoridae	Phlorid pupa	0	0	30
11	Diptera	Scatopsidae	Scatopsidae larvae	0	0	3
12	Shannon index			0.918	1.535	1.466
13	Simpson's Index			0.4572	0.272	0.298
14	Shannon equitable Index (Evenness)			0.835	0.79	0.819
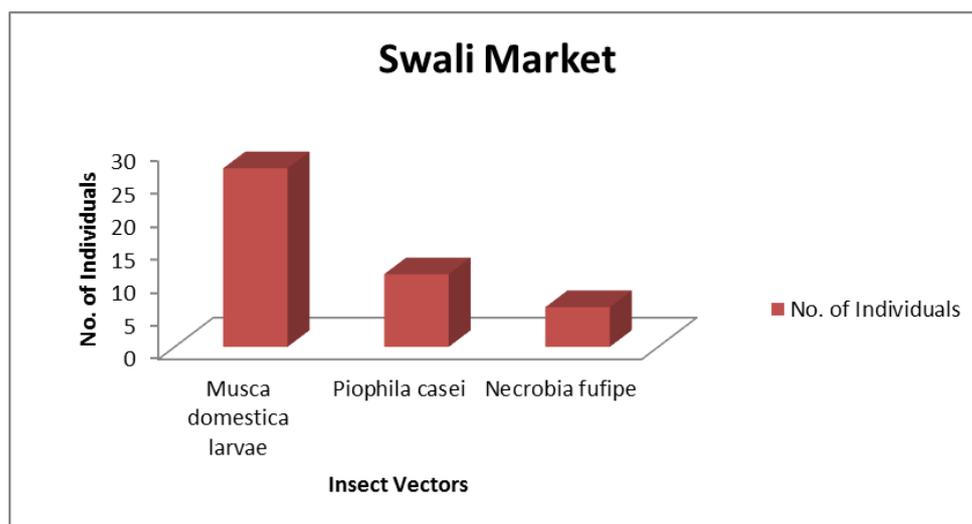
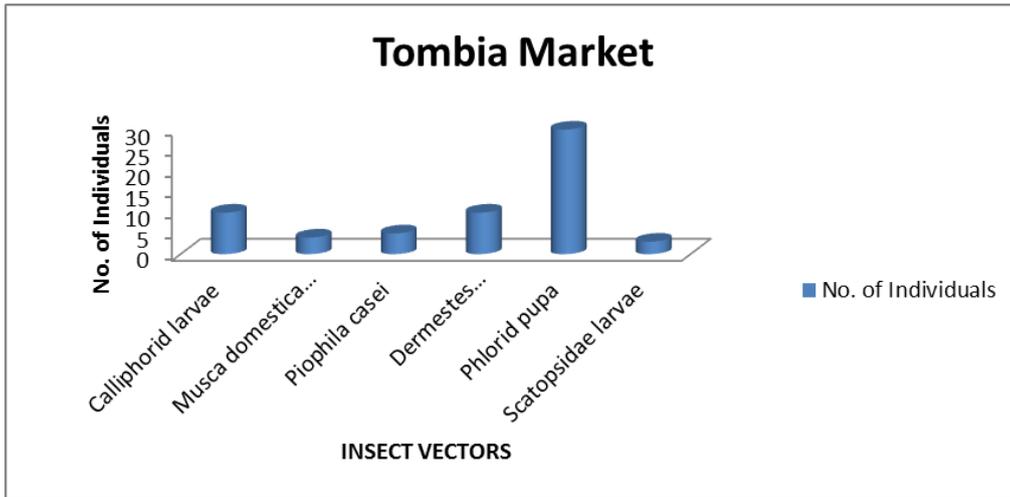**Figure 1** Insect vectors of dry fish in Swali market
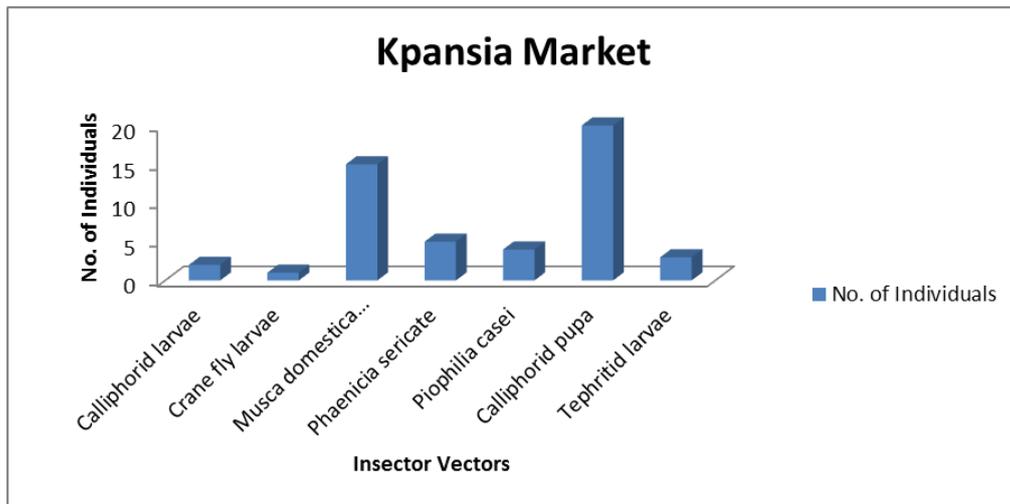
Figure 2 Insect vectors of dry fish in Tombia market
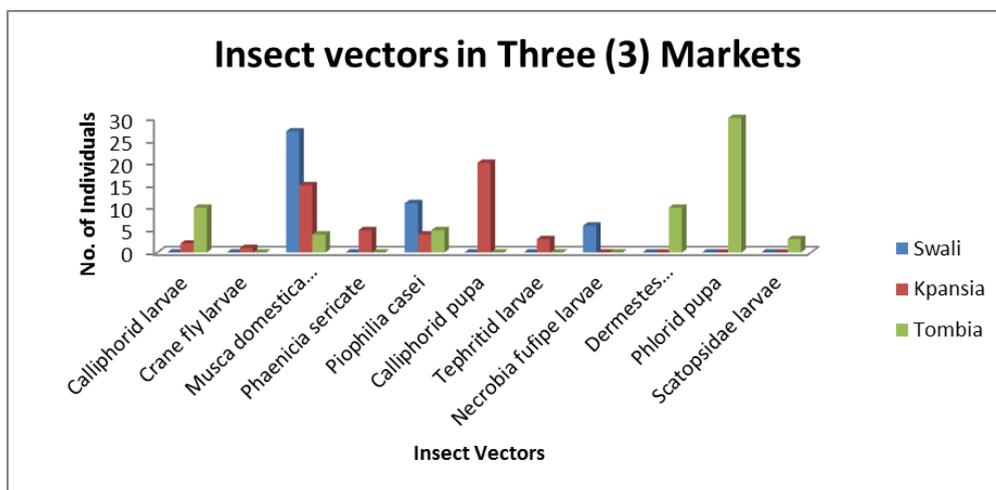

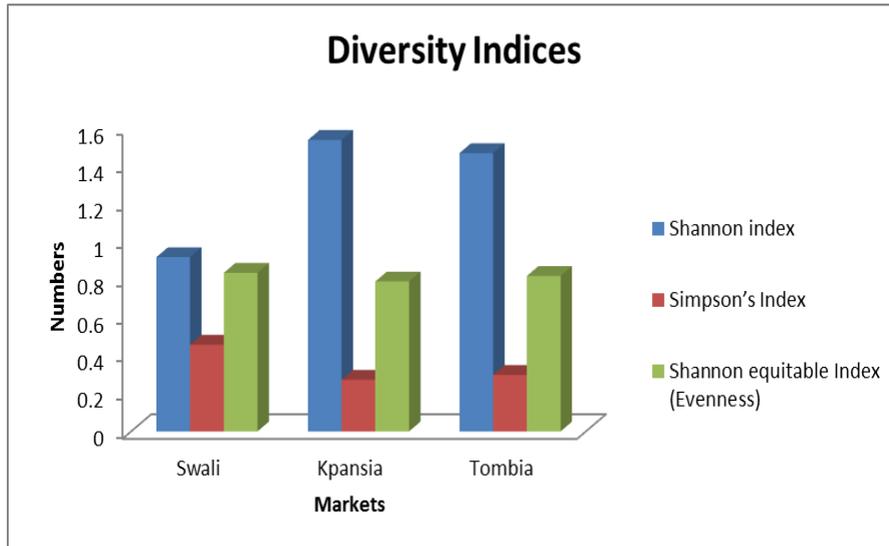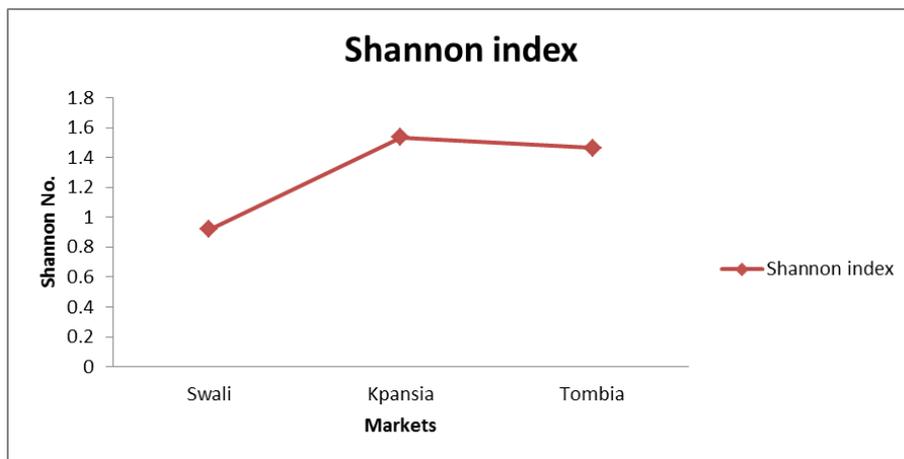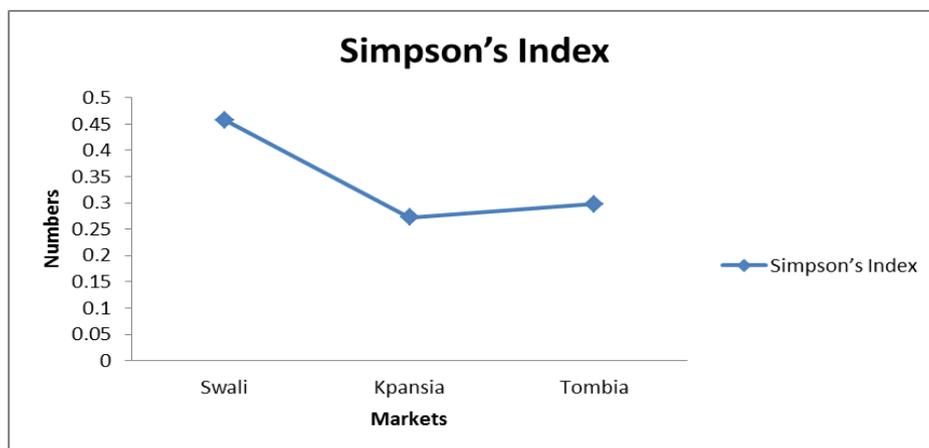**Figure 3** Insect vectors of dry fish in Kpansia market

Figure 4 Insect vectors of dry fish in Swali, Tombia and Kpansia markets
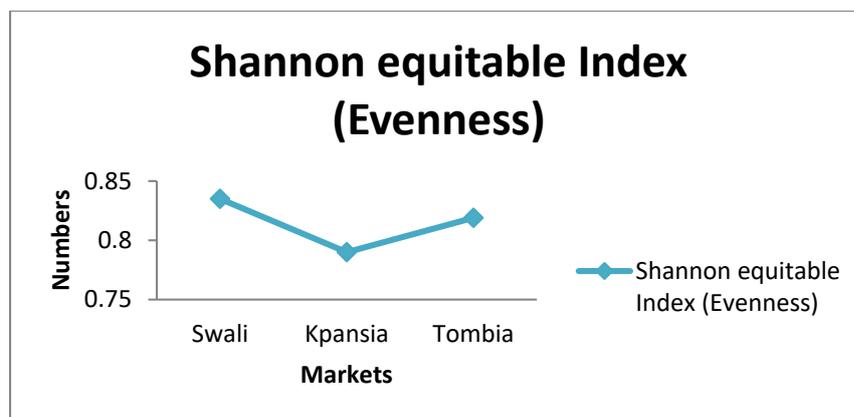
Figure 5 Diversity indices of Insect vectors in all three markets in Yenagoa

Figure 6 Shannon index of Insect vectors in all three markets in Yenagoa

Figure 7 Simpson's index of Insect vectors in all three markets in Yenagoa

Figure 8 Shannon Equitable index of Insect vectors in all three markets in Yenagoa

4. Discussion

The study undertook an investigation on the insect vector organisms involved in dry fish spoilage from three (3) markets in Bayelsa State. In Swali market, insects from 2 order and 3 families with 44 individuals were identified. In Kpansia market, insects from 1 order and 5 families with 50 individuals were identified. In Tombia market, insects from 2 order and 6 families with 62 individuals were also identified. Insect vectors identified in this study infesting fish are Calliphorid larvae, Crane fly, Musca domestica larvae, Phaenicia sericate, Piophila casei, Calliphorid pupa, Tephritid larvae, Necrobia rufipe larvae, *Dermestes masculatus*, Phlorid pupa and Scatopsidae larvae. The findings of this study compare favourably with that of Osuji (1985) where 57.07% of the collected arthropods from dried fish from Ogige market were *D. maculatus* and 21.54% *N. rufipes* among others. The Arthropod pests commonly found on dried fish are beetles (Coleoptera), flies (Diptera) and mites (Acarina) (FAO, 1989). This is somewhat in line with this study.

It was also seen that the insect vectors were most diverse at station B (Kpansia Market) followed by station C (Tombia Market) and lastly by station A (Swali Market). Simpson's index reveals that Swali>Tombia>Kpansia. The difference in their abundance may be due to the slight variation in their storage and preservation methods coupled with the physio-chemical conditions of their environment. Evenness index also reveal that Swali>Tombia>Kpansia. Evenness is a measure of stability, therefore Swali market seem to possess a more stable environment for vector insect survival and preponderance.

Musca domestica larvae were observed to be most abundant (46) and the most diverse. In the same vein, *Phlorid* pupa was the second most abundant (30) and the least abundant was the crane fly larvae (1). The observation of the high abundance of *Musca Domestica* larvae indicates that the people in the areas who eat dried fish might be exposed to adverse health conditions, as it is known that *Musca Domestica* have been implicated as a pathogenic insect vector causing severe enteric disorders such as dysentery, cholera etc [1].

The insect vector of the order coleoptera (Beetles) were present only in fish samples from Swali and Tombia markets and absent from fish samples from Kpansia market. This may not only be due to the storage methods for dry fish in these markets but also due to environmental factors prevalent in these markets, Swali and Tombia markets are sited close to creeks and rivers respectively. Beetles are known inhabit moist and damp surroundings including mudflats. Another reason for the disparity in the type of insect infestation may be the nature of the infesting insects and the type of dry fish available. Certain insects are nocturnal while others are diurnal. Nocturnal insect only infest fish at night and most effective where the method of storage is poor. Also, insect vectors prefer infesting certain fish species over others and therefore the absence of certain insects may be due to their low preference for infesting *Clarias gariepinus* fish. Eke et al, [8] noted that the rate of visitation of nocturnal pest was more on fish species like *Synodontis, Hepsetus, Proepterus and Heterotis* while the diurnal pest was more in Cod fish.

5. Conclusion

The result of this study shows that the distribution, abundance and diversity of insect vectors causing spoilage in dried fishes in the three selected markets in Yenagoa is slightly high but similar to the results of other studies in Nigeria. *Musca domestica* larvae were observed to be most abundant (46) and the most diverse. In the same light, *Phlorid* pupa was the second most abundant (30) and the least abundant was the crane fly larvae (1) across all markets in Yenagoa. The insect

vector of the order coleoptera (Beetles) were present only in fish samples from Swali and Tombia markets and absent from fish samples from Kpansia market. This may be due to the nature of the infesting insect and the prevailing environmental factors and the method of storage in the different markets. Insect vector was most diverse at station B (Kpansia Market) followed by station C (Tombia Market) and lastly by station A (Swali Market). Simpson's index reveals that Swali>Tombia>Kpansia. Evenness index also reveal that Swali>Tombia>Kpansia.

As *Musca Domestica* have been implicated as a pathogenic insect vector causing severe enteric disorders such as dysentery, cholera etc proper care should take in the preservation and storage of dry fish in Yenagoa because of the grave health implications of insect infestation.

Compliance with ethical standards

Acknowledgments

Disclosure of conflict of interest

All the authors hereby declare that there is no conflict of interest before, during and after the conduct of this research.

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