Applied Tropical Agriculture
Volume 23, No. 2, 90-97, 2018

BIO EFFICACY OF *MORINGA OLEIFERA* (LAM) LEAF POWDER AND COMMON SALT AGAINST MOULD INFECTION OF *CLARIAS GARIEPINUS* FOLLOWING INFESTATION WITH *DERMESTES MACULATUS* (DEGEER).

Gbaye, O. A., Oladele, O. O.* and Aluko, O. F.

Department of Biology, Federal University of Technology, Akure, Nigeria
** Corresponding author: E-mail address of Corresponding author: prophetoladele2014@gmail.com*

Abstract
This study was conducted to assess bio efficacy of Moringa oleifera (Lam) leaf powder and common salt against mould infection of Clarias gariepinus (Burchell, 1822) following infestation with Dermestes maculatus (Degeer). 24 adult live samples of C. gariepinus were de-slimed, eviscerated and were separately treated with 15, 20g and 25g of Moringa oleifera leaf powder, common salt and a mixture of M. oleifera leaf powder and salt (1:1) before oven dried at 65±5°C for 24 hours and then stored for 60 days in plastic container and ziplock bag at 28±2°C and 76±5%RH following infestation with newly emerged Dermestes maculatus larvae. Uninfested but treated samples served as control. Results obtained showed that C. gariepinus treated with 20g dose of Moringa; 20 and 25g doses of salt, 15 and 20g doses of Moringa - salt (1:1) proved the most effective, having mean mould assessment values between 1.00±0.00 and 1.33±0.03, indicating no observable mould appearance on the infested fish for the whole 60 days of storage in both plastic and ziplock bag.

Keywords: *Moringa oleifera leaf powder; common salt; Clarias gariepinus; Dermestes maculatus; mould infection*

Introduction
From the beginning of 21st Century, fish has received increased attention as a potentials source of animal protein and essential nutrients for human diets (Adeyemi *et al.* 2013). In addition to its nutritional value, fish plays important roles in providing incomes and alleviating poverty in both rural and urban areas of many developing countries (Amusan and Okorie, 2002, Al-Jufaili and Opara, 2006). Fish protein is of high quality and contains sufficient amount of all the essential amino acids required by the body for growth, maintenance of lean muscles tissue and active metabolism (Talabi, 1995). In fact, the quality of fish protein is superior to proteins obtained from milk, meat and eggs (Abolagba *et al.,* 2015). Its harvesting handling processing, storage and distribution provide livelihood for millions of people as well as providing valuable foreign exchange earnings to many countries (Nowsadi, 2010).

However, fish is an extremely perishable food which is highly susceptible to the growth of food poisoning bacteria. Spoilage begins as soon as the fish dies, and processing should therefore be done quickly to prevent the growth of spoilage bacteria. Thus, processing and preservation of fresh fish is of utmost importance in order to maintain product quality, reduce wastage and prevent economic loss (Adeyemi, *et al.,* 2013). As a matter of fact, Eyo (2001) outlined three categories of post-harvest fish losses which are physical, economical and nutritional. In Nigeria, post-harvest losses have been put at 50% (Dada and Gnanados, 1983) and 30-50% (Tobor, 1984). Ayuba and Omeji (2006) reported insect infestation as the cause of most prominent losses in quality and quantity of stored dried fish.

In fact, *Dermestes maculatus* was reported by Kemabonta *et al*. (2003) as a major pest of stored fish in Nigeria as both larva and adult stages co habits, feed and cause damage on the tissue of the fish. To avoid Infestation, a lot of protectants have been used during drying, storage and transportation. Eyo (2001) reported Gamallin 20 as one of the highly toxic insecticides commonly used by fishermen to prevent infestation in Nigeria. Khan and Khan (2001) also reported that curers apply different types of insecticides such as dichlorvos, malathion, gamaxine endrine and DOT on dried fishes to protect the dried fish from infestation.

Nevertheless, these synthetic chemicals pose health risks to consumers because they are toxic and leave harmful residues in food commodities. Hence, the need for effective post-harvest techniques that are not toxic and hazardous to human's health, ecofriendly cheap and easy to apply in reducing fish losses. It is against this background that assessment of mould infection on *Clarias gariepinus* (Burchell, 1822) infested with *Dermestes maculatus* (Degeer) after treatment with *Moringa* leaf powder (Lam) and common salt was being investigated and more so that

there is paucity of information on the potential impact of *M. oleifera* as a preservative against fish insect pests.

Materials and Methods

Source of Fish Sample

24 adult live samples of *C. gariepinus* with average weight of 37kg were purchased from Baycom Farm, Shagari Village, Akure, Ondo State. They were then de-slimed with salt, eviscerated for 30 minutes and thoroughly washed in clean water before treatment.

Treatment of Fish Sample

The eviscerated fish samples were separately treated with 15, 20g and 25g of *Moringa oleifera* leaf powder. The different grams were also repeated to treat another set of the eviscerated fish samples but with common salt (NaCl) only while in another experimental set up, a mixture of *M. oleifera* leaf powder and salt (1:1) was also applied to the individual fish sample. The treated fish samples were then arranged on a tray fitted with a wire wish in an enclosed kiln and oven dried at 65±5°C for 24 hours. Immediately after being allowed to cool, the oven dried fish samples were then stored separately in transparent plastic container and ziplock bag.

Infestation of Stored Fish Samples

Ten (10) newly emerged *Dermestes maculatus* larvae (24-96 hr old) obtained from infested dried fish were introduced into each storage container (the plastic and ziplock bag) containing the treated and oven dried fish samples and the whole set up stored at 28±2°C and 76±5% relative humidity for 60 days. Uninfested but treated and oven dried fish samples served as control.

Assessment of Mould Infection on Infested *C. Gariepinus* During Storage.

The infested *C. gariepinus* samples were assessed for mould infection during storage and the infection was ranked on a 4 – point hedonic scale and recorded as: 1 - no visible mould growth; 2 - slight infection (about 10-30% of the fish surface area covered with moulds); 3 - moderate infection (about 40-50% of the fish surface area covered with moulds and 4 - heavy infection (70% and above of the fish surface area covered with moulds).

Data Analysis

The data for assessment of mould infection was subjected to one – way analysis of variance (ANOVA) and where the means were significant, they were separated using Tukey's test at $p < 0.05$ (SPSS version 17.0).

Results and Discussion

Assessment of Mould Infection on *C. Gariepinus* Treated With 15g *Moringa* Leaf Powder, Salt and Moringa – Salt (1:1) and Infested With *Dermetes maculatus*.

Results of assessment of the mould infection on *C. gariepinus* treated separately with 15g dose of *Moringa* leaf powder, salt and *Moringa* - salt (1:1) and infested with *Dermestes maculatus* were presented in figures 1 and 2. Results showed that there were no significant differences ($P<0.05$) in the mould assessment of infested treated samples stored in both Plastic (Figure 1) and Ziplock (Figure 2) when compared with the control even up till day 40 in storage. The mean mould assessment values were between 1.00±0.00 and 1.33±0.03 indicating no mould infection for all infested treated samples for the first 40 days of storage in both plastic and ziplock while mean mould assessment values for control were 1.00±0.00 in both storage containers except day 40 of storage where the mean mould assessment values for samples treated with 15g of *Moringa* - salt was 2.00±0.00 in ziplock (Figure 2).

As storage duration increased to day 60, the mean mould assessment of *C. gariepinus* treated with 15g dose of *Moringa* had increased to 2.67±0.60 in plastic and 1.67±0.06 in ziplock and were significantly different ($P> 0.05$) from the control samples stored in plastic (Figure 1) and ziplock (Figure 2) with mean mould assessment values of 1.00±0.00 and 4.00±0.00 respectively. For *C. gariepinus* treated with 15g dose of salt, the mean mould assessment values had also increased to 1.67±0.06 in plastic (Figure 1) which was significantly different ($P>0.05$) from mould assessment of 1.33±0.03 in ziplock and the control having mean mould assessment values of 1.00±0.00 in plastic (Figure 1) and 4.00±0.00 in ziplock (Figure 2). The mean mould assessment values for treated fish samples with *Moringa* - salt (1:1) were still 1.00±0.00 in both plastic (Figure 1) and ziplock (Figure 2) and were not significantly different ($P<0.05$) from the control having the same mean mould assessment value in plastic but significantly different from the control stored in ziplock (Figure 2) having a value of 4.00±0.00.

Assessment of Mould Infection on *C. Gariepinus* Treated with 20g *Moringa* Leaf Powder, Salt and Moringa – Salt (1:1) and Infested with *Dermetes Maculatus*.

In the same vein, results of assessment of the mould infection on *C. gariepinus* treated separately with 20g dose of *Moringa,* salt and *Moringa*-salt (1:1) and infested with *D. maculatus* were presented in Figures 3 and 4. Results showed that there were no significant differences ($P<0.05$) in the mean mould assessment values of infested treated samples with 20g dose of *Moringa*, salt and *Moringa* - salt (1:1) in both plastic (Figure 3) and ziplock (Figure 4) for the whole 60 days of storage. The mean mould assessment values for the 60 days of storage were between 1.00±0.00 and 1.33±0.03 which implied there was no observable mould growth on the infested treated *C. gariepinus.* The same trend of results was observed for control samples except at day 40, 50 and 60 in zipolck storage (Figure 4) where the mould assessment values were 2.00±0.00, 3.00±0.00 and 4.00±0.00 respectively.

Assessment of mould infection on *C. gariepinus* treated with 25g *Moringa* leaf powder, salt and Moringa – salt (1:1) and infested with *Dermetes maculatus*.

Finally, results of assessment of the mould infection on *C. gariepinus* treated separately with 25g dose of *Moringa*, salt and *Moringa* - salt (1:1) and infested with *D. maculatus* were presented in Figures 5 and 6. Results showed that there were no significant differences ($P<0.05$) in the mould assessment values of treated samples for the first 20 days of storage when compared with the control in both plastic (Figure 5) and ziplock (Figure 6). Both treated and control samples had 1.00±0.00 as their assessment values. However, as storage duration increased, only *C. gariepinus* treated with 25g dose of salt maintained the mean mould assessment values of 1.00±0.00 - 1.33±0.00 in both plastic and ziplock till the end of 60 - day storage duration. The values were not significantly different from the control in plastic storage for the same storage duration but significantly different from ziplock

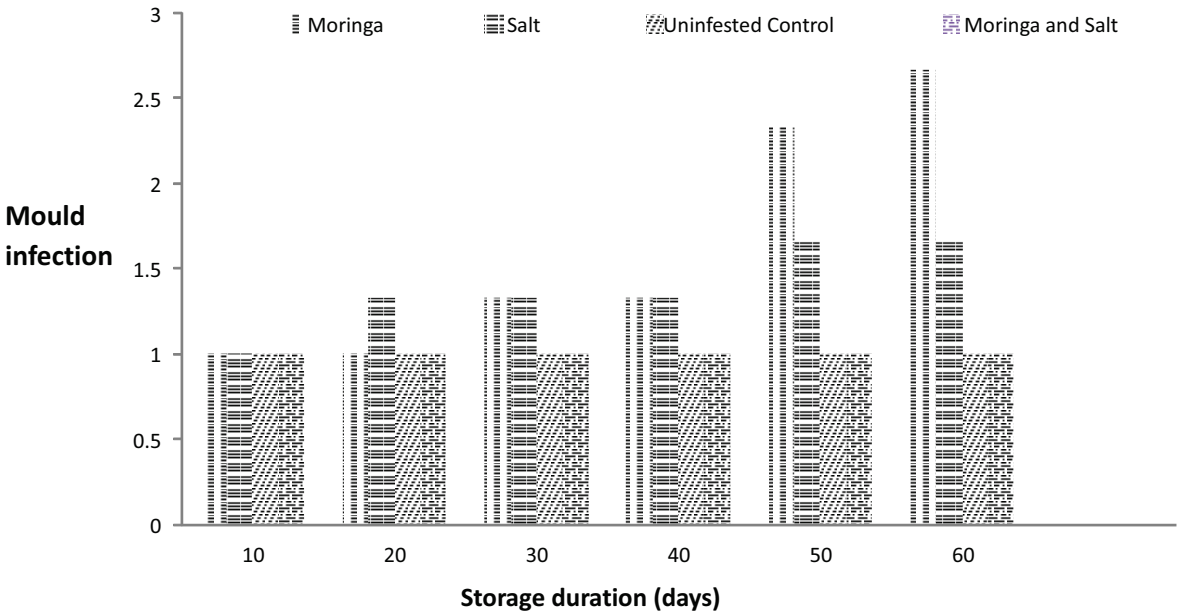

Fig.1. Assessment of mould infection on *C. gariepinus* treated with 15g *Moringa*, Salt and *Moringa* – Salt (1:1) and infested with *D.maculatus*, during storage in plastic container.

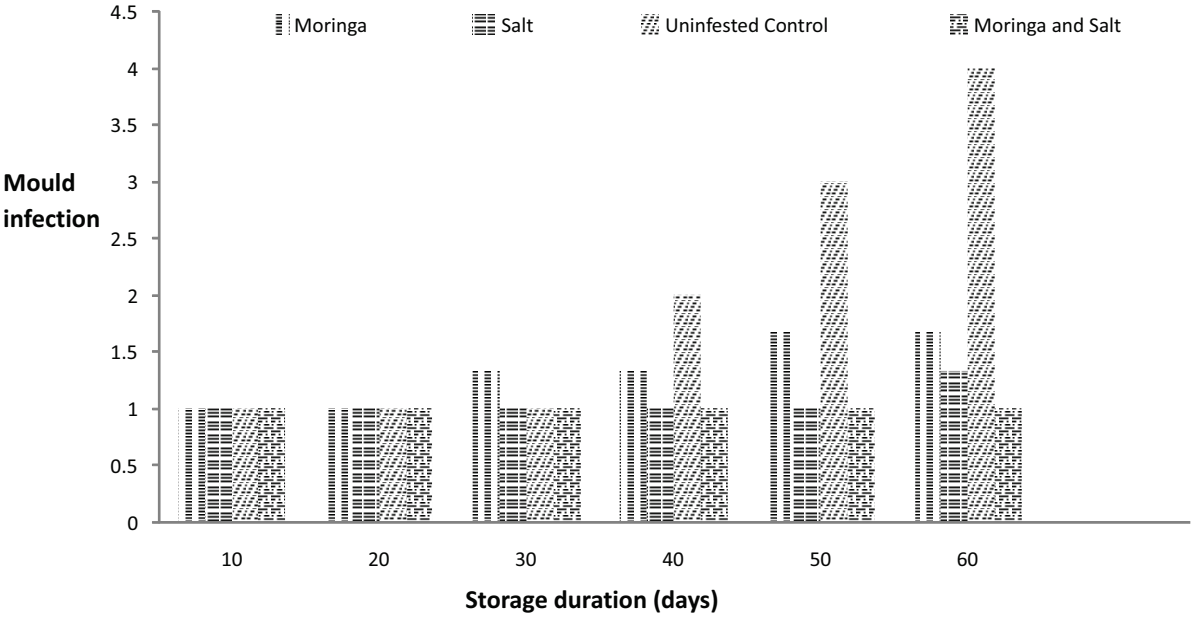

Fig. 2. Assessment of mould infection on *C. gariepinus* treated with 15g *Moringa*, Salt and *Moringa* – Salt (1:1) and infested with *D.maculatus,* during storage in ziplock.

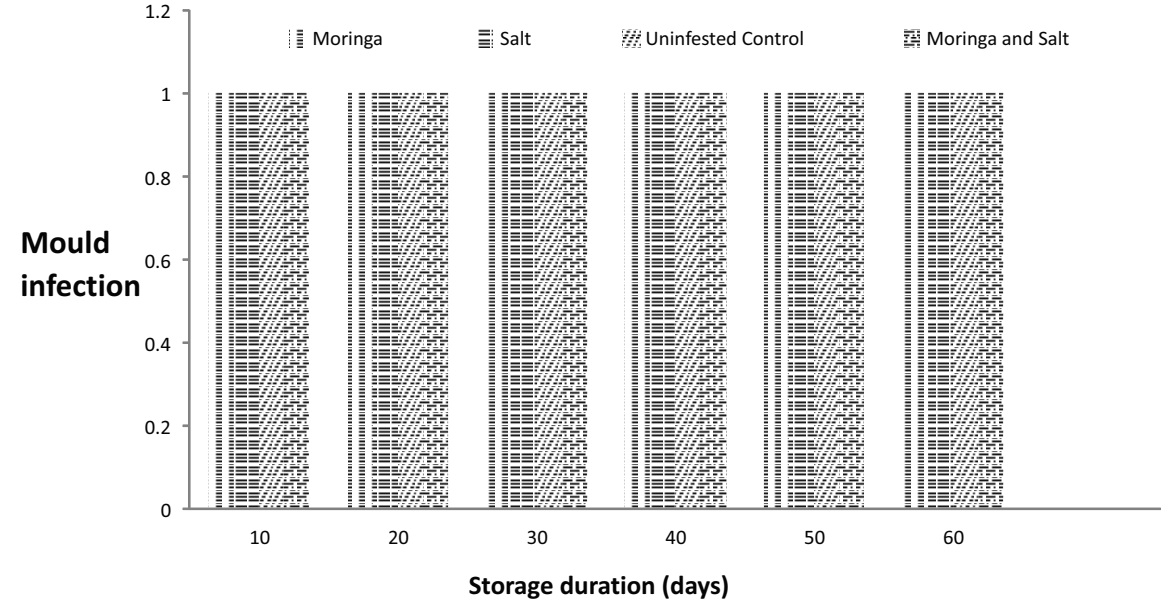

Fig. 3. Assessment of mould infection on *C. gariepinus* treated with 20g *Moringa*, Salt and *Moringa* – Salt (1:1) and infested with *D.maculatus,* during storage in plastic container.

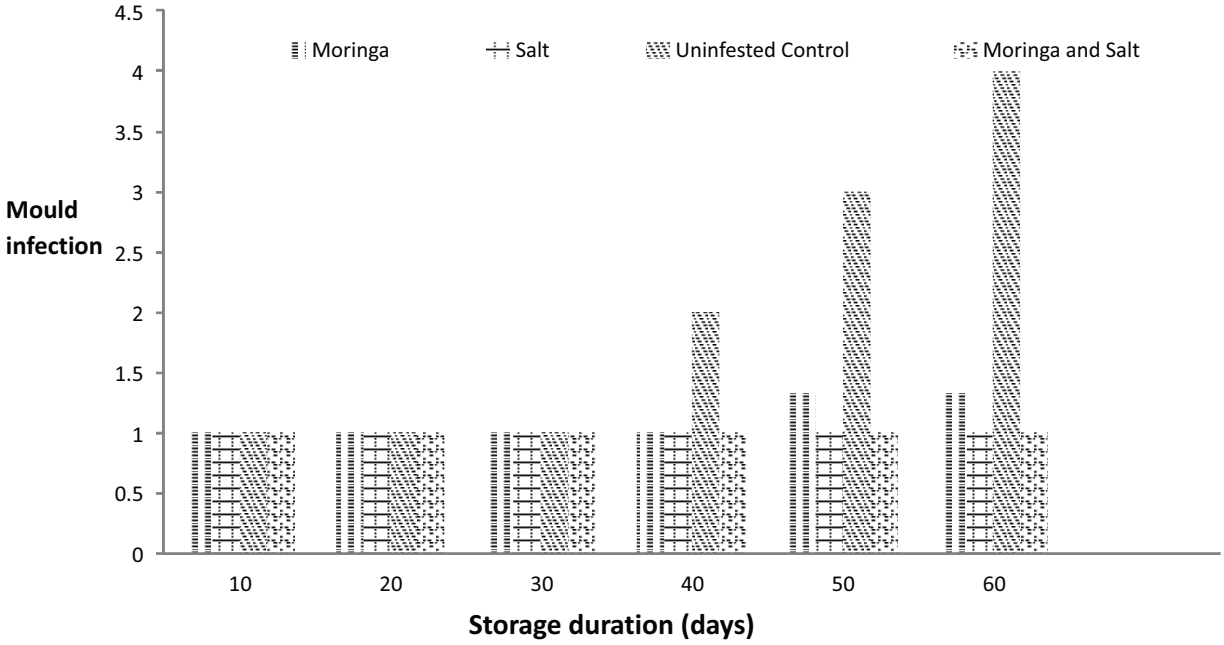

Fig. 4. Assessment of mould infection on *C. gariepinus* treated with 20g *Moringa*, Salt and *Moringa* – Salt (1:1) and infested with *D.maculatus,* during storage in ziplock.

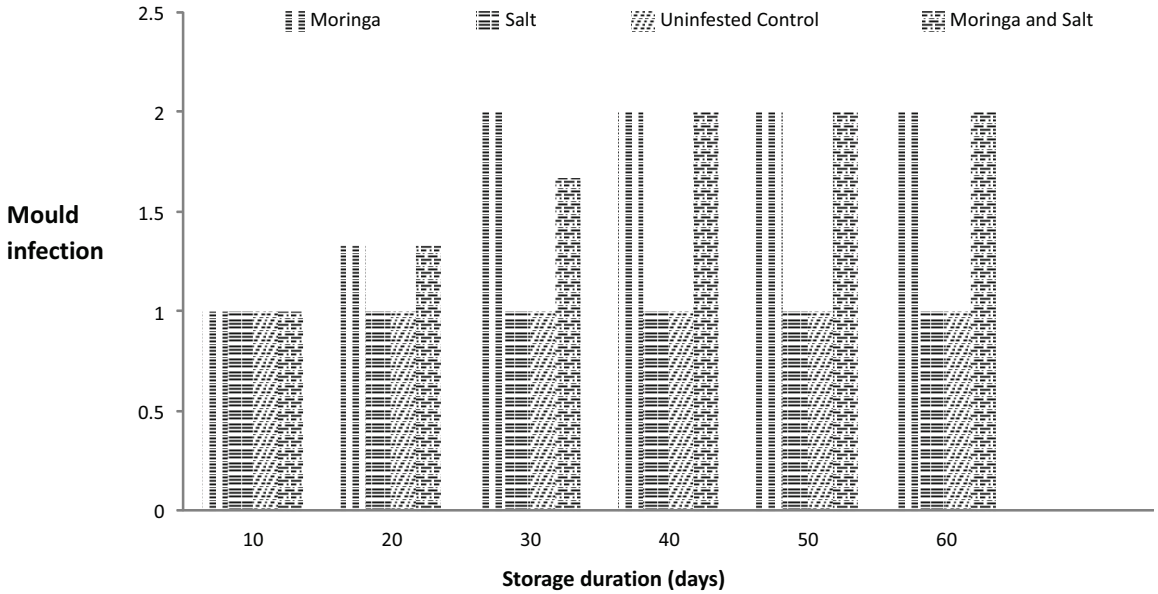

Fig. 5. Assessment of mould infection on *C. gariepinus* treated with 25g *Moringa*, Salt and *Moringa* - Salt (1:1) and infested with *D. maculatus*, during storage in plastic container.

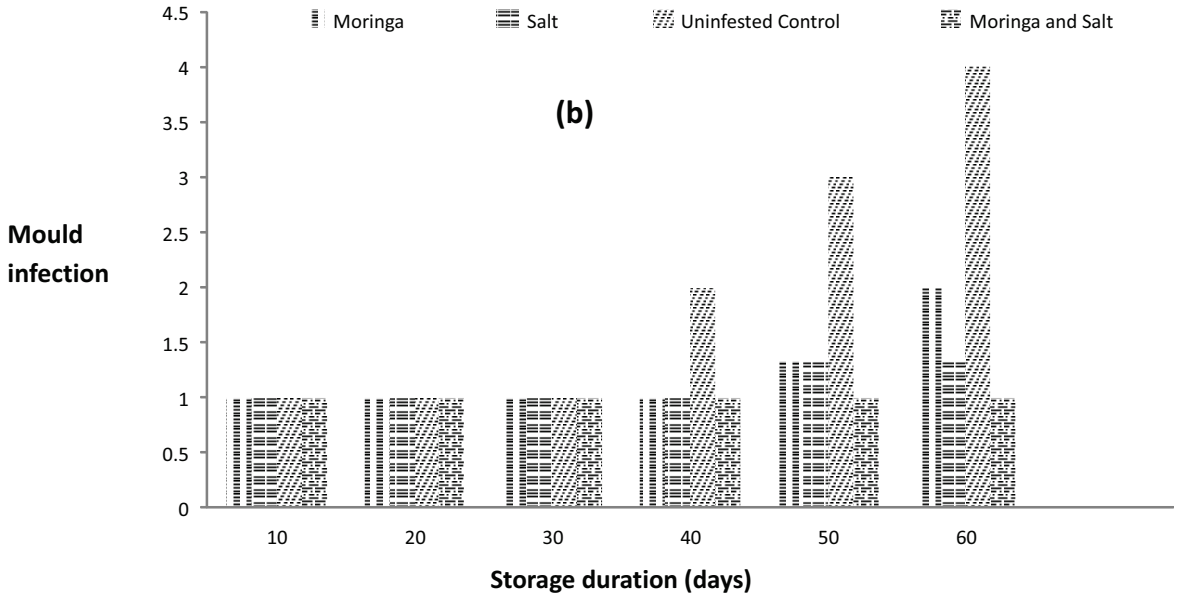

Fig. 6. Assessment of mould infection on *C. gariepinus* treated with 25g *Moringa*, Salt and *Moringa* - Salt (1:1) and infested with *D. maculatus*, during storage in ziplock

storage having a mould assessment value of 4.00±0.00. The same trend of results was obtained for *C. gariepinus* treated with 25g dose of Moringa-salt but stored in ziplock (Figure 6).

Plant materials are known to be effective, cheap and easily available for the control of stored product pests following public awareness of the adverse effects of synthetic chemical insecticides. In fact, Ashamo *et al.* (2013) observed that plant products and their derivatives could be relied upon to replace many of these chemical insecticides since both their powders and extracts have been proven to be effective against a wide range of insects. The results obtained in this work showed that *C. gariepinus* treated with 20g dose of *Moringa;* 20 and 25g doses of salt, 15 and 20g doses of *Moringa* - salt (1:1) in plastic and ziplock storage at 28±2°C and 76±5% relative humidity proved the most effective among all the treatments against mould infection of *C. gariepinus* following infestation with *D. maculatus*. These most effective treatments showed no observable mould appearance on the infested fish samples for 60 days of storage in both plastic and ziplock. The ability of *Moringa* and salt to preserve *C. gariepinus* against mould attack cannot but be connected with the high preservative properties of *Moringa* and salt. Salting of fish is traditionally used as protection against *D. maculatus*, partly because larval development is prolonged and larval mortality increases with the salt content (Abalaka *et al*., 2012). It should be further noted that the efficacy of the salt used in this study for *C. gariepinus* against mould attack was dosage dependent. Higher amounts of salts up to 20 and 25g proved highly effective when compared with the 15g dosage. This is in line with the observation of Osuji (1976) who reported that even NaCl that proved to be very effective against larvae of *D. maculatus* was only effective at higher concentrations like some plant derived insecticides (Don-pedro, 1989; Akinkuolere, 1997). The salt drew water out of the fish sample thereby lowering its moisture content to a level that inhibited fungal growth. The low water content is desirable according to the report of Qayyum *et al.* (2012) that high moisture content encourages growth of microorganisms which could reduce stability and shelf storage capability. Also, the salt treatment could have probably created hypertonic environment to any attacking moulds on the samples thus generating osmotic imbalance that eventually resulted to the destruction of the attacking moulds. This is in consonance with the report of Ademola *et al.* (2011) that salting is one of the oldest methods of preserving food and is used because most bacteria, fungi and other potentially pathogenic organisms cannot survive in a highly salty environment, due to the hypertonic nature of salt and that common salt is probably the oldest known antimicrobial agent. Moringa benefits are quite plenty and these are clearly evident as all its part possesses remarkable medicinal properties when compared with synthetic drugs (Paliwal *et al.,* 2011a). In fact, observations from this work showed that *Moringa oleifera* has insecticidal ability owing

to its activity in causing mortality to *D. maculatus* larvae on treated *C. gariepinus*. This is in line with the report of Akinwumi (2010) who reported that plant powders rather than domestics oil demonstrated protective ability against the fish beetles and confirm the efficacy of plant products as pest control agent. Various compounds have been isolated from moringa preparations and are reported to have pharmacological and antimicrobial properties (Bennet *et al.*, 2003). Although, 15g dose of *Moringa* could not effectively controlled mould growth on the infested samples more than 40 days in storage, combined treatment of 15g *Moringa* and 15g salt (1:1) effectively controlled mould growth for 60 days in storage. The ability of *Moringa*-salt treatment to preserve the C. *gariepinus* from mould infection more than *Moringa* leaf powder alone may be due to the high preservative property exhibited by *M. oleifera* and salt.

Conclusion

Findings from this work showed that with 20g doses of *Moringa oleifera*, 20 and 25g doses of salt and 15 and 20g doses of *Moringa*-salt (1:1), there was no observable mould infection on the infested but treated fish samples in both plastic and ziplock for the whole 60 days of storage. Consequently, since efficacy of *M. oleifera* leaf powder against mould infection of *C. gariepinus* after being infested with *D. maculatus* has been demonstrated in this study, its powders could be incorporated into pest management programmes. Besides, its bioactivity could be further increased when combined with common salt.

References

Abalaka, M. E., Daniyan, S. Y., Oyeleke, S.B. and Adeyemo S. O. (2012). The antibacterial evaluation of *Moringa oleifera* leaf extracts on selected bacterial pathogens. *Journal of Microbiology Research*. 2**:** 1-4

Abolagba, O.J., Omoruyi, K. and Ajiwoni, K. M. . (2015). Effects of smoking on the nutritional qualities of wild *Synodontis calrias* and cultured *Clarias gariepinus* in Delta and Edo State. Nigeria. *Journal of Agriculture, Food and Environment*, 11: 46-52.

Ademola, I. T, Baiyewu, R. A, Adekunle, E. A. , Omidiran, M. B. and Adebawo, F. G (2011). An Assessment into Physical and Proximate Analysis of Processed Locust Bean (*Parkia Biglobosa*) Preserved with Common Salt. *Pakistan Journal of Nutrition*, 10: 405- 408.

Adeyemi, K. D., Ahmed El-Imam, A. M., Olorunsanya, A. O., Sola-Ojo, F. E., Okupke, K. M., Dosunmu, O. O., Shittu, R. M. and Idris, J. T. (2013). Effect of Moringa (*Moringa oleifera*) marinade on proximate composition and sensory characteristics of smoke-dried African catfish (*Clarias gariepinus*). *Creation Journal of Fisheries*, 71: 11-18.

Akinkurolere, R. O. (1997). Control of the major insect pest of dried fish *Dermestes maculatus* (Dermestidae) and *Necrobia rufipes* (Cleridae) using *Parkia clappertoniana*. A dissertation for the award of Bachelor of Technology (B. Tech) in Biology, FUTA,Nigeria, 38.

Akinwumi, F. (2010). Bioefficacy of some – oil mixed plant derivatives against African mud catfish (*Clarias gariepinus*) beetles, *Dermestes maculatus* and *Necrobia rufipes*. *International Journal of Biology, Agriculture, Food and Biotechnology,* 4: 528-535

Al-Jufaili, M. S. and Opara, L. U. (2006). Status of Fisheries Postharvest Industry in the Sultanate of Oman: Part 1 Handling and Marketing System of Fresh Fish. *Journal of Fisheries International*, 1(2): 144-149.

Amusan, A. S and Okorie, T. G. 2002. The use of *Piper guineense* fruit oil (PFO) as protectant of dried fish against *Dermestes maculatus* (Degeer) infestation. *Global Journal of Pure and Applied Science*, 8(2): 197-201.

Ashamo, M. O., Odeyemi, O. O. and Ogungbite, O. C. (2013). Protection of cowpea, *Vigina unguiculata* L. (Walp.) with *Newbouldia laevis* (Seem) extracts against infestation by *Callosobruchus maculatus* (Fabricius). *Archivesof Phytopathology and Plant Prot*ection, 46: 1295-1306.

Ayuba, V. O and Omeji, N. O. (2006). Effect of insect infestation on the shelf life of smoked dried fish. Proceedings of the 21st Annual Conference of the Fisheries Society of Nigeria (FISON), Calabar. 13th – 17th November, 2006, pp. 357-359.

Bennet, R. N., Mellon, F. A., Foidl, N., Pratt, J. H., DuPont, M. S., Perkins, L. and Kroon, P. A. (2003). Profiting glucosinolates and phenolics in vegetative and reproductive tissue of the multi-purpose trees *Moringa oleifera* L. (Horseradish tree) and *Moringa stenopetala* L. *Journal of Agriculture and Food Chemistry,* 51: 3546-3553.

Dada, B. F. and Gnanados, D. A. S. (1983). Nigerian Fisheries Development: Challenges and opportunities of the 1980's. In: The proceedings of the 3rd annual Conference of the fisheries Society of Nigeria (FISON) Maiduguri, 22nd – 25th February. 1983, pp. 14-

24.

Don-pedro, K. N.1989. Insecticidal activity of some vegetable oils against *D. maculatus* (DeGeer) (Coleoptera; Dermestidae) on dried fish. *Journal of Stored Product Res*earch, 25: 81-86.

Eyo, A. A. (2001). Fish Processing Technology in the Tropics. ISBN 9781770457. University of Ilorin press, Nigeria, pp. 403.

Khan, M. A. A. and Khan, Y. S. A. (2001). Insect infestation and preventive measures in dry fish Storage of Chittagong, Bangladesh. *Journal of Biological Science,* 1(10): 963-965.

Kemabonta, K. A., Makanjuola, W. A., Omogunloye, O. A. (2013). Evaluation of Spintor TM Dust in the protection of dried Tilapia niloticus against *Dermestes maculatus* (Degeer) (Coleoptera: Dermestidae). *Journal of Natural Science Research*, 3(4): 80-89.

Noswad, A. K. M. (2010). Post-harvest loss reduction in fisheries in Bangladesh: A way forward to food security. Final Report. PR#5/08 project. NFPCSP-FAO, Food and Agriculture Organisation of United Nations. Retrieved 17th November, 2015 from http:/www.nfpcsp.org/Nowsad_Alam-PRS=08.

Paliwal, R., Sharma, V. and Pracheta, V. (2011a). A review on Horse Radish Tree (*Moringa oleifera*): A Multipurpose Tree with High Economic and Commercial Importance. *Asian Journal of Biotechnology,* 3: 317-328.

Qayyum, M. M., Butt, M. S., Anjum, F. M. and Nawaz, H. 2012. Composition of some selected legumes for protein isolates. *Journal of Animal and Plant Science,* 22: 1156-1162.

Talabi, C. C. and Abowei, J. F. N. (2011). Traditional fish handling and preservation in Nigeria. *Asian Journal of Agricultural Science,* 3(6): 427-436.

Tobor, T. G. (1984). A review of fish industry and status of fish [reservation methods and future growth prerequisites to cope with anticipated increase in production. NIOMR Technical Paper. No. 17.