# ASSESSMENT OF SELECTED PLANT-LEAF EXTRACTS IN THE CONTROL OF ROT DISEASES OF YAM VARIETIES IN STORAGE IN OWERRI.

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**ABSTRACT**
The study was conducted to determine the influence of some plant extracts as fungicides in the control of rot diseases of yam species in storage in Owerri, Southern Nigeria. The experiment was carried out in the laboratory of Crop Science and Technology, Federal University of Technology, Owerri. Two varieties of yam (*Dioscorearotundata*and *Dioscoreaalata*) were variously applied with seven bio-pesticides (*Chromolaenaodorata, Carica papaya, Vernoniaamygdalina,* and *Ocimumgratissimum), Azadirachtaindica, Psidiumguajava,* and *Cymbopogoncitratus*) in a completely randomized design (CRD) in three replications. Data were collected on some chemical constituents, percentage inhibition and analyzed using statistical methods and mean separated using least significant difference of 5% probability level. Result of the investigation revealed that plant extracts were statistically significant on the micro-organisms isolated irrespective of the yam varieties used.*Azadirachtaindica*recorded highest level of inhibition on*D. rotundata*(12.25%) and *D. alata*(12.78%) respectively while *Cymbopogoncitratus*(30.58%) and (24.33%) were lowest as shown on both mean. Result revealed that *D. rotundata*recorded higher chemical constituents than *D. alata.* Results of the study also showed that *Azadirachtaindica*was the most fungitoxic as it recorded the highest level of inhibition on all the organisms isolated from *D. rotundata*19.3%, 10.0%, 8%, 11.3% and *D. alata*9.8%, 11.5%. 11.1% and 18.7% respectively. *Carica papaya* was found to be most effective in the control of *Fusariumoxysporium*on *D. alata*(12%). However, *Cymbopogoncitratus*was less effective in the inhibition of *Aspergillusspp(*37.3%) on *D. rotundata*and *Rhizopusspp(*43.1%) on *D. alata.* Application of *Azadirachtaindica*was able to inhibit the growth of all the micro-organisms identified while *Cymbopogoncitratus*was not. The efficacy of these bio-pesticides in the following order *Azadirachtaindica>Vernoniaamygdalina>Carica papaya >Ocimumgratissimum*will significantly reduce losses resulting from pathogenic attacks on yams in storage and are recommended for use in that sequence.

**Keywords:** Assesment, leaf extracts, rot, yam, storage.

## INTRODUCTION

Yamis a plantof the genus *Dioscorea* that belong to the family known as *Dioscoreceae*and order *Dioscoreales*, (Amusa*et al.*, 1999). Yams (*Dioscorea spp*.) are cultivated in many tropical and sub-tropical countries like Africa, the Caribbean, the Northern and Central part of South East Asia including parts of China, Malaysia, Japan and Oceania, and remain an important food crop for millions of people (Okigbo*et al.*, 2000). The six major edible species of yam that are cultivated and consumed are: White yam (*Dioscorearotundata*), Water yam (*Dioscoreaalata*), Bitter yam (*Dioscoreadumetorum*), Aerial yam (*Dioscoreabulbifera*), Chinese yam, (*Dioscoreaesculenta*), and Yellow yam (*Dioscoreacayenensis*) (Zaknayiba*et al.*, 2013; Ebewore*et al.*, 2013;Lawal*et al.*, 2014; Princewill-Ogbonna*et al.*, 2015).

It is an important staple food in Nigerian and West African diets and provides some 200 calories of energy per capita daily (Onumadu and Eze., 2008). A variety of palatable dishes are also prepared from yam tubers (Aluko*et al*., 2003; Fasasi*et al.*, 2005; Oladebo*et al.*, 2010). Researchers have found that yam has very high food value and a major source of carbohydrate and minerals such as calcium, phosphorus, iron and vitamins including riboflavin, thiamine and vitamins B and C (Okigbo*et al.*, 2006; Okigbo*et al.*, 2010). Yams equally contain about 1-2 % dietary protein which is high when compared with other tropical root crops and tubers (Ekefan*et al.*, 1999) and also have considerable social and cultural significance among the people of Southeastern Nigeria (Sangoyomi, 2004).

Many studies have identified some major problems that are associated with yam production. These include lack of access to farm inputs, high cost of inputs, poor producer prices, very high incidence of pests and diseases as well as inadequate storage facilities which negatively impact yam production (Zaknayiba*et al.*, 2013).Studies (by IITA, 1993; Cornelius, 1999; and Amusa*et al.*, 2003) have also shown that fungal rot is the greatest cause of tuber losses in storage. Microbial attacks on yam result into dry rot, soft rot and wet rot (Ime*et al.*, 2012; Glover *et al.*, 2013;Afiukwu*et al.*, 2013)

The principal species of microorganisms that cause severe losses resulting from the rot of yam in storage in Southern Nigeria as investigated by Onuegbu, (1999) and Okigbo*et al.*, 2015) included *Aspergillusniger*, *Rhizopusnodosus*, *Scerotiarulfii, Fusariumoxysporium*and *Botrydiplodiatheobromae*. Other major microorganisms that cause rot diseases in yams including *Aspergillusflavus, Fusariumsolani, Penicilliumchrysogenum, Rhizoctoniaspp., Penicilliumoxalicum, Trichodermaviride*were identified by many authorities (Okigbo*et al.,* 2001; Okigbo, 2004; Aidoo, 2007).These pathogens reduce the growth, quantity and quality of yam (Arinze., 2005;Okigbo*et al.,* 2006;Okigbo *et al.*, 2009, Taiga, 2011, and FAO, 2013). The use of plant extracts or bio-pesticides is now considered as a safer, more economical and better alternative to the application of chemical pesticides. Plant extracts are composed of various bioactive compounds such as alkaloids, flavonoids, glucosides, phenols, saponins, steroids etc. (Gwa, *et al*, 2017). It has also been reported that extracts from plant leaves/seeds like *Azardirachtaindica*, *Carica papaya*, *Piper nigrum*, *Zingiberofficinale, and Nicotianatabacum*have been effective in the control of yam rots (Gwa*et al.,* 2018). The objective of this work was to assess the bio-pesticides derived from plant leaves in the control of rot diseases of *Dioscorearotundata(White yam) and D. alata* (Water yam) in storage.

## MATERIALS AND METHODS

### Study Area

The study carried out at the laboratory of the Federal University of Technology, Owerri, Imo State, located on Latitude 5° 30' 01" N and Longitude 7° 01' 44" E in the tropical rainforest region of Nigeria.The experiment was a Completely Randomized Design (CRD) with 7 treatments and 3 replications on two (2) yam species of *Dioscorearotundata,* and *Dioscoreaalata* respectively. The seven (7) plant leaves extract used were (*Chromolaenaodorata, Carica papaya, Vernoniaamygdalina, Ocimumgratissimum, Azadirachtaindica, Psidiumguajava*and *Cymbopogoncitratus*). This research was carried out for a period of over eighteen (18) months in different laboratories. Collection of plant materials and rotten yam tuber samples were carried out within a month.

### Pathogenicity Studies

About 200g of sliced peeled potato was boiled in one litre distilled water for 30 minutes. It was filtered throughcheese cloth, saving effluent, which is potato infusion. This was mixed with 20g of agar - agar powder and 20g of glucose D and mixed with decant from the boiled potato. It was autoclaved for 15 minutes at 121$^{o}$C.

Portions of 20-25ml were dispensed into sterile 15 x 100mm Petri-dishes. PH 5.6 ± 0.2 medium was used.

### Physical Identification of the Diseases that Infected the Yams in Storage

Physical investigation of five tubers each of *Dioscorearotundata and Dioscoreaalata* infected yam tubers was conducted by virtual assessment.

### Isolation of Fungal Species from Rotten Yam Tubers:

Pieces of diseased tissues cut from the periphery of rotten yam tubers with a sterilized knife were surface-sterilized in 5% sodium hypochlorite solution for 5 minutes. The surface-sterilized diseased tissues were washed three times using sterile distilled water.
The tissues were allowed to dry in a sterile Lamina flow chamber. The dried diseased tissues were plated on a potato dextrose agar (PDA) medium (Manufacturer: Mearek). Five days after incubation, mycelia that grew from the plated yam tissues were sub-cultured into fresh PDA. Further sub-culturing was carried out until a pure culture of single species isolates was obtained. From these pure cultures, inocula of the different fungal species isolates were obtained for the pathogenicity tests.

### Identification of Fungal Isolates

Characteristics of fungal isolates from rotten yam tubers such as pigment production, colony texture, spore or conidia-producing structures and spore shapes were documented. The characteristics were observed from fungal growth for five days. Spore and mycelium was viewed using the compound microscope. Their characteristics was studied and used in identifying the fungal organism to the species level, following the standards described by Mathur and Kongsdal, (2003) and Barnett and Hunter, (1998).

### Pathogenicity Test:

The method of Okigbo and Ikediugwu, (2000) was used. Healthy-looking yam tubers of the variety *Dioscorearotundata*and *Dioscoreaalata*was thoroughly rinsed in sterilized water and further sterilized with 70% ethanol. Thereafter, cylindrical cores of 1cm deep were removed from various spots of each yam tuber sample with 5mm cork borer that was sterilized by dipping in ethanol followed by flaming. Then the yam tubers were inoculated with the fungal isolates that were identified with Pathogenicity Test. One week old pure cultures of the fungal isolates obtained from the yam tubers produced on PDA were the source of inocula for the pathogenicity studies. The five-millimeter diameter cork borer was used to cut plugs from the one week old cultures of the isolates to be tested. These fungal plugs were put in the holes created in the yam tubers after which the removed yam tuber disc was used to plug the holes. Melted candle wax from burning candle was used to seal the edges of the replaced yam disc. This process prevents any external influence on the positioned inocula. Each fungal isolate was replicated three times (on eight tubers of *Dioscorearotundata* and *Dioscoreaalata*). Control was set up in which the sterile cork borer was used to remove five-millimeter diameter tuber tissue. This disc was used to plug the hole and its edges sealed with melted wax. In the control, no fungal organism/plant extract was placed in the hole. These activities were carried out inside a sterile hood.

### Preparation of Bio-Pesticides

Ethanol extraction method was used for the preparation of the botanical extracts. Fresh leaves of *Azadirachtaindica*(Neem plant leaf), *ChromolaenaOdorata*(Elizabeth plant leaf), *Ocimumgratissimum*(Mosquito plant leaf-ncheanwu), *Psidiumguajava*(Guava), *Vernoniaamydalina*(Bitter leaf), *Cymbopogoncitratus*(Lemon grass) *and Carica papaya* (Pawpaw plant leaf) were washed thoroughly with water. These were further blended into a fine paste separately for each botanical with a blender (Binatone, BLG-401, Hong Kong) at a speed of 4000 r.p.m. for five to ten minutes after drying in an oven at a temperature of $121^{O}$ C. Extract concentrate of 60% (w/v) was obtained by adding 40mls of sterile distilled water to 60g each botanical paste with vigorous stirring. The efficacies of the botanical extracts were tested for their fungicidal activity in controlling yam tuber post-harvest diseases. Ethanol extraction method was used for the preparation of the botanical extracts. Fresh leaves of *Azadirachtaindica*(Neem plant leaf), *Chromolaenaodorata*(Elizabeth plant leaf), *Ocimumgratissimum*(Mosquito plant leaf-ncheanwu), *Psidiumguajava*(Guava), *Vernoniaamygdalina*(Bitter leaf), *Cymbopogoncitratus*(Lemon grass) *and Carica papaya* (Pawpaw plant leaf) were washed thoroughly with water. These were further blended into a fine paste separately for each botanical with a blender (Binatone, BLG-401, Hong Kong) at a speed of 4000 r.p.m. for five to ten minutes after drying in an oven at a temperature of $121^{O}$ C. Extract concentrate of 60% (w/v) was obtained by adding 40mls of sterile distilled water to 60g each botanical paste with vigorous stirring. The efficacies of the botanical extracts were tested for their fungicidal activity in controlling yam tuber post-harvest diseases.

**Anti-fungal Activity of Bio-Pesticides /Percentage Inhibition**

This was obtained by using 0.1ml of each of these plant extracts to establish Koch's postulate.

Seven plant leaves extracts were used namely *Azadirachtaindica, Chromolaenaodorata, Ocimumgratissimum, Psidiumguajava, Vernoniaamygdalina, Cymbopogoncitratus*and*Carica papaya.* Extraction was done using ethanol. The efficacy of these Bio-Pesticides was tested for their fungicidal activities in controlling post-harvest diseases. The inhibiting effects of the Bio-Pesticides was thereafter observed after five (5) days by weighing the difference between the initial and final weights of the inoculated petri dishes and calculated thus:

Percentage Inhibition = $\frac{Wi-Wo}{Wo}$ X $\frac{100}{1}$

Where;

Wo = Initial weight of petri dish before the treatment

Wi = Final weight of the petri dish after the treatment

Data collected were statistically analyzed at 5% probability level as described by Obi (2002) to present results.

## RESULTS AND DISCUSSION

### RESULTS

Table 1 below contains the percentage occurrence of micro-organisms on tubers of two yam species *(Dioscorearotundata*and *Dioscoreaalata)* samples under investigation. It shows the occurrence of different pathogens such as rot and rust on the samples of *Dioscoreaalata*and*Dioscorearotundata*used in this study.

The percentage occurrence of rot was very severe on both yam tuber samples of *Dioscoreaalata*and *Dioscorearotundata*used in this experiment. The percentage severity of rot ranged from 14.60% on yam tuber samples of *Dioscoreaalata* to 14.80% on the yam tuber samples of *Dioscorearotundata* during this investigation.

Rust was significantly less severe than the disease of rot. The percentage occurrence of rust on the tubers of the two yam species ranged from 4.00% for *Dioscoreaalata* tuber samples to 5.20% for *Dioscorearotundata* samples.

The percentage occurrence of micro-organisms of rot and rust on tubers of two yam species *(Dioscorearotundata*and *Dioscoreaalata)* samples under investigation indicated that pathogen with the highest occurrence was rot that was more prevalent and severe than rust. In view of this discovery, this investigation therefore concentrated on evaluating the fungitoxicity of seven plant extracts in controlling the rot diseases of two yam species of *Dioscoreaalata* and *Dioscorearotundata* in storage.

**Table1 Percentage occurrence of micro-organisms on tubers of two yam species *(D. rotundata*and *D. alata)* using Physical assessment**

| | Disease type | | |
|---|---|---|---|
| Yam spp | Rot | Rust | Mean |
| *D. alata* | 14.60 | 4.00 | 9.30 |
| *D. rotundata* | 14.80 | 5.20 | 10.00 |
| Mean | 14.70 | 4.60 | |

**Assessment of the percentage inhibition of the plant extracts on *Aspergillusniger* isolated from the diseased tubers of two yam species(*D. rotundata*and *D. alata*)**

Table 2 shows the percentage inhibition of plant extracts on *Aspergillusniger*isolated from the diseased tubers of two yam species of *Dioscorearotundata*and *Dioscoreaalata.*

Results of the organisms identified on the microscope on *Dioscorearotundata*and *Dioscoreaalata*previously shown on Table 1and Table 2 had indicated that the pathogen of *Aspergillusniger*was present on all the samples of the two yam species investigated. Therefore, the percentage inhibition of the seven plant extracts was investigated to determine their levels of fungitoxicity or inhibition on the disease of *Aspergillusniger*present on the yam samples. The plant extracts used to determine the percentage inhibition on *Aspergillusniger*were *Azardirachtaindica, Cymbopogoncitratus, Chromolaenaodorata, Carica papaya, Ocimumgratissimum, Psidiumguajava*and *Vernoniaamygdalina*, *Azardirachtaindica* on *D. alata* interaction limited the growth of A. nigerto 9.8%.

**Table 2: Assessment of the percentage inhibition of the plant extracts on *Aspergillusniger* isolated from the diseased tubers of two yam species(*D. rotundata*and *D. alata*)**

| Yam spp | Plant extracts | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *A.indica* | *C.citratus* | *C.odorata* | *C.papaya* | *O.gratissimum* | *P.guajava* | *V.amygdalina* | *Mean* |
| *D alata* | 9.80 | 21.73 | 22.00 | 31.53 | 24.87 | 26.67 | 18.00 | 22.09 |
| *D rotundata* | 19.51 | 37.31 | 31.33 | 20.00 | 33.33 | 27.03 | 22.00 | 27.22 |
| Mean | 14.65 | 29.52 | 26.67 | 28.77 | 29.10 | 26.85 | 20.00 | |

**Assessment of the percentage inhibition of the plant extracts on *Rhizopusstolonifer* isolated from the diseased tubers of two yam species(*D. rotundata*and *D. alata*)**

Table 3 shows the percentage inhibition of the various plant extracts on the isolates of *Rhizopusstolonifer*obtained from the diseased tubers of yam *species* (*Dioscorearotundata*and *Dioscoreaalata*) samples. The extract of *Azardirachtaindica*was most effective in the suppression *Rhizopusstolonifer*in tubers and reduced the incidence on*Dioscoreaalata*to 11.53%. This was followed by *Carica papaya* (15.33%), *Cymbopogoncitratus*(15.53%), *Vernoniaamygdalina* (24.00%), *Chromolaenaodorata*(27.33%), *Psidiumguajava*(30.67%) and *Ocimumgratissimum*(43.13%).

The extract of *Azadirachtaindica*was equally the most effective in the suppression of*Rhizopusstolonifer*in tubers and reduced the incidence on*Dioscorearotundata*to 10.00%. The next most effective extract was *Vernoniaamygdalina* (18.67%), followed by *Cymbopogoncitratus*(21.67%), *Caricapapaya* (24.67%), and *Psidiumguajava*alsoat 24.67%. *Ocimumgratissimum*(26.20%) and *Chromolaenaodorata*(34.67%) were less inhibitory on the rot diseases of *Dioscorearotundata*. *A. indica* on *D. rotundata* interaction limited the growth of *R. stolonifer* followed by *A. indica* on *D. alata.*

**Table 3: Assessment of the percentage inhibition of the plant extracts on *Rhizopusstolonifer* isolated from the diseased tubers of two yam species(*D. rotundata*and *D. alata*)**

| Yam spp | Plant extracts | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *A.indica* | *C.citratus* | *C.odorata* | *C.papaya* | *O.gratissimum* | *Pguajava* | *V.amygdalina* | *Mean* |
| *D alata* | 11.53 | 15.53 | 27.33 | 15.13 | 43.13 | 30.67 | 24.00 | 23.90 |
| *D rotundata* | 10.00 | 21.67 | 34.67 | 24.67 | 26.20 | 24.67 | 18.67 | 22.94 |
| Mean | 10.77 | 18.60 | 31.00 | 19.90 | 34.67 | 27.67 | 21.34 | |

**Assessment of the percentage inhibition of the plant extracts on Yeast isolated from the diseased tubers of two yam species(*D. rotundata*and *D. alata*)**

Table 4 shows the percentage inhibition of the various plant extracts on Yeast isolated from two yam species (*Dioscorearotundata*and *Dioscoreaalata*) samples. Results from the table shows that extract of *Azadirachtaindica*was most effective in the suppression *Yeast* in yam tuber samples of *Dioscoreaalata*to 11.13% and *Dioscorearotundata*to 8.00%.

The assessment of the percentage inhibition of plant extracts on *Dioscoreaalata* proved that *Vernoniaamygdalina* (16.40%),*Chromolaenaodorata*(21.33%), *Carica papaya* (21.33%), *Ocimumgratissimum*(24.00%),*Psidiumguajava*(27.53 %), and *Cymbopogoncitratus*(28.87%) were all effective in the suppression of rot diseases of yeast to varying degrees.

The effectiveness of plants extracts to control rot diseases on tubers of *Dioscorearotundata*also varied depending on the extract applied. *Azardirachtaindica*at 8.00%as earlier mentioned was the most fungitoxic. This was followed by *Ocimumgratissimum*(13.73%), *Carica papaya* (18.00%), *Chromolaenaodorata*(25.33%), *Cymbopogoncitratus*(26.67%), *Psidiumguajava*(27.27%) and *V.amygdalina* (28.00%), respectively.*A. indica* on *D. rotundata* recorded the least inhibition of yeast growth than other interactions

**Table 4: Assessment of the percentage inhibition of the plant extracts on Yeast isolated from the diseased tubers of two yam species(*D. rotundata*and *D. alata*)**

| | Plant extracts | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Yam spp | *A.indica* | *C.citratus* | *C.odorata* | *C.papaya* | *O.gratissimum* | *P.guajava* | *V.amygdalina* | *Mean* |
| *D alata* | 11.13 | 28.87 | 21.33 | 23.13 | 24.00 | 27.53 | 16.40 | 21.77 |
| *D rotundata* | 8.00 | 26.67 | 25.33 | 18.00 | 13.73 | 27.27 | 28.00 | 21.00 |
| Mean | 9.56 | 27.77 | 23.33 | 20.56 | 18.86 | 27.40 | 22.20 | |

**Comparison of the percentage inhibition between pathogens isolated from the different yam species.**

The result presented in Table 5 further revealed that *Ocimumgratissimum* has the lowest percentage inhibition of 43.1% on *Rhizopusspecies* isolated from *D. alata* followed by 33.3% inhibition on *Aspergillus* speciesIsolated from *D. rotundata* while the highest inhibition of 13.7% on yeast isolated from *D.rotundata A. indica* had 19.5, 10.0, 8.0 and 11.3% on *Aspergillus species*, *Rhizopusspecies*, yeast and *Botry species* isolated from *D.rotundata*, but it had 9.8, 11.5, 11.1 and 18.7% inhibition on the *Aspergillusspecies*, *Rhizopusspecies*, yeast and *Fusarium*species on D. *alata* respectively. The lowest inhibition was on *Aspergillusspp* and the highest was on yeast both isolates from *D. rotundata*. Also,*Vernoniaamygdalina* had 22.0, 18.7, 28.0 and 26.0% inhibition on *Aspergillusspp*, *Rhizopus* species, yeast and *Botry species* isolated from *D. rotundata*, 18.0, 24.0, 16.4, and 15.5% inhibition on *Aspergillusspecies*, *Rhizopus species*, yeast and *Fusariumspecies* isolated from *D.alata*, respectively. The highest inhibition was on yeast isolated from *D.rotundata*and *D.alata*, respectively. Also *C. odorata* had 31.3%, 34.7%, 25.3% and 26.7% inhibition on *Aspergillusspecies*, *Rhizopus* species, yeast and *Botry species* isolated from *D. rotundata*,respectively, while 22.0, 27.3, 21.3 and 22.1% inhibition on *Aspergillus*species, *Rhizopusspecies*, yeast and *Fusariumspecies* isolated from *D.alata* respectively. The lowest inhibition of *C.odorata* was on *Rhizopusspecies* isolated from *D.rotundata*, while the highest was on yeast isolated from *D. alata*. Furthermore, *P.guajava* had 27.1, 24.7, 27.3 and 22.7% inhibition on *Aspergillus*, *Rhizopus*, yeast and *Botry*. *Species* isolated from *D.rotundata* respectively, while 26.7, 30.7, 27.5 and 28.3% inhibition on *Aspergillus, Rhizopus*, yeast and *Fusariumspecies* obtained from *D.alata*,respectively. The lowest inhibition was on *Rhizopus* specie isolated from *D. alata* while the highest inhibition was on Botry Species isolated from *D.rotundata*. *Carica papaya* had 20.1, 24.0, 18.0 and 19.3% inhibition on *Aspergillus*, *Rhizopus*, yeast and Botry species respectively while 31.5, 15.1, 23.1 and 12.0% inhibition on *Aspergillus*, *Rhizopus*, yeast and *Fusarium*species isolated from *D.alata*,respectively. The lowest inhibition was on *Aspergillusspp* while the lowest highest was on *Fusarium*species isolated from *D.alata*.

Also *C. citratus* had 37.3, 21.9, 26.7 and 36.4% inhibition on *Aspergillus*, *Rhizopus*, yeast and *Botry species*, respectively, while 21.7, 15.5, 28.9 and 31.2% inhibition on *Aspergillus, Rhizopus,* yeast and *Fusariumspecies*,respectively.

**Table 5: Percentage inhibition of pathogens isolated from *D.rotundata*and *D. alata***

| | Organisms | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Plant extracts** | ***D. rotundata*** | | | | ***D. alata*** | | | |
| | ***Aspergillus*** *spp* | ***Rhizopus*** *spp* | ***Yeast*** | ***Botryodiplodia*** *spp* | ***Aspergillus*** *spp* | ***Rhizopus*** *spp* | ***Yeast*** | ***Fusarium*** |
| *Ocimumgratissimum* | 33.3 | 26.2 | 13.7 | 24.7 | 24.9 | 43.1 | 24.0 | 23.5 |
| *Azadirachtaindica* | 19.5 | 10.0 | 8.0 | 11.3 | 9.8 | 11.5 | 11.1 | 18.7 |
| *Vernoniaamaygdalina* | 22.0 | 18.7 | 28.0 | 26.0 | 18.0 | 24.0 | 16.4 | 15.5 |
| *Chromolaenaodorata* | 31.3 | 34.7 | 25.3 | 26.7 | 22.0 | 27.3 | 21.3 | 22.1 |
| *Psidiumguajava* | 27.1 | 24.7 | 27.3 | 22.7 | 26.7 | 30.7 | 27.5 | 28.3 |
| *Carica papaya* | 20.0 | 24.7 | 18.0 | 19.3 | 31.5 | 15.1 | 23.1 | 12.0 |
| *Cymbopogoncitratus* | 37.3 | 21.9 | 26.7 | 36.4 | 21.7 | 15.5 | 28.9 | 31.2 |
| **Mean** | 24.7 | 22.9 | 21.0 | 23.9 | 22.1 | 23.9 | 21.8 | 21.6 |
| **LSD(p=0.05)** | **0.816** | **0.776** | **0.817** | **0.816** | **0.816** | **0.816** | **0.816** | **0.835** |

**DISCUSSION**

This study identified two diseases that infested tubers of two yam species (*Dioscorearotundata*and *Dioscoreaalata*) investigated. The two diseases were Rot and Rust. The interaction disease based on disease type shows that rot had significant difference against rust. This result is in agreement with the findings ofOpara, (2003, 1999) and Cornelius 1998 in which they identified rots as the major disease limiting yam production.

In view of these findings, it was pertinent that this investigation concentrated on the evaluation of the rot organisms of the two yam species (*Dioscorearotundata*and *Dioscoreaalata*) samples used during investigation.

This research work identified the organisms that were associated with the deterioration of diseased tubers of two yam species (*Dioscorearotundata*and *Dioscoreaalata*) during this experiment. The pathogens that caused deterioration on tubers of *Dioscorearotundata*were *Aspergillusniger,* Yeast, *Rhizopusstolonifer*and *Botryodiplodiatheobromae*while the organisms that attacked *Dioscoreaalata*were *Aspergillusniger,* Yeast, *Rhizopusstolonifer*and *Fusariumoxysporium*as found during the experiment.

The pathogens foundthat infested *Dioscorearotundata,*namely, *Aspergillusniger,* Yeast, *Rhizopusstolonifer*and *Botryodiplodiatheobromae,* during this experiment is similar to the earlier works of Amusa*et al.,*(1999), Amusa*et al.,*(2003) and Okigbo (2005). This is also in agreement with the findings of Markson,*et al.,* (2012), Gwa,*et al.,*(2015), Gwa,*et al.,*(2017), Mba,*et al.,*(2017) and Gwa,*et al.,*(2019).

Extracts of *Azadirachtaindica*was found to be the most fungitoxic on rot diseases of *Aspergillusniger*, *Rhizopusstolonifer* and Yeast isolated from *Dioscoreaalata*while *Carica papaya*was the mosteffective *on Fusariumoxysporium*micro-organism isolated from *Dioscoreaalata.* Generally, the application of *Azadirachtaindica*was able to prevent or slowdown of all the micro-organisms identified during the pathogenic test. The interaction between the yam species (*Dioscorearotundata*and *Dioscoreaalata)* with *Azadirachtaindica* is very pronounced on*Dioscoreaalata*at 9.80 inhibition and on*Dioscorearotundata* at 19.51 level, On the control of*Aspergillusniger*, *Vernoniaamygdalina*, *Cymbopogoncitratus*, *Chromolaenaodorata*, and*Ocimumgratissimum* had more effect on *Dioscoreaalata*while *Carica papaya* had more effect on *Dioscorearotundata* than on *Dioscoreaalata*. This result could be attributed to the high level of phytochemicals such as alkaloids, flavonoid, glucosides, phenols, saponinsetc present in the plant extract. This findings is in agreement with the findings of Gwa, et al., (2017) andGwa et al.(2018).

The effect of *Cymbopogoncitratus,Azadirachta indicia Carica papaya* and *Chromolaenaodorata*, *Psidiumguajava* and *Vernoniaamygdalina* too but between *Cymbopogoncitratus*on the inhibition of *R.stolonifer*isolated from *D. alata* while *Ocimumgratissimum* and *Psidiumguajava* did not significantly inhibit *R. stolonifer*.

On the *R. stolonifer* isolated from *Dioscorearotundata*, the effect of *Azadirachtaindica* and *Cymbopogoncitratus*,*Chromolaenaodorata*, *Carica papaya*, *Psidiumguajava* and *Ocimumgratissimum,Vernoniaamygdalina*on the inhibition of this organism were highly significant which could be attributed to the high level of the phytochemicals present. These findings agreed the findings of Markson, *et al.,* (2012) and Okigbo, *et al.,* (2009). The result further is in agreement with the findings of Oyelana, *et al.*, 2011 who worked on the effects of these plant extracts on *R. stolonifer*. The interaction of the two yam species (*Dioscoreaalata*and *Dioscorearotundata*) on *Rhizopusstolonifer*on the plant extracts used for the experiment were all significant the interaction of the seven plant extracts on *Dioscoreaalata*shows that all were significant while they all had significant difference on *Dioscorearotundata.*

The effect of the following plant extracts namely *Azadirachtaindica, Cymbopogoncitratus, Chromolaenaodorata, Ocimumgratissimum*and *Vernoniaamygdalina* significantly inhibited yeast isolated the two yam species except *Psidiumguajava*that did not significantly inhibit yeast in this study. This result again could be attributed the concentrations of the active ingredients in plant extracts such as the phytochemicals used in this investigation as different plant extract contain varying levels of phytochemicals (Oyelana, *et al.*, 2011). The effects of the seven different plant extracts on *Fusariumoxysporium*and *Botryodiplodiatheobromae*isolated from *Dioscoreaalata*and *Dioscorearotundata*respectively revealed that the organisms were highly significant inhibited which may be due to the present of different bioactive compounds.

**CONCLUSION AND RECOMMENDATION**

This work has identified botanicals or plant products with inhibiting properties that were used for yam tubers such as *D. rotundata*and *D. alata*after harvest. Additionally, the postharvest rot pathogens that decimate yam tubers were isolated, identified and confirmed through pathogenicity test. They include*Chromolaenaodorata, Carica papaya, Vernoniaamygdalina, Ocimumgratissimum, Azadirachtaindica, Psidiumguajava*and *Cymbopogoncitratus.* The investigation has shown that fungitoxic compounds were present in all seven (7) bio-pesticides; *Chromolaenaodorata, Carica papaya, Vernoniaamygdalina, Ocimumgratissimum, Azadirachtaindica, Psidiumguajava*and *Cymbopogoncitratus.*

The inhibitory effect of *Azadirachtaindica*was very high on all the organisms isolated from *D. rotundata*and *D. alata*while the other six (6) plants extracts showed high level of fungitoxity on the pathogens isolated at varying degrees.

It is therefore recommended that the plant extracts derived from the leaves of *Azadirachtaindica, Vernoniaamygdalina, Carica papaya,* and *Ocimumgratissimum*be applied in the storage of yam tubers of *D. rotundata*and *D. alata*as alternatives to synthetic chemicals. Application of *Azadirachtaindica*was able to limit the growth of all the microorganisms identified during pathogenicity test. Use of the Bio-pesticides in the following order*Azadirachtaindica>Vernoniaamygdalina>Carica papaya>Ocimumgratissimum*will significantly reduce losses resulting from pathogenic attacks on yams in storage and are therefore recommended for use in that sequence.

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