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Occurrence of Postharvest Fungal Rots of Sweet Potato (*Ipomoea batatas* (L) Lam.) in Southwest Nigeria and their Control with Sawdust Extracts

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Authors' contributions

This work was carried out in collaboration between both authors. Author FB designed the study and performed the statistical analysis, wrote the protocol and the first draft of the manuscript. Author SOA conducted the literature searches. The two authors read and approved the final manuscript.

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ABSTRACT

A study was conducted in three agroecological zones (AEZs) of Southwest, Nigeria to evaluate the incidence and pathogenicity of postharvest fungal rots of sweetpotato and their control with extracts of sawdust from some tropical trees. Survey of rotted tubers was conducted in 18 markets across the three AEZs: humid rainforest (HF), derived savannah (DS), and southern guinea savannah (SGS). Fungi associated with rotted tubers were isolated, identified and their pathogenicity determined. *In vitro* fungitoxicity of *Anogeissus leiocarpus*, *Gmelina arborea* and *Cola nitida* sawdust extracts were assessed in an experiment laid out in a Completely Randomized Design (CRD) with 3 replicates. Six fungi species found to be associated with rot on tubers were *Botryodiplodia theobromae, Rhizopus stolonifer, Aspergillus niger, Trichoderma viride, Penicillium oxalicum* and *Fusarium oxysporum*. Highest (35%) rot incidence was observed in HF zone with *R. stolonifer* as the most prevalent. *Botryodiplodia theobromae* was most prevalent (68.75%, 54.54%) in SGS and DS zones respectively. All the six isolated fungi were pathogenic to sweetpotato but induced varying levels of rot severity. *Botryodiplodia theobromae, R. stolonifer* or *A. niger* induced complete (100%) rot of inoculated tubers. Sawdust extracts reduced mycelial growth of test pathogens at three sawdust concentrations (50 g/L, 75 g/L and 100 g/L) tested. Inhibition of fungal growth increased with extract concentration. *Anogeissus leiocarpus* sawdust extract at 100 g/L exhibited highest

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range of mycelial growth inhibition (8.80 - 73.0%) across tested pathogens. *Gmelina arborea* sawdust extract at 100 g/L significantly inhibited ($p<0.05$) mycelial growth of *B. theobromae, P. oxalicum* and *T. viride* while *C. nitida* exhibited strong fungitoxicity to *F. oxysporum* at 100 g/L. Application of the sawdust extracts at 50 g/L, 75 g/L and 100 g/L concentrations has the potential to minimize postharvest fungal rot of sweetpotato.

Keywords: Occurrence; postharvest; fungal rot; sweetpotato; sawdust extracts.

1. INTRODUCTION

Sweetpotato is the third most important root and tuber crop after cassava and yam in Nigeria, although, it is generally considered as a minor crop in terms of total production and consumption due to the fact that it is usually grown locally by independent smallholders on small plots [1]. The cultivation and consumption of the crop is done majorly in the northern and the central part of Nigeria where it is intercropped with major crops such as sorghum, maize, cassava, yam and millet. Recently, it is gaining importance in Nigerian diet due to its relative ease of cultivation, early maturity (compared to other root and tuber staples) and enormous industrial and economic potentials [2]. In 2000, the United Nations Food and Agriculture Organization (FAO) estimated the total production of sweetpotato in Nigeria at 2,468,000 tonnes and 4,013,786 tonnes by 2017 [3]. It is important as a food and feed as well as cash crop. Apart from being a food and feed crop, it is also very useful as a cover crop to prevent erosion [4].

In the tropics, sweetpotato tuber is subjected to different forms of postharvest spoilage during transportation from farmers' field to market and in storage. Rot caused by fungal pathogens constitute a major loss to farmers in the production of the crop [5]. The rot organisms are, in most cases, parasites that have been introduced through cuts and other wounds on the tubers while harvesting. Several fungi have been found to induce rot in stored sweetpotato. The most important among them are *Botryodiplodia theobromae, Ceratocystis fimbriata, Macrophomina phaseolina, Aspergillus* spp., *Fusarium* spp., and *Rhizopus stolonifer* [6]. According to Tewe et al. [1], *Paisobus* and *Penicillium* spp. are also common agents of tuber rot in storage in Nigeria. The other less frequently occurring spoilage microorganisms include *Cochliobolus lunatus (Curvularia lunata), Sclerotium rolfsii, Rhizoctonia solani* and *Plenodomus destruens*.

The use of plant extracts in the treatment of various fungal infections is a common practice in Africa. In particular, plant extracts are useful in the treatment of plant diseases, different parts of plants including leaves, roots, bark, and stem have been extensively used. Nduagu et al. [7] found the stem bark and root bark of *Azadiracta indica, Vernonia amygdalina* and *Cochlospermum planchonii* to exhibit strong toxicity against *Colletotrichum capsici*, causal agent of pepper anthracnose. Anukworji et al. [8] in their work on control of fungi causing rot of cocoyam with plant extracts reported the efficacy of *Allium sativum, Azadiracta indica, Carica papaya* and *Garcinia kola*. Also, the use of *Alchornea cordifolia* bark, *Annona muricata* leaves, *Allium sativum* bulb, *Zingiber officinale* rhizome and *Gacina cola* fruits for the protection of mechanically injured sweetpotato tubers was reported by Amienyo and Ataga [6]. Wood ash of some tropical forest trees was applied in the preservation of seeds against fungi [9]. Two indigenous plant extracts (*Zingiber officinale* and *Ocimum gratissimum*) had inhibitory effects on postharvest yam (*Dioscorea rotundata*) rot, *in vitro* [10]. Crude extracts from leaves, stem, bark and roots have been used extensively [7,8,11]. However, the use of sawdust extracts as a means of control of fungi is rare. Also, sawdust is a waste with no economic value, it causes environmental pollution if unutilized. It is therefore useful to evaluate the effect of sawdust from some tropical tree species for their antifungal constituents.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiments were carried out in the Laboratory of Department of Crop Protection, Federal University of Agriculture, Abeokuta, Ogun State, Southwest Nigeria (7° 15' N, 3° 25' E, 100 m above sea level).

2.2 Sourcing of Sawdust Samples

Sawdust samples were obtained from a sawmill in Camp Area of Odeda, Ogun State, Southwest

Nigeria. Sawdust from freshly milled timber of three tropical tree species - *Anogeissus leiocarpus, Gmelina arborea* and *Cola nitida* which had shown inhibitory effect in earlier studies [12,13,14] were selected for this study. Sawdust from each tree species was collected separately on a tarpaulin sheet which was emptied into a polyethylene sack ensuring that it was only the desired tropical tree species that was being milled at the time of collection. It was thereafter airdried before use.

2.3 Survey of Fungal Rot of Stored Sweetpotato Tubers in Southwest Nigeria

A survey was conducted across three agroecological zones in Southwest Nigeria to determine the fungi associated with sweetpotato rots in Southwest, Nigeria. Rotted samples of sweetpotato tubers were collected from the Southern Guinea Savannah zone encompassing the northern part of Oyo State; Derived Savannah zone cutting across Ekiti, and parts of Oyo, Ogun and Osun States; and Humid Rainforest zone in Lagos and parts of Ogun and Ondo States.

The survey of rotted sweetpotato tubers in each of the three agroecological zones in Southwest involved sampling in 18 major markets selected across the three zones (Table 1). Three samples showing rot symptoms were collected from each of three stalls visited in a market. The choice of the market in the State was based on: (i) High popularity of market for the sale of sweetpotato; and (ii) Large volume of sale of sweetpotato tubers. Eighteen locations were surveyed across the three agroecological zones with nine rotted samples collected in each location. A total of 162 samples were collected across the zones. Each sample was collected in sterile plastic bags and labelled immediately. The samples were refrigerated at 4°C until ready for use in the laboratory.

2.4 Isolation, purification and identification of fungi associated with sweetpotato rots in Southwest, Nigeria

Rotted tubers collected from the survey were washed with clean water and sections of about $1cm^3$ were cut from the tissue with a sterile scapel at the interface between healthy and infected portions of the tuber. Pieces of the cut tissues were surface sterilized (1% NaOCl for 1 min), rinsed in four changes of distilled water and left to dry for 30 minutes at 28 $\pm$ 2°C, and then plated on sterilized Potato Dextrose Agar (PDA) in petri dishes. Inoculated petri dishes were incubated at 28 $\pm$ 2°C for 5 days and observed daily for fungal development. Subcultures were made by transferring hyphal tips from the colony edge of the mixed cultures to fresh plates of PDA using flame sterilized blades and incubating at 28 $\pm$ 2°C to obtain pure cultures of the fungi associated with sweetpotato rot. Colony characteristics were examined with the aid of a microscope. Cultural and morphological characteristics observed were recorded and compared with typical conidial structures using identification keys described by Barnett and Hunter [15] and Watanabe [16].

2.5 Determination of Fungal Frequency of Occurrence

The most prevalent fungi in the study area were identified by the frequency of occurrence of each of the isolated fungus from the tubers obtained from a particular location. This was determined by recording the number of times each fungus was encountered. The percentage frequency of occurrence was calculated as follows:

Number of times a fungus is encountered / Total fungal isolations X 100 [17]

2.6 Pathogenicity Test of Fungi Associated with Postharvest Rots

The pathogenicity test of each of the isolated fungus was carried out by surface sterilizing healthy tuber in 1% sodium hypochlorite for 1 minute and rinsing in four changes of distilled water and inoculating with fungus. Inoculation was done by removing cylindrical discs on the tuber with a sterile cock borer (5 mm diameter) to a depth of 2 cm. A disc of the fungus culture (5 mm diameter) was introduced into the hole created on the tubers and the tissues previously removed from the hole replaced after about 2 mm had been cut off to compensate for the thickness of the inoculum.

The point of inoculation was then sealed with wax. A control was set up in the same manner in which sterile agar disc was used instead of the inoculum. Experiment was laid out in a completely randomized design with three replicates. Inoculated sweetpotato tubers were incubated for 7 days at 28 $\pm$ 2°C. At the end of the incubation period, the tubers were cut open

along the line of inoculation to expose the rotted portion. A re-isolation was made on PDA from the rotted portion of the inoculated tuber and the isolate compared with the original culture of the fungus for confirmation as the rot-causing organism [6].

2.7 Disease Severity Assessment on Sweetpotato Tubers

The severity of the infection after the incubation period was measured on a 0 – 4 scale:
0 - No infection; 1 - Slight infection (25% of tuber infected); 2 - Moderate infection (50% of tuber infected); 3 - Severe infection (75% of tuber infected); 4 - Complete rot (100% infected) [11].

2.8 *In Vitro* Assessment of the Effect of Sawdust Extracts on Mycelial Growth of Pathogenic Fungi of Sweetpotato Rot in Storage

One hundred grammes, 75g and 50g of each of the freshly collected sawdust from different tree species was weighed and soaked in 1 L of distilled water for about 24 hours. The content was filtered and the stock solution taken as 100g/L, 75g/L and 50g/L concentration respectively. Potato dextrose agar was weighed into the stock solution and sterilized in autoclave at 121°C for 15 minutes. Sterile potato dextrose agar amended with sawdust extract was poured in petri dishes and allowed to solidify. The media was inoculated separately at the centre with 5mm culture discs of each fungus. The negative control was set up using blank PDA plates without sawdust extract, and the positive control which consisted of the fungicide mancozeb (ethylene bisdithiocarbamate) was prepared according to manufacturer directions by mixing 0.5g in 100ml of sterile distilled water. Mancozeb is a multipurpose, preventive, contact, broad spectrum fungicide. Experiment was laid in a CRD and three replicates were maintained for each treatment. Inoculated plates were incubated for 7 days at 28 ± 2°C and each plate was observed for mycelial growth relative to the control plate.

Diameter of the radial growth of the fungus was taken as the means along two directions on two perpendicular lines drawn on the reverse of the plates. Percentage growth inhibition of sawdust was calculated with the formula:

$$\text{Percentage growth inhibition (\%)} = (dc-dt) / dc \times 100$$

Where,

dc = average diameter of fungal colony in control treatment; and
dt = average diameter of fungal colony with sawdust extract [11].

Extracts were rated for their inhibitory effects using the severity rating [18]

0% inhibition (Not effective);
>0-20% inhibition (Slightly effective);
>20-50% inhibition (Moderately effective);
>50-<100% inhibition (Effective);
100% inhibition (Highly effective).

Table 1. Markets surveyed for fungal rot of sweetpotato in Southwest Nigeria

Market	State	Agroecological zone
Mile 12	Lagos	Humid Rainforest
Oyingbo	Lagos	Humid Rainforest
Ikorodu	Lagos	Humid Rainforest
Okitipupa	Ondo	Humid Rainforest
Ondo	Ondo	Humid Rainforest
Ile-Oluji	Ondo	Derived Savannah
Tube	Ogun	Derived Savannah
Kila	Ogun	Derived Savannah
Lafenwa	Ogun	Derived Savannah
Oye	Ekiti	Derived Savannah
Ado	Ekiti	Derived Savannah
Ifaki	Ekiti	Derived Savannah
Oyan	Osun	Derived Savannah
Ife	Osun	Derived Savannah
Ikirun	Osun	Derived Savannah
Ogbomoso	Oyo	Derived Savannah
Saki	Oyo	Southern Guinea Savannah
Igboho	Oyo	Southern Guinea Savannah

2.9 Data Analysis

All Data collected were subjected to analysis of variance and significant means were separated with Duncan's Multiple Range Test (DMRT) at probability level of 0.05. All statistical analysis were performed using General Statistical package GenStat 12.1 Edition.

3. RESULTS AND DISCUSSION

3.1 Isolation and Identification of Fungi with Sweetpotato Rots in Southwest, Nigeria

In this study, *Botryodiplodia theobromae, Rhizopus stolonifer, Penicillium oxalicum, Aspergillus niger, Trichoderma viride* and *Fusarium oxysporum* were implicated as rot causing organisms on sweetpotato in Southwest Nigeria. These organisms were frequently isolated from rotted sweetpotato tubers and have been reported to cause significant rot on tubers in storage in major growing areas in the tropics [19,20]. In Southwest Nigeria, a similar profile of fungal species was also obtained from yam tubers [21] and sweetpotato tubers in Southeast, Nigeria [5,22]. In some cases, *F. solani* and *A. flavus* were also implicated as rot organisms [6]. These were, however, not encountered in the survey probably as a result of environmental differences.

3.2 Incidence of Fungi Associated with Sweetpotato Rots in Agroecological Zones of Southwest, Nigeria

The incidence of the six identified fungal species varied across the different agroecological zones (Table 2). In the humid rainforest, incidence of *R. stolonifer* was significantly (P=0.05) higher (35.00%) than other species while *B. theobromae* had a significantly (P=0.05) higher incidence of 54.54% and 68.75% in the derived savannah and southern guinea savannah respectively. Incidence of *T. viride* (7.50%) and *F. oxysporum* (8.75%) were lowest and comparable in the humid rainforest and both fungi were not encountered in the southern guinea savannah zone. *P. oxalicum* was 11.25% (humid rainforest) and 12.50% (derived savannah) but was not encountered in the southern guinea savannah. The range of incidence of *R. stolonifer* was between 11.90% and 35.00% and that of *A. niger* was between 12.50% and 23.75% across the three agroecologies.

Occurrences of the fungi differed in the three agroecologies surveyed. While all six isolated fungi occurred in the humid rainforest zone, only three isolates were recorded in the southern guinea savannah zone. This affirms that high relative humidity associated with the humid rainforest zone favours disease development as reported by Dania et al. [23] who observed highest overall incidence of fungal isolates of yam in humid rainforest zone of Nigeria compared to derived savannah and southern guinea savannah zones. The high incidence *Rhizopus stolonifer* in humid rainforest zone may be due to the ubiquitous nature of the fungus. Furthermore, its abundant airborne spores and high infection is greatly enhanced by high relative humidity as reported by Scruggs and Quesada-Ocampo [24].

All the fungi isolated from rotted sweetpotato tubers were found to be pathogenic, exhibiting varying degrees of infection (Table 3). *Botryodiplodia theobromae, R. stolonifer,* and *A. niger* caused complete rot of the tuber. *Penicillium oxalicum* exhibited a severe infection while *T. viride* and *F. oxysporum* caused moderate and slight infection respectively.

Earlier reports [8,22,25] have shown that *Botryodiplodia theobromae*, *R. stolonifer* and *A. niger* were more virulent and fast growing. They caused complete rot of tuber while *P. oxalicum*, *T. viride* and *F. oxysporum* caused severe, moderate and slight infections respectively. Prevailing humid conditions and high temperature in the tropics have been reported to enhance the widespread of these rot causing organisms in all sweetpotato producing areas [20]. Furthermore, some of the fungi possess special features enhancing their spread on host. *Botryodiplodia theobromae* forms chlamydospores and specialised hyphae in infected host tissues where it survives unfavourable periods [26]. Also, it was reported that rot by *R. stolonifer* is enhanced by its ability to secrete considerable amounts of pectolytic enzymes (amylase, pectinase and cellulase) which rapidly colonize and liquefy the host [24].

3.3 The Inhibitory effect of Three Sawdust Extract on the Growth of Six Sweetpotato Tuber Rot Pathogens

Table 4 shows the effectiveness of *Gmelina arborea* sawdust extracts on the growth inhibition of sweetpotato rot pathogens at 3 different concentrations 50, 75 and 100g/L *in vitro*. There

was a general increase in growth inhibition with increase in extract concentration of *Gmelina arborea* sawdust extract.

Growth inhibition varied with the pathogens tested. It was effective in inhibiting *B. theobromae* and *F. oxysporum* and moderately effective for *A. niger, P. oxalicum* and *T. viride*, but only slightly effective for inhibiting the growth of *R. stolonifer*. The findings from this study is consistent with earlier reports on the use of several parts of the plant for medicinal purposes. The root, stem bark and leaves of *Gmelina arborea* were reported to be widely used in Ayurveda, one of the major traditional forms of medicine in India [27]. Its root is used in the treatment of chronic fever, hemorrhages, urinary tract infections, gastrointestinal tract disorder as well as ulcer treatment etc. [28]. The antifungal activity of constituents from the heartwood of *G. arborea* against *Trametes versicolor* and *Fomitopsis palustris* was also reported by Kawamura et al. [12].

Sawdust extract of *Cola nitida* proved to be significantly effective in inhibiting the growth of some sweetpotato pathogens *in-vitro*. It showed effective inhibition against *F. oxysporum*, while moderately effective inhibition was observed for *A. niger, B. theobromae* and *T. viride* (Table 5). The extract slightly inhibited the growth of *P. oxalicum* and was not effective against *R. stolonifer*. The relatively reduced efficacy of *Cola nitida* extract may be as a result of the plant part (sawdust) used in this study. Previous authors reported that other parts of the plant showed contrary results. Kanoma et al. [29] revealed that the Colanut extract had antifungal activity against some phytopathogenic fungi. Also, the leaf and seed extracts were reported to exhibit significant inhibitory action against some *Candida* species and dermatophytes [30].

Anogeissus leiocarpus sawdust extract gave significantly effective inhibition on the growth of most of the pathogens tested. Effective inhibition was obtained for *B. theobromae* (63.60%), *T. viride* (44.33%), *P. oxalicum* (43.43%) and *F. oxysporum* (42.70%) while a moderately effective inhibition (35.77%) was observed for *A. niger* and slightly effective for *R. stolonifer*. Increased concentrations caused significant ($p=0.05$) increase in percentage inhibition for all pathogens except *R. stolonifer* (Table 6). The effectiveness of *A. leiocarpus* sawdust extract is corroborated by the findings of Mann et al. [13], who claimed that root extract of *A. leiocarpus* was effective in inhibiting the growth of *Aspergillus* and *Penicillium* species. Furthermore, its application in traditional medicine has been reported by some researchers –use of its leaf extract in the treatment of skin diseases – eczema and psoriasis [31]. It is also commonly used as chewing stick and in curing tooth and gum infections as well as wound healing [32].

This study was necessary to develop cheaper and simpler means of controlling postharvest fungal rot of sweetpotato, which is prevalent across the Southwest states. The choice of plants used is based on the reported activities of their leaves, bark or seeds in the treatment of several diseases in previous studies [14,32,33]. The antifungal effect of *C. nitida, A. leiocarpus* and *G. arborea* sawdust extracts on the growth of the six identified pathogens of stored sweetpotato *in vitro* showed that the sawdust extracts possess some inhibitory components which caused reduction in mycelial growth of all six fungi except *R. stolonifer.* The effectiveness of the sawdust extract is probably suppressed by the fast growth of the fungus [26].

Table 2. Incidence of fungi associated with rotted sweetpotato samples in agroecological zones in Southwest, Nigeria

	Fungal incidence (%)		
Fungi	**Humid rainforest**	**Derived savannah**	**Southern guinea savannah**
Botryodiplodia theobromae	13.75 ± 0.58 c	54.54 ± 0.08 a	68.75 ± 6.06 a
Rhizopus stolonifera	35.00 ± 2.41 a	11.93 ± 1.01 c	18.75 ± 5.77 b
Penicillium oxalicum	11.25 ± 2.41 d	12.50 ± 0.00 bc	0.00 ± 0.00 d
Aspergillus niger	23.75 ± 0.58 b	14.25 ± 0.08 b	12.50 ± 1.73 c
Trichoderma viride	7.50 ± 0.79 e	5.11 ± 1.14 d	0.00 ± 0.00 d
Fusarium oxysporum	8.75 ± 0.67 e	1.70 ± 0.33 e	0.00 ± 0.00 d

Fungal incidence is a mean of data collected from 18 locations in 3 agroecological zones in Southwest Nigeria. Different letters in each column indicate significant differences at P≤0.05 by Duncan's Multiple Range Test; ± Standard error

Anogeissus leiocarpus was the most effective of the three sawdust extracts while *Cola nitida* was the least effective. Further studies are required to investigate the active ingredients in the sawdust and their mode of action. It is suggested that other parts (leaves, bark or nut) of *Cola nitida* plant be evaluated for possibly, better results.

Table 3. Pathogenicity of fungi isolated from rotted sweetpotato tubers

Fungi	Disease Severity	
	Index	Rating
Botryodiplodia theobromae	4.00	Complete rot
Rhizopus stolonifera	4.00	Complete rot
Penicillium oxalicum	2.67	Severe infection
Aspergillus niger	4.00	Complete rot
Trichoderma viride	2.33	Moderate infection
Fusarium oxysporum	1.33	Slight infection

Severity scale: 0-no infection; 1-slight infection (25% of tuber infected); 2-moderate infection (50% of tuber infected); 3-severe infection (75% of tuber infected); 4-Complete rot (100% infected). Data was taken 21 days after inoculation

Table 4. The effect of *Gmelina arborea* sawdust extract on growth inhibition of six sweetpotato tuber rot pathogens at three different sawdust concentrations

Pathogen	Inhibition (%)					*Severity rating
	Sawdust Concentration (g/L)					
	50	75	100	Mean	LSD P<0.05	
A. niger	28.50	38.60	39.20	35.43	7.90	Moderately effective
B. theobromae	32.90	39.40	51.20	41.17	3.53	Effective
F. oxysporum	49.10	56.30	63.40	56.27	14.22	Effective
P. oxalicum	25.30	29.40	40.60	31.77	7.81	Moderately effective
R. stolonifer	4.10	6.50	6.50	5.70	2.67	Slightly effective
T. viride	15.30	27.10	41.80	28.07	2.78	Moderately effective
LSD (P<0.05)	5.39	5.37	1.76			

**Severity rating: 0% inhibition-Not effective; >0-20% inhibition - Slightly effective; >20-50% inhibition - Moderately effective; >50-<100% inhibition - Effective; 100% inhibition –Highly effective*

Table 5. The inhibitory effect of *Cola nitida* sawdust extract on the growth of six sweetpotato tuber rot pathogens at three different sawdust concentrations

Pathogen	Inhibition (%)					*Severity rating
	Sawdust Concentration (g/L)					
	50	75	100	Mean	LSD P<0.05	
A. niger	22.60	25.60	29.80	26.00	4.77	Moderately effective
B. theobromae	32.90	37.70	43.10	37.90	4.47	Moderately effective
F. oxysporum	44.30	46.20	51.90	47.47	2.47	Effective
P. oxalicum	17.10	18.80	21.20	19.03	3.36	Slightly effective
R. stolonifer	0.00	0.00	0.00	0.00	0.00	Not effective
T. viride	15.30	18.80	26.50	20.20	10.01	Moderately effective
LSD (P<0.05)	4.31	5.26	3.37			

**Severity rating: 0% inhibition-Not effective; >0-20% inhibition - Slightly effective; >20-50% inhibition - Moderately effective; >50-<100% inhibition - Effective; 100% inhibition –Highly effective*

Table 6. The inhibitory effect of *Anogeissus leiocarpus* sawdust extract on the growth of six sweetpotato tuber rot pathogens at three different sawdust concentrations

Pathogen	Inhibition (%)					*Severity rating
	Sawdust Concentration (g/L)					
	50	75	100	Mean	LSD P<0.05	
A. niger	22.70	37.30	47.30	35.77	4.36	Moderately effective
B. theobromae	55.80	62.00	73.00	63.60	1.61	Effective
F. oxysporum	32.30	44.80	51.00	42.70	2.73	Effective
P. oxalicum	23.00	49.10	58.20	43.43	3.97	Effective
R. stolonifer	5.30	9.40	8.80	7.83	2.78	Slightly effective
T. viride	24.70	48.20	60.00	44.33	3.08	Effective
LSD (P<0.05)	2.46	4.37	2.73			

**Severity rating: 0% inhibition-Not effective; >0-20% inhibition - Slightly effective; >20-50% inhibition - Moderately effective; >50-<100% inhibition - Effective; 100% inhibition –Highly effective*

4. CONCLUSION

All six fungi were found associated with postharvest rot of sweetpotato in this study and were confirmed as causative agents of sweetpotato tuber rot in Southwest Nigeria. The potential of sawdust of *Anogeissus leiocarpus* and *Gmelina arborea* and *Cola nitida* as antifungal agents was established, therefore, they may be used as cheaper and more environmentally friendly alternatives to control postharvest rots of sweetpotato.

COMPETING INTERESTS

Both authors have declared that no competing interests exist.

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