



## FUNGICIDAL EFFECTS OF *SPONDIAS MOMBIN* LINN STEM EXTRACT ON SOME SELECTED WOOD DETERIORATING FUNGI

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**ABSTRACT:** The fungicidal effects of *Spondias mombin* stem extract was tested against *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum*. Fungi colony count and radial growth were conducted at extract concentration level of 100%, 50%, 25% and 12.5% while Potato Dextrose Agar (PDA) served as culturing media. This experiment was replicated four times and fungi colony count taken at day four. Data analysis showed significant difference in fungal count at concentration levels and among fungi at ( $P \leq 0.05$ ). 100% extract had the highest inhibitory effect on fungal count. Also, there was significant difference in fungal radial growth at the different concentration levels and among the fungi ( $P \leq 0.05$ ). The inhibitory activity of bark extract on radial growth of fungi showed that radial growth increases from 100% to 12.5% level of concentration. The extract was most efficient at 100% concentration level. Result showed that highest inhibitory effect of extract on fungal count and fungal radial growth was recorded in *Fusarium oxysporum*.

Keywords: Fungitoxicity, Colony count, Radial growth, Concentration, media

### 1. INTRODUCTION

Plants produce diverse amount of secondary metabolites, namely phenolic compounds. These secondary metabolites, such as polyphenols play vital roles in defense against plant diseases caused by pathogens, harmful pest and other microorganisms. There are several properties that are shown by these phenolic compounds, such as antifungal (Castillo *et al.* 2010), antimicrobial (Pengelly 2004). Downum *et al.* (1993), stated that higher tropical plants can produce diverse anti-microbe and anti-insect substances. Several types of fungi have been reported to be associated with the wood decay such as *Serpula lacrymans*, *Coniophora puteana*, *Amyloporia xantha*, *Chaetomium globosum*, *Cladosporium* spp, *Penicillium* spp., *Monilia* sp. and *Arthrinium phaeospermum* (Singh 2010). Wood, especially less durable wood is prone to fungal wood decay. Infection by wood fungi such as white rot and brown rot reduce durability and quality of wood. There would be serious economic loss of resources if the effects of the infections are not controlled. Wood preservative industry used synthetic preservatives in order to control wood decay and deteriorations cause by fungi, but synthetic preservatives is a serious threat to human health and environment as well make it unsuitable to be used in long term (Priadi 2005; Astiti and Suprpta 2012). Therefore,

investigations on various plants producing preservatives which are environmental friendly and safe to human health is imperative. Wood bark is generally considered as an unwanted residue rather than a potentially valuable resource. Bark have been found useful for various purposes and small amounts are tolerated in semichemical and kraft pulping processes. Bark also has utility as a source of adhesives and other chemicals (e.g., tannins, dyes, and waxes), in environmental protection applications (e.g., absorption of spilled oil, industrial wastes, and sewage effluents), and as a fuel. Nevertheless, differences in the structure and chemical composition of different barks, difficulties of separating bark from wood when in the form of particles, and differences in the properties of inner and outer bark have impeded fuller utilization. (George 2015) *Spondias mombin* Linn is a species of flowering plant in the family Anacardiaceae. It is native to the tropical Americas, including the West Indies. The tree has been naturalized in parts of Africa, India, Sri Lanka and Indonesia. It is rarely cultivated. The bark contains a certain amount of tannin. (Wikipedia 2014).

This work is designed to evaluate the chemical constituents and fungicidal properties of stem bark against wood deteriorating fungi.

## 2. MATERIALS AND METHODS

Stem barks were collected from *Spondias mombin* tree located within Federal University of Agriculture Abeokuta (FUNNAB) free areas. The inoculum of *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum* were obtained from Veterinary Microbiology Laboratory, Department of Veterinary Microbiology and Parasitology, FUNAAB. Fresh *Spondias mombin* stem bark (500g) was air-dried for four weeks under room temperature (25°C - 27°C). The air-dried wood barks were reduced to fine particles with the use of hammer milling machine and kept in a clean air-tight container. About 100g of the crushed bark was put into a beaker while 500ml of concentrated methanol (99.9%) was added to it. Then, the beaker containing the crushed bark and methanol was covered up with aluminum foil and subjected to room temperature (25°C - 27°C) for seven days until the methanol was decolourized to dark red-brown colour of the bark.

Then, the content in the beaker was sieved and placed on water bath at (34° C) so as to remove the solvent (methanol) and concentrate the extract to usable form in the laboratory. The concentrated extract weighted 250mg was put into a sterile petri dish and kept under a low temperature in a refrigerator (5°c) before its dilution for other experiment.

### 2.1 Phytochemical screening

Quantitative phytochemical screening was conducted on stem bark of *Spondias mombin*. The method described by Harborne, (1973), was used to determine the presence of alkaloids. Boham and Kocipai- Abyazan, (1994), for flavonoids, Brauns *et al.* (1960), for lignin, Obdoni and Ochuko (2001), for saponins and Amadi *et al.* (2004), for tannins.

#### 2.1.1 Alkaloids (Harborne 1973)

Some 2.50g of each wood bark powder was weighed into a 250cm<sup>3</sup> beaker and 200cm<sup>3</sup> of 10 % acetic acid in ethanol was added to each wood powder and allowed to stand for 4 hours. This was filtered and the extract was concentrated on a water bath to one - quarter of the original volume followed by addition of 15 drops of concentrated ammonium hydroxide drop wise to the extract until the precipitation was complete. The whole mixture was allowed to settle for 3 hours, the supernatant was discarded and the precipitates washed with 20cm<sup>3</sup> of 0.1M of ammonium hydroxide and then filtered using Gem fitter paper (12.5cm). The residue was dried in an oven and weighed using electronic weighing balance Model B-218.

The percentage of alkaloid can be expressed mathematically as:

$$\% \text{ Alkaloid} = \frac{\text{weight of alkaloid}}{\text{weight of sample}} \times 100 \dots \dots \dots (1)$$

#### 2.1.2 Flavonoid (Boham and Kocipai- Abyazan, 1994).

Each wood bark powder weighing 2.50g was placed in a 250cm<sup>3</sup> beaker and 50cm<sup>3</sup> of 80% aqueous methanol added, covered and allowed to stand for 24 hours at room temperature. The supernatant was discarded and the residue re-extracted three times with the same volume of ethanol. The whole solution of wood bark sample was filtered through Whatman filter paper No 42 (125 mm). The filtrate of each wood bark sample was later transferred into a crucible and evaporated to dryness over a water bath. The crucible and its content was cooled in a desiccator and weighed until constant weight was obtained. The percentage of flavonoid is expressed mathematically as:

$$\% \text{ Flavonoid} = \frac{\text{weight of flavonoid}}{\text{weight of sample}} \times 100 \dots \dots \dots (2)$$

#### 2.1.3 Lignin (Brauns 1960)

Two hundred milligrams (200mg) of wood bark sample was accurately weight to the nearest 0.1mg into a small beaker. One milliliter of 72% H<sub>2</sub>SO<sub>4</sub> was added to each 100mg of the wood bark sample. The mixture was placed in water bath at 30 ±0.5° and was stirred frequently to assure a complete solution. After exactly one hour (1 hr.), it was diluted and transferred quantitatively to a 125 ml Erlenmeyer flask, using 28 ml of water for each 1ml of acid. Secondary hydrolysis took place in an autoclave at 120°C for one hour. The hot solution was filtered through a fritted glass crucible and the Klason lignin residue was washed with hot water to remove the acid. The crucibles containing the wood bark samples were then dried to constant weight at 105°C and were weight to the nearest 0.1mg. The Lignin content was calculated as a percentage:

$$\% \text{ Lignin} = \frac{\text{weight of Lignin}}{\text{weight of sample}} \times 100 \dots \dots \dots (3)$$

#### 2.1.4 Saponin (Obdoni and Ochuko 2001)

Five grams of wood bark powder was put into a 250cm<sup>3</sup> conical flask and 100cm<sup>3</sup> of 20% aqueous ethanol was added. The mixture was heated over a hot water bath for 4 hours with continuous stirring at a temperature of 55°C. The mixture was filtered and the residue re-extracted with another 100cm<sup>3</sup> of 20% aqueous ethanol, heated for

4 hours at a constant temperature of 55°C with constant stirring. The combined extract was reduced to 40cm<sup>3</sup> over water bath at a temperature of 90°C. The concentrate was transferred into a 250cm<sup>3</sup> separator funnel and 20cm<sup>3</sup> of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated twice. 60cm<sup>3</sup> of n-butanol was added and the butanol extract was washed twice with 10cm<sup>3</sup> of 5% sodium chloride. The sodium chloride layer was discarded and the remaining solution heated in a water bath for 30 minutes, after which the solution was transferred into a crucible and was dried in an oven to a constant weight. The saponin content was calculated as a percentage:

$$\% \text{ Lignin} = \frac{\text{weight of saponin}}{\text{weight of sample}} \times 100 \dots \dots \dots (4)$$

#### 2.1.5 Tannin (Amadi et al. 2004)

The Folin-Denis reagent was prepared by dissolving 50g of sodium tungstate (Na<sub>2</sub>WO<sub>4</sub>) in 37cm<sup>3</sup> of distilled water and adding 10g of phosphomolybdic acid (H<sub>3</sub>PMO<sub>12</sub>O<sub>40</sub>) and 25cm<sup>3</sup> of orthophosphoric acid (H<sub>3</sub>PO<sub>4</sub>). The mixture was refluxed for 2 hours, cooled and diluted to 500cm<sup>3</sup> with distilled water. One gram of each wood bark powder was weighed into a conical flask and 100cm<sup>3</sup> of distilled water added. This was boiled gently on an electric hot plate for 1 hour and filtered through Whatman filter paper No 42 (125mm) into a 100cm<sup>3</sup> volumetric flask. For colour development, 50cm<sup>3</sup> of distilled water and 10cm<sup>3</sup> of diluted extract (aliquot volume) were pipetted into a 100cm<sup>3</sup> conical flask, followed by the addition of 5.0cm<sup>3</sup> Folin-Denis reagent and 10cm<sup>3</sup> of saturated Na<sub>2</sub>CO<sub>3</sub> solution. After thorough mixing, the solution was allowed to stand for 30 minutes in a water bath at a temperature of 25°C. Optical density was measured at 700 nm with the aid of a Spectrum Lab23 A spectrophotometer and optical density (absorbance) compared on a standard tannic acid curve. The tannic standard curve was prepared by dissolving 0.20g of tannic acid in distilled water and diluted to 200 cm<sup>3</sup> mark (1 mg/cm<sup>3</sup>). Varying concentrations (0.2 - 1.0 mg/cm<sup>3</sup>) of the standard tannic acid solution were pipetted into five different test tubes. 5cm<sup>3</sup> of Folin-Denis reagent and 10cm<sup>3</sup> of saturated Na<sub>2</sub>CO<sub>3</sub> solution were pipetted into the test tube, and was made up to the 100cm<sup>3</sup> mark with distilled water. The solution was left to stand for 30 minutes in a water bath at a temperature of 25°C. Optical density was measured at 700nm with the aid of a Spectrum Lab23A spectrophotometer. A plot of optical density (absorbance) versus tannic acid concentration was made.

$$\% \text{ Lignin} \left( \frac{\text{mg}}{100\text{g}} \right) = \frac{C \times \text{extract} \times 100}{AV \times \text{weight of sample}} \dots (5)$$

Where C = concentration of tannic acid read off the graph and AV = Aliquot volume

#### 2.2 Fungicidal Effects of *Spondias mombin* Stem Bark

The antifungal assays method used was based on Satish et al. (2007) with minor modification. The efficacy of stem bark extracts to fungi was evaluated by carrying out fungal count and measuring fungal radial growth (cm) using ruler.

#### 2.3 Fungal Count (Colony Count)

Sterilized petri dishes were used to prepare 100%, 50%, 25% and 12.5% diluted extract. 1ml of diluted extract was dispensed into each petri dish. The positive control experiment contains 1ml of 200g KET (ketoconazole) and another sterile petri dish was dispensed with 1ml of sterile saline water as negative control. About 15ml of PDA (Potato Dextrose Agar) supplemented with 10mg/streptomycin was dispensed into each petri dish which was mixed gently and allowed to solidify. 1ml of diluted fungi was spread on each petri dish and allowed to be properly absorbed by the growth media. The inoculated plates were kept at room temperature (25°C - 27°C) for four days and total fungal count was taken on fourth day of the experiment.

#### 2.4 Radial Growth Measurement

Sterilized petri dishes were used to prepare 100%, 75%, 50%, 25% and 12.5% diluted extract while control experiment contains only sterile water. About 15ml of SDA (Sabourand Dextrose Agar) that has been supplemented with 10mg of streptomycin was poured into the various petri dishes containing extracts and mixed gently and covered. The contents in the petri dishes were allowed to solidify within 10-15 minutes and later a drop of diluted fungi (10<sup>3</sup>g/m) was dropped at the center of each petri dish. The diluted fungi was allowed to be absorbed properly. The inoculated plates were kept at room temperature (25°C - 27°C) for four days where radial growth measurement were taken with ruler at every 24 hour interval.

#### 2.5 Statistical Analysis

Significance of antifungal activity of stem bark extract of *Spondias mombin* on fungi colony count and fungi radial growth was subjected to Two-way analysis of variance and Duncan Multiple Range Test using statistical package (SPSS) at (p≤0.05).

### 3. RESULTS

#### 3.1 Phytochemical Analysis of Stem Bark of *Spondias mombin*

The result of the phytochemical analysis for five bioactive phytochemicals in *Spondias mombin* stem bark are as shown in Table 1. These phytochemicals are; alkaloid, flavonoid, lignin, saponin and tannin. These phytochemicals vary from each other in their percentage composition. From the table, alkaloid had the highest percentage content having the value 91.34% followed by flavonoid with 66.63%. The least percentage phytochemical content was recorded for tannin which had 0.14%.

Table 2 showed that mean fungal count increased from 100% concentration level to 12.5% concentration level. Also, significant relationship exists in fungal colony count among the three fungal in the study.

Table 2: Duncan Multiple Range Test showing Inhibitory activity of *Spondias mombin* bark extract against fungal colony count

Concentration Level (%)	<i>Aspergillus niger</i>	<i>Fusarium oxysporum</i>	<i>Penicillium notatum</i>
100	10.00 ±1.58 <sup>cd</sup>	1.00 ±0.58 <sup>a</sup>	6.25 ±0.85 <sup>bc</sup>
50	12.50 ±1.5 <sup>d</sup>	2.50±0.29 <sup>ab</sup>	10.00 ±0.41 <sup>d</sup>
25	17.50 ±0.29 <sup>ef</sup>	3.00 ±0.00 <sup>ab</sup>	12.50 ±0.65 <sup>d</sup>
12.5	20.00 ±0.91 <sup>f</sup>	3.50 ±0.29 <sup>ab</sup>	13.75 ±0.85 <sup>de</sup>
Ketoconazole (Positive Control)	0.00	0.00	0.00
Sterile water (Negative Control)	30.00 ±1.23 <sup>g</sup>	4.00 ±1.23 <sup>ab</sup>	121.0 ±1.23 <sup>h</sup>

\* Mean of four replicates ± Standard error, values in the same column with different letters in superscripts are significantly different at ( $p \leq 0.05$ )

#### 3.2 Effect of *Spondias mombin* Bark Extract against Radial Growth of Fungi

The result in Table 4 showed how concentration levels of extract influenced the radial growth of *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum* at every 24 hour interval. It was evident from the table that 100% concentration of extract exhibited the least radial growth while the highest was recorded at 12.5% concentration level for the four days.

On day 1, the mean value of radial growth at 100% concentration level of *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum* are 10.50, 9.75 and 11.75% respectively. These values increased from 100% to 12.5% concentration level, the highest mean value was recorded for *Aspergillus niger* (12.5), *Fusarium oxysporum* (14.0) and *Penicillium notatum* (24.0). Only 12.5% level of concentration was significantly different in *Aspergillus niger* but no significant difference existed among other levels. In *Fusarium oxysporum* there was no significant difference between 75% and 50% and

Table 1: Phytochemical Analysis of Stem Bark of *Spondias Mombin*

Phytochemicals	Content (%)
Alkaloid	91.34
Flavonoid	66.63
Lignin	31.47
Saponin	1.27
Tannin	0.14

At 100% concentration level, highest inhibitory activity of extract was recorded for *Fusarium oxysporum* with mean fungal count of 1.0, followed by 6.25 recorded in *Penicillium notatum* and least in *Aspergillus niger* with mean fungal count of 10.0. Using Duncan Multiple Range Test ( $P \leq 0.05$ ), 100% concentration level showed significant difference in fungal colony count among *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum*. But at 50% concentration level, there was no significant difference between *Aspergillus niger* and *Penicillium notatum*.

between 25% and 12.5% concentration level. In *Penicillium notatum*, there was no significant difference between 75% and 50% concentration but other concentration levels are significantly different.

On day 2, the mean radial growth in cm at 100% concentration levels of *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum* are 26.5, 18.25 and 33.75 respectively. At 100%, 75% and 50% there were no difference in radial growth of *Aspergillus niger* and *Penicillium notatum*. Also, no significant difference in radial growth was obtained at 75% and 50% with *Fusarium oxysporum*. *Penicillium notatum* was only significant at only 12.5% concentration.

On day 3, the mean radial growth in cm at 100% concentration levels are 34.30, 27.25 and 52.00 for *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum* respectively. At 12.5% concentration level, the mean radial growth of *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum* are 43.7, 33.5 and 62.30 respectively. There was a significant difference in

the radial growth recorded at 100%, 75% and 50% concentration for the three fungi while only *Penicillium notatum* was significantly different at 25 and 12.5% concentration. On day 4, the mean value for radial growth in cm for *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum* at 100% level of concentration are 52.5, 34.5 and 68.00 respectively. There was a significant difference at all levels of concentration. However, there

was no significant difference in the radial growth at 75, 50, 25 and 12.5% concentration for both *Fusarium. Oxysporum* and *Penicillium notatum*. The highest mean value for the three fungi was recorded at 12.5% concentration for *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum* which gave 59.50, 39.00 and 73.00 respectively.

Table 3: Duncan multiple range test on effect of *Spondias mombin* bark extract against radial growth of fungi

Day Interval	Concentration Level (%)	<i>Aspergillus niger</i>	<i>Fusarium oxysporum</i>	<i>Penicillium notatum</i>
1	100	10.50 ± 1.04 <sup>ab</sup>	9.75 ± 0.48 <sup>a</sup>	11.75 ± 0.63 <sup>abc</sup>
	75	10.75 ± 0.48 <sup>ab</sup>	10.75 ± 0.95 <sup>ab</sup>	14.00 ± 0.41 <sup>ab</sup>
	50	11.25 ± 0.63 <sup>ab</sup>	11.00 ± 0.71 <sup>ab</sup>	15.50 ± 0.50 <sup>ab</sup>
	25	11.50 ± 0.66 <sup>ab</sup>	11.75 ± 0.63 <sup>abc</sup>	18.25 ± 0.25 <sup>e</sup>
	12.5	12.50 ± 0.96 <sup>bc</sup>	12.00 ± 0.95 <sup>abc</sup>	21.25 ± 0.63 <sup>e</sup>
	Control	14.20 ± 1.17 <sup>d</sup>	14.00 ± 0.62 <sup>d</sup>	24.00 ± 1.08 <sup>f</sup>
2	100	26.50 ± 1.19 <sup>d</sup>	18.25 ± 0.45 <sup>a</sup>	33.75 ± 0.63 <sup>fg</sup>
	75	26.75 ± 0.85 <sup>d</sup>	19.75 ± 1.65 <sup>ab</sup>	34.00 ± 0.41 <sup>fg</sup>
	50	27.25 ± 1.65 <sup>d</sup>	20.00 ± 1.47 <sup>ab</sup>	34.25 ± 0.85 <sup>fg</sup>
	25	28.50 ± 0.66 <sup>de</sup>	22.00 ± 1.47 <sup>b</sup>	34.75 ± 1.11 <sup>fg</sup>
	12.5	31.25 ± 2.50 <sup>ef</sup>	22.75 ± 0.75 <sup>bc</sup>	36.50 ± 0.87 <sup>g</sup>
	Control	33.00 ± 0.90 <sup>fg</sup>	25.20 ± 2.04 <sup>bd</sup>	38.70 ± 0.71 <sup>g</sup>
3	100	34.50 ± 2.10 <sup>bc</sup>	27.25 ± 1.44 <sup>a</sup>	52.00 ± 1.08 <sup>f</sup>
	75	37.25 ± 1.65 <sup>d</sup>	28.00 ± 0.82 <sup>a</sup>	54.75 ± 2.32 <sup>fg</sup>
	50	40.25 ± 3.68 <sup>de</sup>	30.50 ± 0.87 <sup>ab</sup>	56.00 ± 0.42 <sup>fgh</sup>
	25	41.00 ± 1.73 <sup>de</sup>	31.00 ± 0.71 <sup>ab</sup>	58.75 ± 1.49 <sup>ghi</sup>
	12.5	41.25 ± 1.11 <sup>de</sup>	32.00 ± 0.91 <sup>ab</sup>	60.25 ± 1.38 <sup>hi</sup>
	Control	43.70 ± 0.83 <sup>e</sup>	33.50 ± 0.43 <sup>bc</sup>	62.30 ± 0.88 <sup>i</sup>
4	100	52.50 ± 5.33 <sup>c</sup>	34.50 ± 1.66 <sup>a</sup>	68.00 ± 3.37 <sup>e</sup>
	75	52.75 ± 1.29 <sup>c</sup>	35.50 ± 0.66 <sup>ab</sup>	68.75 ± 1.49 <sup>ef</sup>
	50	53.00 ± 1.29 <sup>c</sup>	36.25 ± 1.32 <sup>ab</sup>	69.50 ± 9.60 <sup>ef</sup>
	25	57.75 ± 1.03 <sup>cd</sup>	38.00 ± 0.71 <sup>ab</sup>	71.25 ± 2.18 <sup>ef</sup>
	12.5	59.50 ± 1.23 <sup>d</sup>	39.00 ± 1.08 <sup>ab</sup>	73.00 ± 1.47 <sup>ef</sup>
	Control	62.50 ± 0.40 <sup>d</sup>	42.10 ± 1.20 <sup>b</sup>	75.10 ± 1.38 <sup>e</sup>

\* Mean of four replicates ± Standard error. Values in the same column with different letters in superscripts are significantly different at ( $p \leq 0.05$ )

#### 4. DISCUSSION

The fungitoxic effects of *Spondias mombin* stem bark extract on the microorganisms further confirms the importance of organic plant materials as a source of wood fungicide and alternative preservative material for combating wood deteriorating fungi. The result of quantitative phytochemical screening showed the presence of bioactive phytochemicals such as Alkaloid, Flavonoid, Lignin, Saponin and Tannin. Therefore, extracts from plants contain antifungal compounds that can be used as an alternative to synthetic fungicides, including fumigants and contact pesticides (Prakash and Rao 1997). According to Okwu (2005 and 2004), the active constituents contributing to antifungal properties are the phytochemicals. The stem bark extract of *Spondias mombin* had significant effect on fungal colony

count. This is in line with the finding reported by Okwu and Emenike (2006) that phytochemicals are reserved in plants to protect the plant against the attack and invasion of microorganisms. The highest inhibitory effect of extract was on *Fusarium oxysporum* followed by *Penicillium notatum* and then *Aspergillus niger*. Control experiment showed the complete inhibition of *Aspergillus niger*, *Fusarium. oxysporum* and *Penicillium notatum*. This is as a result of supplementary chemical fungicide like Ketoconazole, which completely inhibited fungi growth. However, according to Okwu (2003) the application of chemical fungicide has resulted in pollution of the environment affecting biological organism and causing environmental hazards. The antifungal activities varied from one microorganism to the other. The differences recorded may be due to the fact that the inhibitory ingredient in the chemical composition

of each of the organisms vary. There was a reduction of fungal colony count with increase in concentration and there were significant differences in the different levels of concentration between *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum*. This is in support of Manoranjitham *et al.* (2011) and Narayana *et al.* (2001) that a variation on fungicidal properties of plant extract against fungi may be due to considerable variation in their constituents and variation in fungal species itself.

Fungal radial growth at different levels of concentration showed the mean radial growth increased from highest concentration to the least with control experiment having the highest radial growth. 100% concentration of stem bark extract had the most effective impact on *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum*. The result obtained is in consonance with the work of Enikuomehin and Kehinde (1998), Adetogun and Adeyeye (2002), Singh *et al.* (1993) and Ogunjobi *et al.* (2014). Some researchers have suggested that antimicrobial components of the plant extracts cross the cell membrane interacting with the enzymes and proteins of the membrane, so producing a flux of protons which induces change in the cell and ultimately their death. (Pane *et al.* 2011 and Omidbeygi *et al.* 2007). Other researchers attributed the inhibitory effects of these plant extracts to hydrophobicity characters of these plant extracts and their components. This enables them to partition in their lipids of the fungal cell wall membrane and mitochondria distribution, disturbing their structure and rendering them more permeable. Leaking of ions and other cell contents can then occur causing cell death (Burt 2004).

## 5. CONCLUSIONS

From the results and findings of this study, the following conclusions could be drawn:

1. The stem bark extract of *Spondias mombin* possess fungicidal properties which inhibit the actions of *Aspergillus niger*, *Fusarium oxysporum* and *Penicillium notatum*.
2. The extract would make a good alternative to synthetic preservatives.
3. The concentration level of the extract had influence on its efficacy.
4. At 100% level of concentration, this extract was able reduce fungal count and fungal radial growth.
5. The highest inhibitory effect of extract was on *Fusarium oxysporum*.

## REFERENCES

Adetogun AC and Adeyeye OA (2002). Aqueous leaching of Cashew Nut Shell Liquid (CNSL) treated

- wood of *Triplochiton scleroxylon* K Schum exposed to Basidiomycetous decay fungi. *Journal of Tropical Forestry*. Vol 18(1) 69-74.
- Amadi ES, Nwakpu K, Nworie O and Ogbu O (2004). Evaluation of the in vitro effects of some medicinal plants on Escherichia coli. *J. Health Visual Sci.*, 6: 176-179.
- Amadioha AC and Obi VI (1998). Fungitoxic activity of extract from *Azadirachta indica* and *Xylopiya aethiopia* on *Colletotrichum lindunuthia* in cowpea. *Journal of Herbs, Spices and Medical plants*. 6:33-40.
- Astiti NPA and Suprpta DN (2012). Antifungal activity of Teak (*Tectona Grandis*) Leaf extract against *Arthrinium Phaeospermum* (CORDA) M.B. ELLIS, The cause of wood decay on *Albizia falcataria* (L.) Fosberg. *Journal of International Society for Southeast Asian Agricultural Science (ISSAAS)*., 18: 62-69.
- Bohm BA and Kocipai- Abyazan R (1994). Flavonoid and condensed tannins from the leaves of *Vaccinium raticulation* and *Vaccinium calycium* . *Pacific Sci.*, 48: 458-463.
- Burt S. (2004). Essential oils, their antimicrobial properties and potential application in food. A review. *Int. J. Food Microbiol.* 94: 223-253
- Castillo F, Hernandez D, Gallegos G, Mendez M and Rodriguez R (2010). In vitro antifungal activity of plant extracts obtained with alternative organic solvents against *Rhizoctonia solani* Kuhn. *Industrial Crops and Products Journal.*, 32: 324-328.
- Downum KR, Romeo JT and Sataford HA (1993). Phytochemical potential of Tropical plants. Plenum Press. New York.
- Enikuomehin OA and Kehinde LA (1998). Fungitoxic potentials of ash from plants of Nigeria. *Journal of Tropical Ethno-forestry* 1(1), 65-70. ISN 1595-5168.
- Harborne JB (1973). Methods of plant analysis. In: Phytochemical Methods. Chapman and Hall, London.
- Manoranjitham SK, Prakasam V, Rajappan K (2001). Biocontrol of damping off of tomato caused by *Pythium aphanidermatum*. *Ind. Phytopathol.* 54: 59 - 61
- Narayana Bhat M and Shukla BK (2001). Evaluation of some leaf extract against *Pythium aphanidermatum* In-vitro and pot culture. *Ind. Phytopathol* 54:395 – 397
- Ogunjobi KM, Adetogun AC and Ahmed SO (2014). Evaluation of Fungicidal Effects of *Jatropha curcas* L Leaf Extract on *Aspergillus niger* (Van Tieghem) and *Trichoderma Ingibrachiatum* (Rifai). *J. of Trop. For. Res.* 30(2) 62-68
- Okwu DE (2003). Investigation into the medicinal and nutritional potential of *Garcinia kola* Heckel and *Dennettia tripetala* G. Baker, Ph.D Thesis. Michael

- Okpara University of Agriculture, Umudike, Nigeria. P 4-5
- Okwu DE (2004). Phytochemicals and Vitamins Content of Indigenous Species of South Eastern Nigeria. *Journal of Sustainable and Agriculture and Environment*. 6, 30-37
- Okwu DE (2005). Phytochemicals and Vitamins and Mineral Content of two Nigerian Medicinal Plants. *International Journal of Molecular Medicine and Advance Sciences*. 1, 375-381.
- Okwu DE and Emenike IN (2006). Evaluation of the Phytonutrients and Vitamins Content of Citrus fruits. *International Journal of Molecular Medicine and Advance Sciences*. 2, 1-6.
- Obadoni BO and Ochuko PO (2001). Phytochemical studies and comparative efficacy of the crude extract of some homeostatic plants in Edo and Delta states of Nigeria. *Global J. Pure Appl. Sci.*, 8: 203- 20
- Omidbeygi M, Barzegar M, Hamidi Z and Naghdibadi H. (2007). Antifungal Activity of thyme, summer, savory and clove essential oils against *Aspergillus flavus*, in liquid medium and tomato paste. *Food Control*. 18: 1518-1523.
- Pane C., Spacciini R., Picollo A., Scala F., Bonanomi G., (2011) : Compost Amendments in enhanced peat suppressiveness to *Pythium ultimum*, *Rhizoctonia solani* and *Sclerotinia minor*. *Biol. Control*. 56:115 – 124.
- Pengelly A (2004). Constituents of medicinal plants: An Introduction to the Chemistry and Therapeutics of herbal medicine, second ed. CABI Publishing, United Kingdom and United State of America. Pp 233-323
- Prakash A and Rao J (1997). Botanical pesticides in Agriculture. CRC Press Florida USA 461p
- Priadi T (2005). Wood decay by fungi and the control strategy. Scientific paper. School of Postgraduate Bogor Agricultural University, Bogor Indonesia (in Indonesian language). 24:121-143
- Singh J (2010). Timber decay. Available from [www.buildingconservation.com](http://www.buildingconservation.com)
- Singh SK and Mathur, A. (1993). Fungitoxicity of some higher plants against *Rhizoctonia solani* plant and soil. 72:91-94.
- Wikipedia, (2014) *Spondias mombin*