Survey of Biodegrading Agents in Logs and Planks in Selected Sawmills and Timber Markets in Ibadan Oyo State, Nigeria

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Abstract

Biological deterioration of wood is one of the major challenges on wood utilization especially in tropical countries like Nigeria. This is because of the favourable weather condition for the bio-deteriorating agents to thrive. This study is therefore carried out to investigate the biodegrading agents of logs in sawmills and planks in plank markets in Ibadan, Nigeria. Data for the study were collected using checklist, and laboratory examination of collected samples from decayed logs and planks. The data obtained were subjected to descriptive statistics. The results of the laboratory examination revealed that a variety of fungi moulds, namely *Aspergillus flavus* Fredrick Link, *Aspergillus niger* VanTieghem, *Botryodiplodia theobromae* Pat, *Trichodermalongi brachiatum* Rifai, *Penicillium oxalicum* Currie and Thom, *Rhizopus stolonifer,(*Ehrenb.ex Fr)., that are not host specific were encountered. *Botryodiplodia theobromae* Pat, was present in all the three sawmills and two timber markets while *Aspergillus flavus* Fredrick Link and *Aspergillus niger* VanTieghem, were present in only one sawmill (Moniya). The order Coleoptera and Isoptera were the two prominent insect pest groups identified. These were from seven families out of which five species of insects namely Termites, Beetles, Borers, Weevils and Carpenter ants were identified. The degree of molds growth on the surface of the wood is an indication that the conditions are favourable for wood decay to occur. It is therefore recommended that logs should be properly handled during log storage and processing in the mills by keeping the environment clean. Processed timbers should also be arranged in such a way that there will be free flow of air within stacked timber.

Keywords: Biodegradation, Pathogen, Insects, Fungi

Introduction

Wood as one of the most valuable and a versatile resource for all sorts of constructional purposes has been in use as a building material for over 400,000 years. It is the most common and best known material for house construction because it is easy to form, saw, nail and fit; even with simple hand tools (RMRDC, 1998). The high strength to weight ratio and the ease to work with has made wood to be very useful where only basic technology and procedures are available (Lucas 1997, Apu, 2003). Consequently, it has become one of the most widely used materials and it is found in large quantities in Nigeria. Wood is a porous, permeable, hygroscopic, orthotropic, biological, composite material of extreme chemical diversity and physical properties. It is therefore a renewable, reusable, recyclable material with excellent performance in structural applications (Bryan *et al*., 1991; FRW, 2006; Morris,1998; Sarker *et al*.,2006; *Lucas,*1997, Omole 2000).

Wood is a product of biological process. Therefore, it is thus a source of food to a lot of organisms specifically fungi, insects, bacteria, etc (Morris, 1998). Due to its origin, wood in living trees and also wood in service are highly susceptible to decay and decomposition resulting from attack by organisms termed 'biodegradation of wood'. Biodegradation is dependent upon many factors amongst which are temperature, microbial population, degree of acclimatization, accessibility of nutrient, cellular transport properties and chemical constituents of growth medium (Mohebby, 2003). The ability of timber species to resist biological degradation for a period of time is known as 'natural durability' or 'natural resistance'; it is determined by how long the heartwood is able to resist attack by specific types of wood destroying organisms (Wong *et al*., 2005).

Microscopic organisms that discolour and decay wood belong to the huge group of primitive plants known as fungi (Tanaka *et al*., 2006). Fungal wood decay can be recognized macroscopically by colour and textural changes and microscopically by characteristic hyphae features, boreholes and cell wall erosion (Tanaka *et al*., 2006). The fungi colonize wood in almost every possible habitat, they are natures' scavengers, consuming unwanted (sometimes harmful) and wanted materials (Hudson, 1992). Insect pest which are smaller invertebrate herbivores are capable of damaging plants and also constitute a great threat to timber and timber production (Beal, 1981). Biodeterioration in wood species is common and alarming in the tropics because of the warm and humid climate condition, and as a result, it has given rise to the great diversity of fungi, insects and other biodegrading agents in this region (Arun*et al*, 2006). While the diversity of most of these microorganisms tend to increase in

the tropics, detailed studies on their spread in sawmill and timbers shed are only in their infancy (Isaac *et al.*, 1993).

The negative effects of these microorganisms have rendered timber structures less sustainable. An annual loss of billions of US dollars was reported by the Environmental and Energy Study Institute (2006), and it was reported that more than 5% of all the construction timbers in United States were used to replace timbers that have decayed in service due to microorganisms' attacks. Losses of 15-20% marketable wood volume in standing timber and 10-15% in wood products during storage and conversion have been reported (Blanchette, 2005; Hickman and Perry,2003; Morris,1998, Sarker*et al.*,2006; Smulski,1996). The above statistics is expected to be more in tropical Countries like Nigeria because the climatic condition is more favourable to the activities of these biodegrading agents.

This study was therefore carried out to investigate the fungi and insect pest problems on logs and planks in selected sawmills and timber markets in Ibadan, Oyo State Nigeria with a view to documenting the spread and diversity of these biodegrading agents and to assess any significant relationship between their diversity and abundance with the level of damage and suggest control measures.

Materials and Methods

Study Area

The study was carried out in Ibadan, the capital of Oyo State, Nigeria. Ibadan is located approximately on Longitude $3^0 54^0$East and Latitude $7^0 23^0$ North. The climate of Ibadan is tropical and characterized by two seasons every year (wet and dry seasons). The rainy season starts from late March and ends in October/November, while the dry season starts from November and ends in March. The peak of rain fall is usually in the month of September. The total annual rainfall from January to December is 1322.3mm with the total number of rainy days put at approximately 120 days/year with a mean annual temperature of 22.4^0 C and mean minimum and maximum relative humidity of 54% and 97% respectively. The annual evaporation potential is 1334mm (Zakaria, 2002).

Sample Population/Sampling Technique and Sample Size

During the reconnaissance survey, it was observed that the number of sawmills in Ibadan has drastically reduced, with just a few functioning sawmills left and these were the sawmills sampled; Fasunle Sawmill at Moniya, 30-30 Sawmill at Old Ife Road, and Forestry Research Institute of Nigeria (FRIN) in Jericho, while the plank markets were Bodija and Sango plank markets because they are the two major plank markets in Ibadan metropolis. The study population therefore comprised of the three functioning sawmills and the two plank markets in Ibadan metropolis, Oyo State, Nigeria.

Methods of Data Collection

Culturing and identification of fungal pathogens on the logs and planks

In each location, samples of decayed logs were collected. The criteria for collection were based on unusual colours/stains and fruiting bodies on the logs and planks. The samples collected were chipped off from the affected areas and the fruiting bodies were removed. There were unequal number of species of logs and planks in each location. Collection of samples from a particular species depended on the number of the affected logs in any particular location, a minimum of one (1) and a maximum of three (3) samples were collected and reported for each study site. Bodija plank market had one thousand five hundred (1500) sheds, for convenient collection of samples; it was divided into ten (10) sections, from each of these sections, five (5) sheds were visited for sample collection. Sango plank market had five hundred (500) sheds; it was divided into five (5) sections for convenience. Though, there was unequal number of sheds in each section, collection was carried out in five (5) different sheds. Samples measuring 20x20x20mm were sawn out and put in polythene bags. In the laboratory, chips were cut out from the affected spot and prepared for inoculation. The samples were cultured in the pathology laboratory of Forestry Research Institute of Nigeria (FRIN), Ibadan and identification of the pathogens was carried out at the International Institute for Tropical Agriculture (IITA), Ibadan laboratory and also verified with a fungi identification book in accordance with Barnett and Hunter (1985).

Procedures in Culturing

Preparation of Potato Dextrose Agar (PDA) and Inoculation of wood samples

39g of PDA was dissolved in 1000ml (1 litre) of sterile distilled water. It was sterilized in an autoclave of 121°c for 15 minutes and allowed to cool a little.1ml of lactic acid was added to the PDA solution and stirred gently until it dissolved; this was to eliminate any bacteria. The micro-flow was sprayed with 99% ethanol and swabbed also with cotton wool soaked in 99% ethanol to reduce contamination. Spirit lamp was placed inside the micro-flow and it glowed with 99% ethanol. Hands sterilized with ethanol and the petri dishes were also swabbed with 99% ethanol to reduce contamination.15ml of PDA was poured into each plate and allowed to solidify for 20- 25 minutes. Inoculation of the wood samples was done very close to the glowing spirit lamp, to reduce contamination. After inoculation, the dishes were sealed with a masking tape and labeled, then, they were kept in an incubator for 3-4 days to allow for growth.

Sub- culturing

Individual pathogens were sub-cultured to get pure cultures depending on the growth rate of the pathogen it took as long as a week before identification. The cultures were put on slides and identified under a microscope and also cross-checked with fungi identification books; (Barnett and Hunter, 1985) with the assistance of a forest pathologist in FRIN.

Determination of Frequency of Occurrence of Isolates

To determine frequency of occurrence of isolates, records of the organisms isolated from the plant species in the different locations were kept for 4-5 days. Since isolation and characterization were carried out across all the five locations, the number of times each organism was isolated from each species per location was expressed as a percentage of the total different organisms from all the locations (Okigbo and Ikediugwu, 2000).This was calculated thus:

% frequency of occurrence = $\frac{T}{N} \times \frac{100}{1}$

Where, T=Number of times of occurrence of the individual isolate per species in the locations.

N=Total number of microorganisms isolated per species in the locations.

Determination of Percentage Decay in the Five Locations

Calculation of the percentage decay in a particular location was determined by subtracting the infected logs from the uninfected logs and dividing by the uninfected logs expressed as a percentage in line with method used by Okigbo and Ikediugwu(2000).

$\frac{X-Y}{X} \times \frac{100}{1}$

Where, X = uninfected logs and Y = infected logs

Insect Collection and Identification

Collection was carried out alongside with fungi collection. Hand picking method was used. Most insects were detected easily by the holes they made on the logs and planks and some just underneath the bark of some logs in the sawmills. Some were also collected during log conversion in the sawmills. Insects picked were kept in McCartney bottles and those alive were put in the bottles containing cotton wool soaked in chloroform for the insects to gently die. Identification of the insects was done in the Entomology Department of Forestry Research Institute of Nigeria (FRIN) Ibadan.

Data Analysis

Data collected were analyzed using descriptive statistics such as tables, percentages, frequency, and bar charts.

Results and Discussion

From the five selected sawmills and plank markets in Ibadan metropolis, seven different pathogens were identified: *Aspergillus flavus* Fredrick Link, *Aspergillus niger* Van Tieghem, *Botryodiplodia theobromae* Pat, *Trichodermalongi brachiatum* Rifai, *Penicillium oxalicum* Currie and Thom, *Rhizopus stolonifer,* (Ehrenb.exFr). *Botryodiplodia theobromae* was present in all the five locations, *Rhizopus stolonifer, was* present in four locations, *Fusarium oxysporum, Penicillium oxalicum* and *Trichodama longibrachiatum* were present in three locations while *Aspergillus flavus* and *Aspergillus niger* were the least in just one location(Table 1).

Table 1: Frequency of Fungi Pathogens Isolated from Decayed Wood from the study area

PATHOGENS	SAWMILLS			PLANK MARKETS	
	Moniya	FRIN	Old-Ife	Bodija	Sango
A. flavus	1.5	0	0	0	0
A.niger	4.6	0	0	0	0
B. theobromae	40.9	10.5	23.8	36.1	11.6
T.longibrachiatum	0	3.1	7.1	0	2.3
P.oxalicum	0	3.1	0	14.8	7.1
F.oxysporum	4.6	0	14.3	9.8	0
R.stolonifer	16.7	52.2	0	8.2	39.5

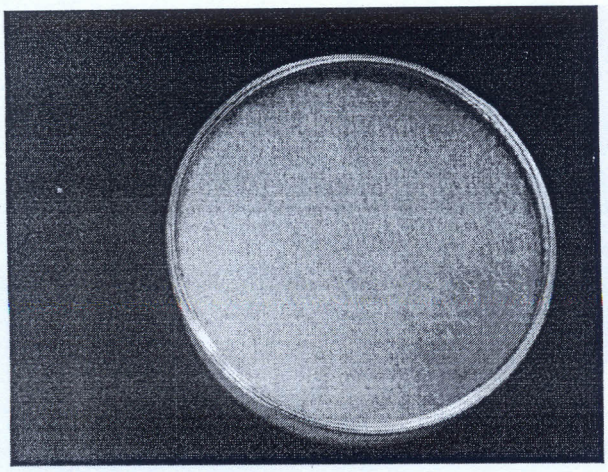


Plate 1: *Rhizopus stolonifer*

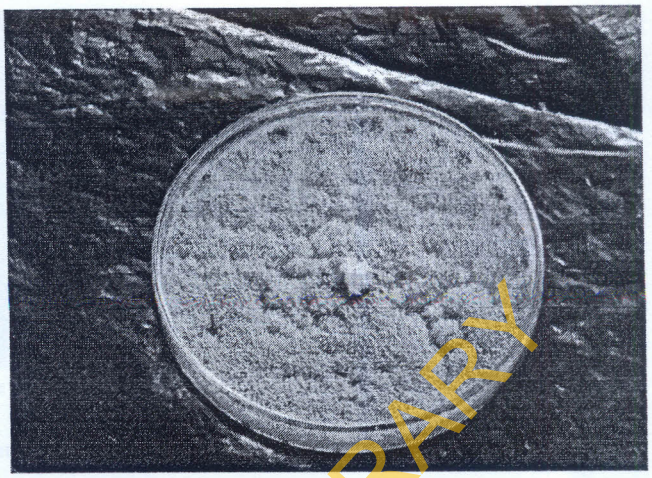


Plate 2: *Aspergillus niger*

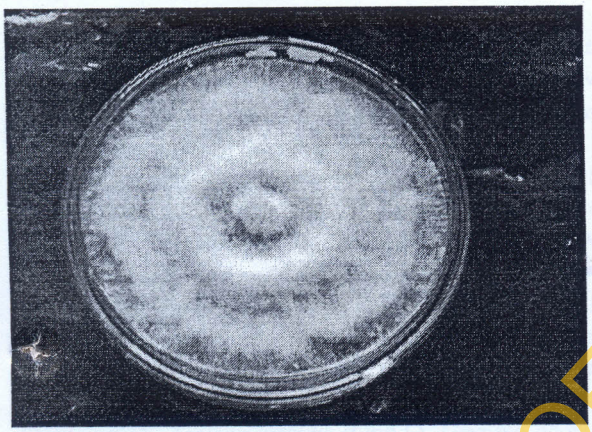


Plate 3: *Fusarium oxysporum*

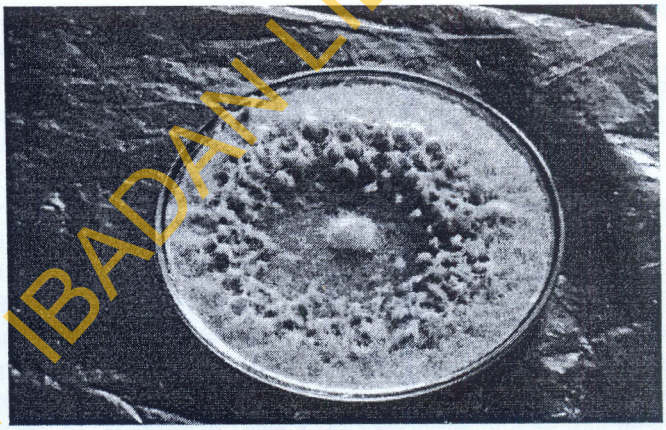


Plate 4: *Aspergillus flavus*

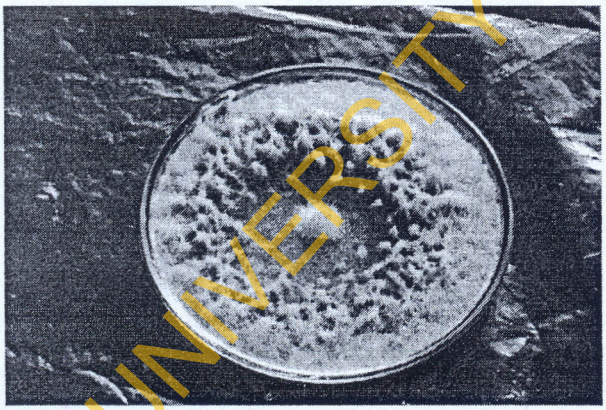


Plate 5: *Botryodiplodia theobromea*

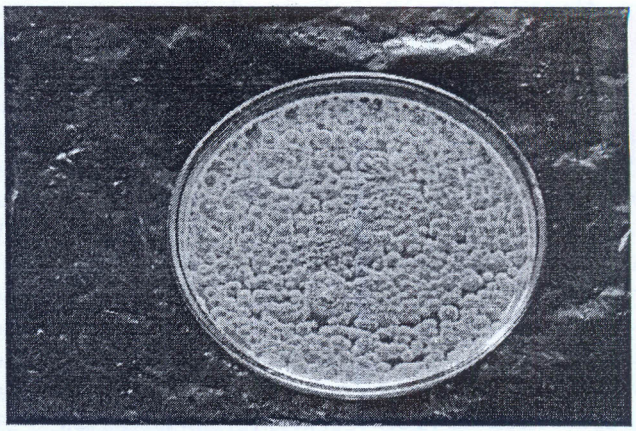


Plate 6: *Penicillium oxalicum*

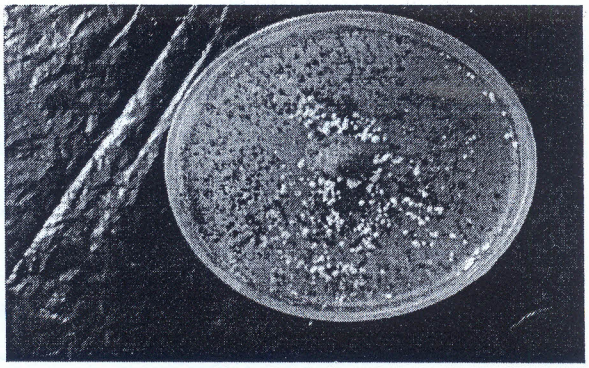


Plate 7: *Trichodama longibrachiatu*

Plates 1-7: Pure cultures of the fungi pathogens identified from decayed logs/wood in sawmills and planks market in Ibadan.

At Moniya sawmill, the species of log affected in this location were; *Ceiba pentandra*(Linn.) Gaertn., *Albizia zygia* (DC.) J.F.Macbr., *Antiaris africana* Engl., *Tectona grandis*(Linn.f.),*Milicia excelsa (Welw.) C.C., Cola acuminata (P. Beeauv).* The pathogens identified on these logs were *B. theobromae, R. stolonifer, A. flavus, A. niger, F. oxysporum. T. longibrachiatum and P. oxalicum*were absent as shown in Table 2. The species and percentages of organisms present in these locations were; A. *flavus* 1.5%, A. *niger* 4.6%, *B. theobromae* 40.9%, *F. oxysporum*4.6%, *R. stolonifer*16.7% while *T. longibrachiatum and P. oxalicum* were absent. It was also observed that *B .theobromae* had the highest percentage infection (40.9%), followed *R. stolonifer (16.7%), F. oxysporum* and *A. niger* (4.6%) and *A.flavus had the least of (1.5%).*The species affected among those collected from FRIN were *Milicia excelsa (*Welw.) C.C., *Tectona grandis (*Linn.f.), *Gmelina aborea* Roxb., *Antiaris toxicaria* Engl., *Terminalia superba* Engl. and Diels, *Ceiba pentandra* (Linn.) Gaertn and *Triplochiton scleroxylon* K.Schum. The pathogens identified on these logs were *B. theobromae, T. longibrachiatum, P.oxalicum, R. stolonifer. A. flavus,* and *A. niger* While *F. oxysporum* was absent. This is shown in Table 3.The percentages of organisms present in this locations were; *B .theobromae* 10.5%, *F. longibrachiatum 3.1%, P. oxalicum 3.1%, R. stolonifer 52.2%.*(Fig 2).*R. stolonifer* was highest with (52.2%) followed by *B. theobromae (10.5%), T. longibrachiatum* and *P. oxalicum* had (3.1%) respectively.

At old Ife road, the decaying species included; Ceiba pentandra (Linn.)Gaertn., Milicia excelsa (Welw.) C. C *Ficus mucuso* Welw.ex Ficalho, *Tectona grandis (*Linn.f.), *Ficus thonningii, Blighia sapida* Konig, *Antiaris toxicaria Engl.* The pathogens identified on these logs were, *B. theobromae, F. oxysporum* and *T. longibrachiatum. A. flavus, A. niger, F. oxysporum* and *R. stolonifer* were absent. This is shown in Table 4.

The percentages of organisms present in these locations were; *Botryodiplodia theobromae 23.8%, Trichodama longibrachiatum 7.1%, Fusarium oxysporum14.3%.* The study revealed that *Botryodiplodia theobromae* had the highest of 23.3% and this was followed by *F. oxysporum* (14.3%) and *Trichodama longibrachiatum* (7.1%).

Plank Markets

At Bodija plank market the following wood species were those affected; *Antiaris africana* Engl, *Triplochiton scleroxylon* K. Schum., *Phyllantus muellerianus, Celtis integrifolia, Daniellia oliveri* (Rolfe) Hutch. And Dalz, *Terminalia superb* Engl. and Diels, *Entandrophragma utile.* The pathogens identified on the logs were; *B. theobromae, P. oxalicum, F. oxysporum,* and *R. stolonifer. A. flavus, A .niger,* and *T .longibrachiatum* were absent as shown in Table 5.The percentages of organisms present in this location were; *B. theobromae* 84.6%, *P .oxalicum 64.3%, F. oxysporum 60%, R. stolonifer71.4%* while *A. flavus, A. niger, and T .longibrachiatum* were absent. *B .theobromae* had the highest (36.1%), followed by *P. oxalicum*(14.8%), *F. oxysporum (*9.8%) and *R .stolonifer* (8.2%).

While the species affected at Sango plank market were; *Antiaris africana* Engl.,*Cordia* millenii, *Afzelia africana, Gmelina aborea* Roxb., *Blighia sapida* Konig, *Delonix regia*(Hook), *Nesogrodonia papaverifera.* The organisms identified on the logs were; *B .theobromae, R. stolonifer, P. oxalicum, and T. longibrachiatum. A. flavus, A.* niger and *F. oxysporum* were absent as shown in Table 4. The percentages of organisms present in this location were; *B. theobromae* 11.6%, *T .longibrachiatum* 2.3%,*P.oxalicum* 7.1%, *R. stolonifer* 39.5%.(Fig 5).*R. stolonifer* was highest with (39.5%), followed by *B. theobromae* (11.6%), *P. oxalicum* (7.1%) and *T. longibrachiatum (*2.3%).

Table 2: Fungi Pathogens identified on Various Decayed Wood Species in Moniya

Wood species	Fungi species
Ceiba pentandra	*R. stolonifer and B.theobromae.*
Albiziazygia	*B.theobromae.*
Antiaris toxicaria	*R. stolonifer.*
Milicia excelsa	*B.theobromae, R. stolonifer.*
Tectona grandis	*B.theobromae, A. flavus*
Triplochiton scleroxylon;	*B.theobromae, A. niger, F. oxysporum.*
Cola acuminata	*B.theobromae.*

Table 3: Fungi Pathogens identified on Various Decayed Wood Species in FRIN

Milicia excels	*R.stolonifer, B theobromae, P.oxalicum.*
Tectonagrandis	*B.theabromae, R.stolonifer.*
Gmelinaaborea	*R.stolonifer.*
Antiaristoxicaria	*R.stolonifer.*
Terminaliasuperba	*R.stolonifer.*
Ceibapentandra	*B. theobromae, R. stolonifer, P. oxalicum, T. longibrachiatum.*
Triplochiton scleroxylon	*R. stolonifer.*

Table 4: Fungi Pathogens identified on Various Decayed Wood Species in Old Ife

Tree species	Fungi present
Ceiba pentandra	*Nil*
Milicia excelsa	*Nil*
Ficus mucuso	*B.theobromae, F. oxysporum.*
Tectona grandis	*F. oxysporum, T.longibrachiatum*
Ficus thonningii	*B.theobromae*
Blighia sapida	*B.theobromae*
Antiaris toxicaria	*Nil*

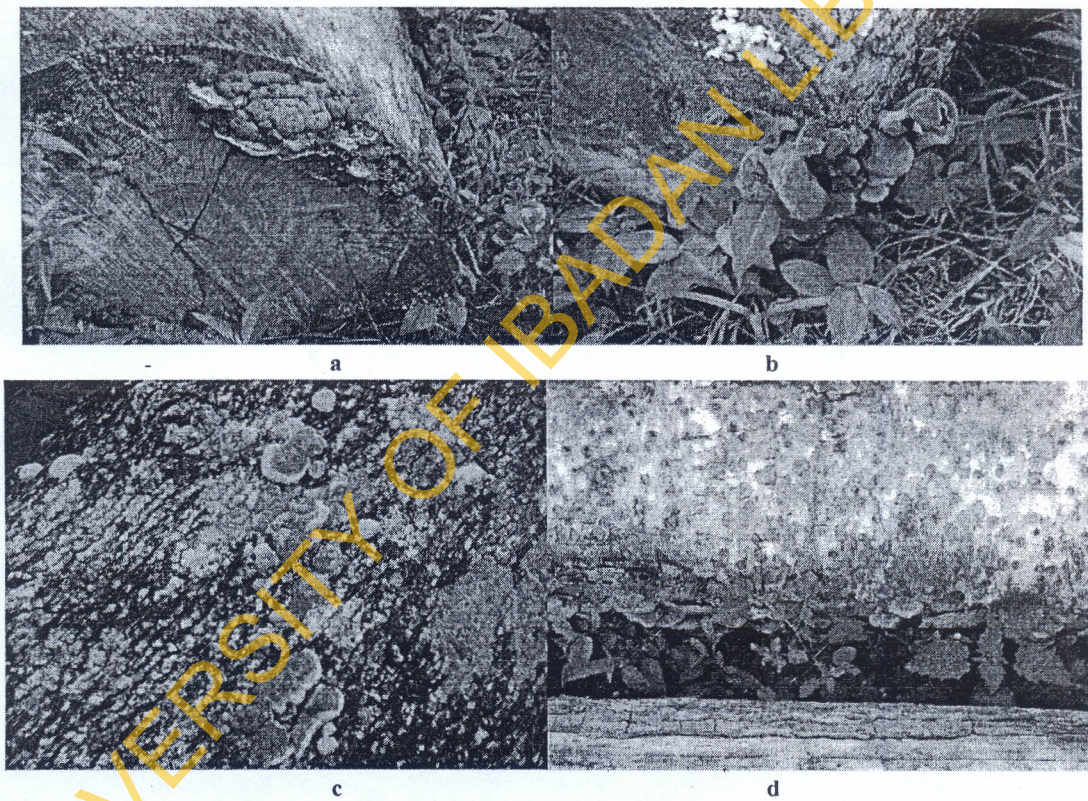
Table 5: Fungi Pathogens identified on Decayed Wood Species in Bodija.

Wood species	Fungi identified
Antiaris toxicaria	*B.theobromae, P.oxalicum.*
Triplochiton scleroxylon	*B.theobromae, R.stolonifer.*
Phyllanthus muellerianus	*B.theobromae, R.stolonifer.*
Celtis integrifolia	*F. oxysporum, B.theobromae, P.oxalicum.*
Daniellia oliveri	*B.theobroma, F. oxysporum.*
Terminalia superba	*Nil.*
Entandrophragma utile	*B.theobromae, P.oxalicum.*

Table 6: Fungi Pathogens identified on Decayed Wood Species in Sango.

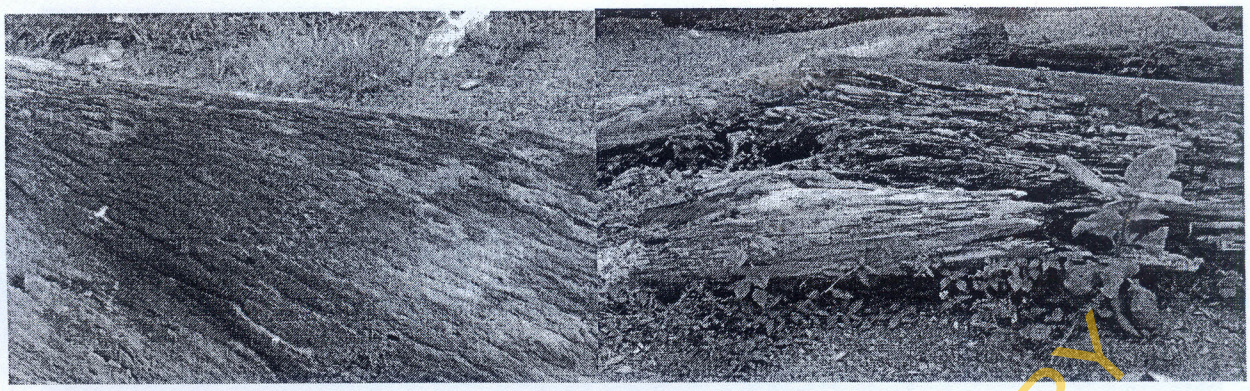
Wood species	Fungi identified
Antiarist oxicaria	*B.theobromae, R.stolonifer.*
Cordia milleni	*B.theobromae, R.stolonifer.*
Afzelia africana	*P.oxalicum, R.stolonifer.*
Gmelina arborea	*R.stolonifer.*
Blighia sapida	*Nil.*
Delonix regia	*Nil.*
Nesogrodonia papaverifera	*R.stolonifer, T.longibrachiatum.*

The percentage decay in the five locations, in descending order indicated that FRIN had the highest with 20.3%, this is followed by Moniya (16.9%), Bodija (4.2%), Sango (2.1%) and Old Ife road (0.67%). These percentages were low, less than 50%. Pictures in plates 1 and 2 (a-d) show some macro-fungi encountered on the wood spices while plate 3 is on insect infestation of the wood species in the Sawmills and Plank Markets in the study locations.

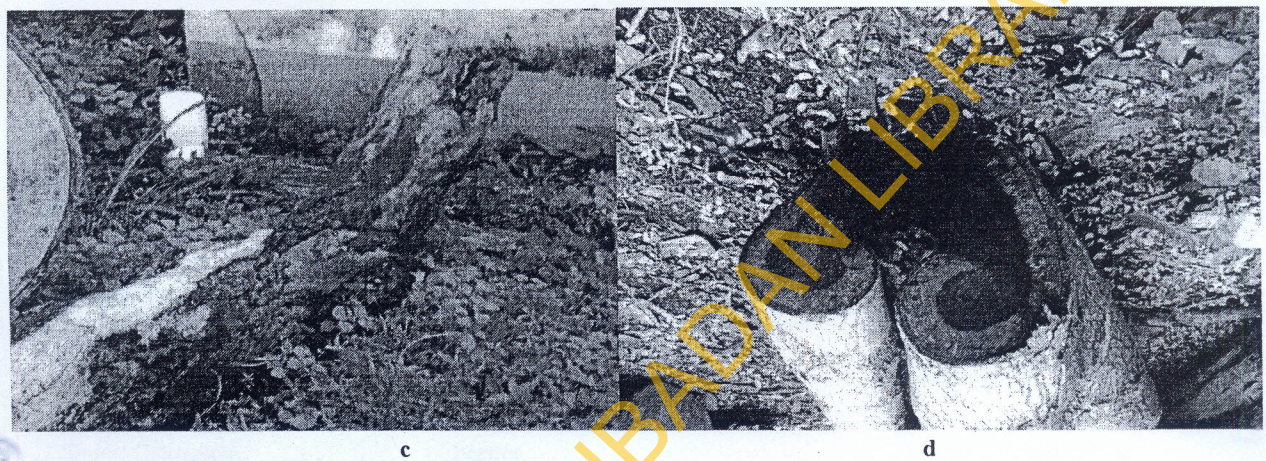


a b c d

Plate 1: Fruiting bodies of Fungi on some of the logs (a, b, c & d)

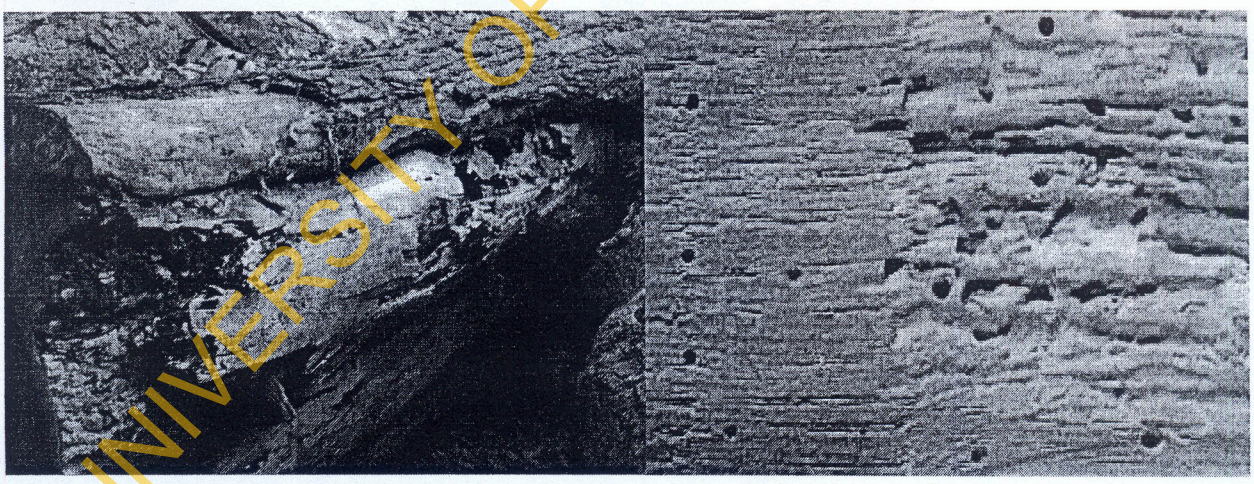


a b

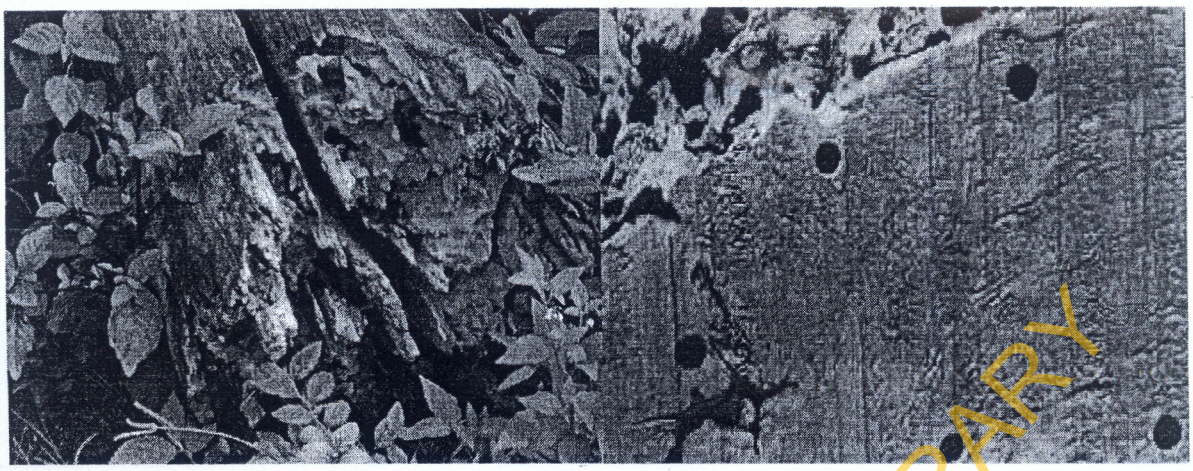


c d

Plate 2: Wood colourations and decay in the study area (a, b, c, d)



a b



c d

Plate 3 (a, b, c, d): Insect infestation on logs in a sawmill

Table 8 Insects and their Hosts tn the Study Area

Insects	Common name	Host
Termites Order: Isopetra Family: Termitidae, Rhinotermitidae	Termites	*Milicia excelsa, Ceiba pentandra, Cassia singueana, Terminalia superb, Gmelina arborea, Cola acuminate,*
Apatemonachus F. Order: Coleoptera Family: Lyctidae	Powder post beetles	Found in plank markets; *Gmelina arborea, Tectona grandis ,Antiaris africana, Ceiba pentandra, Blighia sapida, Delonix regia,*
*Hylotrapes bajulus*Linnaeus Order: Coleoptera Family:Cerambycidae	Longhorn beetles	*Triplochiton scleroxylon*
Platypus *spp* Doliopygus*spp* Order: Coleoptera Family:Platypodidae,Scolytidae	Pinhole borers Ambrosia beetles	*Cola acuminate, Gmelina arborea, Albiziazygia, Daniellia oliveri, Triplochiton scleroxylon,*
Bostrychoplites cornutusoliv. Heterobostrychus brunneusoliv. Xyloperthella piceaoliv.	Powder post beetles	*Tectona grandis,Gmelina arborea, Daniellia oliveri, Ficus mucuso, Triplochiton scleroxylon, Antiaris toxicaria*
Order: Coleoptera Family: Bostrichidae	Powder post beetles Powder post beetles	
Pentarthrum*spp* Order: coleoptera Family: Cocciolidae	Wood boring weevil	*Triplochiton scleroxylon*
Camponotus*spp*	Carpenter ant	

Table 9: Insects Identified in the Five Locations

Bodija	Sango	Moniya	FRIN	Old Ife Road
Carpenter ants	*Bostrychoplites cornulus* oliv.	Platypius *spp*	Termites	Termites
Pinhole borers	*Heterobostrychus brunneus* oliv	*Xyloperthella*	Powder post beetles	Powder post beetles
Ambrosia beetles	*Xyloperthella picea* oliv.	*Picea* oliv	Longhorn beetles	Weevil
Apatemonachus F.	*Apatemonachus*	Termites	*Bostrychoplites cornulus* oliv.	
Bostrychoplites cornutus oliv	*Dolipygus spp*	Platypius *spp*	*Heterobostrychus brunneus* oliv.	
Hylotrapes bajulus Linnaeus	*Bostrychoplites cornulus* oliv.	*Xyloperthella*	*Xyloperthella picea* oliv.	

From the study, two major pest groups belonging to the Order Coleoptera and Isoptera were prominent. There were five species of insects; Termites, Beetles, Borers, Weevils and Carpenter ant. In all five locations, Coleoptera dominated the insect species identified, followed by Isoptera in three locations; Moniya, FRIN and Old Ife road, Carpenter ant was also present in two locations; this is represented in Table 8

Discussion

Seven pathogens were identified with majority common in at least 3 out of the 5 locations. These are *Botryodiplodia theobromae, Rhizopus stolonifer, Fusarium oxysporum, Penicillium oxalicum* and *Trichodama longibrachiatum.* and others in one or two locations. Some of these pathogens in nature such as *Aspergillus species* are not pathogenic on wood while others such as *Botryodiplodia theobromae* are. This study was streamlined basically to identify these pathogens. The presence of *Botryodiplodia theobromae* in all the locations can be attributed to its virulent tendency in nature. It was reported by Ekpo (1998), that, this fungi is highly pathogenic on wood and it is presence is seen on blue colouration on wood. It was reported to have caused blue stain disease in cut timber of *Antiaris toxicaria,* Canker disease in *Parkia species* and seed decay and abnormalities in seed storage and young seedlings.

Aspergillus species (flavus and *niger)* were identified in just one location with low when compared with the rest, a probable reason being that these pathogens are not pathogenic on wood but on seeds, This is in agreement with Ekpo (1998). *A. flavus* produces aflatoxin in maize and ochratoxin in groundnuts which are harmful to health. *A. niger* also has been reported to cause decay in peanuts and grapes. *Trichodermalongi brachiatum* was identified as one of the fungi pathogens in this study, though with low percentages. This species has been reported by Momoh (1974), Calistru*et at.,* (1997) and Hassanein *et al.*, (2000), as a biological control agent on Butt and Root rot diseases in *Tectona grandis* and *Triplochiton scleroxylon* and storage seed rot of maize. This pathogen has been found out to possess antagonistic ability and has various mechanisms which include antibiosis, parasitism, including host- plant resistance, and competition.

*Fusarium oxysporum*are pathogenic on wood, it was reported by Ofong (1979) and Ekpo (1998), to have caused damping-off in pine nurseries and also seed decay in *Pinus caribaea.* The presence of *Rhizopus stolonifer* in four locations with fairly high percentages agrees with the findings of Webster (1970), that, they occur on all kinds of decaying materials and are a major laboratory contaminant of cultures. Although, they have not been found to be pathogenic on wood but studies have reported its growth on soft fruits such as bananas and grapes, strawberry, tomato and sweet potato (Schipper, 1984).

From table 7, the percentage decay of wood species in the five locations shows that FRIN which had the highest percentage decay can be attributed to the long period of strike experienced as at the time of the collection of samples, meaning that work was on hold and the surroundings untidy with overgrow grasses. Most of the logs that were not sawn were left outside in the grass and in the rain, exposing them to moisture which is a very favorable condition for pathogens to thrive. Wood left in this condition is prone to attack from both insects and fungi especially when the log is nondurable. In Moniya location, there used to be five functional sawmills but at present only one is functional, they folded up in search of greener pastures. Some of the problems they encountered were transportation of logs from the forest to the sawmill, lack of man power and unsteady power supply, meaning that, work only went on when there was power, there was no alternative means of supply. The untidy surroundings with sawdust and overgrown grasses could harbor pathogens. Logs were not properly stored, they were left on the ground, creating room for biodegrading agents to thrive.

The percentage of decay in the plank markets (Bodija and Sango) were minimal compared with the other two sawmills (Moniya and FRIN), a probable reason being that these plank markets are the major plank market in the metropolis and are highly patronized by costumers.

The planks were kept on stack and not on the ground and in some sheds the stacks were spaced allowing for the easy flow of air between the planks. Although, sawdust was seen in and around the environment but not inside the shed. But, affected planks were still been offered for sale. Old Ife had the lowest percentage decay(less than 2%) which infers that no matter the level of hygiene and management, biodegrading agents will still thrive because their spores are everywhere and they multiply very fast. Also, some could stay dormant for years until a favorable environment triggers their activity. The two major groups of insect pest identified were the Coleoptera and Isoptera. The coleoptera consist of beetles which were of two types; Pinhole borers/Ambrosia beetles and Powder post beetles. From the result, the powder post beetle was more in Sango plank Market and FRIN Sawmill. A probable reason for this is that the wood in these areas were not freshly fell and PPB thrives well on dry wood, this is in accordance with Akanbi and Ashiru, (2002).

Pinhole borers/ Ambrosia beetles were also identified in Bodija, Moniya and Sango areas. The probable reason been that pinhole (Ambrosia) attacks both sapwood and hardwood and only stops attack when the wood is dry. There was termites in all the sawmills among the insect pest identified. Termites from the Order Isoptera feed mostly on dead plant material and live sand tunnels inside the logs. In most sawmills, the logs were left on the ground for months before sawing and the surroundings were covered with sawdust and grasses. This could be the major reason for termites presence in these locations. The findings also showed that these insect pests are not host specific, they were found in different logs and the damage was also visible on different logs. The occurrence of attack on tree species like *Gmelina arborea, Tectona grandis, Ceiba pentandra, Triplochiton scleroxylon* were higher compared with *Milicia excelsa* species, inferring that the former were more susceptible to insect pest attack than the latter which is very resistant to pest attack; these findings are in accordance with the report of Adeduntan *et al;* (2005).

Conclusion

Fungi and insects attack is a major problem facing wood users today. They deteriorate and degrade the physical and chemical (in some instance) properties of wood. The termite and other insects at larval stage could cause huge economic losses through eating and burrowing. The wood decaying fungi degrade wood and incur big economic losses. The decay alone is responsible for bigger losses in the stand and in the wood than fire and other damages combined. The damages due to decay should be kept under control. This could be achieved by controlling the moisture content of wood.

Dry wood are generally immured to fungi as they can neither attack nor live on well dried wood. They need the free water (water in lumen) for establishment and growth in the wood. The cheapest solution to wood decay problem is to season wood. Hence properly seasoned wood should be used. Although, even after well seasoning, sometimes wood could come in contact with water by several means, as a result absorb water and swell. In this situation, there remains the chance of fungal infestation. To reduce these undesired damages, the wood needs to be protected by painting or varnished or other appropriate measures so that the risks could be minimized. Coating such as paints, varnishes, waxes prevent water penetration into the porous cellular structure of wood thus prevent decay and termite attack

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