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Natural Durability of Three Selected Ghanaian Lesser Used/Known Timber Species Using Accelerated Laboratory Test

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Abstract. Dwindling stocks of primary timber species poses a threat to the wood industry and the focus is gradually shifting towards lesser used/known species in an attempt to broaden the wood resource base in the country. *Blighia sapida*, *Gilbertiodendron limba* and *Lannea welwitschii* are among the lesser used/known timber species being promoted for commercial utilization in Ghana and beyond. The natural durability of heartwood and sapwood of three timber species were tested using the white rot fungus *Coriolopsis polyzona* using accelerated laboratory method in accordance with ASTM D 2017-05 standard. 540 wood blocks each measuring (14mm x 14mm x 14mm) were used. Mass loss, decay resistance rating and decay susceptibility index were the properties determined after 16 weeks of exposure to *Coriolopsis polyzona*. *Blighia sapida*, recorded mean mass loss of 36.07%, whereas *Gilbertiodendron limba* recorded 19.24% and *Lannea welwitschii* recorded 24.36% in that order. The results indicate that the mass loss of *Gilbertiodendron limba* was the least, although none of the species was classified as highly resistance. At 5% level of significance, the section, portion and the species as well as their interactions had significant effects on the decay resistance of the timber species.

Keywords: *Blighia sapida*, *Coriolopsis polyzona*, Decay, *Gilbertiodendron limba*, *Lannea welwitschii*

Introduction

In Ghana, indiscriminate felling of primary timber species and lack of knowledge on the technological properties of some new timber species have caused over-dependency on few timber species resulting in dwindling of the forest cover. This could be as a result of annual increase of wood material demand of the forest industry.

Solid wood, when utilized in places with high moisture conditions, are subject to deterioration and, once attacked, they lose both weight and mechanical resistance (De-Melo *et al.*, 2015; Rowell & Dickerson, 2014). Apart from moisture, De-Melo *et al.* (2015) and Pournou (2020) emphasized that other factors such as temperature, pH and oxygen have an influence on the capacity of xylophagous agents to colonize and consequently, deteriorate any lignocellulosic material. This could be explained by the degradation of polysaccharides in the initial stages of decay and by the degradation of lignin in the later stages (Venäläinen *et al.*, 2014). Each wood has its inherent resistance to attack by wood-destroying organisms even if it is extremely susceptible. However, some species have higher resistance than others (Obanda *et al.*, 2008). It is expedient that studies on the decay resistance properties of some of the lesser-known/used timber species are conducted, in order to enhance their utilization. Aigbokhan *et al.* (2019); Asamoah *et al.* (2010) and Lemmens *et al.* (2012) have reported that *Blighia sapida*, *Gilbertiodendron limba* and *Lannea welwitschii* are appropriate timber resource materials for the construction and furniture industry. However, there is limited information on their natural durability, and this could further pose an obstacle to their utilization (Moya & Muñoz, 2010).

The durability of wood has been classified into very durable, durable, moderately durable, nondurable, and perishable in accordance with ASTM (1999) and AWPA (1999). Wood species belonging to the perishable class are not generally suitable for use in construction

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works and cannot withstand damp environment or last long when in contact with the ground (Sadiku *et al.,* 2021). The natural resistance demonstrated by some timber species is the resultant effect of the presence of extractive compounds in the heartwood region. The relationship between durability and extractive compounds is primarily due to phenolic compounds (Syofuna *et al.,* 2012). Although the heartwood of most wood species exhibits excellent resistance to biodegradation, the resistance is sometimes diminished in the sapwood (De-Angelis *et al.,* 2018; Sadiku *et al.,* 2021). The sapwood undergoes numerous changes, a part of which is the formation of extractive compounds that are transformed progressively into the heartwood. The presence of these extractive compounds in sufficient quantities prevents or minimizes the severity of attack by destructive organisms when the extractive compounds are toxic. However, the toxicity of these extractive compounds varies within and between species and in their chemical properties (Sadiku *et al.,* 2021; Vuckovic *et al.,* 2011).

Blighia sapida (Akye fufuo) is a middle canopy tree growing up to 25 m tall with branchless bole of 15 m and diameter of 80 cm. The minimum mean stocking density in Ghana is estimated at 255 trees per sqkm of stems greater than 30 cm diameter at breast height (dbh) and about 72 trees per sqkm of stems greater than 70 cm dbh. About 6,840 trees of merchantable diameter (above 70 cm dbh) can be harvested every year and this will provide a round log volume of about 39,500 m^3 (Asamoah *et al.,* 2020). Log production is from sustainably managed production natural forest based on the Ghana forest management standards (Appiah, 2001; Hansen & Treue, 2008). Timber exploitation is done on a selective harvesting cycle of 30 to 40 years. At each harvest, the number of stems harvested amounts to less than 30% of all the stems above 30 cm dbh and only stems equal and above 70 cm dbh are harvested. About 50% of the tree population above 70cm diameter are retained for seed production as well as for canopy trees to maintain the architecture of the natural forest for environmental services (Asamoah *et al.,* 2020).

Gilbertiodendron limba (Tetekon) grows up to 25 m tall with a short bole of 15 m and up to 70 cm in diameter. The minimum stack density in Ghana is estimated at 86 trees per sqkm of stems greater than 30 cm diameter at breast height (dbh) and about 35 trees per sqkm of stems greater than 70 cm dbh. About 3,354 trees of merchantable diameter (above 70 cm dbh) can be harvested every year and this will provide a round log volume of about 19, 400 m^3. Log production is from sustainably managed production natural forest based on the Ghana Forest Management standards (Asamoah *et al.,* 2020). Minimum mean stocking density in Ghana is estimated at 131 trees per sqkm of stems greater than 30 cm diameter at breast height (dbh) and about 39 trees per sqkm of stems greater than 70 cm dbh. About 3,672 trees of merchantable diameter (above 70 cm dbh) can be harvested every year and this will provide a round log volume of about 21,200 m^3 (Asamoah *et al.,* 2020).

Lannea welwitschii (Kumanini) grows up to 30 to 35 m tall with a bole branchless up to 15 to 26 m, and up to 100 to 120 cm in diameter. Suitable for round log production. Minimum mean stocking density in Ghana is estimated at 131 trees per sqkm of stems greater than 30 cm diameter at breast height (dbh) and about 39 trees per sqkm of stems greater than 70 cm dbh. About 3,672 trees of merchantable diameter (above 70 cm dbh) can be harvested every year and this will provide a round log volume of about 21,200 m^3 (Asamoah *et al.,* 2020). About 50% of the tree population above 70cm diameter are retained for seed production as well as for canopy trees to maintain the architecture of the natural forest for environmental services (Asamoah *et al.,* 2020).

As a result of rapid exploitation of commercial timber species from the forests of Ghana and the difficulty involved in the natural and artificial regeneration of some timber species, the country will in the coming years rely mostly on the new timber species to supply the wood needs of the country and for export. There are about 680 timber species in the natural forest of Ghana out of which only 20 are utilized economically (Appiah, 2013; Obiri *et al.,* 2002).

Therefore, there is the urgent need to shift from concentration on a few primary timber species to a broader range of species. To accomplish this will require promotion of the lesser-used and lesser-known timber species in Ghana.

Decay resistance has implications on end-use of any given timber species, since it determines its service-life and replacement cost. Naturally toxic compounds from durable woods may lead to the development of more effective wood preservatives, while naturally durable woods may also become an important option where there are concerns for environmental safety of wood preservatives (Gérardin, 2016; González-Laredo *et al.*, 2015). Hence resistance to fungal attack is a very desirable quality for wood utilisation. Thus, for effective promotion and utilization of these timber species, their natural durabilities among other wood technological properties have to be assessed in order to determine their commercial value. This study seeks to evaluate the natural decay resistance of *B. sapida*, *G. limba* and *L. welwitschii* timber species from Moist Semi-Deciduous (MSD) ecological forest zone in Ghana.

Materials and Methods

Selection and Extraction of Timber Species

Blighia sapida, *Gilbertiodendron limba* and *Lannea welwitschii* were selected for the study because they were potential timber species that are among the lesser-used and lesser-known timber species being promoted by BVRio for commercial utilization in Ghana and beyond.

Three disc-shaped samples of thickness 30 mm were cut from the butt, middle and the top (Figure 1) of two matured trees each of *Blighia sapida* (Akye), *Gilbertiodendron limba* (Tetekon) and *Lannea welwitschii* (Kumanini) using a chainsaw machine. The trees of these species were randomly extracted from Bobiri forest (Latitude 6° 39’ and 6° 44’N, Longitude 1° 15’ and 1° 23’W) reserve in Ashanti Region, located in the Moist Semi-Deciduous forest Zone (MSDZ) of Ghana. The average diameter of the selected trees at 1.3 meters above ground (dbh) were 68.85 cm, 48.72 cm and 63.59 cm for *B. sapida*, *G. limba* and *L. welwitschii*, respectively.

Preparation of Test Specimens

Wood disc were ripped into strips and further processed into strips of inner-heartwood, outer-heartwood and sapwood from the base, middle and the top (Figure 1) of each of the timber species. The selected defect-free wood strips were subsequently cross-cut into cubes of dimensions 14 mm x 14 mm x 14 mm blocks (longitudinal x tangential x radial) (Figure 1). One hundred and eighty (180) wooden cubes each of *B. sapida*, *G. limba* and *L. welwitschii* were used for the study, making a total of five hundred and forty (540) specimens. The fungal species used, *Coriolopsis polyzona* was supplied by the Plant Pathology Section of the CSIR-Forestry Research Institute of Ghana.

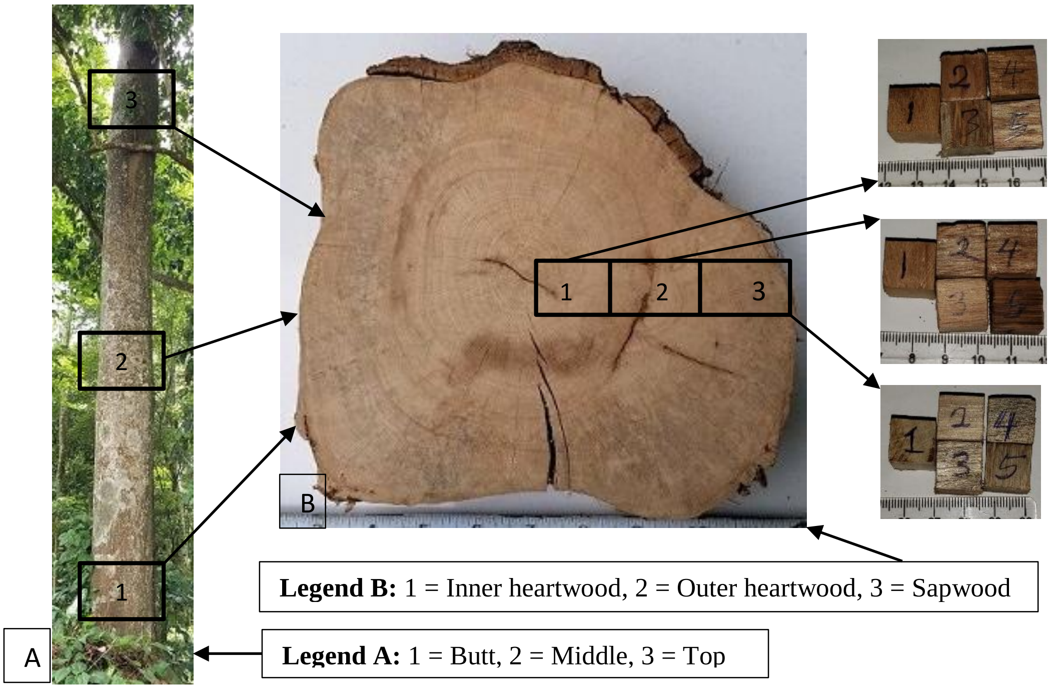

Figure 1. Graphical representation of the selection of study specimens

The decay test was conducted using simple accelerated laboratory (Soil block) method in accordance with ASTM D 2017-05 (2005), which establishes that the test specimens should be conditioned before and after fungal attack in an air-forced at 50 ± 1 ^{0}C, weighed, sterilized and submitted to colonized environment for fungal attack, in a controlled environment at 27 ± 1 ^{0}C and 70 ± 4 relative humidity (RH). Subsequently, the specimens were oven-dried at 103±2 ^{0}C for 24 hours. The specimens were then cooled to room temperature in a desiccator for each timber species and the weight for each specimen per species was taken to represent the initial dry weight.

Decay Resistance Test of Specimen

Decay chamber was prepared using two hundred and seventy French-square-bottles (Kohl bottles), three-quarter filled with moistened sieved garden/agricultural soil at pH of 6.2 and a holding capacity of 39%. Two hundred and seventy (270) strips of *Triplochiton scleroxylon* wood were selected according to the number of French-square-bottles available. These were immersed in distilled water overnight and placed on top of the soil in the French-square-bottles (Kohl bottles). The bottles were loosely closed with their plastic screw-lids and sterilized in an autoclave at a temperature of 121 ^{0}C with a pressure of 15 psi for 20 minutes (Figure 2). After cooling, actively growing mycelium discs of *Coriolopsis polyzona* of diameter 10 mm were introduced on each of the *T. scleroxylon* wooden strip in fungi growing incubator (Figure 3).

Figure 2. Sterilization of substrate in an autoclave

Figure 3. *Coriolopsis polyzona* introduced on the substrate for complete colonization

The bottles and their contents were placed in fungi growing incubator at a temperature and relative humidity of 25 °C and 70 %, respectively for 4 weeks for complete fungal colonization of the *T. scleroxylon* strips (Figure 4). Thereafter, the oven-dried sterilized specimens of the *B. sapida*, *G. limba* and *L. welwitschii* were gently placed on the mycelial mat that had formed on the *T. scleroxylon* strips in the French-square-bottles under sterile conditions (Figure 5).

Figure 4. Decay fungus colonizing substrate

Figure 5. Decay fungus feeding on the test specimens

The set-ups were then incubated again for 16 weeks at a temperature and relative humidity of 25 °C and 70 % respectively to allow the *C. polyzona* to feed on the *B. sapida*, *G. limba* and *L. welwitschii* specimens (Figure 4). At the end of the period, the specimens were removed from the bottles, cleaned by gently removing any adhering mycelium and then oven dried for 24 hours at a temperature of 103 ± 2 °C until a constant mass was recorded. The percentage mass loss caused by the action of the decaying fungus was determined as shown in Equation 1:

$$\text{Percentage weight loss (\%)} = \frac{\text{Im-Fm}}{\text{Im}} \times 100 \qquad (1)$$

Where:
Im = Initial oven-dry mass of specimen
Fm = Final oven-dry mass of specimen

Decay Resistance Rating of Test Specimen

The decay resistance rating of the test specimens (*B. sapida*, *G. limba* and *L. welwitschii*) was based on the mass loss classification adopted from the ASTM D2017-05 (2005) as indicated in Table 1.

Table 1. Decay resistance class for percentage weight loss

Average weight loss (%)	Decay resistance class
0-10	Highly resistance (Class I)
11-24	Resistance (Class II)
25-44	Moderately resistance (Class III)
45 and above	Susceptible (Class IV)

Decay Susceptibility Index

Curlings and Murphy (2002) proposed method for determination of decay susceptibility index (DSI) was used to determine the intensity of attack of the decay fungus on the wood specimen used for the study. The actual mass losses of *B. sapida*, *G. limba* and *L. welwitschii* specimens caused by *C. polyzona* were compared with the mass losses of the appropriate reference timber (*Terminalia superba*). Based on this method the DSI for the specimens were computed as shown in Equation (2):

$$\text{Decay susceptibility index (\%)} = \frac{MLs}{MLc} \times 100 \qquad (2)$$

Where:
MLs = Mass loss of the wood specimen
MLc = Mass loss of the appropriate reference timber (*T. superba*)

Statistical Analysis

The data obtained was analysed using descriptive and inferential statistics. Statistical software used for the analyses was version 20 of Statistical Package for Social Scientists (SPSS). The mean and standard deviation of the percentage weight loss were computed and the decay resistance class determined. Tukey's multiple comparison of means was used to establish significant difference between means of decay susceptibility index at 5% level of significance.

Results

The results obtained after 16-week exposure and analyses are classified into decay resistance, decay resistance rating and decay susceptibility index (DSI).

Decay Resistance

The percentage mass loss of specimens extracted from sections of the stems of the three timber species exposed to *Coriolopsis polyzona* in the accelerated laboratory test, are shown in Figure 6. Generally, the highest mass losses were recorded by the tops of all the trees of the three timber species with *L. welwitschii* t2 recording (58.66%) followed by *B. sapida* t2 (47.88%), *B. sapida* t1 (39.59%), *L. welwitschii* t1 (37.45%), *G. limba* t1 (26.46%) and *G. limba* t2 (25.21%) in decreasing order. In the middle portions, *B. sapida* t2 recorded the highest mass losses of 39.43% whereas *B. sapida* t1 recorded 30.91% followed by *L. welwitschii* t2 (19.43%), *L. welwitschii* t1 (19.12%), *G. limba* t1 (18.92%) and *G. limba* t2 (17.58%) in decreasing order. Similar trend of mass losses were recorded in the butt sections of specimens with *B. sapida* t2 recording 30.63%, followed by *B. sapida* t1 (27.97%), *L. welwitschii* t2 (15.84%), *L. welwitschii* t1 (15.21%), *G. limba* t1 (14.03%) and *G. limba* t2 (13.26%).

However, for the same trees, the portions exhibited different trend of mass losses. The highest mass loss was obtained for the sapwood of *B. sapida* t2 (45.05%) followed by *B. sapida* t1 (37.20%), *L. welwitschii* t2 (27.28%), *L. welwitschii* t1 (26.38%), *G. limba* t1 (23.33%) and *G. limba* t2 (21.69%) in decreasing order (Figure 7). Similar trends of mass loss were obtained for outer heartwood and inner heartwood with *B. sapida* t2 recording the highest and *G. limba* t2 recording the least.

The results further indicated that although *B. sapida* t1 and *B. sapida* t2 recorded different mass losses of similar trend, there was a significant difference in the values recorded according to Tukey's honest significance difference (HSD) at 0.05. However, there was a significant difference in the mass losses obtained for the tops of *L. welwitschii* t1 and *L. welwitschii* t2. *G. limba* t2 with the least mass losses in all the sections recording significance differences between all the values of the sections according to Tukey's HSD at 0.05. Comparatively, wood specimens obtained from *G. limba* recorded lower mass losses than the other species in the study.

Furthermore, for all the sapwood and heartwood portions of the selected timber species, there was no significant difference ($p < 0.5$) in the mass loses recorded for their portions except the sapwoods of *B. sapida* t1 and *B. sapida* t2 (Figure 7). Along the sections (i.e. from Butt, Middle and to the Top) of the wood, mass loss of all the specimens increased from the butt to the top, whereas a decrease in mass loss was recorded across the portions from sapwood, outer heartwood to the inner heartwood of the wood (Figure 7).

Along the sections, the highest mass loss (58.66%) was obtained for top of *L. welwitschii* t2 whereas the minimum mass loss (13.26%) was recorded for the butt of *G. limba* t2 (Figure 4). Across the portions, the highest mass loss (45.05%) was recorded for sapwood of *B. sapida* t2 as the minimum mass loss mass loss (15.86%) was recorded for the inner heartwood of *G. limba* t2 (Figure 7). The differences in mass loss along the sections ($F=1339.472$, $DF=2$, $p=0.00$) and across the portions ($F=199.772$, $DF=2$, $p=0.00$) of the test specimens were significant.

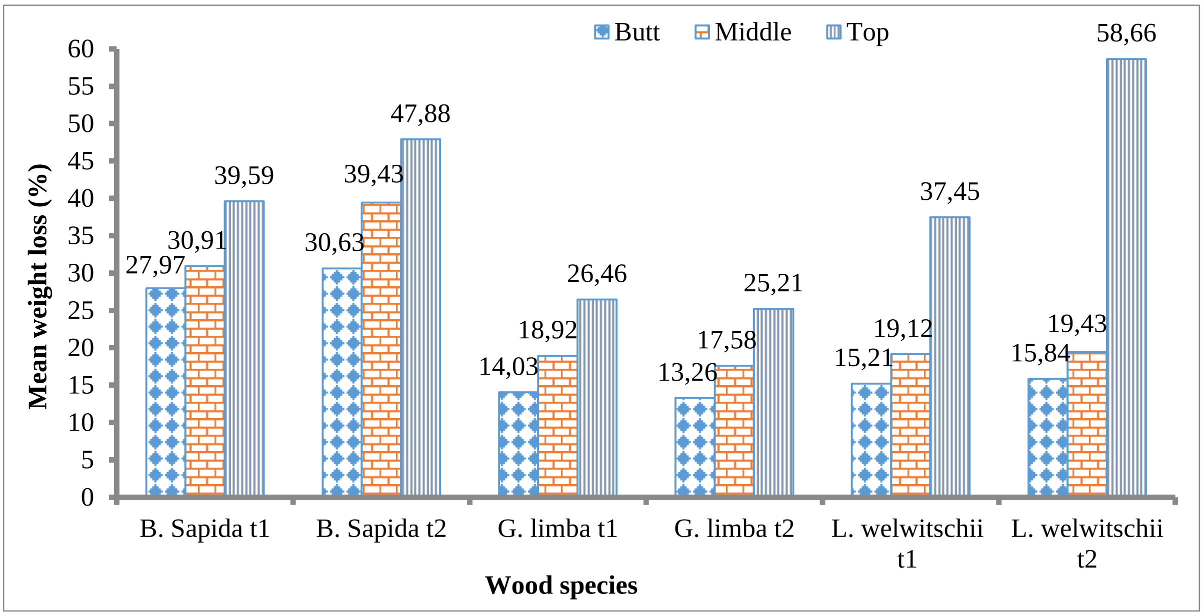

Figure 6. Mean mass loss (%) of wood species from sections of the stem
Legend: t1 = tree 1, t2 = tree 2
Sections: Butt, Middle and Top

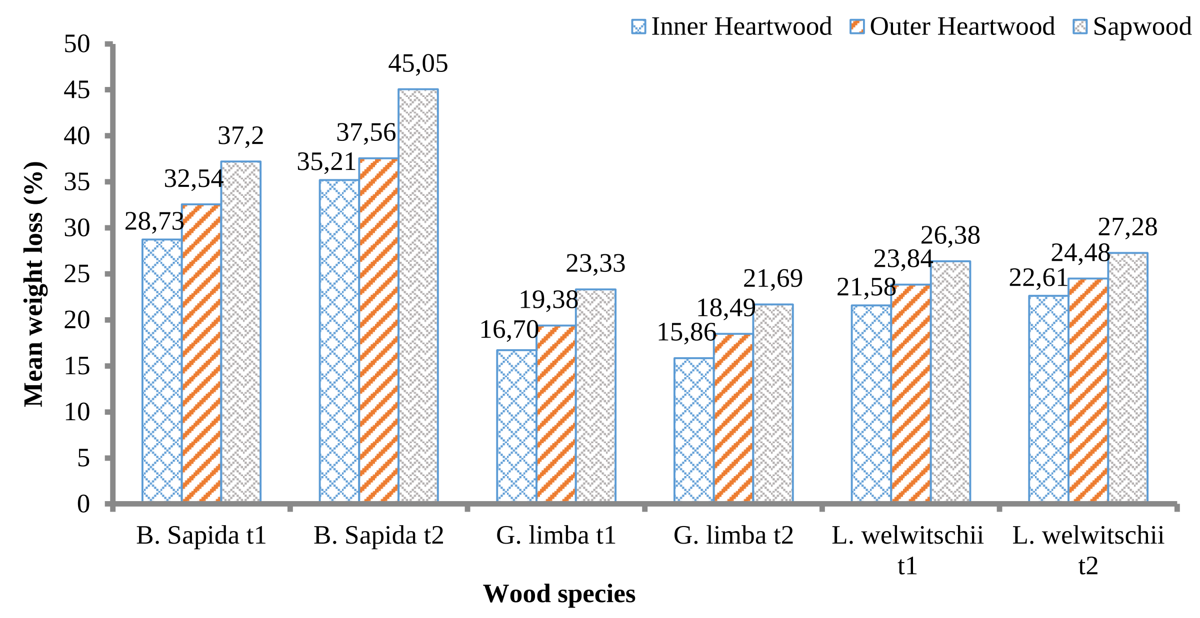

Figure 7. Mean mass loss (%) of wood species from portions of the stems
Legend: t1 = tree 1, t2 = tree 2
Portions: Inner Heartwood, Outer heartwood and Sapwood

Decay Resistance Rating

The effect of the species, sections and the portion of selected specimens on the decay resistance properties of wood is as indicated in Table 2. The ANOVA results showed that at 5% level of significance, the species, sections and the portions had significant effect on the decay resistance of the wood specimens used (p-value < 0.01). The multiple coefficient of determination value R^2 and root mean square error (RMSE) of the ANOVA model were 0.9710 and 2.1211, respectively. These suggest that about 97% of the variability in the decay of the selected timber trees could be explained by the species, the section and the portions the specimens were selected from.

Table 2. ANOVA of decay property of *Blighia sapida, Gilbertiodendron limba* and *Lannea welwitschii*

Source	DF	ANOVA SS	Mean square	F-ratio	p-value
Species	4	11036.076	2759.019	613.278	0.00*
Sections	2	12052.052	6026.026	1339.472	0.00*
Portions	2	1797.472	898.736	199.772	0.00*
Species x Sections	4	1393.930	174.241	38.731	0.00*
Species x Portions	8	189.842	23.730	5.275	0.00*
Sections x Portions	4	430.846	107.711	23.942	0.00*
Species x Sections x Portions	16	296.929	18.558	4.125	0.00*
Error	180	809.785	4.499		
Total	225	206087.557			

Note: *Statistically significant at 0.05 level of significance, DF = Degree of freedom
Portions: Inner Heartwood, Outer heartwood and Sapwood.
Sections: Butt, Middle and Top

The results obtained from the mass loss caused by *C. polyzona* on the selected timber species are as summarized in Table 3. The butts and middle sections of *G. limba* and *L. welwitschii* were resistant to the decay fungus obtaining average mass losses of 13.65%, 18.25% & 15.53%, 19.28%, respectively whereas that of *B. sapida* were moderately resistant with average mass losses of 29.30%, 35.17%, in the same order. The result further indicated that the attack was intense at the Top of *B. sapida* t2 as it is rated susceptible to *C. polyzona* attack.

Table 3. Durability ratings of wood species

Wood species	Tested Sections	Mean mass loss (%)				
		Inner heartwood	Outer heartwood	Sapwood	Average	Durability rating
Blighia Sapida (Tree 1)	Butt	25.73	26.70	31.48	27.97	Class III
	Middle	26.54	32.61	33.59	30.91	Class III
	Top	33.91	38.33	46.53	39.59	Class III
Blighia Sapida (Tree 2)	Butt	26.63	28.91	36.34	30.63	Class III
	Middle	38.89	38.99	40.42	39.43	Class III
	Top	40.49	44.78	58.38	47.88	Class IV
Gilbertiodendron limba (Tree 1)	Butt	13.46	13.61	15.01	14.03	Class II
	Middle	14.72	18.17	23.86	18.92	Class II
	Top	21.93	26.35	31.11	26.46	Class III
Gilbertiodendron limba (Tree 2)	Butt	12.74	12.92	14.11	13.26	Class II
	Middle	13.96	17.66	21.13	17.58	Class II
	Top	20.88	24.90	29.84	25.21	Class III
Lannea welwitschii (Tree1)	Butt	13.94	14.99	16.70	15.21	Class II
	Middle	18.32	18.85	20.20	19.12	Class II
	Top	32.47	37.67	42.25	37.46	Class III
Lannea welwitschii (Tree2)	Butt	14.09	14.93	18.49	15.84	Class II
	Middle	18.82	19.22	20.25	19.43	Class II
	Top	34.92	39.30	43.09	39.10	Class III

Legend: Class II = Resistance; Class III = Moderately resistance; Class IV = Susceptible

Decay Susceptibility Index

Decay susceptibility index (DSI) compensates for the difference arising from wood species and makes it possible to establish a ranking of wood species in terms of their resistance to wood decaying fungi. The DSI values obtained for the wood species under study are shown in Table 4. DSI is a relative value as it compares the specimen mass loss to a reference species (Melo *et al.*, 2015). The DSI of *G. limba* t1 and t2 was 54.12% and 42.57% respectively whereas DSI for *L. welwitschii* t1 and t2 was 61.19% and 63.24% respectively. The worse DSI values were recorded for *B. sapida* t1 and t2 were 86.27% and 104.52%, respectively.

Table 4. Decay susceptibility index of test sections of wood species

Wood species	Tested Sections	Decay Susceptibility (%)			
		Inner heartwood	Outer heartwood	Sapwood	Average
Blighia Sapida (Tree 1)	Butt	59.66	61.93	73.00	86.27[d]
	Middle	61.55	75.64	77.90	
	Top	78.69	88.89	107.91	

Blighia Sapida (Tree 2)	Butt	61.77	67.07	84.36	104.52^{e}
	Middle	90.18	90.87	93.78	
	Top	93.93	103.85	135.43	
Gilbertiodendron limba (Tree 1)	Butt	31.17	31.59	34.79	54.12^{b}
	Middle	34.13	42.16	55.35	
	Top	50.88	61.12	72.21	
Gilbertiodendron limba (Tree 2)	Butt	29.54	29.97	32.71	42.57^{a}
	Middle	32.36	40.97	49.08	
	Top	48.43	57.75	62.23	
Lannea welwitschii (Tree1)	Butt	32.30	34.75	38.75	61.19^{c}
	Middle	42.52	43.71	46.82	
	Top	75.35	87.33	98.01	
Lannea welwitschii (Tree2)	Butt	32.71	34.64	42.86	63.24^{c}
	Middle	43.61	44.59	46.97	
	Top	81.01	91.14	99.89	

Note: Reference species is *Terminalia superba* with average weight loss of 43.13% (1.05) Figures in columns with the same letters are not significantly different (Turkey's multiple test, $p > 0.05$).

Thus among the species used, specimens from *B. sapida* t1 and t2 were more susceptible to decay caused by the action of *C. polyzona*, recording higher average DSI than the specimens obtained from *L. welwitschii* t1 and t2 obtaining 61.19% and 63.24% respectively, whereas 54.12% and 42.57% were recorded for *G. limba* t1 and t2 respectively (Table 4). Thus *B. sapida* is more susceptible to decay caused by *C. polyzona* than the other species used in the study.

Discussion

The durability of wood determines its ability to resist fungi and termites attack and to prevent decay. In construction and engineering applications, wood with high durability will withstand attack from fungi and termites and perform its function in service by carrying specified design loads (Viitanen, 2014). Wood with low durability can easily be attacked by fungi and termites which can lead to decay and mass loss. The loss of mass will lead to reduction in strength of the material, which in turn can cause structural failure (Appiah-Kubi *et al.*, 2017). From the above, the result obtained shows that specimen obtained from the portion or section of the timber significantly affect the durability of wood against decay. Generally, the mass losses recorded for the portions or sections had statistically significant effect on wood resistance against the selected decay fungus, *C. polyzona*. Hence according to the ANOVA, there was a significant effect of the species, section, portion and their interaction on the mass loss of the timber by the action of the fungi (Table 2). The differences in the deterioration rates between the species may be due to the high concentration of phenolic extractive compounds present in the wood specimens. A study by Subki *et al.*, (2018) explored the role of thiamine in plants, current perspectives in crop improvement and the thiamine activities in resistance to pathogens. It was clear that content of thiamine in timber could boost resistance to decay by the activities of *Coriolopsis polyzona*.

Gilbertiodendron limba anatomically has large pores evenly distributed in the growth rings with tyloses containing inclusions. These inclusions could contain fungitoxic substances that could contribute to the resistance of the species to the decaying activities of *C. polyzona* (Ashaduzzaman, 2014). Hence the resistance of *G. limba* to the decaying activities of *C. polyzona* could be as a result of its chemical constituents.

Blighia sapida contains riboflavin (Deng *et al.,* 2014) which enhance pathogen resistance that could contribute positively to the resistance of the species to decaying activities of *C. polyzona*. Boubakri (2017) indicated that ascorbic acid (AsA) protects plants from pathogen attack. He further emphasized that AsA interact with key elements of a complex network orchestrating plant defense mechanism, thereby influencing the outcome of plant-pathogen interaction.

Lannea welwitschii was resistance to the decay fungus. Similar result was obtained by Sadiku *et al.,* (2021). During their study on the resistivity of ten Nigerian timber species to fungi, they concluded that the resistance of *L. welwitschii* to decay fungi could be caused by the high phenolic extractive content in the heartwood that contributed to wood protection. Sadiku *et al.*, (2021) further observed that *L. welwitschii* was resistant to fungi but susceptible to termite attack. Although fungal species attacked all wood species, the attack by white rot fungus (*C. polyzona*) appeared to be more intense. These findings were consistent with previous findings of Nzokou *et al.* (2005) and Schultz and Nicholas (1997).

The DSI of *G. limba* confirms the earlier result which indicates that *G. limba* is resistant to the decaying fungi. Fojutowski *et al.* (2009) and Curling & Murphy (2002) indicated that wood species with DSI value of 100%, means it has the same decay resistance as that of the wood used in the test for comparison. Also, wood species with DSI values lower than 100% indicate more resistance to fungal attack than the wood used in the test for comparison. Finally, DSI values greater than 100% indicate wood species with less resistance to fungal attack than the wood used in the test for comparison. Generally, the selected wood specimens showed higher resistance than the reference wood species as their DSIs were lower than 100%, except *B. sapida* t2. There was a significant influence of the species on the susceptibility to the decaying fungus.

Sadiku *et al.* (2021) acknowledged that comparatively the attack by white rot fungi (*C. polyzona*) on wood species appeared to be more intense. This could be due to the fact that hardwoods are more susceptible to white rot decay fungi than softwoods (Nzokou *et al*., 2005). White rot fungi are always included in the testing of the natural durability of hardwood species because they attack all the wood components, whereas brown rot fungi preferably attack the hemicellulose and cellulose components, leaving the lignin component undigested (Green & Highley, 1997). These findings were consistent with previous findings of Nzokou *et al.* (2005) and Schultz & Nicholas (1997). According to Nzokou *et al*. (2005), the high weight loss values obtained due to *Lentinus sajor-caju* attack in all heartwood samples of 10 timber species were attributed to the fact that hardwoods are more susceptible to white rot decay fungi than softwoods (Schultz & Nicholas, 1997).

Conclusion

Mass loss obtained by the three wood species was used to evaluate their durability to decaying activities of *Coriolopsis polyzona* using accelerated laboratory soil-block test. *Blighia sapida*, tree 1 & tree 2 recorded mean mass losses of 32.83% & 39.31%, whereas *Gilbertiodendron limba* tree 1 & tree 2 recorded 19.80% & 18.68% and *Lannea welwitschii* tree 1 tree 2 recorded 23.93% &31.31% in that order. Although none of the studied specimens recorded high resistance to the decaying fungus, the results indicate that *G. limba* could be classified as resistant to the activities of *Coriolopsis polyzona*, followed by *L. welwitschii* and *B. sapida* which recorded the highest values in terms of mass loss caused by the fungus. Further research could be conducted on the mechanical properties of these species to enhance their utilization in the timber industry.

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