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CORRELATING BARK THICKNESS AND GIRTH OF SOME MEDICINAL TREES

Fasola Taiye R.[1]*, Olagunju B.O.[2] and Robert A.B.C. [3]

[1,2]Department of Botany, University of Ibadan, Ibadan, Nigeria

[3]Department of Statistics, University of Ibadan, Ibadan, Nigeria

*Corresponding author: tr.fasola@mail.ui.edu.ng

Abstract

Tree barks are continually used and sold for medicinal purposes in Nigerian markets. Incessant debarking of trees, particularly the young trees by bark harvesters poses danger on the growth and survival of the plants. As it cannot be ascertained if the harvested tree barks marketed in large numbers are from older or younger trees, the study aimed at providing solution to this problem. As Diameter at Breast Height (DBH) usually reflects the age of a tree, correlation between bark thickness and DBH was attempted with their various uses. Measurements of bark thickness at breast height and DBH of 69 medicinal tree species belonging to nineteen different families were carried out in various locations in the University of Ibadan campus, Ibadan, Nigeria. The findings subjected to correlation analysis had a positive correlation between the thickness of tree barks and tree girth at breast height. The confirmed knowledge of a positive correlation between tree bark thickness and girth of tree plant is necessary to determine if the barks sold in major markets for ethnomedicinal purposes are harvested from older or younger trees. The medicinal values of the tree barks as antimarial, purgative, haematinic and antimicrobial among other uses were discussed.

Key words: Trees, Tree girth, Tree bark thickness, Ethnomedicine, Debarking, Medicinal plants

Introduction

Bark is the outermost layer of stem and root of a woody plant and it refers to all the tissues outside of the vascular system (Raven *et al*., 1981). The epidermis of newly grown stems is replaced by periderm; and as the stems grow, a layer of cells form under the epidermis, called the cork cambium. The cork cells which are characterized by suberin, a fatty substance which usually occurs as a distinct lamella that covers the lumina of cork cells may contain resinous or tanniniferous materials. A limited number of cell layers may form interior to the cork cambium, called the phelloderm. It is however known that as the stem grows, the cork cambium produces new layers of cork which are impermeable to gases and water and the cells outside of the periderm, namely the epidermis, cortex and older secondary phloem die (Mauseth, 2003).

Bark replaces the epidermis, and acts as a protective covering. It consists of the inner bark and the outer bark. The outer bark on trees is also called the rhytidome. It serves as protection against damage from parasites and herbivorous animals as well as dehydration and fire. Besides it protects trees against disease organisms like a scab on a wound. Mature phellem cells have suberin in their walls to protect the stem from desiccation and pathogen attack. Older phellem cells are dead as is the case with woody stems (Peterson and Barker, 1979).

Bark extractives are products derived from bark and used by people. These include: tannin, resin, latex, medicines, spices and cork. Bark has been used to make cloths, canoes, ropes and as a surface for paintings and map making (Taylor, 1996). Tree bark strength was discussed by Myking *et al* (2005) by the presence of fibres known as bast; an old tradition in northern Europe of using bark from coppiced young branches of the small-leaved plant (*Tilia cordata*) to produce cordage and rope, used in the rigging of Viking age longships. Among the commercial products made from bark are cinnamon from various Cinnamomum species, quinine from the bark of Cinchona plant and aspirin from the bark of willow trees (Markham, 1880). The bark of some trees notably oak (*Quercus robur*) is known as a source of tannic acid, which is used in tanning leather. Bark chips generated as a by-product of lumber production are often used in bark mulch. Bark is important to the horticultural industry as the shredded form is used for plants that do not thrive in ordinary soil such as epiphytes.

A number of plants are also grown for their attractive and interesting bark colorations and the surface textures of the bark is also used as landscape mulch (KyellBloch *et al.,* 1993) and (Vaucher and Eckenwalder, 2003). The bark of some trees is edible, for instance, the Sami people of far northern Europe used large sheets of *Pinus sylvestris* bark that were rambemoved in the spring, prepared and stored for use as a staple food resource and the inner bark was eaten fresh, dried or roasted (Zackrisson *et al.,* 2000). As tree barks play significant role in tree fortification, it protects the delicate cambium layer from injury. It is often said that you do not need a chemical to kill a tree, rather infest the bark with injury. Debarking is a form of injurious act on plants, particularly when done without any form of control. In Nigeria, there is no measure of control on debarking and one is not even sure if barks harvested for various uses are from the younger or older trees. The debarking of younger trees has serious implication for conservation and should not be encouraged. It was therefore the aim of this study to correlate the bark thickness with the girth at breast height of the frequently debarked trees and their various medicinal purposes.

Methodology

A portion ($9cm^2$) of the entire bark of each of the 69 frequently debarked medicinal trees were carefully collected at breast height while the tree circumference was also measured at the same level. The tree girth (circumference at breast height) halved gives the Diameter at Breast Height (DBH). Each plant species was replicated thrice by obtaining portions of bark from 3 different points at breast height. The measurements were subjected to correlation analysis according to statistical package for the social sciences (Brace *et al*., 2006). The areas covered in this study were within the University of Ibadan campus, and mostly from the Botanical Gardens, plant nursery of the Department of Botany and Microbiology and the Zoological garden. Through literature and personal communication with herb collectors and users, a list of all species studied is presented with their medicinal importance.

Results and Discussion

The sixty nine tree species studied (Table 1) belong to 19 families with fabaceae (mimosoideae) having the highest frequency of seven followed by fabaceae (caesalpinoideae) with a frequency of five. Mimosoideae, caesalpinoideae and papilonoideae belong to the fabaceae family as subfamilies. Polhill and Raven (1981) have reported fabaceae (leguminosae) as one of the largest families of the flowering plants. Harborne (1994) in the same vein has fabaceae as the most important family in the Dicotyledonae in food production besides other uses including medicinal values. Chew *et al.* (2011) discussed the numerous medicinal benefits derived from fabaceae plants of Peninsular in Malaysia.

Table 1: Tree species indicating families, standard error of bark thickness and girth circumference at breast height

Serial no.	Botanical names	Families (Subfamilies)	Bark Thickness at Breast Height (mm)	Girth Circumference at Breast Height (m)
1	*Acacia aurculiformis* A.Cunn ex Benth.	Fabaceae (Mimosoideae)	7.04 ±0.87	1.07 ±0.37
2	*Adansonia digitata* Linn.	Bombacaceae	19.33 ±2.0	4.50 ±0.20
3	*Albizia lebbeck* (Linn.) Benth.	Fabaceae (Mimosoideae)	11.74 ±0.59	1.52 ±0.19
4	*Albizia saman* (Jacq.) F.Mill.	Fabaceae (Mimosoideae)	13.34±1.00	3.46 ±0.25
5	*Albizia zygia* (DC.) JF	Fabaceae (Mimosoideae)	6.73 ±1.25	1.57 ±0.19
6	*Alstonia boonei* De Wild	Apocynaceae	6.06 ±1.30	4.37 ±0.50
7	*Annona muricata* Linn.	Annonaceae	4.39 ±1.42	0.25±0.00
8	*Anogeissus leiocarpus* (DC.) Gull. & Perr.	Combretaceae	6.59 ±0.61	1.13±0.00
9	*Antiaris africana* Engl.	Euphorbiaceae	17.35 ±3.30	3.75 ±0.44
10	*Artocarpus altilis* (Park.) Forsberg	Moraceae	6.25 ±1.03	2.04±0.00

11	*Averrhoa bilimbi* Linn.	Oxalidaceae	3.76 ±0.52	0.52±0.67
12	*Averrhoa carambola* Linn.	Oxalidaceae	4.91 ±0.63	0.69±0.33
13	*Azadirachta indica* A. Juss	Meliaceae	11.31 ±1.68	1.02 ±0.28
14	*Blighia sapida* Konig	Sapindaceae	8.62 ±1.39	1.52 ±0.43
15	*Bombax buonopozense* P.Beauv.	Bombacaceae	7.96 ±0.24	2.83±0.27
16	*Bosquiea angolensis* Ficalho	Moraceae	4.70 ±0.28	1.63 ±0.23
17	*Bridelia ferruginea* Benth	Euphorbiaceae	4.10 ±0.70	1.48 ±0.24
18	*Cassia siamea* Lam	Fabaceae (Caesapinoideae)	7.19 ±0.88	0.94±0.00
19	*Casuarina equisetifolia* Forst	Casuarinaceae	4.85 ±0.66	1.64 ±0.19
20	*Cedrela odorata* Linn.	Meliaceae	11.65 ±0.57	2.71±0.59
21	*Ceiba pentandra* (Linn.) Gaertn.	Bombacaceae	13.83 ±0.87	4.44 ±0.53
22	*Chrysophyllum albidum* G Dor	Sapotaceae	3.78 ±0.60	2.01±0.33
23	*Citrus sinensis* (Linn.) Osbeck	Rutaceae	3.55 ±0.48	0.63±0.12
24	*Cleistopholis patens* (Benth.) Egle Diels	Annonaceae	4.71 ±0.78	2.29 ±0.33
25	*Cordia sebestena* Linn.	Boraginaceae	12.10 ±1.66	0.77 ±0.11
26	*Dacryodes edulis* (G. Don) H.J. Lam	Burseraceae	6.23 ±0.00	1.30 ±0.00
27	*Daniellia ogea* (Harms) Rolfe	Fabaceae (Caesapinoideae)	14.21 ±0.00	2.60 ±0.00
28	*Delonix regia* (Hook.) Raf.	Fabaceae (Caesapinoideae)	3.91 ± 0.22	1.16 ±0.16
29	*Dialium guineense* Wild	Fabaceae (Caesapinoideae)	5.26 ±0.64	1.90 ±0.19
30	*Enterolobium cylocarpum* (Jacq.) Griseb.	Fabaceae (Mimosoideae)	7.40 ±0.25	1.92 ±0.14
31	*Eucalyptus torelliana*	Myrtaceae	3.83 ±0.28	1.30 ±0.13
32	*Ficus exasperata* Vahl	Moraceae	2.70 ±0.13	1.20±0.28
33	*Ficus mucoso* Welw.	Moraceae	8.37 ±2.43	1.32 ±0.65
34	*Gliricidia sepium* (Jacq.) Walp	Fabaceae (Papillionoideae)	7.06 ±1.04	1.02±0.00
35	*Gmelina arborea* Roxb.	Verbenaceae	5.54 ±0.82	0.83±0.67
36	*Hevea brasiliensis* (Wild.)	Euphorbiaceae	10.14 ±0.93	2.07 ±0.24
37	*Khaya grandifoliola* C. DC.	Meliaceae	18.27 ±0.00	1.60 ±0.00
38	*Khaya senegalensis* (Desr.) A Juss.	Meliaceae	10.34 ±1.35	4.48 ±0.55

39	*Lagerstroemia speciosa* (Linn.) Pers.	Lythraceae	11.46 ±1.77	1.35 ±0.26
40	*Lecaniodiscus cupanioides* Planch.	Sapindaceae	5.07 ±1.71	5.19 ±1.09
41	*Leucaena leucocephala* (Lam.) De Wit.	Fabaceae (Mimosoideae)	3.55 ±1.28	0.57±0.00
42	*Mangifera indica* Linn.	Anacardiaceae	12.14 3.95	1.61 ±0.45
43	*Milicia excelsa* (Welw.) CC Berg	Moraceae	11.55 ±0.43	3.80 ±1.13
44	*Monodora tenuifolia* Benth.	Annonaceae	6.97 ±0.92	1.73±0.00
45	*Morinda lucida* Benth.	Rubiaceae	4.06 ±0.48	1.06 ±0.23
46	*Newbouldia laevis* Seem	Bignoniaceae	12.12±1.46	0.75 ±0.19
47	*Parkia biglobosa* (Jacq.) R.Br.	Fabaceae (Mimosoideae)	12.79 ±3.11	1.9500 0.46
48	*Peltophorum pterocarpum* (DC.) Heyne	Fabaceae (Caesapinoideae)	8.97 ±1.81	1.76 ±0.23
49	*Pentaclethra macrophylla* Benth.	Fabaceae (Mimosoideae)	9.80 ±0.60	1.37±0.00
50	*Persea americana* Mill.	Lauraceae	4.02 ±0.51	0.24±0.00
51	*Phyllanthus discoideus* (Baill.) Mull.-Arg	Euphorbiaceae	9.09 ±3.14	1.06 ±0.14
52	*Pinus caribaea* Morelet		11.52 ±2.46	1.29 ±0.14
53	*Plumeria alba* Linn.	Apocynaceae	9.75 ± 0.54	0.81±0.33
54	*Psidium guajava* Linn.	Myrtaceae	4.47 ±0.63	0.50±0.00
55	*Pterocarpus osun* Craib	Fabaceae (Papilionoideae)	5.16 ±0.00	1.47 ±0.00
56	*Rauwolfia vomitoria* Afzel.	Apocynaceae	4.56 ±0.46	0.86 ±0.14
57	*Spathodea campanulata* P. Beauv.	Bignoniaceae	4.99 ±0.54	2.64 ±0.22
58	*Spondias mombin* Linn.	Anacardiaceae	19.29 ±2.78	1.53 ±0.44
59	*Sterculia tragacantha* Lindl.	Sterculiaceae	11.33 ±0.00	1.60 ±0.00
60	*Synsepalum dulcificum* (Schum. & Thonn.) Daniell	Sapotaceae	1.79 ±0.26	0.37±0.67
61	*Tabebuia rosea* (Bertol.) DC	Bignoniaceae	15.75 ±4.12	2.04 ±0.13
62	*Terminalia catappa* Linn.	Combretaceae	8.80 ±0.78	1.69 ±0.00
63	*Terminalia superba* Engl.& Diels	Combretaceae	9.06 ±0.00	1.87 ±0.00
64	*Theobroma cacao* Linn.	Sterculiaceae	1.20 ±0.23	0.51 ±0.12
65	*Thevetia neriifolia* Juss. ex A. DC.	Apocynaceae	7.32 ±1.35	0.47 ±0.18

66	*Treculia africana* Decne	Moraceae	2.75 ±0.36	0.79 ±0.16
67	*Triplochiton scleroxylon* K Schum	Sterculiaceae	9.49 ±0.4964	4.59 ±0.30
68	*Vitex doniana* Sweet	Verbenaceae	12.81 ±1.24	3.02 ±0.36
69	*Xylia xylocarpa* (Roxb.) Taub.	Fabaceae (Mimosoideae)	10.58 ±1.19	1.15 ±0.29

The tree species are grouped into Figs 1 - 3 according to their generic first alphabetical codes. Figure 1 represents A- C plant species while Fig.2 has D – M plant species and Fig. 3 consists of N - X plant species. Among the Figs 1-3, *Leucaniodiscus cupanoides* had the highest girth circumference of 5.19m (259.5 cm DBH). This was followed by *Triplochiton scleroxylon* (229.5cm DBH) and *Adansonia digitata* was with 225cm DBH, while the least girth was 0.24m (12cm DBH) for *Persea americana*. A statistically generated model shows that there is a positive correlation ($P < 0.05$) between the bark thickness and the DBH and that

Bark thickness = Natural log (Girth Diameter) / 0.67

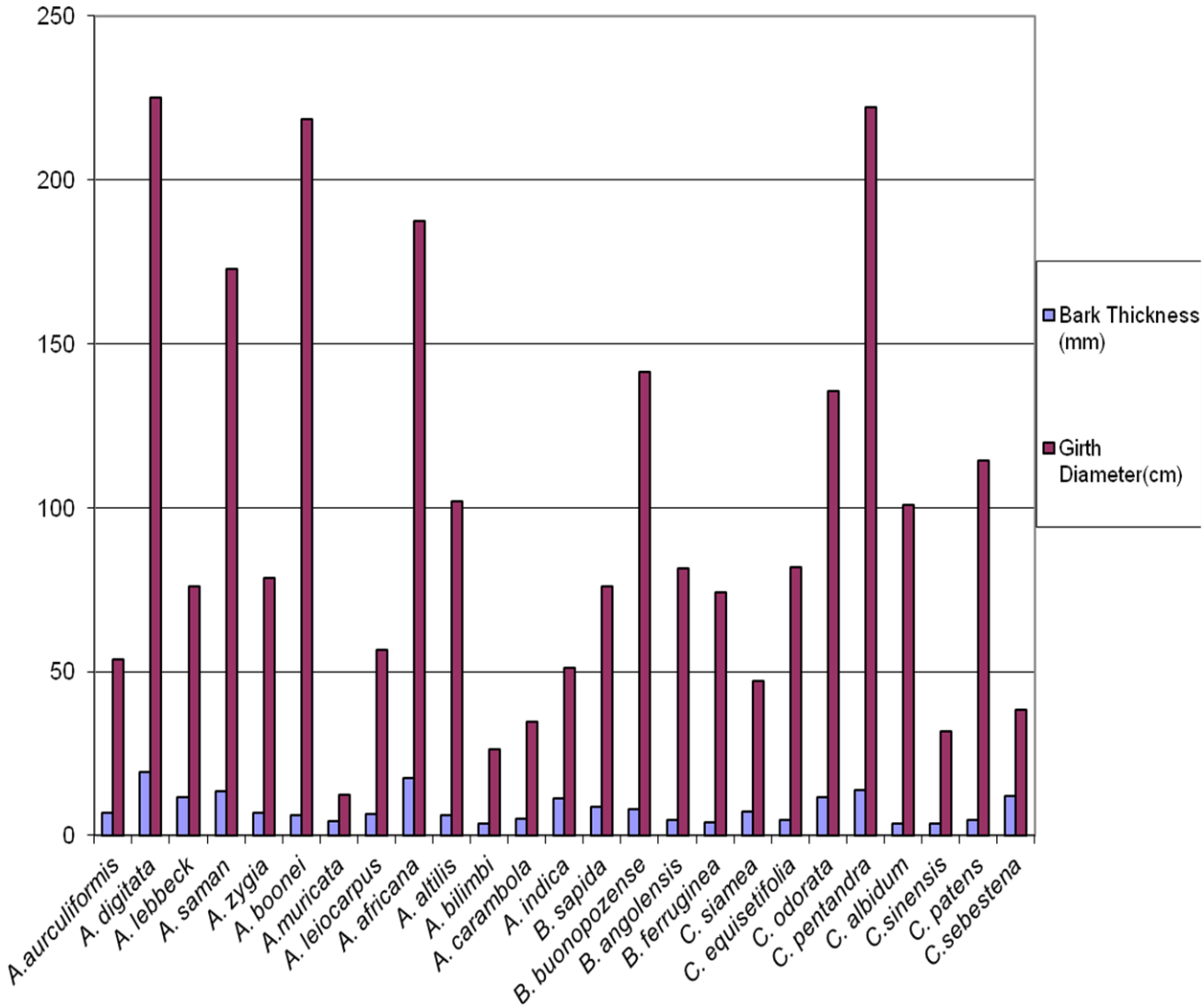

Fig.1 showing trees (A - C species) bark thickness and girth diameter at breast height

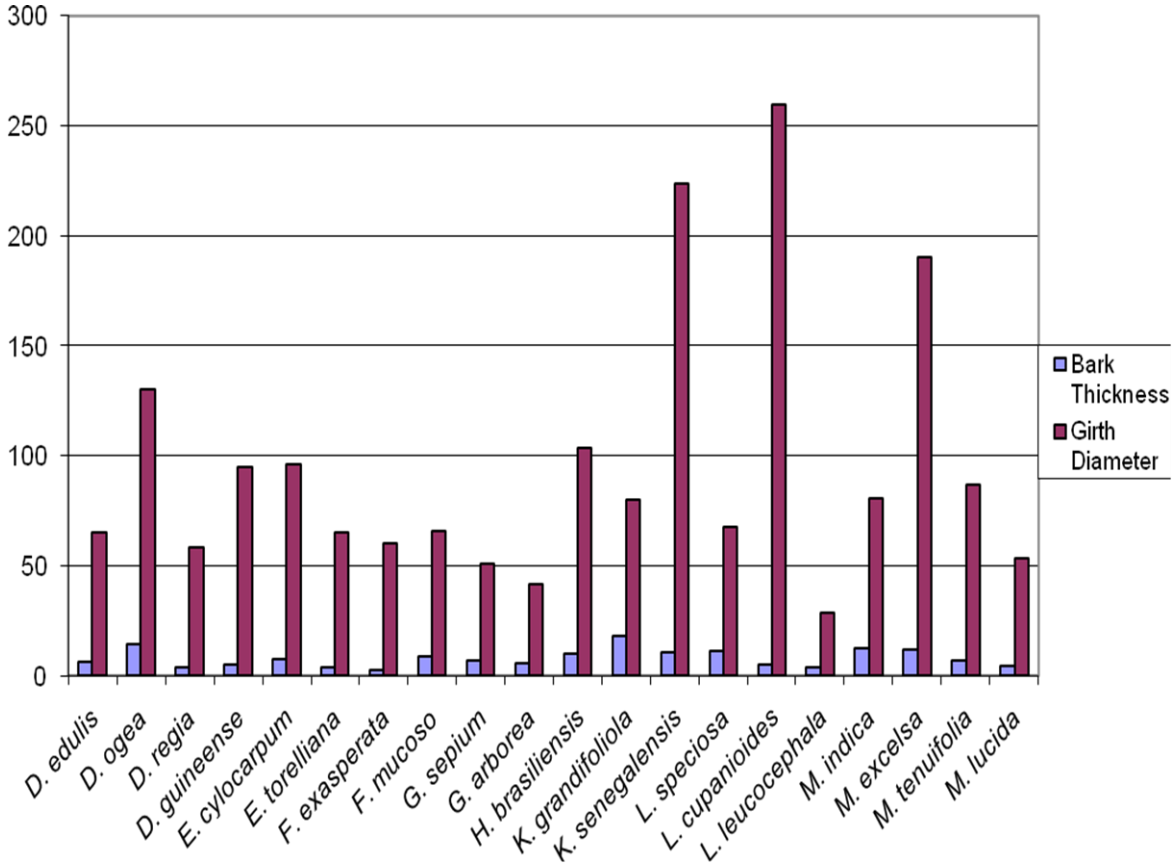

Fig. 2 showing trees (D - M species) bark thickness (mm) and girth diameter (cm) at breast height

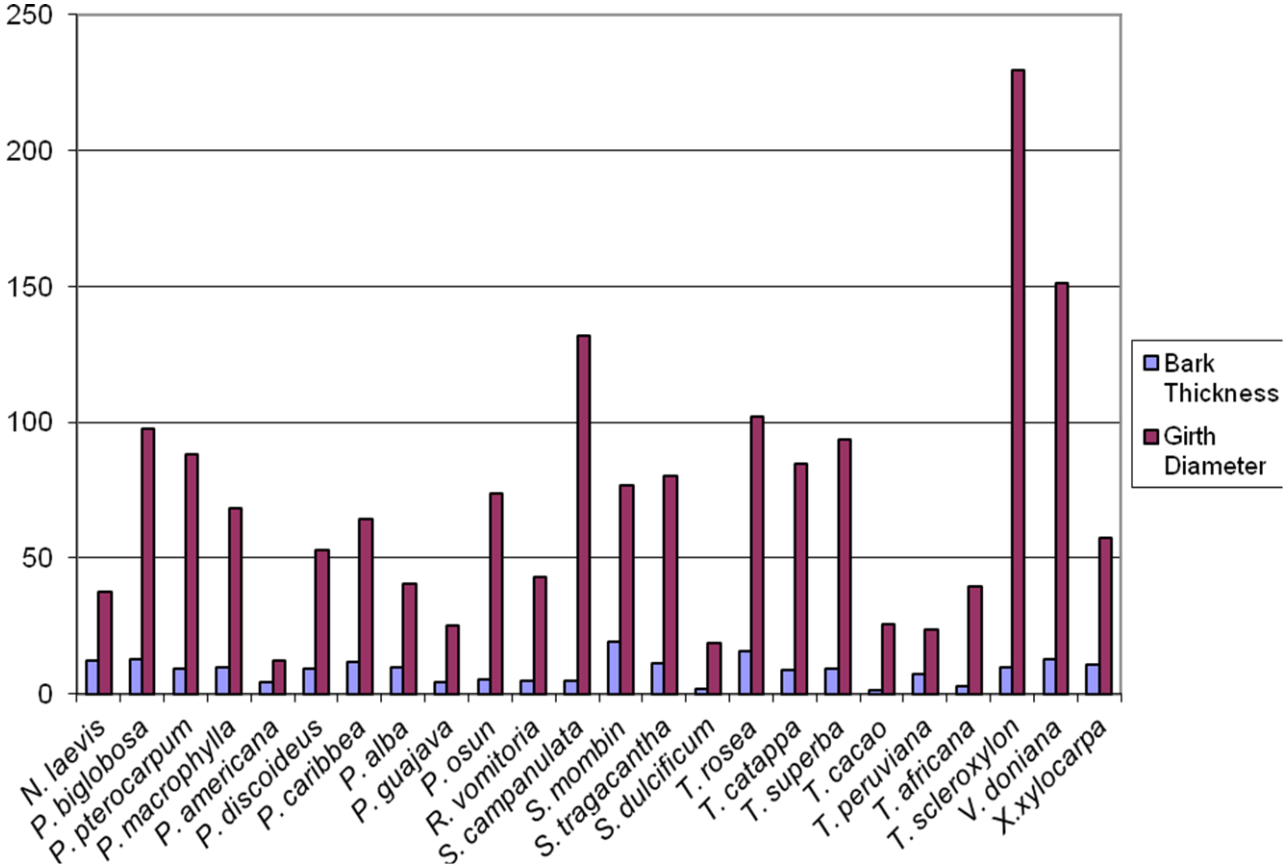

Fig. 3 showing trees (N - X species) bark thickness (mm) and girth diameter (cm) at breast height

This study has shown a positive correlation of tree bark thickness and girth diameter at breast height. Tree bark thickness was observed to vary among different species, thickness of tree bark also varied within the same tree species. The variations observed among the different species are expected in view of the fact that they are not of the same morphological make up. On the variations observed within the same family, these may not only be due to morphological features but also due to the difference in their ages. The clear correlation between the bark and girth in this work is of great importance. This finding may stimulate further research studies on members of the same family of plants. As far as we know, this is the first time this study is being reported in Nigeria hence it is highly significant.

Severe anthropogenic pressure have been reported to deplete and fragment forests in many ways (Rahmam and Rashid, 2013; Chaudhary *et al*. 2014). The plants used in this study were not from disturbed environment as disturbance could be as a result of drought, flooding, overharvesting of plant parts and particularly fire disaster. Hegde *et al.* (1998) reported that though there is a significant tendency for bark thickness to increase with tree girth, their findings showed a significant trend for species from more disturbed habitats to possess thicker bark. These studies also showed that species from more disturbed habitats also have a greater propensity for secreting gums and resins. Nine of the 29 species occurring in more than one habitat type and with a sample size of at least 11 individuals showed a tendency for possession of a thicker bark by individuals in the more disturbed habitats. They however concluded that bark thickness and occurrence of gums and resins are physiognomic-structural attributes of value in characterizing tree communities created by different levels of disturbance. The positive correlation observed at tree diameter at breast height had been used in diverse ways in forecasting and assessing threats associated with increasing age of trees. As an example, Lukaszkiewicz *et al* (2005) forecasted the size of some *Tilia* species in the future with a DBH-based model. In the same vein, O' Brien *et al* (1995) demonstrated a relationship in plant diameter, height, crown, and age of eight neotropical tree species.

The selection of bark thickness is favoured by the girth size. This implies that bark thickness could be selected in considering girth size in future studies. The performance of bark thickness is influenced by girth size and this will serve as a guide to know the tree girth range for a particular thickness of tree bark. The model could therefore be useful in ascertaining if tree barks sold in the herbal markets have been harvested from big or smaller trees, so as to safeguard existing trees. In as much as over debarking of tree barks could be destructive; debarking from young trees has more devastating consequences which may not be reversible. Implication of bark thickness to girth ratio will therefore enable a bark picked up in the market give an idea if it is from young or older tree.

Table 2a: The medicinal importance of the debarked tree species

Serial No.	Botanical Names	Bark Medicinal Values / diseases treated
1	*Acacia auriculiformis* A.Cunn ex Benth.	Rheumatism
2	*Adansonia digitata* Linn.	Antimalaria, febrifuge, anti-periodic, diaphoretic, antidote to poison, toothache.

3	*Albizia lebbeck* (Linn.) Benth.	Eczema, bronchial asthma, insect bites
4	*Albizia saman* (Jacq.) F.Mill.	Local anesthetics
5	*Albizia zygia* (DC.) JF	Aphrodisiac, anthelmintic, stomach pain
6	*Alstonia boonei* De Wild	Antimalaria, cough, sores, anti-poison, sore throat, anthelmintic, ulcers, rheumatism, chronic diarrhoea
7	*Annona muricata* Linn.	Stomachic
8	*Anogeissus leiocarpus* (DC.) Gull. & Perr.	Laxative, diarrhoea, sores, syphilitic chancres
9	*Antiaris africana* Engl.	Chest pain
10	*Artocarpus altilis* (Park.) Forsberg	Skin ailments
11	*Averrhoa bilimbi* Linn.	Fever, strong anti-scorbutic
12	*Averrhoa carambola* Linn.	Prickly heat
13	*Azadirachta indica* A. Juss	Antimalaria, anti-pyretic, syphilis, anthelmintic, stomachic, tonic, stimulant, demulcent
14	*Blighia sapida* Konig	Stimulant, topical embrocation on oedemas and intercostal pain
15	*Bombax buonopozense* P.Beauv.	Emollient, anti-dermatitis, emmanagogue, febrifuge
16	*Bosquiea angolensis* Ficalho	Arthritis, rheumatism, stomach troubles
17	*Bridelia ferruginea* Benth	Mouthwash, toothache, dysentery, diarrhoea, laxative, anti-poison, anti-dermatitis
18	*Cassia siamea* Lam	Antimalaria, purgative
19	*Casuarina equisetifolia* Forst	Dysentery, diarrhoea
20	*Cedrela odorata* Linn.	Bruises, sprains, internal injury
21	*Ceiba pentandra* (Linn.) Gaertn.	Asthma, heart-trouble, febrifuge, astringent, bowel-complaints, diarrhoea, skin infections, dysentry, mouth wash, emetic, hernia, blennorrhoea, anti-spasmodic
22	*Chrysophyllum albidum* G Dor	Purgative, lactation, haemorrhoid
23	*Citrus sinensis* (Linn.) Osbeck	Tonic, carminative
24	*Cleistopholis patens* (Benth.) Egle Diels	Tuberculosis, purgative, whitlows, simple bronchial infections, colic
25	*Cordia sebestena* Linn.	Cough, bronchial ailments
26	*Dacryodes edulis* (G. Don) H.J. Lam	Tonsilitis, anaemia, emmenagogue, parasitic skin diseases, cutaneous conditions, dysentry, gargles and mouth wash
27	*Daniellia ogea* (Harms) Rolfe	Gonorrhoea

28	*Delonix regia* (Hook.) Raf.	Intermittent fever
29	*Dialium guineense* Wild	Anagelsic, sore throat, stomachic, dropsy
30	*Enterolobium cylocarpum* (Jacq.) Griseb.	Colds
31	*Eucalyptus torelliana*	Antibacterial, Gastroprotective
32	*Ficus exasperata* Vahl	Sores, abscesses, eye-troubles, stomach pains, haemorrhoids
33	*Ficus mucoso* Welw.	Convulsions, otitis
34	*Gliricidia sepium* (Jacq.) Walp	Anti-atherogenic
35	*Gmelina arborea* Roxb.	Stomachic, galactagogue, laxative and anthelmintic; improves appetite, useful in hallucination, piles, abdominal pains, burning sensations, fevers, urinary discharge
36	*Hevea brasiliensis* (Wild.)	Latex is antifungal
37	*Khaya grandifoliola* C. DC.	Antimalaria, skin-complaints, venereal diseases, analgesic for post-partum pain
38	*Khaya senegalensis* (Desr.) A Juss.	Antimalaria, anti-dermatitis, strong emetic and purgative
39	*Lagerstroemia speciosa* (Linn.) Pers.	Diarrhoea, constipation
40	*Lecaniodiscus cupanioides* Planch.	Febrifuge, cough, broncho-pneumonial affections, purgative, sprains, burns and bruises
41	*Leucaena leucocephala* (Lam.) De Wit.	Anthelmintic, blennorrhoea, eye-sight troubles, sores
42	*Mangifera indica* Linn.	Antimalaria, haematinic, astringent, diarrhoea, dysentery, toothache, sore gums, sore throat, diuretic, anti-dermatitis
43	*Milicia excelsa* (Welw.) CC Berg	Antimicrobial, expectorant, venreal sores, elephantiasis of the scotum, wash chancres, analgesic, rheumatism, strong purgative, skin troubles, antiseptic, stomachic, blennorrhoea, leprosy, painful menstration
44	*Monodora tenuifolia* Benth.	Dysentery
45	*Morinda lucida* Benth.	Astringent, fever, itching, ringworms, hypertension, cerebral complications
46	*Newbouldia laevis* Seem	Epilepsy, convulsions, dysmonorrhoea, analgesic, chest pain, toothache, cough, diarrhoea, stomachic, rheumatism, dysentery, leprosy, pulmonary affections, breast tumour
47	*Parkia biglobosa* (Jacq.) R.Br.	Tonic, diarrhoea, mouthwash, toothache, orchitis, enema, female sterility, bronchitis, pneumonia, osteitis, skin infections, leprosy, blennorrhoea,

		anti-rachitic, febrifuge
48	*Peltophorum pterocarpum* (DC.) Heyne	Dysentry, gargles, tooth-powder, eye-lotions, embrocations for pains and sores
49	*Pentaclethra macrophylla* Benth.	Sores, psoriasis, leprosy, lactogenic, blennorrhoea, laxative, dysentry, anthelmintic, senile impotence, asthma, analgesic, sedative
50	*Persea americana* Mill.	Cough
51	*Phyllanthus discoideus* (Baill.) Mull.-Arg	Kidneys, diuretics, menstrual cycle, stomach troubles, vermifuges
52	*Pinus caribaea* Morelet	Wounds, skin infections
53	*Plumeria alba* Linn.	Diuretic, strong purgative
54	*Psidium guajava* Linn.	Diarrhoea
55	*Pterocarpus osun* Craib	Asthma, dermatomycosis, candidiasis, antipyretic, sickle-cell disorder, amenorrhoea, rheumatic complaints, fractured bones
56	*Rauwolfia vomitoria* Afzel.	Chickenpox, antimalaria, antimicrobial
57	*Spathodea campanulata* P. Beauv.	Diarrhea, dysentery, scrotal hernia, syphilitic sores, stomachache, cough, intercostals pain, haematuria, urethral discharge, constipation
58	*Spondias mombin* Linn.	Leprosy, antifungal, severe cough, sores, anthelmintic, stomachic, diarrhoea, bronchitis, poison antidote
59	*Sterculia tragacantha* Lindl.	Blood purifier, inflammatory, colds, emetic, dysentery, vermifuge, swellings, leprosy, pneumo-thoracic conditions
60	*Synsepalum dulcificum* (Schum. & Thonn.) Daniell	Anthelmintic
61	*Tabebuia rosea* (Bertol.) DC	Fever, pneumonia, analgesic, abdominal troubles, induce sleep
62	*Terminalia catappa* Linn.	Astringent, dysentery, gonorrhoea, leucorrhoea, bilious fever, stomach-cramp
63	*Terminalia superba* Engl.& Diels	Astringent, dysentery, antiemetic, gingivitis, sterility in women, antiseptic for sores and wounds
64	*Theobroma cacao* Linn.	Haematinic
65	*Thevetia neriifolia* Juss. ex A. DC.	Emetic, febrifuge, purgative, amenorrhoea,
66	*Treculia africana* Decne	Laxative, cough, vermifuge, anthelmintic, leprosy, rheumatism, tonic
67	*Triplochiton scleroxylon* K Schum	Embrocation on oedemas in pregnant women, painful menstration
68	*Vitex doniana* Sweet	Sedative, stomachic, nausea, colic, kidney trouble, epileptic fits, sterility, leprosy, mouth

		infections, cough, diarrhea, trypanosomiasis, skin infections
69	*Xylia xylocarpa* (Roxb.) Taub.	Antidiarrheal, fevers

Sources: Adeniyi *et al* (2006); Burkill (1985, 1994, 1995, 1997, 2000); www.naturia.per.sg/buloh/plants/acacia; www.biomedcentral.com/1472-6882/13/147/table/T2; Dasgupta *et al*., (2013); Edmund *et al* (2014); http://plants.jstor.org/upwta/4_341; Maurice (1993); www.hort.purdue.edu/newcrop/morton/orange.html; www.greenpatio.com; http://en.wikipedia.org/wiki/Gmelina_arborea; http://cat.inist.fr/?aModele=afficheN&cpsidt=1950846; www.wisegeek.com/what-are-the-medical-uses-of-lagerstroemia-speciosa; http://plants.jstor.org/upwta/2_222; Olowokudejo *et al* (2008); http://database.prota.org/PROTAhtml/Pterocarpus%20osun_En.htm; http://nutrisearch.blogspot.com/2011/02/pomegranate-miracle-fruit.html; http://herbstohealth.blogspot.com/2010/03/xylia-xylocarpa-roxb-taub-daeng.html and personal communication

Table 2b: Summary of Table 2a

Serial No.	Botanical Names	No of Uses		Serial No. Cont'd	Botanical Names	No of Uses		Serial No. Cont'd	Botanical Names	No of Uses
1	*A. auriculiformis*	1		24	*C. patens*	5		47	*P. biglobosa*	15
2	*A. digitata*	6		25	*C. sebestena*	2		48	*P. pterocarpum*	6
3	*A. lebbeck*	3		26	*D. edulis*	7		49	*P. macrophylla*	12
4	*A. saman*	1		27	*D. ogea*	1		50	*P. americana*	1
5	*A. zygia*	3		28	*D. regia*	1		51	*P. discoideus*	5
6	*A. boonei*	9		29	*D. guineense*	4		52	*P. caribaea*	2
7	*A. muricata*	1		30	*E. cylocarpum*	1		53	*P. alba*	2
8	*A. leiocarpus*	4		31	*E. torelliana*	2		54	*P. guajava*	1
9	*A. africana*	1		32	*F. exasperata*	5		55	*P. osun*	8
10	*A. altilis*	1		33	*F. mucoso*	2		56	*R. vomitoria*	3
11	*A. bilimbi*	2		34	*G. sepium*	1		57	*S. campanulata*	10
12	*A. carambola*	1		35	*G. arborea*	11		58	*S. mombin*	9
13	*A. indica*	8		36	*H. brasiliensis*	1		59	*S. tragacantha*	9
14	*B. sapida*	3		37	*K. grandifoliola*	4		60	*S. dulcificum*	1
15	*B. buonopozense*	4		38	*K. senegalensis*	4		61	*T. rosea*	5
16	*B. angolensis*	3		39	*L. speciosa*	2		62	*T. catappa*	6
17	*B. ferruginea*	7		40	*L. cupanioides*	7		63	*T. superba*	6
18	*C. siamea*	2		41	*L. leucocephala*	4		64	*T. cacao*	1
19	*C. equisetifolia*	2		42	*M. indica*	10		65	*T. neriifolia*	4
20	*C. odorata*	3		43	*M. excelsa*	14		66	*T. africana*	7
21	*C. pentandra*	13		45	*M. tenuifolia*	1		67	*T. scleroxylon*	2
22	*C. albidum*	3		45	*M. lucida*	6		68	*V. doniana*	13
23	*C. sinensis*	2		46	*N. laevis*	14		69	*X. xylocarpa*	2

The different medicinal uses of the tree barks shown in Table 2a have the highest frequency of usage for diarrhoea and dysentery with abdominal related problems while dermatitis followed closely with cough and sore throat; malaria and fever. Asthma and bronchial related ailments; rheumatism and arthritis were also commonly treated using some of the plants. Based on Table 2b, plants having a frequency of 15 were the most used medicinally. Next are the plants having the frequency of 14. These figures show that plants in both groups are the most variously used medicinally. The implication of their frequency of usage is in their conservation. As examples, *Parkia biglobosa*, *Milicia excelsa and Newbouldia laevis* may face the problem of over debarking and re-debarking since they have multiple uses medicinally. The use of tree bark medicinally has been arrogated to their various constituents. However, the fact that they can keep for a while and do not easily go mouldy is a factor to be considered. Since they are easily accessible for harvesting in the wild, encourages frequent debarking (Fasola and Egunyomi, 2002). It has been observed that some plants have similar uses. As an example, P.guajava bark could treat diahorea as the only use in this study while N.laevis bark that is also used to treat diahorea has 13 other uses (Tables 2a and 2b). Hence, P.guajava bark could be used as the case may be for diahorea treatment so as to reduce pressure on N.laevis bark. It will therefore be essential that in similar bark uses, plant species with least usage be promoted for use over those of multiple uses so as to avoid further debarking of the already over sourced plants.

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