Nigerian Usage of Bark in Phytomedicine

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Abstract

Some investigations on the use of bark in phytomedicine were carried out. A comparison of the phytochemicals of re-grown stem bark (after debarking) with those of older bark of the same tree species, revealed that almost all the phytochemicals screened were present in both old and new bark; indicating that the newly-grown bark is also medicinally useful. A taxonomic key that would facilitate the identification of dry bark of 15 frequently used tree species has been constructed. Seven fungal species, Aspergillus niger, Penicillin digitatum, Rhizopus stolonifer, Neurospora crassa, Fusarium flavus, Mucor mucedo and Botryodiplodia theobrome were isolated from bark stored in the market for 1 – 2 years. Some of these saprophytic organisms of stored products may also cause diseases in humans. The implications of these findings for the use of bark in phytomedicine are discussed.

Introduction

As revealed by the World Bank data on African Development Indicators (2003) the ratio of medical doctors to total population for 1990 – 2000 in Nigeria was 1:5,208. This situation and the fact that international commercial medicines are becoming increasingly expensive and out of reach of most Nigerians have contributed to the dependence of a large percentage of the populace on local produced herbal medicine (Sofowora 1992). Consequently, medicinal plants are indiscriminately harvested from the wild. In an ethnobotanical survey carried out in parts of southwestern Nigeria, (Aboaba 2002) reported that bark constitute 35% of the use-value of various plant parts.

Market Storage Conditions

Bark and other parts sold in herbal markets in southwestern Nigeria are usually displayed openly and often become dust-ridden over a long period of time until they are eventually sold. It seems that there has been no attention focused by researchers on the shelf lives of the plant parts. Due to its relative thickness, bark probably has a longer shelf life than leaf material, but how long they keep for safe use without fungal infestation of stored products is not known. Some are stacked in sheds or containers, which likely promote microbial infections.

Odebode and Sanusi (1996) reported that Botryodiplodia theobromae, Aspergillus niger and Rhizopus oryzae were associated with the ripening of bananas depleting the nutritional content and caused rot during storage. Similarly, Odebode and Unachukwu (1997) observed that B. theobromae, A. niger and R. oryzae caused rot during storage of carrot roots, thereby substantially decreasing the amounts of total soluble sugar in rotted carrots 2 – 4 days after infection. In human medicine, some Aspergillus spp. such as A. flavus, A. niger and A. fumigatus are ubiquitous saprophytes which may cause diseases broadly known as aspergillosis. Species of Mucor and Rhizopus are human pathogens causing common infections collectively referred to as zygomycosis (Brooks et al. 1998)

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Harvest of Bark of Varying Ages

A general field observation in parts of southwestern Nigeria is that tree species that appear to have quick re-growth of their harvested bark are persistently extracted soon after each recovery. Not all trees re-grow their bark and there appears to be a range of variation in recoverability. Cunningham and Mbenkun (1993) reported that at one extreme in Cameroon, *Faurea macnaghtorca* and *Podocarpus henkelli* are the species most sensitive to bark removed while *Warburgia salutaris* (Bertol.f.) Chiov. and *Prunus africana* (Hook.f.) Kalkman are at the other extreme where complete bark re-growth can occur after the trunk has been ring-debarked. Fasola and Egunyomi (2002) reported that *Alstonia boonei* De Wild., *Entandrophragma angolense* (Welw.) C. DC., *Khaya grandifoliola* C. DC., *K. senegalensis* (Desr.) A. Juss. and *Spondias mombin* L., belong to the fast re-growth group while bark of *Adansonia digitata* L., *Gliricidia sepium* (Jacq.) Walp., *Newbouldia laevis* (Pal.) Bureau and *Theobroma cacao* L. had relatively slow re-growth. However, the negative impact of continuous debarking of a tree or shrub may be manifested by some species since the coppicing ability and vulnerability to attacks of pests, vary with the physiology and anatomy of the different species. As bark also vary in morphology and anatomy; this may influence the capacity of a species to withstand continuous bark extraction

Khaya senegalensis and *K. grandifoliola* are used for various herbal formulations in Nigeria. Although the bark is continually harvested soon after each recovery, the re-grown bark seems to differ in morphological features from the original stem bark. Bark users may select older bark, considering it to be more effective, however it is not known if this is true. The result is that bark harvesters are likely to select older bark rather than new. It is unknown whether the different generations of bark have the same phytochemical profiles responsible for their medicinal properties.

Bark Identification

Despite the importance of bark in ethnomedicinal practice, their identification, especially in dry states continues to be a major problem. Information on bark anatomy of tropical trees and its use in taxonomy is scarce (Wood 1952). Whitmore (1962) introduced certain criteria for the identification and classification of different species on the basis of bark morphology. Whitmore's and other criteria were applied by Yunus and Igbal (1990) for field identification of 103 Indian trees. A key for identifying bark of some frequently – used medicinal trees will enhance their use in herbal preparations.

Research Aims

The present study, aims to ascertain whether re-growth bark has similar phytochemical profiles as the old bark of the same tree species. We have constructed a key for identifying stem bark of the most frequently used medicinal trees. We have also isolated fungi on bark stored for extended periods and hope that this information will be useful for those needing to assay bark for fungal contamination. Expectedly, these findings will enhance the use of bark in phytomedicines.

Materials and Methods

Three stores having predominantly bark samples were selected for this study at Bode herbal market, the largest in Ibadan. Some old bark samples of 1 to 2 years of storage were purchased from each. The selection of plant materials was based on external characteristics such as changes in color, powdery formations, perforations and visible fungal infections. The plant materials were identified and in view of the fact that many of them were moldy, it was decided to isolate and identify fungal species. Voucher specimens of each collection have been deposited in the University of Ibadan Herbarium (UIH).

Storage Conditions and Fungal Isolation

Temperature and humidity readings were taken thrice weekly for two months in each store. Temperature was measured with a thermometer. Humidity was measured by whirling hygrometer during the rainy season when moldiness of stored materials was usually common.

Small bark samples were cut from each bark collection. These were surface sterilized with 70% alcohol and cut with sterile inoculating needles on to labelled Sabour and Dextrose Agar (SDA) plates and Potato Dextrose Agar (PDA) plates. Plates were prepared in triplicate. A set of SDA and PDA plates were incubated at room temperature while the other sets were kept at 37oC. The plates were observed daily and the different growing organisms were transferred onto SDA and PDA in separate Petri dishes and incubated at room temperature. They were observed macroscopically and microscopically for characteristic features and identified using the methods of Rebell and Taplin (1978) and Al-Doory (1980).

Phytochemical Tests

The pulverized bark of newly re-grown and old bark of the same tree species were screened for the presence of alkaloids, saponins, tannins, anthraquinone, and glycosides using the methods reported by Odebiyi and Sofowora (1978).

Bark Identification Key

A taxonomic key that facilitates identification of dry, most frequently used bark, was prepared. This was accomplished by closely observing the morphology of bark samples after storage for 6 months.

Results

Storage Conditions and Fungal Isolation

The mean temperature and humidity of the 3 herbal stores ranged from 29 – 31oC and 78 – 95% respectively. Generally, in the market, plant materials were stacked together in shops that lacked ventilation, while some others were spread on the floor. In some cases, the materials were exposed to sunlight and at times beaten by rain.

Biological contaminants included insects and fungi. Some samples were perforated by weevils under storage conditions. As an example *Bridelia ferruginea* released powdery substances from the perforations – an indication that it may not be as potent as the unspoiled sample. Fungi identified from bark are reported in table 1.

Table 1. **Bark samples having fungal contamination.**

Plant species	Fungal contaminant
Adansonia digitata L.	*Neurospora crassa*
	Aspergillus niger
Adenia lobata Engl.	*Mucor mucedo*
Erythrophleum suaveolens (Guill & Perr.) Brenan	*Rhizopus stolonifer*
	Penicillium digitata
Ficus exasperata Vahl.	*Aspergillus niger*
Mitragyna stipulosa O. Kuntze	*Botryodiplodia theobrome*
Spathodea campanulata Beauv	*Fusarium flavus*
Trichilia emetica Vahl.	*Penicillium digitata*

Phytochemical Tests

Experimental results of the original (old) and re-grown (new) bark phytochemically compared (Table 2) show the presence of similar secondary metabolites. As shown in Table 2 exceptions occur with the presence of saponins in the old but not new bark of *Morinda lucida*. Likewise, the

Table 2. **A comparison of phytochemicals of old and new growth stem bark from nine trees used medicinally in Nigeria.**

Species	Voucher	Bark	Saponins	Alkaloids	Tannins	Anthraquinones	Cadiac Glycosides
Alchornea cordifolia	UIH 22266	Old	+	+	+	+	-
		New	+	+	+	+	-
Alstonia boonei	UIH 22260	Old	+	+	+	-	+
		New	-	+	+	-	+
Azadiractha indica	UIH 22261	Old	+	-	-	-	+
		New	+	-	-	-	+
Bridelia micratha	UIH 22267	Old	+	-	+	-	-
		New	+	-	+	-	-
Enantia chlorantha	UIH 22268	Old	+	+	-	-	+
		New	+	+	-	-	-
Khaya senegalensis	UIH 22263	Old	+	-	+	-	+
		New	+	-	+	-	+
Lecaniodiscus cupaniodes	UIH 22264	Old	+	+	-	-	+
		New	+	+	-	-	+
Mangifera indica	UIH 22262	Old	+	+	+	-	+
		New	+	+	+	-	+
Morinda lucida	UIH 22265	Old	+	+	-	-	+
		New	-	+	-	-	+

Figure 1. Key for identification of bark of species commonly used medicinally in Nigeria.

1. Bark smooth 2
    2. Bark with numerous and irregular scattered lenticels..... *Lannea welwitschii*
    2. Bark without lenticels 3
        3. Bark orange brown, flaking off with cross sectional rings..... *Entadrophragma angolense*
        3. Bark dark grey to dark brown, without flakes and no cross sectional rings..... *Theobroma cacao*
1. Bark rough..... 4
    4. Bark light brown 5
        5. Bark thick 6
            6. Bark with wide shallow fissures separated by more or less flat ridges.. *Azadirachta indica*
            6. Bark without wide shallow longitudinal fissures 7
                7. Bark with flakes in irregular patches..... *Spathodea campanulata*
                7. Bark with flakes in irregular patches..... *Newbouldia laevis*
        5. Bark thin 8
            8. Bark fluted and fibrous ..... *Gliricidia sepium*
            8. Bark not fluted and not fibrous 9
                9. Bark deeply fissured flaking off in large thick patches..... *Sarcocephalus latifolius*
                9. Bark not fissured but flakes off in small, thin patches ..... *Alstonia boonei*
    4. Bark not brown 10
        10. Back thick grey 11
            11. Bark fibrous flaking off in very thin regular patches..... *Adansonia digitata*
            11. Back fibrous flaking off in very thin regular patches 12
                12. Bark often deeply fissured ..... *Spondias mobin*
                12. Bark not fissured ..... *Mangifera indica*
        10. Bark thin red to brownish red 13
            13. Bark with red thick rod-like ornamentations on the sur face..... *Khaya senegalense*
            13. Bark with brownish knot-like ornamentation on the surface ..... *Khaya gradifoliola*

presence of cardiac glycoside is shown in the old but not new bark of *Enantia chlorantha*.

Bark Identification Key

The morphological characters identified were color, flaking, scaly, fluted, fibrous, fissures, thickness and smoothness. An indented key (Figure 1) was formed for identification of bark of the frequently used medicinal trees.

Discussion and Recommendations

Storage Conditions and Fungal Isolation

The seven saprophytic fungal species isolated from the bark samples studied have been also associated with other stored crop products. In the light of these reports, long-term bark storage should not be used in phytomedicines as there is a clear risk of causing further health problems.

By stacking plant parts together, herb sellers are unknowingly aiding the infection of freshly harvested fungal-free bark by the infected older ones in storage. In order to protect stored bark from fungal infection, herb sellers need to dry them in the sun immediately after harvest. Another way of preventing or reducing fungal infection is by separating infected samples from uninfected ones. Samples found to be infected with weevils or other problems should be removed, as they will only serve as sources of problems for other bark stored in the same location.

Phytochemical Tests

A comparison of the phytochemicals found in re-grown (new) and the original (old) bark showed that they are largely similar. This shows that newly re-grown bark is likely to be as medicinally useful and potent as old bark. Since the impact of repeated de-barking is not known for most species, this points to additional work that needs to be done. However, bark harvesters should be encouraged to harvest new bark as this will reduce the pressure of bark harvest on other trees that may yet be undamaged. Likewise, in most cases, consumers of medicinal bark products should be confident that new and old bark have similar efficacy.

Bark Identification

Bark become increasingly difficult to identify for use after collection and storage in dry forms hence a new key is essential to facilitate bark identification. As the key was based on bark samples kept at room temperature for 6 months, its usefulness may be limited to the specimens stored within similar periods and under similar condi-

tions. Although, morphological features of some bark may change with increasing storage period the key will still be useful for identification of the most common species encountered. Hopefully, this key will serve as the basis for a more complete key to medicinal bark in Nigeria and elsewhere.

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