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HETEROGENEOUS MICRO-IDENTITIES OF THE NIGERIAN MARKET BRANDED SPICES

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ABSTRACT

Some anatomical characteristics of differently branded commercial spices in Nigeria are investigated with the aid of the light microscope. The branded spices have heterogeneous contents derived from the leaves, stems, roots, flowers, fruits and seeds of different plants. Anatomical features of the foliages found in the various samples were epidermal cells, stomata, peltate scales, cell inclusions and unicellular trichomes while the axial parts as members of the vasculature and support are represented by tracheids, vessels, fibres, osteosclereids and brachysclereid cells where the bioactive compounds are resident. Quantitatively, overall, the lengths of the vascular and supporting structural members varied from 5.0 µm to 40.0 µm while those of the epidermal structures measured 10.0µm to 15.0 µm. Product adulteration, substitution, and wholesome quality check can be ascertained with this document.

KEY WORDS*: aromatic plants, flavour, food science, endomorphology*

INTRODUCTION

Spices are aromatic vegetable products which are of tropical origin used in a pulverized or powdered state basically for seasoning, garnishing foods and beverages (Dawang et al., 2016). They are characterized by their pungency, strong odour, and sweet or bitter taste (Radford, 1974; Kochhar, 1998; Mann, 2011; Dauqan and Abdullah, 2016). They are usually for many economically important plants which are either domesticated or growing in the wild. Spices have the power to change our physiological functioning and they have revolutionized medicine. The useful knowledge of spices has been handed down from generation to generation for thousands of years. Spices can occur as fresh or dried plant part materials; usually available as leaves, stems, roots, flowers, fruits and seeds. The plant parts are combined in various forms, therefore the content of the spices available as package food items available for sale in Nigeria is heterogeneous.

Plant anatomy helps to understand the internal composition of the plants body (Kadiri and Olowokudejo, 2016) and it becomes extremely useful when the external morphological features of the plants have whittled due to processing by milling, pounding, or grinding.

There is paucity of similar data; so, the investigation is an attempt to provide the anatomical information on the contents of different brands of spices that are available for sale in Nigeria. The study has revealed the heterogeneous nature of the plant parts compounded as spices in Nigeria.

MATERIALS AND METHODS

Ten different branded commercial spices in jars were used for the investigation. 5 samples that have fragmented parts were pounded into powders in a ceramic mortar and pestle while the already powdered 5 samples were left intact used for investigation. 5g of each powdered sample were poured in a Petri dish and 20ml of Sodium hypochlorite were added. The soaked samples were left for 7 days until they are fully bleached. Each sample was filtered and the bleached residue and stored in a Petri dish containing 20ml distilled water. Drops were later taken from each sample and directly stained with Safranin O and mounted with glycerine on a glass slide. The slides were covered with cover slips with their edges covered with nail varnish as a sealant. Methodology follows (Kadiri and Olowokudejo, 2016, Kadiri et al., 2019). Ten different slides were investigated per sample. Samples were observed under the microscope and images of the features were captured with ToupView 3.7 microscope digital camera attached to an Olympus compound light microscope and viewed on a Pentium IV Dell computer. The samples were analyzed both qualitatively and quantitatively. Trade names of the spices used are anonymous in the report.

RESULTS AND DISCUSSIONS

Summary of findings can be found in Table 1 and Figures 1-5. Eleven (11) different anatomical features were recorded namely, brachysclereids or stone cells, cell inclusions, epidermal cells, fibres, osteosclereids, peltate scales, scalariform tracheids, other tracheids, vessels and axial parenchyma. The anatomical features were recorded unevenly across the ten branded samples. The least found structure was brachysclereids, which was observed in 2 samples, while epidermal features e.g. cells, members of the vascular structures such as fibres and vessels were found in all the samples (Figs 1-5, Table 1). Tricomes were were found in 7 samples while other randomly encountered epidermal characteristics were cell inclusions and peltate scales (Figs. 1-5). However

supporting structures such as the sclereids and brachysclereid cells were found in not less than 7 samples. Tracheids and copious storage phloem cells i.e. axial parenchyma were recorded in only 2 samples (Figs 1, 5; Table 1).

TABLE 1: Observed anatomical features of the commercial spices and their measured lengths

Observed anatomical features	Number of occurrence	Mean and range of measured length in microns
Brachysclereids	90	10-25 µm
Cell inclusions per cell	50	5 µm
Epidermal cells	400	10 µm
Fibres	270	20-40 µm
Osteosclereids	140	20-25 µm
Peltate scales	40	10 µm
Axial parenchyma	20	10 µm
Scalariform tracheids	50	25 µm
Trichomes	70	14-15 µm
Tracheids	20	15 µm
Vessels	90	20 µm

A comparative content analysis of ten branded spices sold in the Nigerian markets because of their culinary value were investigated anatomically with a view to contribute to the improvement of quality check (Vőfély et al., 2023; Bello et al., 2023) and to ascertain the identity of materials that are ingested in the products. Two categories of plant parts were found in the samples. One group called the epidermis consisting of cell inclusions epidermal cells, peltate scales and trichomes. These structures are obtainable from the epidermis of the leaf and foliar parts of the flower. The epidermal cells of leaves lend themselves readily to observation and display many shapes and types: tabular pavement cells, complex trichomes, and stomatal complexes (Fahn, 1974; Kadiri et al, 2019). Ergastic substances as cell inclusions within the cell lumen. Epidermal cells are specialized structures having a combination of shapes which can be polygonal, irregular or regular (Kadiri and Olowokudejo, 2016; Kadiri et al., 2019). Peltate scales are crystallized formations on the epidermal cells; they are also a repository of bioactive compounds and trichomes have unicellular appearance and glandular in all the ten spices samples. The second group of the structures are found in the axial parts of the plants. The stems and roots constitute this group and the internal structures found include brachysclereids, fibres, osteosclereids, scalariform tracheids, tracheids, vessels, and axial parenchyma. Vessels are distinguished from fibres by their blunt and pointed ends and many other distinctive characters (Dalziel, 1937; Hutchinson and Dalziel, 1972; Radford et al., 1974; Burkill, 1985; Morrison and O'Sullivan, 2015).

Fibres are usually with pointed ends, the walls are usually lignified with their walls so thickened that the lumen or cell cavity is reduced very much or all together obliterated (Hutchinson and Dalziel, 1972; Burkill, 1985; Morrison and O'Sullivan, 2015). Brachysclereids cells are bone shaped elongated sclereids with dilated ends. The sclereids are naturally hard and short, they are cells with very thick lignified walls. They are extremely rare in monocots, but more common in woody and herbaceous species where they form bands around seeds or cover roots or stems (Buccellati and Kelly-Buccellati, 1983). This corroborates our findings that the observed plant parts used in these species as woody and herbaceous. Moreover, the species used as spices in the well-known spice families Apiaceae (carrot family), Lamiaceae (mint family), and Zingiberaceae (ginger family) are in these categories (Pace and Angyalossy, 2018; Davies and Heywood, 1963; Kadiri and Muellner-Riehl, 2021).

The sclereids are components of the xylem, stiffened by the presence of lignin, a hardening substance that reinforces the cellulose cell wall. Tracheids are mostly characteristic of gymnosperms (Singh et al., 2014) and they can also be found in the xylem of angiosperms and they can store up bioactive substances. In all the branded spices, the observed anatomical plant parts are variously formed to serve as stores for some bioactive compounds. The various plant parts documented in Figs 1-5 confirm the statement. Spice plants are rich in volatile organic compounds (Kochhar, 1998). However, this assertion could not be established using the organoleptic means but indications of their presence were observed in the structures such as epidermal cells or the pavement cells, the lumen of the vessels, fibres and tracheids, the glandular unicellular trichomes, and others as revealed in Figs 1-5.

Quantitatively, fibres are the longest structure whose length ranged from 20-40 µm in all the samples and the shortest structure which measured 5µm is the cell containing the inclusions in the epidermis (Figs 1-5). Following Table 1, epidermal cells and fibres are the mostly occurring cells. This is suggestive of foliages, reproductive parts and stems as the most components of the spices used in Nigeria. The least occurring plant parts in the Nigerian spices were the axial parenchyma and tracheids, this thus corroborates the opinion that the spices properties are more in the foliar and floral parts and the main parts of the plant axis (fibres and vessels) (Shyamapada , 2016). Axial parenchyma can be scanty, they transport sugars (food) to the parenchyma cells within the growth ring, and they store starch (Green, 2012).

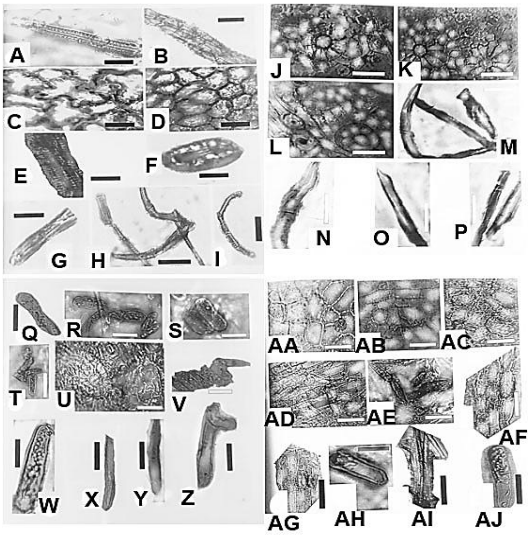

FIG 1: Anatomical features of powdered spices. A, B, I: Scalariform tracheids, C,D, U, AA, AB, AD, AF, AG: Epidermal cells, E: Axial parenchyma, F,S: Brachysclereids cells, G, R, T, Z, AE: Osteoclereids, H,AJ: Trichome, J-L: Peltate scales, M-P, AI: Fibres, Q: Tracheid, V-Y,AH: Vessels. AC: Cell inclusion,. Scale bars: A,B,I,AE,= 25µm, C,D,J-L= 10 µm, E: 10µm, F: 5µm, G, AA-AD, AF, AG= 10µm, H: 14µm, M-P,AI: 40µm. AC= 5µm, AH=20µm, AJ=15µm, Q=15µm.

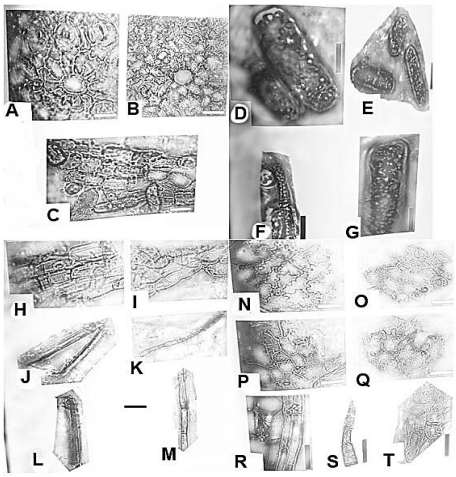

FIG 2: Anatomical features of powdered spices. A,B,H,I,N-R: Epidermal cell, C: Cell inclusion, D,G: brachysclereid cells, E. Osteosclereids, F: Scalariform sclereid, J: Tracheid, K,M: Fibres, L,T: Vessels, S: Trichome. Scale bars: A-C, N-R = 10µm, D,G= 5µm, E,F= 25µm, T=20µm, S=14µm, K,M= 25µm, J=15µm.

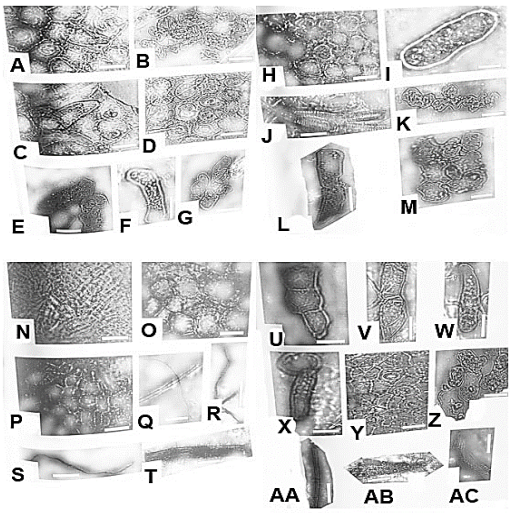

FIG 3: Anatomical features of powdered spices. A-D,M,N-P,AC: Epidermal cells, E,G: Brachysclereids, F,K,U-X: Osteosclereids, H: Peltate scale, I: brachysclereid cell, J: Scalariform tracheid, L: Trichome, Q-T,AA,AB: Fibres, Y,Z: Cell inclusion. A,B,C,D,H,I,M,N-P,Y. Scale bars: AC= 10µm, E-G,J,K,U-X= 25µm, L= 15µm, Q-T,AA,AB= 40µm, Z=5µm.

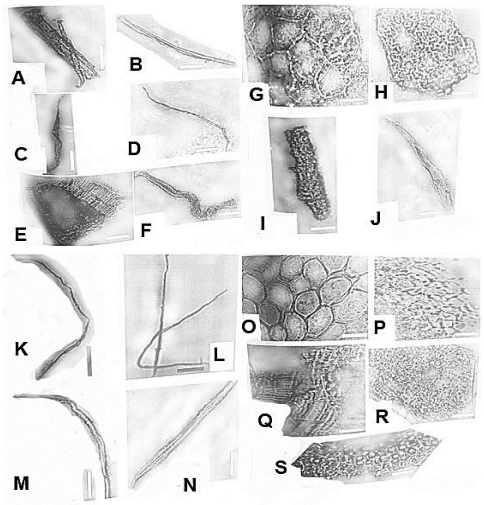

FIG 4: Anatomical features of powdered spices. A-D,F,K-N,Q: Fibres, E: Vessel, G,O,P,R,S: Epidermal cells, H: Cell inclusion, I: Osteosclereids, J: Trichome. Scale bars: A-F, K-N,Q= 40µm, O,P,R,S=10µm, G=10µm, I=25µm, J=15µm, H=5µm.

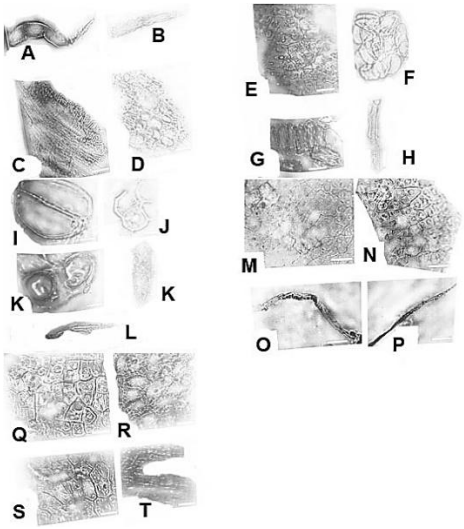

FIG 5: Anatomical features of powdered spices. A: Vessel, B,H: Trichomes, C: Axial parenchyma, D-F,J,M,N,Q-S: Epidermal cells, G: Osteosclereid, I,K: brachysclereid cells, L,O,P,T: Fibres. Scale bars: A,L=20µm, B,H:15µm, C,D,J,M,N: 10µm, I,K=5µm, L,O,P= 40µm, G= 20µm.

This analysis thus confirms that all the branded spices are obtained from leaves, stems, flowers and its parts, fruits and seeds. The known reported useful parts of the plants used as spices are leaves of curry plant- *Bergera koenigii* L., flower buds from cloves- Syzygium aromaticum (L.) Merr. & L.M. Perry, stem bark from cinnamon- *Cinnamomum verum* J. Presl, rhizomes or roots from ginger- *Zingiber officinale* Roscoe, berries from pepper- *Capsicum* spp), seeds cumin- *Cuminum cyminum* as well as main stem and roots of many other plants (Kochhar, 1998; Mann, 2011; Green, 2012; Singh, 2014; Shyamapad, 2016; Dawang et al., 2016). However, the authors made no attempt to link the various parts documented to any plant as there is a strong indication from the result (Figs. 1-5, Table 1) that plant choices for each branded product are different. The use of anatomical features for the purpose of plant identification has been variously publicized (Radford et al., 1974; Kadiri and Olowokudejo, 2016; Kadiri et al., 2019; Kadiri, and Muellner-Riehl, 2021). This study has the potential of being used for quality check of the branded spices in Nigeria.

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