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## WOOD SPECIES OF THE CENTRAL AFRICAN REPUBLIC: ASH AND SILICA CONTENT

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### Abstract

Data on ash and silica content of 28 Central African hardwoods and one monocotyledon (*Dracaena mannii*) are presented. Ash content varied considerably. Most of the values were in the range 0.3 - 1.4 %. The highest value was noted for *Desplatsia floribunda* (4.54 %) and the lowest for *Pachyleasma tessmannii* (0.07 %). In most species, silica was present only in trace amounts (less than 0.01 %). More than 0.1 % silica was found only in the *Gambea beguei* (0.128 %) and *Manilkara fouilloyana* (0.138 %).

**Key words:** *Central African wood species, ash content, silica content, Albizzia adianthifolia, Anthostema aubryanum, Blighia welwitschii, Celtis zenkeri, Combretodendron africanum, Croton aubrevillei, Desplatsia floribunda, Detarium macrocarpum, Dracaena mannii, Ficus sp., Gambea beguei, Gambea boukokoensis, Macaranga barteri, Manilkara fouilloyana, Marquesia excelsa, Morinda lucida, Oldfieldia africana, Pachyleasma tessmannii, Parkia filicoidea, Polyalthia suaveolens, Rauvolfia macrophylla, Stemonocoleus micranthus, Swartzia fistuloides, Tessmannia africana, Tessmannia lescrauwetii, Treculia africana, Tridesmostemon omphalocarpoides, Xylopi hypolampsa*

## LESNE VRSTE CENTRALNOAFRIŠKE REPUBLIKE: VSEBNOST PEPELA IN SILIKATOV

### Izvleček

Izmerjena je bila vsebnost pepela in silicijevega dioksida za 28 tropskih afriških listavcev in ene enokaličnice (*Dracaena mannii*). Vsebnost pepela je močno variirala. Večina zabeleženih vrednosti se je gibala med 0,3-1,4 %. Najvišja vrednost je bila zabeležena pri *Desplatsia floribunda* (4,54 %) in najnižja pri *Pachyleasma tessmannii* (0,07 %). Pri večini vrst je bil SiO<sub>2</sub> določen le v sledih (manj kot 0,01 %). Njegova vsebnost nad 0,1 % je bila izmerjena le pri *Gambea beguei* (0,128 %) in *Manilkara fouilloyana* (0,138 %).

**Ključne besede:** *Centralnoafriške lesne vrste, vsebnost pepela, vsebnost silikatov, Albizzia adianthifolia, Anthostema aubryanum, Blighia welwitschii, Celtis zenkeri, Combretodendron africanum, Croton aubrevillei, Desplatsia floribunda, Detarium macrocarpum, Dracaena Mannii, Ficus sp., Gambea beguei, Gambea boukokoensis, Macaranga barteri, Manilkara fouilloyana, Marquesia excelsa, Morinda lucida, Oldfieldia africana, Pachyleasma tessmannii, Parkia filicoidea, Polyalthia suaveolens, Rauvolfia macrophylla, Stemonocoleus micranthus, Swartzia fistuloides, Tessmannia africana, Tessmannia lescrauwetii, Treculia africana, Tridesmostemon omphalocarpoides, Xylopi hypolampsa*

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## **1 INTRODUCTION**

### **UVOD**

In general, wood possesses a characteristic composition. The same major components are present in all woods. The kinds and amounts of certain minor components are determined to a great extent by species. Small variations are found from tree to tree and in different parts of the same tree (BROWNING 1967).

In summative analysis, ash is often not included but just lignin, cellulose, hemicelluloses and extractives. Summation of ash changes the result from about 99 % to 101 % for most temperate-zone woods. Greater error could arise for tropical woods.

Inorganic substances largely appear in the ash, but some could be volatilised during ashing. In the absence of volatile components, the residue after incineration should be used as test sample, and the major inorganic constituents can be determined by conventional gravimetric or volumetric methods.

It is possible to use some spectrophotometric methods, atomic absorption spectroscopy, potentiometric, complexometric and redox titrimetry, etc. More sophisticated methods include activation analysis and ray emission spectroscopy. By combination of different analytical techniques, special studies can be done (SJÖSTROM / ALEN 1998).

The inorganic components in wood are various salts of carbonates, silicates, phosphates and oxalates, so that the major components of wood ashes are calcium, potassium, sodium, magnesium, iron, silica, phosphate, sulphate, chloride, and carbonate. The components are not distributed uniformly throughout the tissue, but are typically localised with respect to cell structure.

Silica is rarely present in more than trace amounts in temperate climate woods, but can vary in tropical woods from a mere trace to as much as 9 % (SANDERMANN 1966, TORELLI / ČUFAR 1995). More than 0.5 % of silica in wood is harmful to cutting tools (PETTERSON 1984, GOTTWALD 1973), and the machinability of wood is decisively influenced if the silica content is 1-3%. Silica has similar effect on the boring apparatus of marine animals. Even low-density woods are difficult to machine when their silica content is high (NOACK / FRÜHWALD 1977). The cutting process is affected chiefly by basic density, silica content and moisture content. Their influence, however, is intensified by a number of accompanying parameters, such as wood texture (interlocked grain), bark, accessory substances and by

various anomalies. Silica often results in nasal irritation on many people. Some investigators have attempted to evaluate the diagnostic value of siliceous inclusions (AMOS 1952, WELLE 1976). It is recognized that silica levels can vary within a single tree and within one species depending on location and growth conditions.

## 2 MATERIAL AND METHODS

### MATERIAL IN METODE

Test trees were taken from the extreme southwest part of the République Centrafricaine near the triple border with the République Populaire du Congo and République Fédérale du Cameroun. The location is situated approximately between 2°46" and 3°00" north latitude and east of the Sangha River (left bank) and covers the regions of the Kenie, Massapoula and Yobe river basins. For each randomly selected test tree, 10 samples were taken from the peripheral part of the heartwood when present or from stem periphery in species without colored heartwood (Table 1). The number of test trees is given in Table 1.

Determination of ash content of the oven-dry wood and silica content is described in the literature (BROWNING 1967, SIEBER 1951).

## 3 RESULTS AND DISCUSSION

### REZULTATI IN DISKUSIJA

The results of ash content and silica content are shown in Table 1. Ash content varied considerably. Most of the values were in the range of 0.30 to 1.40 % and rarely above 2.00 %. Especially high values were noted for *Desplatsia floribunda* Burret (4.54 %), *Oldfieldia africana* Benth. & Hook. f. (2.42 %) and monocotyledon *Dracaena mannii* Baker (2.08 %). Two species had low ash content: *Pachyleasma tessmannii* Harms (0.07 %) and *Stemonocoleus micranthus* Harms (0.17 %). Most of the species tested contained an insignificant amount of silica, less than 0.01 % based on the oven-dry weight of the wood. Somewhat higher values were determined in *Oldfieldia africana* Benth. & Hook. f. (0.02 %), and *Desplatsia floribunda* Burret (0.04 %). Only two species contained significant, though not critical, amounts of silica: *Manilkara fouilloyana* Aubrev. & Pellegr. (0.14 %) and *Gambea beguei* Aubrev. & Pellegr. (0.13 %).

Table 1: Wood species of the Central African Republic: ash and silica content  
 Preglednica 1: Lesne vrste centralnoafriške republike: vsebnost pepela in silikatov

Botanical and common names	Family	No. of trees tested	Oblig. colored heartwood	Density $\rho_0$ kg/m <sup>3</sup>	Ash content of the oven-dry wood Average [%]	Silica content	
						of the ash Average [%]	of the oven-dry wood Average [%]
<i>Albizzia adianthifolia</i> (Schumach.) W.F. Wight ebamba, sakandi	Mimosaceae	1	*	590	0.77	0.71	0.005
<i>Anthostema aubryanum</i> Baill	Euphorbiaceae	1	—	317	1.20	0.81	0.010
<i>Blighia welwitschii</i> (Hiern) Radlk. botoko, wotoko	Sapindaceae	1	*	897	1.33	0.95	0.012
<i>Celtis zenkeri</i> Engl. Ngombe, gbolo, kakala, ohia	Ulmaceae	5	—	707	0.67	0.87	0.006
<i>Combretodendron africanum</i> (Welw.) Exell dosso, mbose, abale	Lecythidaceae	5	*	841	0.32	0.82	0.003
<i>Croton aubrevillei</i> J. Leonardi molinga, tesso	Euphorbiaceae	5	—	673	0.48	0.83	0.004
<i>Desplatsia floribunda</i> Burret korou	Tiliaceae	1	—	492	4.54	0.92	0.042
<i>Detarium macrocarpum</i> Harms eboto, alen	Caesalpiniaceae	5	*	647	0.68	0.86	0.006
<i>Dracaena mannii</i> Baker geke, lobe	Dracaenaceae	5	—	338	2.08	0.66	0.014
<i>Ficus sp.</i>	Moraceae	1	—	604	1.84	0.76	0.013
<i>Gamboa beguei</i> Aubr. Et Pellegr.	Sapotaceae	1		662	1.23	10.85	0.128

Table 1: Wood species of the Central African Republic: ash and silica content - continuation

Preglednica 1: Lesne vrste centralnoafriške republike: vsebnost pepela in silikatov - nadaljevanje

Botanical and common names	Family	No. of trees tested	Oblig. colored heartwood	Density $\rho_0$ kg/m <sup>3</sup>	Ash content of the oven-dry wood Average [%]	Silica content	
						of the ash Average [%]	of the oven-dry wood Average [%]
<i>Gambea boukokoensis</i> Aubr. Et Pellegr. libele-yongue	Sapotaceae	1	—	710	0.46	0.88	0.004
<i>Macaranga barteri</i> Müll.-Arg.	Euphorbiaceae	1	—	442	0.80	1.15	0.009
<i>Manilkara fouilloyana</i> Aubrev.&Pellegr fou, mounguinsa	Sapotaceae	5	*	904	0.61	18.28	0.138
<i>Marquesia excelsa</i> (Pierre) R.E. Fries	Dipterocarpaceae	1	—	607	1.77	0.51	0.010
<i>Morinda lucida</i> Benth. dongbolongoya	Rubiaceae	1	—	654	1.12	0.70	0.008
<i>Oldfieldia africana</i> Benth.&Hook. f. ndombo	Euphorbiaceae	5	—	370	2.42	0.81	0.020
<i>Pachylesma tessmannii</i> Harms duoma ya zaba, dogabela, gabela	Caesalpiniaceae	5	*	751	0.07	1.95	0.002
<i>Parkia filicoidea</i> Welw. zigna ou zien	Mimosaceae	1	—	471	1.12	0.93	0.010
<i>Polyalthia suaveolens</i> Engler et Diels bapo, etounga	Annonaceae	1	—	783	0.86	0.87	0.007
<i>Rauvolfia macrophylla</i> Stapf.	Apocynaceae	1	—	564	0.73	1.03	0.008
<i>Stemonocoleus micranthus</i> Harms tengi	Caesalpiniaceae	1	*	586	0.17	1.44	0.002

Table 1: Wood species of the Central African Republic: ash and silica content - continuation

Preglednica 1: Lesne vrste centralnoafriške republike: vsebnost pepela in silikatov - nadaljevanje

Botanical and common names	Family	No. of trees tested	Oblig. colored heartwood	Density $\rho_0$ kg/m <sup>3</sup>	Ash content of the oven-dry wood Average [%]	Silica content	
						of the ash Average [%]	of the oven-dry wood Average [%]
<i>Swartzia fistuloides</i> Harms pau rossa	Caesalpiniaceae	5	*	1017	0.37	0.94	0.003
<i>Tessmannia africana</i> Harms paka, wamba, tou-nzeng	Caesalpiniaceae	5	*	910	0.47	0.77	0.004
<i>Tessmannia lescrauwaetii</i> (De Wild.) Harms gama, tou-nzeng	Caesalpiniaceae	5	*	910	0.47	0.72	0.004
<i>Treculia africana</i> Decaisne	Moraceae	1	—	674	1.04	0.97	0.010
<i>Tridesmostemon omphalocarpoides</i> Engl. bongoforo	Sapotaceae	1	*	1093	0.62	0.77	0.005
<i>Xylopia hypolampsa</i> Mildbr.&Diels	Annonaceae	5	—	790	0.88	0.68	0.006

Legend: \* = Oblig. colored heartwood present; - = Oblig. colored heartwood not present

#### 4 POVZETEK

V okviru slovensko ameriškega projekta YO-FS-74-JB-10 so bile raziskane biološke, fizikalne, kemične in mehanske lastnosti lesov 28 neznanih in manj znanih lesnih vrst iz Centralnoafriške republike. Silikati se le izjemoma pojavljajo v lesovih zmerne pasu, medtem ko so pri tropskem drevju redna akcesorna sestavina, ki lahko v ekstremnih primerih doseže 9 % mase absolutno suhega lesa. Vsebnost, večja od 0,5 %, že škodljivo deluje na rezila, vsebnost nad 1 % pa je ekonomsko kritična zaradi visoke obrabe. Silikati

se v lesu lahko pojavljajo v najrazličnejših oblikah, ki imajo lahko tudi določeno lesno diagnostično oziroma identifikacijsko vrednost (AMOS 1952, WELLE 1976). Najdemo jih v aksialnem in trakovnem parenhimu in le redko v trahejah in vlaknih.

Raziskane vrste iz ekvatorialne Afrike imajo zelo nizko vsebnost silikatov, ki je z vidika obdelave in predelave lesa neškodljiva. Vsebnost pepela preiskanih vrst je bila med 0,07 % (*Pachyleasma tessmannii* Harms) in 4,54 % (*Desplatsia floribunda* Burret). Vsebnost silicijevega dioksida je bila med 0,002 % (*Pachyleasma tessmannii* Harms) in 0,138 % (*Manilkara fouilloyana* Aubrev. & Pellegr.).

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