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EVALUATION OF ANATOMICAL AND PHYSICAL PROPERTIES OF *KHAYA NTHOTHECA* (WELW.) C. DC. FROM FORESTS OF DIFFERENT ALTITUDES IN THE DEMOCRATIC REPUBLIC OF CONGO

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ABSTRACT

The anatomical and physical properties of Khaya anthotheca (Welw.) C. DC wood from the transition forest of middle altitude (zone 1) and the humid dense forest of low altitude (zone 2) in the East of the Democratic Republic of Congo were evaluated to ascertain the effect of growth area on the anatomical and physical properties. The heartwood vessels and rays number/mm^2 varied significantly ($P<0.001$) between the two zones. The heartwood collected in zone 1 was significantly the richest ($P<0.001$) in vessel sand rays number. The average number of vessels and width of rays were higher in zone 2 and varied significantly ($p < 0.0001$) between the two zones.. Biotopes rays length was higher in zone 1 and varied significantly ($p < 0.001$) between the two zones. Nevertheless, the wood vessels distribution in the radial direction was homogeneous despite the zone; there was no significant difference in basic density, dry density and total volume shrinkage of K. anthotheca heartwood from the two zones..

Keywords: *Anatomy, vessel, rays, density, Khaya anthotheca*

INTRODUCTION

In recent times, sustainable management of the forest is based at least on a rational use of wooden material. The knowledge of the relation between the tree and its line constituent as well as a good understanding of the relationship between the wood structure and its technological properties are fundamental to determine its use. However, one of the great challenges which render the study and the use of wood difficult is its variability for which anisotropy and genetic character are internal factors. External factors concern all the variations of the area which modifies the trees population growth in space and time (Stéphanie, 2014).

The Democratic Republic of Congo (DRC) occupies 46% of the Africa forests and 52% of the dense Congo basin forests. That country which has abundant forest resources capable to contribute to its sustainable economic

development (Mbala, 2003) is covered with humid dense forest of low altitude (102 million hectares) and transition forest (3.3 million hectares) for a total coverage of 232 million hectares. Despite this great forest superficy, the

DRC is considered as the last country in Congo Basin when is coming to exploitation (OFAC, 2010). Nevertheless, this country which disposes such a strong potential remains less advanced in forest resources utilization. In the year 2007, *K. anthotheca* was the seventh wood species mostly transformed in the national timber industry; it represented4.4% of the total wood stocks volume (MECNT-FORAF, 2008).

Mahogany wood is also consumed locally for construction in great agglomerations; it is also exported from the East to the neighbouring countries like Uganda, just behind Sapelli (Chishweka 2012). In spite of the abundant works related to intra or interspecific variability of the anatomical, physical and technological properties of wood according to its land of growth, no study points out a clear variability of such properties in *K. anthotheca.* The aim of this study was to ascertain the impact of different altitudes on the anatomical and physical properties of *K. anthotheca* wood.

MATERIAL AND METHOD

Blue of methylene, ethanol (90%), and concentrated xylene (98.5%) were purchased from Sigma-Aldrich and used without any purification. Javel La Croix (8° chl eq.2.4% c.a.) and distilled water were obtained from MEDILAB-Gabon. Those chemicals were used for anatomical analysis of wood tissues.

Study Area

The area of study concerns the forests of the East of the DRC neighbouring the republic of Uganda. This zone is the geographic area of *K. anthotheca* described by the International Technical Association of Tropical Wood (ATIBT, 1986). To compare the wood quality, two forest formations were taken into account.

The transition forest of middle altitude (zone 1) is in Mayeba locality in the axis Vuyinga-Mangorijipa (North- Kivu), in Lubero territory (0°10'N, 28°49'E). The elevation is about 1237.5 m. The relief is wavy and dominated by incise valleys, and the ground is a little deep, rich in iron with an alteration strongly dominated by kaolin clay type and free oxides (Vyakuno, 2006). The average temperature is between 24 and 25°C, and the annual precipitation raises to 2183 mm at Mangoridjipa. The vegetation is mainly composed with a guinea-equatorial ombrophilic forest (Vyakuno, 2006) which contains trees of superior strata reaching to several meters, and adapted to the little deep ground by producing abutments. Those trees have jointing tops which constitute cauliflower canopy (Vyakuno, 2006); some species of the plateau forest display altitude floor disposal. Above, between 1000 and 1350 m, heterogeneous forests composed with *Cynometra alexandri, Jubemardia seretii, Staudia stipitata and Khaya anthotheca* can be met. While below, the forests are dominated by *Julbertiodendron dewevrei* (Vyakuno, 2006).

The humid dense forest of low altitude (zone 2) in the bloc B of ENRA (Enzyme Raffiner) forest company concession in the Oriental Province, in Mambasa (0°46' N, 29°13'E) territory of Ituri district. The elevation in this area is nearly 900 m of altitude, and the difference of altitude between zone 1 and 2 is 331 m. In the last 28 years, the minimal, average and maximal precipitations were respectively 934 mm in 1970, 1673 mm and 2096 mm in 1985, for an average temperature of 31° C (Makana et *al*., 2006). This concession has regular topography with some part of little deep rocky ground with occasional hills (Makana et *al*., 2006). The ground of the region derives from precambrian granitic shield (Laveau, 1982) and it is mostly covered by the oxide grounds which dominate most of the Congo basin forest blocs (Brady, 1990). The ground is little deep and its texture varies from sandy-silty to clay-sandy. The ground is acid and poor in nutritional elements with the exception of phosphorus and nitrogen (Makana et al, 2006). The vegetation is a mixing of sempervivate forest including vast areas of «mbau forest» dominated by *Gilbertiodendron dewevrei* (De Wild.) Léonard, and «mixed forests» inside which any specie dominates, but other Caesalpinoid leguminous like *Julbernardia seretii* (De Wild) Troupin and *Cynometra alexandri* are abundant (Makana et al., 2006). Sempervivate forests of quality in a semideciduous forest for which the canopy contains a largest part of heliophilic species like *Entandrophragma spp., Khaya anthotheca*, *Albizia spp.*, etc. are found in the North and in the Est of Ituri principal bloc forest, and in the steep slope. At the oriental and northern limited of the landscape, the closed canopy forest gives up is place to a mosaic of conifer galleries and wooded savanna (Makana et al., 2006).

Wood sampling

Four trees of *K. Anthotheca* were collected in each area of study (zone 1 and 2). The trees in feet were chosen following their vigorous aspect, good conformity of stem and superior or equal to the minimum diameter of exploitation (80 cm for *K. anthotheca* in DRC). The geographical data were taken for each tree thanks with a Garmin trade mark GPS. Then, small wood discs of 10 cm of thickness were collected at 1.30 m of height from each tree with a chainsaw STILL 066 trade mark. Thus, the average thickness of sapwood and heartwood is measuredTo avoid any deterioration of samples by sun or biological agents, they were placed on the shelves and air dried for five months. Wood discs were polished, and the central position of the pith of samples was localised. Three types of sticks were swan in the radial direction and in North exposition: the first according to the East-West direction, the second following the North-South direction and the third in the oblique direction at more or less +45° of the first setting stick. In order to avoid the variability of the results the same sticks were used for anatomical and physical tests .In the lack of precise delimitation between the juvenile and adult wood, we consider three sectors in the radial direction for all the discs: a zone near the pith was called internal heartwood or inner heartwood (IH), an intermediary zone was called median heartwood (MH) and the zone covering the transition sapwood heartwood was called outer heartwood (OH).

Anatomical structure analysis by microscopy

The anatomical structure of *K. anthotheca* was performed by an adaptation of a published procedure (Traoré, 2009 and Normand, 1972) as follows: 72 wood sticks 10mm×10mm×10 mm (Radial ×Tangential ×Longitudinal) of each area of study were softened in hot distilled water for 3 to 4 hours. The heating was stopped when the sticks fell down to the bottom of the vessel. Then, the softened wood sticks were cut with a semi-automatic microtome "TBS 2500" in radial, tangential and longitudinal directions to obtain samples for which thickness is between 20-30µm.The slant between the microtome knife and the section surface was about +8°.

The thin wood blocks were soaked in water and scalded in a Javel:water (10:90) mixture until the samples faded. The faded wood blocks were soaked in distilled water to eliminate residual Javel. The rinsed wood blocks were then colored in blue of methylene and successively dehydrated by soaking in ethanol solution and concentrated xylene. The coloured cuts were then deposited on a blade carrying an object, and a cover-object was then carefully set down above the cuts to avoid bubbles of air between the blade and the gill. The blades were dried to eliminate any traces of chemicals used for dehydration.

The anatomical analysis was performed with an optic microscope "Motic 2.0" to a magnification of 40x. The observation was facilitated by a Ken-A- Vision camera connected to a computer. The software Vision 4 allowed pictures to be taken and to measure the constituent of the woody plan. The following anatomical characters were measured: the number of vessels by mm^2in the longitudinal section, the number of rays by mm in transverse section, the vessel diameter in transverse section, the height of ray in transverse section, and the width of ray in transverse section.

Preparation of wood blocks for physical analyses

The moisture content of the wood was determined according to the NF B51-004 (1985) as follows. Eighty-four (84) wood blocks 20mm×20mm×20 mm (Radial ×Tangential ×Longitudinal) of each zone of study were oven-dried at 103°C until constant weight. Then, the moisture content was determined by the following formula:

$$H(\%) = \frac{P_h - P_0}{P_0} \times 100 \text{ ....(Equation 1)}$$

P_h: Weight of the wood blocks before drying and P_0: Weight of the anhydrous oven-dry wood blocks at 103°C until constant weigh.

Measurement of the basic density

The basic density was determined by adapting a published procedure (Traoré, 2009) as described below: The wood blocks 20mm×20mm×20 mm (Radial ×Tangential ×Longitudinal) were saturated by an oven-dry/water soaked cycles until they fell down in the bottom of the vessels and when the difference between two successive volume measurement was not superior to 0.02 mm^3 according to NF B51-006 (1986). The basic density was calculated according to the following formula:

$$D = \frac{M_0}{V_s} \quad ....\text{Equation 2}$$

M_0: Weight of the anhydrous wood blocks. V_S: Volume of the saturated wood blocks measured in the radial, tangential and longitudinal directions using a manual calliper accurate to 0.01 cm

Determination of the anhydrous density

The anhydrous density was calculated after oven-drying wood blocks of 20mm×20mm×20 mm (Radial ×Tangential ×Longitudinal) at 103 °C until constant weight. Then, the anhydrous density was calculated by the formula below:

$$D = \frac{M_0}{V_0} \quad ....\text{Equation 3}$$

M_0: Weight of anhydrous wood blocks. V_0: Volume of anhydrous wood blocks measured in the radial, tangential and longitudinal directions using a manual calliper accurate to 0.01 cm.

Total volume shrinkage measurement

The total volume shrinkage was measured in the tangential, axial and radial directions for the saturated and anhydrous wood blocks of 20 mm×20mm×20mm (Radial × Tangentia Longitudinal):

119

$$RV(\%) = \frac{V_s - V_0}{V_s} \times 100 \quad ....\text{Equation 4}$$

V_0 and V_S are respectively the volumes of anhydrous, and the volume of saturated wood blocks measured in the radial, tangential and longitudinal directions using a manual calliper accurate to 0.01 cm

Data analysis

All the data were analysis using the two-way analysis test of variance (ANOVA) followed by the Fischer's LSD (last significant difference) test at α = 0.05 level of significance with Rr643.0.2 software. The plan of sampling corresponds to split plot with fixed factor "zone" as main factor and the fixed factor "radial" position as secondary factor as previously published (Treacy et *al.,* 2000; Washusen et *al.,* 2001).

RESULTS

Vessels number/mm²

The vessels number/mm^2 of the wood from the two areas of study is collected in Table 1. Statistical analysis points out a significant difference ($P<0.001$) between the average vessels number/mm^2 of the heartwoods from zone 1 (6.92±0.92) and zone 2 (6.58±1.14), and the coefficient of variation of all the samples is such as Cov≤30%. Despite the strong inter zone vessels number/mm^2 variability, the heartwood from zone 1 did not exhibit significant within tree vessels number difference in the radial direction ($P=0.17$) than those collected in zone 2 ($P=0.037$).

Table 1: Mean number of vessels per mm^2 in the radial direction of *K.* from zone 1 and 2.

Origin	heartwood position	Vessels number/mm² mean±σ	Cov (%)	Vessels number qualification
Zone 1	OH	7.08 ± 1.63^a	23	Middle
	MH	6.98 ± 1.58^a	23	Middle
	IH	6.71 ± 1.76^a	26	Middle
	Average	**6.92 ± 0.92^b**	**13**	**Middle**
Zone 2	OH	6.31 ± 1.30^c	14	Middle
	MH	6.87 ± 1.75^d	26	Middle
	IH	6.57 ± 2.12^e	32	Middle
	Average	**6.58 ± 1.14^f**	**17**	**Middle**

Cov: Coefficient of variation. σ: Standard deviation. Means with the same letter within a column for each zone, or the average value of the anatomical characters between zone 1 and 2 are not statistically different at the significant level of P≤0.05.

Lumen vessels width

The lumen vessels width collected in Table 2 has shown that the heartwood from zone 2 displayed the highest vessels width (191.93±25.17 µm) than that collected in zone 1 (175.42±32.66 µm). A strong within tree variability (P<0.0001) was found only between the lumen vessels width located inside the heartwood from zone 2.

Table 2: Mean lumen vessels width in the radial direction of *K. Anthotheca* heartwood from zone 1 and 2.

Origin	heartwood position	Lumen vessels width mean±σ (µm)	Cov (%)	Lumen vessels width qualification
Zone 1	OH	181.52±51.85[a]	29	Middle
	MH	172.43±54.86[a]	19	Middle
	IH	172.32±52.88[a]	31	Middle
	Average	**175.42±32.66[b]**	**19**	**Middle**
Zone 2	OH	207.19±40.51[c]	20	Bulk
	MH	190.96±54.34[d]	28	Middle
	IH	177.63±41.86[e]	24	Middle
	Average	**191.93±25.17[f]**	**13**	**Middle**

Cov: Coefficient of variation. σ: Standard deviation. Means with the same letter within a column for each zone, or the average value of the anatomical character between zone 1 and 2 are not statistically different at the significant level of P≤0.05.

Rays number/mm

Table 3 shows that the higher heartwood rays number/mm was found in zone 1 (4.72±0.59) than zone 2 (4.03±0.44). Whatever the origin of the wood, the coefficient of variation displayed in Table 3 is lower than 30%. In addition, the rays number/mm was significant higher (P<0.0001) in the heartwood from zone 1 than zone 2. A strong within tree variability (P<0.0001) was observed in the heartwood rays number from the two areas of study.

Table 3: Mean rays number/mm in the radial direction of *K. anthotheca* heartwood from zone 1 and 2.

Origin	Heartwood position	Rays number/mm mean±σ	Cov (%)	Vessels rays qualification
Zone 1	OH	4.89±0.75[a]	15	Middle
	MH	4.79±0.75[b]	16	Middle
	IH	4.49±0.88[c]	20	Middle
	Average	**4.72±0.59[d]**	**13**	**Middle**
Zone 2	OH	4.22±0.64[e]	15	Middle
	MH	4.01±0.54[f]	14	Middle
	IH	3.87±0.72[g]	19	Rare
	Average	**4.03±0.44[h]**	**11**	**Middle**

Cov: Coefficient of variation. σ: Standard deviation.Means with the same letter within a column for each zone, or the average value of the anatomical characters between zone 1 and 2 are not statistically different at the significant level of P≤0.05.

Rays length and lumen rays width

The heartwood rays length as well as the lumen rays width from the two area of study are depicted in Table 4 and 5 respectively. It is noteworthy that the wood from zone 2 displayed the highest rays length (478.36±64.16 µm) and lumen rays width (79.52±16.53 µm) than those collected in zone 1 which were respectively 443.15±49.91 and 70.75±10.88 µm.

Table 4: Mean rays length of *K. anthotheca* heartwood from zone 1 and 2.

Origin	heartwood position	Rays length mean±σ (µm)	Cov (%)	Rays length qualification
Zone 1	OH	429.28±67.63[a]	16	Small
	MH	465.21±92.39[b]	20	Small
	IH	434.98±103.16[c]	24	Small
	Average	**443.15±49.91[d]**	**11**	**Small**
Zone 2	OH	498.82±94.25[a]	19	Small
	MH	484.44±110.35[b]	23	Small
	IH	452.89±128.93[c]	28	Small
	Average	**478.36±64.16[e]**	**13**	**Small**

Cov: Coefficient of variation. σ: Standard deviation.Means with the same letter within a column for each zone, or the average value of the anatomical characters between zone 1 and 2 are not statistically different at the significant level of P≤0.05

Table 5: Mean lumen rays width of *K. anthotheca* heartwood from zone 1 and 2.

Origin	Heartwood position	Lumen rays width mean±σ (µm)	Cov (%)	Lumen rays width qualification
Zone 1	OH	70.36±18.55[a]	26	Middle
	MH	72.05±14.17[a]	20	Middle
	IH	69.86±18.40[a]	26	Middle
	Average	**70.75±10.88[b]**	**15**	**Middle**
Zone 2	OH	91.52±28.89[c]	32	Middle
	MH	83.10±36.39[d]	44	Middle
	IH	63.95±19.26[e]	30	Middle
	Average	**79.52±16.53[f]**	**21**	**Middle**

Cov: Coefficient of variation. σ: Standard deviation. Means with the same letter within a column for each zone, or the average value of the anatomical characters between zone 1 and 2 are not statistically different at the significant level of P≤0.05.

Physical properties

The basic and anhydrous densities as well as the volume shrinkage were investigated according to the growth area of the wood, and the results obtained were collected in Table 6. We observed that the wood of *K. anthotheca* do not displayed significant ($p<0.05$) physical properties difference whatever the origin of the wood.

Table 6: Basic density, anhydrous density and volume shrinkage mean of *K. anthotheca* heartwood from zone 1 and 2.

Origin	Heartwood position	Basic density mean±σ (g/cm^3)	Anhydrous density mean±σ (g/cm^3)	Volume shrinkage mean±σ (%)
Zone 1	OH	0.498±0.048^a	0.550±0.061^a	9.658±4.434^a
	MH	0.481±0.047^b	0.529±0.054^b	8.928±4.208^a
	IH	0.443±0.036^c	0.494±0.034^c	10.243±4.436^a
	Average	**0.474±0.034^d**	**0.524±0.04^d**	**9.610±2.161^b**
Zone 2	OH	0.505±0.059^a	0.553±0.115^a	11.234±6.737^a
	MH	0.472±0.037^b	0.521±0.042^b	9.897±5.153^a
	IH	0.437±0.060^c	0.481±0.630^c	9.204±3.509^a
	Average	**0.471±0.029^d**	**0.518±0.048^d**	**10.112±3.142^b**

σ: Standard deviation. Means with the same letter within a column for each zone, or the average value of the anatomical characters between zone 1 and 2 are not statistically different at the significant level of $P \leq 0.05$.

DISCUSSION

The coefficient of variation displayed by Table 1 has pointed out that the vessels of *K. Anthotheca* are homogenous whatever the growth area of the wood. That is in close agreement with the Normand's distribution (Normand, 1972). In the light of statistical analysis, the wood from the transition forest of middle altitude is more abundant in vessels than that from the humid dense forest of low altitude. Furthermore, the average vessels number/mm^2 displayed by the wood from the two areas of study is in the range 5.01-8.71. That is in close agreement with that obtained by Maroyi (2008) and by Donkor (1997). The latter found an average vessel number/mm^2 of 5±0.79 for *K. anthotheca* collected in Ghana. According to the classification cited above (Normand, 1972), the average vessels number of the African mahogany from the DRC could be classified middle. Considering that the good growth conditions reduces wood porosity as the vessels number/surface unit decreases while the content of wood fibres increases (Tsoumis and Panagiotidis, 1980; Nepveu, 1994; Leclerq, 1983 and 1985), the humid dense forest of low altitude could offer better growth conditions to *K. anthotheca* than the transition forest of middle. Nevertheless, the vessels number/mm^2 order exhibited by the heartwood from the two growth areas of *K. anthotheca* did not increase from the pith towards the sapwood as observed in clones of *Eucalyptus camaldulensis* (Veenin et *al.,* 2005).

The lumen vessels width was significantly higher ($P<0.001$) in zone 2 than zone 1 (Table 2) and the lumen width increased in the radial direction of the wood collected in zone 2 from the pith towards the sapwood as previously published for other wood species (Barij, 2006 and Traoré, 2008). However, the data collected in Tables 1 and 2 are in close agreement with those obtained for *Eucalyptus grandis* from India inside with the lumen vessels width increased while the vessels number/mm^2 decreased (Bhat et *al.,* 1990). Furthermore, whatever the growth area of *K. anthotheca*, the average lumen vessels width is in the range 100-200 μm (Table 2). According to Normand (1972) classification, the wood of *K. anthotheca* has a middle grain. That result is in agreement with that previously published by the IAWA (1989). This grain could trend from middle to bulky in the heartwood for the wood sampled in zone 2. On the other hand, the good conditions of growth in zone 2 should dilate the lumen vessels width for which the increase depends at least on soil water content as described for *Quercus suber* (Barij, 2006). The high pluviometry and the regular relief of the humid dense forest of low altitude should provide high water and minerals content which lead to an increase of the heartwood lumen vessels width collected in this growth area of *K. anthotheca*.

The results collected in Table 3 has pointed out that the rays number/mm was significant higher in zone 1 than zone 2. On the other hand, the coefficients of variation displayed by the woods of the two areas of study have shown clearly that the African mahogany from the humid dense forest of low altitude and the transition forests of middle altitude of the Democratic Republic of Congo can be classified middle. But the rays number/mm mean we found is lower than that obtained for *K. anthotheca* from Ghana which pointed out an average rays number/mm of 9±0.67 (Barij, 2006). That difference shows strong heartwood rays number variability according to the geographic origin of the wood. That ecological variability was also observed between the transition forest of middle altitude and the humid dense forest of low altitude, the two major growth areas of *K. anthotheca* in DRC. Nevertheless, the rays number/mm increased from the pith towards the sapwood as well, and any inside zone variability was found (Table 3).

The data collected in Table 4 and 5 have pointed out that not only the heartwood rays length but also the lumen rays width of the wood from the two areas of growth are significantly different ($P<0.0001$). On the other hand, a significant intraspecific variability ($P<0.001$) was observed within the heartwood rays length and width from the two growth areas. It is noteworthy that the rays length increased from the pith towards the sapwood in zone 2 whereas such a tendency was not observed in zone 1 (Table 4). Nevertheless, the lumen rays width from zone 2 pointed out a significant variability ($P<0.0001$) inside the heartwood while those from the wood collected in zone 1 (Table 5) did not exhibited significant difference within tree variability ($P=0.37$). That result suggests a stability of the anatomical properties over the internal heartwood collected in the transition forests of middle altitude. Such stability of the juvenile wood was previously observed inside the wood of vène from Mali (Traoré, 2009).The physical properties don't point out significant difference whatever the origin of the wood (Table 6). The anhydrous densities obtained in our study are close to those obtained by Barig (2006) and Cirad (2012) who found anhydrous densities of 0.56±0.04 and 0.56±0.08 respectively. In addition, the volume shrinkages we found for the wood from zone 1 and 2 are in agreement with that published by AIBT (11±1%). According to Kauman and Kloot (1968) classification, the wood of *K. Anthotheca* is light whatever its origin and its grain is middle. That wood species is widely used for sawing, fitting and interior decoration displayed weak total volume shrinkage (5-10%) which suggests that its bark is in small splits. It could dry before cutting up and be used for unrolling and modelling.

Although the lack of significant difference between the basic as well as the anhydrous density of *K. anthotheca* from zone 1 and 2 (Table 6), these densities displayed high significant within tree variability ($P<0.001$) both in the transition forests of middle altitude and the humid dense forest of low altitude. However, the volume shrinkage does not exhibit a significant within tree variability as well inside the zone 1 ($P=0.87$) as 2 ($P=0.53$). Given that the physical properties in the radial position of the wood depend on the ecological conditions (Noshiro et *al.,*1994, Noshiro and Suzuki, 1995; Medzegue, 2007), it should be necessary to investigate the impact of the ecological conditions in the physical properties of *K. anthotheca* for an altitude above to 300 m of altitude.

CONCLUSION

The anatomical properties of *Khaya anthotheca* from humid dense forests of low altitude and the transition forests of middle altitude investigated in this study have pointed out significant variability in their vessels number/mm^2, rays number/mm, vessels and rays width as well as rays length in the transverse direction of the woody plan. Heartwood from the transition forests of middle altitude displayed the highest vessels number/mm^2 and rays number/mm than that from the humid dense forests of low altitude. The latter displayed the highest heartwood rays length and width than the former. A within tree variability was found whatever the origin of the wood and the anatomical properties decreased generally from the inner to the outer heartwood. Our results show clearly a patent variability on the anatomical properties of *K. anthotheca* from the two growth areas of the Democratic Republic of Congo. Nevertheless, physical properties such as basic density, anhydrous density and total volume shrinkage did not exhibit significant differences according to the origin of the wood. However, the basic and anhydrous densities exhibited a within tree variability increasing from the pith towards the sapwood. The total volume shrinkage does not point out significant within tree variability. Nevertheless, further investigations based on deep microscopic analysis, physicochemical investigation as well as rheological studies are necessary for a better understanding of the impact of growth area in the variability of *K. anthotheca* from the Democratic Republic of Congo properties.

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