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Quality of Untraded Rattan Stem from Central Sulawesi (Indonesia) Based on the Morphology

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ABSTRACT

Rattan is a non-timber forest product with great economic value. Therefore, this study aims to determine the quality of non-traded rattan from Central Sulawesi based on the morphological characters of the rods. It was carried out to choose alternative species of rattan suitable as raw materials to fulfill the increasing demand. A descriptive method was used with wet rattan specimens obtained from natural forests as study materials to determine the quality species and levels. Moreover, complete identification and determination of morphological characters were used to determine the specific species, while the quality was determined based on the internode length, diameter, cylindricity, color, groove depth (texture), and surface appearance of the rod. Data analysis was carried out using analysis of variance followed by a mean difference test, using the SPSS Version 21 program. The results showed that the morphological characters of the 10 rattan species were distinctively different, therefore, it was used as determinants of all variables studied. Based on the results, the non-traded rattan with a relatively similar quality as the favorite traded speciess include *Calamus insignis, C. minahasae, C. koordersianus, C. leptostachyus, Daemonorops lamprolepsis, D. robusta* and *D. macroptera*.

1. INTRODUCTION

Rattan is a non-timber forest product with great economic value. Globally, the number of species is estimated to be over 512 with approximately 310 found in Indonesia. The speciess of rattan vary according to the morphology, anatomy, as well as physicomechanical and chemical characters of the rods, these variations tend to affect the quality level of each species. Based on the quality level, rattan is classified into two groups, namely traded (commercial rattan) and non-traded (non-commercial rattan). The quality of the non-commercial rattan is not yet widely known [1-3] This is because studies on the morphological characteristics and quality are still lacking.

Rattan has a suitable characteristic for raw material of rattan furniture. The stem shape is round and long with varies of diameter. In the trading world, rattan is classified into small diameter rattan (0.5-20 mm) and large diameter rattan (> 20 mm). Large diameter rattan could be used as furniture frames while the small diameter rattan could be used as woven material. In addition to size, rattan has physical and mechanical characteristics such as flexibility and hardness which are in accordance with the needs of rattan furniture raw materials.

Rattan as a non-timber forest product has a high economic value as a raw material for rattan furniture. Rattan furniture is an export product that is in great demand by many countries outside Indonesia, so that rattan is a source of foreign exchange for the country and one of the 22 leading commodities of Indonesian industry.

The quality of traded rattan is widely determined based on the morphological characteristics and hardness of the rods [4]. The characters used include internode length, diameter, and appearance of surface defects. However, they are not suitable as a basis for determining the species and quality level because only a small part of the vegetative structure is observed without a complete appearance of the rod [5, 6]. Morphological characters also used in determining the quality of rattan include texture, surface appearance, groove depth, and color, while the physical character is only based on its hardness [7, 8].

The species and quality determination based only on the rod's appearance often create problems. This is due to the visual similarities between the different species, for example, *Calamus koordersianus* with *C. zollingerii* as well as *C. inops* with *C. Lejokaulis* [9-11]. To overcome this problem, species and quality determination need to be carried out on the morphology of other organs such as leaves, cirrus or flagella, flowers, and fruit [5, 12]. However, observing these characters is often difficult as rattan taken by farmers or traders no longer have these organs.

The morphological characters of nine rattan speciess traded in Central Sulawesi were studied by Tellu [13-15] and it was concluded that these characters are a determining factor for the quality level. Based on the results, a quality standard in line with the morphological characters was compiled for comparison with the non-traded species [2, 3].

The economic value of rattan as a source of raw material is a basic need for the furniture industry in Indonesia, especially in Cirebon, Sukoharjo and East Java. The rattan-based furniture industry in Indonesia is respectable with export value

the fifth rank among Indonesia's various export commodities. The rattan species needed as raw material for furniture are Calamus zollingerii (Batang), C. inops (Tohiti), C. orantus var celebicus (Noko), C. ornatus var, celebicus (Coat) and C. leijocaulis (Jarmasin).

Global demand for rattan is increasing, but its availability in nature is decreasing. To fulfill the quality demand, efforts are needed to find non-traded speciess whose species and populations are still widely available in nature. The availability is still abundant due to the less use by industries as well as limited information on the morphological character and quality of the rod.

Central Sulawesi is the largest producer of rattan in Indonesia with a wide variety of non-traded species. Rattan has a relatively high commercial value, it can be used as a source of livelihood for the surrounding community [16]. However, the morphological characters and quality are not yet completely understood. Therefore, studies on the speciess of non-traded rattan are needed to determine the quality level and select alternative speciess to improve production and fulfill market demands.

Based on the analysis results of the characteristics determining the quality of rattan that has been traded so far (favorite rattan species), it could be explained that these characteristics also enforced to rattan species have not been traded (non-favorite rattan species). The rattan species that have not been traded in this study have relatively similar characteristics with the rattan species that have been traded. In rattan trading, the quality is determined by class A, B, C and D. Based on the results of the analysis using the characters used for the rattan species that have been traded, three species are classified as A (high) quality, namely: Calamus boniensis, Daemonorops lamprolepsis and Korthalsia celebicus), three species belong to B quality (medium), namely: C insignis, C. leptostachyus, and D. robusta), meanwhile the other four species are C and D quality (low quality).

Rattan species classified as A quality (high) and B quality (medium) which have not been utilized, they should be utilized by the rattan furniture industry, however the availability of traded rattan species so far are still able to fulfill the industry's needs. Whereas, the species classified as C and D (low) quality, are indeed not proper to use as raw materials of rattan furniture.

This study aims to determine the quality standards of non-traded rattan in Central Sulawesi based on the morphological characters of the rods to select alternative species as raw materials to fulfill the increasing demand for quality rattan.

2. METHODS

2.1 Study site

The study was conducted with a descriptive research method, the materials were collected from natural forest in two regencies, which Donggala at Tambu Village (0°11'32.12"-0°12'3.52" South Latitude and 119°52'10.03"-119°52'45.32" East Longitude) and Poso at Tambarana Village (1°12'18.16"-1°13'41.53" South Latitude and 120°31'0.48"-120°32'40.50" East Longitude), Central Sulawesi (Figure 1).

2.2 Materials

The research material were fresh rattan stem of 10 species obtained from Donggala and Poso natural forest, as showed in Table 1.

2.3 Procedure

This study was carried out by collecting samples from natural forests at specific sites. Fresh rattan was collected to identify its morphological characters including roots, rods, leaves, fruit, and other auxiliary organs. Identification and determination were carried out at the Tadulako University Celebence Herbarium in line with Bantika et al. [17], Matsunaga et al. [18], Qian et al. [19], Dransfield [20], Rustiani [21], and Henderson [22]. When a certain name is indicated, then observations and measurements of morphological characters are carried out based on SNI-7208 [23].

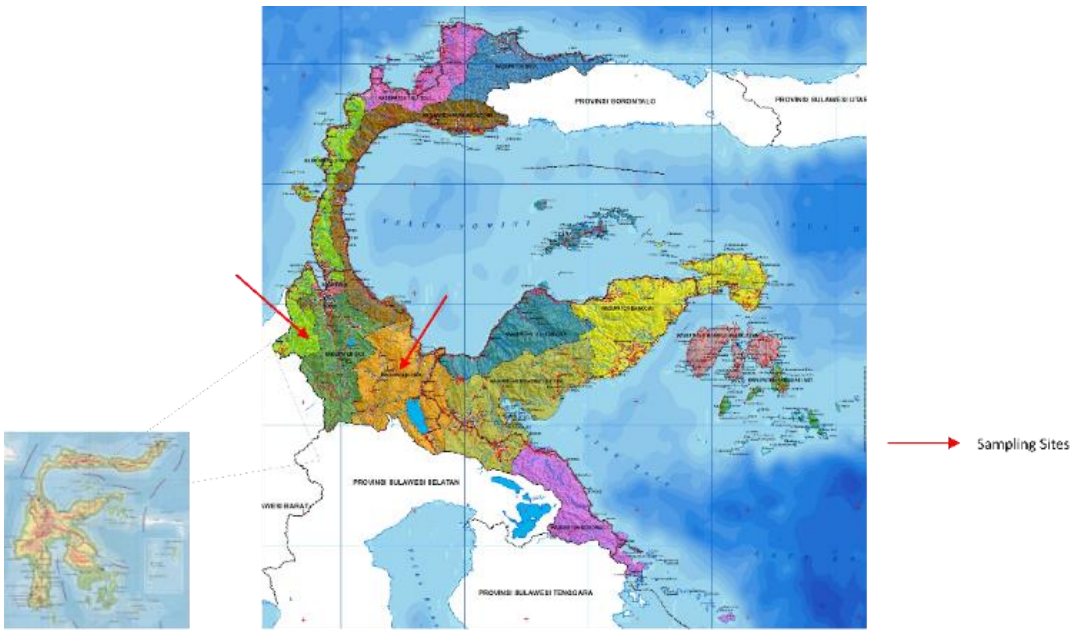

Figure 1. Sampling sites map

Table 1. The research material were fresh rattan stem of 10 species obtained from Donggala and Poso natural forest

No.	Species	Photograph	Status (wild/ cultivated)	Coordinate altitude	
				Location in Poso	Location in Donggala
1	Calamus koordersianus Becc.		Wild	1°12'20.80" South Lat. and 120°32'35.38" East Long.	0°12'1.55" South Lat. and 119°52'13.14" East Long.
2	Calamus insignis Griff.		Wild	1°12'38.54" South Lat. and 120°32'30.69" East Long.	0°12'1.82" South Lat. and 119°52'24.10" East Long.
3	Calamus orthostachyus Furtado		Wild	1°13'10.51" South Lat. and 120°32'35.51" East Long.	0°12'0.37" South Lat. and 119°52'38.98" East Long.
4	Calamus minahassae Warb. ex Becc.		Wild	1°13'27.39" South Lat. and 120°32'36.04" East Long.	0°11'51.85" South Lat. and 119°52'43.04" East Long.
5	Calamus leptostachyus Becc.		Wild	1°13'30.93" South Lat. and 120°32'10.25" East Long.	0°11'52.67" South Lat. and 119°52'32.15" East Long.
6	Calamus boniensis Becc.		Wild	1°13'6.31" South Lat. and 120°32'7.64" East Long.	0°11'52.33" South Lat. and 119°52'19.11" East Long.
7	Daemonorops lamprolepsis Becc.		Wild	1°12'33.40" South Lat. and 120°32'4.52" East Long.	0°11'42.45" South Lat. and 119°52'15.11" East Long.
8	Daemonorops robusta Warb. Ex Becc.		Wild	1°12'35.06" South Lat. and 120°31'40.43" East Long.	0°11'42.35" South Lat. and 119°52'24.90" East Long.
9	Daemonorops macroptera Becc.		Wild	1°12'41.22" South Lat. and 120°31'15.25" East Long.	0°11'36.32" South Lat. and 119°52'37.01" East Long.
10	Korthalsia celebica Becc.		Wild	1°13'18.63" South Lat. and 120°31'26.04" East Long.	No Sample

Table 2. Speciess of non-traded rattan

No.	Rattan Species	
	Scientific	Indonesian/Local
1.	Calamus koordersinaus Becc.	Tumbuawu, lauro pepa
2.	Calamus insignis Griff.	Batu
3.	Calamus orthostachyus Becc.	Popini
4	Calamus minahasae Warb.	Ronti
5	Calamus leptostachyus Becc.	Sambuta
6	Calamus boniensis Becc.	Uweepe
7	Daemonorops lamprolepsis Becc.	Lita
8	Daemonorops robusta Blume.	Kuyui
9	Daemonorops macroptera Becc.	Guyubi
10	Korthalsia celebica Becc.	Uwe keis

Table 3. Morphological characters of 10 rattan rods species

No.	Species name	Internode Length (cm)		Diameter (mm)		Cylindtricity		Texture	Color	Surface Appearance
		Range	Average	Range	Average	Range	Average			
1.	*Calamus koordersinaus* Becc.	53.7-57.7	54.64	21.8-23.3	22.5	0.85-0.89	0.87	grooved	Gray	dull
2.	*Calamus insignis* Griff.	15.7-17.3	16.53	6.8-8.2	7.6	0.93-0.97	0.95	flat	Green	shiny
3.	*Calamus minahasae* Warb.	27.7-29.4	28.58	4.8-6.3	5.6	0.95-0.98	0.96	grooved	Light yellow	dull
4.	*Calamus orthostachyus* Becc.	15.3-17.3	16.53	11.8-13.2	12.6	0.91-0.95	0.93	grooved	Light blue	dull
5.	*Calamus leptostachyus* Becc.	25.7-27.3	26.51	14.8-16.3	15.5	0.88-0.94	0.92	flat	Yellowish green	Slightly shiny
6.	*Calamus boniensis* Becc.	36.8-38.2	37.5	18.7-20.2	19.4	0.85-0.90	0.87	flat	Light yellow	dull
7.	*Daemonorops lamprolepsis Becc.*	18.7-20.4	19.53	18.6-20.3	19.4	0.84-0.88	0.86	flat	Yellowish white	shiny
8.	*Daemonorops robusta* Blume.	43.8-45.3	44.53	30.8-32.3	31.5	0.82-0.86	0.84	flat	Green	dull
9.	*Daemonorops macroptera* Becc.	60.7-62.3	61.53	24.7-26.3	25.4	0.86-0.89	0.87	grooved	Light blue	dull
10.	*Korthalsia celebica* Becc.	28.8-30.3	29.54	10.7-12.3	11.5	0.86-0.90	0.88	flat	Green	dull

The reference for economic value is the rattan species that has been traded so far, known as the favorite rattan species or commercial rattan. The favorite rattan species is based on the suitability of the needs for a quality furniture industry. The characters used in the favorite rattan species trading are the internode length, stem diameter, surface appearance and physical-mechanical properties.

Data analysis was performed based on parametric statistics namely variance analysis (Anova) and then continued with the "Duncan" multiple mean difference test. The data processing and analysis were performed with a computer and SPSS version 21 program, while the results were used as the basis for determining the quality level of the 10 speciess of rattan studied. Meanwhile, the determination was based on morphological characters, categorized according to the results range of the Duncan Multiple Mean Difference calculation. Each character was distinguished into a certain category with different weight values intervals, depending on the character and the number of observations as well as the statistical analysis [24].

3. RESULTS AND DISCUSSIONS

3.1 Rattan morphology character

Based on the identification and determination of the non-traded rattan in Central Sulawesi, 10 speciess were found as shown in Table 2. Meanwhile, the observations and measurements of internode length, diameter, cylindricity, groove, color, and rod surface appearance are presented in Table 3.

Based on the description in Table 3, the six morphological characters are unable to comprehensively explain the characteristics of rattan. However, they play a role in the quality determination based on SNI 01-7254-2006 [4] regarding rattan. According to Dranfield [5], complete data are needed to fully describe rattan with root organs, rods, leaves, flowers, fruits, as well as the auxiliary tools such as cirrus and flagella. The internode length, diameter, cylindricity, groove depth, color, and surface appearance of rods are unable to accurately determine the specific species, therefore, other characteristics are still needed. In a plant classification system, to determine the species accurately, it is necessary to have a complete variety of characters from morphological aspects such as roots, stems, leaves, flowers, fruits, and seeds. Currently, species determination is no longer limited to morphological aspects, but anatomical and chemical aspects have been used, even genetic aspects such as DNA. The characters of xylem and fiber can be used as a determinant of plant species such as only rattan. However, in determining plant species, the anatomical aspect has not been widely applied, except if the morphological aspect cannot provide

accurate instructions, then the anatomical aspect is used as a comparison. To determine the quality of the species in the rattan trade, a reference based on the morphological characters with SNI 01-7254-2006 is recommended.

The characters described above are only the characters used in determining the quality level of each rattan species which could be used for industrial raw materials, as explained from the six characteristics (Table 2 and Table 3), while the other characters are not used as the determining character for the quality level of each rattan species.

To explain the character of rattan comprehensively, other characters are needed, such as root character, leaf character, flower and fruit character, growth and development character, ecological character, anatomical character, chemical content, and other physical and mechanical characteristics.

3.2 The average difference test of rattan rod morphological characters

This study describes six morphological characters of rattan which include internode length, diameter, cylindricity, texture, color, and surface appearance of the rods. However, based on the standard rules, they are not enough to obtain adequate information on the various species of rattan. Nevertheless, for trade purposes that rely on experience and visuals, these characters are used as a basic reference in determining the species and quality.

The analysis results showed that there are three of the six characters studied including internode length, rod diameter, and cylindricity have potential to provide explicit differences, meanwhile the other three are homogeneous, hence, the level of differentiation is very low. These characters are not analyzed using a statistical approach because the data is qualitative. However, the analysis was carried out visually and only applies to non-traded rattan.

Even though these characters are homogeneous and not significant in determining the quality level of rattan, in the world of rattan trading, these characters are still used as characters to determine the quality of rattan, because if these characteristics are not fulfilled then the rattan species has a potential to be rejected by the buyers, or at least it has lower price than the quality rattan.

The analyzed morphological characters include internode length, diameter, and cylindricity, while the texture, color, and surface appearance were not analyzed because the data were more homogeneous and qualitative. The homogeneity analysis showed a significant difference at α 0.01, therefore, it was continued with the analysis of variance test. Furthermore, the results showed a significant F value at α 0.01, indicating that the characters of internode length, rod diameter, and cylindricity are significantly different from one species to another.

The length of each rattan internode was significantly different from one another at α 0.05. The 10 speciess of rattan studied were divided into nine different groups, eight are not clustered, while the other two form one group. Moreover, each species in a group showed no significant difference but was significantly different from other species and groups. Additionally, the rattan with the longest internode was *Daemonorops macroptera* while the shortest was found in *C. insignis*.

The internode length varies based on the species of rattan, species with a longer internode have a better appearance than the shorter one. This is because, during processing, rattan with longer internodes produces a higher quality compared to others with shorter species which are usually coarser and difficult to bend. Therefore, the quality of rattan is determined based on the length of the internode, but this depends on its designation.

The rod diameter was significantly different for each rattan species at α 0.05. Each species in a group showed no significant difference but were significantly different from other species and groups. Based on the results, the species of rattan with the largest rod diameter was *K. celebica* while the smallest was found in *C. minahasae.*

Furthermore, the rattan rod diameter varies depending on the species namely small (≤ 18 mm) and large diameter (> 18 mm - 40 mm). However, certain rattan has a diameter greater than 4 cm, but is rarely sold in the market and even has no price. Seven of the 10 speciess of rattan studied are classified as small in diameter, including *C. insignis, C. minahasae, C. Orthostachyus, Calamus leptostachyus, Calamus boniensis, D. lamprolepsis,* and *K. Celebica.* Meanwhile, there are three species with a large diameter, namely *C. koordersianus, D. robusta,* and *D. Macroptera.*

The rod cylindricity was significantly different from one another with α 0.05. The 10 speciess of rattan studied were divided into seven different groups, six species were not clustered, while the other four formed two groups. Each species in a group showed no significant difference but significantly different from other species and groups. The rattan species with the highest cylindricity namely a value close to one includes *C. inops*, while the lowest was found in *C. ornatus var. celebicus*.

The cylindricity of rattan rods greatly determines the quality and varies depending on the species. This is because it determines the processing outcomes, specifically in polys and core. When the cylindricity is less than 9, a high level of skin tends to be removed to obtain a uniform result. Therefore, it is not good enough to make polys and core. In contrast, rattan is classified as good when the cylindricity is greater or equal to 9. In this study, the rattan in the good category based on the cylindricity include *C. insignis, C. minahasae, C. orthostachyus,* and *C. leptostachyus.*

The rods' texture is generally flat, except for certain speciess, based on the results, six speciess of rattan were found with flat texture or not grooved, namely *C. insignis, C. leptostachyus, C. boniensis, D. lamprolepsis, D. robusta,* and *K. celebica*. Meanwhile, four textured or grooved speciess were found, including C. *koordersinus, C. minahasae, C. orthostachyus,* and *D. macroptera*. Grooved rattan processing tends to be very difficult, hence, its quality is lower compared to the flat-textured species.

The color and appearance of the rod also play a role in determining the rattan quality. A good color turns to white after processing as found in *C. minahasae, C. leptostachyus, C. boniensis,* and *D. lamprolepsis*. Meanwhile, greenish colors including green, and turquoise produce poor results after processing as they usually remain greenish as found in *C. koodersianus, C. insignis, C. orthostachyus, D. robusta, D. macroptera,* and *K. celebica*. The appearance of the rod surface either glossy or dull, also determines the rattan quality. Dull rattan does not have a good appearance after processing, hence, it is only suitable for making core and pitrite, for example *C. koordersianus*. Although the texture, color, and surface appearance of the rods do not show significant differences, these three characters are very important in determining the species and quality of rattan.

3.3 Quality standard approach

The quality determination of rattan is only based on the morphological characteristics and the hardness of the rod. Meanwhile, the internode length, diameter, texture, color, and appearance of the rods vary by species. These variations indicate the quality level as previously reported by Stiegel et al. [25] and Jasni and Krisdianto [26]. Moreover, based on the interviews with rattan communities and furniture entrepreneurs in Central Sulawesi, the quality of rattan is largely determined by the morphological character of the rods.

The analysis of internode length, diameter, cylindricity, groove depth, color, and surface appearance of the rod, indicates that the rattan quality standards are also arranged based on the rod morphological characters. The internode length differs based on the specific species, rattan with a longer internode tends to have a better appearance compared to a shorter one, specifically for whole round rattan. During processing, the results of a longer internode are often better than others with a shorter internode which usually appears to be more coarse and difficult to bend. Therefore, the quality of rattan is determined based on the internode length, depending on its designation [3, 15, 23].

The diameter of the rattan rod varies depending on the species and is divided into two categories, namely small with < 18 mm and large diameter with 18 mm or more. This parameter significantly influences its use, for example, large-diameter rattan is widely used for the manufacture of furniture frames, while the small species is used for woven and binding raw materials. In this study, five among the 10 speciess of rattan studied were classified as small in diameter, including *C. insignis, C. Minahasae, C. Orthostachyus, Calamus leptostachyus,* and *K. celebica,* while five were large-diameter speciess, namely *C. koordersianus, C. boniensi, D. lamprolepsis, D. robusta,* and *D. macroptera*. Furthermore, the diameter of the rod greatly determines the process and designation, hence, it is used as a character to categorize rattan based on its quality. Large diameter rattan is generally used as a frame material, while others with a small diameter are utilized in making accessories or as *core* and *pitrit* [3, 15, 23, 27].

The cylindricity of rattan varies depending on the species and greatly determines its quality. This is because cylindricity determines the processing outcomes, specifically *polish* and *core*. When the value is less than 90%, a high level of skin is removed, thereby producing a uniform result with a low yield. Moreover, the processing requires more time and is capital intensive, hence, rattan with less than 90% cylindricity is not good for *polish* and *core*. However, when the value is equal to or higher than 90% rattan is categorized as good. In this study, *C. insignis, C. minahasae, C. orthostachyus,* and *C. leptostachyus* were categorized as good based on the cylindricity. An absolutely cylindrical rod is rare, based on the existing diameter range, rattan quality is divided into three categories, namely: 1) cylindricity ≥ 90% of A quality, 2) 85-99 % of B quality, and 3) < 85 % of C/D quality [3, 15, 23].

Near-perfect cylindrical rods are more useful for large-diameter speciess due to the wide application for making furniture frames. Usually, rattan with almost perfect cylindrical properties is made by book scraping or mechanical sanding. However, this method requires additional costs and energy, hence, it is not uneconomical.

The rattan rods studied were generally not grooved, except for four speciess namely *C. koordersinaus, C. minahasae, C. orthostachyus,* and *Daemonorops macroptera* which have shallow grooves. Meanwhile, rattan with extremely deep grooves requires more time and costs with inefficient as well as low yields. Moreover, it decreases uniformity, hence, rattan with grooves has lower quality than others without. Based on this parameter, the quality is divided into three categories, including: 1) rattan without grooves of A quality, 2) shallow grooves of B quality, and 3) deep grooves of C/D quality [3, 15, 23].

The rod color varies not only in different speciess but also among the same species, the better the color, the more expensive the price, and vice versa. Furthermore, the color of the young rattan rods is different from the old, while the color at the rod base is different from the middle and extremities. Both color and appearance play a role in determining the quality of the rattan. A good color changes to white after undergoing processing. However, when the color varies, the quality of the rattan product tends to decrease. This is in line with Januminro [28] and Rachman and Jasni [29], which stated that green rattan rods at old age change to white after the silica membrane are peeled off and becomes white again after the bleaching process.

The rod surface appearance namely glossy or dull also determines the quality of rattan after processing. Glossy rattan rods reflect light, give a special characteristic, and add to the beauty [30]. The surface appearance in the form of gloss varies depending on the anatomical structure, content of extractives, and the angle of light incidence. Moreover, the rattan luster is also influenced by the water content, the higher the value, the lower the gloss. Similarly, the presence of fatty and oily substances reduces the luster of rattan [31]. Dull rattan does not appear good after processing, hence, it is only suitable for manufacturing *core*, for example, *C. orntatus var celebicus*. Furthermore, color and surface appearance are applicable as quality determinants when the rattan to be processed is not peeled. This is because rattan to be peeled into *core* and *pitrite* does not require standard color and surface appearance.

Presently, the quality level of rattan is mostly determined based on the morphological properties and rod hardness. Meanwhile, internode length, diameter, texture, color, and appearance of the rods vary by species, these variations indicate differences in the quality levels. However, a definite determination is difficult, as it is only based on a visual assessment. This is in line with Rachman and Jasni [29], as well as the results of interviews with communities and entrepreneurs in the semi-finished processing rattan industry and furniture in Central Sulawesi.

The 10 rattan varieties based on the morphological characters have visual similarities and were classified as the favorite speciess according to the general standard [2, 13-15]. Therefore, they have almost the same quality with varying levels. Moreover, the quality of each species is still considered to fulfill maturity standards and free from defects. Maturity and the percentage of defects are the factors that determine the price. Although the rattan in this study has a good quality, it is still young and has several defects, hence, the price might be adjusted to the prevailing standard [3, 15, 23, 29].

Quality determination of rattan based on the morphological characters of the rods is carried out quantitatively by assigning weights according to the level of differences in the analysis results of each observed feature. The rattan values of Tellu [2] were used because they are the favorite speciess and are widely traded in the market for both domestic and export needs. Furthermore, the higher the total weight, the higher the quality

of the rattan, as shown in Table 4. The data in Table 4 describes the total weight of each rattan species as a sum of the morphological characters. Based on the total weight, a quality rating was assigned from 1 to 10 for each species of rattan studied and then grouped into three quality categories. Quality A includes *Calamus boniensis, D. lamprolepsis*, and *K. Celebica,* while *C. insignis, Calamus leptostachyus,* and *D. robusta* were in the B category. Furthermore, quality C includes *C. koordersianus, C. minahasae,* and *C. daemonorops macroptera*, while *C. orthostachyus* was in D.

Table 4. Quality of rattan based on the weight of each rod morphology character

No.	Rattan Species	Internode length (cm)	Rod Diameter (cm)	Cylindricity (%)	Flow State	Color	Surface appearance	Total	Grade	Quality Category
1.	C. koordersinaus	8.88	6.66	3.75	5	3.33	3.33	30.95	9	C
2.	C. insignis	1.11	2.22	7.5	10	6.67	10	37.5	5	B
3.	C. minahasae	4.44	1.11	8.75	5	10	3.33	32.63	8	C
4.	C. orthostachyus	1.11	3.33	6.25	5	3.33	3.33	22.35	10	D
5.	Calamus leptostachyus	3.33	4.44	5	10	6.67	6.67	36.11	6	B
6.	Calamus boniensis	6.66	5.55	3.75	10	10	3.33	39.29	3	A
7.	D. lamprolepsis	2.22	5.55	2.5	10	10	10	40.27	2	A
8.	D. robusta	7.77	8.88	1.25	10	6.67	3.33	37.9	4	B
9.	Daemonorops macroptera	9.99	7.77	3.75	5	3.33	3.33	33.17	7	C
10	K. celebica	5.55	9.99	10	10	6.67	3.33	45.54	1	A

Table 3 shows that the quality of the 10 speciess of rattan studied vary with different quality levels. When the quality determination is only based on the combination of the six morphological characters, then, category A or B are automatically selected based on the respective total weight. However, the quality of rattan also depends on the suitability of its designation (SNI 7208) [23]. Therefore, the quality level classification for the 10 speciess of rattan studied based on the morphological characters is inseparable from the designation. The designation is used as a guide in choosing a particular species of rattan. For example, to construct a complete frame in the form of washed and sulfurized (WS) rattan, there is a need to consider several factors such as the groove depth, color, and surface appearance, as well as the internode length and cylindricity. Meanwhile, for split rattan such as *core*, *pitrite* or *polish*, the major priority is the cylindricity and diameter of the rod. Based on this analysis, it was concluded that the quality determination based on morphological characters needs to consider the designation of the rattan species to be selected [3, 18, 29].

4. CONCLUSION

Based on the results, the morphological characters of the 10 speciess of rattan studied were various. Therefore, these parameters including internode length, diameter, cylindricity, color, texture, and surface appearance are suitable for determining the quality level of non-traded rattan which are used for various industrial and handicraft purposes in Central Sulawesi. Morphological characters that can be used as species identifiers and determinants of the quality level of rattan that are not yet traded in Central Sulawesi are: internode length, stem diameter, cylindricality, stem color, stem texture and surface appearance. Based on the results of the morphological character analysis, the quality level of the 10 rattan species that have not been traded can be well determined. Of the 10 rattan species, six of them can be used for various industrial purposes and rattan crafts as well as the favorite rattan species that have been traded. This is based on the results of morphological analysis characters of rattan that has not been traded, having the same morphology and quality level with the rattan species that have been traded. Types of rattan that have not been traded that have a quality level that is classified as high (category A) and medium (category B) that can be used are: *Calamus insignis, C. leptostachyus, C. boniensis, Daemonorops lamprolepis, D. robusta, and Korthalsia celebica.*

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