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Effect Of Turmeric (Curcuma) Treatment Toward The Single Fiber Akaa (Corypha) Tensile Strength

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ABSTRACT

The purpose of this study is to determine the effect of natural ingredients treatment such as turmeric (Curcuma) on a fiber sheath Akaa (corypha) toward the fiber tensile strength. The first step is soaking the Akaa fiber sheath in a distill water and then dried it up at a room temperature for about 48 hours. The second step is boiled the fiber in a turmeric solution for about 1 hour and then dried it up at a room temperature for 48 hours. The third step is boiled again in the turmeric solution for about two hours and again dried it up in the room temperature and finally boiled it in the turmeric solution again for three hours and then dried it up again about 48 hours in a room temperature. The fiber boiling process in the turmeric solution temperature is about 100° C and under a pressure of 1 atmosphere. The turmeric solution used has a concentration of 20% turmeric and 80% volume unit distilled water. The fiber was then observed for the fiber tensile strength with a specimen shape standardunder the ASTM 3309-02 regulation. The other observation was the SEM testing with the X-Ray Energy Dispersive Spectroscope (EDS) and lastly the FTIR testing. From the research result it isknown that the highest single fiber tensile strength was found on the fiber which was treated about one hour boiled in the curcuma solution.

Key word: Akaasheath Fiber, turmeric (curcuma)treatment, tensile strength

INTRODUCTION

2009 was a historic moment where the Food and Agricultural Organization (FAO) first suggested return to the implementation of natural fiber which is known by the slogan of the"International Year of Natural Fiber 2009". The aim of this declaration is bring back to natural fibers, increase efficiency, production sustainability and improve the environment. This is the turning point worldwide movement utilizing natural fibers for various industrial purposes [15].

Natural fibers hasa low density, has abiodegradationcapability, easily to be recycled, does not require high energy for the production process, has a good mechanical properties and could be renewed because it comes from nature. So that the use and utilization of polymer composite with natural fiber as the strengthen filler would be continue to be developed and interest the international industry at the last decade [1]. One of the natural fiber properties is having a hydrophilic characteristic which is absorbing water [2]. To improve thenatural fiber compatibility whichis hydrophilic,various ways have been done, either physically or chemically to repair the fiber surface. The natural fiber properties reparationis the fiber strength, the fiber surface shape, fiber impurities removal and the fiber interaction with the matrix. The best solution is by a chemical treatment. [3].

Alkali treatment is commonly used for chemical treatment. By alkali treatment most of hemicellulose, lignin, wax, and oil-soluble alkali could be eliminate, so that the fiber surface becomes rough due to fiber aggregation reduced [4]. Research on fiber alkali treatment has been carried out [4,5,6,7].Natural fibers that have been treated with alkali as a composite reinforcement generally would increase the fiber modulus elasticity and the fiber flexure compare with natural fibers without treatment. So, the fiber pretreatment to improve natural fibers strength for composite reinforcement is still needed [8,9]. NaOH is used to strengthen the natural fiber media on matrix composite and silane coupling agent [10]. Other chemical medias used for fiber treatment is the Potassium Permanganate ($KMnO_4$) [11] and hydrogen peroxide (H_2O_2) [12,13].

Various methods and engineering technology conducted by researchers to obtain a better single fiber mechanical properties. Chemical treatment is usually used by researchers for single fiber pretreatment (characterization).Natural fiber treatment to improve the mechanical properties using natural ingredients like turmeric has never been done by previous researchers.

Turmeric (Curcuma) is a plant which has many benefits for human life, either for human health or for cosmetic, food and drinks. This is because turmeric has many substances in it that possibly by very useful for human life. Some research has done to get thebest soaking time and the best turmeric concentration toward the best tofu lifetime. The turmeric concentration variation is about 1%, 2% and 3% and a soaking time of 2 days, 4 days and 6 days. From the study it is found that for tofu the best soaking time is 4 days with a turmeric concentration of 2%. To rise the tofu life time which is 4 days compared with the untreated tofu would only lasted 2 days. So turmeric is widely used as a preservative.Turmeric has the same preservative powers like formalin. Theoretically turmeric is a plant that contained pretty much anti-oxidant [14].

The purpose of this study was to determine the effect of natural ingredients such as turmeric treatment with several treatment variations toward the best material tensile stress. Furthermore, is to find out the fiber morphology and topography changes of the Akaasheath fiber to determine the best fiber conditions. Finally, is looking for the fiber absorption capability and determine the best treatment of Akaasingle sheath fiber.

MATERIAL AND METHODE

The materials used are the Akaa sheath fiber, turmeric liquid (Curcuma) and distilled water. Akaa sheath fiber taken from Akaatrees that grows in the Wajoarea South Sulawesi, Indonesia. Akaasheath fiber is taken manually from the Akaasheath by pounding it using a rubber hammer to separate the Akaa fiber from the sheath. The fiber is then pulled out manually. The turmeric solution used was a solution with a 20% turmeric powder concentration and 80% distilled water by volume basis. First is soaking the Akaa fiber in distilled water and then boiled the fiber in the turmeric solution for about 1 hour, 2 hours and 3 hours variation. The boiling temperature is 100°C at a pressure of 1 atmosphere. Finally, the fiber is dried up at a room temperature for about 48 hours. This single fiber treated is then observed under a tensile test, SEM and FTIR observation.

A Testometric M500-25CT DBBMTCL 2500 kg RochdaleEngland was used to test the Akaasingle fiber tensile test. The Akaa fiber is then cut into pieces with a length of 90 mm.The specimen length is about 30 mm long based on the ASTM 3379-02 regulation. With a 5 mm/minpulled speed. The Akaa fiber average diameter is about 0,45mm, which is measured with a digital microscope with a magnification of 500 times. The testing procedure was done 7 times for each treatment fiber which is the (NT), (AT), (TT1), (TT2) and (TT3).

The Fourier Transform Infrared Spectroscopy (FTIR) test is using a Shimadzu 8400. The tests were conducted on specimens that have been mashed or on specimens in a form of extracts. The test was done by inserting the specimen into the FTIR machine and the test result is a chart that could be viewed directly on the FTIR monitor screen. To assess the test chart result an IR absorption characteristics table (special functional group absorption table characteristic) was used to help the result assessment. The test was conducted for each treatment fiber which is the (NT), (AT), (TT1), (TT2) and (TT3).

The Scanning Electron Microscopewas done by usinga Vega3 Tescan at a 5kV voltage (SEM). The first test is to determine the fiber sheath Akaaelement content. Each sample was cut into pieces according to the sample size placed on the specimen preparation. The sample was then observed to find out the element content in the Akaa sheath fiber. The results could be seen in the form of graphs and tables of element composition and compounds. This test was performed for all treatments, namely fiber (NT), (AT), (TT1), (TT2) and (TT3).

Furthermore the test was held to determine the fiber surface morphology and topography. The fiber surface morphology and topography test was performed for all kind of fiber treatments, namely fiber (NT), (AT), (TT1), (TT2) and (TT3).

Table 1: Single fiber treatment Notation

Notation	Explanation
NT	Non Treatment
AT	Soaked in distilled water for one hour
TT1	Turmeric Treatment for one hour
TT2	Turmeric Treatment for two hours
TT3	Turmeric Treatment for three hours

NT is the notation for the Akaa fiber without any treatment. The first treatment (AT) is the fiber sheath Akaa soaked in distilled water for 1 hour and then dried up at room temperature for about 48 hours. The second treatment (TT1) is Akaa sheath fiber boiled in a turmeric solution for 1 hour and then cooled and dried up under room temperature for 48 hours. The third treatment (TT2) is the Akaa sheath fiber boiled in a turmeric solution for 2 hours and then dried up and cooled under the room temperature for 48 hours. The fourth treatment (TT3) is the Akaa sheath fiber boiled in the turmeric solution for 3 hours and then dried up and cooled under a room temperature for 48 hours.

RESULT AND DISCUSSION

Based on a single fiber tensile test, as shown in Figure 1, it is seen that there is a tensile strength increase of Akaa fiber without treatment (NT).For the next treatment which is the fiber soaked in distilled water (AT) the fiber tensile strength raise up and the tensile stress continuously increased for the fiber treatment boiled one hour in the turmeric solution (TT1) and was seen as the highest tensile stress. While for the two hours fiber boiled in a turmeric solution (TT2) the tensile stress began to fall down, as well as for the three hours fiber boiled in the turmeric solution (TT3) the tensile stress continues dropped down significantly.

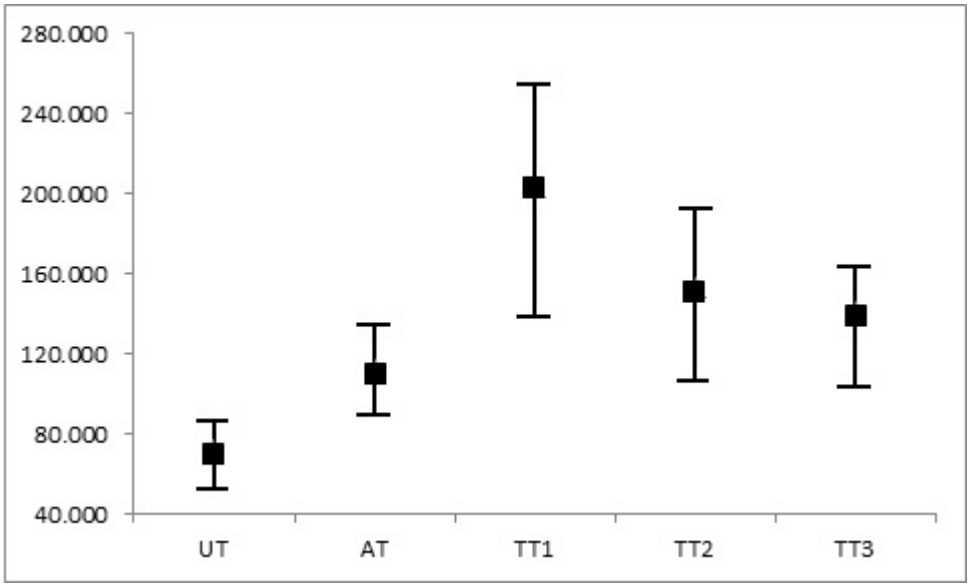


Figure 1: Akaa Single Fiber Tensile

Table 2: Akaa Single Fiber Tensile Strength

Fiber Treatment	Tensile Strength (N/mm^2)						
	1	2	3	4	5	6	7
NT	52.504	59.821	73.602	74.949	77.674	82.579	85.925
AT	91.100	97.848	103.850	104.130	120.850	131.640	134.280
TT1	139.540	152.600	206.710	210.480	215.680	245.990	254.720
TT2	107.270	128.630	150.060	168.740	170.060	152.530	193.310
TT3	112.150	112.150	129.040	158.880	159.970	163.080	164.490

On Figure 2 it is seen the SEM results for the Akaafiber morphology and topography for NT, AT, TT1, TT2, and TT3 treatment. From the AT treatment it could be seen that the Akaafiber surface was cleanedup from the fiber cut debris, dirt and the elements such as chlorine, sulfur, phosphorus and Scandium so that the fiber morphology looks smoother. The TT1 and TT2 treatment produces the best fiber morphology. The treatment time has maximized the Akaa cell fibers to absorb various oxide atoms contained in the turmeric solution. While the TT3 treatment result a number of fiber cells damaged (soluble), the oxide absorption power or the Akaaatomic fiber decreases. The fiber topography appears to be damaged and fragmented and the morphology is no longer homogeneous. The fiber topography and morphology plays an important role in the fiber mechanical properties such as the fiber stress and strain is achieved by the Akaafiber. It is clear that the TT1 treatment result the best fiber treated and has the highest tensile strength.

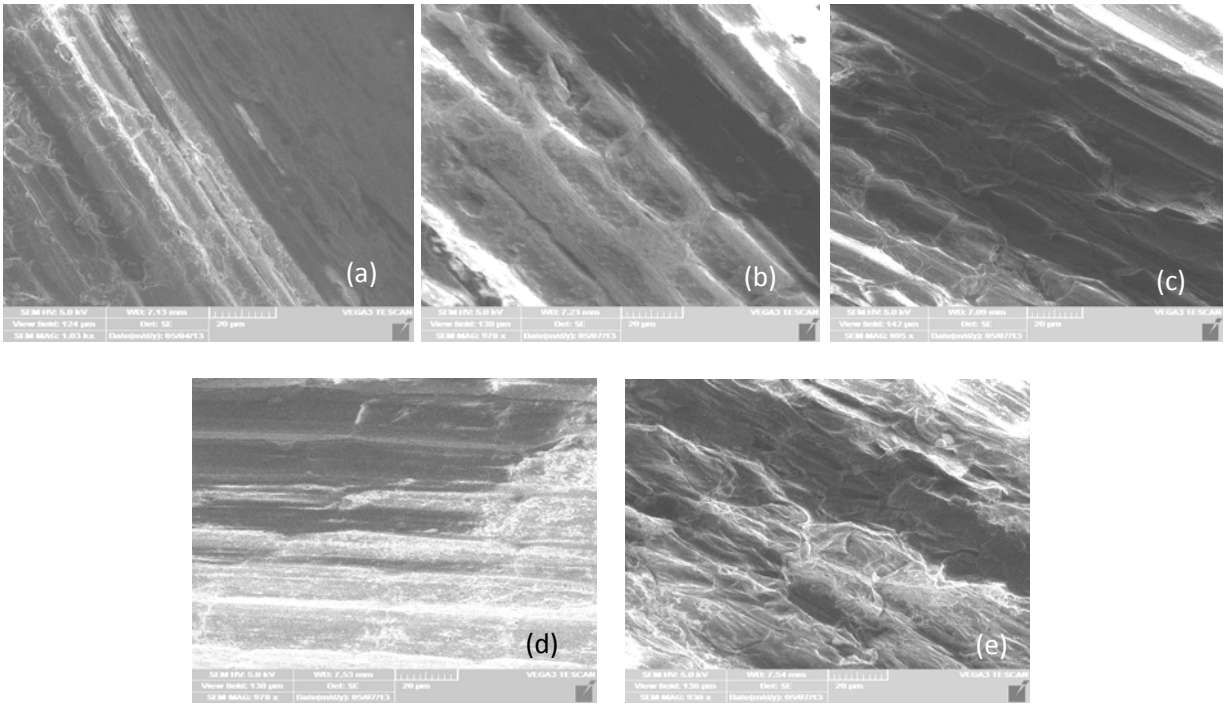


Figure 2: a. Without treatment (NT); b. 1hr soaked in H_2O (AT); c. 1 hour boiled in turmeric solution (TT1); d. 2 hours boiled in turmeric solution (TT2); e. 3 hours boiled in turmeric solution (TT3).

Figure 3 shows that the Akaafiber soaked in distilled water (AT) would increase the Silicon (Si), aluminum (Al), Sodium (Na)percentage of the element. From the X-Ray Energy Dispersive Spectroscopy (EDS) it is detected that under the AT treatment dirt and some elements such as Chlorine, Sulfur, Phosphorus, Scandium were gone. While on the fiber treatment,fiber boiled one hour in turmeric solution (TT1),the Si, Al, and Na percentage raise, while some other elements was not detected or gone. The further fiber treatment boiled two hours in turmeric solution (TT2) and fiber boiled three hours in the turmeric solution (TT3), the Si, Al, Na elements was dropped significantly. On this situation it can be stated that the TT2 and TT3 treatment fiber was already saturated.

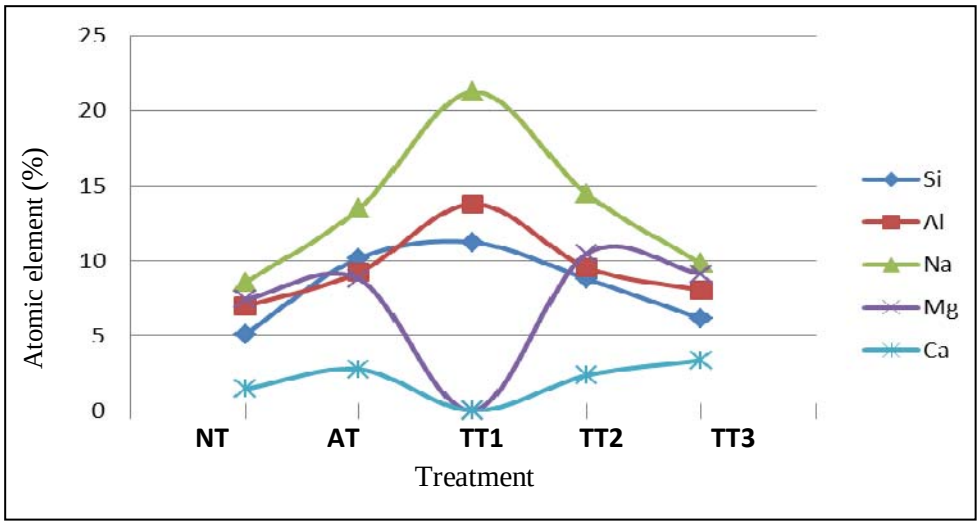
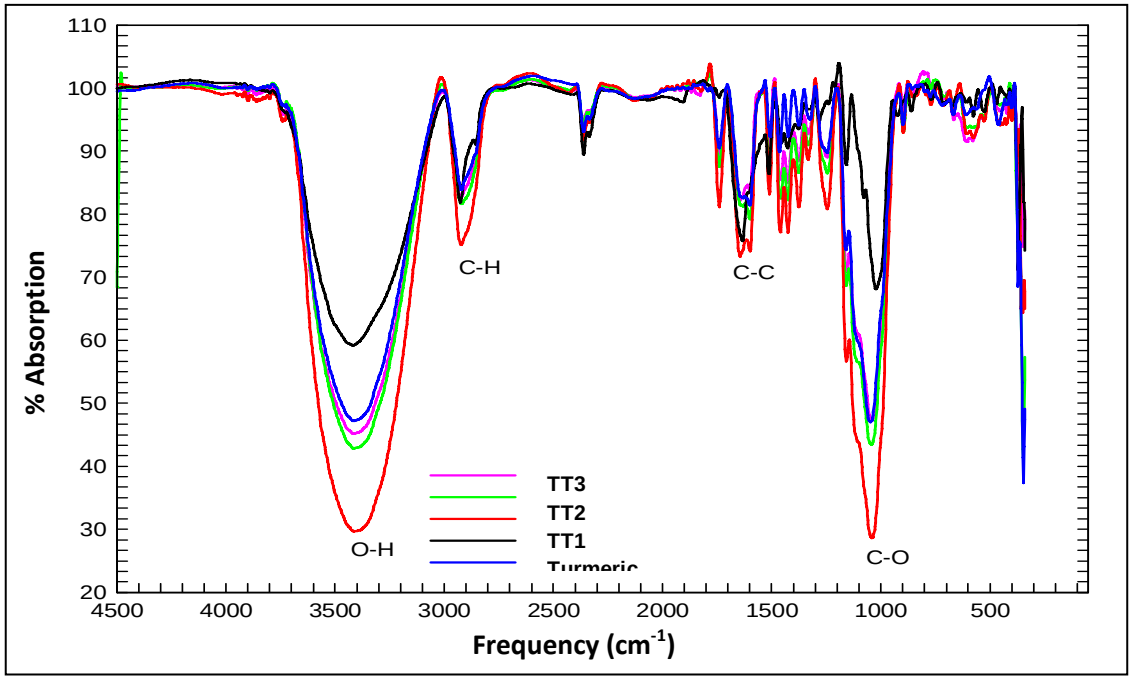


Figure 3: EDS test Result

Figure 4 is the Akaafiber vibrational band graph from the FTIR test results. It is shown that there is wave number shift or frequency shifts due to TT1, TT2 and TT3treatment. From the FTIR spectrum it is seen that the molecules forming the Akaa fiber consists a group of C - O (ethers), C - C (aromatic), C - H (Alkenes) and a water group of O - H (phenols) where in each band in 1000 cm^{-1} in the form of stretching vibration, 1600 cm^{-1} bending vibration, 2800 cm^{-1} bending vibration and 3400 cm^{-1} stretching vibration. However, treatment under a varying time would greatly affect the Akaa fiber absorption capacity. From the graph it is also seen that the longer the boiling time, the Akaa fiber absorption ability would increase significantly at all vibrations tape. It would tell us that the immersion time would significantly raise the Akaa fiber density, and this is seen that the fiber highest level of absorption is in the TT1 fiber treatment.



Picture 4: NT, TT1, TT2, TT3 treatment FTIR Result

CONCLUSIONS

Based on the previous description about natural materials such as turmeric, coconut fiber, it can be concluded that:

1. Turmeric for natural material treatment could increase the fiber tensile strength.
2. Turmeric treatment on fiber could change the fiber morphology and topography.
3. The highest fiber tensile strengthresult is found at the one hour boiled in turmeric solution fiber treatment.

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