Ceiba pentandra (kapok tree) leaf extract as a potential alternative hair grower

Armand S. Budlao¹,³* & Luisa P. Cabiara²,³

¹Relief International Philippines, Makati City, Philippines
²Hi-Precision Diagnostic and Laboratories, Metro Manila, Philippines
³Department of Biological Sciences, College of Science and Mathematics, Western Mindanao State University, Zamboanga City, Philippines

*Corresponding author: ryanmew12@gmail.com

ABSTRACT

Excessive hair loss from the scalp, which is scientifically coined as baldness, affects individuals in framing their personality and general appearance of an individual. This leads to significant psychosocial manifestation which may cost additional expenses on hair treatments. Herein, the effectiveness of *Ceiba pentandra* (kapok tree) crude leaf extract as a potential alternative hair grower was determined and evaluated. Using *Oryctolagus cuniculus* (rabbit) as experimental animals, three treatments were used in the study: treatment 1 (commercial hair grower) as the positive control, treatment 2 (kapok tree leaf crude extract), and treatment 3 (water only) which served as the negative control. The treatments were applied on the shaved patches of the rabbits every day for 30 days. Mean hair length on the 30th day is highest in treatment 2 with 25.32mm while treatments 1 and 3 are 14.93mm and 10.81mm, respectively. Based on the results, it showed that *C. pentandra* crude leaf extract contributed the most significant hair growth activity. Analysis of Variance (ANOVA) statistical results show that there is a highly significant difference (p value = 0.000) at α=0.01 level between the treatments. Furthermore, post-Hoc analysis revealed that *C. pentandra* leaf extract is better than the commercial hair grower in terms of its effect on increasing hair length. Further research for structural interpretation and identifying the mechanism of action responsible of *C. pentandra* as an alternative hair grower is recommended.

*Keywords:* hair loss, *Ceiba pentandra*, hair growth, synthetic hair grower
INTRODUCTION

Hair has psychological and sociological importance throughout the ages in framing the personality and general appearance of an individual (Semalty et al., 2011). With excessive hair loss termed as baldness, it may directly distress self-confidence affecting the individual’s quality of life (Lourith & Kanlayavattanakul, 2013). This psychosocial manifestation poses expenditure on treatment (Harrison & Bergfeld, 2009) by using hair grower products (Amin et al. (2014).

Synthetic cosmetic products had been developed to solve the problem of hair loss, however, there is a greater risk of side effects such as headache, irritation, hypertrichosis, muscle soreness, fatigue and even sexual health problems (Lucky et al., 2004; Semalty et al., 2011). These side effects seem to be the most prevalent reasons why some tend not to use commercial hair growers, aside from the reason that they are costly.

According to Semalty et al. (2011), alternative hair growers from plants are natural herbal remedies which are safe and gentle to use on hair without the harsh side effects caused by other commercially available hair growers. Significant progress is being made on discovering an effective and safe drug for hair growth.

Ceiba pentandra leaves are found to be rich in certain nutrients and contain various bioactive components such as polyphenol, flavonoids, alkaloid and saponins which may promote hair growth (Osuntokun et al., 2017). These bioactive components are also found in the leaves of Aloe vera, green tea, and gumamela plants which are used in other research studies as alternative hair growers (Kumar et al., 2010; Amin et al., 2014; Agrawal & Singh, 2017). In addition, C. pentandra leaves contain vitamin and mineral contents which include: vitamin A, known to protect hair follicle cells from damage caused by free radicals; vitamin C, which helps produce and maintain healthy collagen, the connective tissue type found within hair follicles; and vitamin E, which helps maintain the integrity of cell membranes of hair follicles. These bioactive components and nutrients mentioned are helpful in stimulating hair growth (Almohanna et al., 2019).

C. pentandra, as a tropical tree under Family Malvaceae, are abundantly found in the rural areas in the Philippines and has abundant leaves all year round. While the fibers attached to the seeds are utilized as packing materials for upholstery, mattresses, pillows, quilts and stuffed toys, its leaves are utilized by the Chinese as herbal medicines (Mojica et al., 2004). However, there is no report available on hair growth promoting activity of C. pentandra leaves. Hence, this study was conceptualized which specifically focused on the scientific investigation of the hair growth potential of the leaf extracts of C. pentandra on the Oryctolagus cuniculus (rabbit).

METHODS

Research Samples

The following research samples were used in this study in observing hair growth.

a. Plant Material - This study utilized the fresh and tender leaves of C. pentandra collected at Barangay Putik, Zamboanga City.
b. Test Specimen - Eighteen rabbits were used to test the potential of kapok tree leaf extract as hair grower. The rabbits weighed between 200-250g of either sex, of which, three (3) rabbits came from the same mother rabbit.

**Research Environment**

The study was conducted at the Department of Agriculture Laboratory Unit at Veterans Avenue Extension, Tumaga, Zamboanga City, Philippines. Crude extraction was done at Room 101 of the College of Science and Mathematics, Western Mindanao State University.

**Research Design**

The research design used was Randomized Complete Block Design (RCBD) with three (3) treatments and six (6) replicates in each treatment with two (2) sub-samples, referring to the patches. Each rabbit was randomly assigned to groups using the draw lots method (Fig. 1).

![Research Design Using RCBD](image)

**Legend:**
- T<sub>1</sub> = Treatment 1 (Commercial Hair Grower - Positive Control)
- T<sub>2</sub> = C. pentandra crude leaf extract
- T<sub>3</sub> = Water only (Negative Control)
- R = Replicate

**Figure 1.** Research design using RCBD.

**Research Procedure**

**Cage Preparation**

Eighteen cages were constructed to house the rabbits individually. Each cage measured 1.5ft<sup>2</sup> (flooring area) with a minimum height of 14 inches with an allowance of 5 inches. These measurements were based on the guidelines written on the Animal Welfare Act: Title 7 Chapter 54 Sections 2131-2159 (ARBA, 2014).
**Acclimation**

The rabbits were acclimatized for seven days in cages before the administration of the treatments. This is the minimum acclimation period recommended so that the rabbits can adapt to the environmental condition (ARBA, 2014).

**Rabbit Management**

Thirty (30) grams of commercial pellet food were given to the rabbit in the morning and in the evening. They were also given 448ml water in a bowl daily. The bowls were periodically cleaned with an appropriate cleaning agent to reduce bacteria, molds, and algae build-up. Food and water equipment were also inspected on a regular basis to make sure that they are free from any infections (ARBA, 2014).

**Preparation of Ceiba pentandra (kapok leaf) extracts**

The collected fresh leaves were washed with running water and were cut into small pieces using scissors. Three hundred grams (300g) of these cut fresh leaves was blended with 800ml of 95% ethanol. The samples were then placed in a closed container and soaked for 48 hours. When soaking was done, a 200ml solution was poured into the Erlenmeyer flask for extraction using Soxhlet apparatus at 50°C. On the other hand, the commercial hair grower was purchased from a drug store and served as positive control.

**Hair Growth Initiation Test**

The rabbits were divided into six (6) groups, representing six (6) replicates. Each group is composed of three (3) rabbits from the same parent and received different treatments; Treatment 1 (commercial hair grower which served as the positive control), Treatment 2 (kapok leaves extract which is the experimental control) and Treatment 3 (water only which served as the negative control). The dorsal body hair portion of each rabbit was cut with scissors and removed with hair removing cream using a wet cotton swab and rub (Nandeesh *et al.*, 2008; Banerjee *et al.*, 2009; Semalty *et al.*, 2011) in an area of 1 x 1 inch, 2 patches on each rabbit’s dorsal portion with a distance of 5cm each. The treatment was applied once a day for 30 days on the shaved area (Semalty *et al.* 2011). Each group received 1ml per topical application per patch, equivalent to 2ml per day. Hair growth initiation time (minimum day to initiate the hair to grow) was recorded among the 18 rabbits.

**Measurement of Hair Growth**

Hair length was measured in millimeter (mm) using a ruler; an average hair length was calculated by measuring 25 hairs randomly. The hair length was measured every day until the 30th day. Hair measurement started at 1mm. Those hairs which are less than 1mm were reported as zero.

**Statistical Analysis**

Analysis of Variance (ANOVA), for RCBD data with subsamples, was used to statistically determine the differences between treatments. For the computation of hair growth rate, the formula was used:

\[
\text{Growth rate} = \frac{(\text{change in hair length})}{(\text{change in time})} = \frac{(\text{new length} - \text{old length})}{(\text{current time} - \text{previous time})}
\]
RESULTS AND DISCUSSION

Prominent hair growth initiation response was observed on the 3\textsuperscript{rd} day after giving the treatments to the six (6) replicates, with two (2) subsamples each. Two (2) of the six (6) rabbits with 2 patches in treatment 2 (kapok leaf extract) had an observed hair growth on the 3\textsuperscript{rd} day of application. On the other hand, none of the 6 rabbits initiated hair growth on treatment 3 (water). Only two (2) rabbits receiving treatment 1 (commercial hair grower) had initiated hair growth but the other rabbits had hair growth on one patch only. Figure 2 shows the mean comparative hair growth response in rabbits for a 30-day period with the different treatments.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{Figure2.png}
\caption{Mean comparative hair growth response in rabbits for a 30-day period with the different treatments.}
\end{figure}

Treatment 2 (kapok leaf extract) had the longest mean hair growth after 30 days which is 25.32mm. Treatment 1 (commercial hair grower) attains 14.93mm mean hair length, while the least mean length is that of treatment 3 (water) which is 10.81mm. Hair growth rate of rabbit treated with \textit{C. pentandra} crude leaf extract is shown in Table 1.
Table 1. Hair growth rate of rabbit (mm/day).

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Commercial Hair Grower)</td>
<td>0.01</td>
<td>0.05</td>
<td>0.03</td>
<td>0.12</td>
<td>0.30</td>
<td>1.13</td>
</tr>
<tr>
<td>2 (Kapok leaf extract)</td>
<td>0.02</td>
<td>0.1</td>
<td>0.12</td>
<td>0.30</td>
<td>0.91</td>
<td>1.44</td>
</tr>
<tr>
<td>3 (Water)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.01</td>
<td>0.07</td>
<td>0.20</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Hair growth rate in rabbits treated with kapok leaf extract (Treatment 2) is highest with 0.02mm/day during the 3rd day, which is the day that hair initiated its growth in treatments 2 and 1. In like manner, during the 4th and 5th day, its hair growth rate increased to 0.1mm/day and 0.12mm/day, respectively. For rabbits treated with the commercial hair grower (treatment 1), there was an increase during 4th day, but decreased during the 5th day and increased again on the 10th day. Treatment 3 started its hair growth on the 5th day, but there was no fluctuation in its hair growth rate. Table 2 shows the mean hair length (mm) of rabbits treated with kapok leaf extract and commercial hair grower.

Table 2. Mean hair length (mm) of rabbits.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Commercial Hair Grower)</td>
<td>12</td>
<td>14.93</td>
<td>4.22</td>
</tr>
<tr>
<td>2 (Kapok leaf extract)</td>
<td>12</td>
<td>25.32</td>
<td>11.28</td>
</tr>
<tr>
<td>3 (Water)</td>
<td>12</td>
<td>10.81</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Rabbits treated with kapok leaf extract had the highest mean hair length of 25.32mm. This is followed by the rabbits treated with commercial hair grower with the mean hair length of 14.93mm. Rabbits treated with water only had the lowest mean hair length of 10.81mm.

The Analysis of Variance (ANOVA) presented in Table 3 reveals that there is a highly significant difference between treatments on the mean hair length of the rabbits at $\alpha=0.01$ level. There is no significant difference between blocks.
**Table 3.** Analysis of variance (ANOVA) between 3 hair growth treatments (T1=Commercial hair grower, T2=Kapok leaf extract, and T3=Water only) from an RCBD data with 2 subsamples.

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>1333.11</td>
<td>2</td>
<td>666.55</td>
<td>9.88</td>
<td>.000**</td>
</tr>
<tr>
<td>Blocks</td>
<td>1065.54</td>
<td>5</td>
<td>2.13</td>
<td>3.19</td>
<td>.091 ns</td>
</tr>
<tr>
<td>Error</td>
<td>99.25</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3,167.05</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** **highly significant at α=0.01; ns=not significant**

Post-Hoc analysis using Tukey’s test in Table 4 reveals that the hair length of rabbits applied with commercial hair grower is significantly shorter than the hair length of rabbits applied with kapok leaf extract. Moreover, the hair length of rabbits treated with commercial hair grower is not significantly different from those treated with water only. Finally, the hair length of rabbits treated with Kapok leaf extract is significantly longer than those treated with water only.

**Table 4.** Post-Hoc analysis on the mean difference of the hair length compared with different treatments.

<table>
<thead>
<tr>
<th>PAIR</th>
<th>MEAN DIFFERENCE</th>
<th>SIG.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial vs. Kapok leaf extract</td>
<td>-10.3833</td>
<td>.000**</td>
</tr>
<tr>
<td>Commercial vs. Water</td>
<td>4.1267</td>
<td>.142 ns</td>
</tr>
<tr>
<td>Kapok leaf extract vs. Water</td>
<td>14.5100</td>
<td>.000**</td>
</tr>
</tbody>
</table>

**Note:** **highly significant at α=0.01; ns=not significant**

These results imply that 30 days after treatment application, *C. pentandra* crude leaf extract has the potential for hair growth activity. The mean hair growth activity of *C. pentandra* leaf extract on rabbits was comparable to the mean hair growth activity exerted by the commercial hair grower. *C. pentandra* leaf extract resulted in 25.32mm hair length on rabbits, whereas the commercial hair grower attained 14.93mm mean hair length. These results indicate that the kapok leaf extract is more effective as a hair grower rather than the commercial one.

According to the phytochemical analysis done by Osuntokun *et al.* (2017), *Ceiba pentandra* leaf extracts contain various secondary metabolites such as phenolic compounds. Phenolic compounds (polyphenol, flavonoids, alkaloid and saponins) are in the class of antioxidant agents, which act as free radical terminators (Nandeesh *et al.*, 2008). With this antioxidant activity, it can exhibit hair growth potential properties (Lattanzio, 2013).

Flavonoid strengthens the capillary wall of the blood vessels and supplies the hair follicles (Upadhyay *et al.*, 2013). In a study by Kawano *et al.* (2009), these secondary metabolites promote dermal papilla cell growth and cell cycle with high activity, and induced hair growth *in vivo* by induction of anagen phase from telogen phase. Further, flavonoids can cause expressions of some growth factors, such as vascular endothelial growth factors (VEGF),
hepatocyte growth factors (HGF), keratinocyte growth factors (KGF), and insulin-like growth factor-1 (IGF-1), all of which have stimulatory effects on hair growth (Semalty, 2011).

Similarly, Allayie et al. (2012) had evaluated the hair growth promotion activity of fresh leaf extracts of *Naringi crenulata* and *Russelia equisetiformis* to which the effect is accordingly attributed to the presence of terpenoids and flavonoids in the plant extracts. Accordingly, *Russelia equisetiformis* has a hair growth promoting effect with a significant increase in the rate of hair growth (P<0.05), in a concentration dependent manner. The study of Barnejee et al. (2009) specified plant sources for hair oils. Their results showed that *Amla* is rich in vitamin C, tannins and minerals such as phosphorus, iron and calcium which provide nutrition to hair and also causes darkening of hair. In a study by Banerjee et al. (2009), *Hibiscus* consists of calcium, phosphorus, iron, vitamin B1, riboflavin, niacin and vitamin C, used to stimulate thicker hair growth and prevents premature graying of hair. Some of these components are also found in *C. pentandra* such as Vitamin C and alkaloids.

Moreover, according to Begum et al. (2014), hair growth is coordinated by hormones and it commands the follicle to undergo appropriate changes during this process. The hormone androgens may cause stimulation of hair growth. This process is followed by a specific cyclic order and characterized by anagen (growth phase), catagen (regression), and telogen (resting phase). *C. pentandra* leaf extracts contain saponins that act like the hormonal activity (Abouelela et al., 2018). According to Edeoga et al. (2005) in various studies, the presence of saponins indicate their importance in pharmacy due to their relationship with such compounds like sex hormones especially in the development of female contraceptive pills and thus can treat hormonal imbalance.

The results of this study suggest that topical application of *C. pentandra* crude extract may effectively stimulate the formation of hair follicles and induce an earlier anagen phase through its important secondary metabolites (such as saponins and flavonoids).

**CONCLUSION AND RECOMMENDATION**

*Ceiba pentandra* crude leaf extract has the potential to be an alternative hair grower. Faster hair appearance and longer hair growth rate were observed in the *C. pentandra* leaf extract treatments compared to the commercial hair grower and water. However, it is recommended that cases of allergies or skin irritation be evaluated in future researches using the extract. Further research for structural interpretation and identifying the mechanism of action responsible of *C. pentandra* as an apparent hair growth promoter is also recommended.

**REFERENCES**


