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# PINEAPPLE LEAF FIBRE EXTRACTIONS: COMPARISON BETWEEN PALF M1 AND HAND SCRAPPING

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**ABSTRACT**

In agricultural sectors, there is a lot of waste produced after harvesting activities. This kind of waste is called agricultural waste or agro-waste. Agro-waste has created environmental and technical issue at disposal stage. Agro- waste usually eliminated by burned or decomposed and leads to the arising of some environmental issues. Environmental awareness is one of the vital factors that motivate many researchers to figure out the potential of agro-based crops as an alternative fibre sources. In Malaysia, there has been a growing interest to use agro-waste from pineapple cultivation. Pineapple leaf can be further processed and transformed into high value products. However, current methods need to be improved and new idea need to be developed, with emphasis on pineapple leaf fibre (PALF) extraction methods. This work presents the new idea of pineapple leaf fibre extraction and how it will affected on pineapple leaf fibre properties. A new machine called Pineapple Leaf Fibre Machine 1 (PALF M1) has been invented for this study. In order to analyse the effectiveness of PALF M1, the comparison between current conventional method (hand scrapping) and PALF M1 used to extract pineapple leaf fibre has been made. It has been proof that PALF M1 increased productions rate of pineapple leaf fibre, decreased the pineapple leaves waste and contribute to higher fibre yield (%) compared to hand scrapping.

**Keywords:** agricultural waste, pineapple leaf fibre (PALF), PALF M1, productions rate, and fibre yield.

## INTRODUCTION

Transformation of agriculture waste to wealth is a better approach of developing sustainable agriculture industry especially in Malaysia. Increasing of environmental awareness as well as depletion in timber resources is among essential factors that motivated researchers to discover the potential of agro-waste as alternative fibre sources. Among of agricultural waste that received numerous attentions worldwide, included coir, kenaf, soybean straw, rice stalk and pineapple leaves. Abundance availability of pineapple leaves in Malaysia provides a great platform of exploring its utilization as industry's fibres.

Pineapple plant is widely cultivated in Malaysia for its fresh consumption, canning, and juicing. Pineapple leaves which are the major part of pineapple plants are usually being decomposed or burnt which lead to environmental pollutions. Increasing of pineapple plantations also increased the pineapple waste proportionally. Regarding to this concern, a huge efforts have been made among academia and pineapple farmers to convert pineapple waste into value products.

In Malaysia, some pineapple farmers have made an effort to extract pineapple leaf fibre and utilized for high commercial products included crafts [1]. The pineapple leaf fibres are being extracted by hand scrapping. The quality of PALF produced from this extraction method is good, however the method itself is tedious, time consuming, and labor-intensive process.

Regarding to this concerns, a new idea of extracting pineapple leaf fibre is proposed and developed. This study is an endeavour for the new PALF's extraction method. This work will present the initial phase of larger-scale study on the innovations involved in PALF productions. In this preliminary study, PALF obtained from local pineapple cultivar will be extracted, scoured, and drying by using new technology invented. Then, the comparison is made between conventional method and PALF M1 in terms of PALF's production rate, waste management, and fibre yield.

## EXPERIMENTAL DETAILS

### Materials

Pineapple leaves used in this study is obtained from residues after harvesting pineapple collected from Muzium Nanas, Pontian, Johor. The plant variety used was Josapine belonging to Spanish cultivar.

### Pineapple leaf fibre productions

The main aim of this study is to develop a better mechanism for PALF productions based on current conventional method used in Malaysia that is hand scrapping. In order to analyse the effectiveness of PALF M1 compared to hand scrapping, both methods are applied in this work.

For hand scrapping, a bench or known as 'bangku' with a scrapping tool called as 'ketam' as showed in Figure-1 is used.

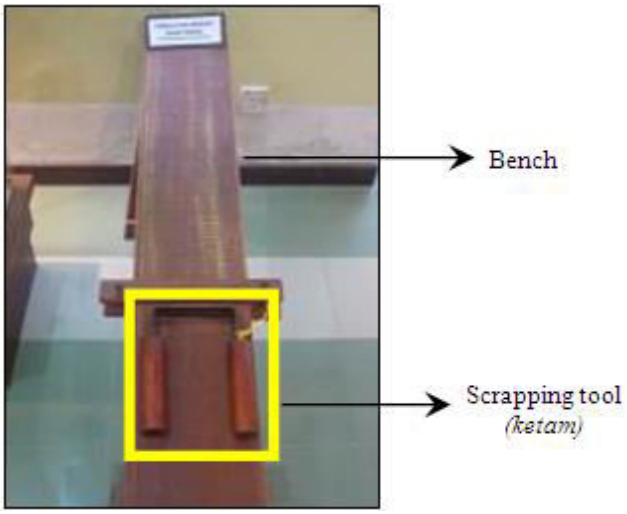


**Figure-1.** Bench and scrapping tool used in hand scrapping.

PALF M1 invented for this study is show in Figure-2, while the mechanism of PALF M1 is show in Figure 3. When most of the extractor or decorticator out there using crusher-like technology to extract PALF, this machine used blades to remove the waxy layer on the pineapple leaf instead of forcing it out by crushing [2].

Unlike most extractor or decorticator, PALF M1 does not crush the leaf to avoid fibre damage. Pineapple leaf was inserted between the two blades, blade 1 and blade 2. Upon entering the blades, the leaf will be sort of 'grind' and the outer waxy layer will be removed during this first step. During second step, when the leaf was being pulled off, yet again, the leaf will be grind for the second time that will remove the entire waxy layer, which was left during the first step.

**Figure-2.** PALF M1

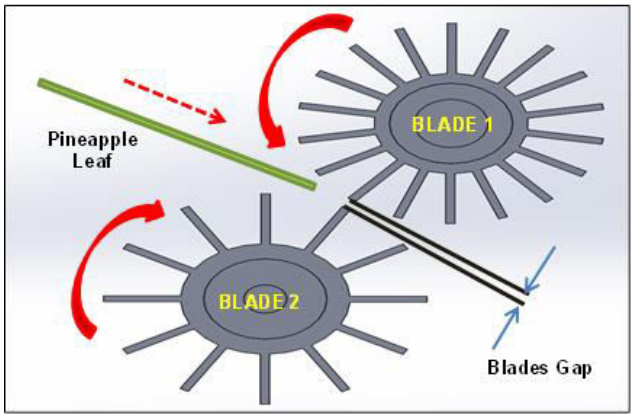


**Figure-3.** Blade mechanism of PALF M1.

## RESULT AND DISCUSSIONS

### Productions rate of PALF

Figure-4 shows the extractions process using hand scrapping and PALF M1. It is apparent that by using PALF M1, both upper and bottom of leaves surface will be scrapped at same time while when hand scrapping is applied, only one side of the leaves surface will be scrapped. As a result, less time is taken to extract a piece of leaves using PALF M1 compared to hand scrapping.

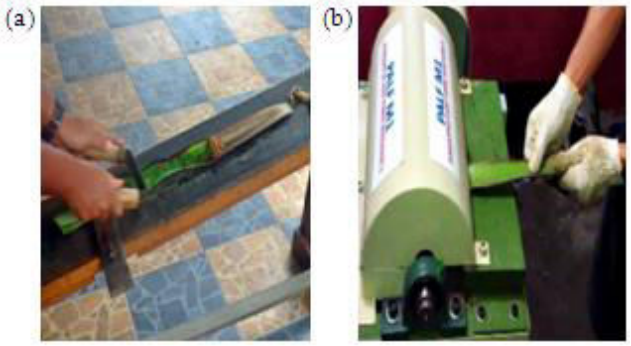


**Figure-4.** PALF extractions by (a) hand scrapping; (b) PALF M1

Table-1 presents the comparison between hand scrapping and PALF M1 in terms of PALF productions. PALF M1 took approximately 5 seconds to extract piece of leave while by hand scrapping it took almost 50 seconds. From that, by assuming 8 hours working per day, PALF M1 manage to extract about 5760 pieces of leaves per day compared hand scrapping with 576 pieces of leaves per day. It can be summarized that productions rate of PALF M1 is approximately 10 times of hand scrapping.

**Table-1.** Comparison between PALF M1 and hand scrapping.

| Method / Parameter | PALF MI | Hand scrapping |
|---|---|---|
| Time | ≈5 sec/piece | ≈50 sec/piece |
| Productions rate | ≈5760 pieces/day | ≈576 pieces/day |
| Time & labor management | Efficient | Less efficient |
| Yield fiber | Uniform fiber length | Less uniform fiber length |

Instead of increased PALF's productions rate, PALF M1 also contribute for efficient time and labour management since it will reduce workforce and save time. As a result, production's cost also can be minimized.

**Fibre yield (%)**

On the other hand, the fibre yield (PALF) of each method also have been analysed in order to determine the effective method. In this case, fibre yield is calculated in term of percentage based on the following equation [3]:

$$\text{Fibre yield (\%)} = \frac{\text{Weight of dry PALF (kg)}}{\text{Weight of fresh pineapple leaves (kg)}} \times 100 \quad (1)$$

The reading of each weight for both extraction methods are summarized in Table 2. Weight of fresh pineapple leaves are set to be constant variable which for both extraction methods, there are about 200 pieces of pineapple leaves that weighted approximately 40kg. After the fresh leaves being extracted, all the fibres are dried before the weight is measured. From the table, we can see that PALF M1 is able to produce about 1.5kg PALF while hand scrapping produced 0.8kg PALF from 200 pieces of pineapple leaves.

**Table-2.** Weight of dry PALF and fresh pineapple leaves.

| Method | Weight (kg) | Reading 1 | Reading 2 | Reading 3 | Ave. |
|---|---|---|---|---|---|
| Hand scrapping | Dry PALF | 0.8 | 0.8 | 0.8 | 0.8 |
| | Fresh leaves | 40.0 | 40.0 | 40.0 | 40.0 |
| PALF M1 | Dry PALF | 1.5 | 1.5 | 1.5 | 1.5 |
| | Fresh leaves | 40.0 | 40.0 | 40.0 | 40.0 |

Results of fibre yield are summarized in Table-3. From the table it is obviously showed that PALF M1 contributed higher fibre yield with 3.75% compared to hand scrapping with 2.0% fibre yield. In addition, PALF M1 is better than hand scrapping not only in terms of productions rate, but also in fibre yield (%).

**Table-3.** Fibre yields (%)

| Method | Fibre yield (%) |
|---|---|
| Hand scrapping | 2.00 |
| PALF M1 | 3.75 |

Apart from that, the value of fibre yield obtained in this study also being compared with a previous study [3]. In the previous study, the fibre yields of 5 different extraction methods have been investigated. From Table-4, it is clearly showed that fibre yield by PALF M1 in this study recorded the highest value compared to that 5 methods. In case of scrapping, hand scrapping in this study generate higher fibre yield with 2.0% compared to scrapping in previous study which denoted by 1.40% only.

**Table-4.** Comparison of fibre yields from previous study.

| Methods | Fibre yield (%) | Reference |
|---|---|---|
| Retting | 1.80 | [3] |
| Scrapping | 1.40 | |
| Ball milling | 2.90 | |
| Milling | 2.80 | |
| Milling of dried leaf | 3.00 | |
| Hand scrapping | 2.00 | Author |
| PALF M1 | 3.75 | |

**Waste management**

In this study, there are two type of waste management will be analysed in pineapple leaves fibre productions using hand scrapping and PALF M1. First and foremost, the supervision of wasted pineapple leaves after harvesting and last but not least, the pulp waste generated after scrapping process.

Besides offered high productions rate, PALF M1 also reduced the accumulated wasted of pineapple leaves after harvesting. The area for this scope is only limited for pineapple cultivations at Pineapple Museum collected from 2008-2013. The data is gathered annually since

pineapple leaves are collected after pineapple harvesting (12-15 months).

The chart in Figure-5 is summarized of the data collection of pineapple leaves waste management. From the chart we can see that, with the used of PALF M1, waste of pineapple leaves can be reduced. Method of hand scrapping seems not very practical since it does not contribute significant impact towards reductions of pineapple leaves waste after harvesting.

From year 2008 until 2010, there are about 85-88% of pineapple leaves have been wasted. After the PALF M1 has been introduced, the percentage is drastically decreased to 2-8%. This low percentage indicates that invention of PALF M1 offered practical management of pineapple leaves wastes towards developing sustainable pineapple industry.

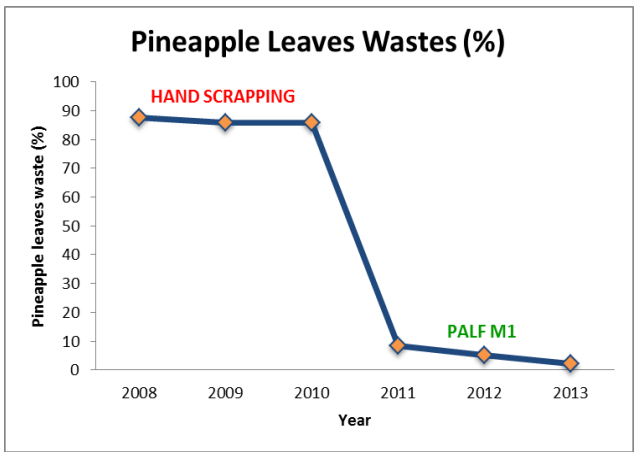


**Figure-5.** Percentage of pineapple leaves wastes at Pineapple Museum (2008-2013).

Basically, after scrapping process there will be amount of green debris waste accumulated. Those green debris waste are defined as pulp waste as shown in Figure-6. This kind of waste can be further utilised for several purposes included vermicomposting and animal pellets.

The amount of pulp waste generated from hand scrapping and PALF M1 are showed in Figure-7. Graph of number of extracted leaves versus pulp waste produced (gram) is plotted. It is obvious that hand scrapping generated large pulp waste compared to PALF M1. For every five pieces of scrapped leaves, hand scrapping method produced about one and a half gram (1.5 g) pulp waste, while PALF M1 generated one gram (1.0 g) waste. PALF M1 managed to reduce the pulp waste produced after scrapping process up to 33%.

**Figure-6.** Pulp waste.

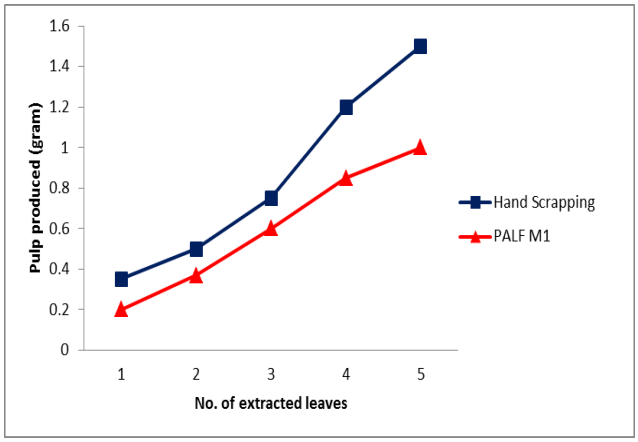


**Figure-7.** Pulp waste generated after scrapping process.

In summary, PALF M1 offered better approach in both wastes management; pineapple leaves wastes and pulp wastes. This proposed novel technology can be better alternative in order to reduce pineapple wastes towards developing sustainable pineapple industry as well as agriculture industry.

## CONCLUSIONS

In response to Malaysia's pineapple industry sector in developing new option for optimize pineapple leaves waste management, this research work aimed on novel technology for sustainable pineapple leaf fibre (PALF) productions. PALF M1 contribute significant improvement in pineapple leaves waste management since it increased the productions rate of PALF and minimize the pineapple leaves waste compared to hand stripping. This is a good starting in developing sustainable pineapple industry especially in Malaysia. The present works shows that the innovation of this new machine contributes significant effort towards PALF productions. Moreover, this works allows great significant reduction in the volume of waste accumulated and contributes in raw materials extraction. Comprehensive works need to be done in future in order to determine the potential area of utilizing PALF as commercial fibre as it can add value to pineapple cultivation, facilitate extra income for entrepreneurs or farmers, and lead to agricultural diversification.

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