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Possibilities of Utilizing Oil Palm (*Elaeis guieneensis*) Trunk as a Solution for Sustainable Agricultural Waste Management

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ABSTRACT

Oil Palm covers nearly 9600 hectares of Sri Lanka. The replacement process occurs once for 25-30 years creates nearly 200 tons of agricultural waste per hectare. The normal procedure of uprooting un- economical plantations is by using bachore machine. Conventional methods of clearing oil palm trunks after remaining materials in the field cause problems such as increasing breeding places for pests like rhinoceros beetles and ratsincrease the disease incidents in immature plants, hindering field operations and taking long time to decompose remains. Therefore, sustainable utilization of oil palm trunk bio mass is important. Oil palm trunks from Elpitiyaplantation were used for the experiment. A trunk has an average biomass of 1550kg with an 8m mean length. The average number of trees per hectare is 125 per one replacement cycle. Bark is removed from trunks and cut into pieces and chopped by using an electrical chopper. The chopped pulp (initial pulp) was grinded by mortar and pestle and blender separately to produce pulp 1 and pulp 2 respectively. Molasse produced using pulp 1 and pulp 2, give final brix values of 58 and 54.4 respectively. Vinegar was produced using pulp1 and pulp 2 shows an undesirable light brown suspension with an alcohol percentage of 2%.Pots and planting containers for nurseries prepared from initial pulp can be used for nurseries and effective in direct field planting. The study revealed there is a possibility of preparing molasse and planting containers from oil palm trunks. Vinegar production process needed to be further studied.

***Keywords*--** Oil Palm, Oil Palm Trunks, Agricultural Waste, Sustainable Use

I. INTRODUCTION

Agricultural waste is an output of an agricultural production process. Rapid agricultural development generates massive amount of bio mass as agricultural waste. Oil palm shows highest production between seven and fifteen years of age. When the tree becomes mature, the requirement of fertilizer increased but after 25 years, managing the plantation is not economical and tends to be replaced. In Sri Lanka oil palm cultivates nearly9600ha. Oil palms are generally replaced in Sri Lanka after the age of 30 years, due to yield decrement or difficulty in harvesting (Dissanayake and Palihakkara, 2019). Approximate rate of biomass production is 20.336 tons per hectare (Dungani *et al.*, 2013). Although oil palm has a greater productivity compares to many oil yielding crops, fairly larger amounts of nutrient and water is absorbed from soil by it to produce higher amount of biomass annually (Dissanayake et al., 2019). Malaysia alone produce about 70 million tons of bio mass including trunks, fronds and empty fruit bunches. Biomass derived from oil palm trunks is 9.4 million tons (Yacob, 2007). Fallen oil palm trunks are left to decompose or burnt in the field. Due to the high moisture content of freshly fallen oil palm stems, they are difficult to be fully burn (Dissanayake et al., 2019). The oil palm stems also provide a good habitat for pests like black beetle, rhinoceros beetles and stem rotting fungi spp. It adds a large amount of agricultural waste to the nearby environment. Oil palm trunk waste contain lot of lignocellulosic materials, it shows specific physical and mechanical properties. Therefore, it has lot of potentials in production of variety of materials (Lim and Gan, 2005). Oil palm trunk waste is used for production of light construction applications. Production of block board, ply wood (Lim and Gan, 2005), binder less particle board (Aidawati et al., 2013), concrete reinforcement (Ahmad, Saman and Tahir, 2010) and Syngas from steam gasification of oil palm trunk lumber for power and heat generation and other industrial and domestic uses (Nipattummakul et al., 2012). The potential of yielding glucose and xylose from oil palm fiber hydrolysis is 40% and 34.4% respectively by using auto hydrolysis pre treatment. In this study, the potentials of using oil palm trunk waste as a raw material for variety of products are studied. Agriculture waste from cultivations like oil palm has the potential to be utilize as food and feed by subjecting to microbial fermentation. The low protein content in oil palm waste can be nutritionally enhanced by microbes increasing the available protein per area (Orimoloye and Sanusi, 2016).

II. METHODOLOGY

Newly fallen oil palm trunks of Elpitiya plantation were used by removing the bark. The pith of the stem is cut into small pieces and then chopped by using an electrical chopper. The initial pulp prepared was used for different product preparation.

Ability to produce molasses is tested by using two samples of the initial pulp. One sample (pulp 1) is

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grinded by using a mortar and pestle and the other sample (pulp2) is grinded by using a blender. The two pulp mixtures are diluted 20% (v/v) with sterilized water and filtered. Research was replicated with three times and initial and final brix values are measured before and after the process. The solutions were heated while stirring for 60 minutes. Both solutions in three replicates were boiled at 102 ˚c. The texture and color of the final molasses prepared was recorded.

Ability to produce vinegar was tested for both pulp1 and pulp2 solutions diluted 60% (v/v) with sterilized water and filtered. 2g of yeast powder was added for each solution. There after solutions were sealed and kept for 3days in a glass bottles and final results were noted. Ability to produced flower pots, planting containers for nurseries were made by using the initial fibrous pulp mixture.

III. RESULTS AND DISCUSSION

Before the molasse preparation, average brix value of pulp1 solution and pulp2 solution are measured as 0.7 and 0.7 respectively in 31.4 ˚c. At the end of the heating process of molasse preparation, final average weight of the molasses from pulp 1 and pulp 2 is 1.12g and 1.62g respectively. The final average brix value of pulp1 solution and pulp2 solutions are 58 and 54.4 respectively. The general brix value of sugar cane molasses is 79 and the sucrose content is 35% (Sahu, 2018). According to the definition, one degree of brix contains one gram of sucrose per 100g of the solution and pulp 2 molasse contains 54.4g of sucrose per 100g of the solution. The sucrose percentage of pulp 1 oil palm molasse and pulp 2 oil palm molasse is 25.58% and 31.14% respectively and when compares to the sugarcane molasse values are far below. Thus, comparatively the brix value of molasses of oil palm is low. But the time taken to reach to final brix value from initial brix value is 55minutes. When compares to the heating process of sugarcane molasse production, this value is comparatively low.

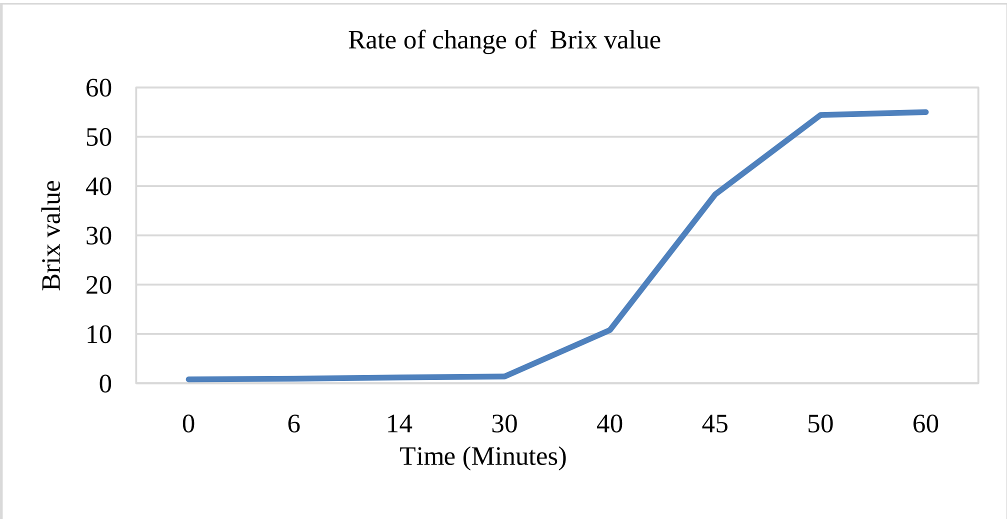

Figure 1: Rate of change of brix value

Figure 1 shows the rise of brix value rapidly from 30 – 50 minutes showing a high brix increment rate when compared to sugarcane.

Table 1: Comparison of sugarcane molasse and oil palm molasse

Chemical or physical property	Sugarcane molasse	Oil palm molasse
Colour	Blackish brown color	Blackish brown color
Texture	Monoclinic	Monoclinic
Taste	Sweet	Comparatively less sweet
Boiling temperature	110-120 ˚C	102 ˚C
Solubility in water	Highly soluble	Highly soluble

According to the study, oil palm trunk molasse production may saves time and energy and ultimately the cost of production process. However, this can be used as an animal feed additive which provides a non-proteins and non-sugars which nutritious for ruminants. The inputs and raw material for vinegar

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production differs with the numerous categories of vinegar (Samuel, Lina and Ifeanyi, 2016). The acetic acid percentage of vinegar is 5%. The colour, aroma, acetic acid percentage and flavor may vary with the fixed fruit acids, salt, coloring matter and fermenting products that has been used in that particular vinegar production process (Vikas Bhat, Akhtar and Amin, 2014).Oil palm juice consist of ethyl lactate, 3-hyroxy-2-pentanone, and ethyl hexanoate as flavor components (Lasekan and Abbas, 2010). Vinegar produced by pulp 1 and pulp2 didn't get the appropriate flavor, color, aroma and alcohol percentage as regular vinegar. The solution is initially mild brown colour without any suspension. But during the reaction from ethyl alcohol to acetic acid by saccharomyces, the solutions produced by both pulp 1 and pulp 2 started forming a suspension. The formation of suspense in pulp 2 solution was intense when compared with pulp 1 solution.

After five day fermentation period, both solutions showed a light brown suspension. Therefore, vinegar production from oil palm using the proposed methodology is unsuccessful. Vinegar can be produced by oil palm juice at 30 ˚C, pH 5.5 with a fermentation period of 72 hours yield 68.12g/L acetic acid solution (Ghosh *et al.*, 2012). Oil palm fruit wastes also had been utilized for vinegar production which consumes 5 days for the production process. Oil palm fruit waste was converted to vinegar by acidic fermentation that involved mesophilic microbes (Orimoloye and Sanusi, 2016). Sterilization of the pulp solutions after diluting and filtering to remove undesired microorganisms (autoclave for 15 minutes at 121˚C).

Pots and planting containers for nurseries can be produced by initial pulp after compressing to a mould. The water absorbing ability is very high when pots made by compressed pulp. But the structure is stable for moderate shocks. These containers are biodegradable and saves polythene cost. Field planting process is easy as the plantlet can be planted along with the container itself which reduce the transplanting shock. Proportional mixing of cement may increase the lifetime of the pots for long term use. Oil palm solid wastes are generally used extensively as fuel for heat generation in palm oil manufacturing mills. The ash produced by this process was proven its ability to be used as a construction material by proportionally mixing with cement, the ash showed an acceptable shrinkage, segregation, density, water absorption, and soundness of cement (Tay, 1990).

IV. CONCLUSION

Molasses can be produced pulp taken from oil palm trunk and the correct industrial process of preparation needed to be further studied. Vinegar production needed to be done after sterilizing the pulp solutions as it contains undesirable microorganisms which contaminate and inhibit the acetic acid production process. Production of grow bags and containers for nurseries is possible with the oil palm trunk.

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