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# Technology Development for Organic Production of High Quality Virgin Coconut Oil

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**Abstract**—Indonesia is a country that has the largest coconut plantation in the world, with its main copra products. The quality of copra produced from rural areas is low and complained by the international market because it is thought to contain aflatoxin. This paper describes the fast-drying machine to produce high-quality desiccated coconut and coconut oil, which is equivalent to virgin coconut oil (VCO). This research produced an innovation consisting of a drying machine for grated coconut, a pressing machine to extract oil and a centrifuge to produce high purity coconut oil.

**Keywords**—coconut, desiccated coconut, drying machine, virgin coconut oil (vco)

## I. INTRODUCTION

Products from coconut processing industries are well recognized giving beneficial impact for human life, such as for food, cosmetics, and pharmaceuticals [1],[2]. For example, virgin coconut oil, the main product in the coconut processing industry, has proven beneficial function in antidiabetic treatment [3]. Therefore, the products attract economic market and are paid the researcher's attention to observe.

Indonesia has the largest coconut plantation in the world, with a share of 31.2% of the total area world coconut and produce 3.2 million tonnes of oil equivalent of copra. Philippines (25.8%) is ranked at the second, followed by India (16.0%), Sri Lanka (3.7%) and Thailand (3.1%). Exports of coconut products in 2006 accounted for USD 364,575 in part large still in the form of the raw coconut fruit. The contribution of coconut cooking oil is 0.4 million tons, or 12 percent of national cooking oil consumption which is in amount reached 3.3 million tons as a result of rapid development palm oil industry [1].

With such high potency, coconut products are included in the fifteen best Indonesia's export commodities. Therefore, attempts at improving and applying technology related to coconut products can gain national benefit in increasing Indonesia's competitiveness advantage from coconut products, for instance, previous three years project at Ahmad Dahlan University [5],[6],[7],[8]. Moreover, most of the coconut farmers in Indonesia live in a rural area, and most of the copra production is done as household business activities [1]. Hence, the enhancement of coconut processing in a rural area is expected to provide more working places and accordingly improve people economically.

However, it is miserable that recent coconut crop productivity remains very low, which is about 4,200 grains/ha, equivalent to 0.83 tons of copra/ha. Also, the products go to oil processing industries, which are still dominated by semi-finished products such as copra and crude coconut oil [1].

This situation might be implied by limited national research and development to diversify processed coconut products. For instance, the quality of copra in the rural market is deficient which cannot be accepted by the market and hence the nominal price of copra is relatively decreasing so that incremental input does not increase the added value [8]. Even high demand and reasonable price in European and American markets, the selling price in rural development is still around 30,000 rupiahs (or 2 dollars) per kg finished product of virgin coconut oil.

For this reason, this research is aimed at contributing to the development of applied technology to improve the quality of coconut products. The previous research findings from this research project, namely fast-drying machines to produce high-quality desiccated coconut, processing coconut fiber for food and pressing tool to optimise oil extraction from coconut [5],[6],[7]. This paper shall discuss a short overview of the new situation of coconut processing technology. Besides, this paper also present recent results from our research team and future research in technology development in processing coconut products.

## II. PRODUCTS AND PROCESSES

### A. Products Roadmap

Figure 1 reveals the proposed road map of national coconut products, compiled from some information [1], [5], [9]. As shown in figure 1, four main intermediate products are demanded in the market, namely meat, fiber, shell, and water. Moreover, these four intermediate products can be processed with several added-value products. Therefore, there are huge potentials from the whole product derives from the coconut processing industry. As mentioned before, copra still dominates main processed coconut products, followed by crude coconut oil. Recent utilization of coconut processing capacity is still relatively low, around 40 percent. As one consequence of this situation, Indonesia coconut products are diverted much fewer product diversities compared to the Philippines, which has produced and marketed more than 100 types of coconut processing products. Copra is dried coconut

fruit/endsperm, which is the main intermediate product in previous coconut business. Copra is then further processed to produce more valuable products, such as virgin coconut oil (VCO). However, the new situation is complicated to export copra in the international market since it contains aflatoxin, which is harmful to human health [9]. Also, international buyers see the problem because home industries (considered) are not sterile and hence not suitable for food industries.

One solution to solve this complication is producing desiccated coconut to substitute copra. Coconut fruit is grated and then dried. Now, many small industries consider using desiccated coconut to process further crude VCO. Then the VCO is processed again to become expected VCO as an important product in coconut processing industries due its valuable fatty acid components such as C6:0 caproic acid, C8:0 Caprylic acid, C12:0 lauric acid and C14:0 myristic acid [12],[13],[14]. Table 1 presents the quality standard of VCO according to national standard industry [4].

TABLE I. STANDARD QUALITY OF VCO

Properties	Standard
Additives	None
Moisture content (at ambient T.P)	Max. 0.1
Free fatty acid	Min 20%
Peroxide value	0.2 meq/ kg oil
Iron	Max. 5 mg/ kg
Copper	Max. 04 mg/ kg
Lead	Max. 0.1 mg/ kg
Arsenic	Max. 0.1 mg/ kg

B. Processes

In general, there are two main processes to produce virgin coconut oil in a rural area, namely dry process and wet process [8]. Figure 2 and figure 3 represent both processes to produce several products from fresh dehusked coconut fruits. The dry process produces desiccated coconut, whereas wet process produces wet oil (or equivalent with crude coconut oil). In the dry process, as shown in figure 2, the process steps are run stepwise as follows: deshelling, paring, washing, blanching, and drying. The intermediate product of the dry process is desiccated coconut. In the production of VCO, the next processes shall be expelling (to produce crude VCO), settling and filtration.

Whereas in the wet process, as shown in figure 3, the process is done through steps of splitting and grating, coconut milk extraction, fermentation and at the end the fermented products are decanted to produce wet oil (or also known as crude VCO as in dry process). This crude VCO contains relatively more water which must be simmered and filtered to obtain expected VCO.

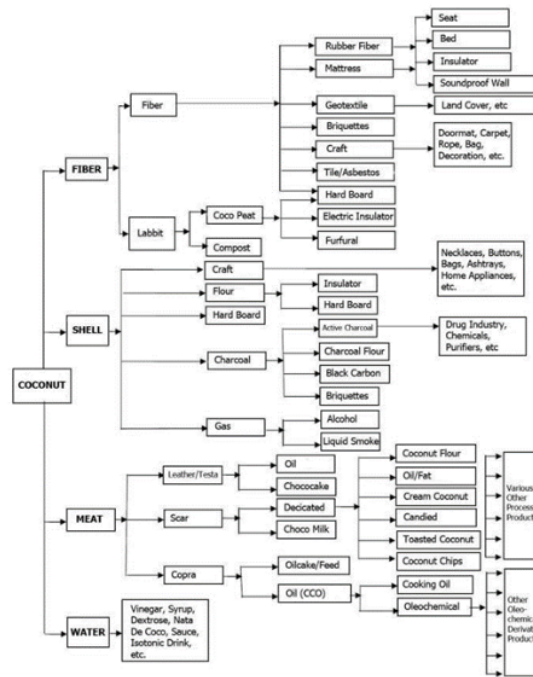


Fig. 1. Roadmap of national coconut products.



Fig. 2. The dry process to produce desiccated coconut.

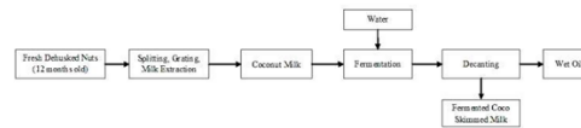


Fig. 3. The wet process to produce wet oil or crude coconut oil.

Besides, the general process of making copra can be done in several ways, namely:

- 1) Sun drying
- 2) Drying through smoking
- 3) Drying by indirect heating (indirect drying)
- 4) Drying using solar systems (solar thermal power)

Unfortunately, the home industries in the rural area to produce VCO from both processes usually are still neither environmentally friendly nor hygienic from the view of international markets. The process still produces unprocessed waste, mainly from the fermentation process, which is stank for people surrounding. Also, the conversion is not 100%, and the coconut oil is fast to get rancid. Other than that, the blanching process needs chemical, which is later unused and becomes chemical waste and might pollute the environment.

### III. RECENT RESEARCH PROJECT

With the previously mentioned background, efforts are required to find innovative coconut processing technology that can provide more added value to rural farmers. The desired technology is expected to enhance the quality of VCO and produce it in environmentally friendly process. Targeted products in this research are desiccated coconut, coconut oil, and low-fat desiccated coconut. Coconut fruit must be dried as soon possible after dehusking of coconut fruit process to avoid problems associated with the process as mentioned before. Shall it takes time to be dried after it has been dehusked, then the acid content is higher because it is oxidized in the air. The higher the acidity, the more chemical (normally: KOH) to be used to neutralize.

Recent research at Ahmad Dahlan University focuses on three things, respectively. Figures 4, 5, and 6 show the pictures of dryers, pressing machines and centrifuge respectively, The dryer is used to dry the sliced dehusked coconut and produce high quality desiccated coconut. The drying concept is based on the principle of evaporative crystallizer, where the diffusion of moisture to air takes place. For fresh coconut, the drying time takes no more than 8 hours for a single batch drying. The drying capacity is 15 kg and produces moisture content of the product is zero. By using this dryer, the produce desiccated coconut is white-color and has a long life without it gets rancid. Compared to previous research from Malau et.al. [15], the drying capacity is 0,67 kg/hr, whereas in the dryer (this project) has a drying capacity of 1,8 kg/ hr.

Whereas, the pressing machine, as shown in figure 5, is used to press the sliced coconut fruits to extract the oil. This pressing equipment exhibits an optimum pressure per squared inch to extract coconut oil. The pressing capacity of 10 grams shows an ideal pressure per square inch to obtain optimal oil. The equipment is designed and assembled for a capacity of 1 kg pressing. Moreover, the centrifuge has a capacity of 6 liters and is used to obtain a precise coconut oil minimum speed of centrifuge and shortest purification time.

The advantage of what we are doing is a non-chemical process, and hence, it can be attributed to the more added value of the product. The proposed name of organic VCO has a reason since the process does not consume chemical additives compared to the normal conventional process.

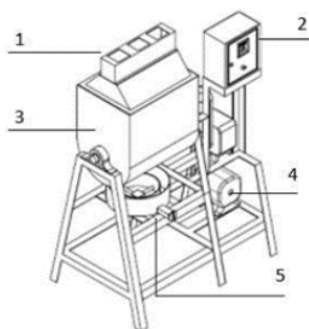


Fig. 4. Dryer machine of desiccated coconut  
1: exhaust; 2: temperature measurement and control; 3: mixing and drying chamber; 4: motor; 5: heating stove

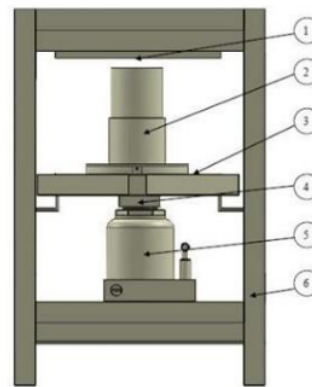


Fig. 5. Pressing tool. 1: top layer; 2: Pressing chamber; 3: bottom 4: pressure sensor; 5: leverage tool; 6: wall construction

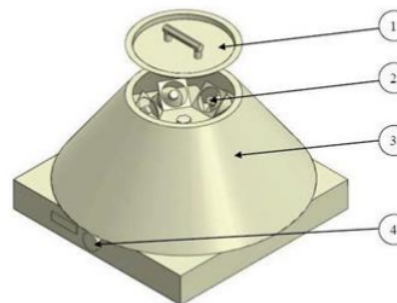


Fig. 6. Centrifuge. 1: top lid; 2: centrifuging chamber; 3: wall; 4: box for speed control

### IV. CONCLUSION

The new conventional process of coconut processing leads to a low-quality of coconut products. As a consequence, products cannot be accepted by the international market. This paper presents recent technology development to produce high quality of desiccated coconut, coconut oil, and low-fat desiccated coconut. The research innovation consists of dryer machine to produce a higher quality of desiccated coconut, pressing machine to extract coconut oil and centrifuge to obtain high purity of coconut oil.

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