THE COMMERCIAL POSSIBILITY OF THE LAVA PROCESS.*

From the Standpoint of Machinery and Equipment.

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With the organization of the National Coco-nut Corporation, considerable interest is being shown in the rehabilitation of the coco-nut industry. The problem of how to get the highest possible income from the coco-nut comes foremost to the leaders of the Corporation. A general solution would be (*a*) the growing of the best-quality coco-nut through the application of modern scientific methods of agriculture, (*b*) the search for the most efficient and most economical method for the manufacture of coco-nut oil, and (*c*) the utilization of the products of coco-nut other than the meat, such as the husks, shells, &c.

At present coco-nut oil is the main product of the coco-nut industry; hence, one of the most important lines of attack on the main problem should be the search for the most economical and efficient method of producing oil from the coco-nut meat. The present commercial method used is the expeller process of producing oil from copra. This method, in spite of its high degree of mechanization and efficiency, is always beset with several disadvantages, among which are the following:—

(1) It uses copra which, in spite of the exercising of utmost care in handling and storage, always produces an oil having a large amount of free fatty acids, and is rancid and coloured, thereby requiring additional refining operations.

(2) The only by-products it produces are the copra meal and cake which are dirty and rancid, and can only be used for animal feed.

To avoid these ever-present disadvantages of the expeller process, the best way would be to use a method which produces oil directly from coco-nut meat, without the use of excessive pressure and heat. After thorough investigation of the possibilities of extracting oil directly from the fresh meat, the Lava process has been evolved. This process consists of extracting the "gata" from the fresh meat; processing the "gata" to separate the cream from the "skimmed milk" or maceration water and from the protein solids; and subsequently treating and processing the cream to break up the oil-water-protein emulsion, thereby separating the oil in its free state. How these stages were evolved is beyond the scope of this article.

In the design of a commercial plant, the two most important considerations to be followed to ensure continuity of operation are the choice of equipment and the design of the plant layout. These entail good engineering knowledge. From experience it is generally found that it is advisable to select standard equipment—which can easily be procured and replaced. With this basis in mind, it will be seen from this article that the Lava process can be worked out commercially.

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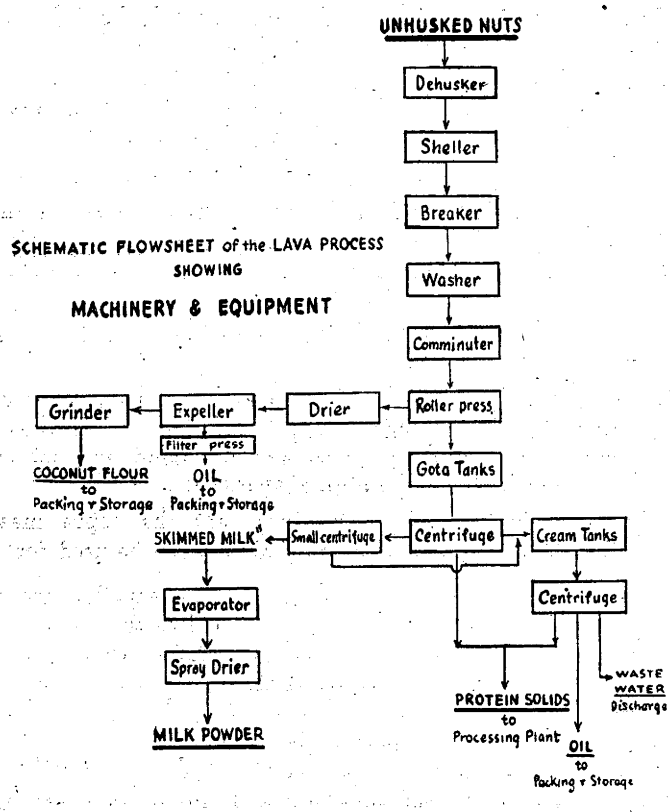
In the accompanying figure is shown the schematic flowsheet of the Lava process showing the machinery used in the production of the coco-nut oil and the processing of the different by-products. The uses of the machinery can be summarized in the following discussion of the various steps.

Shelling.

Up to the present time there has been no efficient machinery to perform the shelling operation. This operation is rather difficult to mechanize on account of the variation in the size and shape of the nuts. Consequently, this operation



is being done by manual labour. Around the coco-nut regions, especially where there are plants for the manufacture of desiccated coco-nut, there are plenty of men who are skilled in the art of shelling; so that the supply of these shellers would not be lacking during commercial operation.

In connexion with the shelling operation unhusked nuts may be brought to the plant so a dehusking operation by machines and the subsequent defibring of the husks may be necessary. These operations have been thoroughly discussed in several articles of this journal so no further discussion of the machines is necessary.

Breaking.

The breaking operation is preparing the meat for the washing and comminuting operations. A breaking machine ordinarily consists of a series of knives which cut the meat into smaller pieces. This is similar in construction and operation to the cutting machines used in the cane sugar manufacture.

Washing.

The washing operation consists in passing the broken pieces of meat under a spray of water to take away the dust and other impurities from the meat surface. The washing machine may consist of perforated vibrating jigs through which the wash water can pass. Vibrating jigs are most commonly used in the mining and quarrying industries.

Comminuting.

This operation prepares the washed meat for the pressing operation. Ordinary grinders for meat, rocks and other fibrous materials, or even the shredding machines used in desiccated coco-nut plants may be used here. The current practice, however, favours the disk grinders which break the meat into small sizes by the shearing action caused by the rotating disks. Disk grinders are most commonly used in the desiccated coco-nut plants.

Pressing.

This operation is done by feeding the ground meat into a series of roller presses (like flaking rolls) to express the juice or the "gata" from the meat. It has been found that in order to get the maximum possible percentage of oil extraction by the use of roller presses, the following factors must be considered:—

(1) Method of feeding the ground meat into the rollers.
(2) Water of dilution.
(3) Pressure between the rollers.
(4) Successive order of pressing.
(5) Speed of the rollers.
(6) Particle size.

From the standpoint of mechanization, factors (1), (3) and (5) should be carefully considered. All these factors have been studied in pilot plant operation, and it has been found that all of these factors can be controlled to get a total oil extraction of as high as 98 per cent., and an average extraction of around 77 per cent. in the first pressing, 85 per cent. in the second, and 94 per cent. in the third and last pressing. These figures clearly show that the roller press is an efficient machine for extracting the "gata". The method of feeding can be so mechanized as to give the minimum time of pressing for a given percentage of oil extraction. If it is required to get the most oil from the meat, then a duo-expeller, like the one used in the copra mills, could be incorporated after the first set of roller presses. The dried sapal could be fed to the expeller to have most of the oil expressed and a cake low in oil content but fairly high in protein content could thus be obtained. With the proper combination of the

factors mentioned above and the proper mechanization for feeding, it can be experimentally shown that a very simple machine such as the roller-press can be used to get a high percentage of oil extraction from the coco-nut meat.

Separation of the Oil.

This operation consists first in passing the "gata" through a suitable centrifuge having low speed to separate the cream, consisting primarily of oil and protein, from the maceration water, containing most of the sugar and a part of the protein. Suitable equipment for this operation would be a solid-ejecting centrifuge, where, by means of pressure, the solid accumulating inside would be ejected, rendering a continuous passage of the "gata". Pilot plant experiments show that a Westphalia non-ejecting centrifuge with a small bowl capacity could be used, but in commercial practice a solid-ejecting centrifuge would prove very efficient. It should be pointed out that these centrifuges are used in various industries, among which are the manufacture of yeast, the recovery of lubricating oils, &c.

After the treatment of the diluted cream in the cream-treatment tanks, it is then passed through a solid-ejecting centrifuge where the protein solids and the waste water are separated from the oil. The centrifuge used here is the same in construction as the one used in the centrifuging of the "gata", but runs at greater speed to ensure the complete separation of the oil.

In connexion with the centrifuging operation small centrifuges which need not be solid-ejecting may be used to recentrifuge the "skimmed milk" and the waste water to recover most of the cream and the oil, respectively.

Materials, Handling and Storage.

For the continuous flow of meat from washer to comminuter, and of the coco-nut shells from the shelling section to the power-house, ordinary chain belt-conveyors may be used. Liquid centrifugal pumps can be used for transporting the "gata" from the troughs below the roller presses to the wood tanks before it goes over to the first centrifuge. The cream could be transported from the centrifuge to the cream treatment tanks by means of displacement pumps.

For purposes of storing the "gata" and the treated cream, wooden tanks are preferable, as found by experiments. Oil is usually stored in tin-lined cans or in large oil tanks of riveted steel plates. In case of blockade and shortage of tin cans or any other metallic containers, other native materials may be used. There are now investigations being made to determine the keeping qualities of oil in gasoline cans, galvanized sheet cans, wooden tanks, and other native materials.

Processing of By-products.

The coco-nut sapal or cake coming out of the roller press goes to a drier. The drying operation may be made intermittent with the use of tray driers, or it may be made continuous with the use of a revolving conveyor drier. Both kinds of driers are being used in desiccated coco-nut plants. The dried sapal is then ground in a pulverizer, preferably a hammer mill, to reduce it to flour particle size. The coco-nut flour may be packed in cloth bags or any other package

depending on the demand, and sold as flour substitute. The analysis of this flour is discussed fully in another paper, and it is sufficient to say that good bread and cakes can be made from it by incorporating with wheat flour, cassava, &c.

The "skimmed milk" or maceration water is probably potentially the most important by-product of the process, for the following reasons:—

(1) Its protein constituent contains all the amino acids necessary for normal growth, as found by several American investigators.
(2) It contains plenty of carbohydrates mostly in the form of sugars, and a fat content which can be varied at will.
(3) Its nature and composition permit its processing into different products which can replace imported milk and milk products.

How the coco-nut "skimmed milk" is to be processed depends on the nature of the product to be manufactured. As an example, the "skimmed milk" may be spray dried just like powdered milk. This processing entails the use of a vacuum evaporator on the same principle of the vacuum pan used in cane-sugar manufacture. The concentrated milk is then dried in a spray drier by means of hot air. The problem of spray drying has been thoroughly studied in the milk industry, so that there will be no difficulty of its application to the coco-nut "skimmed milk", a product very similar to milk.

The manufacture of coco-nut syrup again requires evaporation of the "skimmed milk" and compounding with sugar and other ingredients to suit the taste. Again this process is only an adaptation of the process of making syrup or coco-honey from the coco-nut "gata". There are numerous products that can be formed from the coco-nut "skimmed milk" which can compare with the products of natural artificial milk. However, the two above-mentioned offer the greatest possibilities, so for the present they are the only ones discussed.

The protein solids deposited from the centrifuging of the "gata" and the treated cream have been found to contain a very high percentage of protein. These solids can be incorporated with the coco-nut flour to increase its nutritive property, or they may be mixed with squash, &c., for making candies, or they may be separately processed to give amino acids in their pure form for feeding experiments and for food compounds. The production of amino acids from these protein solids requires the use of resistant cookers, reaction kettles and evaporators, and a great amount of technical control. However, this need not go with an oil plant and can, therefore, be processed in a small separate processing plant.

Summary.

From the above discussion it is clear that all the machines used in the manufacture of coco-nut oil and by-products by the Lava process are being used in allied industries and, in some cases, in totally different industries. For this reason the machinery and equipment cannot be classified as belonging to special types. Hence, under favorable conditions, it would not be difficult to procure at regular prices some of that equipment which cannot be fabricated locally.

From the standpoint of the choice of machinery and equipment, therefore, the manufacture of coco-nut oil directly from fresh coco-nut meat by the Lava process is commercially feasible.