Feature Article

Mongana Basic: 7 – Extraction by Non-continuous Press

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This method of pressing was tried out in a revolving press capable of exerting a pressure of about 97 bar (100 kg cm^{-2}) on the cake. The cage had a height of 1 m and a diameter of 0.520 m having a capacity of 212 litres.

A number of factors were examined, the most important ones being: number of plates, pressure, duration of pressing, digestion, sterilization and the nut breakage. Contrary to what has been done with the centrifugal and the screw presses in this case the study will not deal with different type of fruits.

The non-continuous press is actually more versatile and capable of dealing with almost any type of fruit.

Number of Plates

The number of plates does not seem to affect the oil extraction. No difference in the oil content of the fibre was recorded when pressing was carried out without plates at all or with an increasing number of plates until the cake thickness was reduced to a mere 10 mm to 20 mm. The only advantage in the use of plates appears to be the easier unloading of the cake. When only two or three plates were used, the discharge of the cake was slow and laborious. The disadvantage of producing thin cake slices was the increase in the percentage of nut breakage.

The utilization of partitions made of canvas was envisaged but according to the advice of specialists no improvement could be expected from there. The object of canvas partitions was to increase the porosity of the cake. Their use is fully justified in the case of compact and closely packed cake (palm kernel cake *etc.*) but in the case of oil palm fruit, the cake remains very porous even at the end of pressing owing to the presence of fibre and nuts.

Plates

The top and the bottom plates are thicker than the intermediate plates with the diameter 9 mm smaller than the cage diameter. The plates may or may not be centred but with D x P fruits if there is excess gap between the plate and the cage, some press cake may escape through the gap without being pressed. Even though the matter ejected may be only a few hundred grammes it can trigger a significant pressure drop (20% to 30%) in the press.

In addition to the adverse effect on the pressure, the expelling of the matter can also increase the dirt content of the crude oil. This sort of contamination occurs only with D x P fruit.

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The degree of oil extraction is contingent upon the intensity as the pressure build-up of the applied pressure but is not directly proportional to it. The effect decreases as the pressure build-up. For instance, the five results were recorded under standard conditions shown in *Table 1*.

TABLE 1. THE PRESSURE EXERTED ON THE CAKE AND THE OIL LOSS

Pressure (kg cm^{-1})	Oil on dry fibre (%)
30	33.3
60	23.2
90	22.4
150	20.7

The duration of pressing does not appear to affect the extent of oil extraction except in the case of low pressure range.

Similarly, repeated pressure build-ups and releases are effective as long as maximum pressure is not attained but two successive applications of maximum pressure do appear to have higher oil removal efficiency than one. In a totally enclosed press, it is difficult to observe what happens but in Mongana, the flow of liquid through the cage and into the crude oil receiving funnel was easily visible.

Digestion

Digestion had a marked effect on the efficiency of a non-continuous press, more than that of centrifugal extraction. For instance, two series of pressings involving 19 and 11 loads respectively were carried out. In the first, digestion was carried out at a shaft speed of 17 rpm with eight beater arms. In the second, the speed was 30 rpm with 10 beater arms fitted. The other conditions were identical (sterilization and pressing cycle). The results are shown in *Table 2*.

Sterilization

Sterilization carried out with live steam at atmospheric pressure on D x P fruit spikelets affects extraction efficiency. It can be observed that fibre feels greasy between the fingers not only as a result of the high oil content (30% - 40%) but also because the pressure of a lot of cellular debris. It is opportune to recall that the above conditions of sterilization an oil wall eventuate in the centrifugal extraction process. Sterilization with flowing live steam appears to lead to easier extraction than sterilization under pressure when operating on stored loose fruit. Easier should be taken to mean that application of pressure not up to maximum level leads to a higher oil recovery. However, at maximum pressure, the difference does not necessarily exist any more. For instance, a 10 kg cm^{-2} pressure removes 80% of the oil contained in fruits sterilized in live steam at atmospheric pressure against 50% for sterilization done under pressure. However, after applications of a 75 kg cm^{-2} pressure, both cakes are identical.

Triple peak sterilization applied to bunch of any type of planting material makes it possible in the best conditions of digestion and at the rate of six pressings per hour to record 11.5% to 14.0% oil on dry fibre and 0.5% to 0.8% oil on nuts together with a settling coefficient of 0.98. As has been pointed out elsewhere, fibre with less than 10% oil on non-oily solids was obtained in a non-continuous press as a result of eliminating an important portion of the cellular debris during digestion through the use of a perforated bottom plate for instance. The cellular debris is thus drained off into the crude oil and this lowers the coefficient.

In the case of fruit of high pericarp content, the above mentioned rates of extraction can be obtained practically without nut breakage. Serious breakage occurs when fruit of low pulp content is extracted up to 12% to 14% oil on dry fibre.

TABLE 2. EFFECT OF DIGESTION ON OIL EXTRACTION EFFICIENCY

	Oil on dry fibre	Oil on nuts	Settling coefficient
Insufficient digestion	26.4	1.5	0.975
Adequate digestion	12.2	0.7	0.984

Nut breakages were assessed in relation to applied pressure. *Table 3* gives the daily analytical results obtained on fibre and the percentage of broken nuts for five different intensities of pressing. In order to set-up the worst possible conditions, the fruit was sterilized with live steam at atmospheric pressure for 20 min. Only steam jacket heating was used during digestion (temperature of the mesh approximately 70°C). The shell did not therefore acquire springiness and kernels remained attached to the shell. The nut breakage recorded must therefore be considered as maximum. It may however occur at industrial scale in similar conditions of processing. The pressure indicated in *Table 3* is that shown by the pressure gauge. The effective pressure on the cake is approximately one-third of it.

Figure 1 provides the pattern of residual oil in fibre and nut breakage. The diagram should be compared with that of *Figure 2* obtained on a screw press. The observation clearly lends support to the hypothesis of the equilibrium of fibre to nuts. It can be observed that between 50 and 150 kg cm^2 (gauge pressure) nut breakage occurs. At that point, the void between the nuts is filled up and the equilibrium is attained. Nut breakage ceases and the oil content of fibre follows an asymptotic curve.

As in the case of other two extraction processes in use (centrifuges and screw presses), an attempt was made to press pericarp alone without nut specifically with the object of evolving a procedure specially adapted to the fruit of palm groves. The

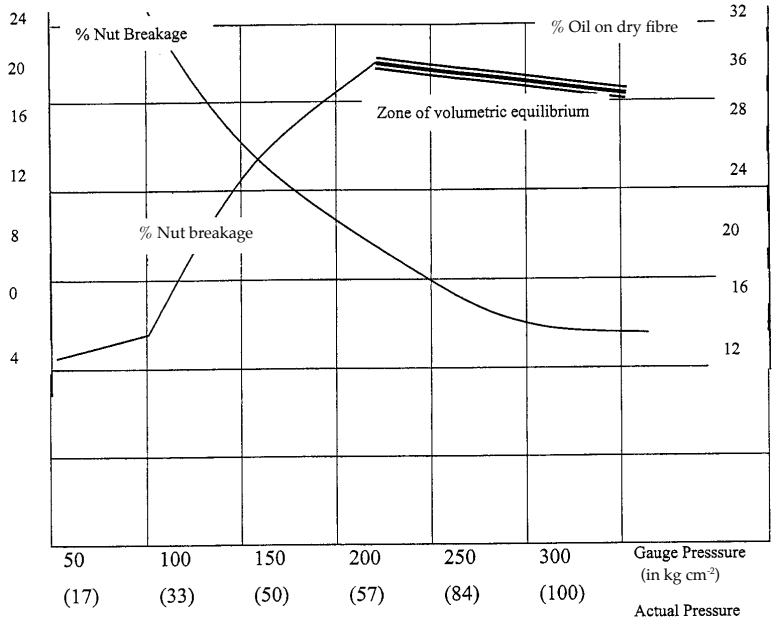

Figure 1. Nut breakage and oil content of fibre in relation to pressure.

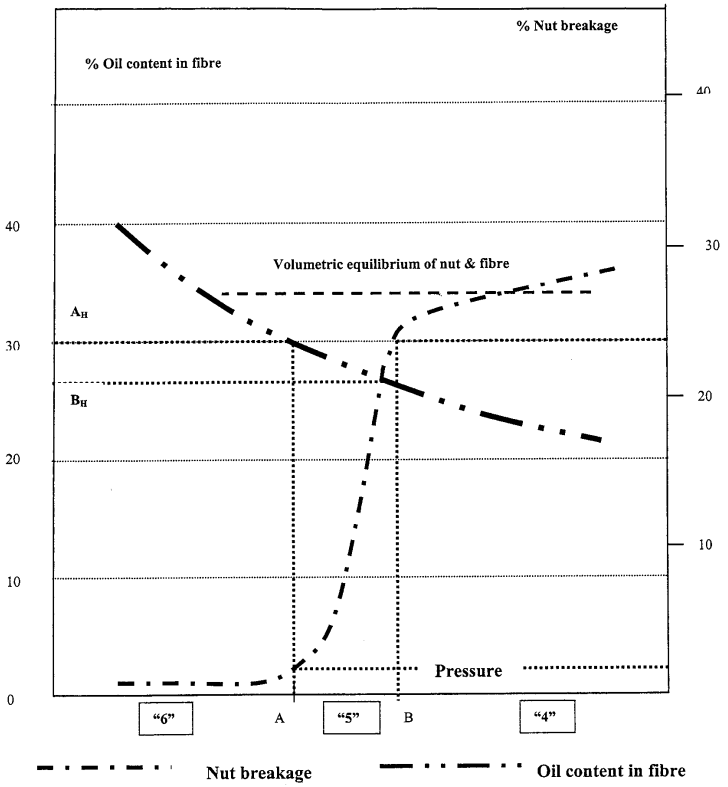

Figure 2. Oil content of fibre and corresponding nut breakage in relation to pressure (palm grove fruit).

TABLE 3. EFFECT OF PRESSURE ON NUT BREAKAGE AND OIL CONTENT OF FIBRE

Pressure in bar (psig)	Broken nuts (%)	Oil in dry fibre	Moisture in wet fibre
49 (711)	1.0	35.8	53.1
98 (1 450)	13.8	22.4	53.2
147 (2 175)	21.5	20.2	52.0
196 (2 900)	20.6	16.9	52.3
245 (3 625)	19.9	14.4	47.4
294 (4 350)	18.4	13.9	-

results are very similar to those recorded for the other processes: the pressing of straight pulp leads to a lower rate of extraction than when nuts are present (17% to 18% oil on dry fibre against 11.5% to 14%). It can therefore be stated that generally and regardless of the process used, the extraction of straight pulp is not to be recommended.