Feature Article

Mongana Basics: Part 25 – Appendices**

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APPENDIX 3

Preparation of Synthetic Palm Oil and of Methyl Esters

The oil was prepared with a view to clarifying certain points connected to the bleaching and the oxidation of palm oil. The fatty acids were extracted from a blend of several palm oil lots with free fatty acid (FFA) ranging from 3% to 7%. They were distilled twice under vacuum. Their optical density was below 0.002 at 420 mμ (milli-microns). [Note that optical density is a dimensionless ratio of refractive indices before and after light penetration at different wavelengths given in milli-microns (CGS units) or nano meters (SI units) equivalent to 10^{-9} m]. The fatty acids were then esterified with glycerol (the amount of acid used was 5% in excess of the theoretical quantity). The glycerol had first been distilled over tin chloride (0.5%) dissolved in glycerol. The activity of the catalyst is more or less intense depending on preparation procedure. Preliminary trials carried out on a number of brands led to the selection of Riedel de Haen tin chloride. The esterification is achieved by heating to 175°C for 2 hr at atmospheric pressure, then under a slight vacuum (20 mm – 30 mm of Hg) accompanied by stirring. After 3.5 hr, only 35.5% of the acids remained in the reactor. The vacuum is then intensified until the esterification of glycerol is completed (as assessed by the hydroxyl value).

Total time of the operation:18 hr – FFA content of the oil: 8.9%.

It is important to prevent contact between the hot oil and air because under these conditions, the oil assumes a yellow tinge and oxidises quickly owing to the lack of natural antioxidants.

The oil is subsequently dissolved in petroleum ether, neutralised, bleached using active carbon (wynert extra) – if the oil is badly discoloured, this process is ineffective – then washed with metabisulphite to eliminate peroxides (1.2 times the theoretical quantity of metabisulphite is necessary). The oil is then washed with sodium hydroxide to eliminate the excess of metabisulpshite then with water until it is neutral. The petroleum ether is finally driven off under CO_2.

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The characteristics of the synthetic oil are given below:

FFA	0.2%
Peroxide value	0.8 milliequivalent
Iodine value	53.0 (54 for the initial oil)
Hydroxyl value	4.1
Optical density at 420 mμ	0.04

Preparation of the Methyl Esters of Palm Oil

Methyl esters were prepared from SPB oil (FFA 1.96%) through transesterification in alkaline medium and distillation of the esters thus prepared.

Methyl esters are completely colourless with an optical density lower than 0.005 at 420 mμ. The yield is 92%. The FFA content is 0.065%.

APPENDIX 4

Determination of the Flash Point and the Flame Point of Oil

Oil with a high flash point is preferred for application in metallurgy. A few determinations were carried out to ascertain whether the FFA content had an effect on the flash point. (Determination carried out with the Pensky – Martens apparatus.)

The results in *Table 1* show that FFA have no effect, also that there is no relationship between the flash point and the appearance of vapour. The flame point appears very steady.

APPENDIX 5

White Nuts

Some nuts in the bulk before cracking or in the cracked mixture are observed to have a light colour from pale yellow to brown. The occurrence of this type of nuts has, to our knowledge, never been explained satisfactorily. A number of hypotheses were put forward (malformation, disease of the palm, characteristics of the palm).

In the course of the research work, unripe or under-ripe bunches (from 3 to 15 days away from ripeness) were processed on many occasions with a view either to assess the efficiency of stripping after sterilisation or to evaluating the quality of the oil (bleachability, carotene content).

On some batches of fresh fruit bunches (FFB), up to 35% of the nuts were observed to be white against a normal concentration of 1% at the most. It would appear therefore that white nuts originate exclusively from bunches which have not reached complete ripeness.

It is known that the density of white nuts and the shell thereof is lower than 1. They are consequently carried away with the light fraction, that is kernel, in the mud bath or in the hydrocyclone. The low specific gravity of these nuts and shell has however been made use of to separate them from the cracked mixture in a water bath in which all normal shell and kernels sink. The examination of 'white nuts' has shown that in exceptional cases the kernel is not yet formed (milky consistency), that in most instances the kernel is relatively small and finally, that exceptionally the kernel is of normal appearance.

The proportion of white nuts might possibly be used as a criterion of ripeness of bunches.

APPENDIX 6

Density of Oil

More that 99% of the oil exported from the Congo by Congopalm are shipped in bulk. In the production areas, oil is stored in bulk except in a very few isolated cases. The same remark applies to the transport of oil in the Congo. As a result, the oil is practically not weighed. The determination of the quantity of oil dealt with is carried

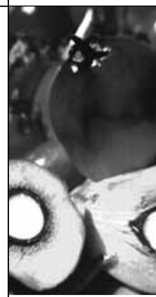


TABLE 1. SOWS FREE FATTY ACID (FFA) OF CRUDE PALM OIL (CPO) HAS NO RELATIONSHIP TO ITS FLASH POINT

	Free fatty acid	Moisture	Flash point (°C)	Inflammation point (°C)	Vapour emission
High acidity oil	7.20	0.36	248	330	Average
Average acidity oil	2.50	0.13	240	325	Intense
Same oil but dried under nitrogen at 100°C	2.50	0.05	235	350	Low
SPB oil	1.35	0.15	280	320	Very low
Same oil but stored for 12 hr at 60°C	-	-	-	-	Low

through volume and density measurements. The subject deserves further elaboration.

The determination of the density of liquefied palm oil presents no difficulty. It can be carried out as for any other liquid. Unfortunately, the volume of the oil is usually determined at a temperature below that of complete fusion. In that semi-solid state, the density cannot be obtained by extrapolation of the results pertaining to the liquid oil since the solidification of oil induces a contraction and consequently an increase in density. The dilatometric curves given in *Figures 1* and *2* show the extent of the increase in density resulting from the gradual crystallisation of the constituents of the oil. The ratio of solid to liquid fraction is not the only factor affecting density. In order to obtain densities usable for the determination of weight from volume, it would also be necessary to take into account the corrections resulting from the buoyancy of air, the moisture content, the FFA content and the impurities content. The effect of these factors on the density of oil is however comparatively less marked than that of the variations of the ratio of solid to liquid fraction. Moreover, extrapolation is possible to some extent in the case of these factors whereas it is to be precluded in the case of the solid to liquid fraction ratio. This is due to the fact that variations of the ratio are not solely governed by temperature but also by the conditions of cooling or heating (type of crystallation on the one hand and suffusion on the other).

It is therefore not possible in practice to ascertain with accuracy the weight of oil from its density if the oil is not completely fluid. In order to illustrate this statement, reference is made to the data of *Table 2* giving the density of three samples of oil at different temperatures reached by cooling and heating.

Figure 1 gives a plot of the density against temperature for oil at 1.82% FFA. The straight line indicates the normal variation of the density, that is -0.00068 per degree for the completely fluid oil.

For the same oil, calculations show that on cooling down the variation of the density against temperature within the range 30°C to 40°C amounts to -0.00145 per degree.

APPENDIX 7

Effect of the Moisture Content of Pulp on the Extraction of Oil

It is a known fact that the extraction of oil from oleaginous seeds (kernel, soyabean) is affected by the moisture content. The same

TABLE 2. DENSITY OF OIL (kg litre^{-1})

Moisture FFA	0.12% 1.82%		0.12% 4.23%		0.13% 11.22%	
Temperature °C	**H**	**C**	**H**	**C**	**H**	**C**
25.05	0.9171	0.9157	0.9164	0.9150	0.9137	0.9115
28.45	0.9126	0.9155	0.9116	0.9148	0.9100	0.9115
31.40	0.9098	0.9100	0.9087	0.9088	0.9064	0.9068
34.75	0.9055	-	0.9052	-	0.9039	-
34.80	-	0.9057	-	0.9045	-	0.9022
38.45	0.9017	0.8982	0.9034	0.8997	0.8993	0.8962
41.15	0.8993	-	0.8985	-	0.8962	-
41.45	-	0.8960	-	0.8962	-	0.8942
45.65*	0.8931	-	0.8932	-	0.8913	-

Note: C means gradual heating of the oil.
F means gradual cooling of the oil.
* 1 liquid oil.
The density used in the determination of the weight of oil equals the true density less 0.0012.

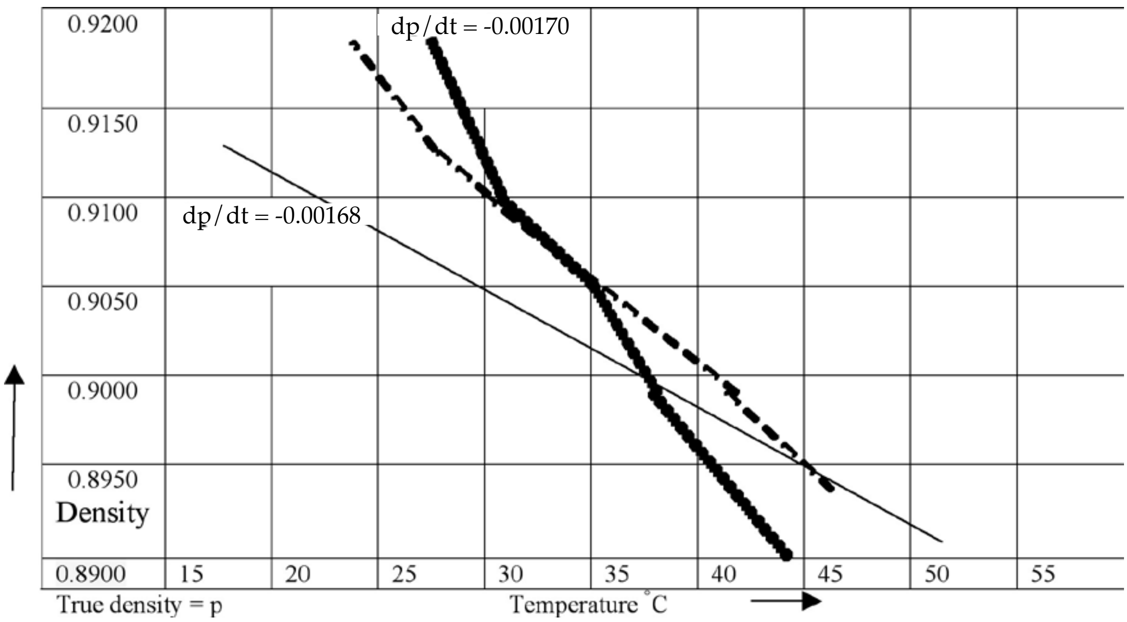


Figure 1. Density of oil in relation to temperature determined on gradual cooling and heating.

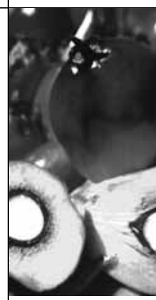
remark has also been made in the case of oil palm fruit.

This point was investigated at laboratory scale. The following factors were considered:

- time of digestion;
- temperature of digestion;
- temperature of the mash subjected to pressing;
- moisture content of pulp; and
- nut content of the digested mash.

EXPERIMENTAL

The effect of the above factors on the oil content of fibre and the composition of crude oil was ascertained. The fruits were sterilised according to the Mongana technique. Only the pericarp was subjected



to digestion in a laboratory digester fitted with a jacket using oil as heating fluid. The pulp was extracted in a Carver press under a pressure of 86 bar. The pulp was dried in an oven set at 100°C.

RESULT AND CONCLUSIONS

The effect of the moisture content of pulp on the oil content of fibre was determined under the following conditions:

1. No heat applied during digestion or pressing:
   - without digestion.
   - after 10 min digestion.
   - after 40 min digestion.
2. Heat applied during pressing but not during digestion:
   - after 10 min digestion.
   - after 40 min digestion.
3. Heat applied during digestion and pressing:
   - after 10 min digestion.
   - after 40 min digestion.
   - after 60 min digestion.
4. Factory digested pulp:
   - after 10 min digestion.
   - after 40 min digestion.

The main results are shown graphically in *Figures 2* to *4*. The following conclusions are drawn:

- the optimum moisture content of pulp is 10% corresponding to the lowest oil content in the fibre;
- drying of the pulp below that level entails an increase in the oil content in the fibre;
- above a moisture content of 10%, the oil content of fibre also increases but levels off at and beyond a moisture content of 20%;
- the extraction efficiency is far better for factory digested fruit than for fruit digested in laboratory equipment, even if the appearance of the digested mash is the same in both cases. The pressing of factory digested mash easily yields fibre with an oil content of 15% on dry basis. The lowest oil content recorded on pressing laboratory digested fruit was 20% even when the time of digestion was lengthened;
- the optimum moisture content for laboratory digestion differs from that applicable to factory digestion. In the latter case, the optimum was found to

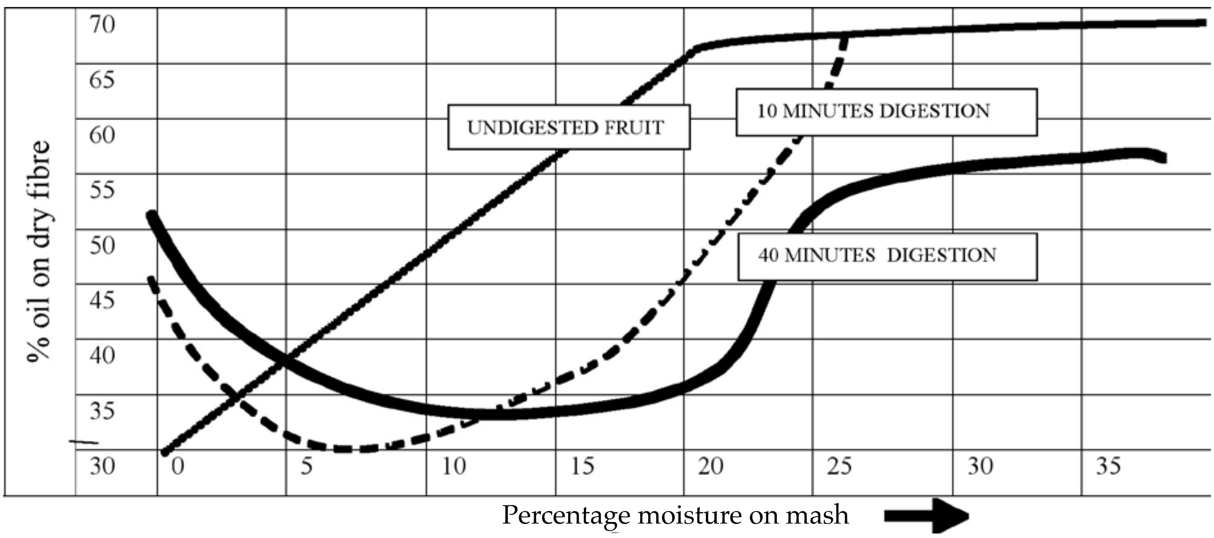
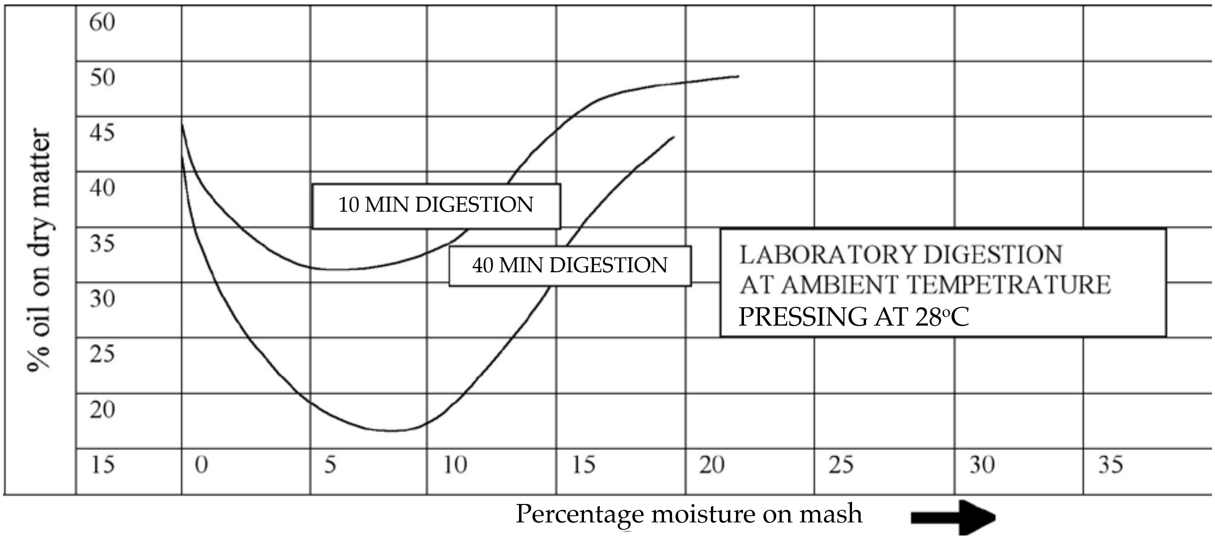
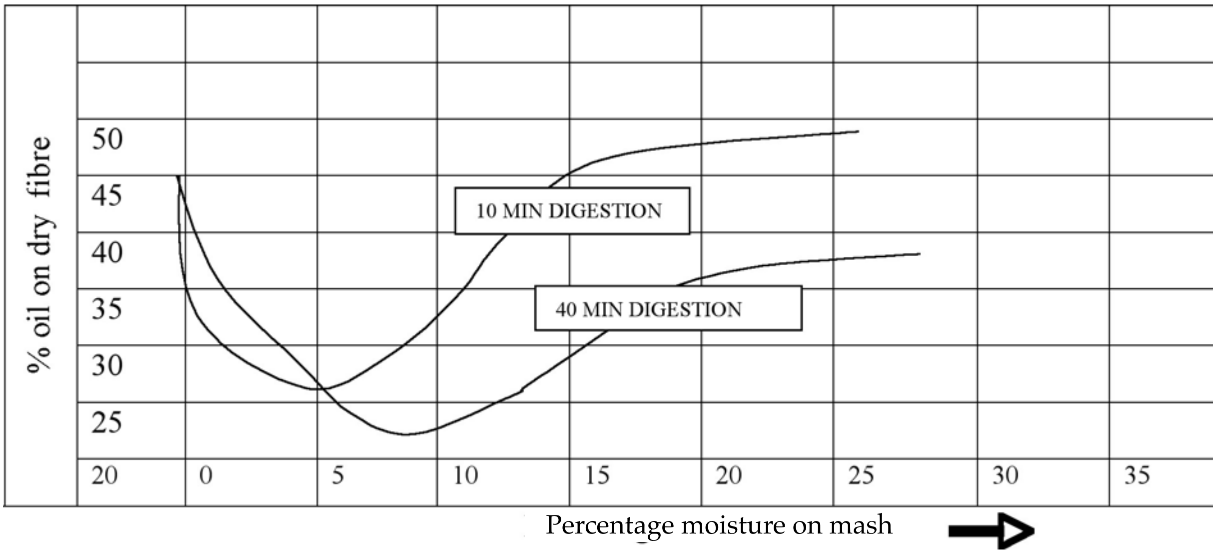


Figure 2. Oil content of dry fibre in relation to the moisture content of mash under various conditions of digestion and pressing.



Figures 3. Oil content of fibre in relation to the moisture content of the mash under various conditions of digestion and pressing.



Figures 4. Oil content in fibre in relation to moisture content of mash under various conditions of digestion and pressing.

be approximately 30% moisture in pulp (moisture content was increased up to 50% by addition of water);

- the efficiency of digestion is affected by the proportion of nuts. However, the lack of sufficient can be compensated by an increase in the time of digestion;
- the lower the moisture content of pulp, the lower the dirt and moisture content of crude oil. The effect of the former on the latter is very sharp;
- the separation of crude oil into its constituents is very fast when the ratio of moisture to non-oily solids is close to or lower than 1. This points concedes fairly well with the optimum moisture content of pulp. This would indicate that when the ratio is higher than 1, the

NOS is highly hydrated and forms a stable suspension in the oil;
- in special instances the moisture content of pulp was reduced considerably. In these particular cases, the moisture content of oil was found to be lower than the saturation limit; and
- the desiccation of pulp or fruit at industrial scale gives rise to technical difficulties (the technique used in the pilot plant consisted in flowing air heated up to 140°C through a rotating drum loaded with fruit).

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An advertiser places a one Full Page advertisement in say the second-quarter (Q2) of year 2011. Under the existing system, he will get four listing in the Palm Oil Mill Vendor's List beginning from Q2 until Q1 of the following year. Under the revised system, the Palm Oil Mill Vendor's List listing in this case will only commence in 2012 (Q1) ending in 2012 (Q4). The New Palm Oil Mill Vendor's List will be printed and distributed once a year.

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