Pressed Fibre Oil: Quality and Implications

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INTRODUCTION

Pressed mesocarp fibre oil or commonly known as pressed fibre oil (PFO) has gained attention due to its potential in palm oil industry. This type of oil is basically extracted using solvent extraction from palm pressed mesocarp fibre produced after pressing stage as shown in *Figure 1*. On dry basis, the mesocarp fibre contains up to 5% to 8% of oil (Abd Majid *et al.,* 2012). Since palm pressed mesocarp fibre constitutes of mesocarp fibre, kernel shell, crushed kernel and debris, the PFO has the characteristics of all these products with high triglycerides, palmitic and oleic content from mesocarp and high diglycerides and lauric acid from palm kernel (Neoh *et al.,* 2011).

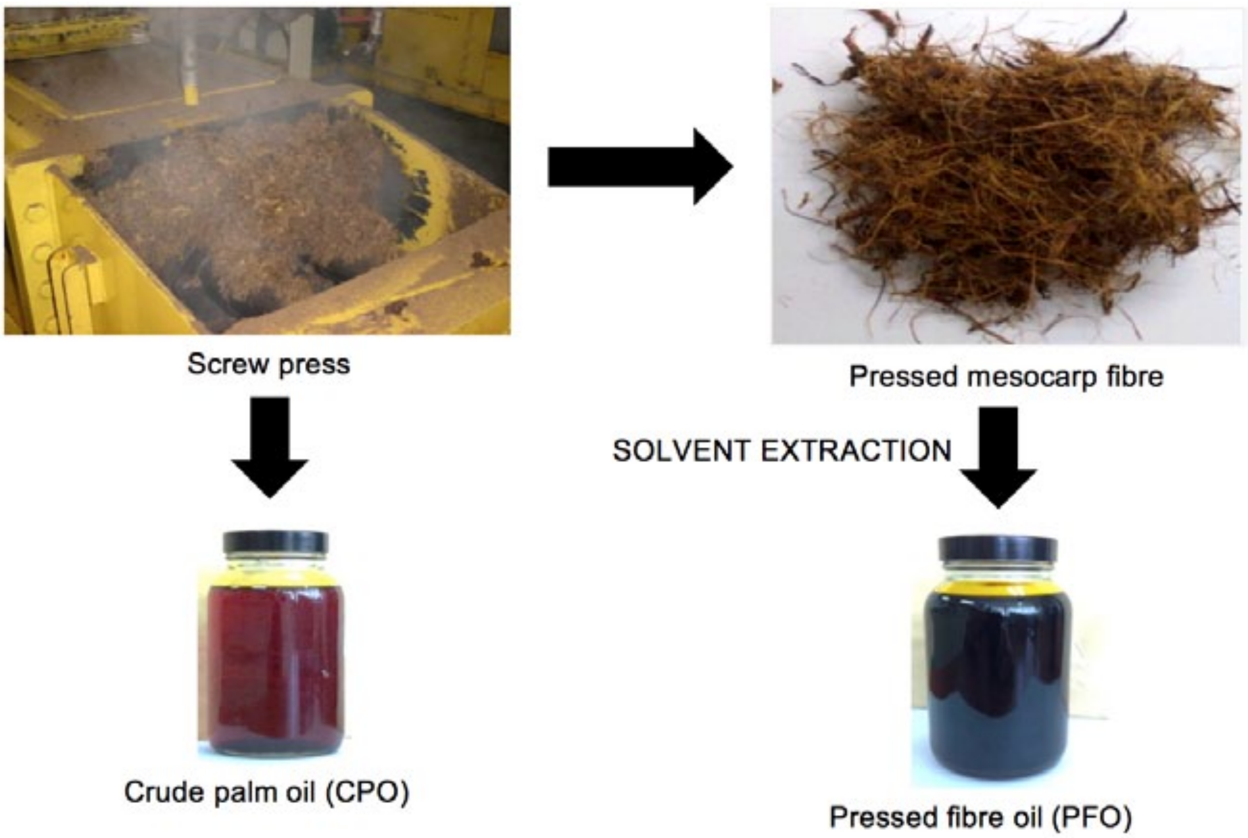


Figure 1. Production of pressed fibre oil (PFO) from palm pressed mesocarp fibre.

PFO QUALITY SURVEY

A survey on PFO quality from nine palm oil mills in Malaysia was carried out by MPOB with results summarised in *Figure 2*. The pressed mesocarp fibre samples obtained from different mills were subjected to solvent extraction using hexane. Results indicated that the free fatty acids (FFA) values for PFO extracted from the pressed mesocarp fibre samples taken from those mills exceeded the standard limit (>5%). The PFO also has low deterioration of bleaching index (DOBI) as well as high phosphorous content. Owing to the differences in operating parameters and practices of mill employing solvent extraction technology, the quality of PFO produced from different palm oil mills varied. Standard specifications of crude palm oil (CPO) according to PORAM (MS 814:2007) are as follows: FFA <5%; DOBI >2.3; phosphorous content between 10 ppm-20 ppm.

Table 1 shows the fatty acid compositions of PFO and CPO from nine palm oil mills. Palmitic acid was predominantly present in PFO in the range of 40.3%-44.1%, followed by oleic acid (37.8%-42.5%) which is mostly similar to the fatty acid compositions of CPO. However, it was found that PFO contained high lauric acid (0.9%-4.7%) compared to CPO (0.1%-0.4%). This could be due to contamination of kernel oil which is extracted through solvent extraction from the mixture of broken nut and kernel discharged along with pressed mesocarp fibre after mechanical pressing (Abd Majid *et al.,* 2012). *Table 2* depicts chloride content analysed in PFO samples obtained from 9 palm oil mills, indicating that PFO samples possessed high chloride content which is one of the precursors for 3-monochloropropane-1,2-diol (3-MCPD) esters formation in palm oil.

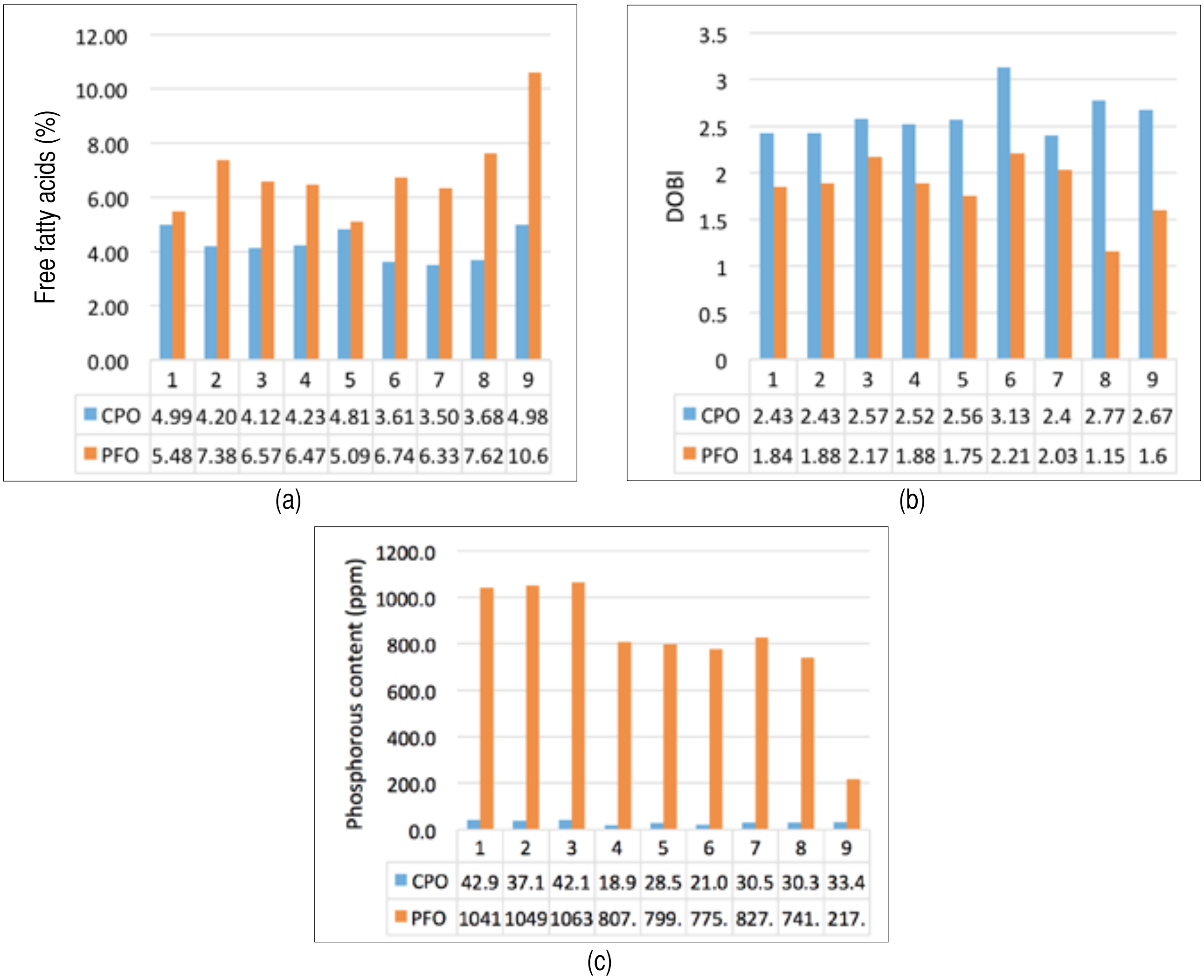


Figure 2. Comparison of quality of pressed fibre oil (PFO) and crude palm oil (CPO) from nine palm oil mills; (a) FFA, (b) DOBI, (c) phosphorous content.

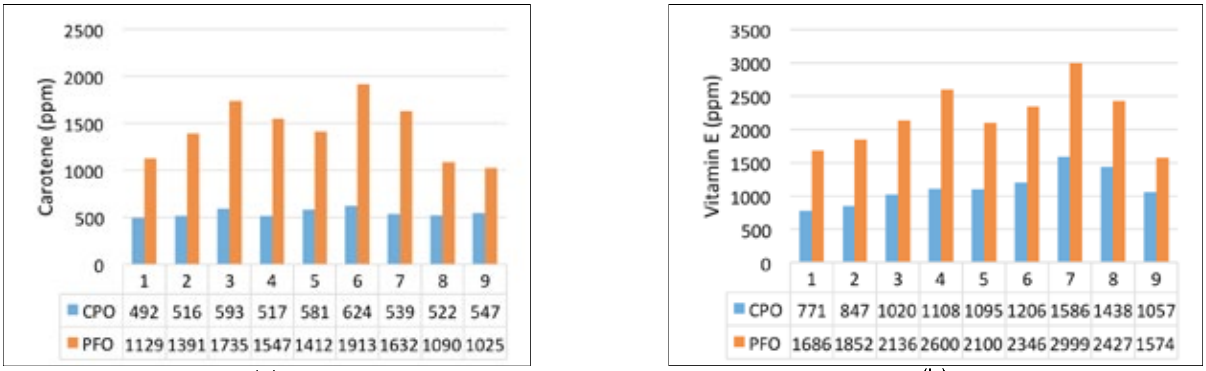
TABLE 1. COMPARISON OF FATTY ACIDS COMPOSITION IN PRESSED FIBRE OIL (PFO) AND CRUDE PALM OIL (CPO) FROM NINE PALM OIL MILLS

No. of mill	Fatty acids composition (%)					
	C12 (lauric acid)	C14 (myristic acid)	C16 (palmitic acid)	C18:0 (stearic acid)	C18:1 (oleic acid)	C18:2 (linoleic acid)
Mill 1	1.4	1.3	43.3	3.9	40.9	9.0
Mill 2	0.9	1.1	43.8	4.0	40.0	9.6
Mill 3	3.5	2.3	43.1	3.5	38.8	8.4
Mill 4	1.2	1.3	44.1	3.3	40.1	9.4
Mill 5	4.3	2.4	42.0	3.2	38.0	9.2
Mill 6	4.7	2.6	41.9	3.3	37.8	9.0
Mill 7	1.6	1.5	43.8	3.4	38.9	10.2
Mill 8	4.2	2.4	40.3	2.8	40.4	9.3
Mill 9	1.2	1.2	41.5	2.9	42.5	10.2
CPO	0.1-0.4	0.9-1.2	45.2-49.9	1.0-3.9	39.3-42.2	9.2-10.0
PORAM Specifications (MS814:2007)	0.1-0.4	1.0-1.4	40.9-47.5	N/A	36.4-41.2	9.2-11.6

TABLE 2. CHLORIDE CONTENT ANALYSED IN PRESSED FIBRE OIL (PFO) FROM NINE PALM OIL MILL

No. of mills	Chloride content (ppm)
Mill 1	230.47
Mill 2	207.62
Mill 3	379.58
Mill 4	336.46
Mill 5	367.12
Mill 6	295.05
Mill 7	369.35
Mill 8	228.11
Mill 9	219.86

Although the quality of PFO is not comparable to that of CPO, it has substantial amount of valuable minor components such as carotenes and vitamin E (tocopherols and tocotrienols) compared to CPO (Abd Majid *et al.,* 2012). *Figure 3* depicts the comparison of carotenes and vitamin E obtained from PFO extracted from the pressed mesocarp fibre samples of nine palm oil mills. It can be seen that PFO has high carotenes and vitamin E content compared to CPO which is a valuable source for phytonutrients extraction. The PFO is rich with natural carotenes, vitamin E (tocopherol and tocotrienols), sterols, squalene, co-enzyme Q10, and phenolic compounds (Choo *et al.,* 1996; Lau *et al.,* 2005) which are suitable for nutraceutical industry (Abd Majid *et al.,* 2012).

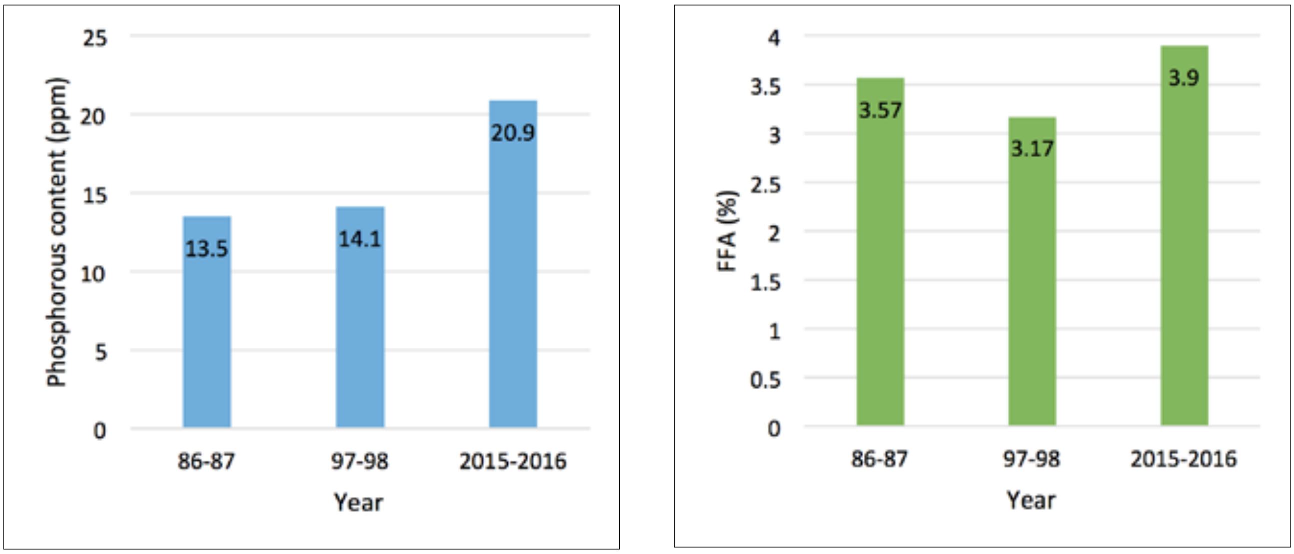


(a) (b)

Figure 3. Comparison of carotenes and vitamin E of pressed fibre oil (PFO) and crude palm oil (CPO) from nine palm oil mills; (a) carotene, (b) vitamin E

IMPLICATIONS OF BLENDING PFO

Pressed mesocarp fibre has very limited applications. It is normally incinerated as fuel for boiler, but PFO has high potential to be explored with hidden values. Unlike sludge oil, despite the potential and valuable components identified for PFO, it has yet to be classified in any group. As a result, some millers tend to blend PFO with CPO to increase the mill's oil extraction rate as PFO has better quality than sludge oil although slightly lower than that of CPO. However, this practice should not be done as it will seriously affect the quality of CPO due to high free FFA and high phosphorous content. *Figure 4* shows a comparison of the survey on phosphorous content and FFA in CPO in different years. It can be observed that increment of phosphorous content in CPO became significant in recent years.



(a) (b)

Figure 4. Comparison of (a) phosphorous content and (b) FFA in CPO from different years.

Phosphorous facilitates the formation of gums and destroys vitamin A in CPO. High FFA and gummy materials in PFO will complicate the refining process (Harrison *et al.,* 2013). Consequently, high bleaching earth consumption is needed and subsequently incur higher cost for the refinery plant. Nevertheless, PFO is suitable for other applications where it should be graded and sold as industrial grade oil or to feed mill industry (Ibrahim and Menon, 2017) as supplementary ingredient for animal feed (Harrison *et al.,* 2013).

Blending PFO with CPO could also lead to the formation of 3-MCPD esters if heated at high temperature since crude oil is acidic (Ramli *et al.,* 2015). This is evident from *Figure 5* which shows the increase in formation of 3-MCPD esters when the amount of PFO blended with CPO increases. A random survey of total chlorine content in crude palm oil (CPO) from several palm oil mills was carried out from

October 2018 to April 2019 with results as depicted in *Figure 6.* There were palm oil mills which recorded high amount of total chlorine content in their CPO. In October 2018, the European commission suggested two possible maximum levels for 3-MCPD esters in refined vegetable oils as shown in *Figure 7*. This two levels of 3-MCPD esters will be enforced in European Union in 1 January 2021.

CONCLUSION

The 3-MCPD esters is affecting Malaysia's palm oil production as it is identified as potential contaminant. Its presence has become a barrier for international trade in relation to quality and food safety. As a result, awareness on the implications of blending PFO with CPO should be

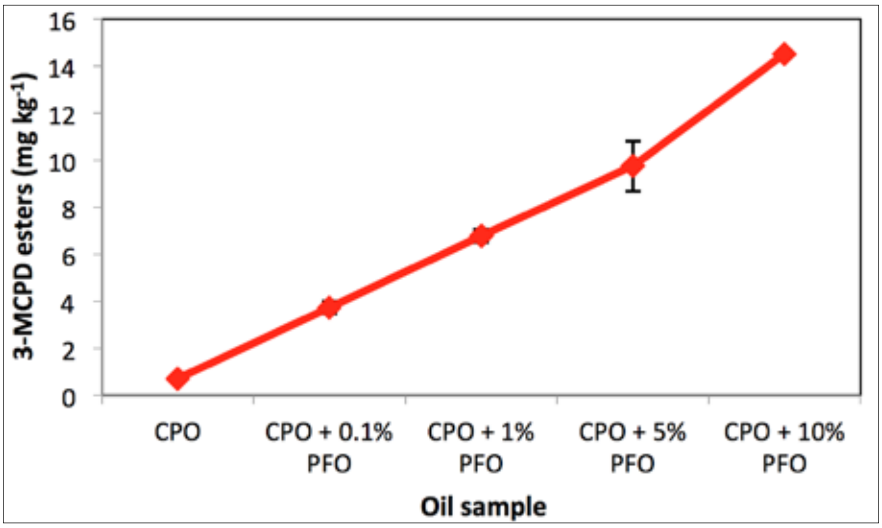


Figure 5. Effect of blending PFO with CPO on 3-MCPD esters formation at different percentages.

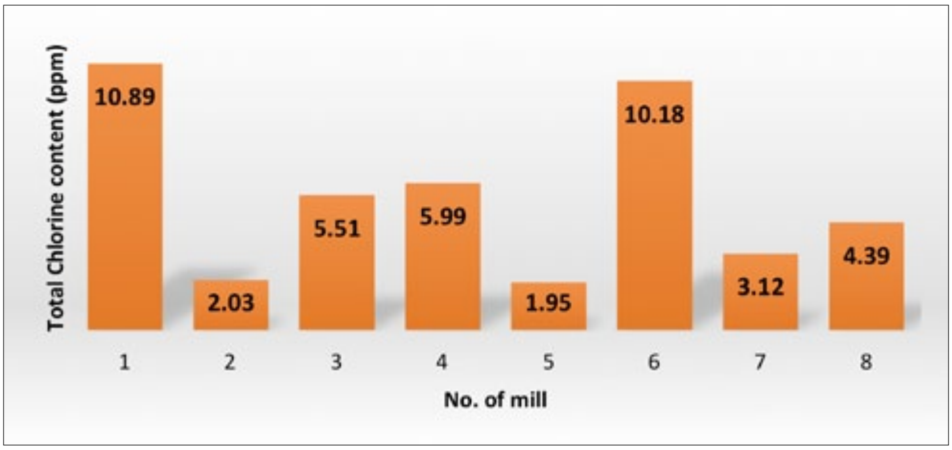


Figure 6. Survey of total chlorine content in CPO from different palm oil mills.

1.25 ppm: For oils and fats from coconut, maize, rapeseed, sunflower, soybean and palm kernel oil and mixture of oils and fats only from this category

2.50 ppm: For other vegetable oils and fish oil and mixture of oils and fats only from this category

2.50 ppm: For mixture of oils and fats from the two categories

Figure 7. Two possible maximum levels set for 3-MCPD esters.

nurtured among palm oil millers. It is crucial for everyone in palm oil industry to play their roles in ensuring the best quality of CPO produced and meet the requirement set either by national or global regulations. Due to the valuable phytonutrients components contained in PFO, other applications should be broadly explored.

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