Oil Content in Empty Fruit Bunch

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INTRODUCTION

Oil content in empty fruit bunch (EFB) is one of the oil loss components in palm oil mill process control. It affects the oil extraction rate (OER). It is generally assumed that only oil from the fruits (mesocarp) is lost during steaming and threshing of fresh fruit bunch (FFB) and is subsequently adsorbed to the EFB. In the laboratory, as the oil is extracted using organic solvent like hexane, the process also extracts any hexane-soluble substances that are present in the EFB. Hitherto, no attempts have been made to investigate if there are any solvent extractable (indigenous oil and waxy matters) substances in the fresh fruit stalks, spikelets and calyx or collectively called fresh empty fruit bunch (FEFB). If they are present, they will contribute to the oil loss figure in the oil loss analysis. This study aims to quantify, if any, the oil and solvent extractable in the FEFB before steaming and threshing as well as the oil content in normal EFB.

METHOD AND MATERIALS

Fresh Fruit Bunch

FFB having one to five empty fruit sockets and acceptable stalk lengths (less than 50 mm) were selected from a palm oil mill for the study. The bunches selected were weighed on site. They were brought back to the laboratory and left under the sun in the open until all the fruits were detached. The spikelets were carefully removed from the stalk. The stalk and the spikelets were weighed separately before they were shredded into small pieces and dried. The dried stalk and spikelet were then separately subjected to soxhlet extraction. Hexane was used to extract the solvent-extractable (oil and other hexane-soluble substances).

Empty Fruit Bunch

EFB were randomly selected after the thresher at the same palm oil mill. The above oil extraction process was repeated for the selected EFB.

RESULTS AND DISCUSSION

Fresh Fruit Bunch

A total of 10 FFB were selected for the study. The weights of the FFB ranged from 7 kg to 25 kg. The sources of FFB were not known. It was assumed that all the FFB were of the *tenera* species. Generally, the FFB fruit-sets were very compact, a result of weevil pollinated crops. However, the shapes and sizes of the fruits from different bunch were very different. This is not the focus of this study.

It was also observed that the shapes and sizes of the stalks were very different from one another, especially the bases of the stalks. There was no correlation between the weight of the FFB and the stalk. This is clearly shown in *Table 1*.

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TABLE 1. OIL CONTENT IN FRESH EMPTY FRUIT BUNCH

Materials	Weight (kg)									
FFB	7.0	11.5	15.0	15.1	19.3	22.2	19.4	15.0	13.5	17.8
Stalk	1.2	0.2	1.1	1.9	0.7	1.6	2.0	0.9	1.5	0.7
Spikelet	0.6	1.1	1.3	1.6	1.7	1.2	1.7	0.8	1.6	1.5
FEFB	1.8	1.3	2.4	3.5	2.4	2.8	3.7	1.7	3.1	2.2
Dried stalk	0.4	0.1	0.3	0.6	0.4	0.5	0.5	0.4	0.5	0.6
Dried spikelet	0.5	0.7	0.9	1.0	1.3	1.0	0.8	0.6	1.2	1.0
Dried FEFB	0.9	0.8	1.2	1.6	1.7	1.5	1.3	1.0	1.7	1.6
Stalk oil	0.0025	0.0006	0.0023	0.0040	0.0015	0.0023	0.0032	0.0007	0.0020	0.0013
Spikelet oil	0.0060	0.0082	0.0142	0.0083	0.0087	0.0093	0.0060	0.0021	0.0033	0.0088
Total oil	0.0085	0.0088	0.0165	0.0123	0.0102	0.0116	0.0092	0.0028	0.0053	0.0101
% Total oil to dried FEFB	0.94	1.1	1.38	0.77	0.60	0.77	0.71	0.28	0.31	0.63
Mean (%)	–	–	–	–	0.75	–	–	–	–	–

Empty Fruit Bunch

A total of nine EFB emitted from the thresher was randomly selected for the study. The weights of the EFB ranged from 1.35 kg to 5.5 kg. The weights of the originating FFB were not known.

Oil Content of the Bunches

The oil contents of the FEFB and EFB were shown in *Tables 1* and *2* respectively. It can be seen that the FEFB, contrary to general believe, does contain some oil and other hexane-soluble substances, albeit very little, that ranged from 0.28% to 1.38% to dry FEFB with a mean of 0.75%. But it is surprising to note that there is no correlation between the oil content and the weight of the FEFB. It is expected that the bigger or heavier FEFB would contain more oily substances.

The oil content of the EFB consists of the indigenous oil and the mesocarp oil lost during steaming and threshing and got adsorbed to the EFB. The oil content ranged from 3.5% to 12.0%

TABLE 2. OIL CONTENT IN EMPTY FRUIT BUNCH

Materials	Weight (kg)								
FFB	1.4	2.3	2.5	5.5	1.8	3.2	2.7	1.9	2.1
Stalk	0.65	1.01	1.40	1.75	0.70	1.51	1.39	0.70	0.90
Spikelet	0.65	1.23	0.95	3.75	1.10	1.67	1.30	1.18	1.19
Dried stalk	0.25	0.45	0.45	0.65	0.31	0.51	0.51	0.31	0.42
Dried spikelet	0.35	0.55	0.65	1.40	0.49	0.75	0.56	0.62	0.58
Dried EFB	0.60	1.00	1.10	2.05	0.80	1.26	1.07	0.93	1.00
Stalk oil	0.003	0.037	0.029	0.027	0.0028	0.026	0.030	0.003	0.015
Spikelet oil	0.018	0.083	0.081	0.189	0.039	0.091	0.078	0.081	0.068
Total oil	0.021	0.120	0.110	0.216	0.0418	0.117	0.108	0.084	0.083
% Total of dried EFB	3.5	12.0	10.0	10.5	5.2	9.3	10.1	9.0	8.3
Mean (%)	–	–	–	–	8.6	–	–	–	–

to dry EFB with a mean of 8.6%, which is much higher than from FEFB. At this stage, it is impossible to separately quantify the indigenous oil from the lost mesocarp oil. However, it can be said that most of the oil loss were from the mesocarp oil.

In the palm oil mill process control, it is generally accepted that the oil loss in EFB ranges from 0.4% to 0.5% or about 5% to dried EFB. The above study shows that the oil loss in EFB at this mill was on high side. It is unfortunate that this oil loss is inevitable if there is no change in the milling technology starting from steaming to threshing of FFB.

Characteristics of the Oil

The oil mentioned in this section means the total solvent-soluble-extract obtained from the FEFB and EFB samples. *Table 3* shows the typical fatty acid compositions (FAC) of these oils compared to that of commercial CPO obtained from the same palm oil mill. Generally, the FAC of the oils obtained from stalks and spikelets of FEFB and EFB are similar to a large extent to that of commercial CPO. The percentages of palmitic acid (C16:0) of the stalk and spikelet oils are slightly higher than that of CPO. However, the stearic acid (C18:1) content is a bit lower than that of CPO. The results also show that the spikelet oil contains a higher percentage of C16 and C18:1 fatty acids than the stalk oil. There were a small percentage of unknown substances (about 0.3%).

TABLE 3. FATTY ACID COMPOSITION OF OILS

Fatty acid composition	CPO	Stalk	Spikelet
C10:0	0.03	0.1	–
C12:0	0.47	1.6	0.1
C14:0	1.11	1.7	1.1
C16:0	43.79	44.8	47.0
C16:1	–	0.2	0.2
C17:0	–	0.2	0.1
C18:0	3.92	4.7	4.3
C18:1	40.88	34.6	37.7
C18:2	9.12	9.3	8.2
C18:3	0.27	–	0.3
C20:0	0.31	0.2	0.4
C20:1	0.10	0.2	0.1

Nowadays, many palm oil mills process the EFB to recover the above oil to boost their OER which may amount to about 0.2%. It is not certain if the slight variation in FAC in the EFB oil will have any impact on the quality (FAC) of the CPO. Perhaps the quantity is too small to have any impact at all. However, other quality parameters like free fatty acid, peroxide values, DOBI and metal contents need to be considered as well.

It must be mentioned here that the oil samples for the analysis were obtained by solvent extraction. Thus, it extracts all solvent-soluble matters. However in the mill, screw presses are used to squeeze the oil out of the bunch. Obviously, it is not so exhaustive and the oil thus obtained will contain much less non-oily substances.

CONCLUSION

The study shows that the FEFB and EFB contain about 0.75% and 8.5% (on dry matter) of oil that comprises all solvent-soluble substances in the samples respectively. The industrial norm for oil loss in EFB is 5% (on dry EFB). Most of the oil is obviously the mesocarp oil that have been lost and attached to the EFB during the milling process. Broadly, the FAC of the oil obtained are similar to those of commercial CPO.

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