HEXANE FREE OIL EXTRACTION FOR ESTIMATION OF IODINE VALUE AND CAROTENE CONTENT[1]

Wong C. K.[1] and Mariam M. S.[1]

1. Applied Agricultural Resources Sdn Bhd, Locked Bag 212, Sg Buloh Post Office, 47000 Sg Buloh, Selangor, Malaysia. Tel: +603-6156 1152, Fax: +603-6156 1206, Email: aarsb@aarsb.com.my

ABSTRACT

For estimation of iodine value and carotene content, the conventional method to extract oil from oil palm fruits follows the following procedure: - collect bunch, sample spikelets, sterilize/autoclave the spikelets, separate fruits from spikelets, peel mesocarp, dry peeled-mesocarp, mince dried-mesocarp, mix minced-mesocarp with Hexane, filter the mixture, collect filtrate, eliminate Hexane from filtrate with rotary evaporator, collect oil. This novel Hexane free method to extract oil from oil palm fruits follows the following procedure: collect bunch, sample spikelets, sterilize/autoclave the spikelets, separate fruits from the spikelets, peel mesocarp, screw-press peeled-mesocarp using HealthyJuicer™, filter screw-pressed-mesocarp using filter paper under controlled temperature 40 degree celcius for overnight, collect filtrate (oil).

32 bunches were collected. Two oil samples were extracted from each bunch, with one using the conventional oil extraction method and the other with the novel Hexane free oil extraction method. All the oil samples were sent to one of the credible laboratories to analyze for iodine value and carotene content. Using paired t-test, the iodine value and the carotene content were examined if they vary due to the difference in extraction methods. The differences in the iodine values of oil samples extracted via the two methods were statistically not significant at the probability level of 5%. In contrast to carotene content, the differences in the carotene content of the oil samples extracted via the two methods were statistically significant at the probability level of 5%. Linear regression analysis of the two methods, suggests a systematic downward bias of carotene content estimated from oil samples extracted via the Hexane-free method, with $R^2 = 0.966$.

Many analyses are required in oil palm breeding. The authors advocate this novel method to be used in order to reduce the usage of Hexane for safe and clean work environment and cost saving, while the integrity of the data, specifically iodine value and carotene content, is not compromised.

Keywords: Conventional and Hexane Free Oil Extraction Method, Iodine Value, Carotene Content.

[1] Paper presented at the International *Seminar on Breeding for Sustainability in Oil Palm, held on* 18 November 2011 in Kuala Lumpur, Malaysia. Jointly organised by the International Society for Oil Palm Breeders (ISOPB) and Malaysian Palm Oil Board (MPOB). P. 43 - 50

INTRODUCTION

Iodine Value (IV) and Carotene Content for Oil Palm Breeding Program

One of the oil palm breeding goals is to change the current palm oil profile from current 50 – 50 unsaturated – saturated fats ratio to higher unsaturated – saturated fats ratio, through the change of planting materials. Although the current palm oil profile is neutral in its cholestrolemic behavior as the saturated component is mainly palmitic, due to pressure from some consumers, breeding for oil palm with higher unsaturated – saturated fats ratio is considered. In addition, this shall diversify the palm oil market, targeting the cooking and salad oil markets of the temperate countries. Carotene content, the precursor to the synthesis of Vitamin A and one of the antioxidants, is important for general health. There is also demand of high carotene palm oil, so the carotene could be used as natural food coloring.

Conventional Oil Extraction Method For Estimation of IV and Carotene Content

The conventional method to extract oil from oil palm fruits to estimate IV and carotene content follows the following steps:

1) collect bunch,
2) sample spikelets (3 – 4 spikelets),
3) sterilize/autoclave the spikelets at 15-20 p.s.i. for 45 minutes,
4) separate fruits from the sterilized spikelets,
5) peel mesocarp using forceps,
6) dry peeled-mesocarp at 105 degree Celsius for 3 hours,
7) mince dried-mesocarp using a blender,
8) mix minced-mesocarp with 100 ml Hexane,
9) filter the mixture,
10) collect filtrate,
11) eliminate Hexane from filtrate with rotary evaporator (the evaporator operates at 55 degree Celcius for about 20 minutes for one sample), and
12) collect oil.

Hexane Free Oil Extraction Method For Estimation of IV and Carotene Content

Modifying from the conventional oil extraction method, Hexane free method to extract oil from oil palm fruits follows the following steps:

1) collect bunch,
2) sample spikelets (3 – 4 spikelets),
3) sterilize/autoclave the spikelets at 15-20 p.s.i. for 45 minutes,
4) separate fruits from the sterilized spikelets,
5) peel mesocarp using forceps,
6) screw-press peeled-mesocarp using HealthyJuicer™ (Plate 1),
7) filter screw-pressed-mesocarp using filter paper and leave for overnight in oven at temperature 40 degree celcius,
8) collect filtrate (oil).

Careful oil sample preparation starting from a fresh fruit bunch is important for repeatable IV and Carotene Content results. The essential principal to the repeatable IV and carotene content results is the oil must be lipase free, which explains the step to sterilize the spikelets is necessary, in both extraction methods. Meanwhile, carotene is heat sensitive; therefore, under the conventional method and the hexane free method, both temperatures while extracting the oil were relatively low. The exercise illustrated in this paper aims to compare the IV and carotene content from oil samples extracted via the two methods.

METHODS & MATERIALS

Comparison of the two extraction methods

32 bunches were collected with each bunch collected at different day of tenera palms in plant breeding trials. Two oil samples were extracted, one via the conventional method and the other via the Hexane free method, from each bunch. All the oil samples (in total 64 samples) were sent to a credible lab for IV and carotene content in each oil samples. The IV and carotene content of the two oil extraction methods were examined using paired t-test and linear regression analysis

RESULTS

Differences between iodine values of the two extraction methods are statistically not significant

The mean IV for the conventional method is 54.9, while the Hexane free method is 54.6. The differences in the iodine values of oil samples extracted via the two methods were statistically not significant at the probability level of 5% (Table 1). The scatter plot of IV (conventional method) versus IV (Hexane Free Method) if fitted with a straight-line, follows the function $y = 1.0038x$, with $R^2 = 0.6151$ (Figure 1).

Differences between Carotene Content of the two extraction methods are statistically significant

The mean carotene content for the conventional method is 784, while the Hexane free method is 690. The differences in the iodine values of oil samples extracted via the two methods were statistically very significant at the probability level of 5% (Table 1).

Systematic downward bias of Carotene Content from oil samples extracted via the Hexane-free method

The scatter plot of Carotene Content (Conventional Method) versus Carotene Content (Hexane Free Method) if fitted with a straight-line, follows the function $y = 1.1056x + 21.463$, with $R^2 = 0.966$ (Figure 2). Since the straight-line is well fitted, as shown with the high R^2, the results suggest a systematic downward bias of Carotene Content from oil samples extracted via the Hexane-free method.

DISCUSSIONS

Oil Palm Breeding Program require many analyses

The experience in oil to bunch analysis suggests, to characterize a family, 50 – 100 analyses are required. Therefore, we foresee similar number of analyses might be required to characterize a family for IV and carotene content.

Conventional Oil Extraction Method as a mean of quality control check for the Hexane-free extraction method

In an oil palm breeding program, the role of conventional oil extraction method could serve as a mean of quality control check for the Hexane-free extraction method. Currently, the authors are practicing the quality control checks at a frequency of every 20 oil samples.

Hexance-free extraction method is cost saving and encourage safe and clean work environment

Hexane-free extraction method has strong linear relationship with the conventional oil extraction method when estimating IV and carotene content. Therefore, hexane-free method is suitable to be used as an alternative to the conventional method when many oil extractions are required, as in an oil palm breeding program. The hexane-free method was innovated to encourage safe and clean work environment with additional advantage of cost saving, while the integrity of the data, specifically iodine value and carotene content, is not compromised.

PLATE

Picture source: http://www.healthyjuicer.com/pages/about.html

Plate 1: HealthyJuicer™ used in screw-pressing the peeled-mesocarp

FIGURE

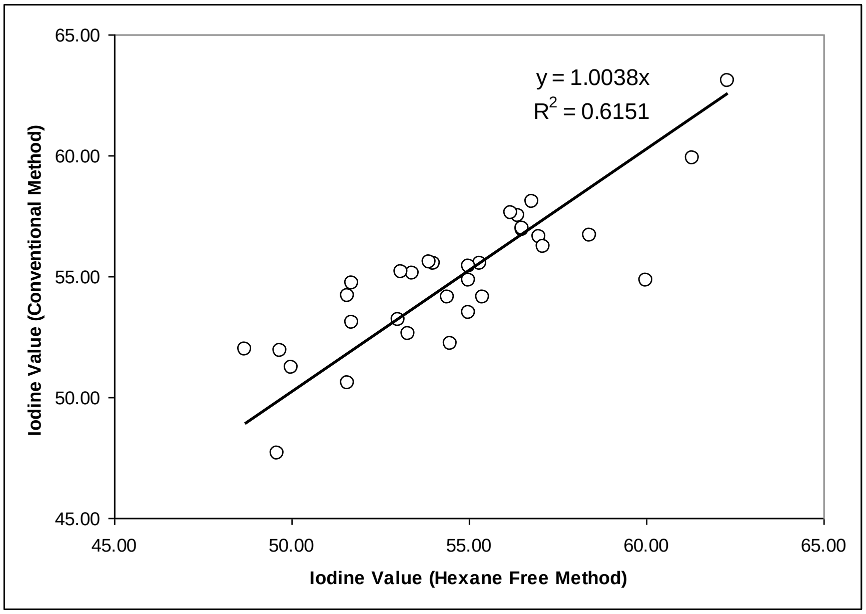

Figure 1. Scatter plot of Iodine Value (Conventional Method) versus Iodine Value (Hexane Free Method)

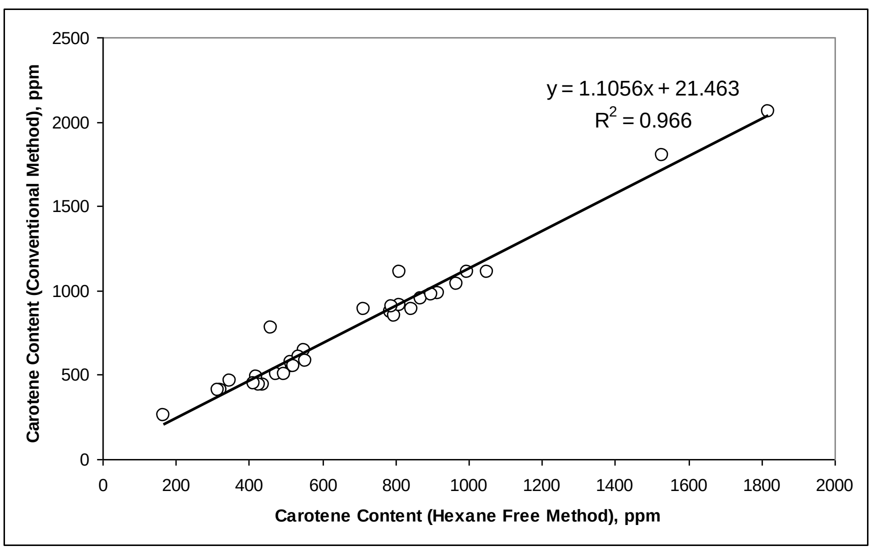

Figure 2. Scatter plot of Carotene Content (Conventional Method) versus Carotene Value (Hexane Free Method)

TABLE

Table 1: Iodine Value and Carotene Content (ppm) for oil samples extracted via the conventional method and the Hexane-free method, from each bunch.

Bunch	Iodine Value		Carotene Content (ppm)	
	Conventional Method	Hexane-free Method	Conventional Method	Hexane-free Method
1	55.5	55.3	461	347
2	56.6	57.0	642	551
3	55.5	54.0	871	788
4	53.1	51.7	406	321
5	55.6	53.9	1040	966
6	55.4	55.0	852	796
7	63.1	62.3	1800	1530
8	57.5	56.4	442	437
9	58.1	56.8	552	518
10	54.1	54.4	777	461
11	51.2	50.0	952	869
12	55.1	53.4	892	844
13	54.8	60.0	2060	1820
14	52.6	53.3	1110	996
15	56.9	56.5	256	168
16	53.5	55.0	488	419
17	57.6	56.2	502	473
18	56.2	57.1	1110	813
19	54.1	55.4	572	513
20	55.2	53.1	408	314
21	54.7	51.7	983	916
22	59.9	61.3	972	900
23	53.2	53.0	437	427
24	52.2	54.5	450	414
25	57.0	56.5	504	497
26	52.0	48.7	605	538
27	54.2	51.6	583	555
28	51.9	49.7	552	522
29	56.7	58.4	914	810
30	54.8	55.0	904	789
31	47.7	49.6	887	713
32	50.6	51.6	1110	1050
Mean	**54.9**	**54.6**	**784**	**690**
P-level (paired t-test)	**0.42**		**2.18E-07**	

ACKNOWLEDGEMENT

The authors would like to express their gratitude to the AAR Principals, i.e. Boustead and Kuala Lumpur Kepong Bhd, to present this paper, and to Breeding and Genetics Group, Advanced Biotechnology & Breeding Centre, Malaysia Palm Oil Board to provide the initial learning platform for the conventional oil extraction method.

REFERENCES

Ainie K, Siew W L, Tan Y A, Nor Aini I, Mohtar Y, Tang T S, Nurul A I (2005) MPOB Test Methods – A Compendium of Test on Palm Oil Products, Palm Kernel Products, Fatty Acids, Food Related Products and Others. Malaysia Palm Oil Board. Kuala Lumpur.

Cook R D & Weisberg S (1999) Applied Regression Including Computing and Graphics. John Wiley & Sons, Inc. New York.

Soh AC, Wong G, Hor TY, Tan CC and Chew PS (2003) Oil Palm Genetic Improvement. Plant Breed Rev. 22:165 – 220

Malaysia Palm Oil Council (2009) Oil Palm… tree of life. Malaysia Palm Oil Council, Kelana Jaya.

http://www.whywheatgrass.com.my/products/

http://www.healthyjuicer.com/pages/about.html