

# Survey on the Red Palm Olein Versus Refined, Bleached and Deodorised (RBD) Palm Olein upon Completing Dietary Intervention – Preference of the Users (overweight adults)

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## ABSTRACT

*A short survey was conducted to study the preference for red palm olein versus commonly used refined, bleached and deodorised (RBD) palm olein on free-living abdominally overweight working subjects after a chronic crossover dietary intervention incorporating both oils in succession. The intervention was conducted in a randomised controlled trial with crossover design at the dining hall of the Malaysian Palm Oil Board. Fifty three questionnaires were distributed to the participants who underwent chronic dietary intervention (n=53). Questionnaires assessed background of oils, consumers' perception of health benefits and suitability of using red palm olein on a daily basis, and preferences for using red palm olein after dietary intervention. Majority of the participants, 95% used palm oil as cooking oil at home at baseline. The difference in taste was identified by 72% of them. It was found that 19% of participants felt healthy when consuming the red palm olein as compared to RBD palm olein, 9% of the participants. Majority of them or 62% stated that they would consider using red palm olein after the study. Overall, the red palm olein was well accepted by participants. As this was a single centre study, the study population may not represent the Malaysian population in terms of ethnicity and socio-demographic pattern variation.*

**Keywords:** red palm olein, palm olein, cooking, preference, sensory.

## INTRODUCTION

The American Heart Association encourages the practice of healthy eating patterns with healthy food choices of all required nutrients and

antioxidants (American Heart Association, 2014). Cooking oil is an essential part of the daily diet preparation (Loganathan *et al.*, 2018). In addition to providing nutrients or beneficial antioxidants to promote the health of the general population, natural cooking oils rich in antioxidants can also meet their daily dietary needs (Loganathan *et al.*, 2018). Red palm oil is obtained from crude palm oil through a novel low-temperature process (Loganathan *et al.*, 2017). Owing to this special process, red palm oil is rich in phytonutrients, (carotenes, vitamin E, phytosterols, squalene, and co-enzyme Q10) that are known to have cardio-protective effects (Loganathan *et al.*, 2010). Red palm oil is traditionally used in the tropical rain forest regions of West Africa (Burri, 2012) and North-Eastern Brazil (Rice and Burns, 2010). Despite the high production and usage of refined palm oil in countries like Malaysia and Indonesia, little advantage has been taken of the nutritional potential of red palm oil (Scrimshaw, 2000).

The RBD palm olein is the commonly used cooking oil obtained through fractionation of that yields liquid (palm olein) and solid (palm stearin) fractions (Loganathan *et al.*, 2020c). During refining, carotenes are decomposed to produce light yellow refined oil while other minor phytonutrients are retained in the refined oil (Loganathan *et al.*, 2020a). Our recently published article stated that red palm olein is also thermally stable like RBD palm olein and is suitable for normal cooking practices (Loganathan *et al.*, 2020b). However, red palm olein is not suitable as a heavy duty cooking oil when carotenoid retention is of concern (Loganathan *et al.*, 2020b). The RBD palm olein serves as the control or bench mark in the current study.

Red palm oil can be promoted for use as salad dressing, cooking

oil or blended oil (Scrimshaw, 2000). Consumer acceptance and preference are another important area to consider besides the nutritional and stability aspects. Red palm oil is carefully refined to expel colour, odour and taste to make it more palatable (Burri, 2012). Red palm oil intake is influenced by geographical location and local preference. It should be recommended to take moderate amounts of red palm oil regularly to ensure adequate vitamin A intake.

There are limited reports on the health benefits of red palm oil as complete replacement of background cooking oil (Loganathan *et al.*, 2018). Studies in Africa and China have incorporated red palm oil into children's biscuits (Van Stuijvenberg *et al.*, 2000; Van Stuijvenberg *et al.*, 2001; Guo *et al.*, 2018). In India, researchers used traditional sweets, such as besan laddhu (Manorama *et al.*, 1997) (Mahapatra and Manorama, 1997) and kesari (Manorama *et al.*, 1997) made from red palm oil, while in Malaysia, aboriginal orang asli children were supplemented with local snacks/kuih made from red palm oil (Ng *et al.*, 2012). In Africa, they also have red palm oil biofortified cassava flour (Zhu *et al.*, 2015; Mosha, 1998), or the oil itself given in the form of sachet (Radhika *et al.*, 2003), pills (Zeba *et al.*, 2006) or emulsion (Aykroyd and Wright, 1937). The feasibility and acceptability of red palm olein for daily cooking purpose is unknown. Therefore, this study was strategised to analyse the preferences of subjects to use red palm olein as cooking oil as compared to RBD palm olein and factors that influence their choices after a chronic dietary intervention.

## MATERIALS AND METHODS

### Study Design

Using a crossover design, we conducted a randomised, single-

blinded, controlled trial in 53 free-living high-risk abdominally overweight subjects. This is to compare the effects of incorporating red palm olein and RBD palm olein as control in a supervised isocaloric 2100 kcal diet of 30% en fat. The two-thirds (45 g day<sup>-1</sup>) of which were derived from the test-oil for a period of 6 weeks each to exhibit a change in lipid and inflammatory markers. There was a 3-week wash-out period between the two diets (red palm olein vs. RBD palm olein). During the 2x6 week study period, the participants were provided with food from Monday to Friday. During the weekends, the participants were given test oil for home consumption. Subjects were randomised to receive either red palm olein followed by RBD palm olein or RBD palm olein followed by red palm olein. The intervention was conducted in the dining hall of the Malaysian Palm Oil Board (MPOB) in Bangi. Ethical approval was obtained from the Ministry of Health, Malaysia and the trial registered with the National Medical Research Register (NMRR-12-632-12810) and <https://www.clinicaltrials.gov/NCT02263183>. A detailed study design and biochemical parameters have already been published and therefore will not be discussed in current context (Loganathan *et al.*, 2018).

### Study Population

Subjects were recruited by advertisement at the research facility of the MPOB and nearby institutes. The inclusion criteria were abdominal obesity (with waist circumference > 90 cm for male, > 80 cm for female), age between 20-50 years and BMI  $\geq$  18.5 kg m<sup>2</sup>.

### Sampling Procedure

Fifty-three questionnaires or feedback survey were distributed

to subjects who underwent a 6-week randomised controlled trial with a crossover design to test the chronic effects of diet enriched with red palm olein and RBD palm olein (Loganathan *et al.*, 2018). The chronic dietary intervention (Loganathan *et al.*, 2018) was novel because red palm olein was used as cooking oil to prepare local Malaysian diets for a duration of six weeks/test diet as compared to the usual RBD palm olein. Subjects were provided breakfast, lunch, dinner, snacks and refrained from eating outside food. Compared with the usual RBD palm olein, since the subjects are familiar with their daily diet and trained to use red palm olein for cooking their food on weekends, we took this opportunity to conduct a feedback survey on them.

### Compliance Measures and Questionnaires

Meal attendance and weekends oil consumption were recorded and monitored throughout the intervention. In the first week of each diet, visual analogue scales (10 cm) were used to determine the degree of acceptability and palatability as previously described (Teng *et al.*, 2016). The feedback survey was given upon completion of the whole dietary intervention. The survey consisted of five simple questions. Questionnaires assessed the background of oils consumed, observation on perception of health benefits, suitability for daily use, taste difference, and preference for using red palm olein after the dietary intervention. This questionnaire was piloted by study researchers to ensure the content was relevant to the study objectives and the language was appropriate prior to distribution of the questionnaires.

### Data Analysis

The data was analysed using descriptive statistics. Repeated

measures analysis of variance and comparisons between treatments were made using t-test. Statistical analysis was conducted using GraphPad Prism (version 6.00; GraphPad, La Jolla, CA 9203, USA).

## RESULTS AND DISCUSSION

Based on the feedback survey, red palm olein was found to be well accepted as a cooking oil.

### Baseline Characteristics

The baseline characteristics of 53 subjects who completed the study are presented in *Table 1*. The mean age was  $32.83 \pm 9.18$  years old and the majority (66%) were females. Almost all study subjects were Malays, only one was a Chinese male. Most of the subjects were from MPOB (85%), 15% from Universiti Putra Malaysia and one self-employed person.

100% and all questionnaires (n=53) were analysed. *Table 2* provides details of all the compliance and monitoring measures employed to ensure adequate and appropriate dietary intake for the duration of the treatment periods.

The overall percentage of meal attendance for both treatments was high for both 6-week feeding intervention periods and there was no significant difference in percentage of meals missed. There were no significant differences in the percentage of meal attendances between both treatments for total meal attendance, breakfast attendance, and dinner collection. However, a significantly higher percentage of lunch meal attendances ( $P < 0.0002$ ) was recorded for the RBD palm olein group. Red palm olein had a significant higher percentage of meals missed due to sick leave ( $P < 0.0311$ ).

Visual analogue scales (10 cm) were used to determine the

**TABLE 1. BASELINE CHARACTERISTICS**

Variable	Value
<b>Age (year)</b>	32.83 ± 9.18
<b>Gender</b>	
- Male	18
- Female	35
<b>Ethnicity</b>	
- Malay	52
- Chinese	1
<b>Affiliation</b>	
- Employees of MPOB	44
- Intern at MPOB	1
- Employees of Universiti Putra Malaysia (UPM)	2
- Post graduate students from UPM	6
- Self-employed	1

### Response and Dietary Compliance Rate

All 53 subjects who successfully completed the dietary intervention responded giving a response rate of

degree of acceptability (*i.e.* degree to which the food consumed met participants' caloric needs) and the degree of palatability (*i.e.* degree of acceptability of a meal to taste or mind). Little variation in the

**TABLE 2. MEASURES AND MONITORING OF COMPLIANCE FOR MEALS AND WEEKEND OIL CONSUMPTION DURING THE TWO TREATMENT PERIODS**

	Red palm olein	RBD palm olein
<b>Meal attendance</b>		
Meals attended (%)	97.21±4.84	96.72±5.34
Breakfast	97.57±4.63	96.77±5.35
Lunch	93.53±2.11	96.90±5.24**
Dinner	96.83±5.23	96.50±5.24
Meals missed (%)	2.79±4.84	3.28±5.39
Due to sick leave	0.61±1.68	0.07±0.49*
<b>Visual analogue scales for degree of acceptability and palatability</b>		
Acceptability (cm)	7.11±1.68	7.43±1.21
Breakfast	7.26±1.84	7.46±1.46
Lunch	7.24±1.78	7.83±1.30*
Dinner	6.85±2.04	7.01±1.56
Palatability (cm)	7.12±1.74	7.40±1.21
Breakfast	7.15±1.97	7.38±1.48
Lunch	7.31±1.84	7.79±1.24
Dinner	6.89±2.09	7.03±1.64
<b>Weekends oil consumption</b>		
Issued over 6 weeks (g)	1566±693.6	1962±807.7
Returned at end of 6 weeks (g)	202.5±277.6	149.2±220.1
Consumed over 6 weeks (g)	1363±641.3	1813±781.4***
Consumed/weekend day (g day <sup>-1</sup> )	113.6±53.44	151.1±65.12***

Note: Values are means ±SD. n=53 complete data set. \*P<0.05, \*\*P<0.01, \*\*\*P<0.001 between treatments.

participants' responses to the visual analogues across the treatments was detected. Both red palm olein and RBD palm olein diets were equally accepted above average scale.

Intervention-specific oil supplies were provided to the participants for use at home over the weekends when meals were not provided. Participants were encouraged to cook at home during weekends using the test oil provided according to the guidelines given for home reference. At the start of the study, 1 litre of the specific oil was issued to each participant and it was possible to have new bottles as often as desired during each treatment. At the end of

each treatment, the bottles were collected before the next treatment oil was issued. A significantly lower amount of red palm olein was used at home over the weekends of the respective 6-week treatment as compared to RBD palm olein (P<0.0004).

#### Suitability and Acceptability of Red Palm Olein

Table 3 shows the results obtained from 53 questionnaires, which assessed the background of oils consumed, perception of health benefits, suitability of red palm olein for daily use, difference of taste and preference to use

red palm olein after the dietary intervention.

A total of 53% (n=28) of participants stated that red palm olein is not suitable for daily use. Many participants prefer to use red palm olein only for certain types of cooking styles. This is mainly because of its physical properties: yellow stains and viscous texture. Despite the drawbacks of the aforementioned physical properties, 62% (n=33) of participants would choose to use red palm olein after the study because it is perceived to be healthy. Most of the participants (72%, n=38) found difference in taste between red palm olein and RBD palm olein. Compared to RBD palm olein (9%), 19% felt healthy when consuming red palm olein.

#### Preferred Cooking Style Using Red Palm Olein

Figure 1 depicts the preferred cooking styles with red palm olein. The most preferred style is fried chilli gravy (39%), fried tomato sauce (20%) and deep-frying (15%). Other types of food preparation were less preferred because of the unique physical and sensory properties of red palm olein.

#### Weightage of Further Use of Red Palm Olein after the Study

Figure 2 depicts the main reasons stated by participants to accept or reject the further use of red palm olein in their daily life. In this study, the main reasons for the rejection of red palm olein were high cost of red palm olein, yellow stains on food, less crispy texture of fried food and viscosity of the oil as compared to RBD palm olein. Nutritional awareness and taste were the main positive considerations with regards to the further use of red palm olein after the study.

Palatability of the food, which included sensory properties of the

**TABLE 3. QUESTIONS AND ANSWERS TO CHECK SUITABILITY AND ACCEPTABILITY OF RED PALM OLEIN**

Questions	Answers [n (% from total)]		
	Yes	No	Maybe
Is red palm olein suitable for daily use?	25 (47%)	28 (53%)	-
Will you consider using red palm olein after study?	33 (62%)	19 (36%)	1 (2%)
Can you find difference in taste with red palm olein?	38 (72%)	15 (28%)	-
Do you feel health improvements when using red palm olein?	10 (19%)	43 (81%)	-
Do you feel health improvements when using RBD palm olein?	5 (9%)	48 (91%)	-

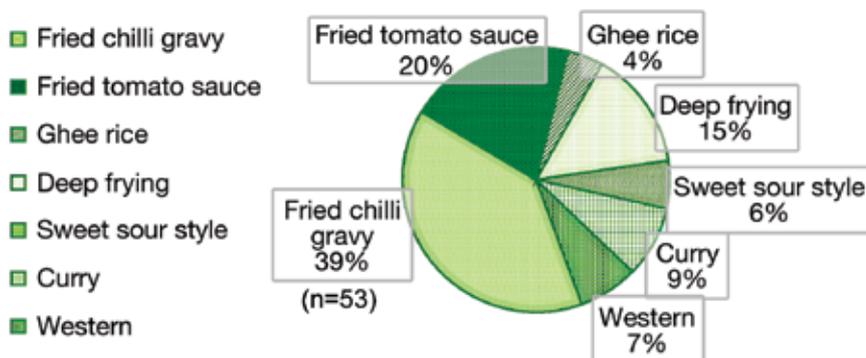


Figure 1. Preferred cooking style using red palm olein (% of total).

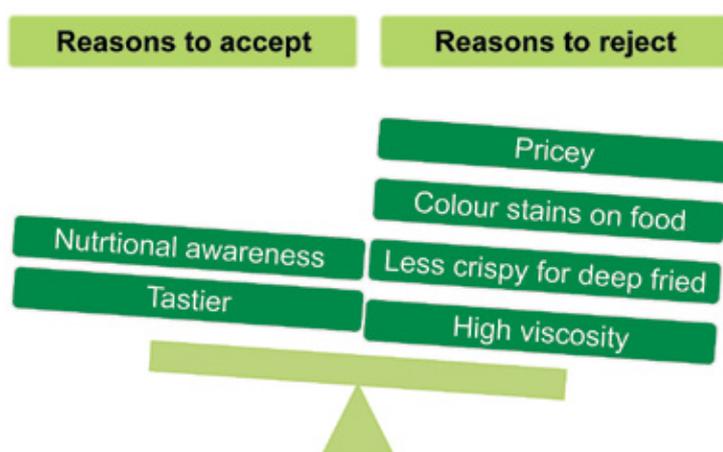


Figure 2. Reasons to accept or reject the further use of red palm olein as cooking oil by study participants after the dietary intervention.

food, such as taste, smell, texture and appearance also played a role in preferences. Fat carries most of the aroma from food, therefore red palm olein and RBD palm olein will surely bring two distinct flavours

and aromas (Sørensen *et al.*, 2003). Interestingly, aroma was not a factor of rejection or acceptability in our case.

Taste, appearance and texture of the food influenced food choice

spontaneously (Sørensen *et al.*, 2003). The high viscosity of red palm olein was not favoured by participants. In comparison to RBD palm olein, food products deep fried with red palm olein were found to be less crispy. Moreover, red palm olein was found to leave yellow stains on meals and dishes. Humans have been trained/habituated to certain types of texture, mouthfeel and flavour from childhood, and therefore, it is natural for participants to develop resistance to food with different content and texture (Paisley *et al.*, 1995). Thus, even despite awareness of the high nutritional value of red palm olein, sensory values over-shadowed and predominated over the choice of oil.

Cost is one of the primary factors in selecting food product, especially for those with an average household income (De Irala-Estevez *et al.*, 2000). The high chance of wastage might stop the consumer from buying or 'trying' it in their family. Therefore, in order to satisfy their whole family with various food demands and beliefs, they tend to stick to their habitual diet, i.e. in the current case being RBD palm olein.

Not only socio-economic status, but the level of nutrition education might also influence the dietary behaviour (Kearney *et al.*, 2000). Nutritional information and education on food products are proven to help the consumer to choose the product (Kearney *et al.*, 2000). However, during this survey, study conductors did not mention the health benefits of red palm olein in order to avoid bias in respondents' decision or perception. Although cost is important in food choice, it appears that this factor was over-shadowed by increasing food nutritional awareness. It is found that participants preferred the red palm olein's taste to RBD palm olein. In other words, red palm

olein was accepted by participants even though there were some properties to be improvised in red palm olein.

There were some limitations to this study. As this was a single centre study, the study population (for example 98% Malay, and 66% female), may not represent the Malaysian population in terms of ethnicity and socio-demographic pattern variation. Another disadvantage of selecting this group is that we cannot assess the acceptance of red palm olein by consumers other than MPOB, who may not have tasted or known about red palm olein/red palm oil. Moreover, the feedback survey used was not a pretested or validated questionnaire. A more comprehensive survey with a larger multi-centre sample size involving populations unexposed to red palm olein outside of MPOB is recommended.

In addition, this was a single-blind study as we couldn't blind the volunteers to the diet allocation given that red palm olein has a distinct red colour. Moreover, as the subjects were given take-home oils for weekend consumption, it was neither feasible nor worth the effort to design menus that can mask the colour of the oil. We had the option to mask RBD palm olein with egg yolk colour, but we were concerned about unwanted health issues associated with the use of food colourant.

The strength of our study was that this was the first supervised study assessing preference and acceptance of red palm olein as background/cooking oil in daily diet preparations. Importantly, our study was conducted under free living conditions in that the subjects underwent daily life and physical activity as usual, albeit whilst receiving a semi-supervised prepared diet incorporating the test oils into all three main meals during weekdays with stringent checks on

compliance. Current study showed that red palm olein was suitable for daily diet preparations and the meals were well accepted by the participants as compared to RBD palm olein.

## CONCLUSION

Red palm olein was found to be well accepted with majority of the participants keen to continue using the oil after the dietary intervention. There were differences in taste, flavour, and texture between red palm olein and RBD palm olein. The high viscosity and yellow staining of red palm olein were disliked by the participants. Overall, the red palm olein was preferred by most of the participants mainly because they are aware of the health benefits of using red palm olein. A more comprehensive survey with a larger multi-centre sample size, involving populations unexposed to red palm olein other than MPOB is recommended. Red palm olein has high market potential to be promoted as healthy cooking oil. As such Malaysian government can explore more in giving tax incentives for local companies and foreign direct investment to trade red palm oil/olein; provide grants to accelerate investment of more companies to produce red palm oil/olein and create revenue through technology transfer and commercialisation.

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