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Evaluation of the Quality of Selected Locally Sourced Oil Base for the Making of Salad and Mayonnaise Creams

Oyet Gogomary.I,[1] and Chibor Bariwere S.[1]
[1] Department of Food Science and Technology,
Rivers State University, Port Harcourt.
Corresponding author: gogomaryo@yahoo.com
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Abstract:
The study is aimed at investigating the quality of locally extracted Palm and Melon oil in the formulation of food cream such as mayonnaise and salad respectively. Also, to determine the storage stability, and rancidity of the developed products. The hydro-distillation method was used for the extraction of melon oil. Crude and refined palm and melon oil were analyzed with respect to quality parameters: Moisture content 0.37%, for crude palm oil (CPO) and 0.28% for Crude melon oil (CMO), 0.14% for refined palm oil (RPO), 0.07% for Refine Melon Oil (RMO), peroxide values (PV) (Meq/kg) CPO 0.80, CMO 0.65, RPO 0.63 and RMO 0.53. Free fatty acids (% Palmitic) CPO 2.43, CMO 9.63 RPO 0.72, and RMO 1.37 %. Saponification value (S.V) CPO 197.4, CMO 185.8, RPO 124.9 RMO 139.80. Iodine value (IV) CPO 52.98, CMO 80.71, RPO 57.98 and RMO 86.03 respectively. Refined palm and melon oil were winterized. Cloud point of refined palm oil was significantly ($p<0.05$) higher, with value ranging from 20.14 to 21.92 ^oC, while cloud point of refined melon seed oil ranged from 3.00 to 3.05 ^oC. The food creams compositional blend was prepared in the following proportions: mayonnaise, 60, 70, 80 and for salad, 40, 30, 20 using refined palm oil and melon oil as base. Analysis of the formulated products showed emulsion stability in mayonnaise ranging from 62.21 to 92.77 % for the heat-thaw cycle and 68.43 to 98.77 % for the freeze-thaw cycle. pH ranged from 3.8 - 4.5 for mayonnaise 3.7 to 4.4 for salad cream. Rancidity test showed that the products were stable with few exceptions. Peroxide value of mayonnaise samples M_8, M_9 and S_7 were significantly ($p<0.05$) higher, with values 8.72, 9.12 and 8.72 mEq/kg, respectively. Peroxide value of salad cream samples T_7, T_8 and T_9 were significantly ($p<0.05$) higher. Nigeria today is highly import dependent in most of the food creams used in garnishing vegetables salads, thus, there is urgent need to patronize these locally sourced oils in food cream formulations.

Key words: *Mayonnaise, Salad, Palm, Melon Oil, stability, Rancidity, Winterization.*

1.0 Introduction:

The increasing demand for convenient, nutritious, and affordable foods has stimulated interest in the development of food products from locally available agricultural resources. Among such products are salad cream and mayonnaise, which are widely used as accompaniments for vegetables, sandwiches, snacks, and other prepared foods (Eke-Ejiofor and Beleya, 2015; Schweizer, 2012). Both products are emulsion-based foods in which vegetable oil constitutes an important component of the formulation (FAO, 2025). Consequently, the type and quality of oil

used can substantially influence the physicochemical properties, nutritional value, stability, sensory characteristics, and shelf life of the finished product. Recent research has demonstrated that the selection of oil is particularly important in mayonnaise because changes in the oil phase can affect viscosity, oxidative stability, colour, emulsion stability, and sensory quality (Gülen et al., 2025). Salad cream and mayonnaise are generally classified as oil-in-water (O/W) emulsions, although they differ in formulation and consistency. In these systems, oil droplets are dispersed within a continuous aqueous phase containing ingredients such as water, egg or egg yolk, acidifying agents, salt, sugar, spices, and, where appropriate, starches or hydrocolloids (Nwosu & Eke-Ejiofor, 2021). Egg yolk is particularly important because its phospholipids and proteins possess emulsifying properties that facilitate the formation and stabilization of oil droplets. The stability of the emulsion is essential because separation of the oil and aqueous phases results in an unacceptable product (Raza et al., 2024). Current research on mayonnaise confirms that formulation variables and processing conditions have major effects on the rheological and physical properties of the resulting emulsion (Gülen et al., 2025).

Mayonnaise is a high-fat emulsion and normally contains a considerably greater proportion of oil than salad cream. The high concentration of dispersed oil droplets gives mayonnaise its characteristic thick and creamy consistency. Salad cream, in contrast, generally contains a lower oil concentration and often relies more heavily on starches or hydrocolloids to obtain the desired viscosity and stability (Nwosu & Eke-Ejiofor, 2021). The Codex Alimentarius classification places mayonnaise and similar products within the category of emulsified sauces and dips, reflecting their nature as formulated emulsion-based foods (FAO/WHO, 2025).

The use of locally sourced oils for salad cream and mayonnaise production is therefore of considerable interest, particularly in countries such as Nigeria where oil-bearing crops are readily available. Local utilization of these resources can provide opportunities for agricultural value addition, encourage the development of indigenous food products, and potentially reduce dependence on externally sourced raw materials (Chibor et al., 2023). However, availability alone is insufficient to establish the suitability of an oil for food formulation. Locally produced oils must be evaluated for their physicochemical quality, oxidative stability, functional characteristics, and performance in the finished product.

One potentially valuable locally sourced oil is melon seed oil. Melon seeds contain substantial amounts of oil and protein and have increasingly attracted research attention as an underutilized source of edible oil. Recent research has shown that melon seed oil is rich in unsaturated fatty acids, particularly linoleic acid and oleic acid. A 2024 study investigating different extraction methods reported that melon seed oil contained approximately 53.6–70.8% linoleic acid and demonstrated the presence of bioactive compounds such as squalene and β-sitosterol. The study further showed that extraction method influenced the physicochemical properties and oxidative stability of the oil, indicating that processing conditions are important determinants of oil quality (Esan et al., 2024). A recent comprehensive review also reported that melon seed oil generally possesses physicochemical characteristics consistent with its potential use as an edible oil and emphasized the importance of acid value, peroxide value, iodine value, and fatty-acid composition in assessing its quality (Zhang et al., 2024a).

Another important locally available oil in Nigeria is palm oil. Palm oil is obtained from the fruit of *Elaeis guineensis*, a crop with longstanding agricultural and economic importance in West Africa. Palm oil is widely used in food preparation and processing because of its availability and functional characteristics. However, crude palm oil contains pigments, free fatty acids, moisture, odour-producing substances, and other minor components that may influence its suitability for

certain food products (Awogbem et al., 2022). Earlier researchers noted that refined oils generally showed reduced free fatty acids and improved properties relevant to industrial and food applications (Esan et al., 2024).

The direct incorporation of alternative vegetable oils into mayonnaise has received increasing scientific attention. Earlier reports showed that the proportion and type of oil used influenced the physicochemical behaviour of the finished product (Gülen et al., 2025), confirming that the choice of oil is not merely a nutritional consideration but is also a major technological factor in mayonnaise and salad cream formulation.

In addition, recent research specifically examining melon seed oil in food applications provides evidence of its potential as an edible oil resource. Its relatively high unsaturated fatty-acid content and the presence of compounds such as tocopherols and phytosterols make it a potentially valuable ingredient in food formulation. (Zhang et al., 2024b).

The quality of the final salad cream or mayonnaise is determined by the interaction between the oil and other ingredients, including egg, water, acids, starches, gums, and seasonings. Hydrocolloids such as xanthan gum may improve viscosity and help maintain emulsion stability, particularly in products with reduced oil content. Oli et al, (2017) reported that the wide diversity of physicochemical and organoleptic characteristics exhibited by food emulsions is the result of product formulation and processing conditions Processing factors such as order of ingredient addition, mixing intensity, homogenization, temperature, and storage conditions can also influence droplet size, viscosity, phase separation, and oxidative stability. Therefore, evaluation of the oil alone should be complemented by assessment of the finished food product.

Based on these considerations, there is a need to investigate locally sourced oil bases that can be used effectively in the production of salad cream and mayonnaise. Melon seed oil represents an underutilized source of edible, unsaturated oil, while refined palm oil represents a readily available and established Nigerian vegetable oil. Comparing their quality and performance may provide useful information on their suitability for food cream production. Accordingly, this study focuses on the evaluation of the quality of selected locally sourced oils, melon seed oil and refined palm oil and their application as oil bases in the formulation of salad cream and mayonnaise.

2.0 Materials and Methods

2.1. Materials

Extracted and stored palm oils were purchased from mile 1 market in Port Harcourt.

Melon seeds were purchased from Mile 1 market in Port Harcourt for oil extraction. All Reagents used were of analytical grade and obtained from the Food Science and Technology Laboratory in Rivers State University, Port Harcourt.

2.2 Procedure for Extraction of Melon Oil: According to AOAC (2019)

The melon seed oil was extracted using hexane, following AOAC (2019) standard procedures.

2.3. Physicochemical properties of Palm and Melon Oil.

Physicochemical properties including iodine value, free fatty acids, peroxide value, Saponification value, Unsaponifiable matter, melting point, smoke point, cloud point, fire point, Refractive index and specific gravity were determined by the method of AOAC (2019).

2.4 Formulation of Food Creams.

The food creams: Mayonnaise and Salad were developed using different compositional ratios of oil as the base ingredients.

2.4.1 Procedure for the Formulation of food creams

The food creams: Mayonnaise and Salad were developed using different compositional ratios of oil as the base ingredients (Tables 1a, 1b, 2a and 2b), following the procedure of Ariahu and Emmanuel (1991). Whole egg, oil and other ingredients were mixed using a household mixer. This was followed by the addition of water and other water-soluble ingredients. The mixture and subjected to constant whipping to enhance air incorporation. The pH of the formed emulsion was adjusted by the addition of vinegar (4.5%). The heating effect was monitored between 10 - 25°C for the oil phase and the encapsulation stage where the flavour was incorporated. The products were packaged and stored under refrigerated conditions, for further analysis.

Table 1a. Formulation of food cream (mayonnaise) from Refined Melon Oil

Ingredients (%)	M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8	M_9
RMO	60	60	60	70	70	70	80	80	80
Water	19	19	19	9	9	9	Qs	Qs	Qs
Egg (whole)	7	7	7	7	7	7	7	7	7
Sugar	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Salt	1	1	1	1	1	1	1	1	1
Gum Arabic	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Starch	2	2	2	2	2	2	1.5	1.5	1.5
Vinegar (4.5%)	8.5	8.5	8.5	8	8	8	7	7	7
Spice	0.5 ocg	0.5 ocb	0.5 cmc	1 ocg	1 ocb	1 cmc	1.5 ocg	1.5 ocb	1.5cmc

Adapted from Ariahu & Emmanuel (1991).

Key: RMO = Refined Melon Oil, EO = Essential Oils, Qs = Enough Water, M_1-M_9= Mayonnaise from refined mellon Oil, Ocg= Ocimum gratissimum (Scent leaves), Ocb=ocimum basilicum (curry leaves)
Cmc = cymbopogon citratus (lemon grass)

Table 1b. Formulation of food cream (mayonnaise) from Refined Palm Oil

Ingredients (%)	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9
RPO	60	60	60	70	70	70	80	80	80
Water	19	19	19	9	9	9	Qs	Qs	Qs
Egg (whole)	7	7	7	7	7	7	7	7	7
Sugar	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Salt	1	1	1	1	1	1	1	1	1
Gum Arabic	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Starch	2	2	2	2	2	2	1.5	1.5	1.5
Vinegar (4.5%)	8.5	8.5	8.5	8	8	8	7	7	7
Spice	0.5 ocg	0.5 ocb	0.5 cmc	1 ocg	1 ocb	1 cmc	1.5 ocg	1.5 ocb	1.5cmc

Adapted from Ariahu & Emmanuel (1991).

Key: RPO = Refined Palm Oil, EO = Essential Oils, Qs = Enough Water, S_1-S_9= Mayonnaise from refined Palm Oil, Ocg= Ocimum gratissimum (Scent leaves), Ocb=ocimum basilicum (curry leaves)
Cmc = cymbopogon citratus (lemon grass)

Table.2a. Formulation of Food Cream (salad) from Refined Palm Oil

Ingredients (%)	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
RPO	40	40	40	30	30	30	20	20	20
Water	30	30	30	40	40	40	50	50	50
Egg (whole)	8	8	8	8	8	8	8	8	8
Sugar	3	3	3	3	3	3	3	3	3
Salt	2	2	2	2	2	2	2	2	2
Gum Arabic	3	3	3	3	3	3	3	3	3
Starch	3	3	3	3	3	3	3	3	3
Vinegar (4.5%)	9	9	9	8	8	8	7.5	7.5	7.5
	2.0	2.0	2.0	3.0	3.0	3.0	3.5	3.5	3.5
Spice	ocg	ocb	cmc	ocg	ocb	cmc	ocg	ocb	cmc

Adapted from Oli et al. (2017)

Key: RPO = Refined Palm Oil, EO = Essential Oils, Qs = Enough Water, T_1-T_9= salad from refined Palm Oil Ocg= Ocimum gratissimum (Scent leaves), Ocb=ocimum basilicum (curry leaves), Cmc = cymbopogon citratus (lemon grass)

Table.2b. Formulation of food cream (salad) from Refined Melon Oil

Ingredients	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Q_7	Q_8	Q_9
RMO	40	40	40	30	30	30	20	20	20
Water	30	30	30	40	40	40	50	50	50
Egg (whole)	8	8	8	8	8	8	8	8	8
Sugar	3	3	3	3	3	3	3	3	3
Salt	2	2	2	2	2	2	2	2	2
Gum Arabic	3	3	3	3	3	3	3	3	3
Starch	3	3	3	3	3	3	3	3	3
Vinegar (4.5%)	9	9	9	8	8	8	7.5	7.5	7.5
	2.0	2.0	2.0	3.0	3.0	3.0	3.5	3.5	3.5
Spice	ocg	ocb	cmc	ocg	ocb	cmc	ocg	ocb	cmc

Adapted from Oli et al. (2017)

Key: RMO = Refined Melon Oil, EO = Essential Oils, Qs = Enough Water, Q_1-Q_9= salad from refined mellon Oil Ocg= Ocimum gratissimum (Scent leaves), Ocb=ocimum basilicum (curry leaves), Cmc = cymbopogon citratus (lemon grass)

2.5 Emulsion stability (ES) and pH Test

2.5.1 Freeze - thaw cycle

In the freeze - thaw cycle test of emulsion stability, the food creams were subjected to temperature of -3° C for 24 hours in a refrigerator (model BFC-390EN, Hong Kong). Percentage stability was measured using the procedure of Huang *et al*. (2022). Ten grams (10g) of the refrigerated cream sample was thaw at 25°C and centrifuged at 5,000xg for 30min. the fraction remaining as emulsion/sediment was measured and calculated in percentage (%).

2.5.2 Heat - thaw cycle

Samples of food Mayonnaise and salad were heated to a temperature range of 45°C then reduced to room temperature (28±2°C). Ten grams (10g) of the cream sample was centrifuged at 5,000xg

for 30min. the fraction remaining as emulsion/sediment was measured and calculated in percentage (%).

ES (%) = $\frac{Ws}{WO}$ x 100

Wo = Weight (g) of stable/emulsified fraction after centrifugation

Ws = Initial weight (g) of sample

2.5.3 (pH) Test

The pH of mayonnaise and salad creams were determined using a pH meter (Model 3B, LW Scientific, China) from the Department of Food Science and Technology, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt. Using AOAC (2019) standard method.

2.6 Experimental Determination of Rancidity

Rancidity was determined by measuring the quantity of hydro-peroxide that might be present in the mayonnaise and salad cream due to primary oxidation during storage. AOAC (2019) standard method was used.

2.7 Statistical Analysis

All the analyses were carried out in triplicate. Data obtained were subjected to Analysis of variance (ANOVA), differences between means were evaluated using Tukey's multiple comparison test, and significance accepted at $p \leq 0.05$ level. The statistical package for social sciences (SPSS) version 24.0 was used.

3.0 Results and Discussion

3.1 Formulation of Food Cream

Table 1.0(a, b) and 2.0 (a, b) showed the formulation of products from different substitute ratios of refined melon oil (RMO) and refined palm oil (RPO). The use of RMO and RPO in products formulation with a compositional ratio of 60:70:80 for products M_1-M_9 and S_1-S_9, for mayonnaise, and a ratio of 40:30:20 for products T_1-T_9 and Q_1 – Q_9 for salad cream was done to ascertain their application in mayonnaise and salad formulation. Table1.0 and 2.0 showed a higher level of fat substitution for mayonnaise and a lower ratio for salad cream. In both emulsions, eggs are the emulsifying agent. According to Nwosu and Eke-Ejiofor, (2021) Salad cream is a readymade creamy non-Newtonian white dressing with a flowing consistency often consisted of "hard-boiled eggs mash with cream, mustard, salt and vinegar", it is a creamy, pale-yellow condiment based on an emulsion of oil in water). It can be prepared with various ingredients of which modified starches serves as the (thickener) base raw material. Sugar spices, flavouring and colouring may also be included (Flanders and Judith, 2003). In practice, mayonnaise is normally thicker than salad cream and contains a higher proportion of both oil and egg yolk. Indeed, in many countries, the oil content of mayonnaise must be greater than that of salad cream (Sudjatinah, et al., 2022). According to these authors, in America for example, mayonnaise must contain at least 6 per cent of oil (compared with 30 per cent for salad cream) and in certain countries as much as 80 per cent is required. In a similar study carried out by Oli et al, (2017), that a highly nutritious salad cream was formulated with locally refined bleached deodorized palm kernel oil and palm oil respectively at various compositional values.

3.2 Physicochemical Properties of Crude and Refined Palm and Melon Oils.

Crude and refined palm and melon oils were analysed with respect to quality parameters to assess their fitness in the formulation of food and body creams. These parameters include, peroxide values, free fatty acids, saponificaction values, iodine values and moisture content. Table 3.0 shows the quality parameters of the crude and refined oils. It shows that the crude palm oil had a peroxide value of 0.80 (mEq/kg), while crude melon oil had 0.65meq/kg. Peroxide values of 0.63 mEq/kg and 0.53 mEq/kg were recorded for refined palm and melon oils respectively. Peroxide value gives an indication of the degree of oil oxidization (Okashi et al., 2013). The peroxide values of crude and refined palm oil. 0.8 and 0.63 meq/kg agrees with the work of Ekpa *et al* (1994), who reported that crude palm oil used for industrial purposes should have a peroxide range of 0.70 to 0.80 meq/kg. The values of 0.65 and 0.53 meq/kg were recorded for crude and refined melon oil stored at 5 - 7°c. The above results show a marked decrease in the values of the peroxides for alkaline refined oil compared with crude oils. This observation agreed with the work of Chibor et al. (2024) who reported a decrease in peroxide values of refrigerated oil but reported a marked increase in peroxide values of alkaline refined Sabeh and Sumatra oil compared with the crude oil of the same source. Increase in peroxide value could be due to the storage temperature, packaging materials and storage prior (El-Sayed et al., 2025). However, Malik & Ahmad (2024) recorded that there were no detectable changes in the P.V. of refined melon oil under refrigeration storage of 5 - 7°c. Thus, refrigeration is an effective way of storing melon oil. Thus, the observed decrease in P.V. showed an effective refining and storage process and its eventual fitness for use in the formulation of food creams. Also, it was observed that free fatty acid contents for crude palm and melon oils were 2.43 and 9.63 %, respectively. while refined palm and melon oil had a free fatty acid value of 0.72 and 1.37 %. The above results show a drastic reduction in the level of the free fatty acids between the crude and refined samples. Refining reduces the free fatty acid of the oil drastically, which agrees with the work of Chibor et al. (2018). That refining reduces the free fatty acids (FFA) and moisture content of vegetable oils. The high free fatty acid observed for the crude melon sample could be due to its corresponding high moisture content which gives a correlation to its hydrolytic process for free fatty acid liberation.

In a similar study carried out by Ajogun and Chibor (2024) Low free fatty acid of 0.061 % seen in virgin coconut oil is an indication that it is chemically safe for use and needs no further refining. A low AV means that an oil sample contains less free acids thus reducing its exposure to rancidity (Asuquo et al., 2012; Anderson-Foster et al., 2012).

FFA of the vegetable oils were ≤0.25%, which is the standard value of free fatty acid for refined vegetable oil (IS:8323 2014; CODEX 1999). Peroxide value, saponification value and unsaponifiable matter content ranged respectively from 0.11 to 1.20 mEq/kg, 182.75 to 260.71mgKOH/g and 0.095 to 0.420%. Peroxide value gives an indication of the degree of oil oxidization (Okashi et al., 2013). Oxidation of an unsaturated oil takes place through the formation of hydroperoxides. The hydroperoxides being the primary products of oxidation. The peroxide value of the oil samples was lower than 10.00 mEq/kg and 3.00 mEq/kg recommended maximum for virgin and refined vegetable oil, respectively (CODEX 1999), indicating that the oils were not rancid but suitable for culinary purposes (Chibor et al., 2017). Peroxide value (PV) gives an indication of the degree of fat oxidized (Ononogbu, 2002; Okashiet al., 2013). Saponification value is an indication of the molecular weight, and the percentage concentration of fatty acids components present in oil (Jan et al., 2010). Saponification value is a measure of the content of ester linkages (Wypych, 2017). It is an indicator for fat/oil suitability for industrial use (Chibor et al., 2023). According to Chibor et al., (2023) reported that sunflower oil and Palm olein at low

cloud point has the quality to remain liquid with less crystals at different temperatures regime. Similarly, refined melon oil showing clarity, pourability and low cloud point of 3.00 to 3.05 ºC, which corroborates with the findings of earlier researchers (Chibor et al., 2023),

Saponification value of 197.4 and 185.8 mgKOH/g. Also, the values of 124.9 and 139.50 mgKOH/g are recorded for refined palm and melon oils respectively. SV is an indication of the saponifiable fatty acids excluding the free acids of the fat (Aremu et al. 2015).

The iodine values for crude palm and melon oils were 52.98 and 80.71 g/100g, while for refined palm and melon oils they were 57.98 and 86.03 g/100g respectively. The moisture content of 0.37 and 0.28 % were obtained for crude palm and melon oils, while for refined palm and melon oils they were 0.14 and 0.07 %.

The results showed marked decreases in the peroxide values, free fatty acids, moisture content and saponification values of alkaline refined oils compared to the crude samples. There was a marked increase in the iodine value of alkaline refined oils compared to crude oils.

According to Ajogun and Chibor (2024) Iodine value of coconut oil was significantly low (5.72 g/100g) which is an indication of high content of saturated fatty acids. These values were relatively less than the Indian standard of 7.50g/100g – 10.00g/100g (Gopala et al., 2010), this was probably due to varietal differences. The Iodine value (IV) however, fall within the CODEX standard range of 6.0 g/100g to 10.6 g/100g for coconut oil (CODEX STAN. 210, 2009). Significantly ($p<0.05$) higher iodine value of 127.60 g/100g was shown in soyabean oil. Iodine value is a simple chemical constant used to measure the degree of unsaturation or the average number of double bonds in an oil sample. It is the number of grams of iodine that could be used to halogenate 100 g of oil (Chibor et al., 2018; Shahidi, 2005). Moisture content of the oils ranged from 0.010 to 0.069%. These values were within the recommended moisture level of < 0.20%, which is the maximum allowable moisture content for refined vegetable oil (CODEX-STAN-192, 2009). Low moisture content of oil enhances oxidative stability (Chibor et al., 2023). Crude palm oil moisture values of 0.37 ± .02 percent agreed with the range of 0.2 - 0.5 percent reported by Ngando *et al* (2011) for Cameroonian plantation crude palm oil. The observed reduction in the moisture content of the crude and refined oil was a function of the refining process. According to Chibor et al. (2018), refining reduces the moisture contents of vegetable oils.

Standards of commercial palm oil are normally based on the free fatty acids (FFA) contents, with oil of low free fatty acid commanding a better price on the world market than oil of higher free fatty acids. Moreso, oil of moderately low free fatty acid is also generally considered to be of good taste so that for almost all industrial purposes, palm oil of low free fatty acid content is preferred (Ngando et al, 2011). Table 3.00 shows that crude palm and melon oils have a saponification value of 197.4 and 185.8 percent respectively. Also, it was observed that the values of 124.9 and 139.50 percent were recorded for refined palm and melon oil respectively.

Table 3.00 shows a tremendous decrease in the saponification value of refined oils when compared with the crude samples. This decrease indicates an effective refining process and a corresponding quality increase for the intended industrial usage.

As shown in Table 3.00 iodine values of 52.89 and 86.03 percent were recorded for crude palm and melon oil, respectively. Iodine value is a simple chemical constant used to measure the degree of unsaturation or the average number of double bonds in an oil sample. It is the number of grams of iodine that could be used to halogenate 100 g of oil (Ononogbu, 2002; Shahidi, 2005). High iodine value of 86.03 g/100g obtained for refined melon seed oil, indicates that the oil is rich in polyunsaturated fatty acids (Adejumor and Oyedeji, 2015), which enhances the nutritional value of the cream.

Table 3 Physicochemical Properties of Crude and Refined Oils

Sample	PV (mEq/kg)	FFA (%)	Sap Value (mgKOH/g)	Iodine Value (g/100g)	Moisture (%)
CPO	$0.08^{c}\pm0.050$	$2.43^{b}\pm0.060$	$197.40^{a}\pm0.620$	$52.98^{d}\pm0.425$	$0.37^{a}\pm0.02$
CMO	$0.65^{a}\pm0.016$	$9.63^{a}\pm0.320$	$185.80^{b}\pm0.701$	$80.71^{b}\pm0.689$	$0.28^{ab}\pm0.08$
RPO	$0.63^{a}\pm0.031$	$0.72^{d}\pm0.030$	$124.90^{d}\pm0.603$	$57.98^{c}\pm0.473$	$0.14^{c}\pm0.04$
RMO	$0.53^{b}\pm0.020$	$1.37^{c}\pm0.520$	$139.50^{c}\pm0.223$	$86.03^{a}\pm1.498$	$0.07^{d}\pm0.05$

Values are means ± standard deviation of triplicate samples.
Mean value bearing different superscripts in the same column differ significantly ($p<0.05$).
Key: CPO=crude palm oil, CMO= crude melon oil, RPO= refined palm oil, RMO= refined melon oil

3.3 Winterization and Emulsion stability of oil Samples used for the cream formulation

Result in Table 4.0 showed cloud point of refined palm oil ranging from 20.14 to 21.92 °C after 4 weeks of storage, while cloud point of refined melon oil ranged from 3.00 to 3.05 °C with no significant ($p>0.05$) increase, after 4 weeks of storage. Refined palm oil was cloudy, with significantly ($p<0.05$) higher cloud point. For refined, bleached and deodorized melon oil, the Table showed a positive result, as the oil was unclouded, not solidified, pourable and stable throughout the period of storage. The above result showed that refined, bleached and deodorized melon oil (RMO) is preferable to refined, bleached and deodorized palm oil (RPO) in mayonnaise and salad formulation due to its low cloud point (Gómez & Purroy, 2023). According to (Onuoha et al., 2019), salad oil however, will remain clear and pourable for several weeks and months when stored in a refrigerator. Therefore, emulsion of mayonnaise and salad made from refined melon oil (RMO) will remain stable, if effectively homogenised. Instability results in phase separation (Torres & Canet, 2001). Emulsion stability of mayonnaise ranged from 62.21 to 92.77 % for heat thaw cycle and 68.43 to 98.77 % for freeze thaw (F-T) cycle. An increase in temperature can accelerate the movement and collision frequency of oil droplets, making them more prone to coalesce (Zhao et al., 2022). This coalescence leads to the separation of the dispersed and continuous phases, a phenomenon known as emulsion breakdown, which is visually unappealing and indicates a spoiled product. Under heat exposure, the control formulation with only egg yolk exhibited the highest stability (89%), retaining its structure with minimal phase separation even after centrifugation. Sample M_4 showed significantly ($p<0.05$) higher emulsion stability of 92.77 %. Samples M_1 to M_6 showed very good emulsion stability (above 90% stability). Freeze-thaw cycles represent destabilization through the crystallization of water in the continuous phase, whereby ice crystal formation and expansion can disrupt the structural integrity of encapsulated oil droplets (Shariful et al., 2018). This disruption is seen during the thawing cycle as syneresis, whereby the compact gel structure is replaced by a watery, curdled and visually unappealing matrix with layers of liquid or oil (Arshad *et al*., 2025).

The pH values ranged from 3.9 - 4.4 for samples M_I - M_9, while S_1- S_9 had a pH value of 3.8 - 4.5, a state of acidity for the products. Results of stability, test as shown in Table 6.0 indicates that samples T_1 - T_9 showed a high degree of instability, while samples Q_1- Q_9 were highly stable. The pH values ranged from 3.7 to 4.4 for T_I - T_9, while Q_1 - Q_9 a pH range of 3.9 to 4.5, all the samples showed an acidic medium. Higher cloud point indicates higher crystallization potential (Ajogun and Chibor, 2024). Low Cloud point of 0.00 and 0.45 °C seen in sunflower oil and palm

olein respectively, showed that the oils could stay liquid with less crystals at a wide range of temperature (Chibor *et al*., 2023).

Table 4 Cloud Point of oil Samples used for the formulation

Sample	Cloud Point (°C)			
	WEEK I	WEEK II	WEEK III	WEEK IV
Refined Palm Oil (RBD)	$20.14^{b1}\pm0.050$	$20.29^{b1}\pm0.060$	$21.58^{a1}\pm0.020$	$21.92^{a1}\pm0.025$
Refined Melon Oil (RMO)	$3.00^{a2}\pm0.040$	$3.00^{a2}\pm0.027$	$3.02^{a2}\pm0.001$	$3.05^{a2}\pm0.101$

Values are means ± standard deviation of triplicate samples.
^{abcd}Mean value bearing different superscripts in the same row differ significantly ($p<0.05$).
^{123}Mean value bearing different superscripts in the same column differ significantly ($p<0.05$).

Table 5 Emulsion Stability (%) and pH Test for Mayonnaise

Samples	Heat-Thaw Cycle (at 28 °C)	Freeze-Thaw Cycle (at -3°C)	pH Values
M_1	$90.85^{bc}\pm0.045$	$97.85^{b}\pm0.111$	$4.2^{c}\pm0.01$
M_2	$90.23^{c}\pm0.055$	$96.23^{c}\pm0.001$	$4.3^{bc}\pm0.02$
M_3	$90.00^{c}\pm0.074$	$96.00^{c}\pm0.632$	$4.2^{c}\pm0.11$
M_4	$92.77^{a}\pm0.001$	$98.77^{a}\pm0.000$	$3.9^{d}\pm0.00$
M_5	$91.26^{b}\pm0.002$	$97.26^{b}\pm0.085$	$4.0^{d}\pm0.01$
M_6	$90.83^{c}\pm0.005$	$95.83^{c}\pm0.092$	$4.1^{cd}\pm0.02$
M_7	$76.73^{e}\pm0.832$	$85.98^{d}\pm0.992$	$4.4^{ab}\pm0.02$
M_8	$79.20^{d}\pm0.003$	$81.88^{e}\pm0.980$	$4.3^{bc}\pm0.00$
M_9	$77.25^{e}\pm0.011$	$83.13^{e}\pm0.051$	$4.4^{ab}\pm0.00$
Si	$76.23^{ef}\pm0.000$	$87.43^{d}\pm0.078$	$4.4^{ab}\pm0.03$
S_2	$76.00^{f}\pm0.000$	$70.00^{f}\pm0.000$	$4.0^{d}\pm0.12$
S_3	$74.76^{g}\pm0.016$	$69.96^{fg}\pm0.011$	$4.1^{cd}\pm0.00$
S_4	$70.00^{h}\pm0.010$	$69.55^{fg}\pm0.622$	$4.3^{bc}\pm0.02$
S_5	$67.66^{i}\pm0.014$	$68.85^{g}\pm0.042$	$4.0^{d}\pm0.01$
S_6	$64.00^{j}\pm0.000$	$69.00^{fg}\pm0.018$	$4.2^{c}\pm0.10$
S_7	$62.21^{k}\pm0.086$	$68.55^{g}\pm0.014$	$3.8^{e}\pm0.11$
S_8	$67.56^{i}\pm0.016$	$68.43^{g}\pm0.000$	$4.5^{a}\pm0.02$
S_9	$67.78^{i}\pm0.116$	$68.85^{g}\pm0.010$	$4.4^{ab}\pm0.11$

Values are means ± standard deviation of triplicate samples.
Mean value bearing different superscripts in the same column differ significantly ($p<0.05$).

Table 6 Emulsion Stability (%) and pH Test for Salad Cream

Samples	Heat-Thaw Cycle	Freeze-Thaw Cycle	pH Values
T_1	$58.91^{e}\pm0.033$	$50.83^{d}\pm0.031$	$3.7^{e}\pm0.10$
T_2	$57.69^{e}\pm0.016$	$52.69^{d}\pm0.000$	$4.4^{b}\pm0.01$
T_3	$57.35^{e}\pm0.133$	$52.11^{d}\pm0.101$	$4.3^{bc}\pm0.11$
T_4	$76.55^{c}\pm0.835$	$72.99^{c}\pm0.431$	$3.8^{e}\pm0.02$
T_5	$74.66^{c}\pm0.000$	$74.66^{b}\pm0.000$	$4.0^{d}\pm0.01$
T_6	$73.22^{c}\pm0.014$	$72.02^{c}\pm0.024$	$4.2^{c}\pm0.02$
T_7	$70.28^{d}\pm0.000$	$70.00^{c}\pm0.000$	$4.3^{bc}\pm0.01$
T_8	$71.04^{d}\pm0.000$	$70.01^{c}\pm0.000$	$4.3^{bc}\pm0.02$
T_9	$72.11^{cd}\pm0.002$	$70.10^{c}\pm0.001$	$4.4^{b}\pm0.01$
Q_1	$84.38^{a}\pm0.002$	$80.11^{a}\pm0.010$	$3.9^{de}\pm0.00$
Q_2	$84.00^{a}\pm0.180$	$81.00^{a}\pm0.080$	$3.9^{de}\pm0.03$
Q_3	$80.11^{b}\pm0.001$	$79.91^{a}\pm0.101$	$4.0^{d}\pm0.01$
Q_4	$79.89^{b}\pm0.078$	$79.44^{a}\pm0.023$	$4.5^{a}\pm0.01$
Q_5	$80.76^{b}\pm0.002$	$80.00^{a}\pm0.002$	$4.3^{bc}\pm0.03$
Q_6	$81.00^{b}\pm0.000$	$81.00^{a}\pm0.001$	$4.2^{c}\pm0.01$
Q_7	$82.11^{b}\pm0.081$	$80.10^{a}\pm0.000$	$4.2^{c}\pm0.00$
Q_8	$84.00^{a}\pm0.043$	$81.00^{a}\pm0.033$	$4.4^{b}\pm0.02$
Q_9	$84.32^{a}\pm0.020$	$81.33^{a}\pm0.000$	$4.0^{d}\pm0.00$

Values are means ± standard deviation of triplicate samples.
Mean value bearing different superscripts in the same column differ significantly ($p<0.05$).

3.4 Rancidity Test for Mayonnaise and Salad cream

Result for the rancidity test of mayonnaise and salad cream, through peroxide value determination is shown in Table 7.0 and 8.0, respectively. Peroxide value (PV) of mayonnaise samples M_8, M_9 and S_7 were significantly ($p<0.05$) higher, with values of 10.72, 11.12 and 10.72 mEq/kg, respectively (Table 7.0). These values are also higher than 10.00 mEq/kg recommended maximum PV for edible oil and fat-based products (Chibor *et al*., 2017). Indicating onset of rancidity in samples M_8, M_9 and S_7. Peroxide value (PV) of salad cream samples T_7, T_8 and T_9 were significantly ($p<0.05$) higher with values of 11.92, 11.93 and 10.92 mEq/kg, respectively.

Table 7 Rancidity Test in Mayonnaise (Peroxide Value mEqO₂/kg)

Samples	Week I	Week II	Week III	Week IV
M_1	$2.00^{c2}\pm0.001$	$4.30^{b2}\pm0.067$	$4.98^{ab2}\pm0.610$	$5.12^{a4}\pm0.000$
M_2	$2.20^{c1}\pm0.011$	$4.56^{b2}\pm0.000$	$4.92^{b2}\pm0.030$	$5.65^{a3}\pm0.030$
M_3	$2.00^{c2}\pm0.001$	$4.30^{b2}\pm0.067$	$4.98^{ab2}\pm0.610$	$5.30^{a4}\pm0.001$
M_4	$2.00^{d2}\pm0.001$	$4.31^{c2}\pm0.003$	$5.28^{b2}\pm0.010$	$6.02^{a2}\pm0.000$
M_5	$2.02^{c2}\pm0.041$	$4.30^{b2}\pm0.060$	$4.98^{ab2}\pm0.600$	$5.33^{a4}\pm0.000$
M_6	$2.10^{c1}\pm0.021$	$4.30^{b2}\pm0.127$	$4.98^{ab2}\pm0.610$	$5.12^{a4}\pm0.000$
M_7	$2.00^{c2}\pm0.001$	$4.30^{b2}\pm0.067$	$4.98^{ab2}\pm0.617$	$5.12^{a4}\pm0.000$
M_8	$2.21^{d1}\pm0.001$	$6.59^{c1}\pm0.054$	$8.88^{b1}\pm0.410$	$10.72^{a1}\pm0.030$
M_9	$2.10^{d1}\pm0.061$	$6.38^{c1}\pm0.000$	$9.98^{b1}\pm0.300$	$11.12^{a1}\pm0.080$
S_1	$1.00^{c3}\pm0.001$	$3.00^{c3}\pm0.067$	$4.60^{b2}\pm0.150$	$5.06^{a4}\pm0.000$
S_2	$1.00^{c3}\pm0.001$	$3.00^{c3}\pm0.043$	$4.60^{b2}\pm0.050$	$5.02^{a4}\pm0.000$
S_3	$1.00^{c3}\pm0.111$	$3.00^{c3}\pm0.022$	$4.60^{b2}\pm0.000$	$5.01^{a4}\pm0.000$
S_4	$1.00^{b3}\pm0.002$	$3.00^{b3}\pm0.044$	$4.60^{a2}\pm0.850$	$5.02^{a4}\pm0.000$
S_5	$1.00^{c3}\pm0.033$	$3.00^{c3}\pm0.031$	$4.60^{b2}\pm0.010$	$5.11^{a4}\pm0.000$
S_6	$1.07^{b3}\pm0.101$	$3.00^{b3}\pm0.055$	$4.60^{a2}\pm0.630$	$5.02^{a4}\pm0.000$
S_7	$2.30^{d1}\pm0.650$	$5.99^{c1}\pm0.500$	$8.99^{b1}\pm0.750$	$10.72^{a1}\pm0.070$
S_8	$1.06^{d3}\pm0.000$	$4.30^{c2}\pm0.067$	$4.80^{b2}\pm0.650$	$5.52^{a3}\pm0.000$
S_9	$1.89^{b2}\pm0.761$	$4.25^{b2}\pm0.686$	$5.60^{a2}\pm0.650$	$5.93^{a2}\pm0.010$

Values are means ± standard deviation of triplicate samples.
^{abcd}Mean value bearing different superscripts in the same row differ significantly ($p<0.05$).
^{123}Mean value bearing different superscripts in the same column differ significantly ($p<0.05$).

Table 8 Rancidity Test in Salad Cream (Peroxide Value mEqO₂/kg)

Samples	Week I	Week II	Week III	Week IV
Ti	$1.02^{c3}\pm0.011$	$3.00^{c4}\pm0.055$	$5.69^{b2}\pm0.110$	$5.42^{a2}\pm0.210$
T_2	$1.00^{d3}\pm0.111$	$3.13^{c4}\pm0.003$	$5.68^{b2}\pm0.050$	$5.05^{a3}\pm0.002$
T_3	$2.00^{c2}\pm0.111$	$4.09^{c3}\pm0.012$	$4.67^{b2}\pm0.110$	$5.08^{a3}\pm0.002$
T_4	$2.00^{c2}\pm0.002$	$2.00^{c3}\pm0.004$	$4.72^{b2}\pm0.600$	$5.34^{a2}\pm0.060$
T_5	$2.00^{c2}\pm0.033$	$2.00^{c3}\pm0.031$	$4.73^{b2}\pm0.150$	$5.77^{a2}\pm0.005$
T_6	$2.07^{c2}\pm0.100$	$2.00^{c3}\pm0.155$	$4.70^{b2}\pm0.150$	$5.93^{a2}\pm0.007$
T_7	$2.81^{d1}\pm0.001$	$6.59^{c1}\pm0.014$	$8.76^{b1}\pm0.010$	$11.92^{a1}\pm0.030$
T_8	$2.99^{d1}\pm0.043$	$6.88^{c1}\pm0.040$	$9.68^{b1}\pm0.100$	$11.93^{a1}\pm0.080$
T_9	$2.71^{d1}\pm0.015$	$6.69^{c1}\pm0.052$	$8.88^{b1}\pm0.480$	$10.92^{a1}\pm0.030$
Qi	$2.07^{c2}\pm0.001$	$4.70^{b2}\pm0.007$	$4.88^{b2}\pm0.630$	$5.42^{a2}\pm0.000$
Q_2	$2.13^{c2}\pm0.010$	$4.56^{b2}\pm0.000$	$4.78^{b2}\pm0.632$	$5.85^{a2}\pm0.030$
Q_3	$2.00^{c2}\pm0.000$	$4.59^{b2}\pm0.000$	$4.78^{b2}\pm0.610$	$6.00^{a2}\pm0.401$
Q4	$2.02^{c2}\pm0.000$	$4.63^{b2}\pm0.022$	$4.75^{b2}\pm0.017$	$5.83^{a2}\pm0.000$
Qs	$2.07^{c2}\pm0.011$	$4.70^{b2}\pm0.030$	$4.98^{b2}\pm0.210$	$5.53^{a2}\pm0.100$
Q_6	$2.15^{c2}\pm0.011$	$4.75^{b2}\pm0.007$	$4.88^{b2}\pm0.000$	$5.72^{a2}\pm0.000$
Q_7	$2.00^{c2}\pm0.000$	$4.88^{b2}\pm0.111$	$4.98^{b2}\pm0.030$	$5.71^{a2}\pm0.005$
Q_8	$2.02^{c2}\pm0.004$	$2.56^{c2}\pm0.027$	$4.78^{b2}\pm0.440$	$5.82^{a2}\pm0.011$
Qg	$2.23^{c2}\pm0.112$	$4.79^{b2}\pm0.010$	$4.82^{b2}\pm0.230$	$5.65^{a2}\pm0.032$

Values are means ± standard deviation of triplicate samples.

[abcd]Mean value bearing different superscripts in the same row differ significantly ($p<0.05$).
[123]Mean value bearing different superscripts in the same column differ significantly ($p<0.05$).

Conclusion:

It was also observed that the products developed were found to be highly stable, and some are unstable due to the quality of the oil. Products stability could be due to the quality of the raw materials used coupled with effective and efficient mixing, especially, for products formulated from refined melon oil, which does not solidify and could not cause coalescence and breakage of emulsion during storage. Considering the importance of locally source oil in food cream formulation, It is recommend that more studies be conducted on the melon oils, to ascertain oil's quality parameters, since it could be used as a salad oil due to its stable emulsion formation during storage, and such use will offer an economic application since the melon residue after oil extraction could also function as a thickening agent in soup.

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