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Potential Uses of Selected Indigenous Spices as Flavorants in Food Cream Formulations

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Abstract
Three commonly used leafy spices were studied for their flavour application in locally formulated food cream such as mayonnaise and salad. Also, to determine organoleptic properties of the developed products. The spices for the study were Ocimum gratissimum (Ocg), Ocimum basilicum (Ocb) and Cymbopogon citratus (Cmc). The hydro-distillation method was used for the extraction of the essential oils using the BP-volatile oil apparatus. Results showed that the spices had an essential oil yield of 0.34% (Ocg), 0.30%(Ocb) and 0.56%(Cmc) respectively. Moisture contents of 72.55%, 74.60% and 70.67% for Ocg, Ocb and Cmc were recorded respectively. 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, using essentials oils from the three leafy spices as flavourants. Imported mayonnaise and salad creams products were used as control in the organoleptic test. Sensory evaluation showed that mayonnaise and salad creams were not significantly different ($P > 0.05$) in terms of texture but showed significant difference ($P < 0.05$) in taste, colour, flavour and general acceptability with reference to sample flavoured with Ocimum gratissimum and Ocimium basilicum. The Preference test showed ($P < 0.05$) significant difference for salad, mayonnaise and imported products in terms of flavour and general acceptability, no significant difference ($P >0.05$) for taste, texture and colour. In view of the current food insecurity that Nigeria is going through, the need for the use of local spices as flavoring agent in food cream formulations is here by proposed.

Key words: *Indigenous Spices, Essential Oils, formulations, Mayonnaise, Salad, sensory evaluation.*

1.0 Introduction:

The use of food creams such as salad and mayonnaise are not part of the traditional Nigerian menu, except for the well to do families and corporate restaurants. Thus, most of the salad creams and mayonnaise are imported products. The study aimed at introducing locally made salad cream and mayonnaise flavored with local spices to enhance its organoleptic acceptability. Spices are plant products that add flavour and taste to meals that could otherwise be monotonous (Achinewhu et.al, 1995). According to Kukadia (1992) spices are aromatic vegetable materials used in the seasoning of foods. They are valued not only as flavouring agents, but also other properties like stimulation

of appetite, carminative action, preservation, antioxidants action, medicinal and perfumery. The aromatic and pungent principles that render spices valuable are contained in their volatile oils and oleoresins. The volatile oils called essential oils are a complex mixture of volatile compounds responsible for the aromatic characteristics of the spice (Ogbonna et al., 2015). There is need to determine the antioxidant activities of these spices with a view to incorporation into food systems especially now that emphasis is on functional foods (Ogueke *et.al*., 2018). The oils from these leaves have been recognized from ancient times as medicinal and flavouring agents. According to Flavor and Extract Manufacturers Association (FEMA), flavors have a place in the food supply to meet consumer demand for a variety of safe and tasty products (Ghada, 2022). Flavor is the sensory impression of a food or other substance and resulted from the stimulation of the chemical senses of taste and smell. The "trigeminal senses", are detected in regions of the tongue, mouth, and throat, may also occasionally determine flavor (Small and Green, 2012; Jeremy *et al*., 2012). Marja and Natasja, (2010) noted that flavour is the property of a substance (commonly food), or one used in food which causes a simultaneous reaction or sensation of taste on the tongue and odour, in the olfactory centre in the nose. They can be made from natural products or from synthetic aromatic chemicals. The natural products are obtained in the form of essential oils which are volatile products obtained by a physical process from plant materials containing odorous constituents, e.g., Some indigenous spices of interest to this work due to their oleoresins profile are *Ocimum basilicum* (curry leaves), *Cymbopogon citratus* (African lemon grass) and *Ocimum gratissimum* (scent leaves).

A famous culinary herb in the *Lamiaceae* family, *Ocimum basilicum* L., known as sweet basil, is native to India and other Asian countries such as Pakistan, but it is now grown all over the world including Africa (Rubab *et.al*., 2017). It has been used in India for centuries as condiments and has long been popular in England because of its aromatic qualities. According to Hafiz *et.al*. (2022) Basil (Ocimum basilicum L.) locally called curry leave is one of the most common aromatic herbs, a rich source of bioactive compounds, and is used extensively to add aroma and flavor to food. The leaves, both in fresh and dried form, are used as a cooking ingredient in different cultures. O. basilicum is also famous for its therapeutic potential and preservation effects (Ranjha *et al*., 2020).

Cymbopogon citratus (African Lemon grass) belong to the family of grass called Graminae and of genus cymbopogon. Lemon Grass is commonly utilized as a food spice and flavoring in Nigeria and most African Countries, used as herbal medicine to treat malaria and other ailments, and even as scent in cosmetic products. The distinct odor of lemon grass is due to its essential oil. Essential oils are a complex mixture of acyclic and/or cyclic terpenoids (Romuga and Lizardo, 2020). These are monoterpenes, lipophilic, volatile substances which give the characteristic odor of many plants (Croteau, 1987). According to a report by Rumuga and Lizardo, (2020) that Lemon grass essential oil was also known to exhibit antimicrobial activity, and its use as a natural preservative as well as a flavoring in foods. This flavoring quality of Lemon grass was one of the reasons for the choice in the current investigation.

Finally, according to Salvi *et al*. (2022) *Ocimum gratissimum* is one of the medicinal and aromatic plants (MAPs) that is a rich source of bioactive compounds that are significantly important due to their potential use in pharmacological and agricultural applications. Furthermore, the study shows that Ocimum Gratissimum possesses promising

antimicrobial properties, and therefore could be utilized as a potential antimicrobial agent. The genus Ocimum gratissimum of the Lamiaceae family encompasses about 150 species that are widely known for their diverse phytoconstituents employed in aromatherapy, phytomedicine, food and cosmetic industry (Kumar *et al*, 2020; Singh & Chaudhuri, 2018). According to Hafiz *et.al*. (2022), it was observed that synthetic food additives have been implicated in adverse health effects due to their imprudent application in the food industry, thus, the need for exploring an extended role for natural ingredients in food processing and preservation. This is further collaborated by Ribeiro *et al*. (2020) that growing evidence on the risks of health hazards linked to indiscreet application of synthetic food additives is suggesting limiting their application and exploring relatively safer choices of natural origin (Tortosa *et al*., 2020). During the last few decades, polyphenols have gained considerable attention as promising additives for improving food quality and the potential to prevent the risk of certain diseases, including oxidative stress, inflammation, and cancer (Rubab *et al*., 2017). Generally, spice extracts cellular structure, and the presence of natural antioxidants protect important flavour constituents from volatilisation and oxidation (Dziezak, 1989). However, whole spice may release flavour too slowly to be of value in some applications. Dziezak (1988) noted that spices are available whole or dried, some dried and ground or as extracts - essential oils and oleoresins. These extracts are formulated to produce secondary products such as essences, emulsion used as flavors/fragrance in food creams and other related industries. *Gratissimum* is not commercially used, but due to its aromatic components, it is used in the flavouring of foods, especially in the cooking of "Pepper soup" traditionally. It has a medicinal property against diarrhoea or dysentery, if burnt, it serves as a mosquito repellent. Nutritionally, it has a stimulating effect.

The term salad cream means, according to the legal definition, any smooth, thick stable emulsion of vegetable oil, water, egg or egg yolk and an acidifying agent with or without the addition of one or more of the following substances, namely, vinegar, lemon juice, and other minor ingredients and permitted additives (Allan & Fox 1982).Allan and Fox recorded that the minimum proportion of vegetable oil and egg yolk solids that are allowed in Great Britain are 25% and 1.35% respectively. In Great Britain the legal standards for mayonnaise are the same as those for salad creams and this gives rise to the confusing situation that two products with different names can be identical. 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. Allan and Fox (1982) reported that in America, for example, mayonnaise must contain at least 60% oil (compared with 30% for salad cream) and in certain countries as much as 80% is required. In a similar study by Eke-Ejiofor and Beleya (2015), the consumption of salad cream and mayonnaise in Nigeria in general and Port Harcourt city in particular has increased tremendously in the recent past because of the widespread use with vegetables during official and domestic functions. Conventionally, salad cream and mayonnaise are packaged in a bottle. Salad creams, a creamy, yellow condiment based on an emulsion of about 25 to 50% of oil in water is emulsified by egg yolk and coloring. It contains 30 to 40% vegetable oil which accounts for 35% of the production of all dressings, mayonnaise and sandwich spreads (Cleese & Booth, 2001). For people not too familiar with salad cream, the condiment is probably like mayonnaise in terms of composition and texture. Mayonnaise was made also in same process

of formulation of salad cream although salad cream is slightly yellowish, rather than white and the flavor of salad cream is a bit complex. Many salad creams are also lightly seasoned, coming in a variety of flavors to cater for various palates depending on the brand and style (Turgeon et al., 1996). Salad cream should be viscous and have a creamy consistency, and this can only be achieved if the Oil/Water emulsion is stable. To produce such a product an emulsifying agent must be present, the chief one being lecithin contained in egg yolk. In addition, mustard and other gums are added and these are both effective emulsifiers. The stability of the emulsion formed is increased by the addition of a stabilizer which increases viscosity. Such an increase in viscosity becomes increasingly important, the smaller the oil content, and is brought about by the addition of starches and gums tragacanta (Nwosu & Eke-Ejiofor, 2021). Norman (1977) reported that salad cream is an oil-in-water (O/W) emulsion containing some 30 - 40% oil. Norman (1977) noted that mayonnaise is another oil-in-water (O/W) emulsion but contains more than 70% oil. It is a potentially unsaturable system because of this high internal phase content and is usually prepared by careful mixing at relatively low temperature. Cream formulations have high levels of oil and water at low PH. Water levels are increased in low-fat versions. Modified starches manage the water to provide the best viscosity, which will pour from a bottle at cold temperatures. Method of production includes mixing all dry ingredients with eggs and milk and slowly whisking in vinegar. The mix is then cooked over low heat until it becomes thick, like a white sauce. It can be canned by putting it in a jar and processing it in a hot water bath, cooled and kept for 2-3 days in the refrigerator. Salad cream and mayonnaise have a sharper taste and is less sweet, often prepared for eating with mixture of raw vegetables. The inclusion of salad cream in vegetable salad improves the taste of the vegetables thus more vegetables could be consumed for more health benefits apart from other nutritional benefits of the cream (Schweizer, 2012). 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 used to create them. The manufacture of an emulsion-based food product with specific desirable quality attributes depends on the selection of the suitable raw materials and optimization of processing conditions. Several polysaccharide gums or cellulose derivatives could be incorporated in the preparation of salad cream and mayonnaise, especially xanthan gum was proved to be an excellent stabilizer (Mc Clements, 1999).

2.0 Materials and Methods

2.1. Materials

Palm oil, melon seeds and spices such as *ocimum gratissimum* (ocg) (Scent leaves), *ocimum basilicum* (ocb) (curry leaves) and *cymbopogon citratus* (Lemon grass) were all purchased from Mile I market in Port Harcourt, Nigeria. All Reagents used were of analytical grade and obtained from the Food Science and Technology Laboratory in Rivers State University, Port Harcourt.

2.2 Extraction of Melon Oil

The melon seed oil was extracted using hexane, following AOAC (2012) standard procedures.

2.3 Essential Oils Extraction from Leafy Spices.

Figure 1 is a typical flow chart of the production steps associated with the extraction of essential oils, using hydro-distillation method (Tilaoui *et al*., 2015).

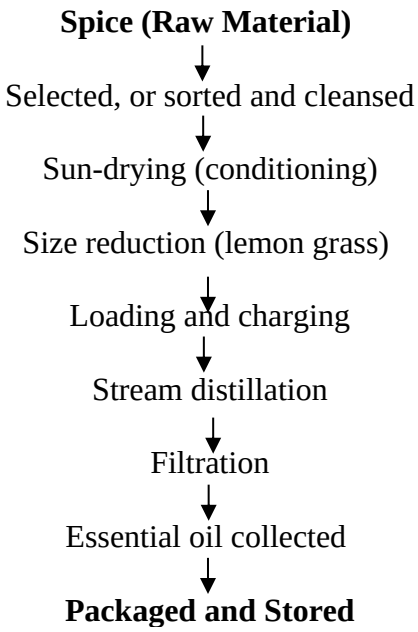

Figure 1. Flow Chart for Essential Oils Extraction by Hydro-Distillation Method (Tilaoui *et al*., 2015)

The spices (leaves) were collected and sorted to remove dead and infested leaves and other extraneous materials to enhance quality of the extract. The samples were subjected to size reduction using electric blenders to facilitate the efficiency of the extraction process. The distillation unit was set-up, and the samples put into a quick fit flask and the experiment ran for about 8 hours using steam as solvent (Tilaoui *et al*., 2015), The filtrate was collected and filtered and stored in sample glass bottles in the refrigerator (4^{o}C) and kept away from light until subjected to analysis (Kacaniova *et al*., 2022).

2.4 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 Emmanuel (1991). Whole egg, oil and other ingredients were mixed using a household mixer. This was followed by the addition of the 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	1.5 cmc

Adapted from Ariahu & Emmanuel (1991).

Key

RMO = Refined Melon Oil, EO = Essential Oils, Qs = Enough Water, M_1-M_9= Mayonnaise from refined Palm 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
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	1.5 cmc

Adapted from Ariahu & Emmanuel (1991).

Key

RMO = Refined Melon 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
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
Spice	2.0 ocg	2.0 ocb	2.0 cmc	3.0 ocg	3.0 ocb	3.0 cmc	3.5 ocg	3.5 ocb	3.5 cmc

Adapted from Oli et al. (2017)

Key
RMO = Refined Melon 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	T_8	T_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
Spice	2.0 ocg	2.0 ocb	2.0 cmc	3.0 ocg	3.0 ocb	3.0 cmc	3.5 ocg	3.5 ocb	3.5 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 Palm Oil
Ocg= Ocimum gratissimum (Scent leaves), Ocb=ocimum basilicum (curry leaves), Cmc = cymbopogon citratus (lemon grass)

2.5 Sensory Evaluation

Developed food creams and imported samples were subjected to sensory analysis on a nine-point Hedonic scale (ranging from 1 to 9 representing extremely dislike and extremely like respectively), using the method of Iwe (2007). Twenty-five semi-trained panelists were used to assess the organoleptic attributes of taste, flavour, texture, colour and overall acceptability of the food cream samples. The panelists were selected randomly from the staff and students of the Rivers State University, Port Harcourt, Nigeria. They were made to carry out the organoleptic assessment under controlled environment to avoid biased results. The panelists were required to observe and test each coded sample and score them accordingly.

2.6 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 Volatile Oil and Moisture Content of Some Indigenous Spices

Table 3 showed the volatile oil and moisture content of some indigenous spices. The table shows a volatile oil content of 0.30 % for *ocimum basilicum,* 0.34 % for *ocimum gratissimum,* while 0.56 % for *cymbopogon citratus* and 53.93 % for melon seed. The moisture content of the spices was 70.67 % for *cymbopogon citratus,* 72.35 % for *ocimum gratissimum,* 74.60 % for *ocimum basilicum* respectively. Table 1(a,b) and 2 (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. 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). 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 (Allan & Fox, 1982). 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. Products formulated were flavoured with essential oils and it was observed that the products had good quality attributes such as colour, texture and an appealing flavour. According to Marja and Natasja, (2010) Flavour enhancers are substances that have no pronounced flavor or taste itself, but which bring out and improve the existing taste and/or odor in the foods to which they are added. Essential oils can be

incorporated into vegetable oils and fats and the flavour strength standardized as in mayonnaise, salad, margarine, baked goods and cosmetics (Kukadia 1992). Essential oil enhanced the flavour of the developed product via its property of instant release of flavour into the food matrix. Kukadia (1992) reported that encapsulated spice extracts are designed to give extended shelf-life and a much slower release of flavour. Among the three spices used, essential oils flavour was favoured in these orders ocb > ocg > cmc. However, the volume of extraction for economic reasons shows a volatile oil content of 0.30 % for *ocimum basilicum,* 0.34 % for *ocimum gratissimum,* while 0.56 % for *cymbopogon citratus* respectively (Table 3). Ghada, (2022) reported that the primary function of flavors is to add taste or aroma to foods, as they have no nutritional properties. *O. basilicum* has been shown to improve functional and modifies technological characteristics of fresh cheeses, presenting good acceptability (Jessyca *et.al*., 2019). Accordingly, the flavour imparting essential oils content of spices/herbs were high and oil yield ranged from 0.1 to 5.2 percent.

Table 3 Volatile Oil and Moisture Content of Spices

Sample	Volatile Oil	Moisture
Ocimum gratissimum(ocg)	0.34^{ab}±0.023	72.38^{ab}±0.177
Ocimum basilicum(ocb)	0.30^{b}±0.014	74.60^{a}±0.721
Cymbopogon citratus (cmc)	0.56^{a}±0.028	70.69^{b}±0.870

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

3.2 Sensory Properties of Food creams

Results of statistical analysis from Tables 4 and 5 (a.b) showed that the formulated food cream (Mayonnaise) show no significant difference ($P > 0.05$) in terms of texture as a quality attribute, but there were significant differences ($P < 0.05$) for taste, colour, flavour and general acceptability, with preference to products flavoured with *ocimium gratissimum* and *ocimium basilicum.*

Table 5(a, b) showed the quality attributes of formulated salad cream, with statistical analysis showing no significant difference ($P > 0.05$) in terms of texture, while there were significant differences ($P < 0.05$) for colour, taste, flavour and general acceptability with ocimium gratissimum and ocimium basilicum highly favoured.

Tables 4a,b and 5a,b showed that the food creams (mayonnaise and salad) showed no significant difference ($p > 0.05$) in terms of texture, but there were significant differences ($p < 0.05$) in terms of taste, colour, flavour and general acceptability, with particular preference to products flavoured with *ocimium gratissimum* and *ocimium basilicum. cymbopogon citratus* ranked last in terms of general acceptability. This result indicates that *ocimium gratissimum* contains essential oils that are highly volatile and hydrophobic in nature, and are known for flavor, aromas and antimicrobial activity that showcase them as an appeasing asset for commercial purposes (Salvi *et al*., 2022). Also, according to Carocho *et al.* (2016) Basil (Ocimum basilicum Lamiaceae) is rich in polyphenols, antioxidants, antimicrobial and antifungal properties. The basil branches mainly contain fibers, essential oils and minerals, such

as nitrogen, calcium, potassium and magnesium. These substances have high potential to be utilized as food preservatives (Bhat, 2012). Similarly, Dumbravă *et al*. (2012) reported that Basil leaves have significant amounts of carotene, vitamin B (1, 2, 3), vitamin C, minerals (calcium, phosphorus and iron), polyphenols and essential oils). Thus, foods can be added to the functional ingredient, such as dairy products (Dumbravă *et al*., 2012). The absence of significant differences for the product's texture could be attributed to its viscosity. The texture and mouth feel of liquid foods is closely related to their viscosity. The studies show a sensory comparison of quality attributes of an imported mayonnaise and the locally formulated one. From the statistical analysis it was evident that the imported product showed significant difference ($p < 0.05$) in terms of colour and no significant difference ($p > 0.05$) in terms of taste and texture, while the locally made mayonnaise shows a significant difference ($p < 0.05$) in terms of flavours and overall acceptability of the products. However, Table 12.0a, b showed that salad cream made locally showed significant difference ($p < 0.05$) for flavour and general acceptability, while there was no significant difference ($p > 0.05$) in terms of colour, taste, and texture between some locally made products and the imported salad cream. (Q_9) and (T_9) were significantly different ($p < 0.05$) from the imported cream as they were less tasty, which could be due to the level of fatty substitution and the flavour enhancer *cymbopogon citratus.*

This result is in conformity with a similar study carried out by Nwosu, and Eke-Ejiofor (2021). That means scores of colours, appearance, flavour, taste, mouth feel, texture and overall acceptability of the millet-based salad cream samples compared with a commercial salad cream.

Tables 6 (a.b) showed a sensory comparison for quality attributes of imported mayonnaise, salad and locally formulated food cream. The statistical analysis showed that the imported mayonnaise was significantly different ($P < 0.05$) in terms of colour from the other local samples, while for salad, there was no significant difference ($P > 0.05$) between the imported and the local formulated sample. The formulated product showed significant difference ($P < 0.05$) for flavour and general acceptability over the imported product. For taste and texture both imported and formulated showed significant difference ($P > 0.05$).

Table 4a. Sensory Scores for the Formulated Food Cream (Mayonnaise) from Refined Melon Oil

Samples	Taste	Texture	Colour	Flavour	General Acceptability
M1	$8.2^{a}\pm0.010$	$7.8^{a}\pm0.017$	$7.0^{b}\pm0.011$	$8.3^{a}\pm0.010$	$8.1^{a}\pm0.000$
M2	$7.7^{ab}\pm0.014$	$7.7^{a}\pm0.214$	$8.3^{a}\pm0.083$	$8.4^{a}\pm0.004$	$7.8^{ab}\pm0.018$
M3	$6.8^{b}\pm0.011$	$7.1^{a}\pm0.014$	$8.0^{b}\pm0.013$	$7.2^{b}\pm0.001$	$6.4^{c}\pm0.015$
M4	$8.2^{a}\pm0.004$	$7.8^{a}\pm0.234$	$7.2^{b}\pm0.014$	$8.3^{a}\pm0.013$	$8.1^{a}\pm0.002$
M5	$7.7^{ab}\pm0.000$	$7.8^{a}\pm0.010$	$8.2^{a}\pm0.011$	$8.4^{a}\pm0.007$	$7.8^{ab}\pm0.014$
M6	$6.8^{b}\pm0.015$	$7.1^{a}\pm1.010$	$8.0^{a}\pm0.017$	$7.2^{b}\pm0.000$	$6.4^{c}\pm0.018$
M7	$8.1^{a}\pm0.014$	$7.8^{a}\pm0.066$	$7.0^{b}\pm0.131$	$8.3^{a}\pm0.000$	$8.1^{a}\pm0.011$
M8	$7.7^{ab}\pm0.005$	$7.7^{a}\pm0.000$	$8.2^{a}\pm0.010$	$8.4^{a}\pm0.011$	$7.8^{ab}\pm0.014$
M9	$6.8^{b}\pm0.012$	$7.2^{a}\pm0.001$	$7.9^{a}\pm0.019$	$7.1^{b}\pm0.014$	$6.4^{c}\pm0.000$

Values are means ± standard deviation of 20 responses.
Mean values bearing different superscripts in the same column differ significantly ($p<0.05$).
Key
M_1-M_9= Mayonnaise from Refined Melon Oil, M_1, M_4,M_7= Samples flavoured with ocg, M_2, M_5,M_8= Samples flavoured with ocb, M_3, M_6, M_9= Samples flavoured with cmc

Table 4b Sensory Scores for The Formulated Food Cream (Mayonnaise[b]) from Refined Palm Oil

Samples	Taste	Texture	Colour	Flavour	General Acceptability
S1	$8.1^{a}\pm0.013$	$7.3^{a}\pm0.810$	$6.9^{b}\pm0.014$	$8.3^{a}\pm0.010$	$8.3^{a}\pm0.050$
S2	$8.0^{a}\pm0.000$	$7.1^{a}\pm1.010$	$8.0^{a}\pm0.018$	$8.2^{a}\pm0.011$	$7.9^{ab}\pm0.500$
S3	$6.6^{b}\pm0.015$	$7.0^{a}\pm1.000$	$8.4^{a}\pm0.000$	$6.6^{b}\pm0.000$	$7.0^{b}\pm0.012$
S4	$8.0^{a}\pm0.007$	$7.3^{a}\pm0.010$	$6.7^{b}\pm0.300$	$8.2^{a}\pm0.016$	$8.3^{a}\pm0.023$
S5	$8.0^{a}\pm0.066$	$7.2^{a}\pm0.015$	$7.7^{ab}\pm0.010$	$8.1^{a}\pm0.034$	$7.9^{ab}\pm0.076$
S6	$6.7^{b}\pm0.000$	$6.9^{a}\pm0.014$	$8.1^{a}\pm0.014$	$6.7^{b}\pm0.017$	$7.0^{b}\pm0.000$
S7	$8.0^{a}\pm0.019$	$7.6^{a}\pm0.008$	$7.0^{b}\pm0.017$	$8.1^{a}\pm0.000$	$8.3^{a}\pm0.012$
S8	$8.1^{a}\pm0.034$	$7.3^{a}\pm0.022$	$8.0^{a}\pm0.034$	$8.1^{a}\pm0.044$	$7.9^{ab}\pm0.080$
S9	$6.8^{b}\pm0.510$	$7.0^{a}\pm0.011$	$7.6^{ab}\pm0.020$	$6.7^{b}\pm0.000$	$7.0^{b}\pm0.510$

Values are means ± standard deviation of 20 responses.
Mean values bearing different superscripts in the same column differ significantly ($p<0.05$).
Key
S_1-S_9= Mayonnaise from Refined Palm Oil, S_1, S_4,S_7= Samples flavoured with ocg, S_2, S_5,S_8= Samples flavoured with ocb, S_3, S_6, S_9= Samples flavoured with cmc

Table 5a Sensory Scores for Formulated Food Cream (Salad[a]) from refined Palm Oil

Samples	Taste	Texture	Colour	Flavour	General Acceptability
T1	$8.4^{a}\pm0.015$	$7.3^{a}\pm0.035$	$6.8^{b}\pm0.01$	$8.3^{a}\pm0.023$	$8.4^{a}\pm0.410$
T2	$8.0^{a}\pm0.011$	$7.0^{a}\pm0.005$	$8.3^{a}\pm0.000$	$7.9^{a}\pm0.010$	$8.4^{a}\pm0.011$
T3	$6.9^{b}\pm0.010$	$7.4^{a}\pm1.011$	$8.3^{a}\pm0.011$	$6.6^{b}\pm0.077$	$6.8^{b}\pm0.115$
T4	$8.0^{a}\pm0.000$	$7.6^{a}\pm1.000$	$7.0^{b}\pm0.055$	$8.2^{a}\pm0.010$	$8.4^{a}\pm0.013$
T5	$8.2^{a}\pm0.310$	$7.4^{a}\pm0.045$	$8.0^{a}\pm0.017$	$7.8^{a}\pm0.011$	$8.4^{a}\pm0.225$
T6	$6.9^{b}\pm0.012$	$6.9^{a}\pm0.012$	$8.4^{a}\pm0.010$	$6.6^{b}\pm0.005$	$6.9^{b}\pm0.000$
T7	$8.1^{a}\pm0.014$	$7.7^{a}\pm0.035$	$6.8^{b}\pm0.000$	$8.1^{a}\pm0.014$	$8.6^{a}\pm0.013$
T8	$8.0^{a}\pm0.019$	$7.2^{a}\pm0.012$	$8.1^{a}\pm0.005$	$8.1^{a}\pm0.015$	$8.4^{a}\pm0.016$

T9	$7.0^{b}\pm0.010$	$7.2^{a}\pm0.011$	$8.4^{a}\pm0.010$	$6.4^{b}\pm0.018$	$6.8^{b}\pm0.085$

Values are means ± standard deviation of 20 responses.
Mean values bearing different superscripts in the same column differ significantly ($p<0.05$).
Key
T_1-T_9= Salad from refined Palm Oil
T_1, T_4, T_7 = Samples flavoured with ocg
T_2, T_5, T_8 = Samples flavoured with ocb
T_3, T_6, T_9= Samples flavoured with cmc

Table 5b Sensory Scores for the Formulated Food Cream (Salad[b]) from refined Melon Oil

Samples	Taste	Texture	Colour	Flavour	General Acceptability
Q1	$7.9^{a}\pm0.000$	$7.8^{a}\pm0.012$	$7.0^{b}\pm0.017$	$8.4^{a}\pm0.033$	$8.2^{a}\pm0.062$
Q2	$7.3^{a}\pm0.018$	$7.4^{a}\pm0.592$	$7.9^{ab}\pm0.052$	$8.6^{a}\pm0.014$	$8.4^{a}\pm0.077$
Q3	$6.9^{ab}\pm0.042$	$7.6^{a}\pm0.972$	$8.4^{a}\pm0.014$	$7.0^{b}\pm0.000$	$6.9^{b}\pm0.014$
Q4	$7.7^{a}\pm0.019$	$7.4^{a}\pm0.010$	$7.0^{b}\pm0.015$	$8.2^{a}\pm0.011$	$8.8^{a}\pm0.011$
Q5	$7.3^{a}\pm0.011$	$7.4^{a}\pm0.015$	$7.9^{ab}\pm0.002$	$8.2^{a}\pm0.016$	$8.1^{a}\pm0.000$
Q6	$6.8^{ab}\pm0.222$	$7.4^{a}\pm0.010$	$8.8^{a}\pm0.015$	$7.1^{b}\pm0.014$	$7.0^{b}\pm0.018$
Q7	$7.7^{a}\pm0.014$	$7.9^{a}\pm0.000$	$7.2^{b}\pm0.015$	$8.4^{a}\pm0.011$	$8.3^{a}\pm0.032$
Q8	$7.1^{ab}\pm0.032$	$7.9^{a}\pm0.015$	$7.9^{ab}\pm0.012$	$8.0^{a}\pm0.062$	$8.3^{a}\pm0.011$
Q9	$6.1^{b}\pm0.011$	$7.2^{a}\pm0.039$	$8.4^{a}\pm0.011$	$7.2^{b}\pm0.014$	$6.8^{b}\pm0.016$

Values are means ± standard deviation of 20 responses.
Mean values bearing different superscripts in the same column differ significantly ($p<0.05$).
Key
Q_1-Q_9= Salad from refined Melon Oil
Q_1, Q_4, Q_7= Samples flavoured with ocg
Q_2, Q_5, Q_8= Samples flavoured with ocb
Q_3, Q_6, Q_9= Samples flavoured with cmc

Table 6a Sensory Scores for Comparison of Quality Attributes of Formulated Mayonnaise and Imported Mayonnaise

Samples	Taste	Texture	Colour	Flavour	General Acceptability
M1	$4.6^{a}\pm0.032$	$3.7^{b}\pm0.012$	$3.7^{b}\pm0.016$	$4.7^{a}\pm0.012$	$4.3^{ab}\pm0.015$
M5	$4.4^{a}\pm0.012$	$3.6^{b}\pm0.023$	$3.6^{b}\pm0.077$	$4.6^{a}\pm0.000$	$4.2^{ab}\pm0.018$
M9	$2.7^{b}\pm0.064$	$4.3^{ab}\pm0.061$	$3.9^{b}\pm0.000$	$3.4^{b}\pm0.007$	$2.8^{c}\pm0.017$
S2	$4.4^{a}\pm0.052$	$3.8^{b}\pm0.072$	$3.4^{b}\pm0.010$	$4.6^{a}\pm0.022$	$4.7^{a}\pm0.014$

S4	$4.6^{a}\pm0.002$	$3.6^{b}\pm0.004$	$3.6^{b}\pm0.001$	$4.7^{a}\pm0.042$	$4.3^{ab}\pm0.031$
S9	$2.3^{b}\pm0.000$	$4.4^{a}\pm0.000$	$3.8^{b}\pm0.002$	$3.6^{b}\pm0.000$	$2.9^{c}\pm0.019$
S10	$4.9^{a}\pm0.017$	$4.8^{a}\pm0.032$	$4.7^{a}\pm0.005$	$2.6^{c}\pm0.002$	$3.4^{b}\pm0.011$

Values are means ± standard deviation of 20 responses.
Mean values bearing different superscripts in the same column differ significantly ($p<0.05$).

Keys:

M_1-M_9= Mayonnaise from refined Palm Oil, M_1= Samples flavoured with ocg, M_5= Samples flavoured with ocb
M_9= Samples flavoured with cmc, S_1-S_9= Mayonnaise from Refined Palm Oil, S_2= Samples flavoured with ocb
S_4= Samples flavoured with ocg, S_9= Samples flavoured with cmc, S_{10}= Imported Mayonaise as control

Table 6b Sensory Scores for Comparison of Quality Attributes of Formulated Salad and an Imported Salad

Samples	Taste	Texture	Colour	Flavour	General Acceptability
Q1	$4.7^{a}\pm0.002$	$3.6^{c}\pm0.017$	$3.6^{a}\pm0.000$	$4.6^{a}\pm0.000$	$4.4^{a}\pm0.011$
Q5	$4.6^{a}\pm0.001$	$4.3^{ab}\pm0.003$	$3.8^{a}\pm0.022$	$4.4^{ab}\pm0.334$	$4.2^{a}\pm0.032$
Q9	$2.4^{b}\pm0.054$	$3.9^{b}\pm0.009$	$3.2^{a}\pm0.805$	$3.7^{b}\pm0.012$	$2.1^{b}\pm0.001$
T2	$4.4^{a}\pm0.010$	$3.8^{c}\pm0.011$	$3.8^{a}\pm0.001$	$4.8^{a}\pm0.009$	$4.4^{a}\pm0.033$
T4	$4.6^{a}\pm0.003$	$3.4^{c}\pm0.006$	$3.8^{a}\pm0.004$	$4.4^{ab}\pm0.054$	$4.6^{a}\pm0.001$
T9	$2.4^{b}\pm0.008$	$4.4^{ab}\pm0.21$	$3.2^{a}\pm0.007$	$3.3^{c}\pm0.001$	$2.1^{b}\pm0.040$
T10	$4.8^{a}\pm0.004$	$4.8^{a}\pm0.001$	$3.7^{a}\pm0.045$	$3.0^{c}\pm0.0048$	$2.3^{b}\pm0.004$

Values are means ± standard deviation of 20 responses.
Mean values bearing different superscripts in the same column differ significantly ($p<0.05$).

Key:

Q_1-Q_9= Salad from refined Melon Oil, Q_1= Samples flavoured with ocg, Q_5= Samples flavoured with ocb
Q_9= Samples flavoured with cmc, T_1-T_9= Sala from refined Palm Oil, T_2= Samples flavoured with ocb, T_4= Samples flavoured with ocg, T_9= Samples flavoured with cmc, T_{10}= Imported Salad as control

4.0 Conclusion:

In the present research, it was evident that products flavoured with essential oils had a better general acceptability than products without flavours, as seen in samples M_1 and S_2, T_4 and Qi, when compared with S_{10} and T_{10}, imported mayonnaise and salad without flavours. These products were insipid, thus these spices become particularly indispensable as they add savour and taste to insipid dishes, with preference given to *ocimium basilicum,* followed by *gratissimum* and *cymbopogon citratus* ranking last. Sensory evaluation showed that salad cream made from locally

available raw materials were acceptable to the panelists, especially formulation S_4. Acceptable and nutritious salad and mayonnaise cream can be processed from these raw materials. In Nigeria many spices (essential oils) used as food flavourants are obtained from the wild.
To date, little attempt has been made to domesticate and cultivate these spices, thus many of these indigenous spices could become extinct due to little knowledge about its proper utilization and deforestation menace. local formulation of salad and mayonnaise should be encouraged to offset the foreign exchange due to importation of these food creams.

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