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CHARACTERIZATION OF *Citrillus colocynthis* (MELON) SEED OIL AND ITS APPLICATION IN THE PRODUCTION OF COSMETICS

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ABSTRACT

The study focused on the extraction, storage, and characterization of *Citrillus colocynthis* (melon) seed oil, as well as the production of perfume, soap, hair cream, and lip gloss using the extracted oil. The physicochemical characteristics of *Citrillus colocynthis* seed oil were investigated for a period of 0 to 2 months. We evaluated specific gravity, viscosity, volatile matter, appearance, and odor as physical parameters in the oil analysis and evaluated iodine value, saponification value, percentage free fatty acid (FFA), acid value, and peroxide value as chemical parameters. The results showed that the acid value was 1.04–1.05 mg KOH/g, the saponification value was 212.05–214.14 mg KOH/g, and the iodine value was 117.42–117.28 mg I^2/100 g. It contained 0.45–0.58 mg KOH/g percent free fatty acid. The value of peroxide was 1.14–1.22 meq/kg. The appearance was golden-yellow and odorless. It had a volatile matter within the range of 0.06 and 0.07. The results also showed that the viscosity was between 39.01 and 39.88 mm^2/s and the specific gravity was 0.90 and 0.85. The physiochemical characterization of the stored *Citrillus colocynthis* (melon) seed oil for a while conformed to Nigerian and international standards; hence, the plant seed oil may be edible and suitable for the formulation of various cosmetic products.

Keywords: *Citrillus colocynthis*, Seed oil, Production, Hair cream, Lip gloss, Perfume, Soap

INTRODUCTION

Vegetable oils have become more important lately because they contain fatty acids that are used in the production of renewable fuels, food, medicine, and beauty products. These oils are not just for cooking anymore; they have a variety of applications in our everyday lives. Many vegetable oils are used for cosmetic purposes based on their composition and their correlation with antioxidant activity properties, which can fight off damage caused by oxygen and light, thereby resulting in healthier and younger-looking skin and hair (Ionescu *et al*., 2015). The use of vegetable oils in cosmetic formulations for hair care can enhance hair gloss and softness while increasing resistance to breakage. Vegetable oils are a good choice for developing hair care cosmetics to improve hair gloss, softness, and resistance to breakage. Formulations infused with vegetable oil are effective in strengthening, moisturizing, and improving hair cuticles (Leite *et al*., 2018). In the last decade, the cosmetics industry has shifted towards natural ingredient-based products due to market demand. Essential oils have gained attention for their various beneficial properties, such as anti-inflammatory, antibacterial, antifungal, anti-aging, and regenerative effects. Some essential oils can be used directly on the skin, but many of them need to be used carefully because they can cause skin reactions. Rather, they are used in different forms, like incorporated in various pharmaceutical forms or using vegetable oils as a carrier. Numerous studies have highlighted the anti-inflammatory, antibacterial, antiseptic, and antioxidant action on the skin and the anti-dandruff, anti-sebum, or stimulation of hair growth (Galea *et al.*, 2023).

Citrillus colocynthis, also known as melon, has long been utilized for its nutritional value due to its high protein and oil content. However, the potential applications of these seeds extend beyond their use as food ingredients. In recent years, researchers have started exploring the utilization of melon seed oil in the production of personal care products, such as perfumes, soap, and hair products. Extracting vegetable oil from melon seeds and incorporating it into these products not only adds a natural and eco-friendly aspect but also offers potential benefits for skincare due to its composition of essential fatty acids and antioxidants (Ionescu *et al*., 2015; Nwoke *et al*., 2023). Omozuwa *et al.* (2024) reported that melon seed oil possesses medicinal benefits such as antioxidant, antidiabetic, antibacterial, anti-inflammatory, and anticarcinogenic potentials since it contains a handful of vital micronutrients and polyphenolic chemicals, fatty acids, antioxidants, and lots more.

Soap is an essential daily household commodity that is used for cleaning. It is produced in different forms, such as bars, flakes, granules, and liquids, made from fatty acids of organic fats and oils mixed with the salts of sodium or potassium. The use of soap in cleaning is paramount because it removes stains that ordinary water alone cannot eliminate. Soap exerts its cleansing potential by allowing the contaminants of dirt, oil, or grease to be dissolved in water and then washed away (Igbashio and Obasuyi, 2022). Different oils have different kinds of fatty acids in them, which affects the properties of the soap that is made from them. This means that the type of oil used will determine how the soap looks, feels, and works (Arasaretnam *et al*. 2019). The objectives of this study are to produce melon seed oil, characterize the physicochemical properties stored over some periods of months, and use it for the production of soap, perfume, hair cream, and lip gloss.

MATERIALS AND METHODS

Plant collection and Preparation

Citrillus colocynthis seeds were obtained from Jattu Market in Etsakor West Local Government Area, Edo State, Nigeria, and identified by a botanist at the Department of Plant Biology and Biotechnology, domiciled at the University of Benin. Extraction was done using a mechanical extractor as described by Omozuwa *et al*. (2024). The extracted oils were stored at 40 °C awaiting further analysis.

Determination of physicochemical properties of *Citrilus lanatus* (Melon) Seed Oil

The AOCS recommended practice (1995) was used for the determination of saponification value, iodine value, acid value, peroxide value, and specific gravity was determined according to the method of AOAC (1990). The kinematic viscosity was determined following ASTM D 445.

Production of Perfume

One hundred (100) ml of extracted melon seed oil was measured into a beaker as the base node and 100 ml of grove land. The mixture was carefully stirred until a homogeneous mixture without any demarcation. With the aid of a syringe, the mixture was then transferred into perfume oil bottles according to the volume of the bottles, corked, and labeled.

Production of Soap

Caustic soda and soda ash were fermented in different bowls precisely and left to ferment for 24 hours. The heated oil was added to a container and the color was at intervals. 500 ml of already dissolved caustic soda was added to the same container as the oil and stirred to uniformity. 250 ml of dissolved soda ash was added to the resulting mixture and stirred continuously. A foaming agent was added to the mixture and stirred continuously. 2 rubber spoons of vitamin E, 1 rubber spoon of glycerine, 2 spoons of kaolin, and perfume were added.

Production of Hair Cream

A dry pot was put on heat. 500 grams of petroleum jelly and paraffin oil were added and allowed to dissolve and blend properly. 250 grams of lanolin and paraffin wax were then added, followed by 250 ml of glycerine and 1 rub of Vitamin E. The heat was put off and the pot was brought down, then allowed to cool for about 4 minutes. 1rap Menthol, camphor, and fragrance were added, stirred, and left to cool a bit, followed by 140 ml melon seed oil. The semi-liquid was scooped into several sterilized containers, capped with a tight-fitting lid, and allowed to sit overnight till the content settled down.

Production of Lip gloss

A dry pot was put on heat. A rap Paraffin wax and 1rap Shea-Butter were added and allowed to melt completely. This served as the base. The heat was put off and the pot was brought down and allowed to cool, followed by 10 ml of olive oil, 10 ml of coconut oil, and 20 ml of melon seed oil, and the mixture was stirred for an even consistency. Color and flavor were added to the still-hot mixture, which was then stirred and left to cool a bit. The semi-liquid was poured into several sterilized containers, capped with a tight-fitting lid, and allowed to sit overnight till the content settled down.

Statistical Analysis

Statistical Package for Social Sciences (SPSS) was used to analyze the data obtained. Data were expressed as mean±SEM. ANOVA was used to determine the levels of statistical significance. Values were deemed statistically significant at $P<0.05$.

RESULTS AND DISCUSSION

Table 1 shows the saponification value of the mechanically extracted melon seed oil. From the results obtained, it was observed that the saponification values increased steadily over the storage period when compared between months. The initial saponification value was 208.84 mgKOH/g, and it gradually increased to 288.84 mgKOH/g after 5 months of storage. The increase in saponification value could be attributed to the hydrolysis of triglycerides in the oil, leading to the formation of free fatty acids. The higher saponification value indicates a higher percentage of free fatty acids in the oil, which could affect its quality and shelf life.

Table 1: Saponification value of mechanically extracted melon seed oil

Storage Month	Saponification Value (mgKOH/g)
0	208.84 ± 0.057
1	210.03 ± 0.056
2	221.73 ± 0.007
3	248.35 ± 0.057
4	275.07 ± 0.012
5	288.84± 0.003

(ASTM Standard Value: 195-205). Data are expressed as SEM± mean of 3 determinations

Table 2 shows the saponification value of the chemically extracted melon seed oil. From the results, a different trend in saponification values over the storage period was observed. The initial saponification value was 217.00 mgKOH/g, and it increased to 310.08 mgKOH/g after 5 months of storage. The increase in saponification value for chemically extracted oil could be due to the formation of additional byproducts during the chemical extraction process. These byproducts may react with the KOH during saponification, leading to higher saponification values. When compared with the saponification values of mechanically extracted and chemically extracted melon seed oil, it was evident that the chemically extracted oil had higher saponification values at each time point. This could be due to the presence of byproducts or impurities in the chemically extracted melon seed oils, which fell within this range and above the ASTM recommended range for soap production, indicating that the oils meet the quality requirements set by the regulatory bodies.

Table 2: Saponification values of chemically extracted melon seed oil

Storage month	Saponification value(mgKOH/g)
0	217.00± 0.577
1	219.14 ± 0.006
2	225.59 ± 0.003
3	274.50 ± 0.001
4	296.14 ± 0.000
5	314.08 ± 0.000

(ASTM Standard Value: 195-205). Data are expressed as SEM± mean of 3 determinations

Saponification Value

The saponification value represents the number of milligrams of sodium hydroxide (NaOH) or potassium hydroxide (KOH) required to saponify one gram of oil or fat under the conditions specified. In general, the produced esters have similar saponification values as their corresponding oil (Sajjadi *et al*., 2016)**.** In this study, the saponification values for *Citrillus colocynthis* were high and favorable when compared to the values of palm oil (196–205 mgKOH/g), olive oil (185–196 mgKOH/g), soy oil (193 mgKOH/g), and linseed oil (193–195 mgKOH/g). The high saponification value of the oil may be useful for manufacturing soap and shaving cream with higher lather. A high saponification value implies a greater proportion of fatty acids of low molecular weight (Anhwange *et al.,* 2010). The higher the saponification numbers of the oil, the more soluble the soap that can be made from it.

Table 3 presents the physiochemical parameters of mechanically extracted *Citrillus colocynthis* (melon) seed oil. The appearance of the oil observed within 0–2 months was golden yellow with no odor at all. Volatile matter at 105^0C was 0.07 at 0-1 month and 0.06 after 2 months of storage.

Table 3: Physiochemical Parameters of Mechanically Extracted *Citrillus colocynthis* Oil

Storage Month	Apperance (Colour)	Odour	Volatile Matter @ 105°c	Acid value mg KOH/g	Free fatty acids mgKOH/g	Peroxide value Meq/kgoil	Iodine value MgI_2/100g	Specific gravity g/ml	Viscosity mm^2/s	Saponification value mgKOH/g
0	Golden yellow	Odourless	0.07	1.04	0.45	1.14	117.42	0.90	39.01	212.05
1	Golden yellow	Odourless	0.07	1.03	0.49	1.18	117.38	0.87	39.55	210.25
2	Golden yellow	Odours	0.06	1.05	0.58	1.22	117.28	0.85	39.88	214.14
Standards SON\NIS				0.6	3.5	10	45-53wijs	0.898-0.907		195-205

Acid Value

The acid values for mechanically extracted melon seed oil, as presented in Table 3, are in the range of 1.03-1.05. When compared with the SON/NIS standards of 0.6, the results were higher than the standard the zero and first months of the mechanically extracted melon seed oil were low, but the second month of both oils had the highest acid value, showing a high level of deterioration of the oils as the storage time increased steadily. The acid value is the degree to which lipase action has hydrolyzed the glycerides in the oil is indicated by the acid value. In the presence of air and possibly microorganisms, water hydrolyzes the glycerides as well. Light and heat increase the breakdown process (Low and Ng, 1987). Low acid value in oil indicates that the oil will be stable over a long period and protect against rancidity and peroxidation. Acid values are used to check the level of oxidative deterioration of oil by enzymatic or chemical reaction. It measures the degree of unsaturation of oil and corresponds to the amount of potassium hydroxide required to neutralize free fatty acids (Dijkstra, 2016). The lower the acid values, the lower the free fatty acids it contains, which makes it less exposed to rancidity.

Free Fatty Acid Value

The free fatty acid values for mechanically extracted melon seed oil, as shown in Table 3, fall within the range of 0.45-0.58 and are much lower when compared with the SON/NIS standards of 3.5 mg NaOH/g. The lower acid values also indicate that the oils could be stored for extended periods without deterioration. The free fatty acid content values of both fatty acid values are used to check the level of oxidative deterioration of oil by enzymatic or chemical reaction. It measures the degree of unsaturation of oil and corresponds to the amount of potassium hydroxide required to neutralize free fatty acid ((Dijkstra, 2016)). The lower the acid values, the lower the free fatty acids it contains, which makes it less exposed to rancidity.

Peroxide Value

The peroxide values, as shown in Table 3, increased with time but were much lower than the WHO/FAO stipulated range; thus, the oil is suitable for consumption. Peroxide values indicate the deterioration of the oil. Oils with higher peroxide values are more unsaturated than those with lower peroxide values. High values of peroxide values are indicative of high levels of oxidative rancidity of the oils and also suggest the absence or low levels of antioxidants. WHO/FAO stipulated a permitted maximum peroxide value of not more than 10 meq/kg of oils (Gotoh and Wada, 2006).

Iodine Value

According to Ichu *et al*., 2019, the iodine value of melon seed oil indicates that the oil is a semi-drying oil. The class of oils whose iodine value is between 100 and 150 possesses the property of absorbing oxygen on exposure to the atmosphere, they become thickened and remain sticky but do not form a hard dry film. They are used in the production of soap. According to Table 3, the iodine values of *Citrillus colocynthis* (melon) seed oil were high and above the standard range, and when compared within the period of storage, there was no significant difference at $P>0.05$. This is an indication that the mechanically extracted melon seed oils would be suitable for use as drying oils, and the storage time also enhances its suitability as a drying oil. In chemistry, the iodine value (IV) also known as the iodine index) is the mass of iodine in grams that is consumed by 100 grams of a chemical substance. Iodine values are often used to determine the degree of unsaturation in fats, oils and waxes. Thus, the higher the iodine value, the higher the unsaturated fatty acids present in the oil (Thomas, 2000). In this study, the high iodine values are an indication that the *Citrillus colocynthis* (melon) seed oil has good edible and drying oil qualities.

Specific Gravity

Specific gravity is the ratio of the density of a substance to that of a standard substance (Britannica, 2023). It is commonly used in conjunction with other figures in assessing the purity of oil. (Yahaya *et al.* (2012). In this study, the specific gravity for the oil decreased as the storage time increased but was still within the accepted range.

Viscosity

The viscosity of the oil increases as the storage time increases. Viscosity increased with the molecular weight and decreased with increasing unsaturated levels and high temperatures. The viscosity of the investigated oils ranges from 39.01 mm^2/s to 39.88 mm^2/s. The more viscous oil is, the better its use as a lubricant (Ichu and Nwakanma, 2019).

Products Produced Using *Citrillus colocynthis* (Melon) Seed Oil

A lot of vegetable oils are used industrially in the production of candles, soaps, skin care products, perfumes, and other cosmetic and personal care items *(McGraw,2000).* Figures 1-4 are pictures of products produced using *Citrillus colocynthis* (melon) seed oils. Figure 1 represents the picture of perfumes produced using *Citrillus colocynthis* (melon) seed oil. Perfume plays a significant role in elevating the allure of makeup. Since perfume may effectively cover up unpleasant odors, it is frequently considered by consumers to be the most important consideration when choosing cosmetics (Sharmeen *et al*., 2021).Figure 2 shows a picture of soap produced using melon seed oil. Oils play a crucial role in the process of manufacturing soap since the saponification reaction cannot occur without oil or the fatty acids found in oils (Rathod, 2016). Leita and Maia-Campos (2018) reported that the formulations that have been developed and infused with vegetable oil are shown to be effective in strengthening, moisturizing, and improving hair cuticles. In this sense, the use of vegetable oils in the creation of cosmetic formulations for hair care can enhance the gloss and softness of hair while strengthening its resistance to breakage. Figure 3 is a picture of hair cream produced using *Citrillus colocynthis* (melon) seed oil. Given the substantial influence hair has on women's perceptions of their bodies, hair care is essential to women's quality of life and well-being (Gabarra *et al*., 2015). Figure 4 represents picture of lip products made with melon seed oil, lip oils have several advantages for the lips, including smoothing out lipid gaps on the lips and forming a protective barrier against weather fluctuations. A report by Mintel shows that 87% of women use lip products, with lip balm being the most often used product type. Lip gloss, lipstick, and balm all penetrate the skin at comparable speeds, indicating that many women use a variety of lip cosmetics depending on the situation or style desired (Lam-Phaure, 2022).

Figure 1: Picture of produced oil perfumes packaged in bottles

Figure 2: Picture of produced tablet soaps using melon seed oil

Figure 3: Picture of produced hair cream using melon seed oil

Figure 4: Picture of produced lip gloss using melon seed oil

CONCLUSION

The physiochemical characterization of the stored *Citrillus colocynthis* (melon) seed oil for a while has been found to conform to Nigerian and international standards, which is an indication that the plant seed oil may be edible and is suitable for industrial purposes, which may be utilized for the formulation of various cosmetic products.

LIST OF ABBREVIATIONS

WHO: World Health Organization
FAO: Food and Agriculture Organization
SON: Standard Organization of Nigeria
NIS: Nigerian Industrial Standard
ASTM: American Society for Testing and Materials
ANOVA: Analysis of Variance

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