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Enhancing the Value of Date Palm Seeds from the Oriental Region

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Abstract

With the aim of making a contribution to the phœnicicultural sector in Morocco's eastern region, a cream and soap trial was carried out incorporating date kernel oil in the form of waste products, to produce a moisturizing cream and a foaming soap. First, the physicochemical parameters are determined. The weight of the kernel is 0.4 g and 2.9 g, with an average fat content of 11% (dry matter). On the other hand, it allows us to know the water contents, these results are 2.313% - 4.562%; the mineral elements of fresh matter, we have in cadmium: 0.0122 - 0.0775 ppm, in zinc: 0.896 - 2.1946 ppm, in cobalt: 0.0272 ppm, in lead: 0.5086 - 0.5123 ppm, in copper: 0.478 - 0.3766 ppm, nickel: 0.2348 - 0.0736, iron: 1.7424 - 2.1484 ppm, chromium: 0.214 - 0.2368 ppm, nitrate ions: 3.333 - 8.555 µM/ml, nitrite ions: 19.071 - 20.357 µM/ml, phosphate ions: 7.074 - 8.888 µM/ml, sulfate ions: 20.714 - 30.714 µM/ml. In order to gain a better understanding of the formulation for a cream and a soap, the extracted oil is incorporated with argan oil, shea butter for the cream. For the soaps, hot and cold saponification methods were used with argan oil, shea butter, and soda. These results show that date pits can be put to good use in the cosmetics sector, where they add considerable value.

Keywords

Phoeniculture, Eastern Morocco, Date Oil, Seeds, Mineral Elements

1. Introduction

When Phoeniculture is part of the oasis ecosystem. It plays several roles that give it environmental, economic and social importance. More than 3000 varieties of dates are grown worldwide: 400 in Iran, 370 in Iraq and 250 in Tunisia. The origin of the first date palm cultivation is uncertain, and many authors place it in Babylon on the Persian Gulf.

The date palm was originally cultivated in the hot arid and semi-arid zones of the Old World. It was subsequently propagated outside its area of extension and cultivation, not only as a fruit tree, but also as an ornamental species. It is found in association with other palms of related species in all the favoured mild-winter localities of the Mediterranean shores, where its presence imparts a note of warmth and exoticism to the landscape [1].

From its ancestry in antiquity and among the oldest cultivated crops in the world, it progressed in the Middle East and then through the Maghreb countries, followed by its domestication in the Americas and Europe through colonization and commercial traffic. Given its importance in the structure of the Oriental oasis, our contribution focuses on the exploitation and valorization of secondary products from date waste, and consequently their cosmetic value.

Cosmetics are products used to cleanse and beautify the skin [2].

The first use of cosmetics is attributed to the Egyptians in 4000 BC [3]. Kligman can be described as the father of cosmeceuticals [4], but they first appeared on the world market in 1996 [5]. Cosmeceuticals are generally presented as lotions or creams primarily targeted at dermatological issues [6].

According to [7], the traditional use of plants against skin diseases and especially for cosmetic purposes is a fairly common practice in the domestic medicine of many cultures. Organic cosmetics are products containing a maximum of natural ingredients from the plant kingdom, such as olive oil, almond oil, argan oil, walnut oil, shea butter or fruit extracts, essential oils and floral waters [8].

The current work focuses on the physicochemical characterization of date pits (waste products) and the extraction of their oils. The incorporation of these date kernel oils into organic cosmetic skincare creams and soaps offers added value. To the best of our knowledge, there are no specific interdisciplinary studies on traditional knowledge concerning cosmetics at the national level, hence our contribution to a brand-new date kernel oil cream and soap.

2. Materials and Methods

The varieties selected are *Medjhoul* (Jordan), Deglet Nour (Algeria), *Mejhoul* or Majhoul and *Boufeggous gharas* (Morocco).

They are harvested in the regions of Morocco, namely the palm groves of Tafilalet, Drâa and Figuig, and commercially during the spring season.

The date stone is surrounded by a parchment-like, elongated endocarp of varying size, smooth or with lateral ridges or fins, with a ventral groove and a hard, horny albumen (endosperm). The embryo is dorsal and always very small compared to the albumen (2 to 3 mm) (**Figure 1**).

2.1. Morphological Characteristics

The morphological characteristics studied on the seeds are distinguished in two sample batches (Batch A and B), which are date stone lengths, date stone widths, date stone weights and length/width ratios.

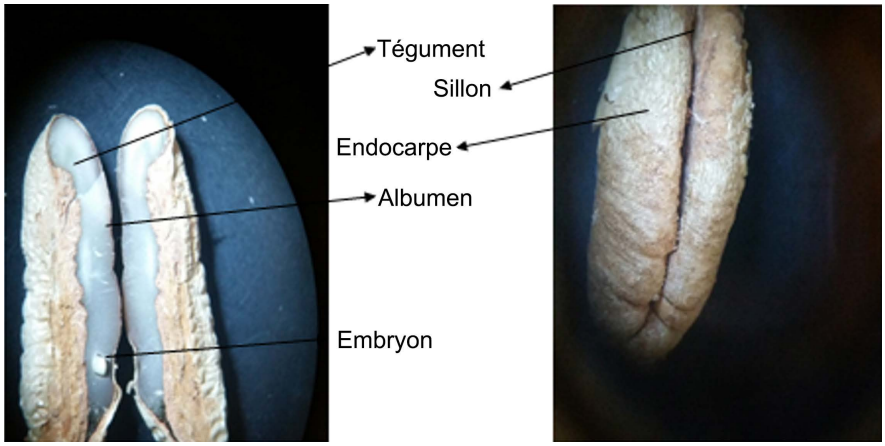

Figure 1. Date pits viewed under binocular magnifying glass.

2.2. Moisture Content of Date Pits

One week is enough time to dry the pits obtained at 70˚C in the oven, since water content is a quality criterion used mainly to estimate the moisture content of the date pit, providing information on the stability of the product against the risk of spoilage during storage.

2.3. Sample Parameters

Temperature conditions for drying: The cores studied come from Morocco and the trade. The cores were collected, washed, dried in an oven at 50°C for 48 h and then finely ground.

2.4. Preparation Protocols

- Saponification steps

  Step 1: Add the seed powder to the distilled water.

  Step 2: Add NaOH.

  Step 3: Add olive oil and date oil.
- Formulation ratios of the cream

  For 100 g of the cream, infuse 15 g of date seed powder in 250 ml of distilled water for 20 min.

  Then filter 15 g shea butter, 15 g argan oil, 15 g date oil and 50 ml aqueous date extract into a 50 ml beaker.

  Blend the mixture until all the oil phase has been incorporated. Heat to 60˚C for 5 minutes, pour into tins and leave to cool.

2.5. Fat Content

The 6-hour duration was sufficient for better oil extraction and higher yields using hexane as the apolar solvent. Generally speaking, the solvent extraction process is very efficient, especially for seeds with a low-fat content such as date pits. It should be noted that the oil from the date pits studied is yellow in color with a pleasant odor.

3. Results

The aim of this work is to valorize the secondary wastes of dates, in particular the pits, in order to contribute to their possible valorization in the Eastern region. Before proceeding with the experiments, it was necessary to characterize the biological material with which we are interested. Indeed, the morphological and physicochemical characterizations of date pits and oil were determined.

3.1. Morphological Characteristics

The morphological data for the date pits studied shows the masses and dimensions of two batches, ranging from 0.4 g to 2.9 g, with an average of 1.4 g for the weight of the pit, 2.2 cm for its length and 0.9 cm for its width. This gives an overview of the wide diversity of fruit waste seeds from the same farm.

- 0.4 g and 2.9 g with an average core weight of 1.4 g.
- 1.6 cm and 2.8 cm with an average core length of 2.2 cm.
- 0.6 cm and 1.5 cm with an average core width of 0.9 cm.

3.2. Moisture Content of Date Pits

Results ranged from 3 to 5% for batch A and 2 to 4% for batch B.

3.3. Fat Content

The oil content exceeds 6% and the higher content is Lot B, which is between 10% and 12%. Comparisons of oil extraction (Figure 2):

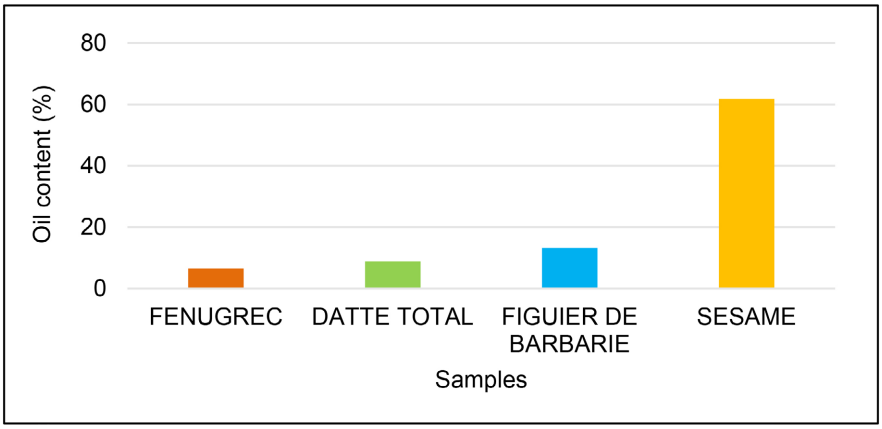

Figure 2. Comparative yields of vegetable oils from other species.

Among the contents obtained, we note that sesame seeds are far superior to the seeds crushed to extract the oils. Rates are −10% for Fenugreek and date seeds. Over 10% for prickly pear and over 60% for sesame seeds.

3.4. Physico-Chemical Analysis

The mineral elements are nitrates with 3.3 - 8.5 µM/ml, nitrites are 19 - 20.3 µM/ml, phosphate ions comprise 7 - 8.8 µM/ml, sulfate ions are 20.7 - 30.7 µM/ml (Figure 3).

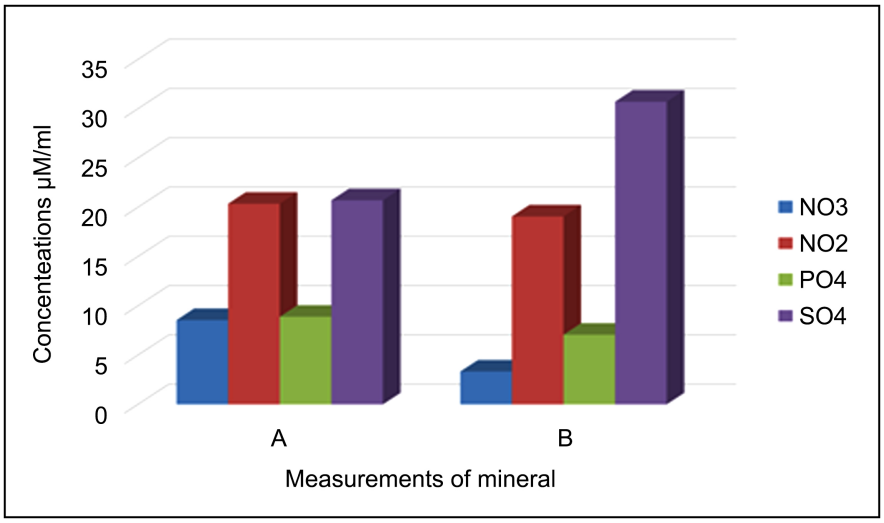

Figure 3. Mineral ion content of date cores.

3.5. Heavy Metals

Cadmium content in date cores is 0.01 - 0.07 ppm, zinc 0.9 - 2.2 ppm, copper 0.5 - 0.4 ppm, iron 1.7 - 2.1 ppm, nickel 0.2 - 0.07 ppm, cobalt 0.02 ppm. Lead content in date cores is 0.5 ppm, chromium around 0.2 ppm (Figure 4).

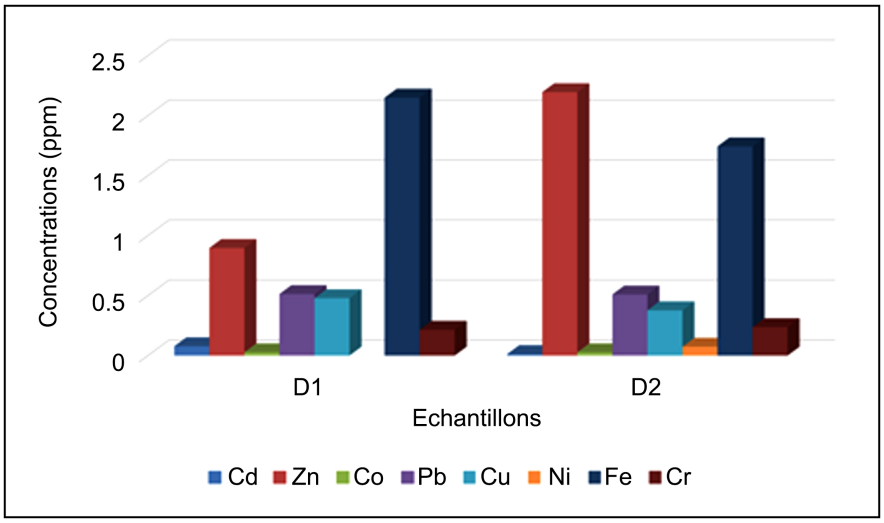

Figure 4. Determination of heavy metals.

3.6. Cream

A 100% natural cream is prepared under specific conditions and contains no synthetic products. It contains a complex of 7 components that work in synergy to repair the damage caused by time, to which fragile mature skin is more sensitive.

- Phytosterols: protective action.
- Phytosteroids: compensators for hormonal decline.
- Isoflavones: anti-aging.
- Ursolic acid: regenerating.

- Policosanols: fatty alcohols that strengthen the skin's lipidic cement and barrier.
- Tocotrienol: anti-oxidant.
- Vitamin A: anti-oxidant.

This complex stimulates the production of collagen1, the main dermal collagen responsible for skin suppleness and firmness. It also helps repair damage caused to cells by stress. It also has a protective function, boosting the skin's natural defenses against oxidative stress (Figure 5).

Figure 5. Date seed cream.

3.7. Soaps

The transformation of oil into soap (saponification), followed by cold and hot saponification, has enabled us to obtain soaps that are very different from those on the market, thanks to the properties of date kernel oil.

Using this method, the soap obtained did not foam. According to some authors [9], date kernel oil helps improve the soap's foaming power through its short-chain C12 and C14 GAs. It should be noted that in our practice, we have used date kernel oil in small quantities.

3.7.1. Cold Preparation

The soap obtained did not lather (Figure 6).

Figure 6. Cold process soap.

3.7.2. Cold Preparation

This method gives the soap its foaming power (Figure 7).

Figure 7. Hot soap.

3.8. Comparisons of the Water and Mineral Content of Different Date Seeds (Jordan, Algeria, and Morocco)

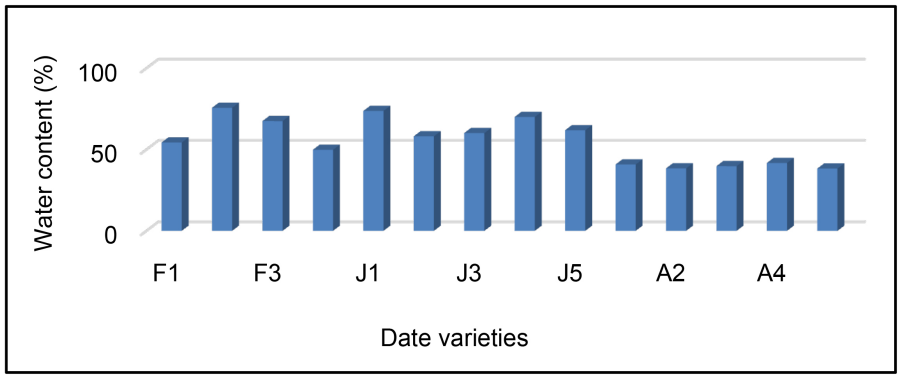

Figure 8. Dates from Jordan (J), Algeria (A) and Morocco (F). Numbers correspond to samples (Figure 8).

Table 1. Assays of mineral elements in dates from Jordan, Algeria and Morocco.

	Nitrate	*Nitrite*	*Phosphate*	*Proteines*	*Nitrogen*	*TE*
	µg/g (DM)	µg/g (MS) (0.58 in)	µg/g (DM)	mg/g (MS)	mg/g (MS)	%
Date J1	0	3	23.8	1.73	88	73.7103175
Date Ag	0	10.5	25.1	2.5	-	40.7894737
Date F1	0	3.3	5.7	0.9	-	54.326

The results measured on the date samples (J1, A1, F1) in Table 1 contain very low levels of nitrates (0 µg/g) and nitrites (3 - 10 µg/g), which are within expectations and do not pose any health risks. Samples J1 and A1 (≈24 - 25 µg/g) are close

to normal values reported in plant environments. F1 shows a much lower value of 5.7 for phosphate.

The protein content in seeds is higher (≈5 g/100 g), but the pulp is mainly sweet. The measurement of J1 at 88 mg/g suggests a significant nitrogen component. This value clearly exceeds the indicated protein content (1.73 mg/g), with J1 showing the highest value (≈73.7%), F1 a moderate value (≈54%), and A1 the lowest (≈40.8%).

This may reflect the proportion of sugars or energy fibers in dry matter. A1: Higher in protein and nitrites, with high phosphate but low TE. J1: Balanced profile: moderate in phosphates and protein, but very high in total nitrogen and TE. F1: The poorest nutritionally: low in phosphates, protein, and TE.

4. Discussion

The aim of this work is to contribute to the physicochemical and biological characterization of date kernel waste, which may highlight its possible valorization in the Eastern region. To this end, a trial was carried out to incorporate an aqueous extract and date kernel oil into cosmetics in the form of cream and soap.

Morphological data on the date cores studied show that the masses and dimensions of the two batches range from 0.4 g to 2.9 g, with an average of 1.4 g for core weight; from 1.6 cm to 2.8 cm, with an average of 2.2 cm for core length; and from 0.6 cm to 1.5 cm, with an average of 0.9 cm for core width.

The values found are about the same as those obtained by [10], from 1.48 g to 2.56 g. They are similar to those given by [8], in a study carried out on 13 varieties of Libyan date pits after extraction and characterization of dates of the *Mech-Degla* (Kentichi) variety and [11]-[13] for the cultivars *Allig*, *Mejhoul, Deglet Nour, Boufeggous gharas, Admam, Aziza manzou and Horra* respectively between 0.70 and 2.53 g indicating that the average value of the weight, length and width parameters are respectively 0.7 - 2 g and 0.2 - 1.32 g; 1.8 - 2.8 cm and 2.2 - 2.5 cm; 0.8 - 1.1 cm and 0.7 - 0.83 cm. A length-to-width ratio of 2.342 - 2.404 is a quality criterion.

According to [12] the proportion of core is a varietal characteristic and a selection criterion for prospectors. Concerning the biochemical composition of date pit waste: moisture content is a frequent analysis, as it estimates the moisture content of the date pit, which determines quality, spoilage during storage, stability and processability.

Our results of 2.313% - 4.562% are similar to those of [14] which are 4.22% - 4.78%, and [15] which are 3.14% for the *Mabseli* variety, 4.4% for the *Um-Shahal* variety and 5.19% for the *Shahal* variety. Notwithstanding those of [8] which are 7.87%; 7% and 7% - 11% respectively for the *Khalas, Lulu* and *Fard* varieties.

Compared with other foods such as cereal straw: 10% - 15% and 7% - 11% [16] [17], date pedicels: 10.4% [18], wheat:13.8% - 14%, barley: 12.4%, oats: 12.6%, beans: 12%, soybeans: 8% [19], white terfez: 68%, red terfez: 75%, black terfez: 77% [20]. Our results show that water content is the lowest among the named

groups, followed by cereals.

In date-growing and consuming regions, date pits are used as animal feed. In addition to nutritional constituents, recent research has also shown that date seeds have positive potential on health properties thanks to the presence of components with different biological actions, such as anti-inflammatory, antiviral and antioxidant activities [15] [21]-[23].

Date pits in powder form are added to livestock feed, contributing to an increase in plasma estrogen and/or testosterone. Confirmed by the pits of different date varieties, which are mainly used in cattle, sheep, camel and poultry feed (10% of the rate in flour in feed) [15] [24] [25].

Mineral analysis of date pits is carried out (**Figure 2**) to check for undesirable quantities that may be hazardous or toxic to the skin, whatever the source. The cadmium content of date pits is 0.0122 - 0.0775 ppm, which is still low compared with that obtained from *Mech-Degla* date pits [8] < 0.167 mg/100g MS. [26] obtained an undetected value.

Zinc content is 0.896 - 2.1946 ppm, which is also low compared with that obtained from *Mech-Degla* date pits of 3.11 ± 1.54 mg/100g [8], as well as the values given by [27], which range from 1.17 - 1.36 mg/100g DM from two Tunisian varieties of *Deglet Nou*r and *Allig.* In the literature, [25] obtain 0.2 mg/100g, while [28] detect 1.0 - 1.6 mg/100g and [29] record 1.0 - 1.5 mg/100g (variety: Bahraimi).

The copper content found in date pits is 0.478 to 0.3766 ppm, which is lower when compared with date pits of the *Mech-Degla* variety 11.9 mg/100g [8] and those given by [27] for the Tunisian varieties *Deglet* Nour and *Allig* of the order of 1.041 - 1.123 mg/100g and 1.12 mg/100g.

The iron content in date pits is 1.7424 - 2.1484 ppm which is low compared to *Mech-Degla* date pits 5.13 mg/100g. [8] obtained in Tunisian *Deglet Nour* and *Allig* date varieties 2.3 ± 0.21 mg/100g and 2.21 ± 026 mg/100g MS respectively.

The cobalt content in date cores is recorded at 0.0272 ppm, which is too low. According to [30], cobalt is one of the classic "indispensable" elements or trace elements commonly found in both human and animal nutrition. It is necessary in low doses and toxic in high quantities.

Mineral elements show highly variable values for both macro-elements and trace elements. In fact, nitrates and nitrites, as well as phosphates, are represented in very low quantities. The macro-element composition shows that potassium is the most abundant, followed by phosphorus, magnesium, calcium and finally sodium.

In terms of microelements, iron is the most abundant, followed by zinc. Calcium and phosphorus are often deficient in food. Fruit kernels can express levels of elements that are closely linked to soil type and the composition of irrigation water [31].

By analyzing the various sugars in date pits contain, allose (1.96 g/100g); arabinose (0.99 g/100g); galactose (0.35 g/100g); glucose (2.01 g/100g); fructose (0.01 g/100g); mannose (20.9 g/100g); rhamnose (0.03 g/100g) and xylose (0.48 g/100g)

[32] [33].

According to [34], the phenolic content was 215 - 526 mg/kg dry matter. Other authors have shown the range of polyphenol content in date stones. The fat content is 4% - 13% [8] [26] [33], the total sugar content (2.21% - 7.41%) and the proportion of reducing sugars (2.18% - 3.99%), non-reducing sugars (0.52% - 3.74%) and sucrose in date pit depending on variety.

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According to [34], the phenolic content was 215 - 526 mg/kg dry matter. Other authors have shown the range of polyphenol content in date stones. Fat content is 4% - 13% [8] [26] [33].

Fats are extracted hot in a soxhlet for 6 hours, which was sufficient for good depletion of date pits and better oil extraction yield using hexane.

Hot extraction gives better results than cold extraction, with a shorter extraction time and using the same solvent. The differences observed can be explained by several factors: the variety of core types, the type of solvent used for extraction, the ratio of powder mass to solvent volume, and the extraction technique used.

All the hexane is recovered at the end of the extraction process. The solvent extraction process is particularly effective for low-fat seeds such as date pits and olive pomace.

According to [9] [25] [35] [36], Date kernel oils contain capric, lauric, myristic, palmitic, stearic, oleic, linoleic and linoleic acids.

Date kernel oil is less well studied than other vegetable oils. The viscosity corresponds to 20 - 40 m Pa.s [35], which is directly linked to the presence of short-chain fatty acids [37] [38]. Our observation of color and odor showed a pleasant pale yellow to greenish-yellow color due to the presence of carotenoids.

They are highly superior natural antioxidants [35] [39]. Scientists in various fields are investing in their new product, date kernel oil, and its industrial application as cooking oil, for pharmaceutical and cosmetic purposes, and nowadays as a source of biofuel [40] [41].

Date kernel oils are opening up new fields in the food industry for frying and dietetics, as well as in the manufacture of margarine, where they are used for their color and protection against oxidation. In cosmetics, the oil is incorporated into creams and helps improve the foaming power of soap [9] [22] [23].

5. Conclusions

The results of the oil content obtained are between 6% - 11% on average for the samples.

Naturally, this work will need to be taken further, as many points remain to be clarified, including the cosmetic cream and the preparation of the soap, which will enable us to demonstrate any cosmeceutical properties.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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