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Exploring Vegetable Butter Production and Management in Tropical and Subtropical Regions

Barbara SAWICKA[1] Imran ASLAN[2] Mohammed MESSAOUDI[3,7] Hakiye ASLAN[4*]

Dominika SKIBA[1] Zahnit WAFA[5] Maria ATANASSOVA[6] Abdelkrim REBIAI[7]

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Abstract

(1) Background: The returning fashion for using natural raw materials in cosmetics raises interest in vegetable kinds of butter. However, there are more new types of butter from exotic tropical plants on the market for cosmetic raw materials. (2) The purpose of this manuscript is to review vegetable kinds of butter used in the cosmetics industry in the world, cultivated in tropical conditions. (3) Methods: Descriptive and comparative methods were used. (4) Results: This review provides an overview of the importance of vegetable kinds of butter in the global market, their applications in various industries, and their potential as a sustainable alternative to animal fats. The most important challenges and opportunities are associated with producing vegetable kinds of butter in tropical regions. Vegetable kinds of butter belong to the group of lipids and are characterized by a semi-solid consistency resembling traditional butter. They can be used in their pure form as home cosmetics, but they are usually present as a fatty component of the emulsions of various cosmetic preparations. (5) Conclusion: Naturally produced vegetable kinds of butter are Kokum, Sal, and Morah, also called Mahua. Tropical vegetables-based butters origin are not only raw materials rich in valuable bioactive ingredients, but also the products that are very pleasant to use.

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[1] https://orcid.org/0000-0002-8183-7624, Department of Plant Production Technology and Commodities Science, University of Life Science in Lublin, 20-950 Lublin, Poland, barbara.sawicka@up.lublin.pl,https://orcid.org/0000-0003-1572-1591 dominika.skiba@up.lublin.pl;

[2] https://orcid.org/0000-0001-5307-4474, Faculty of Health Sciences, Health Management Department, Bingöl University, Bingöl, Türkiye, imranaslan@gmail.com

[3] https://orcid.org/ 0000-0002-3536-6358, Nuclear Research Centre of Birine, P.O. Box 180, Ain Oussera, Djelfa 17200, Algeria, messaoudi2006@yahoo.fr

[4*] https://orcid.org/0000-0002-2936-5367, Food, Agriculture and Livestock Vocational School, Department of Food Processing, Bingöl University, Bingöl, 12000, Türkiye, heaslan@bingol.edu.tr

[5] https://orcid.org/0000-0001-5248-5984, Department of Chemistry, Faculty of Sciences, University of Ferhat ABBAS Setif 1, 19000 El Bez, Algeria; zahnit_07_hanane@outlook.fr

[6] https://orcid.org/0000-0002-6188-7990, Nutritional Scientific Consulting, Chemical Engineering, University of Chemical Technology and Metallurgy,1734 Sofia, Bulgaria; atanassovamarias@uctm.edu

[7] https://orcid.org/0000-0003-4353-7441, Laboratory of Applied Chemistry and Environment (LCAE), Chemistry Department, University of Hamma Lakhdar El-Oued, B.P.789, El-Oued 39000, Algeria, rebiai-abdelkrim@univ-eloued.dz

Tropikal ve Subtropikal Bölgelerde Yarı-Katı Bitkisel Yağların Üretimi ve Yönetimini Keşfetmek

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Anahtar kelimeler
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Öz

(1) Arka plan: Kozmetikte doğal hammaddelerin kullanımına yönelik modanın geri dönüşü, yarı-katı bitkisel yağlara ilginin artmasına neden olmaktadır. Bununla birlikte, kozmetik hammadde pazarında egzotik tropikal bitkilerden elde edilen daha fazla yeni yarı-katı bitkisel yağ türü bulunmaktadır (2) Bu çalışmanın amacı dünyada kozmetik sanayinde kullanılan, tropik koşullarda yetiştirilen yarı-katı bitkisel yağları incelemektir. (3) Yöntemler: Tanımlayıcı, karşılaştırmalı yöntem kullanılmıştır. (4) Sonuçlar: Yarı-katı bitkisel yağların küresel pazardaki önemi, çeşitli endüstrilerdeki uygulamaları ve hayvansal yağlara sürdürülebilir bir alternatif olarak potansiyelleri hakkında genel bir bakış sağlanmıştır. Yarı-katı bitkisel yağlar, lipit grubuna aittir ve geleneksel tereyağına benzeyen yarı katı bir kıvama sahiptir. Ortak noktaları cildi yağlandırma, yumuşatma ve yüzeyinde koruyucu bir tabaka oluşturma yetenekleridir. Saf formlarında ev kozmetikleri olarak kullanılabilirler, ancak genellikle çeşitli kozmetik preparatların emülsiyonlarının yağlı bir bileşeni olarak bulunmaktadırlar. (5) Sonuç: Doğal olarak üretilen yarı-katı bitkisel yağlar şunlardır: Kokum, Sal ve Mowrah, aynı zamanda Mahua, olarak da bilinir. Tropikal kökenli yarı-katı bitkisel yağlar, yalnızca değerli biyoaktif bileşenler açısından zengin hammaddeler değil, aynı zamanda kullanımı çok keyifli ürünlerdir.

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Introduction

Vegetable kinds of butter are a large group of lipids characterized by a semi-solid consistency resembling traditional butter. These are mainly triglycerides and esters of fatty acids with chain lengths of 12-22 carbon atoms. They are characterized by a variety of medicinal and cosmetic properties. They are rich in unsaturated fatty acids such as oleic acid, linoleic acid, and alpha-linolenic acid, which are beneficial to human health. They also contain fat-soluble vitamins such as vitamin E, which is a powerful antioxidant and protects against free radical damage. They are often used in the cosmetics industry as an ingredient in lotions and creams because they have moisturizing and nourishing properties for the skin (Maanikuu and Peker, 2017; Naaz, 2016; Vyas and Agrawal, 2012). They are very effective at lubricating, softening, and creating a protective layer on the skin's surface. Most plant butter can be used in their pure form as home cosmetics. However, they are usually used as a fatty component of emulsions of cosmetic preparations, such as creams, balms, masks, and other preparations (Maanikuu and Peker, 2017; Warra et al.,2010).

Vegetable kinds of butter of tropical origin are widely used in the food, cosmetic, and pharmaceutical industries, as well as in the production of biofuels. They are sold all over the world and are an important part of international trade. The largest importers of vegetable butter are China, India, and the European Union. According to Transparency Market Research, the global shea butter market could reach $3.5 billion in 2028 (Anonymous, 2023a). The United States, the Netherlands, Denmark, and France are among the leading importers of shea butter. Although the cosmetics industry is only a tiny part of the global market for shea butter, it is a key component of this sector that plays a significant role in increasing global demand. In the fat industry around the world, there is a lot of competition between different types of vegetable kinds of butter, such as palm oil, soybean oil, rapeseed oil, sunflower oil, and others. This competition affects the prices and availability of vegetable butter on the market. In recent years, more and more attention has been paid to the sustainable development of the production of vegetable kinds of butter, due to the impact on the environment and workers' rights. Most tropical countries where vegetable kind of butter is produced implement sustainable production programs to ensure the sustainability of these raw materials and minimize negative environmental impacts. All these factors influence the production and sale of vegetable kinds of butter in the world, making them one of the most important products in the food, cosmetics, pharmaceutical, and energy industries (Maanikuu and Peker, 2017).

Warm regions of Asia and Africa, from dry to tropical and humid, abound in plants from which cosmetic butters are obtained. The most common naturally occurring Asian butter include Kokum, Mowrah, Sal and mango butter from India and Il-lipe butter from Malaysia (Maanikuu and Peker, 2017; Vyas and Agrawal, 2012; Warra et al.,2010). On the other hand, it is known that dry lands account for 41% of the global land area and are inhabited by over 2 billion people on all continents (FAO, 2022).

Global population growth and economic development are leading to an increase in global demand for vegetable kinds of butter of tropical origin, which contributes to increased production and trade around the world. Vegetable kinds of butter are of great economic importance on the global market, especially as an alternative to animal fats. They are widely used in the food, cosmetics, and pharmaceutical industries, as well as in the production of biofuels and chemical products. The value of the global butter market in 2020 was approximately USD 250 billion, and it is forecast that this value will increase in the coming years (FAO, 2022).

Given the environmental challenges and increasing global demand, sustainable production of vegetable kinds of butter is imperative. This paper aims to review vegetable kinds of butter of tropical origin, their utilization in cosmetics industries, and the importance of sustainable practices in their production.

Material and Method

A comprehensive review of plants yielding butter used in cosmetics and food industries was conducted using databases such as Medline/PubMed, SCOPUS, Embase, and Web of Science. Over 90 articles on ethnobotany, phytochemistry, pharmacology, and cosmetology were analyzed to gather insights into the phytochemical properties and traditional uses of medicinal plants. Thematic articles were selected based on inclusion and exclusion criteria, focusing on tropical and subtropical climates. Quality assessment of primary studies was performed, and data were synthesized to provide a comprehensive understanding of vegetable kinds of butter (Tricco et al., 2011; Zeng et al., 2015).

Breakdown of butters

Vegetable kinds of butter, also known as triglycerides, consist of a glycerol molecule attached to three chains of fatty acids. Lipids in food and in cosmetology are a source of essential, unsaturated fatty acids (EFA), and play a significant role in the development of taste and smell. They contribute to the flavor of food due to their degradation to volatile compounds during food processing (heating/cooking and storage and/or interaction with other ingredients such as Maillard reaction and Strecker degradation) (Shahidi et al., 2022; Shramko et al., 2020). Lipids can contribute to the production of odors. In cosmetology, vegetable oils and butter are often used as natural fragrance ingredients that add a characteristic aroma to cosmetic products. In addition, they play an important role in skin and hair care, providing them with hydration and protection against moisture loss. Vegetable oils and butter are rich in nutrients such as vitamins, fatty acids, and antioxidants that improve the condition of the skin and hair, protecting them from harmful environmental factors. In addition, lipids are also used in the production of cosmetics as emulsifiers and stabilizers, improving the consistency and durability of products (Cieślik et al., 2016; Shahidi and Zhong, 2015). In cosmetics, fragrance is often one of the most important factors influencing the perception of a product by the consumer. Incorporating butter and lipids into cosmetic products such as creams, lotions, or perfumes can increase their durability and fragrance intensity, as these fragrances can be trapped in butter and released gradually during the use of the product. Vegetable kinds of butter and oils, such as coconut oil and jojoba oil, are popular ingredients in producing natural perfumes and cosmetics because they are readily available and have moisturizing and nourishing properties for the skin. For example, shea butter can have a characteristic nutty smell, and coconut oil can be sweet and exotic. Lipids are also often used as fragrance carriers in cosmetics to allow an even and long-lasting fragrance release (Shahidi et al., 2022). The breakdown of vegetable kinds of butter involves the hydrolysis of the ester bonds between glycerin and fatty acids, which is catalyzed by the enzyme lipase. This causes the release of fatty acids and glycerol, which can then be further metabolized by the body

for energy (Cieślik et al., 2016; Shramko et al., 2020). The breakdown of vegetable kinds of butter can occur through various metabolic pathways, including beta-oxidation and ketogenesis. Beta-oxidation occurs in the mitochondria of cells and gradually removes the two-carbon units from the fatty acid chains, which are then converted to acetyl-CoA. They can then enter the citric acid cycle to produce energy. Ketogenesis occurs in the liver and involves the conversion of acetyl-CoA into ketone bodies, which the body can use as an alternative source of saturated energy (Cieślik et al., 2016). The most common types of fatty acids found in vegetable kinds of butter include saturated fatty acids: These fatty acids have no double bonds in their carbon chain and are usually solid form at room temperature. The breakdown of vegetable kinds of butter is an important process for maintaining the body's energy balance and is regulated by hormones such as insulin and glucagon. Disruptions in this process can lead to metabolic disorders such as obesity and diabetes. The breakdown of vegetable kinds of butter, also called lipids, occurs in a process called lipolysis. This process consists of the hydrolysis of triglycerides, which are the main form of fat storage in plants, to glycerol and fatty acids (Shahidi et al., 2022; Shramko et al., 2020). Lipolysis is catalyzed by enzymes called lipases, which are produced by various plant tissues. This process allows you to obtain the energy and nutrients needed for growth, development and reproduction. In addition, the breakdown of vegetable kinds of butter also plays an important role in the stress response, such as during periods of nutrient deficiency or exposure to environmental stressors. Understanding the mechanisms and regulation of lipid metabolism in plants can provide insight into the development of new approaches to improve crop productivity and nutritional quality, as well as to promote human health and well-being (Shahidi et al., 2022). Lipid degradation occurs mainly through auto-oxidation, photo-oxidation, and enzymatic oxidation, which cause the production of many volatile compounds. Oxidation of unsaturated fatty acids generates hydroperoxides, which are then decomposed into aromatic volatile secondary products of lipid oxidation, including aldehydes, alcohols, and ketones (Shahidi et al., 2022; Shahidi and Zhong, 2015). The meaty flavor is generated by the breakdown of fatty acids during degradation to aldehydes, ketones, and alcohols, among others. In addition to the type and content of fatty acids, flavor and aroma are influenced by protein content, temperature, time, water activity, reaction medium, pH, maturation, marbling and cooking technique (Kerler et al., 2001; Shramko et al., 2020). Cooking methods modify the chemical composition of meat and promote lipid oxidation. Compared to other cooking methods, baking results in increased oxidation and volatiles due to the longer cooking time and high temperature. Thus, flavor production is enhanced by the Maillard reaction and lipid oxidation (Choungo et al., 2021; Tagliamonte et al., 2023).

Vegetable kinds of butter of tropical origin and their cosmetic use

Vegetable kinds of butter of tropical African origin

Shea butter

Material: Seed of *Vitellaria paradoxa* or *V. nilotica* tree belonging to the family *Sapotaceae* found mainly in Africa (Figure 1). The shea tree grows in the wild in the sub-Saharan savanna belt from West to East Africa, covering about twenty countries. The butter extracted from the fruit of this tree is used locally as food and cosmetic products for skin and hair (Ugwu-Dike et al., 2022). International Nomenclature of Cosmetic Ingredients name (INCI): Karite butter seed, Gulam butter seed.

Features: The kernels contain about 45% fat melting at 45°C. The refined product is almost white and somewhat granular with little or no odor. Shea butter is solid at room temperature but melts quickly at around body temperature.

Figure1. *Vitellaria paradoxa* tree (A); open fruit showing nut and files (B) and shea butter (C)

Source: own based on (Choungo et al., 2021)

Ingredients: This butter includes the saponification fraction, consisting mainly of stearic and oleic acids, but also palmitic, linoleic and arachidic acids. It also contains a significant unsaponifiable fraction composed of bioactive substances that are responsible for the healing properties of Shea butter, which has sunscreen properties and has a softening and moisturizing effect on the skin (Ugwu-Dike et al., 2022).

Production: The steps involved in the traditional method of extraction are shown as follows:

Action: Fungal and bacterial infections, scabies, acne vulgaris, measles, herpes, eczema, stye, cancer, smallpox, measles, herpes, hair loss, hair strengthening, dandruff, Wound care, burns, keloids, ulcers. Shea butter also has anti-aging and anti-inflammatory properties. Consuming it has a hypo-cholesterolemia effect and reduces the protein concentration in the blood serum and internal organs (Bello and Akinyele, 2016).

Application: Treatment of buttons all over the body, cord care, wound healing, eczema, bacterial infections, fungal skin infections, acne vulgaris, hair loss, bruises, strengthened hair, and ulcers (Choungo et al., 2021). Recently, there has been an increase in commercial and industrial demand for shea butter products. This surge of interest is attributed to the discovery of its importance in the cosmetics and confectionery industries, where it is used as a substitute for cocoa butter in the chocolate industry (Bello and Akinyele, 2016).

Kombo Butter

Material: Seed of *Pycnanthus angolensis* tree belonging to the family *Myristicacea* found in Africa (Figure 2).

INCI Name: Kombo butter seed better also referred to as *Myristica angolensis*

Features: The fat has a red brown color and an aromatic odor. The kernel resembles nutmeg in appearance. Ingredients: Lauric acid, myristic acid, oleic acid, palmitic acid (Banerji et al., 1984).

Production: The seeds of *P. angolensis* are milled into a fine paste and boiled to obtain combo oil.

Figure 2. *Pycnanthus angolensis* tree (A); fruit of *Pycnanthus angolensis* (B); Kombo butter (C) (Bello and Akinyele, 2016)

Action: The treatment of oral thrush, fungal skin infections, and body aches, which are symptoms associated with Type 2 diabetes mellitus (Bello and Akinyele, 2016).

Application: Antimicrobial activity, antifungal activity, anti-inflammatory activity using the 12-O-tetradecanoylphorbol-13-acetate (TPA)-induced mouse ear edema assay, antioxidant activity using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay (Bello and Akinyele, 2016).

Vegetable kinds of butter of tropical from South and North American origin

Cocoa butter

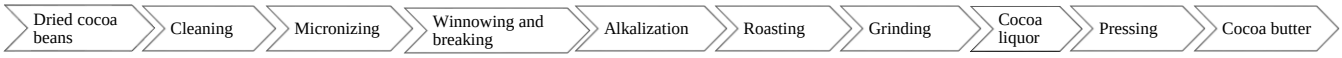
Material: Cocoa beans of *Theobroma cocoa* tree belonging to the family *Sterculiacea* found in tropical regions of America (Figure 3).

INCI Name: Cacao butter beans.

Features: The cocoa butter is light yellow solid fat, melting at 33°C, has a pleasant aroma and taste, and a good shelf life.

Ingredients: Palmitic acid, stearic acid, oleic acid, linoleic acid.

Production: The steps involved in the traditional method of fat extraction are shown as follows (de Souza et al., 2018):



Action: It is used to make chocolate, as well as some ointments, toiletries, and pharmaceuticals (Singh et al., 2020).

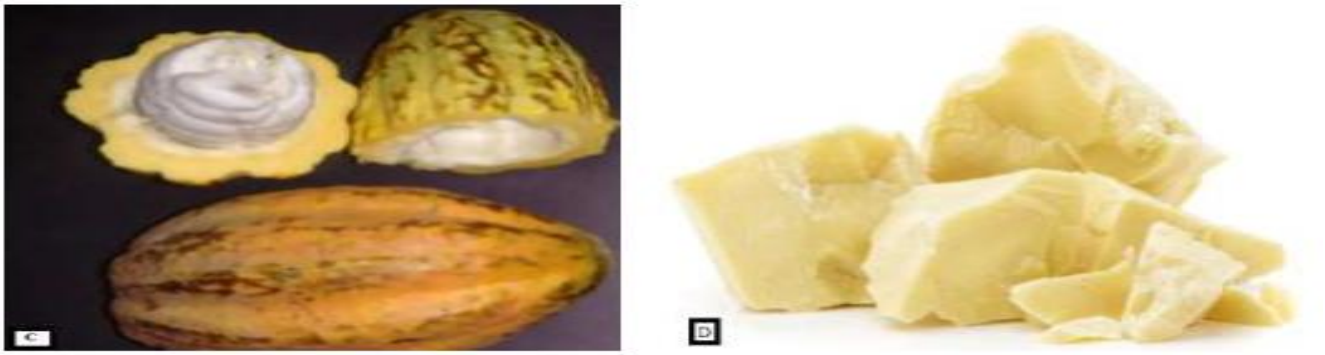


Figure 3. *Theobroma cocoa* tree (A); fruit of *Theobroma cocoa* (B) and open fruit *Theobroma cocoa* (C); Cacao butter (D) (Anonymous, 2023a)

Application: Cacao butter beans have a wide range of applications in various industries, including cosmetics, pharmaceuticals, and food. Here are some of the common applications of cacao butter beans:

- Cosmetics: Cacao butter is a popular ingredient in cosmetics due to its moisturizing and nourishing properties. It is used in various skincare products such as body butter, lotions, creams, and soaps. It is also used in hair care products to moisturize and protect the hair (de Souza et al., 2018).
- Pharmaceuticals: Cacao butter is used in the pharmaceutical industry to make suppositories and as an excipient in tablet formulations. It is also used as a base for topical ointments and creams.
- Food: Cacao butter is used in the production of chocolates, confectionery, and baked goods. It is also used as a substitute for dairy butter in vegan and lactose-free products (de Souza et al., 2018; Singh et al., 2020).
- Aromatherapy: Cacao butter is used as a carrier oil in aromatherapy to dilute essential oils for topical application (Singh et al., 2020).

Overall, cacao butter is a versatile ingredient with a variety of applications, and its unique properties make it a popular choice in many industries (Anonymous, 2023a; FAO, 2022; Singh et al., 2020; Warra et al., 2010).

Cupuaçu butter

Material: Fruit seeds of *Theobroma grandiflorum* tree, found in Brazil. Cupuaçu butter is derived from the seeds of the Cupuaçu fruit, which is native to the Amazon rainforest in Brazil (Esprendor et al., 2019).

INCI Name: *Theobroma Grandiflorum* Seed Butter. Features: nutty smell, beige color and quite hard consistency.

Ingredients: palmitic acid, palmitoleic acid, stearic acid, oleic acid, linoleic acid, arachidic acid, vit. C and A, phytosterols (Esprendor et al., 2019).

Production: The production process of Cupuaçu butter involves the following steps:

Harvesting > Fermentation > Drying > Roasting > Pressing > Cooling > solidifying > Refining (Esprendor et al., 2019).

Action: anti-inflammatory, soothing, moisturizing, lubricating, protects against UV radiation. Application: body care preparations with a moisturizing effect, used as an agent for the care of irritated skin and as an agent accelerating wound healing (Esprendor et al., 2019).

Murumuru butter

Murumuru butter is derived from the seeds of the *Astrocaryum murumuru* palm tree, which is native to the Amazon rainforest in Brazil (Lima et al.,2017).

INCI Name: *Astrocaryum murumuru* Seed Butter. Ingredients: Murmuru butter is composed mainly of fatty acids, including lauric acid, myristic acid, palmitic acid, stearic acid, oleic acid, and linoleic acid. It also contains phytosterols and vitamins, including vitamin A and vitamin E, which act as an antioxidant and help to protect the skin from environmental stressors (Shramko et al.,2020).

Actions: Murumuru butter acts as a protective barrier for the skin, protecting it from harmful external factors such as cold, wind, pollution, and UV radiation. Murumuru butter has anti-inflammatory properties and soothes inflammation of the skin, such as acne, eczema, and psoriasis. It moisturizes and nourishes the hair, preventing damage and brittleness. It contains phytosterols that help improve skin elasticity, which can help reduce wrinkles and loss of skin firmness (Lima et al.,2017).

Production: The production process of Murumuru butter involves the following steps: harvesting > extraction> cleaning > drying > roasting > pressing > cooling and solidifying > refining (Lima et al.,2017).

Applications: Murumuru butter has a range of applications in the cosmetic and food industries. It is a versatile ingredient with a range of applications in the cosmetic and food industries (Lima et al.,2017).

A) Other vegetable kinds of butter of tropical origin

- Mango Butter: Derived from the kernels of the mango fruit (*Mangifera indica*), mango butter is rich in fatty acids, vitamins, and antioxidants. It has moisturizing and emollient properties, making it suitable for skincare products.
- Babassu Butter: Derived from the seeds of the babassu palm, babassu butter has a light texture and is easily absorbed by the skin. It has moisturizing and soothing properties, making it suitable for dry and sensitive skin (Bezerra et al., 2020).
- Kokum Butter: Extracted from the seeds of the kokum tree (*Garcinia indica*), kokum butter is rich in antioxidants and fatty acids. It has emollient and regenerative properties, making it beneficial for skin and hair care (Anonymous, 2023a).
- Illipe Butter: Obtained from the nuts of the *Shorea stenoptera* tree, which is native to Southeast Asia, illipe butter has a high melting point and is often used in lip balms, lotions, and soaps. It has moisturizing and healing properties (Cieślik et al., 2016; Shramko et al., 2020).
- Tucuma Butter: Derived from the seeds of the tucuma palm (*Astrocaryum tucuma*), which grows mainly in the Amazon and other regions of South America such as Bolivia, Colombia, Peru, Ecuador and Guyana. Vegetable oil is produced from them, and tucuma butter is obtained from its fat, which has many uses in cosmetics and the food industry. Tucuma butter is yellow in color and has a consistency like shea butter, and its care properties result from the presence of vitamins, antioxidants and fatty acids. It has emollient and nourishing properties, making it suitable for skincare products (de Souza et al., 2018; Israel, 2014; Salas et al., 2009).

These tropical vegetable kinds of butter offer a range of benefits for skin and hair care and are valued for their natural properties and effectiveness in cosmetic formulations. The fruits of opuntia contain large amounts of water (92.8-93.4 g 100 g-1 FM). Its main components are carbohydrates, among them dietary fiber (47-51% DM). Due to its high nutritional value, opuntia is a valued medicinal plant used in phytotherapy. It also contains bioactive phytochemicals that contribute to its high antioxidant potential. Fruit gives a feeling of satiety (fiber). Because of the high content of flavonoid glycosides, it acts as an antidepressant. The anti-inflammatory properties of *Opuntia Ficus indica* seed oil make it popular in

skin care products (Cieślik et al., 2016). Other oils obtained from exotic seeds or fruits of wild plants are also important for pharmacy and cosmetology such as fan cactus seed oil is extracted from the seeds of the *Carnegiea gigantea* cactus, which is found in the southwestern United States and Northern Mexico. This oil is rich in unsaturated fatty acids and vitamin E, which makes it a moisturizing and nourishing ingredient in skin and hair care products (Salas et al., 2009; Shramko et al., 2020). Sabal cactus seed oil is extracted from the seeds of the Sabal palmetto cactus (*Serenoa repens*), which is found in Florida and other parts of the southeastern United States. Sabal palmetto is known for its healing properties. Sabal palmetto fruits contain phytosterols, fatty acids, flavonoids and carotenoids, which are used in natural medicine to treat inflammation of the prostate and relieve symptoms of prostate hyperplasia in men (Salas et al., 2009; Shramko et al., 2020).

Vegetable kinds of butter of tropical Asian origin

Bacuri butter

Material: Seed of *Platonia insignis* Mart. a tree belonging to the family *Crustacean* found in Brazil (Figure 4).

INCI Name: Bakri butter seed. Features: Lipid nanoparticles incorporated in semi-solid formulations melting at 54-56 ºC.

Ingredients: Myristic acid, palmitic acid, stearic acid, oleic acid, linoleic acid, and arachidic acid (Banerji et al., 1984).

Production: The production process of Bacary butter involves several steps, the following scheme: harvesting the fruit > extracting the seeds > processing the oil > refining > solidification. The oil is then allowed to cool and solidify to form the semi-solid Bacuri butter, which can be used in a variety of applications. Overall, the production of Bacuri butter involves a simple process that results in high-quality natural butter with a variety of beneficial properties.

Action: As a raw material for making soap, as well as treating skin diseases and formulating wound healing substances for animals (Silva et al., 1986).

Application: Cosmetic (Lima et al., 2022), Wound healing (Rodrigues Lima et al., 2022), Antioxidants and anticarcinogenic (da Costa Júnior et al., 2012), leishmanicides (Costa Junior et al., 2013), Antiepileptic, Immunomodulator (da Silva et al., 2014).

Figure 4. *Platonia insignis* Mart. Tree (A); fruit and pulp of *Platonia insignis Mart.* (endocarp) (B); seed of *Platonia insignis Mart.* (C); bakery butter (D) (Esprendor et al., 2019; Krist, 2020)

Cupuaçu butter

Material: Seeds of the cupuaçu tree, *Theobroma grandiflorum*i

INCI Name: *Theobroma Grandiflorum* Seed Butter. Features: Yellowish white in color, solid at room temperature, with a smooth texture and a mild, sweet aroma. Ingredients: Fatty acids, including oleic, palmitic, stearic, linoleic, and arachidic acids (da Costa Júnior et al., 2012).

Production: The seeds are harvested, roasted, and then ground into a paste. The paste is then pressed to extract the oil, which is then further processed and refined to produce the final butter product.

Action: Cupuaçu butter is known for its hydrating and emollient properties, making it a popular ingredient in skincare products. It is high in phytosterols, which can help to improve skin elasticity and reduce inflammation (Esprendor et al., 2019).

Application: Cupuaçu butter is used in a variety of cosmetic products, including lotions, creams, and soaps, as well as hair care products (Esprendor et al., 2019).

Mango Butter

Material: seed kernel of mango tree, *Mangifera sylvatica* Roxb. belonging to the family *Anacardiaceae* found in Bangladesh, India, China, Cambodia, Myanmar, Nepal and Thailand (Figure 5).

Figure 5. *Mangifera sylvatica* tree (A); fruit of *Mangifera sylvatica* with big kernel on left and fruit of *Mangifera indica* with big pulp in right (B) seed of *Mangifera sylvatica* (C); Mango Butter (D) (Adhikari-Devkota et al., 2023)

INCI Name: Mango Butter seed kernel. Features: Light yellow fat that is not greasy to the touch and has a characteristic nutty flavor (Akhter et al., 2016).

Ingredients: Palmitic acid, stearic acid, oleic acid, linoleic acid, arachidic acid (Adhikari-Devkota et al., 2023)

Production: Production of mango butter involves several steps, including harvesting the seed kernel, removing the husk, washing, drying, and grinding. The resulting powder is then pressed to extract the fat, which is then refined and purified to produce the final product (Adhikari-Devkota et al., 2023; Akhter et al., 2016).

Action: Mango butter is known for its moisturizing and emollient properties, making it an excellent ingredient in skincare products. It is also high in antioxidants, which help to protect the skin from environmental damage. The fatty acids in mango butter make it an effective emulsifier, which means it can help to combine oil and water-based ingredients in cosmetic formulations (Adhikari-Devkota et al., 2023; Akhter et al., 2016).

Application: Mango butter can be used in a variety of cosmetic products, including lotions, creams, soaps, and hair conditioners. Its moisturizing properties make it particularly well-suited for use in products designed for dry or sensitive skin. Mango butter is also a popular ingredient in lip balm, as it helps to hydrate and protect the delicate skin on the lips. Overall, mango butter is a versatile and beneficial ingredient in the cosmetic industry, offering a range of skincare benefits and applications (Kaur et al., 2023; Odion et al., 2020).

Chyuri butter

Material: Seed kernels of *Diplonema butyracea* (Roxburgh) belonging to the family *Sapotaceous* tree found in India (Figure 6).

Figure 6. Photographs of Chyuri tree (a); Chyuri seed (b); Chyuri butter (C) (Adhikari-Devkota et al., 2023)

INCI Name: Chura he lunches butter seed. Features: white fat with pleasant taste and odor. Like cocoa butter, the fat melts between 39-47°C. Ingredients: palmitic acid, stearic acid, oleic acid, linoleic acid (Adhikari-Devkota et al., 2023).

Production: The ripe Chyuri fruits are collected from the trees and dried. The seeds are then separated, cleaned, dried, and crushed to obtain flour. The seed flour is steamed in a perforated bamboo basket and placed over a boiling metal pot for steaming. The steamed flour is squeezed to extract the fat (Thapa, 2019).

Action: the treatment of headaches, rheumatism boils, pimples, and burns and used as an emollient for chapped hands and feet during winter.

Application: Leaves have been used to treat mouth ulcer and to relieve muscular pain, the stem has been used as a toothbrush to remove the foul smell, a decoction prepared by the inner bark is used to treat amenorrhea and diarrhea (Adhikari-Devkota et al., 2023).

Rambutan butter

Material: Seeds of the rambutan fruit, *Nephelium kappacism*, found in Southeast Asia, particularly in Indonesia, Malaysia, and Thailand.

INCI Name: Rambutan butter. Product name: Rambutan butter. Features: The butter has a fatty consistency and is not as hard and brittle as cocoa butter. Ingredients: Fatty acids (palmitic acid, stearic acid, oleic acid, and linoleic acid), lipids (Sulphoquin of syndical glycerol, di galactosyl diglycerides, cerebrosides, sterol glycosides, mono galactosyl diglycerides, and esterified sterol glycosides), bioactive compounds, such as flavonoids, terpenoids, saponins, fatty acids, aromatic compounds (Issara et al., 2014).

Production: The seeds are removed from the fruit and then cold-pressed to extract the oil, which is then further processed to produce the butter. Action: Skin disease, rheumatism, headache, laxative, piles, and sometimes used as galactagogue. Application: Rambutan butter is used in a variety of cosmetic products, including lotions, creams, and soaps. Its moisturizing properties make it particularly well-suited for use in products designed for dry or mature skin. It can also be used in hair care products to help moisturize and nourish the hair and scalp (Afzaal et al., 2023).

Illipe butter

Material: fruits of rambutan tree (*Nephelium lappaceurn*), belonging to *Sapindaceae* found in Southeast Asia (Figure 8). Rambutan is an exotic fruit native to Southeast Asian countries such as Indonesia, Malaysia, Thailand, the Philippines, Latin America and Australia. Its fruit is valued for its exotic appearance and the pleasant taste of its whitish flesh. Rambutan is primarily consumed fresh, but it is also used in the production of alcohol, preserves, syrups, and juices. During the processing of this fruit, its inedible thick epicarp and seeds, which respectively constitute 37–62% and 4–9% of the whole fruit,

are discarded. Rambutan seeds have a bitter taste and are consumed roasted, as well as used in chocolate recipes. Recent studies suggest that its peel may be rich in bioactive compounds such as ellagitannins, indicating potential applications in the food and pharmaceutical industries. Butter is not produced directly from the rambutan fruit, but an oil that can be used in the cosmetics and pharmaceutical industries (Lipp and Anklam, 1998).

INCI Name: Illipe butter, Rambutan tallow, Rambutan seed kernel fat (RSKF). Features: The rambutan tree can be propagated from seed or vegetatively through grafting or budding. Seed-grown trees take longer to mature and produce fruits, while grafted trees typically bear fruit within 3-4 years. Different parts of the rambutan tree, including the bark, leaves, and roots, are used in traditional medicine to treat various ailments, including diarrhea, fever, and diabetes.

Ingredients: the seeds of the rambutan fruit and contain a variety of ingredients, including fatty acids: a high percentage of saturated and monounsaturated fatty acids, including arachidic acid, palmitic acid, stearic acid, and oleic acid; carbohydrates, a small amount of protein, fiber; vitamins, including vitamin C and niacin (vitamin B3), minerals, including calcium, iron, and copper (Shramko et al., 2020).

Production: the process of extracting illipe butter from rambutan seeds is like the extraction process of other plant-based butter, such as shea butter or cocoa butter. However, illipe butter has a higher melting point than these other kinds of butter, making it more suitable for use in products that require a higher degree of heat stability, such as lipsticks, soaps, and candles (Cisse et al., 2019).

Action: Food, Immune System, Strengthen Bones, Improve the Sperm Quality, Anticancer, Blood Formation. Application: Rambutan oil is used in cosmetics as an ingredient in creams, lotions, and other skincare products because it has moisturizing, softening, and anti-inflammatory properties. It can also be used in the food industry as an edible oil (Muhammed et al., 2019).

Mowrah butter

Material: fruits of *Madhuca longifolia* tree (Figure 7).

INCI name: "*Madhuca longifolia* Seed Butter". This butter is commonly used in cosmetic and personal care products due to its emollient, moisturizing, and skin-conditioning properties. It is also known as Mowrah butter, and it has a creamy texture, a mild nutty aroma, and is solid at room temperature. Its high stearic acid content gives it excellent oxidative stability, making it a popular ingredient in skincare formulations (Ramadan et al., 2006).

Features: *Madhuca longifolia* Seed Butter is known for its excellent emollient and moisturizing properties, making it ideal for use in skincare formulations. It is easily absorbed into the skin and can help to improve skin texture, hydration, and elasticity (Shramko et al., 2020).

Ingredients: The butter is composed of fatty acids, including oleic, stearic, palmitic, and linoleic acids, which provide emollient and moisturizing properties to the skin. It also contains natural antioxidants such as vitamin E, which can help to protect the skin from free radical damage. Applications: *Madhuca longifolia* Seed Butter is used in a variety of cosmetic and personal care products, including creams, lotions, lip balms, and hair care products. It can also be used in massage and aromatherapy applications. Overall, *Madhuca longifolia* Seed Butter is a valuable ingredient in cosmetic and personal care formulations due to its moisturizing and skin-conditioning properties (Ramadan et al., 2006).

Figure 7. *Madhuca longifolia* tree (A); Fruits, (B) Madhuca processing, seeds elongate (Banerji et al., 1984).

Tengkawang butter

Tengkawang butter, also known as *Shorea stenoptera* butter, is derived from the nuts of the tengkawang tree native to Indonesia and Malaysia. It appears as a light yellow, semi-solid butter with a smooth texture and a slightly nutty aroma. Tengkawang butter, also known as *Shorea stenoptera* butter, is derived from the nuts of the tengkawang tree native to Indonesia and Malaysia. It appears as a light yellow, semi-solid butter with a smooth texture and a slightly nutty aroma. Rich in oleic, linoleic, and stearic acids, as well as vitamins A and E, it has a high melting point and remains solid at room temperature. Produced through cold pressing, it finds applications in traditional medicine, cooking, and cosmetics, supporting sustainable forest management and rainforest biodiversity in Southeast Asia. Produced: Through cold pressing, it finds applications in traditional medicine, cooking, and cosmetics, supporting sustainable forest management and rainforest biodiversity in Southeast Asia (Darmawan et al., 2021).

Vegetable kinds of butter profiles of tropical origin

Tropical vegetable kinds of butter are known for their high saturated fatty acid content, providing them with suitable melting points and rheological properties for food and cosmetic production. These butters fall into three groups: medium-chain fatty acids (e.g., coconut oil, palm kernel oil), butter rich in palmitic acid (e.g., palm oil), and butter rich in stearic acid (e.g., cocoa butter). While vegetable kinds of butter typically contain unsaturated fatty acids, exceptions like coconut and palm oil have high saturated fatty acid content (approx. 90% in coconut oil and 50-80% in palm oil). Palm oil's increased nutritional use is partly due to its historical consumption in tropical countries without causing cardiovascular diseases. Studies suggest its fatty acid composition resembles that of animal kinds of butter like lard, albeit with lower saturated fatty acid content (Anonymous, 2023b; Ngala et al., 2016; Sadowska and Wlodarczyk, 2022; Salas et al., 2009). Palm oil contains about 1% potentially health-promoting components including carotenoids, sterols, coenzyme Q10, vitamin E, and squalene. International guidelines recommend keeping saturated fatty acid intake below 10% of total energy, within which palm oil consumption has not shown adverse effects on health. However, assessing its impact is challenging due to the diverse types of palm oil available.

Modern biotechnology provides many alternatives for these species in modified oilseeds enriched in saturated fatty acids and in processes aimed at enriching common oils with unsaturated TAGs by enzymatic transesterification (Salas et al., 2009). Palm pulp or seed oil can be fractionated to produce palm olein or palm stearin. Palm olein is liquid at room temperature and has a higher content of unsaturated acids, especially monoenoic oleic acid. Palm stearin contains more saturated fatty acids, which is why it is solid at room temperature. Pulp or seed oils may be refined (Karupaiah et al., 2016).

Additionally, the pulp oil may be subjected to hydrogenation (curing), after which it has a more compact consistency, a lower melting point, and is slightly more chemically and thermally stable. The hydrogenation process, however, causes the formation of trans fatty acids in the oil, which have a proven negative impact on health (Karupaiah et al., 2016; Vega-Lopez et al., 2006). The limitations of these analyzes were the different composition of fatty acids in palm oils and different analytical techniques for determining markers of the cardiovascular profile (Sadowska et al., 2022). The properties of vegetable oils or butter of tropical origin make them suitable as emollients for softening and smoothing the skin and hair. These products are easily absorbed, leaving the skin and hair soft and flexible (Karupaiah et al., 2016). Vegetable butter is generally safe for sensitive skin and can offer various healing properties, depending on the plant it comes from. For instance, shea butter has anti-inflammatory properties and can alleviate symptoms of skin conditions like eczema and psoriasis. In summary, vegetable butter is a valuable ingredient in many cosmetic products, benefiting both the skin and hair (Szybiak and Wiechula, 2013; Vega-Lopez et al., 2006).

Increased consumption of vegetable oil has led to significant changes in fatty acid (FA) intake profiles among European populations, including the British. Oil profiles of sunflower (*Helianthus annuus*) and rapeseed (*Brassica napus*) are considered healthy substitutes for SFA-rich oils or butters, potentially improving European diets. However, despite modest reductions in SFA intake, it still exceeds health recommendations in most of Europe. Strategies to further reduce SFA intake are necessary (Harland, 2014).

Vegetable kinds of butter in cold-made soaps

Vegetable kinds of butter of tropical origin are a popular ingredient in cold-processed soaps due to their beneficial properties for the skin and the ability to add a creamy texture to the soap. In cold-processed soaps, vegetable kinds of butter of tropical origin are a favored ingredient due to their skin-nourishing properties and their ability to impart a creamy texture (Piskur. 1951).

These butters serve as a vital component alongside vegetable oils and water. Typically, they are incorporated into the soap in a dissolved state for easier integration with other ingredients. During the cold process of soap-making, the vegetable butter is heated to melt before adding a mixture of oils and alkaline water. Once all the ingredients are thoroughly mixed and the soap is set, it retains the benefits of the vegetable butter, contributing to its soft, creamy texture and enhancing its skincare properties. Soaps are anionic surfactants known since ancient times for their cleansing properties. They are salts, usually sodium or potassium, of higher fatty acids such as stearic, palmitic, or oleic acids (Norazlina et al., 2021).

These soaps are typically obtained through the saponification of butter (triglycerides) with hydroxides, following the reaction: fat + alkali (lye/soda) → Soap (salt) + glycerin. The resulting products include white and hard sodium soaps, commonly found in bar soaps, as well as soft, water-soluble potassium soaps. Other variations, such as lithium soaps and aluminum soaps, have specific industrial applications beyond general cleansing. The primary function of sodium and potassium soaps is their use as cleansing agents. They interact with insoluble dirt components such as grease and hydrocarbon lubricants, forming spherical micelles in which the hydrophobic parts of soap molecules absorb dirt particles while the hydrophilic COO- groups remain on the exterior, facilitating rinsing. Additionally, soap solutions lower the surface tension of water, aiding in wetting dirt and penetrating fabric pores. The formation of foam further assists in removing dirt from surfaces (Anonymous, 2023a; Ngala et al., 2016).

The resurgence of soapmaking began approximately three decades ago, with an increase in small-scale soap shops where enthusiasts handcraft soaps using both cold and hot methods. These artisanal soap makers utilize vegetable oils, butters, and a diverse array of natural additives such as herbs, clays, fruits, and dairy products, moving away from animal fats. While this trend is prominent in the United States, especially in southern states, and Australia, Europe, including traditional soapmaking centers like

France, Greece, and Spain, has also seen a rise in such soap factories, with Great Britain hosting a significant number of them (Anonymous, 2023a; Maanikuu and Peker, 20017).

Vegetable butter of tropical origin in cold-processed soap can indeed influence its color, fragrance, and properties. Depending on the type and quantity of butter incorporated, the soap may exhibit a richer hue, a subtle aroma, and enhanced skincare benefits. The fragrance of cosmetics is intricately linked to their chemical composition and the use of fragrances. Various cosmetics, including perfumes, deodorants, body creams, soaps, and shampoos, contain fragrance additives to impart distinct scents. These fragrances typically consist of a blend of chemical compounds such as esters, aldehydes, ketones, and alcohols, resulting in complex scent profiles with different fragrance notes. The aroma of cosmetics is not only intended to enhance the user experience but can also influence the emotional state and mood of the individual using the product (Ayegnon et al., 2015; Maanikuu and Peker, 2017; Naaz, 2016; Salas et al., 2009; Shahidi et al., 2022).

Here's how some common butter ingredients in cold-processed soaps behave:

- Aloe vera butter contains soothing and soothing properties for the skin and can also help moisturize and nourish it. In cold-processed soaps, Aloe vera butter can impart a delicate fragrance and texture that is easily absorbed. This butter is very hard and foams strongly (Naaz, 2016).

- Avocado Butter: Obtained from the flesh of avocados is rich in vitamins and fatty acids, imparting a smooth texture to soap and a subtle, earthy aroma (Maanikuu and Peker, 2017).

- Cocoa butter is renowned for its rich emollient properties, firming soap bars and subtly infusing them with a chocolate aroma. Rich in antioxidants and fatty acids, it helps maintain skin moisture. In cold-processed soaps, cocoa butter not only provides a creamy texture but also imparts a luxurious chocolate scent. Deodorized cocoa butter, lacking the intense cocoa aroma, is more versatile in soap making, offering a creamy texture and beneficial skincare properties. Despite being very hard and creamy, cocoa butter produces minimal lather (Naaz, 2016; Warra et al., 2010).

- Coffee bean butter contains caffeine, which can enhance blood circulation and reduce puffiness. In cold-processed soaps, it imparts a subtle coffee aroma along with beneficial skincare properties. This butter is characterized by its low hardness, creamy color, and high moisturizing properties (Naaz, 2016).

- Cupuacau butter is rich in vitamins and a fatty acid that can help keep skin moist. In cold-processed soaps, Cupuaçu butter introduces a delicate fragrance and creamy texture. It is characterized by medium hardness, moisturizing and low foaming (Warra et al., 2010).

- Mango Butter: Extracted from the seeds of mangoes, mango butter is prized for its moisturizing and nourishing effects on the skin, often contributing a fruity scent to soap formulations. Mango butter is rich in antioxidants and fatty acid that can help keep skin moist. In cold-processed soaps, mango butter introduces a delicate fragrance and creamy texture. This butter is characterized by medium hardness, hydration and low foaminess (Anonymous, 2023a; Warra et al., 2010).

- Murumuru butter is very hard, very cleansing and strongly foaming (Warra et al., 2010).

- Kokum Butter: Derived from the seeds of the kokum tree is valued for its non-greasy texture and ability to enhance the hardness of soap bars, typically without adding any significant fragrance.

- Mochaccino butter is a blend of cocoa butter and coffee that imparts a rich chocolate flavor and light coffee flavor to cold processed soap. Mochaccino butter can also add a creamy texture. It is characterized by medium-low hardness, is moisturizing and does not foam well (Naaz, 2016).

- Shea Butter: Renowned for its moisturizing properties, shea butter contributes to a creamy texture in soap and can impart a mild, nutty fragrance. Shea butter has a medium-high hardness, which makes it a popular ingredient in cold-processed soaps as it helps to keep their shape. Shea butter is also very

conditioning to the skin, which means it can help moisturize and nourish it. In cold-processed soaps, Shea butter introduces a very creamy texture (Ayegnon et al., 2015; Choungo et al., 2021; Ugwu-Dike et al., 2022).

Each butter contributes unique properties to cold-processed soaps, affecting fragrance, texture, moisturizing capabilities, and lathering. They influence both the physical aspects of the soap and its fragrance profile and skincare benefits (Ayegnon et al., 2015; Salas et al., 2009).

Solid oils of tropical origin that can be used like vegetable butter

Solid oils, derived from tropical sources, are hydrogenated vegetable oils that remain solid at room temperature. They serve as a versatile alternative to vegetable butter, offering similar consistency and applications in cooking and baking. Babassu oil, extracted from the seeds of the babassu palm (*Orbignya speciosa M.*) found in the Amazon rainforests of South America, exemplifies such a solid oil (Shramko et al., 2020).

Babassu oil, with its light-yellow hue and delicate nutty aroma, is solid at room temperature but easily melts upon contact with the skin. It boasts high concentrations of lauric and myristic acids, imparting moisturizing and emollient properties. Additionally, it is rich in vitamin E, phytosterols, and fatty acids, endowing it with antioxidant and anti-inflammatory capabilities. Babassu oil's ability to be readily absorbed by the skin without clogging pores makes it a sought-after ingredient in skincare and haircare products (Shramko et al., 2020).

Research of Shramko et al. (2020), underscores babassu oil's efficacy in moisturizing and nourishing the skin, positioning it as a natural substitute for coconut oil or shea butter in formulations, particularly for dry or sensitive skin types. Moreover, its utility extends beyond cosmetics; babassu oil finds application as a carrier for essential oils and massage oil. Furthermore, it serves culinary purposes in South America and is utilized in the production of soaps, detergents, and candles. Additionally, the meal resulting from babassu oil extraction has been evaluated as a potential feedstock for solid biofuel production (Bezerra et al., 2020; Silva et al., 2023).

Contemporary studies continue to explore babassu oil's potential benefits, including its antimicrobial properties, potential as a treatment for dermatitis, and its role in wound healing. Its multifaceted applications make it a valuable ingredient in various industries, from skincare to culinary and beyond.

Coconut oil continues to be a popular choice for its versatile applications and health benefits. Recent research has further highlighted its potential in various areas. Studies suggest that coconut oil's medium-chain fatty acids, particularly lauric acid, may have antimicrobial properties and could aid in combating certain strains of bacteria and fungi. Additionally, emerging evidence indicates that coconut oil could play a role in promoting heart health by increasing levels of HDL (good) cholesterol and improving overall cholesterol profiles. Furthermore, ongoing research explores its potential neuroprotective effects and its use in managing neurological conditions such as Alzheimer's disease. With its broad spectrum of uses ranging from skincare to dietary supplementation, coconut oil remains a staple ingredient appreciated for its multifaceted properties and contributions to overall well-being (Ayegnon et al., 2015; Cieślik et al., 2016; Shramko et al., 2020). Coconut oil, rich in lauric, decanoic, and octanoic acids, along with corresponding medium-chain triglycerides, possesses antibacterial and antioxidant properties. Scientific research has evolved over the years, from studying the fatty acid composition and cholesterol-lowering effects to investigating its impact on methane production in ruminants and exploring the influence of nanoparticles on its properties. Future research will focus on rapid detection methods, effectiveness, and the development of coconut resources, aiming for further advancement of the coconut oil industry (Yin et al., 2024). Trends in research on palm oil may focus on similar aspects to coconut oil, while also addressing issues of sustainable development and environmental protection. Here are a few suggestions for possible research trends:

1. Sustainable production practices: Research on sustainable palm oil production practices may focus on reducing deforestation, protecting biodiversity, and minimizing negative environmental impacts associated with its cultivation.

2. Development of alternative technologies: Research alternative palm oil production technologies that can minimize environmental impact, such as using modern cultivation methods or processing technologies.

3. Optimization of product properties: Research on optimizing palm oil properties to adapt it to various applications, such as changes in the refining process or modification of chemical composition.

4. Detection and prevention of adulteration: Like coconut oil, research on detecting and preventing palm oil adulteration may be a significant trend, aiming to ensure the quality and integrity of products in the market.

5. Research on health properties: Research on potential health benefits arising from the consumption of palm oil may also be a significant area of study, aiming to understand the impact of this oil on human health (Deen et al., 2021; Ghasemloy et al., 2017; Krist, 2020; Norazlina et al., 2021; Yin et al., 2024).

It is worth noting that research on palm oil should consider both its potential benefits and its effects on the natural environment and public health to ensure sustainable development and social engagement.

Production of vegetable butter of tropical origin

The production of vegetable kinds of butter involves several processes, from the selection of raw materials to the final product packaging. The quality of vegetable butter depends on the extraction method, raw material selection, and processing steps. In this section, we will discuss the different aspects of vegetable butter production (de Souza et al., 2018).

Extraction methods for vegetable kinds of butter

The extraction of vegetable kinds of butter can be done through various methods, including mechanical pressing, solvent extraction, and enzymatic extraction. Mechanical pressing involves applying pressure to the seeds or nuts to extract the oil, while solvent extraction involves the use of solvents such as hexane to extract the oil. Enzymatic extraction involves the use of enzymes to break down the cell walls and release the oil. Each extraction method has its advantages and disadvantages, and the selection of the method depends on the type of raw material and the desired quality of the final product (Silva et al., 2023; Singh et al., 2020).

Traditional methods of vegetable butter production

Traditional methods of vegetable butter production involve manual labor and simple equipment. These methods have been used for centuries and are still used in some parts of the world. For example, the traditional method of shea butter production in Africa involves hand-picking the shea nuts, roasting them over an open fire, crushing them, and boiling the crushed nuts in water. The mixture is then allowed to cool, and the butter is skimmed off the surface. Although traditional methods are labor-intensive and time-consuming, they produce high-quality butter with a unique flavor and aroma (Ghasemloy et al., 2017; Singh et al., 2020;).

Modern methods of vegetable butter production

Modern methods of vegetable butter production involve the use of advanced equipment and technology. These methods are faster and more efficient than traditional methods and can produce larger quantities of butter. One such method is the hydraulic press method, where hydraulic pressure is used to extract the butter from the nuts or seeds. This method is more efficient than traditional methods as it produces a higher yield of butter, and the butter is of better quality (de Souza et al., 2018; Norazlina et al., 2021). Another modern method is the screw press method, where a screw is used to apply pressure to the nuts

or seeds, extracting the butter. This method is also efficient and produces a high yield of butter. For example, the modern method of shea butter production involves using mechanical presses to extract the oil from the nuts, which is then refined and deodorized using advanced equipment. Modern methods can also produce a consistent quality of butter, which is important for large-scale production (Deen et al., 2021; de Souza et al., 2018; Norazlina et al., 2021).

Comparison of traditional and modern methods

Traditional methods of vegetable butter production are still used in some parts of the world, while modern methods are used in large-scale commercial production. Traditional methods produce butter with unique flavors and aromas, but they are labor-intensive and time-consuming. Modern methods are faster and more efficient, but they may not produce butter with the same unique qualities as traditional methods. The selection of the method depends on the type of raw material and the desired quality of the final product. However, modern methods can be more expensive and require more energy to operate, leading to a higher environmental impact. Traditional methods, on the other hand, are less efficient but may have a lower environmental impact (Table 1) (Deen et al., 2021; Ghazani et al., 2018; Krist, 2020).

Table 1. Comparison between traditional and modern methods of vegetable butter of tropical origin

	Traditional Method	**Modern Method**
Yield	Lower yield	Higher yield
Quality	Unique flavors and aromas	Consistent quality
Efficiency	Labor-intensive and time-consuming	Faster and more efficient
Cost	Lower cost	Higher cost
Environmental Impact	Lower environmental impact	Higher environmental impact
Equipment and Technology	Simple equipment and technology	Advanced equipment and technology

Source: own

Table 1 compares traditional and modern methods of tropical plant-based butter production. Traditional methods yield unique flavors but have lower efficiency and higher environmental impact. In contrast, modern methods offer higher yields and consistency, albeit with higher costs and resource use. Overall, modern methods, despite their higher initial investment, provide increased efficiency and quality consistency, making them favorable for large-scale production (Bonté, 2021; Deen et al., 2021; Ghazani et al., 2018; Honfo et al., 2014; Hurtado-Fernández et al., 2018; Krist, 2020; Mahbub et al., 2022; Mooz et al.,2012; Naik et al., 2014; Nguyen et al., 2023; Pereira et al., 2019).

Raw materials for vegetable butter production of tropical origin

Vegetable butter is extracted from the seeds, nuts, and fruits of various plants. The selection of raw materials is critical in determining the quality of the final product. The raw materials must be of high quality, free from contaminants, and harvested at the right time. The quality and composition of raw materials can affect the flavor, aroma, and texture of the final product. Here are some examples of raw materials used in vegetable butter production (Table 2).

Table 2. Some of raw materials used in the production of vegetable butter of tropical origin

Raw Material	**Source**	**Fatty Acid Composition**	**Melting Point (°C)**	**Yield (%)**	**References**
Shea Butter	Shea Tree	Oleic Acid (40-60%), Stearic Acid (20-50%), Palmitic Acid (3-9%)	31-45	15-25	(Ayegnon et al., 2015; Honfo et al., 2014; Israel, 2014)
Cocoa Butter	Cocoa Bean	Oleic Acid (29-43%), Stearic Acid (30-37%), Palmitic Acid (23-35%)	31-36	25-30	(Mahbub et al., 2022; Norazlina et al., 2021)

Mango Butter	Mango Seed	Oleic Acid (41-48%), Stearic Acid (32-45%), Palmitic Acid (6-9%)	32-40	15-20	(Kaur et al., 2023; Odion et al., 2020)
Avocado Butter	Avocado Pulp	Oleic Acid (60-70%), Palmitic Acid (10-20%), Linoleic Acid (5-12%)	23-30	10-15	(Hurtado-Fernández et al., 2018; Mooz et al., 2012)
Illipe Butter	Shorea Stenoptera Seed	Stearic Acid (36-48%), Oleic Acid (34-44%), Palmitic Acid (10-20%)	32-36	50-55	(Muhammad et al., 2019)
Kokum Butter	Kokum Tree Seed	Stearic Acid (35-40%), Oleic Acid (35-45%), Palmitic Acid (5-10%)	34-40	50-60	(Chate et al., 2019; Krist and Krist, 2020a; Thippeswamy and Raina, 1989)
Cupuacu Butter	Cupuacu Tree Fruit	Oleic Acid (30-35%), Palmitic Acid (8-10%), Stearic Acid (30-35%)	30-35	50-55	(Krist and Krist, 2020b)
Murumuru Butter	Murumuru Palm Fruit	Lauric Acid (43-49%), Myristic Acid (20-33%), Oleic Acid (16-25%)	25-30	60-70	(Lima et al., 2017)
Hemp Seed Butter	Hemp Seed	Linoleic Acid (50-60%), Alpha-Linolenic Acid (15-25%), Oleic Acid (10-15%)	24-30	30-40	(Silva et al., 2023)
Soy Butter	Soybean Oil	Linoleic Acid (44-62%), Oleic Acid (20-30%), Palmitic Acid (7-14%)	25-30	80-85	(Nguyen et al., 2023; Pereira et al., 2019)

Table 2 summarizes key details of raw materials used in tropical vegetable butter production, including their source, fatty acid composition, melting point, and yield percentage.

Processing steps of vegetable butter production of tropical origin

The processing steps for vegetable butter production depend on the extraction method and the type of raw material. Generally, the processing steps include cleaning and sorting the raw material, roasting or heating to release the oil, pressing or extracting the oil, refining and deodorizing the oil, and packaging the final product. Each step must be carefully monitored to ensure the quality of the final product (Table 3) (Naik and Kumar, 2014; Nguyen et al., 2023; Poljšak et al., 2020).

Table 3. Information on the processing steps for vegetable butter production

Processing Steps	**Description**	**Time**	**Cost**	**Notes**
Cleaning and Sorting	Raw materials are cleaned and sorted to remove any impurities and foreign matter.	1-2 hours	Low	This step is essential to ensure the quality and purity of the final product [a].
Roasting/Heating	Raw materials are roasted or heated to soften them and facilitate the extraction process.	2-4 hours	Medium	Roasting also enhances the flavor and aroma of the final product [a, b, c.]
Grinding	Roasted/heated raw materials are ground into a fine paste or powder.	1-2 hours	High	The grinding process should be done carefully to avoid over-processing, which can negatively affect the texture and quality of the final product [a, c.]
Extraction	The ground raw materials are pressed or otherwise mechanically extracted to separate the butter from the solids.	2-4 hours	High	Care must be taken to ensure that butter is not exposed to high temperatures or harsh chemicals, which can affect its quality [a, b, c.]
Clarification	The extracted butter is heated to remove any remaining water, impurities, or solids.	1-2 hours	Medium	Clarification is important to improve the texture and shelf life of the final product [arc].

Filtration	The clarified butter is filtered to remove any remaining impurities or solids.	30 minutes - 1 hour	Low	Filtration is important to improve the appearance and texture of the final product [a, b, c.]
Cooling	The filtered butter is cooled to solidify it and make it easier to handle.	1-2 hours	Low	Care must be taken to avoid exposing the butter to high temperatures or moisture during the cooling process [a, c.]
Packaging	The cooled butter is packaged in appropriate containers for storage and distribution.	30 minutes - 1 hour	Low	Proper packaging is important to ensure the quality and shelf life of the final product [a].

Source: ([a] : Naik and Kumar, 2014; [b] : Nguyen et al., 2023; [c] : Poljšak et al., 2020)

Quality control measures in vegetable butter production of tropical origin

Quality control measures are essential in vegetable butter production to ensure that the final product meets the required standards. Quality control measures include monitoring the raw material quality, controlling the processing conditions, testing the final product for contaminants and impurities, and ensuring that the product meets the required specifications (Abdul-Mumeen et al., 2019; Hamed et al., 2019; Kazazić et al., 2021; Kumoro et al., 2020).

The following are some of the key quality control measures in vegetable butter production:

- Raw material inspection: The first step in quality control is to inspect the quality of the raw materials used in production. The quality of the raw materials can affect the quality of the final product. The raw materials must be inspected for freshness, purity, and quality.

- Processing control: Quality control measures must be implemented throughout the production process. Parameters such as temperature, pressure, and time must be controlled and monitored closely to ensure that the product meets the required specifications (Kumoro et al., 2020).

- Product testing: Finished products must be tested to ensure that they meet the required specifications. Tests may include sensory evaluation, chemical analysis, microbiological testing, and physical testing.

- Traceability: Traceability is crucial in vegetable butter production to ensure that products can be traced back to their source if any quality or safety issues arise. All raw materials must be properly labeled, and production records must be kept tracking each batch of products (Bezerra et al., 2020).

- Good manufacturing practices (GMPs): GMPs are a set of guidelines that ensure that products are consistently produced and controlled according to quality standards. GMPs cover all aspects of production, including personnel hygiene, equipment maintenance, and cleaning procedures (Hamed et al., 2019; Kazazić et al., 2012).

Quality control measures in vegetable butter production of tropical origin are crucial to ensure product quality and safety. These measures include inspecting raw materials, controlling processing conditions, testing final products, ensuring traceability, and adhering to good manufacturing practices (GMPs) (Abdul-Mumeen et al., 2019; Hamed et al., 2019; Kazazić et al., 2021; Kumoro et al., 2020).

Traceability is vital for identifying the source of any quality issues, requiring proper labeling and record-keeping. Adhering to GMPs ensures consistent production according to quality standards, covering personnel hygiene and equipment maintenance (FAO, 2022).

Safety considerations in vegetable butter production of tropical origin

Safety in the production of plant-based butter is crucial for the protection of both workers and consumers. Hazards may include fires, electrical hazards, exposure to harmful chemicals, and allergens (Bao et al., 2023; Papadopoli et al., 2020; Sithole et al., 2022a). To ensure a safe working environment, it is necessary to adhere to appropriate safety procedures and guidelines, such as:

1. *Chemical Hazards*: Workers must be trained in the safe handling of chemicals used in the production process, such as solvents and cleaning agents. Personal protective equipment (PPE), including gloves, goggles, and respiratory masks, is required.

2. *Physical Hazards:* Machinery used in production can pose risks of injury to workers. Adequate safeguards, training in machinery operation, and regular maintenance protocols are crucial to mitigate these risks.

3. *Biological Hazards:* Raw materials used in production may contain harmful bacteria and microorganisms. Proper hygiene practices and strict cleaning protocols must be implemented to prevent the spread of bacteria.

4. *Allergen Control:* Allergens pose significant risks to individuals with food allergies. Production must be designed to minimize cross-contamination. Separate production lines for allergen-containing products and thorough equipment cleaning between runs are necessary.

5. *Environmental Considerations:* Tropical ecosystems are delicate and biodiverse. Production practices must not harm local ecosystems, water sources, or wildlife.

6. *Regulatory Compliance:* Compliance with local and international safety regulations is essential. Regular audits and adherence to standards ensure that production processes meet safety requirements.

7. *Community Health and Safety:* The potential impact of production activities on surrounding communities must be considered. Measures should be taken to minimize pollution and promote community health and safety.

Environmental Impact of Vegetable Butter of Tropical Origin Production

Vegetable butter production can have positive and negative environmental impacts (Konstantas et al., 2018; Nilsson et al., 2010). While the use of renewable raw materials such as nuts, seeds, and fruits make vegetable butter production more sustainable than animal-based butter production, there are still environmental considerations to address:

1. *Energy Consumption:* Significant energy consumption is often required for heating, cooling, and processing in vegetable butter production. Efforts to reduce energy consumption by adopting energy-efficient equipment and processes are crucial to minimizing environmental impact (Sithole et al., 2022b).
2. *Water Usage:* Vegetable butter production relies heavily on water, particularly for cleaning and sanitation purposes. Optimizing water usage through water-efficient equipment and processes and implementing water recycling initiatives can help mitigate the environmental impact (Abdul-Mumeen, et al., 2019).

3. *Waste Management:* Vegetable butter production can generate substantial waste, including packaging waste, organic waste, and wastewater. Implementing recycling programs and waste reduction strategies are essential for minimizing environmental impact (Nilsson et al., 2010; Sithole et al., 2022b).

Ethical considerations in vegetable butter production also merit attention, particularly concerning fair trade and labor practices:

- Fair Trade and Labor Practices: Many raw materials used in vegetable butter production come from developing countries where labor standards may not be as stringent. Fair trade certification and ethical sourcing programs can ensure that farmers receive fair compensation for their products and that labor practices meet ethical standards.

- Support for Small-Scale Farmers: Efforts to support small-scale farmers and promote sustainable farming practices can contribute to ethical vegetable butter production. This includes initiatives to

improve working conditions, provide fair wages, and promote environmentally sustainable farming methods.

By addressing both environmental and ethical considerations, vegetable butter production can strive to minimize its impact on the environment while promoting fair and ethical practices throughout the supply chain (Codex Alimentarius, 2019; Goldstein et al., 2016; Sage, 2003).

Towards the future

These days, plants and vegetable kinds of butter are becoming more and more popular due to their potential health benefits and environmental impact. There are several important directions for future research on plants and vegetable kinds of butter of tropical origin:

- Research on the chemical composition of plants, which aims to understand what chemical compounds occur in plants, how they affect health, and what applications they can have in the production of cosmetics, food, pharmaceuticals, and other products of tropical origin,

- Research on the health effects of vegetable butter: Although vegetable butter is considered healthier than believed, there are still differences in the composition and properties of butter from different plant species and from different regions of the world. They can help to better understand the impact of vegetable kinds of butter on human health and better understand their role in disease prevention,

- Research on edible plants and their impact on health. Edible plants contain many nutrients and phytonutrients that affect human health. This research can help identify the best sources and ways to use them in nutrition,

In addition, future research should focus on developing more sustainable production methods, as well as supporting and advancing knowledge of its potential health benefits and environmental impact. The introduction of standards and regulations to produce vegetable butter of tropical origin can also help ensure its quality and safety for consumers (Codex Alimentarius, 2019). However, with the growing popularity of vegetable butter of tropical origin, there are also concerns related to the cultivation and processing of plants rich in vegetable oils and butter, and therefore, attention should be paid, especially in drought-prone countries, to integrated plant production and good industrial practices in cosmetic production.

Conclusions

Vegetable kinds of butter of tropical origin are becoming more and more popular due to their positive properties for health and the environment. In recent years, many studies have focused on the potential benefits of plant-based butter consumption, such as reducing the risk of heart disease and improving digestion. The best-known natural vegetable butters of tropical origin in the world are shea butter from West Africa, cocoa butter from South and Central America, as well as West and East Africa; kokum butter from India; murumuru butter from the Amazon in Brazil and tucum butter - from the rainforests of South America. These vegetable kinds of butter are popular for their care properties, as well as for their use in the cosmetics and food industries. They also have the potential to improve living conditions and income for the local communities that produce these crops. In addition, vegetable butter of tropical origin is widely used in the cosmetic, pharmaceutical, and food industries. They are increasingly replacing traditional animal kinds of butter, which are considered less healthy. Vegetable butter is a popular ingredient in the production of cosmetics because it contains many beneficial substances for the skin. However, with the growing popularity of vegetable butter of tropical origin, there are also concerns about the cultivation and processing of plants rich in vegetable oils and butters. It is necessary to take measures to ensure sustainable production of vegetable butter and to prevent the negative effects of its cultivation, such as the logging of rainforests or destruction of the natural environment. For food security

and sustainable development, it is important to use certified products and ensure the shortest possible supply chains.

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