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Evaluation and characterization of kokum-butter baby oil

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Abstract
The transition from intrauterine life to the relatively dry and chilly surroundings occurs throughout infancy. Because of their underdeveloped immune systems, infants' skin is more sensitive and more susceptible to issues. Varied age groups of children have varied skin conditions, including diaper rash, cradle cap, baby eczema, prickly heat, and many more. Items like light cleansers and lotions are used in the early stages of infancy. Later, as part of normal care, massage oils, creams, lotions, soaps, bubble baths, and other items are used for a few more years. Preterm babies are particularly vulnerable to topical product toxicity and skin damage. When selecting a product for a baby, careful consideration must be given to the substances included in such items. Before applying any such treatment topically to an infant's skin, it must be carefully screened for any potentially dangerous chemicals. Products for babies should be safe and free of irritating substances such as coloring, plant oils, extracts, parabens, and scent. In order to create and assess the physicochemical qualities of Kokum-Butter Baby Oil, appropriate ingredients were used in this research, including Kokum-Butter, olive oil I.P., sesame oil I.P., and cod liver oil B.P. in varying amounts. The Kokum-Butter Baby Oil formulation underwent assessments of its chemical and physical stability.

Keywords: Evaluation, characterization, kokum-butter and baby oil

Introduction
This research aims to develop Kokum-Butter Baby Oil utilizing natural extracts and assess its Physico-chemical characteristics, conditioning effects, and moisturizing impact. The methodology used for this evaluation is straightforward, replicable, and quantitative in nature. In our practice, we use oil formulations that include natural herbal components as opposed to synthetic oil alternatives. Nevertheless, the development of cosmetic products consisting only of natural ingredients poses significant challenges. Medicinal plants have the potential to be used in several forms, including extracts, powders, crude preparations, and derivatives. The researchers endeavor to create oil formulations that include naturally occurring substances in order to achieve a safer and gentler impact. However, the process of commercializing these oils poses significant challenges. One may begin the application of a little quantity of a mild herbal Baby Oil into the infant's skin. A limited quantity of skin-protective oils remains adhered to the surface of the skin. As the infant matures and develops a complete head of hair, it becomes appropriate to increase the amount of oil used in order to effectively cleanse the newborn. Infants possess a thinner epidermis that exhibits a heightened susceptibility to dehydration relative to adult skin. Consequently, the selection of a mild shampoo specifically formulated for babies may effectively mitigate the occurrence of dryness and itchiness in their delicate skin [1, 2].
The use of herbal baby oil has the potential to facilitate the loosening of substances such as spit-up, food particles, oils, and other foreign matter that may accumulate inside the infant's oral cavity. The appropriate baby oil is characterized by its soothing properties, making it suitable for daily use without causing skin or hair dryness. Each infant exhibits unique characteristics, therefore making the effectiveness of any given oil variable among individuals. It is advisable to take into consideration the use of fragrance-free goods. It is possible that they might be seen as less bothersome. The use of herbal baby oil does not possess the ability to induce hair growth or accelerate the rate of hair growth in infants. Hair development is influenced by both hormonal and hereditary factors. The use of herbal baby oil has been shown to contribute to the maintenance of hair health, hence promoting long and robust hair growth.

This research used several herbal crude materials depending on their respective roles, including the dried fruits of kokum [3].

Nutritional composition of kokum Butter

Primary metabolites of kokum Butter

The nutritional value of a fruit is determined by the presence and quantity of essential components such as carbohydrates, proteins, and sugars. The flavor of the fruit, as well as the growth and development of the fruit, may be directly influenced by these factors. Kokum is mostly composed of carbohydrates, which serve as the predominant metabolites in this substance. Fruits mostly include carbohydrates, which serve as the primary macronutrients. They serve as the primary energy source for the cell and represent the most basic biomolecules that are naturally produced. Reducing sugars are a class of carbohydrate molecules that include a free aldehyde or ketone functional group, allowing them to undergo reduction reactions by reducing metal ions to a lower oxidation state. The sweetness of a fruit is attributed to reducing sugars such as glucose and fructose. Proteins play a crucial role in cellular healing and the synthesis of new cells. Dietary fats have a crucial role in facilitating the absorption of vitamins. Kokum is a fruit that is abundant in proteins and carbohydrates [4, 5].

Fig 1: Kokum plant

Mineral composition of kokum Butter

Minerals serve a significant role in metabolism and functioning of cells and are required in minuscule amount for human health. Kokum contains macro minerals such as sodium, potassium, calcium, magnesium, and phosphorus in addition to micro minerals such as iron. High levels of potassium, calcium, magnesium, and iron are found in kokum. Minerals aid in a variety of ways, including sodium and potassium's contribution to fluid balance, magnesium's contribution to protein synthesis, calcium and phosphorus' contribution to healthy bones, and iron's contribution to an elevated blood level. Magnesium and potassium were discovered to be the most abundant minerals. A high percentage of fruit tissue contains potassium, calcium, and magnesium, making kokum an essential medicinal fruit [6].

Vitamin composition of kokum Butter

Vitamins are organic, essential micronutrients that play a crucial function in enzyme regulation and metabolism. As shown in the table, kokum is rich in vitamin B2, which is a water-soluble vitamin that cannot be retained in the body and cannot be synthesized by the body; therefore, it must be consumed through food. Since kokum is rich in vitamin B2, it should be consumed routinely to maintain vitamin balance. Vitamin B2 facilitates the transformation of carbohydrates into glucose [7].

Medicinal benefits of kokum Butter

Ayurvedic texts make reference to the usage of the kokum (*Garcinia indica*) plant in the treatment of a wide range of ailments, including liver failure, diarrhea, cancer, and heart disease. The phytochemical properties of kokum include, among others, those of being antiulcerogenic, cardioprotective, anticancer, chemopreventive, radical scavenging, and anti-obesity. It is also beneficial in treating acne, diarrhea, bladder discomfort, and cardiac issues. The "kokum butter" found in garcinia seeds has a fat content between 33 and 44%. It has been lauded for its nourishing, toning, and soothing properties. Due to its high di-saturated glyceride concentration, it is a welcome replacement for cocoa as an extender in chocolate and other sweets. Because of the vitamin E it contains, kokum butter is readily absorbed by the skin. It has remarkably hydrating and nourishing effects. As a result, it has found a thriving market outside of the confectionery sector, particularly in the field of cosmetics [8].

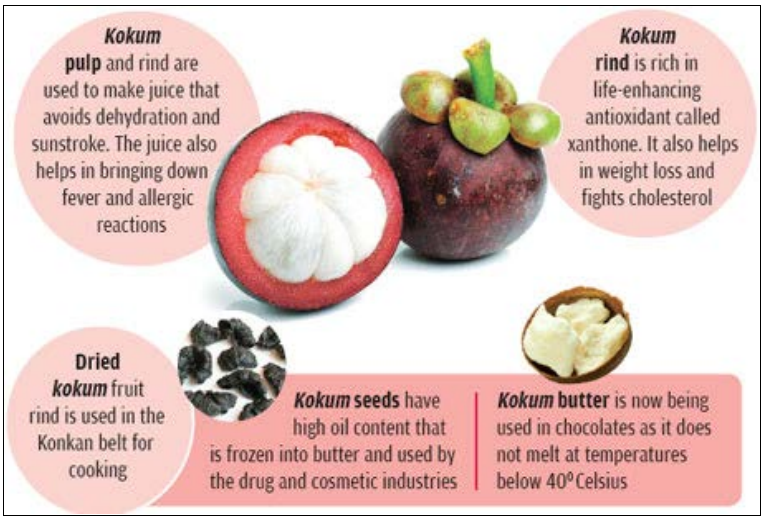

Fig 2: Medicinal benefits of kokum

Anti-Fungal Activity

Pathogenic mushrooms are the plants that spread the most, and they can change during growth and after harvest. There are many types of fungi that can grow on fruits and veggies. These fungi can cause genetic problems that affect the amount of good food, the taste, and the shelf life. There are also times when the fungus indirectly causes allergic responses or allergies in customers because it makes mycotoxins or allergens. Some experts have looked into how well a liquid extract of kokum rind can kill candida albicans and Penicillium. Chloroform with kokum skin extracts stops the growth of aspergillus flavus and aflatoxin [9].

Antibacterial Activity

The kokum rind extract, which contains hexane, benzene, and garcinols, has significant antibacterial properties. The anti-inflammatory effect of the aqueous extract derived from the fruit rind of *Garcinia indica* was investigated in mice via the evaluation of carrageenan-induced paw edema and cotton pellet-induced granuloma. The susceptibility of salmonella paratyphi a, salmonella typhimurium, and salmonella typhi to kokum leaf extract was observed in terms of its antiviral effect. The primary antibacterial action against Bacillus subtilis, and subsequently Escherichia coli, is shown by the secretion of a liquid substance from the outer layer [11].

Anti-neoplastic activity

The act of inhibiting, preventing, or halting the growth of neoplasms (Tumors) is referred to as antineoplastic activity. The growth effects of kokum, namely garcim-1, garcinol and its derivatives, garnica-2, and cambogia, are shown to be restricted on immortal intestinal cells and neoplastic colon cancer cells.

Need of work

- When compared to other products that are widely available on the market, natural baby oil is the safest to use and the most effective.
- Suitable for every kind of skin. Anybody with any kind of skin may use them without ever having to worry about their skin becoming worse.
- No adverse reactions.
- Herbal products are those derived from plants or botanicals that are used to prevent or cure illnesses.
- The natural minerals and nutrients found in botanicals nourish the body without causing any negative impact on the baby's health.
- To make sure they are secure and efficient for use in baby, the majority of baby oil products undergo initial testing on animals. However, animal testing is not required for natural cosmetics. Ayurvedic experts evaluate these natural compositions in lab settings with cutting edge machinery without involving any animals [11].
- The cost of natural baby oil is quite low. In actuality, they are inexpensive and widely accessible.

Material and Methods

Collection and Purification of Crude Kokum butter [12-14]

The botanical origins of many dried powdered substances are obtained from officially sanctioned herbal establishments.

Removal of high melting point impurities

100 gos of raw kokum butter wow melted on water bath at 55-60 °C. Filtered through muslin cloth to remove solid particulate high melting point impurities. filtered material is solidity and again melted at 50 ºC again filtered.

Removal by free fatty aide by alkali treatment

400 ml of petroleum ether were mixed with filtered kokum butter. It was shaken well after adding 80 to 100 ml of a 10% sodium bicarbonate solution. This got rid of the free fatty acids in the soap's foam in the water layer. Two parts were separated, and the etherial solution was mixed with two or three additions of 100 ml of Luke warm water. The mixture was then shaken well to get rid of any soap that might still be in the sticky layer. We got the biological layer that was full of water, and to get rid of the water, we kept it in contact with a drying agent. (sulfides of sodium without water for After 24 hours, the ether was finally drained away, and the product that was left over was dried. The color of the product that was made was off-white to pale yellow. The yield was between 40% and 50% w/w. Then it went through Decolorization.

Refine product without Decolorization to have following standards

Acid value = 1.122
Saponification value = 0.187
Iodine value = 37
Unsaponificable matter = 3%
Melting point = 39 °C
Refraction index (at 40 °C) = 1.546-1.457

Decolorization process

Various technique has been reported (23-24) for Decolorization. But none of methods was found to be satisfactory for getting a product of cosmetic elegance. Following technique was used & to be found satisfactory.

1. Fullers earth and activated charcoal (20:1). The etherial solution of kokum butter was mixed for about 20 min with above mixture.
2. To neutral melted kokum fat (200 gm) was added (60 ml) of sodium disulphide solution (10%). To this solution of HCl (10%, 10 ml) was gradually added and mixture stirred for one and half hour on hot water bath. The fat was separated from aqueous phase and future treated with mixture of Fullers earth and activated charcoal (20:1). Separated from aqueous phase and further treated with a mixture of Fuller's earth & activated charcoal (20:1).
3. Kokum fat was made free from fatty acid by using following step-

- The etherial layer was collected &10% by weight of fat Fuller's earth was added. The mixture was then refluxed for 20-25 min. on water bath. Then Fuller's earth was removed by filtering through muslin cloth. Ether was distilled off and collected. A product was dazzling white in color.
- Pretreatment with citric acid and sulphuric acid: to raw kokum fat sulphuric acid (15%) were in proportion 1:0.05 (by weight) were slowly mixed. Then mixture stirred well at 60-65 °C for half an hour. The acid layer was removed and remaining oil washed well with water. The alkali refined product thus obtained was bleached with 59% fuller's earth

Preformulation and product development (Baby oils)
This involves determination of Hygroscopicity at different relative humidities, oxidation & photo degradation. This involves determination of peroxide content. The Preformulation studies carried out revealed that Kokum-Butter is prone to oxidation, proto degradation and hydrolytic degradation therefore use of water in the formulation was avoided. Also during throughout the product development Kokum-Butter with requisite quantity of an antioxidant was used. Since water was avoided in the product it also reduces the risk of microbial contamination. Obliviously the antimicrobial agent way poses the problem of allergy in the neonatal skin which is not desirable in baby specialty products. Kokum butter is a solid fat at room temperature due to which difficulty was face for application and product development was thought to be necessary by incorporating it into and to another vehicle.

Fig 3: Prepared baby oils

Evaluation of the formulation
Prepared herbal kokum baby oil was estimated for product performance which includes physicochemical parameters.

Organoleptic Property
- **Color:** Detected by naked eyes
- **Sensitivity:** Applied to the skin and exposed to the sunlight for 5 minutes to check for any irritation over skin
- **Grittiness:** Rubbed to the skin and observed
- **Sedimentation:** Keep the whole preparation aside for overnight and check for sedimentation.

pH Determination
The pH of the prepared herbal baby oil in distilled water (10% v/v) was evaluated by means of pH analyzer at room temperature [15].

Viscosity Measurement
The viscosity of prepared herbal baby oil was estimated by Ostwald's Viscometer at a room temperature. The viscosity of prepared herbal baby oil was calculated by using the equation,

$$\text{Viscosity of liquid } (\eta 2) = \frac{\eta 1 \times f 2 \, t}{f 1 \, t 1}$$

Ƞ1 = Viscosity of water
ƒ2 = Density of sample
t2 = Mean time of oil from A to B
ƒ1 = Density of oil
t1 = Mean time of flow of water from A to B

Acid Value
To make the 0.1 molar solution, we weighed out 0.56 g of KOH pellets, mixed them with 100 mL of pure water, and shook them all the time. The burette was filled with the ready-made 0.1 molar KOH solution. Getting the sample ready: 10 mL of oil was measured out, mixed with 25 mL of ethanol and ether, and then shacked. 0.1 molar KOH solution was used to titrate with 1 mL of phenolphthalein solution added [16].

Saponification value
It was the exact weight of 1 mL of oil that was put into a 250 mL conical flask. Then, 10 mL of a blend of 2:1 ethanol and ether was added. This jar had 25 mL of 0.5 N alcoholic KOH added to it. The flask was kept for 30 minutes and was cool. A phenolphthalein indicator was used to measure the cooled solution against 0.5 N HCl. In the same way, the blank titration was done without any oil samples. It was worked out how much KOH was used in mg.

Iodine Value
A fixed amount of iodine monochloride solution in glacial acetic acid (Hanu's solution) was added to the carbon tetrachloride medium to treat the baby oil sample. The extra iodine monochloride was treated with KI, and the amount of iodine that was released was measured by titration with sodium thiosulphate [17].

Specific Gravity
Specific gravity of the prepared oil was determined using specific gravity bottle.

Stability Study
It is performed by keeping the prepared herbal baby oil in a closed container at cooled and dry place.

Results
Organoleptic Property
- **Color:** white or greyish white
- **Melting point:** 39-42 ºC
- **Weight per ml:** at 40 ºC 0.895-0.899g/ml
- **Sensitivity:** No irritation
- **Grittiness:** smooth
- **Sedimentation:** No sedimentation.

pH Determination
pH of the prepared herbal baby oil is 6.21.

Fig 4: pH determination of Herbal baby oil

Viscosity
The measured viscosity of the oil was determined to be 0.966. The viscosity measurements of herbal baby oil, as reported by Gautham *et al.* (2012) [23] and Rohan *et al.* (2018) [24], were found to be 0.93 and 0.9936, respectively.

Acid value

The term "saponification value" refers to the quantity of potassium hydroxide, measured in milligrams, necessary to neutralize the unbound fatty acids contained inside a single gram of fat. The relative measure of rancidity is determined by the presence of free fatty acids, which are typically produced during the degradation of oil glycerides. A higher acid value is indicative of a greater proportion of free fatty acids, resulting in increased oxidation and diminished oil quality. The acid value determined for the sample of herbal baby oil was found to be 1.60. The observed low acid value suggests that the oil has a little or negligible water content. The quality of oil is positively correlated with a decrease in acid value.

Specific gravity

The specific gravity of the herbal oil was determined to be 0.916, a value that is within the range suggested by the Bureau of Indian Standards (BIS). The substance has a lower density compared to water and possesses a slender physical profile. The findings of this study align with those reported by Kamal (2015) [25] in relation to herbal baby oil.

Saponification value (SV)

This method quantifies the mean molecular weight of fatty acids found in the oil. The relationship between the shorter chain fatty acids and the glycerol backbone is one of direct proportionality. The saponification value of the herbal oil in this investigation ranged from 186 to 190 mg $KOHg^{-1}$ oil. A higher saponification score is indicative of a greater amount of short chain fatty acids.

Fig 5: Saponification test performed in laboratory to check the sap value of the baby oil preparation

Iodine value

Iodine values were in the range of 35-37 mg /100 g.

Unsaponificable matter

The Unsaponificable substance refers to the portion of oil and fat that remains unreacted with caustic alkali yet is capable of dissolving in non-polar solvents. The Unsaponificable substance present in oil or fat comprises hydrocarbons, higher alcohols, oil-soluble vitamins, and sterols that exhibit insolubility in water subsequent to esterification. Kokum butter-infused infant oils often exhibit a USM content ranging from 1 to 2 percent.

Stability Study

It is observed that the prepared five formulations are stable throughout the shelf life for 3 months.

Biological Evaluation

The primary skin irritation test, which included the application of the produced formulation on intact skin of volunteers, indicated that the formulation exhibited no irritating properties and was deemed safe for usage. The findings indicate that the product was well received in the organoleptic evaluation. The assessment of quality indicates that the physicochemical and biological properties of the completed product meet optimal requirements that are within the established safe limits.

Discussion

Geographical to specific regions of India, *Garcinia indica*, an evergreen tropical tree that is occasionally called kokum, is classified as a Clusiaceae member and grows in the mangosteen family. Beyond its culinary and commercial applications, it has been utilized as an acidulant in butter, wine, relishes, curries, and health beverages. Traditional medicine has utilized G. indica for the treatment of diarrhea, dermatitis, inflammation, and to facilitate digestion. The pharmacological actions of various phytochemicals extracted from G. indica, including garcinol, hydroxycitric acid (HCA), cyanidin-3-sambubioside, and cyanidin-3-glucoside, have been documented in numerous studies. This article examines recent studies concerning the various pharmacological effects of G. indica. According to these investigations, G. indica has antibacterial, hepatoprotective, anxiolytic, anti-inflammatory, anti-arthritic, anti-obesity, anti-inflammatory, and anxiolytic properties both *in vitro* and *in vivo*. A number of previously published studies on the pharmacological action of components extracted from the plant support the notion that G. indica may serve as a viable preventative therapeutic agent against a wide range of diseases [18].

Conclusion

In general, the developed kokum baby oil offers several nourishing properties for the skin, including the presence of vitamins, minerals, and essential oils. The final outcome falls within the established boundaries. In summary, the use of baby oil may be advantageous in safeguarding infant skin from the detrimental effects of pollution, as well as promoting the maintenance of healthy hair. Furthermore, it is essential to provide an alternate supply that is free from dangerous substances [19, 20]. Addressing skin issues in newborn care formulations presents a significant difficulty due to the necessity for active formulations that satisfy particular criteria in terms of components, compatibility, and rationale for the formulation design. The objective of this research was to develop many infant oil formulations that include well-documented natural active components, while meeting the typical needs of baby care products. Furthermore, there have been observations of compatibility evidence about the natural actives used in the investigated systems. In this study, we will present the formulation design of two distinct formulations intended for baby care. These formulations include a baby wash, a product for immediate rash recovery, an after sun emulsion, and a calming and soothing product. Each formulation will be described in terms of the rationale behind the active ingredients it contains, and a comprehensive formulation design will be provided for each product. Particular focus will be given to those components for which there exists clinical evidence substantiating the anticipated advantages for the skin [21, 22].

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