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Product Development and Evaluation of Kokum-Butter Baby Oil

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ABSTRACT

Kokum is one of the under-utilized fruits with many health benefits. Kokum's scientific name is Garcinia indica, and it grows primarily in the forests of Maharashtra, West Bengal, and Kerala. Fruit is orange-sized and can remain fresh for up to a week; kokum seeds contain more oil. Vitamins, minerals, organic acids, and phenolic compounds are abundant in kokum. Consumption of kokum results in numerous health benefits, including anti-oxidant, anti-ulcer, anti-fungal, neuroprotective, and anti-bacterial activity. It has bioactive compounds like garcinols, HCA. There are many by-products in market which are made from kokum and its fruit segments like kokum butter. In this investigation, we develop and evaluate infant oil made from kokum butter. It is an active ingredient in cosmetic preparations.

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INTRODUCTION

Typically, normal skin is characterized by its perceived moisture content, cleanliness, softness, suppleness, pliability, and little presence of wrinkles. Typically, normal skin may exhibit a state of optimal health and aesthetic appeal that renders the use of cosmetics unnecessary. However, it often manifests a pale and lackluster appearance. Dry skin is characterized by a lack of elasticity and flexibility in the protective coating. Insufficient levels of elasticity and extensibility may lead to the occurrence of granum cracking and dry skin. The cosmetic sector exemplified this perspective by focusing on skincare, which involves the use of emollients and lubricating agents. Upon the realization that water, rather than oil, is responsible for making the skin soft, malleable, and flexible. Baby goods include a range of items designed specifically for the care and well-being of infants. These products often consist of baby soaps, cleaning creams, baby oils, protective creams or ointments, and baby powder, among others. Cleansing creams are not widely favored among consumers (1).

Protective creams and ointments that include zinc oxide and castor oil are also used. The primary purpose of baby powder is to create a dry and lubricated surface on the skin, which has been cleaned and shielded with oils and lotions. This phenomenon is referred to as Natural Moisturizing Factors (NMF). Emollients are substances used to mitigate and prevent dryness, while also serving as a protective barrier for the skin. These mechanisms enhance the flexibility and moisture retention of the skin by minimizing water loss from the skin surface, promoting further hydration of the outermost layer of the skin, known as the stratum corneum. The elimination of contaminants with high melting points and the removal of free fatty acids using alkali treatment. The validation of this phenomenon is often conducted by the use of several analytical techniques, such as thin-layer chromatography for assessing the purity of the sample, differential thermal analysis for determining the melting point, and X-ray diffraction pattern analysis for structural characterization (1, 2).

Kokum *(Garcinia indica)*

Kokum is a botanical condiment that belongs to the family Guttiferae. It is one of the underexploited tree seasonings found in Assam, Meghalaya, and West Bengal forests. They are primarily found in the Konkan region of Maharashtra, Goa, Karnataka, Kerala and the minor district of Gujrat on the west coast of India and also in some sections of North -eastern India. Around 35 species are commonly found in India. It has magnificent Nutritive and

Medicinal Properties Kokum is not grown in the same manner as other fruits. The tree is tall with oblong, elliptic, lustrous, dark-green leaves measuring 5.5-8 centimeters in length and 2.5- 3 cm in width. The flowers of the kokum plant are pink and succulent. The fruit is generally brownish or brownish-grey in color with a yellow-marbled pattern. It is surmounted by a stalkless stigma. Typically, six to eight seeds are found in each pod, and the substance of the kokum has a distinct flavor and aroma. A kokum fruit is roughly the size of an orange. A week is the shelf life of ripe produce. The fruit's seed accounts for a quarter of the fruit's total weight and contains approximately 40-42 percent oil (2-4).

Figure 1 Kokum fruit

Nutritional composition of kokum butter

Kokum butter is derived from the seeds of the kokum fruit, which possess an edible oil content ranging from 23% to 26%. The extraction process involves crushing the seeds and subjecting them to boiling with water, followed by the removal of the top layer of fat. Kokum fat may also be isolated by the process of solvent extraction. It is worth noting that kokum butter consists of around 30% crude fat. Initially, crude kokum butter has a yellow hue, but after the refining process, it undergoes a transformation and becomes white in color (5).

Figure 2 Kokum butter

It is used in detergents, moisturizers, lipsticks, and the cosmetic industry due to its fatty acid content. It is a consumable lipid with a melting point between 39 and 43 degrees Celsius. Due to its high melting point, it is used to prevent chocolate from dissolving at low temperatures. Kokum seeds are abundant in fatty acids. Kokum butter, which is extensively used in the cosmetics industry, is also employed in the treatment of dysentery and mucoid diarrhea. Almost every species has antibacterial, antifungal, anti-ulcerogenic, cardioprotective, anti-cancer, chemopreventive, free radical-scavenging, and anti-oxidant properties. Kokum is a slender and evergreen tree which does not require frequent irrigation or use of fertilizers, Pesticides or herbicides. They are generally found adjacent forests, wastelands and riversides (6).

Table 1 Fatty acids of kokum butter

S. No	Fatty acid	Quantity
1	Stearic acid	55 – 56.4%
2	Oleic acid	40%
3	Palmitic acid	2.5 - 3%
4	Linoleic acid	1.5%
5	Hydroxyl citric acid	10%
6	Myristic acid	0.5%

Baby oils

Baby oils are considered a practical and cost-effective approach for washing the diaper region. Additionally, the residual layer of oil that stays on the skin provides a certain level of

protection. Derived from the term "nappy content," the aforementioned phrase refers to stuff that is considered to be of low quality or lacking in substance. Baby oils primarily consist of high-quality mineral oil, together with a modest quantity of fatty acids, esters, vegetable oils, lanolin derivatives, and other appropriate substances. The addition of aromatic solubility enhancers should be done cautiously, taking into account safety concerns and the risk for irritation. The regular use of baby oil is often advised in the treatment of many skin conditions. Regular use of baby oil is necessary to maintain smooth and moisturized skin, due to the frequent occurrence of dryness. The flexibility of the corneal layer is contingent upon the presence of a certain amount of moisture. Insufficient water is the primary cause of dehydration and the development of dryness and chapping (7).

The use of a substance that effectively moisturizes the skin has the potential to greatly enhance the management of dry, scaly dermatosis. The infant mortality rate is a significant indicator of community development, with low birth weight and preterm serving as measures of neonatal death. Annually, an estimated 20 million newborns are delivered with low birth weight. The prevalence of preterm birth in the least developed nations is significantly elevated. These nations are responsible for a significant proportion of neonatal mortality. Consequently, the responsibility of caring for these infants imposes a strain on the health and social institutions within the community. Skin massage is recognized as a therapeutic method including tactile stimulation that elicits physiological and psychological benefits in newborns. A considerable body of research has been conducted to examine the impact of massage therapy on the dermal condition of preterm newborns. The collective findings consistently indicate a favorable influence on several aspects, including metabolic processes, birth weight, duration of hospitalization, occurrence of delayed infections, behavioral patterns, as well as motor and cognitive development (8).

The careful consideration of oil selection is crucial due to the potential adverse consequences associated with some local goods, such as delayed skin healing caused by toxic absorption. It is essential to recognize that the use of traditional oils for skin massage has shown a notable inclination, mostly owing to their inherent benefits. Notably, the application of natural oils on the skin of newborn children has been a prevalent practice for many centuries in regions such as India and the Mediterranean. This phenomenon may be attributed to the characteristic of natural oils being less abrasive on the skin in comparison to their synthetic counterparts. The use of natural oils on newborn skin has several advantages, such as the mitigation of damage

and skin infection, management of skin temperature via the reduction of water loss via the epidermis, and absorption of vital lipids (9).

Literature survey

There is now an upward trend in the manufacturing of products derived from kokum. The potential medical applications of kokum and its derivatives are extensive, owing to the substantial nutritional composition found in its juice, nectar, flour, and butter. A wide range of industries depends on the autonomous extraction of hydroxycitric acid (HCA) and other bioactive substances found in kokum. In addition to possessing therapeutic properties, the kokum rind is used for the management of many health conditions such as hemorrhoids, heart disease, tumors, and diarrhea. In addition to its recognized therapeutic benefits, kokum has considerable processing value (7, 8). Several valuable products, including butter, amsul, agal, kokum sarbat, and solkadhi, are derived via the process of refining kokum. The fruit known as kokum has several beneficial health benefits, yet its recognition remains relatively limited. Kokum, scientifically known as Garcinia indica, is an indigenous plant species originating from India. The species is mostly distributed among the forested regions of Maharashtra. Additionally, it may be seen in the regions of West Bengal and Kerala. The fruit, which has dimensions similar to those of an orange, maintains its freshness for a duration of around one week. Kokum grains have a greater oil content. Kokum is comprised of a mixture of phenolic compounds, organic acids, minerals, and vitamins. Kokum has been linked to several health benefits, including its antibacterial, antifungal, neuroprotective, and antioxidative characteristics. The chemical constituents of this substance include garcinol and hydroxy citric acid (HCA), both of which are known to possess advantageous properties. Kernels derived from kokum butter are a singular example among other byproducts of the kokum fruit that might potentially be encountered in commercial establishments. The use of kokum syrup rinds extends beyond the production of syrup, finding application in other sectors such as confectionery, pharmaceuticals, and cosmetics (9,10).

Material and Methodology

Procurement, Purification and standardization of kokum butter

Kokum butter refers to the solid lipid obtained from the extraction of seeds belonging to the Guttiferae family, namely the Garcinia Indica species. Fresh materials were procured from several wholesale dealers, and comparatively superior items were bought from M/S Sadav

Lee Lalubai located on Mohamad Ali Road in Bombay. The determination of acid value, saponification value, melting point, iodine value, and Unsaponifiable materials was conducted using the technique outlined in the Indian Pharmacopoeia (I.P.). In addition to thin layer chromatography and x-ray diffraction pattern (10-12), The values that were obtained are;

Acid value = 17.80

Saponification value = 266.87

Iodine value = 39

Unsaponificable matter = 6%

Melting point = 40-44^{o}C

Figure 3 Kokum butter

Preformulation and product development (baby oils)

This study encompasses the assessment of Hygroscopicity under varying relative humidities, as well as the investigation of oxidation and photo deterioration. This entails the determination of the peroxide content. The results of the Preformulation experiments indicated that Kokum-Butter is susceptible to oxidation, proto deterioration, and hydrolytic degradation. As a result, the use of water in the formulation was deliberately avoided (13). Additionally, during the process of product creation, Kokum Butter was used together with the appropriate amount of an antioxidant. The exclusion of water in the product mitigates the potential for microbial contamination. The use of antimicrobial agents in newborn skincare products presents a significant concern about the potential for allergic reactions, which is

considered undesirable in the context of infant-specialized goods. The solid-state of kokum butter at room temperature posed challenges for its application, thereby prompting the need for product development. To address this issue, it was deemed essential to incorporate kokum butter into another medium or vehicle (14-16).

Selection of vehicle

The present research used a range of frequently used vehicles (olive oil, sesame oil, cod liver oil, light liquid paraffin) to develop body oil (17, 18). The oils underwent Monographic examination, and the findings are documented as follows:

I) Monographic analysis of sesame oil I.P

Acid value = 1.83

Saponification value = 195

Iodine value = 112

Unsaponificable matter = 1.49%

Refractive index = 1.4642

Figure 4 Sesame oil

II) Monographic analysis of cod liver oil B.P

Acid value = 0.95

Saponification value = 184

Iodine value = 159

Unsaponificable matter = 1.52%

Refractive index = 1.652

Figure 5 Cod liver oil

Evaluation of the formulation (In vitro and vivo studies)

Stability Study

A predetermined volume of 5 mL was extracted and purified, followed by the use of standardized kokum butter. Varying quantities of matter, ranging from 1 mL to 15 mL, were introduced into a test tube containing oil. The mixture was then kept for a duration of 7 days, during which daily observations were made to assess the occurrence of phase separation. The degree of phase separation was seen to grow with time. The investigation included determining the upper limit of solubility, expressed as a maximum percentage, at which the precise concentration of kokum butter in oils results in the formation of a monophasic system. This was achieved by fractionating the concentration beyond which a dramatic fall in percent transition occurred (17, 18).

Table 2 Four combinations for stability study

Combination	Exact max % solubility	% transition
A	7.6%	6.2
B	5.2%	11.1
C	10.4%	12.2
D	4.4%	15.6

The four test tubes contain the above four combinations were stored for three weeks and subjected for stability studies.

Phase separation:

Observe visually as well as for turbid metric study.

Hygroscopicity:

The determination of moisture content in test tubes was conducted using the Karl Fischer technique. The moisture content of each sample was determined to be zero.

Microbial Count:

A volume of 1 milliliter of Kokum butter solution was introduced into molten agar medium contained inside a petri dish and then homogenized by turning the dish to ensure thorough mixing. The petri dishes were cooled to room temperature and thereafter incubated for a period of 48 hours (18, 19).

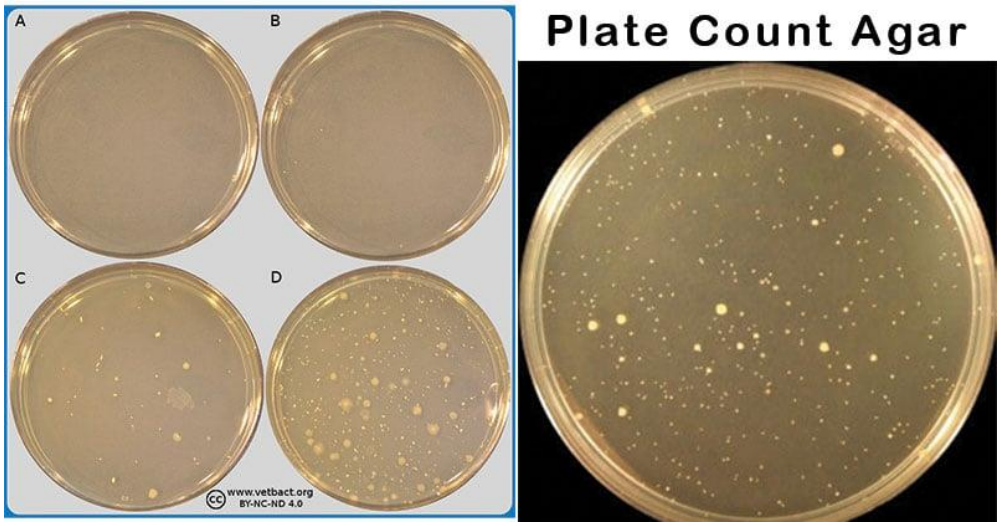

Figure 6 Microbial Count by using agar plate

Result and discussion

Purification & Standardization of Kokum Butter

The purification pressure used earlier did not yield a good cosmetically elegant product. Hence here attempts are made to standardize the process. The purification process was carried out in three steps:

1. Removal of high melting point impurities

2. Removal by free fatty aide by alkali treatment

3. Decolorization

Preformulation and product development

Selection of vehicle

i) The monographic estimation of olive oil I.P, Sesame oil I.P and cod liver oil B.P showed that the acid, and iodine saponification values were less than those values of kokum butter. Hence the oils were chosen seemed to be perfect solvents for kokum butter.

ii) It was observed that % transmittance decreased gradually but there was concentration for all solutions at which % transmittance decreased suddenly. It means that in the solutions above those concentration, the phenomenon of phase separation starts.

iii) To determine the exact % solubility in four all the functions of maximum solubility concentrations, the solutions were subjected to turbid metric study. The maximum percent solutions are already reputed in the above table.

Stability studies

The stability studies for four products have shown the following result:

Table 3 Result of stability studies

% concentration of Kokum Butter in oil	% transmittance			
	a	**b**	**c**	**d**
1	11	12	14	16.5
2	11	12	13.5	16.5
3	11	11.5	13	16.5
4	10.5	11.5	13.5	16
5	10.5	11.5	13.5	13.5
6	9	10	13	13.5
7	8.5	10	13	13.5
8	5	9.5	13	13
9	5	9.5	13	13
10	0.5	9	13	12.5
11	4.5	9	11.5	12
12	4.5	8	11.5	12
13	3	7.5	11.5	11.5
14	-	-	11.5	-
15	-	-	-	-

The blank space in the table shows the concentration in which phase separation was seen.

a: kokum butter with cod liver oil

b: kokum butter with olive oil

c: kokum butter with Sesame oil

d: kokum butter with liquid-liquid paraffin

Phase separation

All four solutions, namely a, b, c, and d, were held for a duration of three weeks and were subsequently examined for phase separation using visual observation as well as a turbidity metric analysis. According to the study, there was an absence of phase separation and a lack of attention to the percentage transmittance.

A clear solution was observed and the observations are as follows;

Table 4 Visual observations of Phase separation

Combination of kokum butter	Max. solubility of kokum butter in oil
Kokum butter in cod liver oil	10%
Kokum butter in olive oil	8%
Kokum butter in sesame oil	14%
Kokum butter in light liquid paraffin	7%

All the combinations showing clear solutions were subjected for turbid metric studies & the transmittance was noted.

Hygroscopicity:

Four products stored in a loosed container, were shown to contain zero percent moisture determined by Karl Fischer method. This is showed that it is must to keep container well closed during storage of products containing kokum butter.

Microbial Count:

Done by pour plate method for four solutions to nutrient age media. The products were net contaminated by microbes. No microbial were seen because products did not absorbed moisture which supports microbial growth. Although for kokum-butter only two formulation containing higher concentration of kokum-butter were chosen for further studies. Those are reported below:

Formulation -1

Kokum butter I. P = 10.4%

Sesame oil I.P = 100ml

BHT = 0.013%

Formulation -2

Kokum butter I.P = 7.6%

Cuddlier oil B.P = 100ml

BHT = 0.013%

Thus it shows that in the above aqueous one-phase system without the use of presentation maximum quantity of kokum butter was accommodated. Here the Hygroscopicity of kokum-butter was not distributed at all preparing no aqueous product, so as to maintain moisturizing efficacy. Hence those oils used to be ideal formulations for babies.

Evaluation of formulations

A more comprehensive evaluation of different items may be achieved via the use of in vitro and in vivo investigations. To assess the moisturizing effectiveness of the formulation, in vitro tests were conducted on isolated stratum corneum. The investigation of the moisturizing effectiveness of substances in vivo has been facilitated by the use of the water vapor transmission through the skin approach. Due to the unavailability of cadaver skin, the trials were conducted using stratum corneum derived from rabbit abdomen skin, which is hypothesized to possess a higher degree of permeability akin to that of infant skin. As

previously stated, two formulations with the highest concentration of kokum butter were chosen for the assessment of moisturizing effectiveness.

In vitro studies

Moisturizing Efficacy determination

Burch Windsor conducted a study on the rate of water loss via excised stratum corneum (SC) by quantifying the weight reduction of a diffusion chamber. The phenomenon of water loss in the current research, excised stratum corneum (SC) was used as a measure to assess the effectiveness of miniaturization.

Hydration Dynamics SC

1) Isolation of SC

The SC specimens were harvested by klingman & christophers method. Fresh rabbit abdominal skin was frozen overnight. The epidermis was divided from the dermis by immersing the skin sample in 60 C water for two minutes. The epidermis was stripped away using instruments. The epidermal sheet was then deposited dermal side down on several sheets of filter paper saturated with a trypsin 0.01% solution containing 0.5% sodium bicarbonate, and the PH was adjusted to between 8 and 8.6 with phosphate buffer. In a 24-hour incubation at 37 degrees Celsius, filter paper was coated with a trypsin solution and then incubated with the solution for 24 hours. After incubation, the epidermal sheet was kept plump on a glass slab with the dermal side facing up, and the gelatinous, digested layers of epidermis were removed by delicately pressing with a cotton-tipped application. The product (SC) was a transparent, resilient, and durable sheet. It was momentarily floated on distilled water & elevated in between two glass rods and air-dried.

TEWL determination

Martin M.R & Donard E. Deems developed a small diffusion cell whereby in vitric water loss through SC could be determined.

a) Fabrication of the cell

A small diffusion cell was fabricated from cylindrical aluminum stock (3.7 cm in diameter and 2.7 in height) into which 1.2 cm deep hole was druid, having a diameter 1.4 cm. This

depression had a capacity of 2 ml. An aluminum top (lid) provided with a hole of 1.4 cm diameter in the center was cut. It was superimposed on the lower chamber with the help of four bolts and would be fitted with wing nuts. for mounting S.C (placed between silicone rubber gasket) small depressions were cut.

Table 5 TEWL through unexpected specimens (without applying formulation)

SR No	Time in hours	Moisture loss $mg/cm^{-2}/hr^{-1}$ Quantity of water			
		2	1.5	1	0.5
1	24	0.4801	0.4703	0.4801	0.4705
2	48	0.3501	0.3580	0.3810	0.4332
3	72	0.3015	0.3520	0.3933	0.4410
4	96	0.2575	0.2571	0.2572	0.4331
5	120	0.2575	0.2572	0.2573	0.2842
6	144	0.2571	0.3201	0.2538	0.2791
7	168	0.2574	0.2608	0.2531	0.2661

Table 6 TWEL through extracted specimens (without applying formulation)

SR No	Time in hours	Moisture loss $mg/cm^{-2}/hr^{-1}$ Quantity of water			
		2	1.5	1	0.5
1	24	3.010	2.970	2.830	3.013
2	48	2.753	2.830	2.790	2.970
3	72	1.815	1.902	1.803	1.700
4	96	1.635	1.610	1.613	1.617
5	120	1.623	1.573	1.570	1.570
6	144	1.620	1.571	1.570	1.577

Table 7 TEAL through extracted and unextracted specimens of stratum corneum (SC) without applying formulation

SR No	Moisture loss mg/cm-^{2}/hr^{-1} Quantity of water		
	Unextracted	**Extracted**	**Ratios E/U**
1	0.257 (a)	1.620	6.2
2	0.263 (b)	1.570	4.9

a: water is directly in contact with the stratum corneum in the cell.

b: water vapor is directly in contact with the stratum corneum in the cell.

E: Extracted specimen of the stratum corneum (moisture loss mg / sq. cm/hr.).

U: Un-extracted specimen of the stratum corneum (moisture loss mg / sq. cm/hr.).

Summary and Conclusion

The demand for processed kokum products has been on the rise in recent times. Kokum and its derivatives, including syrup, powder, butter, and juice, are known for their high nutritional content and potential therapeutic benefits. The bioactive components included in kokum, such as hydroxy citric acid (HCA), have been shown to play a significant role in several aspects. Consequently, HCA is extracted independently by numerous companies. The kokum rind has therapeutic properties and is used in the management of conditions such as piles, diarrhea, tumors, and heart ailments. In addition to its therapeutic properties, kokum has significant processing value (20, 21). Various value-added products are derived from the processing of kokum, such as kokum sarbat, kokum solkadhi, amsul, and butter, among others. Both formulations exhibited favorable appearance, pH levels, and appropriate viscosity, and no occurrence of phase separation was detected. Additionally, both formulations exhibited no signs of redness, erythema, or irritation in the irritancy tests, and they were readily removable by washing.

Future Scope

The use of kokum butter in the formulation of baby oil resulted in a versatile impact, while the inclusion of other herbal constituents exhibited noteworthy variations in their respective

activities. Based on the findings and further analysis, it can be concluded that both formulations exhibited stability while stored at room temperature, hence establishing their suitability for safe application on the skin (22, 23).

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