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Effects of Oral and Topical Use of the Oil from the Nut of *Vitellaria paradoxa*

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Abstract

Shea butter is the fat extracted from the nut of Africa Shea tree (*Vitellaria paradoxa*). It is used in cosmetic formulations and as a substitute for Cocoa butter in chocolate industries. It is edible and used cooking fat in Africa. The saponifiable fraction of Shea butter is composed primarily of stearic and oleic acids with lesser amounts of palmitic, linoleic and arachidic acids while the unsaponifiable fraction of Shea butter is composed of bioactive substances that are responsible for Shea butter's medicinal properties. Shea butter is a solid at room temperature and melts at body temperature. It is therefore useful for skin care as it has sun screening properties and acts as an emollient and skin moisturizer. Topical use of Shea butter has also demonstrated anti-aging and anti-inflammatory properties. Dietary intake of Shea butter has hypocholesterolemic effect and reduces serum and organ protein concentrations.

Keywords: Shea butter; Skin; Allergy; Inflammation; Cholesterol

Introduction

Shea butter is an off-white or ivory-coloured fat extracted from the nut of African Shea tree (*Vitellaria paradoxa* formerly *Butryspermum paradoxum, B.parkii* and *B. paradoxa*) [1]. Shea tree grows naturally in the wild of the dry savanna belt of West Africa, from Senegal in the West to Sudan in the East and onto the foot hills of the Ethiopian mountains [2-4]. The West African trees are classified as the subspecies *"paradoxa"* and the East African one as *"nilotica"* [5-7]. It is considered a sacred tree by many communities and ethnic groups and plays important roles in religious and cultural ceremonies where is also believed to have some spiritual protective powers [8,9]. It has been claimed to have potential to improve nutrition, boost food supply in the annual hungry season [10], foster rural development, and support sustainable land care [11]. Different parts of the plant including leaves, roots, seeds, fruit and stem bark have been used in the treatment of enteric infections such as diarrhea, dysentery, helminthes and other gastrointestinal tract infections, skin diseases and wound infections [12]. The bark is used to suppress cough and also to treat leprosy [13]. Shea nut contains about 60% fat (Shea butter) [14], and together with the oil palm serve as sources of edible oil for many households in many parts of the Sahel Africa, particularly Northern Nigeria [3,11,15-18].

Shea butter is renowned for its use as a component of cosmetic formulations [16,19] and as a substitute for Cocoa butter in chocolate industries [20], although the taste is noticeably different [21]. Shea butter is used by local healers as a treatment for rheumatism, inflammation of the nostrils, nasal congestion, leprosy, cough, and minor bone dislocation [22-25]. It is also used as raw material for the production margarine, soap, detergent and candle [26]. Low quality butter and by-products of processed nuts are smeared on earthen walls of houses as a waterproof to protect walls during the rainy season [27]. Shea butter has also been used for soothing and accelerating healing after circumcision, and for preventing stretch marks in African pregnant women and as an insect repellent, providing protection against *Simulium* infection [24]. There are no reports of allergic reaction owing to consumption of Shea butter or its produce [28,29]. The United States Agency for International Development, Gassel Consulting, and many other companies have suggested a classification system for Shea butter separating it into five grades: A (raw or unrefined, extracted using water), B (refined), C (highly refined and extracted with solvents such as hexane), D (lowest uncontaminated grade), E (with contaminants) [30]. Large quantities of Shea butter produced in West Africa though the exact production figures are not known [31]. This work reviews the effects of Shea butter on animal system.

Chemical composition of shea butter

In addition to a stearic and oleic acids rich saponifiable fraction, Shea butter contains an unsaponifiable fraction composed of bioactive substances that are responsible for Shea butter's medicinal properties [32]. With regional variation in concentrations [6,33], the unsaponifiable fraction of Shea butter is composed primarily of triterpene alcohols, with some hydrocarbons, sterols, and other minor components such as vitamin E [34-36]. The saponifiable triglyceride fraction of Shea butter constitutes about 90% by mass of the butter [34-38] and is composed primarily of stearic and oleic acids with lesser amounts of palmitic, linoleic and arachidic acids [39]. The triacylglyceride fraction is made up of fatty acids (acyl chains) attached to a glycerol backbone [40]. Since different fatty acids are present in Shea butter, different combinations of fatty acids attached to the glycerol are possible. In Shea butter, the most predominant combination is SOS (S-Stearic, O-oleic) making up to 40% of the total triacylglycerol molecules, followed by SOO (27%), POS (P-palmitic, 6%) and POP (1%) [36]. Di Vincenzo and co-workers [6] however concluded that SOO, OOO, and SOS were the major triglycerides in Shea butter with regional variation. Shea butter contains relatively high amount of saturated fatty acids compared to other plant-sourced lipids including: grape seed oil (total saturated fatty acids: 10.4-14.3% of total fatty acids), olive oil (12.7-16.2%), and canola oil (5.5-7.7%) which are all, in contrast to Shea butter, liquid at room temperature and have saturated fatty acids less than 20% of total fatty acids [41-43]. Shea butter fatty acid composition has been found to vary across the African countries [6,44]. Maranz and co-workers [44],

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Fatty Acids	Mean (%)	Min (%)	Max (%)
Palmitic (16:0)	4.0	2.6	8.4
Stearic (18:0)	41.5	25.6	50.2
Oleic (18:1)	46.4	37.1	62.1
Linoleic (18:2)	6.6	0.6	10.8
Arachidic (20:0)	1.3	0.0	3.5

Source: Maranz and co workers [44]

Table 1: Fatty Acid Composition of Shea Butter.

as shown in Table 1, nevertheless presented ranges and mean values of the fatty acid compositions.

Effects of shea butter

Sun-screening function: Sun-screens absorb or reflect some of the sun's ultraviolet (UV) radiation reaching the skin exposed to sunlight and thus helps protect against sunburn, preventing erythema and reducing further risk of sun-induced skin-cancer. The major cause of photo carcinogenesis is UVB radiation (290-320 nm) since it directly interacts with cellular DNA and subsequent formation of cyclobutane pyrimidine dimers and thymine glycols [45]. Cinnamate esters of triterpene alcohol which are the main constituent of Shea butter's unsaponifiable fraction are known to have strong absorbance of UV radiation in the wavelength range at 250-300 nm, which make the addition of Shea butter's unsaponifiables into sunscreens provide synergistic sun-protection by increasing absorption of UVB radiation [46]. However, the effectiveness of the triterpenes is somewhat doubted since studies using double-fractionated Shea butter with 20% of triterpene esters found that this triterpenic fraction only provided the sun protection factor (SPF) of 3-4 [36,47].

As an emollient and skin moisturizer: Due to its semi-solid characteristics and buttery consistency, Shea butter is great emollient and moisturizer for the skin hair, scalp and hair even without further processing [46]. However Shea butter is usually found as active component of processed moisturizers [48]. In addition, fractionated Shea butter especially olein fraction is easily formulated in creams or surfactant based products such as bath products and shampoo to provide the skin, scalp, and hair with well-maintained or increased moisture [36,46,49]. Shea butter melts at body temperature, acts as a «refatting» agent, has good water-binding properties and absorbs rapidly into the skin; making it useful for skin care [50]. In an article titled 'Winter Itch', Shea butter was recommended for repairing dry inflamed skin caused by dermatitis and as a night time moisturizer for hands and feet [51]. In a study by Poelman and co workers [52], a cream containing 5% Shea Butter versus a placebo cream were applied to the forearms of 10 volunteers. Short-term moisturization was observed; it peaked after 1 hour and persists for 8 hours. For all subjects, a daily application maintains a very good moisturization of the superficial layers of the skin. Shea butter has also been shown to be superior to mineral oil at preventing transepidermal water loss (TEWL). In a test where participants' arms were washed in ethanol, it was found that Shea butter was able to help the skin totally recover from TEWL within two hours [53]. One study showed that it worked as an emollient for eczema. Using a scale from zero to five-zero denoting clear and five denoting very severe disease — Shea butter took a three down to a one, while Vaseline only took a three down to a two [54].

Anti-aging properties: It has been revealed that Shea butter has UV anti-erythemic activity, which helps tissue cell regeneration and softening of the skin [55]. In a clinical study involving 30 volunteers, Renard [56] reported that Shea butter diminished various aging signs. In another clinical study performed by the same author for studying dry, delicate or aging skin, 49 volunteers applied twice a day either 15% or pure Shea Butter and discovered that Shea butter prevented photo-aging. In another study with rats, Shea butter was shown to boost collagen production [57]. Collagen and elastin are the major structural proteins providing skin with toughness and plumpness and α-amyrin and lupeol, the triterpenes also found in the unsaponifiable fraction of Shea butter, were found to contribute to the inactivation of proteases such as metalloprotease (e.g., collagenase) as well as serine protease (e.g., elastase) [36]. The anti-aging, potentially collagen-boosting effects were therefore attributed to its unsaponifiable components [32,36].

Anti-inflammatory properties: The anti-inflammatory effects of Shea butter have been demonstrated through inhibition of Inos, Cox-2, and Cytokines via the Nf-Kb pathway in Lps-Activated J774 Macrophage cells [58]. Loden and Andersson [57] also showed that Shea butter will reduce reaction to skin irritants. Hee [46] found α-amyrin to be the most dominant triterpene in Shea butter's unsaponifiable fraction. Bioactivities of α-amyrin have been studied especially with α-amyrin extracted from *Protium kleinii,* a plant used in Brazillian folk medicine belonging to Burseraceae family. When administered, α-amyrin was reported to show dose-related antinociceptive effect against the visceral pain when mixed with β-amyrin *in vivo* test on mice [59]. The topical application of α-amyrin showed anti-inflammatory effects, inhibiting skin inflammatory responses such as edema formation, migration of polymorphonuclear leukocyte, and increase in tissue IL-1β levels [60]. Another study on the anti-inflammatory effect of α-amyrin and β-amyrin of *Protium heptaphyllum* and the result showed they retarded acute inflammation in rat model of periodontitis [61].

Effect on cholesterol metabolism: Shea butter has been reported to be used by a pharmaceutical company, BSP Pharma, to lower cholesterol levels [62]. Tholstrup and co workers [63] observed a reduction of total cholesterol and low density lipoprotein (LDL) by Shea butter administration and attributed the antihypercholesterolemic effect to the high stearic acid content of Shea butter. In a study with rats, Akinwale and co workers [64] reported a significant reduction in High density lipoprotein (HDL), Total Cholesterol and Low density lipoprotein (LDL) when rats were fed with Shea butter. The antihypercholesterolemic effect of Shea butter was attributed to the presence of saponins in it. Saponin which is present in the unsaponifiable fraction of Shea butter [34-36] has been reported by several authors to lower serum cholesterol by forming mixed micelles with cholesterol and bile acids in the intestine thereby inhibiting its absorption and increasing its excretion [65-69].

Allergy: Although, Shea nut is distantly related to Brazil nut [70] which cross-reacts with almond, hazelnut, walnut, and peanut [71], there are no reports of allergy reaction owing to the topical or oral use of Shea butter. Furthermore, Kanwaljit and co workers [29] reported that Shea butter contains no IgE-binding soluble proteins and reassures that Shea butter is safe for use even for individual with nut allergy. Conversely, Wiedner [72] found that pharmaceutical composition containing at least 5% of Shea butter's triterpenes such as butyrospermol, lupeol, parkeol, germanicol, dammaradienol, 24-methylene-dammarenol, and α, and β-amyrins effectively suppresses hypersensitivity reaction in a mammal such as Immunoglobulin E (IgE)-mediated allergic reactions and autoimmune reactions in a mammal.

Effect on protein metabolism: In a study with rats, Malachi [73] observed a decrease in total protein concentrations of the hepatic and renal tissues as well as the serum following the administration of Shea butter based diet. The decrease was attributed to the presence of saponin, which have been reported reduce protein digestibility by the

forming sparingly digestible saponin-protein complexes in the intestine [74,75]. However, Belewu and Yahaya [76] reported that there was no digestive disturbance in feeding goats with Shea butter cake after observing a significant increase in crude protein digestibility in goats fed with Shea butter cake against control goats fed with soybeans cake. Furthermore, Akinwale and co worker [64] suggested that the decrease in serum albumin level following the feeding of rats with Shea butter based diet is as a result of utilization of Albumin in the transport of free fatty acids resulting from lipolysis from adipocytes.

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