Chapter

Phytocosmetics and Phytopharmaceuticals from African Medicinal Plants

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Abstract

Africa contains some of the richest biodiversity in the world, blessed with bountiful plants of economic importance and plants of medicinal importance which when developed would reduce our expenditure on imported drugs to meet our health needs. Plants are source of phytochemicals that possess emollients, humectants and medicinal properties. A complex mixture derived from plant sources are also used as a medicine or drug (phytomedicine, or phytopharmaceuticals). The demand for phytocosmetics and phytopharmaceuticals is increasing. Due to growing global market demand for phytocosmetics such as skin care, toiletries, perfumes and other cosmetics, there are greater opportunities through participation of local community in processing the plant resources to extract the products at subsistence level for industrial needs especially now that Africa needs local source of raw materials for the development of local industries for contribution to continental and interbational development. However, little or no research was conducted on the cosmetic potential of such plant resources. Plant-based cosmetics have an important role in modern society, natural based cosmetics, fragrances, and personal care products have increasingly become the greener alternative to nonherbal preparations. In this chapter, African perspective of phytocosmetics and phytopharmaceuticals are covered. Aspects of phytochemistry, botanicals for cosmetic use and formulation, the importance of phytocosmetic in traditional medicine, efficacy, safety research and patent among other areas are discussed in details. Applications of nanobiomaterials in phytocosmetics and phytopharmaceuticals, functional herbal cosmetics, emerging technologies in phytocosmetics phytopharmaceuticals development, and pharmaceutical phytocosmetics were explicated. Entrepreneurial platform for phytocosmetics is captured using the selected African medicinal plants.

Keywords: Medicinal plants, phytocosmetics, phytopharmaceuticals, phytochemistry, nanotechnology, entrepreneurship

1. Introduction

Plants are complex organisms that produce different metabolites responding to the environment they live in. In relation to the skin, its well-being and appearance is affected by phytomolecules interacting with skin cells. Using ethnobotanical studies on the one hand and physico-chemical analyses on the other, a rich inventory of

plants with potential to enrich modern cosmetic products have been pictured [1]. Examples of plants used for personal care which are investigated with new scientific advances was reported [2]. Mutations of viruses and microbes and the emergence of distinct types of diseases along with numerous patients with specific cases that continuous to develop push the industrial and biopharmaceutical sectors to collaborate with each other to innovate and develop new biodrug to face this dilemma and serve the interest of all mankind healthcares [3]. In this regard Biopharmaceutical researchers are pursuing many innovative scientific approaches that are driving therapeutic advances. They are working on new medicines for many diseases, including: cancers, heart dierese and stroke, HIV, asthma and allergy, skin diseases, mental disorders, rare diseases and neurological disorders [4]. A number of advantages including rapid production and scalability, the ability to produce unique glycoforms, and the intrinsic safety of food crops has enable plants to be used in the production of useful recombinant proteins. The expression methods used to produce target proteins are divided into stable and transient systems depending on applications that use whole plants or minimally processed forms [5]. A review has addressed the demand for recombinant biopharmaceuticals in the COVID-19 era [6]. A recent trend in what is seen as an emerging technology for phytocosmetic science development, where new technology updates consumer demand, the phytocosmetics enterprise requires that industries have the technical know- how to develop new technologies with lower costs and time to launch, which demands expertise that often small and medium scale industries do not have, requiring a process of transferring knowledge and technology [7].

1.1 Phytocosmetic development

Formulatation of a polyherbal cosmetic cream comprising plant extracts such as *Glycyrrhiza glabra* root, *Piper betle* leaves and *Azadirachta indica* leaves and to check their antimicrobial potential which can be used in the treatment of infectious skin diseases was reported [8]. Herbs are used in pharmaceutical and cosmetic industry for extracting active ingredients. Medicinal plants whose oils, extracts and tinctures contain active basic principles of plant protection preparations and resources used in obtaining pharmaceuticals and cosmetics products was reported [9, 10]. **Table 1** and **Figure 1(a–h)** showed some plants used in cosmetics and their potential.

1.1.1 Innovation using Plant stem cells

Current development has made it possible to prepare extract from the plant stem cells for the production of both common or professional care cosmetics. The impact of the plant stem cell extract, common apple tree type (Uttwiler Sp‰tlauber) to human skin as one of the first plant sorts, which are used in cosmetology and esthetic dermatology was described [11]. An emerging innovation of using cosmetic ingredients containing plant stem cells and their extracts has made its way into the industry. To create safe and effective organic topical skin care, plant stem cells could hold an interesting role if we can harness these benefits in cosmetics. A recent research interest has focus on the unique properties of plant stem cells which have been both in developing new cosmetics and studying how these extracts/ phytohormones will influence animal skin. A report has dwell into current hand- on experiments in plant stem cell-based cosmetics and has deeply highlighted on the challenges that we need to overcome in order to see meaningful changes in human skin using topical cosmetics derived from plant stem cells [12].

Plants	Potential
Aloe (*Aloe vera*_L)	Depigmentation, moisturizing
Lemon grasss (*Cymbopogon citratus*)	Anti-dandruff, fragrance
Rose (*Rosa centifolia*, L.)	Perfuming effect
Coconut (*Cocos nucifera* L.)	Preventing hair damage
Thuja (*Thuja Occidentalis`*	Counter irritant
Fenugreek (*Trigonella foenum graecum* L).	Wash for skin inflammations and eczema
Garlic (*Allium sativum*)	Antiseptic, bacteriostatic, antiviral
Ginger(*Zingiber officinale*, Roscoe)	Antiseptic, fragrance

Mohd-Nasir and Mohd-Setapar [10].

Table 1.
Some plants used in cosmetics and their potential.

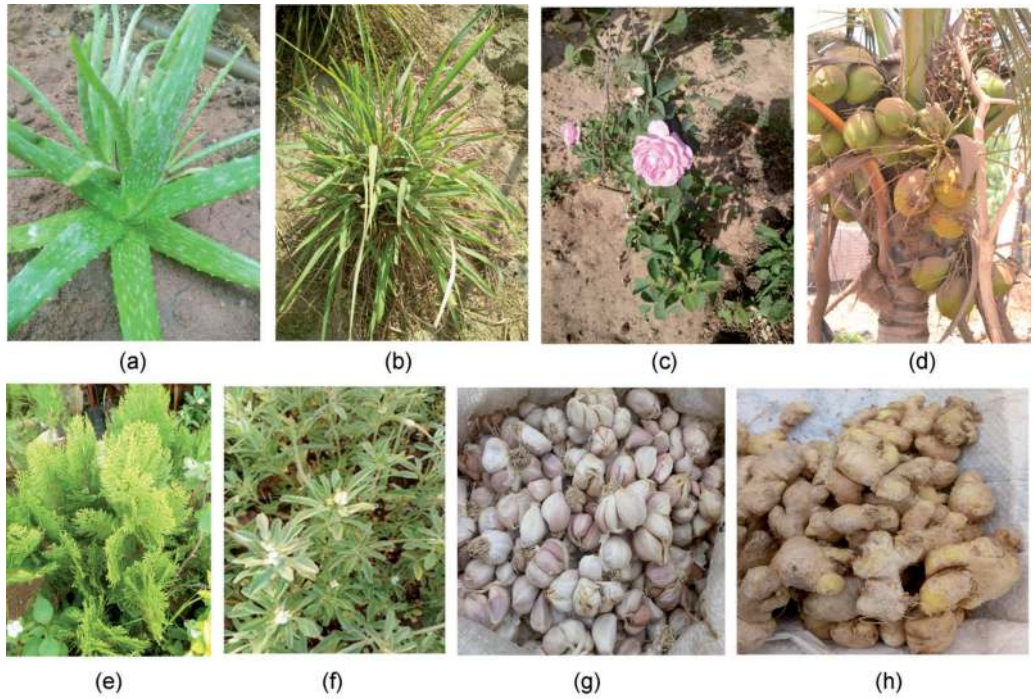

Figure 1.
(a-h) Some plants used in cosmetic preparations. (a) Aloe (Aloe vera_L) (b) Lemon grasss (Cymbopogon citratus) (c) Rose (Rosa centifolia, L.) (d) Coconut (Cocos nucifera L.) (e) Thuja (Thuja Occidentalis) (f) Fenugreek (Trigonella foenum-graecum L.) (g) Garlic (Allium sativum L.) (h) Ginger (Zingiber officinale).

1.1.2 Potential of plant extracts in herbal cosmetics

Plant oils and leaves have played a significant role in improving the quality of human life for thousands of years and have served as valuable raw materials for phycosmetics [13, 14]. Lipids from plants are used in their natural form as emollients and humectants, they provide a rich, non-greasy skin-feel with low odor and color to cosmetic and personal care formulations. In addition to the use of extracted seed oil for cooking, seed oils are also used for soaps, detergents, perfumes and related products. Inedible oil from seeds can be used to reduce the over use of the edible ones [15]. Common seed oils in most areas, especially rural

areas are mostly underutilized coupled with low productions due to a lack of good markets. To achieve national and entrepreneurial development, we need to design and develop strategy in order to explore and utilize full benefits of these seed oils [16]. Various methods of extraction are employed for the extraction of plant oils, leaves, stems and root extracts ranging from traditional to laboratory methods. Hot water floatation is the most common for traditional extraction; mechanical means is used for cold pressing while for researches in the laboratory different suitable solvents are used to achieve the desired results [17]. Herbal extracts are primarily added to the cosmetic formulations due to several associated properties such as antioxidant, antiinflammatory, antiseptic and antimicrobial properties. Even today, people in rural and urban areas depend upon herbs for traditional cosmetics [18].

1.2 Biopharmaceutical development

Plant-made pharmaceuticals have economic potential in the manufacture of biologic pharmaceuticals [19]. In recent years, there is paradigm shift in the use of transgenic plants for the production of therapeutic compounds from being an laboratory- base with potent capacity to be commercialized in order to deliver products useful in animal and human therapies. Productions have been made possible not only in more traditional areas of therapeutic development (e.g., the identification and isolation of bioactive secondary metabolites), but also with efforts in relatively unexploited areas such as the production of novel bioactive peptides therapy, and edible oral vaccines [20].

1.2.1 Transgenic plants platform

Due to their easy transformation, plants have considerable potential for the production of biopharmaceutical proteins and peptides and provide a cheap source of protein. Several biotechnology companies are now actively developing, field testing, and patenting plant expression systems, while clinical trials are proceeding on the first biopharmaceuticals derived from them. Product purification being a an expensive process has now made it an urgent need to develop new methods are to overcome this problem, including oleosin-fusion technology, which allows extraction with oil bodies. In some cases direct ingestion of the genetically modified plant which is a method of a biopharmaceutical product delivery potentially removes the need for purification. Such biopharmaceuticals and edible vaccines have the tendency of making immunization programs in developing countries cheaper and potentially easier to administer by storing and distribution as seeds, tubers, or fruits Some of the most expensive biopharmaceuticals of restricted availability, such as glucocerebrosidase, could become much cheaper and more plentiful through production in transgenic plant [21]. For the production of extraordinary high amounts of recombinant proteins, it has been demonstrated that transgenic plants can be developed facilitating the rational production of therapeutics [22]. Considering the nearly 500 biotechnology products approved or in development globally, and with production capacity limitation, it is very clear the need for efficient means of therapeutic protein production. Through recombinant DNA technology, plants can now be used to produce pharmacologically active proteins, including mammalian antibodies, blood product substitutes, vaccines, hormones, cytokines, and a variety of other therapeutic agents. In view of a decision as to whether a food crop or a non-food crop is more appropriate, efficient biopharmaceutical production in plants involves the proper selection of host plant and gene expression system [23].

1.3 Herbal cosmeceuticals

Herbal cosmeceuticals are a new type of plant product representing a hybrid between pharmaceuticals for skin diseases and cosmetic products. Considering the valuable scientific contributions welcomed by the scientific community on the field of cosmeceuticals, research should be further expanded as one can tap into a wealth of discovery and development of important cosmeceuticals from natural resources to address consumer and patients demand [24]. As an alternative to prevent adverse effect from chemical or artificial compounds usage natural ingredients from plants in cosmetics are incorporated. The active compounds in natural ingredients offer valuable bioactivities such as antioxidant, Various plants along with their active phytochemicals like alkaloids, flavonoids, saponins, sterols, triterpenes, tannins, etc. are responsible for activities like antioxidant, anti-inflammatory, sunlight protection, skin regeneration, de-pigmentation, anti-dandruff, anti-hair fall, anti-lice, etc. [25]. Herbal manufacturers are engaged in the production of cosmeceutical products such as body lotion, face packs, skin cleansers, fairness creams etc. There has been tremendous improvement in the cosmeceutical industry with natural products being more in demand than their synthetic counterparts; due to shift in consumer preference from synthetic cosmetics to natural ones this has been possible [26]. Novel drug delivery systems are nowadays used in herbal cosmetics the advantage of which includes; enhanced efficacy, improved stability and decrease allergic potential of some herbal substances, hence, choosing an appropriate drug delivery system for a herbal cosmetic is able to provide increased efficacy, stability and enhanced safety of the final product. Besides these advantages above mentioned, the complex nature of herbal cosmetics have made them more complicated in the fulfillment of quality requirements either during production or after packaging and during shelf life the critical nature that need to fulfill long-term stability and dermatological safety. Interestingly, critical parameters that affect the final quality and stability of herbal cosmetics are the specifications of herbal inputs, structure of formulation and manufacturing process [27].

1.4 African perspective

Apart from other herbal pharmacopeia, the use of phytocosmetics in the African culture is perhaps the oldest and most diverse. Rural Africa is especially blessed with affordable phytocosmetics prescribed by traditional healers accessible to the local community and sometimes the only option left for skincare in such remote areas. In fact, there remains insufficient updated favorable compendium of phytocosmetics from the African herbal pharmacopeia. In an attempt to provide a key scientific databases which have been screened to probe trends of the rapidly increasing amount of scientific publications on phytocosmetics from the African herbal pharmacopeia, updated general review of a few plants which are among the most popular and promising phytocosmetics from the African pharmacopeia are presented. This will also help to create important impact of phytocosmetics of African origin with different aspects, such as phytochemical profile, botanical aspects, biological properties, traditional uses, taxonomy, and clinical studies as well as future trials regarding the usage of these plants [28]. Since developing African countries face health problems that they struggle to solve. The major causes of which are high therapeutic and logistical costs, this made Plant-made therapeutics easy to produce due to the lack of the safety considerations associated with traditional fermenter-based expression platforms, such as mammalian cells. The easy nature of plant biosystems to scale up and being inexpensive and do not require refrigeration or a sophisticated medical infrastructure made it advantageous

to provide an opportunity for plant-made pharmaceuticals to counteract diseases for which medicines were previously inaccessible to people in countries with few resources [29]. Plants have the potential to rapidly produce recombinant proteins on a large scale at a relatively low cost compared to other production systems, provided concerns about biosafety, human health (allergenic response to plant-specific glycans), and other factors are adequately addressed and the right candidate genes, a strong commercial need, and a good production system are build as bridge between basic research on Plant Molecular Farming and its commercial application. They are able to produce a number of therapeutic proteins, some of which have been through pre-clinical or clinical trials and are close to commercialization. They have the potential to mass-produce pharmaceutical products with less cost than traditional methods. For combating the Ebola outbreak in Africa, tobacco-derived antibodies have been tested and used [30]. Herbal-based and plant-derived products can be exploited with sustainable comparative and competitive advantage. Some indigenous African plants with chemotherapeutic properties and possible ways of developing them into potent pharmacological agents using biotechnological approaches were reviewed. Examples of the selected plants and their active compounds are, *Garcinia kola* Kolaviron, Palm Oil Carotenoids, Alchornea laxiflora (Benth) alkaloids, cadiac glycosides saponins and phenolic compounds, Vernonia amygdalina (compositae) vernodaline, vernolide, vernomygdine and edotides, Mallotus oppositifolius (Euphorbiaceae) alkaloids, phenols, flavonoids, anthraquinones and cardenolides, *Hibiscus sabdariffa* L gossypetin, glucoside, bibiscin, hibiscus anthocyanin and Hibiscus protocatechuic acid [31]. The importance of the traditional medicine in the preparation of natural phytocosmetics was highlighted in north-eastern Algeria, the study was able to record the available information the importance of phytocosmetic in traditional medicine [32]. Explorative survey was conducted to document the natural resources (plant and non-plant materials) used for folk cosmeceuticals by rural communities in Vhembe district municipality, Limpopo province, South Africa. Documentation of the high number of natural resources in Vhembe district which is rich in ethnopharmacological knowledge is an indication that scientific investigation of the efficacies and safety of these natural resources is highly recommended as a drive aimed at innovations with benefits to the rural communities who are the custodians of this valuable knowledge [33]. A study was able to record the remaining available information on phytocosmetics in traditional medicine orally passed down through generations in South West Nigeria [34]. A study explored the indigenous knowledge of traditional cosmetic plants used by the Xhosa women of the Eastern Cape Province of South Africa. The local cosmetic applications of the plants included uses for changing skin complexion, sunlight protection, treating pimples and body rashes, removing spots, making skin soft, treating sunburns, making skin smooth and maintaining a healthy skin [35]. International companies with their marketing potential are been attracted by the development of cosmetics from Africa, from seed oils and their component. The African phytocosmetic enterprise is expected to double in the next decade with the rate of sales increasing up to a rate of 5–10% of beauty care products. In Africa the per capita spending on cosmetics ranges from 10 to 20 times lower than in developed market, but Africans a resurgence of phytocosmetic products when look forward can provide increase of marketers who are interested in their future growth [36]. A study was conducted to assess the knowledge of the. The pharmacognostic review of traditional herbal cosmetics in Gbaya ethnic group in the Eastern Cameroon showed that these plants all contain diverse phytochemicals like enzymes, minerals, vitamins, alkaloids, phenolic compounds, steroids, saponins, glycosides, carbohydrates, coumarins, lecithin, and essential oils that are all active cosmetic ingredients. The Gbaya people use various recipes for their tooth hygiene,

skin and hair care. Thus, promoting their sustainable use and the equitable sharing of benefits which is a pathway for harnessing the conservation of these plants and the local development [37]. Medicinal plant extracts are widely used as active ingredients in cosmetics. Plant material can come from a variety of sources, including commercial production horticulture and wild harvest in developing countries. Sustainably produced plant material does not threaten biodiversity, release pollution, compete with the food supply, or exploit local people [38].

2. Conclusion

With recent development in phytocosmetis and biopharmaceuticals especially in Africa, it is imperative to establish a cluster between academia and industry to ensure smooth development of emerging cosmetic products. In fact, efforts in making greener cosmetics shows promising progress worldwide and it is expected to keep expanding to meet growing consumer demand.

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