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Past and Current Prospectives of Herbal Product for Skin Care

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ABSTRACT

The treatment of skin ageing is vital in controlling numerous skin problems, especially in the elderly, which is a welcome side effect. Consumer demand for non-invasive products with fewer harmful effects than those currently on the market has led to a rapid surge in the development of new dermocosmetics. Herbal-derived formulations and natural compounds from plants have gained popularity because to the wide range of effective, non-toxic active ingredients they contain, many of which target different parts of the skin's ageing signalling pathways. The purpose of this review was, therefore, to identify the most current developments in the study of herbal-derived products, such as herbal formulations and isolated components with skin anti-aging effects. Clinical trials with available pharmacodynamics data support the protective effects of herbal-derived products used to treat, prevent, or control the ageing of human skin, and these investigations assessed the biological effects of these products in in vitro, ex vivo, and in vivo settings.

Keywords- Herbal, Skin Ageing, Essential oil treatment, Anti-oxidant.

I. INTRODUCTION

The body's largest organ, the skin, serves as a partition between the interior and exterior. As a result, it continuously protects the body from noxious stimuli like bacteria, sunlight, allergens, and irritants. Its unique function is directly related to its structure and makeup, particularly the epidermis (the outermost layer). The epidermis is composed of keratinocytes, melanocytes, [1][2] Merkel cells, gamma delta T-lymphocytes, and Langerhans cells. Basal keratinocytes in the epidermis retain their ability to proliferate and eventually give rise to the spinous and granular layers. The terminal differentiation that leads to corneocyte formation occurs once keratinocytes reach the horny layer.[3][4] The stratum corneum, the outermost layer of the epidermis, is composed of corneocytes (nucleated compact keratinocytes) and the lipids that compose the intercellular lamellar compartment (SC). The body's largest organ, the skin serves as the first line of defence against pathogens, toxins, and harmful sun radiation. Additionally, it helps to keep fluid balance and a healthy internal temperature. The skin's outermost layer, the stratum corneum, is a selectively permeable, heterogeneous epidermis that holds onto enough water to keep the skin supple and functioning in the face of environmental stress. Transepidermal water loss and skin hydration are negatively impacted when the stratum corneum's integrity is damaged, showing a breakdown in the skin's barrier function [5,6][7,8].

Despite having no legal definition, the term "cosmeceutical" is frequently used to refer to cosmetics that include active ingredients that are supposed to have therapeutic effects. A cosmeceutical therefore contains active ingredients with therapeutic properties that manifest as advantageous topical actions and offer

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defence against deteriorating skin conditions. They improve appearance by providing the necessary nutrients for healthy skin. They can improve the radiance, tone, and smoothness of your skin. The market for natural cosmetics and personal care items is increasing quickly [9,10].

Natural ingredients have been used for centuries to care for the skin, and their use in contemporary formulations is rising [11]. When something naturally occurs or is taken from sources like plants or animals, it is referred to as being "natural" [13]. There are numerous potential sources of natural components, including herbs, fruits, flowers, leaves, minerals, water, and soil [12]. Depending on the sort of dermatological basis they are added to and their in vitro and in vivo efficacy, natural ingredients in skin care products have various impacts [14]. Since using plants for medical purposes is as old as humanity, it is expected that the market will continue to see the introduction of new products incorporating natural oils and herbs in the coming years. Cosmetics were predominantly made from plants before synthetic compounds with comparable properties were employed [15]. In the scientific community, natural plant compounds are still a hot topic. However, it is essential to pay close attention to the extraction processes, plant-to-solvent ratios, and the quantity of active compounds when working with extracts [16]. Plant extracts have become more prevalent in skin care products as a result of consumers' growing awareness of how their purchases affect the environment [17]. Many consumers, however, are unaware that natural products are a mixture of many chemical components, any one of which could have a negative effect. By examining the chemical composition of their extracts, researchers can avoid this problem. A variety of human cell lines can be used to assess the cytotoxic potential of extracts in vitro before they are applied to people or tested for potential irritation in cosmetic formulations. These steps can help make natural products more appealing to buyers by making them safer for consumers to use.[18][19]

II. HISTORY OF HERBAL CARE PRODUCT FOR SKIN

The giant cosmetic companies that generate billions of dollars of revenue annually [20] were founded in the twentieth century by chemists and pharmacists in the United States. A well-known cosmetic company started by selling books door-to-door, along with colognes manufactured by a friendly pharmacist [21]. After the First World War, the athletic look became fashionable for the first time, and the fashion statements made by Coco Channel, including dark eyes, red lipstick, red nail polish and suntanned skin, which became popular as a contrast to then dominant fad for pale skin [22].

The global use of cosmetics is said to date back to the end of the Second World War. Military camouflage paints and sunscreens (in 1944, Benjamin Green, a pharmacist from Miami Beach, developed a sunscreen for soldiers in the Southern Pacific) became available to civil society in the form of make-up creams [23]. Initially Hollywood, and then colour television, engendered the idea of the “American Beauty”, i.e., the desire to look like movie stars such as Marilyn Monroe, Grace Kelly, or Audrey Hepburn [24,25].

Five thousand years before, the Sumerians, Assyrians, and Babylonians removed skin devils with mud, unguent, poultices, and plants such as castor oil (*Ricinus communis* L.), anise (*Illicium verum* Hook.f), belladonna (*Atropa belladonna* L.), cinnamon (*Cinnamomum* Schaeff.), cardamom [*Elettaria cardamomum* (L.) Maton], myrrh (*Boswellia sacra* Fluck.), and mustard (*Sinapis alba* L.) [26].

Museum collections reveal the importance of cosmetics in ancient Egypt [27], where it was believed that the spiritual essences of healing plants possessed supernatural powers. The Egyptians used oils and creams for protection against the hot dry desert sun and winds, whose basic ingredients were myrrh, thyme (*Thymus* L.), marjoram (*Mentha* L.), chamomile (*Matricaria* L.), lavender (*Lavandula* L.), lily (Liliaceae), peppermint (*Mentha* L.), rosemary (*Rosmarinus officinalis* L.), cedar (*Cedrus libani* A. Rich), rose (*Rosa* L.), aloe (*Aloe barbadensis* Mill.), and olive (*Olea europaea* L.), sesame (*Sesamum indicum* L.), and almond (*Prunus dulcis* Mill.) oils, the plant species that provide the basic ingredients of most perfumes [27]. Manniche [29] has described the composition of a body oil from the Egyptian period as based on sesame, castor oil, Thron tree [*Balanites aegyptiaca* (L.) Delile], horseradish tree/moringa (*Moringa oleifera* Lam.), and olive oil.

The plants used for mummification were coniferous resin (*Cedrus libani* A. Rich; *Cupressus* L.), mastic (*Pistacia lentiscus* L.), myrrh, cassia (*Cassia* L.), onions (*Allium cepa* L.), lichens, henna (*Lawsonia inermis* L.), and arabic gum (*Acacia* Mill.) [30].

In the tombs of the Egyptian pharaohs, a bouquet of rosemary was placed to perfume their trip to Hades (Greek god of the underworld) or through the *Laguna Estigia*, according to Greek mythology [31]. In the period of Ramses IX (1100 BC), moringa oil was considered an exotic and luxury product and was included in their treasures for the afterlife. A paleographic stamp drawn on an amphora states: *moringa oil and mandrake extract* (*Mandragora officinalis* Mill.) [32]. The most famous Egyptian perfume was *Kyphi* (of uncertain botanical composition but certainly including incense (*Plectranthus madagascariensis* Pers. Benth)), which means “welcome to the gods”, and was also used to induce hypnotic states. In Heliopolis, the City of the Sun, resins were burnt in the morning, while myrrh was burnt at noon and

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sunset in honour of Ra, the sun god. The Egyptians used minerals and plants to make their eyes look bigger and brighter, initially employing malachite (Cu) to decorate eyelids and later *kohl*, that is, galena (PbS) and traces of antimony (Sb) [33]. A mixture of incense powder, beeswax, virgin olive oil, cypress resin (*Cupressus* L.), and milk was applied to the face, while the hair was coloured with henna leaves [34].

Egyptian customs were exported to Greece and Rome. Indeed, the word "cosmetic" is derived from the Greek *Kosmetos* (Κοσμετός), which means "adornment" or "ornament". The Hellenes established canons for beauty, such as the *Venus de Milo*, an icon of the cult of body shape. In Greece and Rome, the body was depilated as a sign of youth. At night, ointments composed of cypress, cedar, and incense resins were applied. The face was treated with lead acetate (white lead) and cinnabar (Hg) [35]. Perfumes were obtained from oriental essences and rose water. Dioscorides (ca. 40–90 AD (*Anno Domini* or After Christ)) named rosemary *libanotis coronaria* (pre-linnean nomenclature) that is, having the property of toning the fatigued body (external use) [36]. In Rome, figs (*Ficus carica* L.) became very popular after the conquest of Carthage. They were mixed with banana (*Musa* L.), oats (*Avena* L.), and rose water to obtain a facial cream. Olive oil was used to clean the body, in general, and to combat wrinkles [37]. White lead (*cerusa*) was used as a face bleach, while red lead (*minio*) was used as a face blush. The invention of the *Frigus crepito*, a predecessor of the current cold cream, a skin protector (rose water, almond oil, and beeswax), is attributed to Galen (1[–ca. 216 AD) [38].

Recently, amphoras containing well-preserved unguents, in which moringa oil is a major component [39.40], have been found in archaeological sites such as Chuisi (Italy). The composition of moringa oil, with <1% polyunsaturated fatty acids, makes this oil an excellent basis for cosmetics, soaps, and perfumes, since it absorbs odour and retains floral fragrances. Along with marula oil (*Sclerocarya birrea* (A. Rich.) Hochst.), moringa oil is considered one of the best of all oils for cosmetic use. It was very appreciated by ancient Egyptians, Greeks, and Romans, who imported it from Somalia and Ethiopia in the Horn of Africa [41].

Cosmetic products are also important in Israeli culture. Before online shopping facilities existed, people visited the Dead Sea to experience the historical (biblical) context of the place and to float in the hypersaline water; they also spent large amounts of money purchasing cosmetic products such as mud, clay, and water. These products have been used for thousands of years for skin care and the treatment of illnesses, and have a balanced composition of mineral salts [42]. According to the Bible, the Child Jesus received gold, frankincense, and myrrh from the Three Wise Men about 40 km from the Dead Sea in Bethlehem of Judea (Matthew. 2). Mary, Lazarus' sister, dried Jesus' feet with the very expensive spikenard perfume (*Nardostachys jatamansi* (D. Don) DC-De Candolle.) (John. 12) [43], and at the end of his life, he was shrouded and placed in a tomb with aromatic oils, myrrh, and aloe. However, most of the early Christians considered skin care to be a sin, and one of Satan's tricks. Modesty and austerity became merits, and bathing and shaving were abandoned [44]. The only beauty accepted was the virtue of the soul. In a medieval Spanish text, this concept is stressed as *Atavío y afeite, cuesta caro y miente* (proverb XLII) ("Wearing good clothes and good makeup is expensive, and a deceit") [45]. The library of Alexandria was destroyed in 391 AD. The Roman archives (dating from 410 to 476) were looted by the barbarian tribes of Alaric (in 410–476), while the few classic vestiges of Athens (year 529) were destroyed in the Justinian period [24]. However, much of what was left of this scientific knowledge was rescued by the Arabs [47]. Many branches of Islam established a series of basic rules relating to purity and cleanliness, not only in body but also in spirit. The Quran says that Allah loves people who return to him, and also those who purify themselves. Doctor Abu'al-Qasim Al Zahrawi (936–1013) wrote the 30-volume medical encyclopaedia of Al-Tasreef, of which chapter 19 is dedicated to cosmetics. Al-Zahrawi considers cosmetics as a branch of medicine, and referred to it as *Adwiyat al-Zinah* (Medicine of Beauty). This treatise contains the first descriptions of lipsticks and solid deodorants [48]. In the Middle Ages, European cities were converted into castles and monasteries were fortified, the latter becoming places where knowledge was preserved and stored. Towards the year 1100, the Salerno medical school was founded, and *De Ornatu Mulierum*, the first written work about cosmetics, was published. It depicted 96 plant species of cosmetic value, many of which are still in use (albeit not all in the same way) in the twenty-first century [49]. At the same time, the Arabs translated classic texts, including *Dioscorides* by the monk Nicholas [50]. Crusaders brought the *kohl* back to Europe and the first essences of distillation processes, such as those developed by Avicenna, appeared. Perfumes and fragrances soon began to be used in *Al-Andalus* as the Muslim domination spread across the Iberian Peninsula (the perfumers of Granada were very famous) [51].

Before 1492 Jews, Muslims and Christians had lived together for centuries in Hispania. Jews and Muslims, with their purifying baths and their perfumes, had a great influence on Christian women. Later, it was said that Spanish women were the cleanest and the most perfumed of all European women, a custom that has remained. On a trip to Spain, Madame d'Aulnoy described how a lady from this period made herself up: she had a full bottle of blusher and applied it with a paint brush to her cheeks, lips, forehead, hands, and shoulders. Every day, Spanish women put on make-up before going to bed and when they get up. Although this custom was

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not particularly approved, women did not want to appear to have the pale skin of a sick woman [52]. Arab wisdom went beyond the frontiers of Hispania, and the medieval knowledge preserved in Italian monasteries expanded towards south-eastern France. The beginning of modern perfumery in Europe dates from the fourteenth century in Montpellier, where the ancient *libanotis coronaria* became *Queen of Hungary's water* or *Spirits of Rosemary*, a hydroalcoholic solution of essence of Rosemary used by the Queen Consort of Hungary (1305–1380) [53]. During the Middle Ages, a certain amount of phytotherapy "research" took place within monasteries, as monks used plants and minerals for medicinal and cosmetic purposes. Nevertheless, medicinal—but not cosmetic—remedies were shared with nobles and aristocrats (and common people). Arboretums were created to try and acclimatise exotic plants and oriental essences, such as vetiver (*Chrysopogon zizanioides* (L.) Roberty), patchouli (*Pogostemon cablin* (Blanco) Benth.), and benzoin (*Styrax* L.), which were used together with Mediterranean products such as labdanum (*Cistus ladanifer* L.), saffron (*Crocus sativus* L.), and bergamot (*Citrus bergamia* Risso & Poit.). With the discovery of America, Tolu balsam [*Myroxylon balsamum* (L.) Harms] was brought to Europe for the first time [54].

In Japan, crushed safflower petals (*Carthamus tinctorius* L.) were used to paint the eyebrows, the edges of the eyes, and the lips. Rice powder (*Oryza sativa* L.) was employed to whiten the colour of the face and back. The Chinese upper classes made abundant use of fragrances during the Tang and Ming dynasties (seventh–eighth centuries AD). Their bodies, bathrooms, clothes, houses, and temples were richly perfumed. In China, the aesthetic conditions of women changed during the Tang dynasty, when the country was rich and powerful. Eyebrows shaped like silkworms, eyes shaped like almonds and cherry-shaped lips. China imported sesame oil scented with Indian jasmine (*Murraya paniculata* (L.) Jack.) [55,56,57,58], rose water from Persia along the Silk Road, and even aromatic compounds from Indonesia: cloves (*Syzygium aromaticum* (L.) Merr. & L.M. Perry), benzoin, ginger (*Zingiber officinale* Roscoe), nutmeg (*Myristica fragrans* MF Hott.), and patchouli. Women in India did not use soap; rather, they used a germicidal cream of turmeric (*Curcuma longa* L.), and a treatment composed of one gram of wheat flour (*Triticum* L.) mixed with milk to eliminate dead cell tissue [60].

In America, the Yanomami Indians have virtually never had any contact with other human beings, and currently live in the Amazon in a Stone Age state. They paint their faces with extracts of *bija/achiote* seeds (*Bixa orellana* L.) that provide information about the person's moment of sexual maturity or the status of an individual within the tribe [61], just as many social groups do in today's cities—the so-called "urban tribes".

In the book *General History of Things in New Spain*, the Franciscan Father Bernardino de Sahagún (1499–1590) explained how the Mexicas prepared to go to the war. Dead soldiers were thought not to have actually died, but just to have gone to the place where the sun sets. With this aim in mind, they painted their eyes black and their mouths red (*Aquellos mexicas que morían yendo a la batalla, no morían, sino que marchaban allí donde estaba el Sol. Por ello eran pintados de un modo muy particular: se les teñía de negro los ojos y de colorado la boca*). Iron and lead ores, as well as plant-based resins, were used to paint their faces, namely achiote (*Bixa orellana* L.) and copalli (Burseraceae family) [62]. The Guarani Indians also used achiote as face paint and as a repellent [63].

The sixteenth century marks the beginning of the Renaissance and the return of concepts of beauty and pleasure. The printing press had been invented, America had just been discovered and, thanks to Paracelsus, chemistry and minerals began to be used in medicine.

Miguel de Cervantes (1547–1616) provides numerous references to cosmetics that reflect the culture and society of the time: arnica tincture (*Arnica montana* L.), *argentadas* or silver-plating (Ag) *bujelladas*, (mixture of essences to perfume the body), *cerillas* (mixture of virgin bee-wax with various ingredients, usually plants, used by women as beauty cream), *clarimente* (milk or cleansing tonic made of lemon juice *Citrus limon* (L.) Osbeck and barley water *Hordeum vulgare* L.), *solimán* (Hg and As used at the time against syphilis and also as a cosmetic preparation for whitening the face), and *albayalde* or lead [64]. Many of these words are archaisms, and are no longer in use in modern Spanish.

By the time of Philip IV (1605–1655), Spain had the largest overseas empire in the World. On an elegant dressing table, there would be rose water, *azahar* (orange blossom, *Citrus* L.), *jaboncillo de Venecia* (Venice medicinal soap with ammonia), *estoraque* (*Liquidambar styraciflua* L.), and benzoin, violet (*Viola* L.), pine nut (*Pinus* L.), and lupin (*Lupinus* L.) oils; *canutillo de albayalde* (a small tube with Pb), engraved *solimán* to whiten the skin (box with Hg and As), deer marrow, fragrant pills, and other ingredients were stored in small pots (*salserillas*) [65].

In Europe, the enamelling of face with arsenic and lead became popular [66,67], and ever since, these two components have been combined in numerous compounds. In general, not only kings but also the rich and powerful whitened their faces as a mark of distinction: Mary Stuart of Scotland (1542–1587), Elizabeth I of England (1533–1603), Maria Theresa I of Austria (1717–1780), Louis XVI (1754–1793) and his wife Marie Antoinette (1755–1793), Napoleon Bonaparte (1769–1821), and Joséphine de Beauharnais (1763–1814). However, Pb can lead to lead poisoning due to absorption through the skin, a phenomenon first noticed in 1760 when the first significant cosmetic

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victim, the Countess of Coventry, came to light. In England, women cleaned their faces with their own urine, a habit that was practiced in other historical times, while some doctors even prescribed arsenic pills to cause pallor to the face [68].

At the end of the eighteenth century, the industrial manufacture of soap was invented, and cosmetics began to be taxed [69]. The word "soap" comes from a legend: supposedly, near Rome, there was a certain Mount Sapo, where the fat from goats burned in holocausts was mixed unintentionally with beech ash (*Fagus sylvatica* L.) to produce a kind of soap. Soap, as it is known today, was a real revolution that has contributed to the personal hygiene and cosmetics of millions of people. Previously, only a small number of people had access to soap plants, which are rich in saponins and foam producers (*Saponaria officinalis L.—soap dish*, *Quillaja saponaria Molina*, *Sapindus L.*, *Solanum L.*), or rich in alkalis, and whose ashes are used in soap-making (*Laminaria* JV Lamour and *Salsola* L.—*barrilla*) [70]. In Spain, rancid olive oil was used to make Castile soap. In Marseille, a sophisticated soap was made by adding lavender [71]. Soap is a solid product made from oil by means of saponification, a process that requires caustic soda or potash. Thanks to the caustic soda that can be derived from common salt, the amount of soap that can be made cheaply is unlimited. Some of the most commonly used oils include olive, coconut, (*Cocos nucifera* L.), palm (*Elaeis guineensis* Jacq.), sunflower (*Helianthus annuus* L.), and karité (*Vitellaria paradoxa* C.F.Gaertn.). [72]. *Eau de Cologne*, the oldest "perfume" (considered as such) in the world appeared in this century. At the Versailles Court, Eau de Cologne was a great success; originally prepared by Florentine nuns to resemble *Aqua de Regina* (bergamot extracts), its formula was acquired by an Italian apothecary who first manufactured the fragrance in the German city of Cologne in 1729 [73]. In this work, only the history of human personal care products (skin, cosmetics and fragrances), mixed between the skin, the good smell and the good aspect, is confirmed. Many of these products are no longer used, as they are old. However, olive oil, argan, and aloe, as we will see in the next chapter, are first class products in cosmetics and personal care. [74]

III. PRESENT SCENARIO OF HERBAL PRODUCT FOR SKIN CARE

Based on traditional uses and ethnobotanical knowledge, humans have, until recently, used natural resources empirically for skin care and modifying their physical appearance. However, in recent years, interest in health and skin care has become much more widespread, and there is now great demand for certain effective plant extracts [75]. Our skin separates our body from the exterior and its densely packed nerves make it a sensory organ that reflects feelings, emotions, and health. Ageing is defined as the accumulation of molecular damage produced by reactive oxygen species (ROS) (ions, free radicals and peroxides). Consequently, unlike the internal organs that do not visibly age, the ageing of the skin has great social importance. Therefore, the concern for cutaneous ageing is radically different from that generated by the general ageing of the rest of the organism [76]. There are natural or chronological ageing processes that occur with the passage of time and are the product of the cellular oxidative stress of the organism. Accelerated ageing is caused by various environmental factors: ultraviolet (UV) radiation, electromagnetic fields, chemicals, and climatology. In these cases, ROS are produced and damage DNA telomeres, enzymes, and cell membranes [77]. These and other considerations are fundamental for understanding the present and the future of skin and beauty products. It is no longer enough to look good—it is also vital to delay ageing and prevent the appearance of illness.[78][79[80]

The chemical and pharmaceutical industries are well aware of this, and therefore, are under great pressure. Indeed, in recent years, a new term has been coined: "cosmeceutical" (cosmetic with therapeutic action) [81], which is the intersection of pharmacy and cosmetics. This concept involves an interdisciplinary integration of physics, chemistry, and biology that studies in great depth—in some cases, leading to rediscoveries—the properties of plants. This is a consequence of the application of techniques such as chromatography and spectrometry [high performance liquid chromatography (HPLC), gas chromatography–mass spectrometry (GC-MS), fourier-transform infrared spectroscopy (FTIR)] and the use of plant extracts in in vitro and in vivo tests. We already know something about the mechanisms of ROS acting at molecular level on different layers of the skin, and we also understand the chemical structures of a whole series of potent antioxidants [82]. The leaves of green tea (*Camellia sinensis* (L.) Kuntze) are rich in vitamin C, while the polyphenols of grape seeds (*Vitis vinfera* L.) inhibit lipid peroxidation [82]. The compounds extracted from green coffee seeds (*Coffea arabica* L.) stimulate the production of collagen and elastin [83]. The antioxidants of cucumber (*Cucumis sativus* L.) inhibit skin hyaluronidase and elastase [84]. The rhizomes of ginger and turmeric are used in anti-ageing preparations due to their inhibitory effect on cutaneous tyrosinase [85]. Extracts of *Polypodium leucotomos* Hook. (a Central American tropical fern) are used as a sunscreen, due to their richness in caffeic, ferulic, and chlorogenic acid [86].

Nowadays, non-toxic and hypoallergenic products are much in demand [4] since, for a long time, dangerous chemicals such as mercury, lead, and arsenic were used for bleaching and firming up the skin, until they were banned due to their toxicity [87].

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Confidence in these products also begins with packaging, and it is currently very common to see botanical names on labels misspelled and incorrectly written. During the "mad cow" bovine spongiform encephalopathy (BSE), "bird flu" (H5N1 virus), and other epizootic crises, the idea gained ground in the collective subconscious that animal products are especially harmful [88]. These ideas have turned people's gazes towards green, bio-, ecological, or natural cosmetics derived from plants, which are said to be innocuous [89]. In 2007, the term phytosome was introduced to define a nanocompound produced by the layer of phospholipid that surrounds a phytoconstituent that is easily absorbed by the skin [90]. Tests have also been carried out with the fungi *Fomes officinalis* (Will.) Bress., due to its botox effect [91]. Nowadays, the cells of plant meristems (cells in pluripotent state) extracted from the common apple tree (*Malus pumila* Mill.) can be cultivated in bioreactors to obtain a menu of plant tissues and seedlings, producers of secondary metabolites [92]. Although this is still hypothetical, it could be possible in many cases as a means of avoiding damage to the environment when obtaining products. This is the case of argan oil (*Argania spinosa* (L.) Skeels), a small tree endemic to Morocco with little capacity for regeneration, the demand for whose oil has led to a drastic decline in its numbers [93]. We should not forget either the enormous potential of the marine world. Marine ecosystems are inhabited by the oldest organisms in evolutionary history, and so are phylogenetically distant from humans and other animals, which, to some extent, could imply lower intrinsic toxicity [94]. Being marine creatures, whose hostile habitats make scientific research inherently difficult, the potentialities of marine species have, to date, been little investigated compared to those of terrestrial ones; however, they are just starting to be seen as a source of sustainable exploitation that could complement the use of terrestrial plants. It is hoped that new healthy and beneficial molecules (not only for the skin) will be found in this environment. Traditionally, macroalgae have been used in cosmetics as a source of phycocolloids (*Chondrus crispus* Stackh., *Laminaria saccharina* J.V. Lamour.) [95]—due to their richness in minerals and amino acids—in thalassotherapy sessions. Moreover, trials are taking place aimed at understanding the cosmeceutical properties and possibilities of exploiting microalgae such as *Chlorella* Beijerinck) and *Anacystis nidulans* P. Richter (cyanobacteria) [96]. Molluscs (glycogen), crustaceans (chitosan), fish (oils with essential fatty acids, collagen, and hyaluronic acid) and corals (trace elements and mineral salts in high concentration) are also currently under study [97].

Finally, we would to highlight the fact that, in this work, only a small number of plant species have been mentioned. Indeed, the number of plant species used in skin care, cosmetics and fragrances is considerably greater and continues to grow: sabal (*Serenoa serrulata* (Michx.) G. Nicholson) [56], gooseberry (*Phyllanthus emblica* L.) [96], (*Matricaria chamomilla* L.) [98], pomegranate (*Punica granatum* L.) [98], mango (*Mangifera indica* L.) [99], gotu kola (*Centella asiatica* (L.) Urb.) [99], and many others.

IV. BENEFITS OF PLANT EXTRACT FOR SKIN CARE

When used as ingredients in cosmetics, bioactive extracts or phytochemicals from a variety of botanicals serve two purposes: they take care of the body while also influencing the biological processes of the skin and supplying essential nutrients for healthy skin [100]. The majority of the time, botanical products are a great source of vitamins, antioxidants, essential oils, hydrocolloids, proteins, terpenoids, and other bioactive substances [101]. These extracts can offer a variety of qualities depending on their composition.

4.2.1. Antioxidant Activity

One of the main causes of skin ageing and dermatological disorders is oxidative stress [102]. Sunlight's ultraviolet rays are by far the most prevalent external element known to cause skin damage. Continuous exposure to external stimuli causes modifications in connective tissue from the generation of lipid peroxides and reactive oxygen species (ROS), as well as the activity of enzymes, which in turn causes a variety of skin problems [103].

Antioxidants are a group of chemicals that work to prevent cell damage by neutralising free radicals. These radical scavengers protect the organism by stopping oxidative reactions in their tracks. Exogenously produced reactive oxygen species (ROS) react with skin biomolecules, contributing to skin diseases [104,105]. The topical use of antioxidants is an effective technique for enhancing the endogenous cutaneous system, which in turn reduces oxidative damage caused by UV radiation and protects against diseases caused by oxidative stress [106,107,108].

Phenolic compounds are a class of bioactive plant compounds that play an essential role in the human diet due to their abundance and diversity in plant species. Flavonoids (anthocyanins, flavonols, flavones, etc.) and various groups of non-flavonoids (phenolic acids, lignins, stilbenes) are all examples of phenolics found in plants [109]. Natural antioxidants can scavenge free radicals or encourage their breakdown, thereby reducing the risk of disease. Some chemicals prevent or repair oxidative damage to cells caused by oxygen by blocking the onset or progression of oxidative chain reactions [110].

Plants' concentrations of secondary metabolites, known as phenolic compounds, can be affected by a variety of factors, including physiological variation, local climate, genetics, and evolutionary history [111]. Each phenolic compound has a unique molecular structure, which affects its antioxidant activity [112]. According to the structure-activity connection [113], the

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amount of hydroxyl groups is the primary determinant of the antioxidant activity of phenolic compounds.

Because of their potent ability to mop up free radicals, phenolic antioxidants have gained significant traction in the recent decade [114]. Plants high in phenolic compounds may be useful for shielding the skin from the sun's damaging rays [115].

Plant extracts used in pharmaceuticals, nutritional supplements, and personal care products are a common route for delivering phenolic chemicals to the body. The extraction technique and solvent used have a major impact on the phenolic component content of the extract [116].

4.2.2. Tyrosinase Inhibition Effect

Humans have a pigment called melanin that determines the colour of their skin, hair, and eyes. Melanocytes, which are present throughout the dermis' basal layer, create and secrete it through a physiological process known as melanogenesis. The melanocytes generate two different types of melanin pigments: pheomelanin, which is red or yellow, and eumelanin, which is black or brown. The kind and distribution of melanin pigment determines the colour of human skin and hair. The amount of melanocytes present in each member of the various ethnic groups is typically the same, therefore the type of melanin generated relies on how well those melanocytes are operating, i.e., persons with darker skin are genetically predisposed to continuously produce more melanin [117]. Thyrosinase, a crucial enzyme in melanogenesis, is activated when skin is exposed to sunlight, which promotes melanogenesis [118].

Figure 1 illustrates the two different reactions that the polyphenol oxidase tyrosinase can catalyse: the first is the conversion of L-tyrosine to L-dihydroxyphenylalanine (L-DOPA), and the second is the conversion of L-DOPA to dopaquinone (second reaction). Dopaquinone is then converted to leukodopachrome via a non-enzyme-catalyzed mechanism (third reaction). This molecule undergoes a very quick, non-enzyme-catalyzed oxidation to produce dopachrome (fourth reaction). Then, through a sequence of chemical and enzyme-catalyzed processes, dopachrome is converted to melanin. As a result, the mechanism in question demonstrates how dopachrome synthesis can be suppressed when any of the steps are blocked. However, not all drugs, for instance thymol [119,120], that can prevent the production of dopachrome are tyrosinase inhibitors.

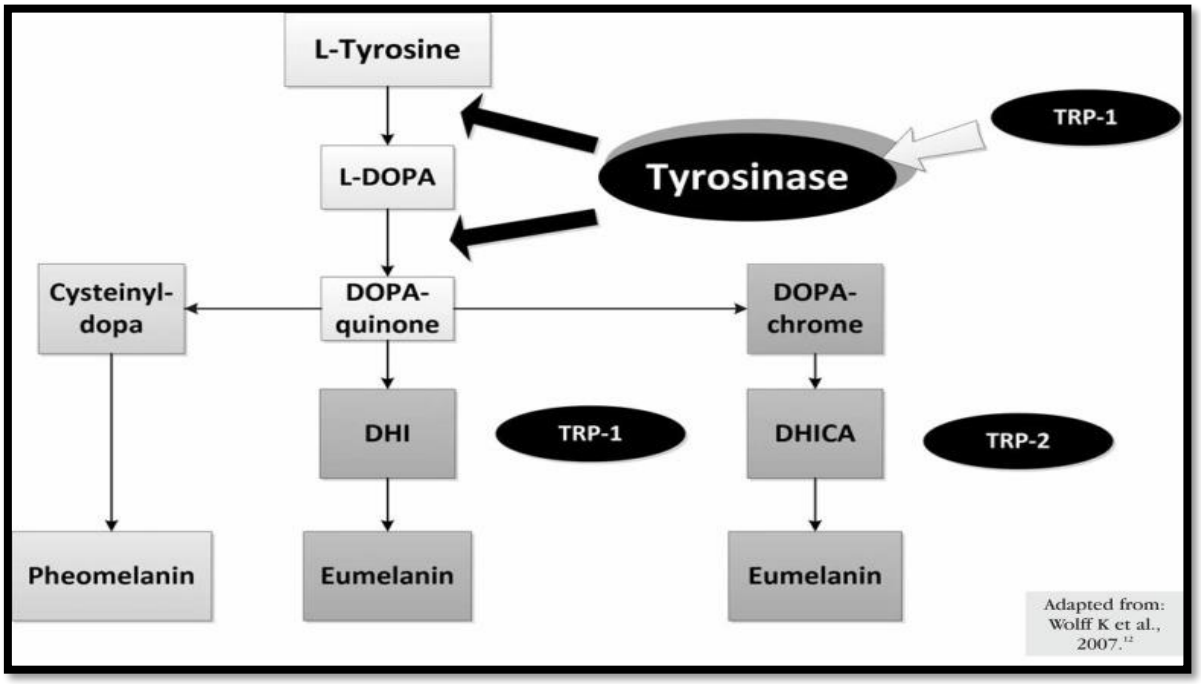

Figure 1: Representation of the melanin synthesis. [wolff k. et.al]

4.2.3. Natural Anti-oxidant for skin care

An abundance of metabolic processes, including the production of free radicals, take place on the skin, a protective organ (reactive oxygen and nitrogen species). Oxidative stress is a key factor in epidermal barrier disruption, skin ageing, and melanogenesis, despite ROS's importance in biological signalling systems. Triggers of oxidative stress in the environment, such as ultraviolet (UV) radiation and visible light, both affect skin parameters in similar ways, resulting in compromised skin barrier function and cosmetically unattractive hyperpigmentation [121,122,123].

We used non-invasive biophysical methods to assess skin colour, melanin, erythema index, skin pH, skin-surface temperature, radiance, and viscoelasticity,

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expanding on our previous work [124,125,126] on the relationship between the tested drugs and the skin barrier qualities. In the first place, we used the transepidermal water loss (TEWL) probe to assess the skin's barrier function [127].

Figure 2: Skin ageing factor

In a recent study [128], we found that applying a cream containing 3% S. balsamita extract increased SC hydration and transepidermal water loss ($p = 0.005$), a sign of the skin's ability to keep out environmental pollutants. There were no parallel findings between the TXF and placebo creams. The purpose of this study was to determine the relationship between the skin penetration of S. balsamita extract and TXF and the changes in biophysical (melanin index, erythema index, brightness, red intensity, yellow intensity, individual typological angle, pH, skin temperature, diffuse reflected/scattered light) and biomechanical (viscoelasticity) skin parameters.

Acidifying the SC exogenously has been shown to correct barrier defects in older skin [129]. Thus, xerosis or eczema, which are common in middle-aged women, may be avoided with acidification therapy utilising S. balsamita extract (pH = 4.5). Clinical investigations have shown that treating the elderly population with skincare products with a pH of 4.0 results in a considerable improvement in SC integrity after just 4 weeks [130]. Therefore, the decrease in baseline skin surface pH after using the cream containing 3% extract of S. balsamita ($p = 0.0323$) may have been caused by the enhancement of SC integrity. Notably, neither the TXF cream (at 3% concentration) nor the placebo had any effect on the skin's pH.

Anti-inflammatory compounds that can slow or stop the signs of ageing are becoming increasingly popular in the beauty industry. With the knowledge that melanogenesis is an oxidative process, the potential benefits of antioxidant therapy have been studied. Melanin acts as an antioxidant by scavenging free radicals and contributes to the establishment of skin barrier functions [131]. Compared to less-pigmented keratinocytes, melanized keratinocytes showed improved barrier performance in a study conducted by Man et al. [132]. Those with darker skin tones may have a distinct

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skin barrier function and other biophysical properties [134,134,135,136]. Significant problems exist in the human population due to hyperpigmentation diseases, which are defined by compromised stratum SC. Age-related skin inflammation also causes a weakened epidermal barrier, decreased moisture retention, redness, scaling, and changes in pigmentation [137]. Antioxidants have been shown to have clinical efficacy for the reduction in melanogenesis [138,139,140], supporting the well-established function of oxidative stress in melasma. According to our findings, TXF has the potential to be a novel natural source of cosmetics with therapeutic applications for melasma patients, therefore this finding is in line with our expectations. The MI readings showed a marked decrease in melanin content for both the 3% TXF cream and the 3% S. balsamita extract cream, but not for the base cream (placebo). As an added bonus, the 3% S. balsamita extract cream enhanced skin tone, while the 3% TXF cream and the placebo had no such effect. According to the results of the studies conducted on anti-inflammatory chemicals, TXF and S. balsamita extract have the potential to lessen the outward manifestations of skin inflammation across all of its stages, including hyperpigmentation and erythema. To ensure that novel compounds used in cosmetics do not cause skin irritation or allergic reactions, it is crucial to conduct appropriate testing. Consequently, we opted to use individuals with eczema, who are predisposed to skin irritation and contact delayed-type hypersensitivity, as a positive control group. Results showed that even on sensitive skin, none of the tested creams caused irritation or allergic reactions, validating our in vitro findings on the biosafety of TXF and S. balsamita extract.[141,142,143,144,145]

Creams containing either 3% TXF or 3% S. balsamita extract successfully lowered skin temperature. Similar to smoking and obesity, photoaging of the skin is characterised by a chronic inflammatory response that can increase body temperature [146,147,148,149]. Therefore, these data may indicate that both tested products aid in maintaining a healthy skin temperature.

Viscoelasticity [69] improvements were seen only in TXF (p 0.005), suggesting that the 3% TXF cream successfully tensioned the skin, in contrast to the 3% S. balsamita extract cream and the placebo. Further refining of this parameter would be expected with continuing use; nevertheless, it is probable that improvements in skin viscoelasticity would require a longer application duration of the investigated formulations.[150]

Antioxidant use might be hampered by factors like penetrability. We decided to compare the transdermal administration of 3% TXF cream and 3% S. [149] [150] balsamita extract cream. Permeability measurements for S. balsamita extract and TXF showed some intriguing trends. The 3% TXF cream penetrated deeper than the 3% S. balsamita extract cream, as measured by ESI-MS tape-stripping. Possible explanations for this include the presence of a bound version of TXF in S. balsamita that makes skin penetration more challenging. The 3% TXF cream was not detected in the skin cross-section using Raman mapping. There are two possible explanations for this: (2) the cream permeated the entire tested layer of skin, which is conceivable due to the relatively long incubation period of the cream on the skin, but (1) the sample did not penetrate the skin; however, in such a scenario, it should be seen on the skin surface, and this was not observed (6 h).

V. CONCLUSION

Natural alternatives to synthetic chemicals in cosmetics and personal care items are gaining popularity among consumers. Because of the inherent economic potential in the exploitation of natural resources in ecosystems, plant extracts can be used in cosmetic science to beautify and preserve the physiological balance of human skin. In addition, they break down naturally and are safer for the environment than their synthetic counterparts in the cosmetics industry. However, the disposal of various waste products from plant-processing sectors (such as the food industry) is a serious challenge. However, some of these waste products are rich in chemicals with biological qualities well-suited for topical application to the skin. Therefore, natural plant extracts from both wild and industrially processed plants can be used to make natural topical antioxidants, lighteners, and preservatives, extending the life of items that would otherwise be wasted or thrown away. Vitamins and antioxidants are widely used in the cosmetics industry as key components. The advantages of these more bioactive cosmetics for customers are supported by both scientific research and anecdotal evidence. An effective component will be one that is safe for human consumption, can be stored and used without spoiling, and works when applied. More study is required to determine how to enhance the skin's absorption of these bioactive cosmetics. Maybe some sort of apparatus, like an iontophore, is required for more efficient transport through the skin. The economics of the market indicate that formulations containing antioxidants and vitamins are highly received. Although vitamins have many potential applications, their instability and hydrophilicity make them difficult to work with. Improvements in encapsulation and targeted distribution have allowed for the creation of drug delivery systems in recent years that appear to circumvent these drawbacks. And as scientists have learned more about these molecules, they have been able to create variants with improved stability and novel chemical features. Vitamins used topically help with skin photodamage prevention, keratinocyte differentiation, dermal-epidermal junction cohesiveness, and hyperpigmentation. Many cosmetics use flavonoids,

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which are multi-active chemicals with antioxidant and calming qualities, because they are inexpensive and widely available. Flavonoids are underutilised despite their many benefits. This research aimed to explore the feasibility of using flavonoids as the primary active components in cosmetics. We talked about some of the most promising plant-based antioxidants with potential cosmetic applications. Antioxidants have been shown to be effective, however human studies on their usage to delay skin ageing are scarce. This allows for the possibility of further experimental data exploration, and the recommendation that synergistic effects be pursued for increased combined efficacy.

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