

Review

The Use of Plants in Skin-Care Products, Cosmetics and Fragrances: Past and Present

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Abstract: This work discusses the way people have used plants over time (basically since Ancient Egypt) to care for their physical aspect, and also how natural resources (especially plants) are currently used in personal-care products. Many plant species are ancient. This paper also shows examples of plants used for personal care which are investigated with new scientific advances.

Keywords: anti-aging products; cosmeceuticals; ethnobotany; history of cosmetics; medicinal plants; skin care

1. Introduction

Since time immemorial, humans have embraced the habit of modifying their external aspects, be it to improve their chances of social success, or in war or in love—in short, to heighten their self-esteem [1]. To care for their skin and physical appearance, different civilizations have used—and still use—a variety of different mineral, animal, plant, and chemical products. However, we must bear in mind that beauty is a fashion that changes over the time, and depends on cultural and religious traditions [2,3]. Currently, skin-care products and cosmetics are part of the daily life of many people. The chemical-pharmaceutical industry strives to obtain high quality products and, in many cases, depends on plants, an inexhaustible source of raw materials that are generally deemed to be safe and non-toxic [4].

2. History

The giant cosmetic companies that generate billions of dollars of revenue annually [5] 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 [6]. After the First World War, the athletic look became fashionable for the first time, and the fashion statements made by Coco Chanel, including dark eyes, red lipstick, red nail polish and suntanned skin, which became popular as a contrast to then dominant fad for pale skin [7].

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 [7]. 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 [2,8].

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.) [9].

Museum collections reveal the importance of cosmetics in ancient Egypt [10], 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 [7]. Manniche [11] 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.) [12].

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 [13]. 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.) [14]. 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 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) [15]. 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 [16].

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) [15]. 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) [17]. 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 [2]. 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) [3].

Recently, amphoras containing well-preserved unguents, in which moringa oil is a major component [18,19], 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 [20].

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 [21]. 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) [22], and at the end of his life, he was shrouded and placed in a tomb with aromatic oils, myrrh, and aloe (Lukes. 24). 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 [23]. 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") [23].

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 [25]. 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 [25].

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 [26]. At the same time, the Arabs translated classic texts, including *Dioscorides* by the monk Nicholas [25]. 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) [27].

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 not particularly approved, women did not want to appear to have the pale skin of a sick woman [28].

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) [8].

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 [29].

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.) [30,31], 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 [8,30].

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 [31], 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) [32]. The Guarani Indians also used achiote as face paint and as a repellent [33].

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 [34]. Many of these words are archaisms, and are no longer in use in modern Spanish.

By the time of Philip IV (1605–1665), 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 (*salserrillas*) [28].

In Europe, the enamelling of face with arsenic and lead became popular [8,15], 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 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 [27].

At the end of the eighteenth century, the industrial manufacture of soap was invented, and cosmetics began to be taxed [35]. 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) [36]. In Spain, rancid olive oil was used to make Castile soap. In Marseille, a sophisticated soap was made by adding lavender [37].

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.). [37]. *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 [8,27]. 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.

3. Present

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 [4]. 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 [38]. 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 [39]. 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.

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) [40], 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 [41]. The leaves of green tea (*Camellia sinensis* (L.) Kuntze) are rich in vitamin C, while the polyphenols of grape seeds (*Vitis vinifera* L.) inhibit lipid peroxidation [42]. The compounds extracted from green coffee seeds (*Coffea arabica* L.) stimulate the production of collagen and elastin [43]. The antioxidants of cucumber (*Cucumis sativus* L.) inhibit skin hyaluronidase and elastase [44]. The rhizomes of ginger and turmeric are used in anti-ageing preparations due to their inhibitory effect on cutaneous tyrosinase [45]. 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 [46].

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 [15].

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 [47]. These ideas have turned people’s gazes towards green, bio-, ecological, or natural cosmetics derived from plants, which are said to be innocuous [4]. 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 [48]. Tests have also been carried out with the fungi *Fomes officinalis* (Will.) Bress., due to its botox effect [49]. 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 [50]. 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 [51].

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 [52]. 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.) [53]—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) [54]. 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 [55].

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.) [57], (*Matricaria chamomilla* L.) [58], pomegranate (*Punica granatum* L.) [59], mango (*Mangifera indica* L.) [60], gotu kola (*Centella asiatica* (L.) Urb.) [61], and many others.

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