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Review

Market Availability of Natural Colorants: A Comprehensive Analysis

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Abstract

Herbal natural colorants are becoming more and more popular as a result of the cosmetics industry's need for sustainable and natural alternatives. Compared to synthetic dyes, which are frequently linked to allergy responses and environmental issues, these plant-derived pigments provide a safer, more environmentally friendly and skin-compatible option. Flavonoids, anthocyanins, carotenoids and chlorophyll are among the bioactive substances found in herbal colorants that are produced from plants including turmeric, beetroot, hibiscus, henna, saffron and indigo. Many of these substances have anti-inflammatory, anti-microbial and antioxidant qualities in addition to their coloring capabilities, which give cosmetic formulations additional medicinal advantages. Notwithstanding its benefits, issues with scalability, color uniformity and stability for commercial use still exist. These restrictions are being lessened in part by developments in formulation and natural preservation strategies. This research highlights the potential of herbal natural colorants as both functional and aesthetically pleasing constituents formulations by examining their origins, characteristics, uses and current trends in cosmetic product use.

Keywords: herbal natural colorants, curcumin, annatto (bixin/norbixin), crocin, indigo, lawsone.

1. INTRODUCTION

Due to the problems with synthetic dyes, many people would rather use natural colorants in cosmetics. More natural colorants are being used in cosmetics these days. Natural colorants are derived from biological sources and are generally environmentally benign. Natural colors can be made from bacteria, plants and other biological sources. Most natural colorants come from environmentally friendly sources. Natural colorants are made from plant materials such as stems, bark, leaves, fruits, flowers and seeds, among others. Henna, teak, annatto, paprika, carrots, red cabbage, turmeric and other natural sources of color are all examples. Environmental friendliness, non-toxicity, lack of side effects, non-carcinogenicity, decreased pollution and enhanced health benefits like vitamin A content and anti-cancer qualities are some advantages of natural colourants.[1]Natural pigments can be used in many different industries, including the food industry to color food goods, the pharmaceutical industry to market tablet coatings, the textile industry to dye natural and synthetic fibers and the cosmetics sector to color cosmetics[2]. Lists of natural coloring agents used vary from one country to another and are lengthy. The majority of natural coloring agents fall into one of the following categories: annatto, carmine, lycopene, paprika, turmeric, saffron, carotenoids, anthocyanins, betanins, caremel coloring and a wide range of fruit juices[3].

2.SOURCES OF NATURAL COLOURANTS

2.1 MICROBIAL PIGMENTS

A wide variety of microbes produce microbial pigments, which are highly significant in both science and industry. These pigments have a variety of uses, including as photo protection, antioxidant defense and nutrient uptake. They include carotenoids, flavonoids and prodigiosins. Additionally, they are used in a variety of industries, such as textiles, food, medicine and cosmetics. For example, carotenoids are useful as natural colorants and antioxidants in food goods in addition to helping microorganisms survive in hostile settings. Research into prodigiosins' potential as a treatment is prompted by their encouraging antibacterial and anticancer characteristics. Optimizing pigment production and successfully utilizing their biotechnological applications require an understanding of the regulatory mechanisms and processes involved in microbial pigment biosynthesis. As a result, microbial pigments are useful resources for a range of industrial and therapeutic applications in addition to being fascinating aspects of microbial physiology[4].

2.2 PLANT PIGMENTS

Different plant parts, such as roots, nuts and flowers, contain vibrant pigments and dyes. Henna plant fronds are used to make henna, which is orange-red. Catechu (brown) is made of resin, a sticky substance found in acacia tree foliage. Indigo (blue) is manufactured from the leaves and stalks of the indigo plant, whereas fustic (yellow) is made from the bark of the fustic tree.[5] The metabolic processes that produce a range of organic molecules with distinct physicochemical characteristics are what give rise to pigments obtained from plants. These vibrant substances are widely distributed in nature, provide crucial functions in photosynthetic processes, draw pollinators, and offer defense against predators and sun radiation. Different chemical groups that may selectively absorb some light wavelengths while reflecting others are known as plant pigments. These include porphyrins, carotenoids, anthocyanins and betalains, which are covered below.[6]

2.3 ANIMAL PIGMENTS

Pigments are also produced by animals. Animal pigments are created to act as warning colors and shield the animal from predators. Sometimes, animals generate pigments to entice potential mates. Melanin is the best example of an animal pigment. According to, melanin is what gives animals their color in their hair, skin, and fur. The red hue is produced by the blood of the Cochineal beetle insect, which is found in prickly pear plants Rarely utilized in eye shadow, this pigment is frequently found in lipsticks. Additionally, it is used to provide color to Cherry Coke. According to certain marine sources, such as fish species and jellyfish, have colorful pigments[7].

2.4 MINERAL PIGMENTS

Mineral pigments work incredibly well as colorants to impart color to high-quality cosmetics. Opacity, color effects, and distinctive hues that appeal to customers are produced by blending these chemicals with other colors[8].Natural colors are produced by heating and mixing naturally occurring substances. They consist of spinel and ultramarine pigments. The precious stone lapis lazuli was the source of ultramarine blue in the past. Because it was more expensive than gold during the Renaissance, artists frequently saved this rare color for the Virgin Mary and Christ's garments. The costly imported pigment, which Michelangelo, da Vinci and Raphael used, was referred to the Europeans as "ultramarine," which translates to "over the sea"[9].

3.MARKET AVAILABILITY OF NATURAL COLOURANTS

3.1 TURMERIC

Fig 1: Turmeric[10]

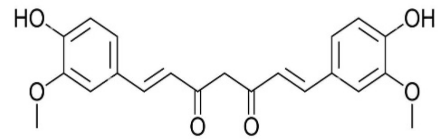

Fig 2: Chemical structure of turmeric [11]

Botanical name: *Curcuma longa* [12]
INCI: Curcuma longa root extract [13]
Family: Zingiberales [14]
Colour: Yellow /Orange [12]
Biological source: It is made up of both fresh and dried rhizomes from the plant *Curcuma longa* ***Linn***. Another name for turmeric is Indian saffron.
Geographical source: The plant is widely grown in temperate regions and is indigenous to southern Asia. It is cultivated in China, India, Malaya, Pakistan and the East Indies.
Chemistry of pigments: About 5% of turmeric is made up of volatile oil, resin and compounds called curcuminoids that give it its yellow hue. "Curcumin" is the primary constituent of curcuminoids. Curcumin (50–60%), starch and volatile oils are chemically present in curcuma species. Curcumin and other related curcuminoids are reported to be responsible for yellow colour of the dye.
Chemical Test: Put a few drops of water and concentrated HCL into a clear glass filled with turmeric powder. Then give it a good shake. Metanil yellow is present when the mixture turns pink. The presence of chalk powder is indicated if little bubbles appear in the mixture.
Toxicology: 200 substances derived from turmeric were tested for toxicity in this study, including bacterial mutagenicity, rodent carcinogenicity and human hepatotoxicity.
Marketed products: curry powder, curcumin, turmeric oleoresins, ground turmeric, fresh turmeric, dried turmeric and oil [14].
Uses:

- Antioxidant,
- Anti-inflammatory,
- Anti cancer,
- Hepatoprotective
- Reduces the risk of alzheimer [15].

3.2 ANNATTO

Fig 3: Annatto [16]

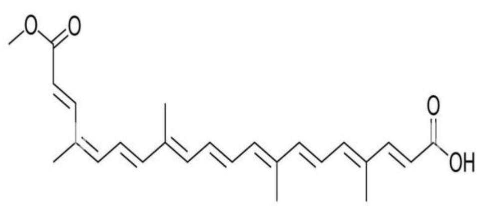

Fig 4: Chemical structure of annatto [17]

Botanical name: *Bixa Orellana*
INCI: Bixa Orellana seed extract [12]
Family: Bixaceae [14]

Colour: Reddish brown to Orange red
Biological source: The exterior coatings of *Bixa Orellana L.* seeds are the source of this carotenoid-based color. One significant naturally occurring colorant is annatto. pictures of the dye and annatto plant.
Geographical source: Native to South America, notably the Amazon region, anatto is a plant. Growing and gathering: Stem cuttings or seeds can be used to propagate the plant. Polyculture is used to raise seedlings.
Chemistry of pigments: Bixa Orellana seeds contain a number of carotenoid derivatives, including as bixin and norbixin, as well as some terpenoid, tocotrienols, arenes and flavonoids, such as luteolin and apigenin, according to phytochemical studies. The resinous outer layer of the plant's seeds (bixin, norbixin, and their esters) is primarily responsible for the reddish orange hue of annatto dye.
Marketed products: It is mostly used to color food items such as cheese, butter, ghee, vanaspati, chocolates and cosmetics [12]
Uses:

- Anti-septic,
- antibacterial,
- anti-fungal properties [18].

3.3 SAFFRON

Fig 5: Saffron [19]

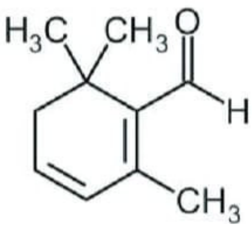

Fig 6: Chemical structure of Saffron [20]

Botanical name*: Crocus sativus*
INCI: Crocus sativus extract [12]
Family: Iridaceae [21]
Colour: yellow to reddish orange [22]
Biological source: The upper portions and dried stigmas of *Crocus sativus Linn*. It is frequently utilized as a natural color in the food and cosmetics industries and is commonly referred to as crocus.
Geographical sources: It is found in China, Germany, Iran, India (Kashmir), France, Italy and Persia.
Chemistry of pigments: Crocin, crocetin, picrocrocin, and safranal are the primary components of saffron. The primary carotenoid pigment that gives saffron its golden yellow orange hue is called a crocin. The flavor of saffron is derived from the bitter glycoside picrocrocin, which combines with safranal, an aldehyde subelement that gives saffron its scent. Saffron-derived crocin analogs considerably improved blood flow to the retina and choroid, aided in the recovery of retinal function and may be used to treat age-related macular degeneration and/or ischemic retinopathy. The presence of picrocrocin and safranal in coronary artery disease patients suggests that saffron may have antioxidant properties. Crocetin, a key component of saffron, has an antiparkinsonian action that may help prevent perkinsonism.
Marketed products: saffron cake mix, saffron cream powder, saffron beverage powder, saffron cream, caramel powder and saffron desert powder[14].
Uses:

- It improves memory.
- Helps in avoiding obesity.
- It aids in preventing hair loss,
- anti-inflamatory, antioxidant [14,23]

3.4 INDIGO

Fig 7: Indigo [24]

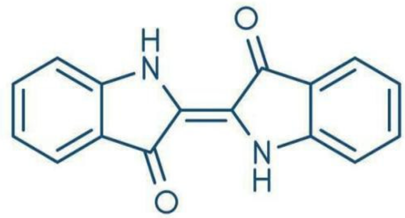

Fig 8: chemical structure of indigo [25]

Botanical name*:* *Indigofera tinctoria* [26]
INCI: Indigofera tinctoria[27]
Family: Fabaceae [14]
Colours: Blue or Dark blue to black[28]
Biological source: The Fabaceae family includes the enormous genus Indigofera, which has over 750 species of flowering plants. *Indigofera tinctoria* is a plant that is extensively found in tropical and subtropical regions of the world.
Geographical source: Many diverse plant species, genera and families that represent a wide range of geographical outcomes can be utilized to produce natural indigo. These include temperate plants like isatis spp., which are used in Europe, as well as sub-tropical and tropical plants like indigofera ssp.
Chemical of pigments: Pigment chemistry includes galactomannan, which is made up of galactose and mannose in a molar ratio of 1:1.52, Indian glycoside, coloring matter (indigotin), flavonoids, terpinoids, alkaloids and glycosides, as well as rotenoids, indigotine, and indigruben .
Uses:

- The leaves of the indigo plant are used to manufacture medicinal hair oil and hair dye.
- Leaf powder is used to naturally tint hair black.
- The plant's leaves are processed to create,
  - ✓ Dye
  - ✓ indigo is one of the earliest textile dyes
  - ✓ printing materials [14].

3.5 SAFFLOWER

Fig 9: Safflower [29]

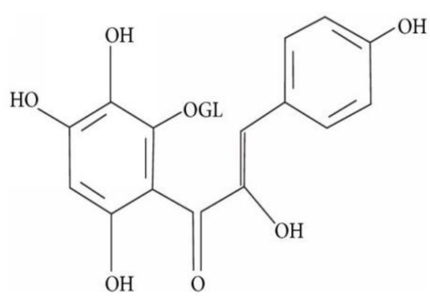

Fig 10: Chemical structure of safflower [30]

Botanical name*:* *Carth mus tinctorius*
INCI: Carthmus tinctorius seed oil
Family: Asteraceae
Colour: Yellow ,Orange and Vibrant pink / red [31]
Biological source: Carthamus *tinctorius L* or safflower, has long been used as an oilseed crop and a source of carthamin, a red dye.

Chemistry of pigments: Carthamin and carthamidin are the primary components of safflower. Safflower yellow, arctigenin, tacholoside, N-feruloyl tryptamine, N-feruloylserotonin, steroids, flavonoids and polyacetylenes are other components. Water-insoluble red dye is produced by carthamin, while water-soluble yellow dye is produced by carthamidin.

Uses:

- Its blooms are used to extract carthamin, which is then used as an infusion to treat illnesses relating to the circulatory system.
- Its coloring qualities, safflower petals are used to treat a number of,
  - ✓ chronic conditions
  - ✓ Rheumatism
  - ✓ Hypertension
  - ✓ coronary heart disease
  - ✓ Issues with both male and female fertility.
- Carthamin, the main component, has hypertensive, coronary dilatation and uterine stimulating properties. Additionally, it contains antigenic, cytotoxic and anti-platelet properties [14].

3.6 HENNA

Fig 11: Henna [31]

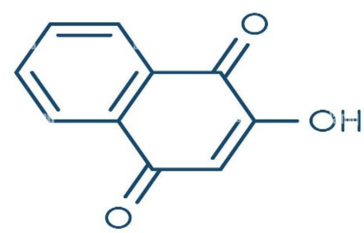

Fig 12: Chemical structure of henna [32]

Botanical name: *Lawsomi inermis* [35]
INCI: Lawsomi inermis leaf extract [36]
Family: Lythraceae [35]
Colour: Reddish brown to red-orange [36]
Biological source: It is made up either dried or fresh *Lawsonia inermis* leaves. Henna is a common dyeing agent in the cosmetics business. In addition to its ability to color, it has therapeutic value.
Geographical source: Madhya Pradesh, Gujarat and Rajasthan are the states where henna is primarily farmed. Originally from Africa, it is mostly grown in Egypt, Sudan, the Caribbean islands, Florida and India.
Chemistry of pigments: Lawsone (0.5–1.0%) is the leaf's active ingredient. The remaining components of the leaves include xanthones, white resin, tannin and 5.10 percent gallic acid. The 'Lawsone' is primarily in charge of the henna leaves' colorant quality.
Marketed product: Mehendi kits, mehendi cones, mehendi oil, mehendi stencils, mehendi tubes, mehendi tattoo stickers and mehendi paste.

Uses:

- Henna is utilized in the production of,
  - ✓ Cosmetics
  - ✓ hair colors
  - ✓ hair care items.
- Additionally, it is utilized as a skin, nail, and garment dye [14].

4. IDEAL PROPERTIES OF NATURAL COLOURANTAS:

- ➢ It must not be poisonous.
- ➢ It ought to have no physiological activity
- ➢ It must be devoid of dangerous contaminants.
- ➢ To ensure that is coloration powder is dependable and that its test is feasible and simple,it should be highly tinctorial (colouring) so that minimal amounts are needed.
- ➢ When stored ,it should be protected from light, tropical temperature, hydrolysis and microbes.
- ➢ It should not be impacted by pH various or oxidizing or redusing substance.

- It ought to work well with medication.
- Although oil-soluble and sprit soluble colours are also necessary,it should be easily soluble in water.
- The tests and assays that the preparation containing it go through shouldn't be affected by it.
- It must not adhere to the suspended substance.
- The flavor and smell should be satisfactory.
- It should be affordable and widely accessible [37].

CONCLUSION

In conclusion, the market availability of herbal natural colourants is on the rise. With the increasing demand for natural and sustainable products, the use of herbal colourants has gained momentum in various industries. Consumers are increasingly seeking products that are free from synthetic chemicals, leading to a growing market for herbal natural colourants. This trend presents opportunities for businesses to cater to the preferences of environmentally conscious consumers. As the market continues to embrace natural alternatives, the availability and variety of herbal colourants are expected to expand, offering exciting prospects for the future.

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