

A Sustainable and Healthful Substitute for Synthetic Colourants in Pharmaceuticals: Natural Colourants

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Abstract-

The growing public knowledge of the therapeutic benefits of natural dyes has boosted the market for natural dyes on a global scale. Colorants are mostly employed to provide pharmaceutical dosage forms look. Various pharmacological preparations, including tablets, tablet coatings; capsules (hard gelatin, soft gelatin), liquid orals, dental pastes, ointments, and salves, all require colouring. Colorants may be necessary to improve the aesthetic appearance, promote stability, provide standard preparations, or identify a specific formulation. Due to increased awareness of natural dyes' positive qualities, there is now a greater demand for them on a global scale. The medicinal herbs are frequently used to treat a wide range of illnesses. The information regarding the use of natural colorants in pharmaceutical formulations is described in the current review.

Keywords: *Natural dyes, therapeutic benefits, Medicinal herbs, Pharmaceutical formulation, Medicinal plant.*

I. Introduction

When a component in colourants or colouring agents is primarily employed to give the pharmaceutical dosage forms a distinctive appearance, colour can also be utilised to make a preparation more uniform and help patients tolerate unappealing medications. Since appropriate colourants can improve the dosage forms' visual appeal, we can also refer to colourants as the pharmaceutical preparations' cosmetics. Oral liquids, topical creams, toothpastes, ointments, salves, tablets (either the core or the coating), and hard or soft gelatin capsules (either the capsule shell or coated beads) are the primary types of coloured dosage forms.^(3,5)

Particularly for youngsters, who are frequently treated with syrups, tablets, or capsules to prevent injections and enable therapy at home, the beauty and aesthetic appeal of a coloured medication

are invaluable. The range of natural dyes is enormous. In the current situation, it has been observed that natural colourants or dyes have become a desirable substitute for synthetic dyes because of their many advantages. Natural dyes are recognised as substitutes for synthetic dyes because of certain characteristics. Because they can cause allergic and intolerant reactions in people, synthetic colourants are generally detrimental. In the meantime, natural hues have been shown to be harmless because of their inherent qualities of being non-toxic, non-carcinogenic, and biodegradable.^(3,5,9)

They are eco-friendly, non-toxic, and good for the environment. In addition to being productive in the use of wasteland, they are visually appealing and create jobs. The pigments in natural colours are easily removed. Because they are readily available in nature and offer substantial health advantages to consumers, plants have long been utilised as colouring agents in a variety of businesses. Plants include a variety of active ingredients that function as various colour pigments, including anthocyanins, carotenoids, betalains, crocins, anthraquinone, and others. It involves using water as a solvent to boil the entire plant, including the bark, roots, flowers, fruits, and leaves.^(3,14)

A highly sophisticated method that can be effectively applied to the qualitative and quantitative extraction of natural dyes is required in the present day. Natural products are in high demand and have thus become the focus of research as the advantages of using natural pigments are increasingly demonstrated by science.^(5,9,14)

Pharmaceutical preparations are coloured mainly for following reasons:

Increases acceptability -

The look of the formulation varies from batch to batch. Many patients rely on colour to identify the recommended medication and the appropriate dosage. These qualities help to increase patient compliance. Brightly coloured tonics, cherry red children's cough remedies, and flesh-hued powders

and ointments are thought to be used more frequently because they are appealing.¹¹

For identification -

It is beneficial to recognise a product during the manufacturing and distribution processes. Colors can be used to distinguish between products with similar appearances that are part of the same product line or across product lines from different manufacturers. Errors can also be reduced by using different colours for various dosages of the same medication. A doctor may use colouring to identify a past therapy. Doctors and pharmacists get familiar with particular coloured items, which may increase sales.^{12, 13}

Stability purpose -

When used in tablet coatings or gelatin shells, some insoluble colours or pigments also offer helpful opacity, which can help maintain the stability of light-sensitive active components when making tablets or capsules. Among the pigments that are especially useful for this are iron oxides, titanium dioxide, and specific aluminium lakes.¹⁴

The Psychological Effects of Colour


The study of colour is difficult and complex because it involves so many various systems, including aesthetic, psychological, physiological, associative, and symbolic systems. As a result, the psychophysiological properties of colour have been found. The effectiveness of therapy may also be impacted by a product's colour, according to colour




psychology. Globally speaking, colour impacts are important. Warm colours, which can be found in the red section of the colour spectrum, include red, orange, and yellow (Fig.1). These warm hues arouse a range of feelings, including warmth and comfort as well as rage and wrath. Examples of "cold colours," or those that are located on the blue side of the colour wheel, are blue, purple, and green. Although these hues are typically thought of as serene, they can also evoke melancholy or discord. The study was also applied to prescription drugs.^{12, 15, 16}




Ideal properties of a colorant¹⁷



- They are harmless and have no physiological activity. Free from harmful impurities
- Is a specific chemical compound since only then will its ability to colour be trustworthy, and doing an assay will be more convenient and practicable.
- It should have a high tinctorial (colouring) power so that only little amounts are needed.
- Light, tropical temperatures, hydrolysis, and microorganisms have no effect on it, making it stable when stored.
- Unaffected by reducing and oxidising substances as well as pH fluctuations.
- Compatible with drugs and do not conflict with them.
- Although most of the time ready water solubility is preferred, some oil-soluble and spirit-soluble pigments are also required.
- Doesn't affect the tests and assays that the preparations containing it must pass. Must not significantly adsorb on suspended substance.
- Free from offensive flavours and odours.
- Easily accessible and reasonably priced.

A Few Plant-Based Natural Colouring Agents

Name of Colouring Agent	Pigments and Its Medicinal Properties	Images
1. Annatto:^(1,2,3) Annatto is one of the beautiful red and orange dyes can be extracted from this plant. Annatto seed contains a pigment called carotenoid on top of the C24 bixin present. An apocarotenoid-like methyl ester is present. After removal of the ester group, dicarboxylic acid and norbixin are formed, forms annatto dyes. In the food industry, annatto dye is very useful.	It is very important medically. Annatto seed used as an anti-pruritic and purgative.	
2. Turmeric rhizomes:^(4,7) Turmeric rhizomes have been used since ancient times to treat healing	Curcumin is the main component of the pigment. It has various properties including	

<p>wounds. It is used as a spice when cooking vegetables for its aroma and taste. The common name of turmeric is Indian saffron. It consists of fresh rhizomes and dried curcuma longa Linn. Curcumin is the main colour of the rhizome present. It adds flavour and colour to food.</p>	<p>anticancer activity, anti-inflammatory and antioxidant properties. Curcuminoids exhibit some pharmacological activities due to their molecular structure, which is very unique. It has medical significance because antibacterial and antifungal properties.</p>	
<p>3.Saffron: ^(6,7) Saffron is a colourful flowering plant that is incredibly appealing. It is known by the name crocus. Stigmas and styles were utilised in dried form to provide colour. As a result of its pleasing colour and high demand in the food and cosmetics industries.</p>	<p>Alpha crocin, picrocosin, and safranal are the primary components of saffrons. crocetin, picrocroc, safranal, and crocin. Saffron contains the essential pigment carotenoid, which gives the spice its orange and golden-yellow hue. The bitter glycosides in saffron are what give it its flavour. The saffron is fragrant thanks to safranal. It is renowned for its healing capabilities. Saffron has sedative,eupeptic,carminative, diuretic, expectorant &stimulating properties, among others.</p>	
<p>4.Tomato: ⁽⁹⁾ Tomatoes of the colour red are particularly favoured for their flavour as veggies. It has potent antioxidant and anticancer effects. Delicious meal is prepared with tomatoes. Tomatoes contain a variety of colourants and pigments.</p>	<p>A particularly appealing fruit in the vegetable world is the tomato. It is crucial in food recipes. It is well-known for its flavour. Lycopene, β-carotene, lutein β-cryptoxanthin, and zeaxanthin are the tomato's primary nutrients. The tomatoes' lycopene and carotenoid content are what gives the fruit its red colour. Lycopene has a number of health advantages. Lycopene levels in tissues and serum have been proven to be negatively correlated with the risk of breast and prostate cancer. Additionally, it is helpful in the prevention of many cancers. A powerful antioxidant among carotenoids is lycopene. Tomatoes are used as a high source of vitamin A.</p>	
<p>5.Marigold or Tagetus: ^(15,22) Tagetus is commonly called as marigold. These flowers are very attractive in colours. The flowers of</p>	<p>Marigold contains lutein pigment which impart attractive colour to the flowers. It gives orange and yellow colours</p>	

<p>marigold used for the decoration and making for garland. It contains carotenoid pigments. From ancient time it is useful in culture event for decoration and in food colouring. Marigold is well known for its medicinal activities. The reddish and yellow coloured flowers consist of the xanthophylls pigment which is called as lutein.</p>	<p>because of presence of carotenoid. Some other compounds like carotene and galenine are also present in marigold. Lutein is present in marigold flower petals which are act as antioxidant. These are easily reacting with metal mordents to reduce free radicals. It protects skin and eyes from harmful damage because it filters blue ultraviolet light spectrum.</p>	
<p>6.Henna Herb: ⁽¹⁰⁾ The botanical name of heena is <i>Lawsonia inermis</i> Lam. Heena has a great importance in cometics because of its colouring property from ancient time. Fresh and dried leaves of heena can be used for colouring because of its dying property. It is also having some medicinal use. The leaves paste is applied on palm and for hair colouring.</p>	<p>In the cosmetic industry Henna is widely used as dyeing agent. It consists of fresh or dried leaves of the plant <i>Lawsonia inermis</i> Lam. It has medicinal as well as dying properties. Its natural orange dye used to dye protein fibre. It has been used as a sunscreen agent and in conjunction with dihydroxyacetone. Lawsone is active constituent of the leaf which is generally extracted from the leaves of the plant using sodium bicarbonate. The Lawson present in leaves of henna and responsible for the colourant property. It is worldwide known as analgesic and antipyretic and anti-inflammatory properties.</p>	
<p>7.Beet root- ^(15,22) The botanical name of the red beetroot is <i>Beta vulgaris</i> and family <i>Amaranthaceae</i>. It consists of group of plant pigments. The yellow exanthema and red betacyanis which are collectively described as betalaines. Indole colourant is obtained from the beet root.</p>	<p>The dried beet root powder can be used for the preparation of the dye; it contains a glycoside betanin, which on hydrolysis yields the income betanidine and glucose. The dye is heat sensitive with certain limitation on their use as food dye in food colouring. Red dye from beet root is widely used as food colourant and pharmaceutical colorant</p>	
<p>8. Paprika-⁽⁸⁾ Paprika pigment is present in chilli seeds. Red carotenoids principles, capsanthin and capsorubin are present in dried fruits of chilli. Paprika pigment is extracted from dry capsicum fruits. Paprika possess many medicinal properties like</p>	<p>Paprika contains capsorubin and capsanthin components in the form of carotenoids which causes red colour in paprika. The carotenoid principle of paprika is permitted colouring agent for food pharmaceutical, preparation of cosmetics,</p>	

<p>antibacterial, anti-inflammatory and antioxidant. It help to control and slow down the growth of the bacteria like <i>E.coli</i> & <i>Salmonella</i> . It has a rich source of vitamins A and E which neutralises the free radicals and shows its antioxidant effect.</p>	<p>beverages and juices. Capsaicin use to apply externally as a pain reliever. It is used in many ointments and creams which helpful for headaches & arthritis. It is also used as stimulant because it stimulates production of saliva and stomach acid.</p>	
<p>9. Pomegranate: ^(15,22) Pomegranate juice's appealing reddish-purple colour is mostly due to the water-soluble pigments called anthocyanins. Punicalagin, punicalin, gallagic, and ellagic acids are some of its main ingredients. Alkaloids like isopelletierine are also present in it. Due to the presence of a significant amount of tannins, punica granatum dye and many other common natural dyes are considered to be powerful antibacterial agents.</p>	<p>According to data from contemporary research, pomegranate fruit includes anti-microbial, and anti-viral compounds in addition to being utilised as a natural colour and having traditional therapeutic value. Pomegranate juice has been demonstrated to lower blood pressure. Recent biological researches have showed that specific components in pomegranate juice are anti-atherosclerotic and drastically lower LDL oxidation. The pomegranate's high degree of antioxidant activity and high total phenolic content are credited with these effects.</p>	

Technology for Making Natural Colorants:

Depending on the product's requirements and purity, different production methods for natural colourants from plants may be used, ranging from straightforward solvent extraction to complicated methods. Soxhlet method to extract colour from quercus robur L., pressurised liquid extraction and supercritical fluid extraction on annatto seeds and jabuticaba skins, and microwave aided extraction on milkweed leaves to extract colour are a few examples of regularly used extraction procedures. To guarantee the quality of the completed product, filtration and drying are necessary after the extraction procedure. To remove impurities and improve the purity of the extracts, purification procedures like filtration, reverse osmosis, or preliminary high-performance liquid chromatography will be performed. The two methods most frequently used to maintain colour stabilisation are freeze drying and spray drying. These approaches are very practical for storage needs. Additional characterization and analysis are key steps that must be taken in terms of their colour

and chemical analysis to assess the characteristics of natural colourants. ^(15, 18)

Implications for the Wellness Sector: ^(15, 17, 18)

Natural pigments' growing use in wellness-related industries, particularly in the food, cosmetics, and pharmaceutical sectors, has been attributed to their inherent versatility.

Food Industry: The Food and Nutrition Board has emphasised the need of using colourants in food components to preserve food's original appearance, ensure colour uniformity, amplify food's natural colour, safeguard food qualities including flavour and vitamins, and increase food acceptability. Since most natural food colourings, including anthocyanins and carotene, have antagonistic properties, they can guard against bacterial, viral, and fungal food deterioration. Carotenoids can also shield food from harsh light, preserving the meal's quality. Annatto pigment in cheddar cheese and marigold flower extract in poultry products are two examples of natural colourants in food.

Cosmetic Industry: Due to their advantages of having no side effects, being suitable for all skin types, providing UV protection, not being tested on animals, and having anti-aging characteristics, natural dyes are frequently used in the cosmetic business. Numerous cosmetics, including those for skincare, hair care, and scent, have been developed. In addition to giving creams, shampoos, and lotions a bright yellow hue, the antioxidant properties of the carotenoid found in annatto oil and the potent antibacterial properties of turmeric are just a few examples. Due to the anthocyanin concentration of roselle's natural colour, which effectively reduces fine lines, wrinkles, and dryness of lips, it is frequently used as a natural colourant in lipstick. The β -carotene in carrot oil gives it its orange colour, and this β -carotene can be converted into Vitamin A, a key anti-aging, renewing, and rejuvenating agent.

Pharmaceutical Industry - The formulation of tablets, tablet coatings, capsules, liquid orals, toothpaste, and ointments is typically coloured in the pharmaceutical business to improve visual appeal, extend stability, generate standard preparations, or for identification purposes. The demand in medicine is satisfied by using the active components found in natural pigments. For instance, bixin is utilised as one of the natural colouring agents for ointments and plasters, while film coating for tablets employed chlorophyll, carotenoids, and anthocyanins as fundamental ingredients. Carotenoids are also used as vitamin supplements.

II. Conclusion:

The public's intense interest encourages businesses to keep looking for and producing natural colours to replace synthetic ones. Natural pigment derived from plants has shown promise as a source of colouring agent due to its non-toxic and low side effect characteristics. In addition to its colour, the natural pigment also has a wide range of medical benefits, which adds value to it. Despite increasing consumer demand and understanding of the benefits of natural ingredients in consumable products, handling and stability problems continue to be a barrier. Knowing each natural pigment's restrictions allows for the consideration of the proper safety measures. The wellness sector must continue to evolve in order to avoid wasting the abundant natural resources by not incorporating current technologies to address the downsides and safety issues of natural colourants. To assess their true potential for daily use and commercialization, further research is required on the availability, characterisation, and documentation of colour-producing plants.

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