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Mini Review

Anthocyanin: A Revolutionary Pigment for Textile industry

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Abstract

Chemical dyes from textile industry continuously degrading environment. Dyes from natural resources are proved to be eco-friendly since ancient times. Anthocyanin from plants is not only a natural dye but have many other potential characteristics. Colour of anthocyanin varies with pH which shows its adaptability to nature with varied environmental conditions Research showed that they possess antimicrobial properties. Advance research using Anthocyanin and its related gene, textile could develop with antibacterial and self-fluorescence properties. Anthocyanin is also known to protect plant in extreme weather conditions. This property could be used to develop super cloths. Anthocyanin has been used in organic solar cells because of their ability to convert light energy into electrical energy. Anthocyanin is also known to double the Shelf Life of plants. The application of genetic modification using properties of Anthocyanin in textile producing plants could bring revolution.

Keywords: Anthocyanin; Solar cells, Shelf life, Visual markers, Fluorescence, pH

Mini Review

Dyeing process in textile industry is one of the major breakthroughs in the evolution of fashion. On the other hand, it is well-known fact that fast fashion today degrades the environment. The textile industry produces and uses approximately 1.3 million tons of dyes, pigments and dye precursors, valued at around $23 billion, almost all of which is manufactured synthetically [1]. Textile clothing ends up in landfills and chemical dyes leach into the water bodies. Some of the chemicals found in synthetic dyes are mercury, lead, chromium, copper, sodium chloride, toluene, and benzene. Exposure to large doses of these substances can be toxic and can have severe effects in the human body.

Nature has given us all necessary molecules for sustainable development, especially in form of secondary metabolites from plant kingdom. Natural pigments, one of the secondary metabolites, are alternative for chemical dyes. Natural dyes are environment friendly and have many advantages over synthetic dyes. Natural dyes are suitable for skin and are biodegradable. Anthocyanin is one of the pigments that can be used as a natural dye [2]. Anthocyanin pigment can very well used as dye material giving primarily different shades of blue purple to red. The large-scale production of textile dyed with anthocyanin is a new concept for the textile industry.

The word 'anthocyanin' is derived from the Greek language. 'Anthos' translates into flower and 'kianos' means blue. Anthocyanins belong to a group flavonoid synthesized via phenylpropanoid pathway. They are the largest group of water-soluble natural pigments. They are present in flower, fruit, stem, leaves and root of plants. They soluble in water and generally occur in the aqueous cell sap. They are found in fruits and vegetables such as red cabbage, strawberries, grape skin, blueberries and raspberries [3]. Anthocyanin extract of Hibiscus rosa-sinensis flowers yield shades with good fastness properties [4]. Anthocyanin is soluble in aqueous solutions. It becomes brighter in lower pH range and becomes blue at higher pH levels. Colour of anthocyanin varies with pH which shows its adaptability to nature with varied environmental conditions [5].

Research shows that Anthocyanin has many significant properties along with its coloring nature. Some are discussed as follows (Figure 1).

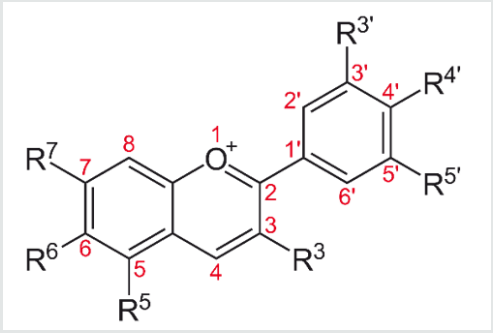

Figure 1: Structural formula of Anthocyanin.

A. Antimicrobial properties: Anthocyanin has been proved effective against bacteria and fungi [6]. Antibacterial fabric / infectious disease resistant fabric could be developed using anthocyanin. The application can also be used in medical linen and military uniforms. Antimicrobial clothing can prevent the growth and spread of microorganisms within the fabric and surrounding.

B. Anthocyanin as visual markers: Anthocyanins fluorescence, enabling a tool for plant cell research to allow live cell imaging without a requirement for other fluorochromes [7]. Its ability gives off fluoresce could be used for developing new advance self-fluorescence textile. Anthocyanin production may be engineered into genetically-modified materials to new generation cloths.

C. Anthocyanins double the shelf life: There are certain fabrics that do not last for a long time, although of high quality and great demand. Anthocyanins can play a role here. Life of fabrics can be increased by adding anthocyanins. Anthocyanins double the Shelf Life of tomatoes by delaying over ripening and reducing susceptibility to grey Mold [8]. This property can be genetically engineered into fabrics and used to improve shelf life of materials such as silk or chiffon.

D. Anthocyanin for extreme weather conditions: Research done for photo electrochemical cell utilizing an Anthocyanin Dye-Sensitized TiO_2 Nano crystalline Electrode [9]. With advanced research, fabric could be developed with dye anthocyanin and some nanoparticle and could be proved as excellent absorber of solar energy. This property can be utilized for development of fabric for cold regions. Jackets can be manufactured which absorb the sun rays and transform them into heat. Anthocyanin has also shown a protective role in plants against extreme temperatures [10]. Tomato plants protect against cold stress with anthocyanin countering reactive oxygen species, leading to a lower rate of cell death in leaves. With advance research, properties shown by anthocyanin can be used for protective fabric for prevention from heat [10] also.

E. Anthocyanins: dye-sensitized solar cells: Anthocyanins have been used in organic solar cells because of their ability to convert light energy into electrical energy. Benefits using dye-sensitized solar cells instead of traditional p-n junction silicon cells include lower purity requirements and abundance of component materials, as well as the fact that they may be produced on flexible substrates, making them amenable to roll-to-roll printing processes [11]. This property of anthocyanin could be used in textile industries to make super cloths.

Conclusion

Research has proven that anthocyanin holds great potential for fabric industries not only as dye but for development of "super cloths". The world is now moving towards 'Eco-fashion'. The use of natural dyes such as anthocyanin may bring revolution in textile industries. The application of genetic modification can bring about many other benefits such as visual markers and solar dyes which will increase the output of the fabric industry thus reducing the total cost. The washing fastness is also considerably good in anthocyanin dyed fabric. This pigment has good scope in the commercial dyeing of cotton, silk and wool for garment industry.

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