Colour, health and wellbeing: The hidden qualities and properties of natural dyes

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Is it feasible that the chemicals present in the natural dyes and colours of both plants and insects, which in the past have been exploited for their colour, could exhibit other properties that in the future will be understood and exploited for the health and wellbeing of mankind?

Historically many dye plants were once regarded to possess 'magical properties' with the power to heal and to keep evil away [1]. Today many of these plants that can be used for dye extraction are classified as medicinal and in recent studies have been shown to process remarkable anti-microbial, anti-fungal, anti-viral activity [2]. The cosmetic industry now employs many natural dyes due to the fact they will cause fewer side affects than the employment of synthetic dyestuffs but they can also provide extra properties such as UV protection, skin moisturising and anti-aging [3,4].

In the context of these facts, this paper asks the question: What possibilities exist within the chemical nature of certain natural dyes to help with healing and well-being and if in the future we will be wearing clothes dyed with such colours from nature that we will be able to enhance our well being as well as be fashionable?.

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Introduction

In the world today, the position of natural dyes and colorants, 'natures colours' are at a crossroad: They will either vanish and with them the ancient knowledge and skill that has advanced with their use over centuries and across civilisations or they will evolve to create a new form of colouration and with this be applied to new environmental/sustainable applications and possibility be recognised for the health/healing aspects they can provide [5,6]. Currently there is increasing interest into natural dyes and colorants, as interest grows within the Industrialised Nations in natural (Green) products and sustainable ways of living.

But this could also be in response to the negative impact synthetic dye manufacturing is having on the environment and human health. This is caused during dye synthesis, the release of undesirable/hazardous and toxic chemicals in nature and the effect synthetic dyes can have upon human health, as irritants/sensitisers synthetic dyes are often the cause of allergic reactions [5,7]. Today there is a whole spectrum of colours that can be obtained from a multitude of plants, insects and fungi, and these have been used across the centuries to dye textiles; colour artefacts; pattern and colour our skin, hair and even colour the food we eat, the discovery and use of such natural colorants has contributed to the maintenance of a strong bond between humankind and nature, which with help could revive and enhance what was once integral to human society. Natural dyes and colorants are still an essential part of the world's ecological and cultural heritage, their selection and use to create permanent colours that were once common to all nationalities is now in decline [8]. But with an increased interest in sustainability there appears to be a changing cultural landscape towards natural dyes. Today the explorations of natural dye practitioners are more directed to a deep connection with the land, often twinned with a sense of community and challenge our modern perception of what an acceptable colour is [9]. For many natural dyers the purpose of employing natural dyes is often not to try and meet the self imposed standards of the chemical dyeing industry but to work within the limits of nature and adapt creativity and practice accordingly. As natural dyes and their colouring properties are integral with the seasons, planning and dyeing revolve around the availability of dye imparting materials this creates challenges for unified colours but also enables us to challenge our modern perception of what an acceptable colour is and reveals how we are influenced by what commerce communicates to be desirable [8].

Much has been written about the healing power of colour and their effect on human health and well being through the selection of the wrong or right colours that we surround and clothe ourselves with [10].

Faith in the healing power of colour is ancient but we must remember colour in the past was not an abstract concept but was often defined by its source in nature; for example, Bryan [11] translation of the Papyrus Ebers dating from 1550 BC listed among its cures were indigo: blue; red: lead; copper: verdigris; black: knife stone and white: oil but also mentioned were plants such as pomegranate, elderberry, henna, indigo, onion, saffron and turmeric which were used for colouration purposes as much as for healing. Today many of these plants continue to be used as 'natures colours' in the colouration, cosmetic and food industries.

Historically many dye plants were once regarded to possess 'magical properties' with the power to heal and to keep evil away. For example Indigo (*Indigofera tinctoria*) and Woad (*Isatis tinctoria*) produced the colour blue, a scarcity in the natural world and with its production arose mystery and superstition [12]. This was possibly enhanced by the almost magical reaction that happens during the dyeing process and as a response to the complexity involved in producing a permanent colorant blue from the plant material.

Throughout the World indigo blue was and in some areas still is considered a 'cool' and 'magical' colour and has in the past been widely used for cooling feverish conditions. The dyes are said to have a 'cooling' quality [2] but could this be linked more to the visual colour than any physical properties held within the dyestuff. There are extensive accounts of its use throughout history, many of which list the countless ailments that Indigo and its European equivalent Woad have been reputed to cure, these are based mostly upon its apparent antiseptic, astringent and purgative qualities, although it is also said to prevent nervous afflictions such as hysteria, epilepsy and depression [1]. See Figure 1 [13].

Figure 1: (left) Indigo [Indigofera tinctoria] and (right) Woad (Isatis tinctoria).

The European Elder *(Sambucus nigra)* was historically regarded as a magical plant with the power to keep evil spirits away and was once thought to have a myriad of uses and health giving properties. Historically various parts of the elder tree have been used in medicine while the berries were used to make wine and pies but also employed as a natural dye. Currently, extracts of the berries are used primarily as anti-viral agents for colds, influenza but recent research shows that they have immune modulating, anti-oxidant, and insulin-stimulating properties due to their high proportions of anthocyanins present [14]. These chemicals are also known to possess anti-inflammatory functions (Figure 2 [13]).

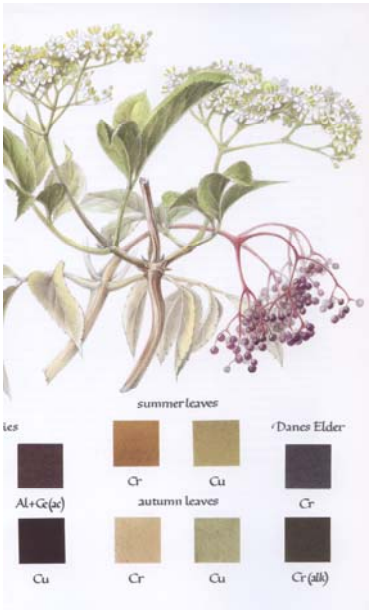

Figure 2: Elderberry [Samburcus nigra].

Henna (*Lawsonia inermis*) has been used as a colorant for over three thousand years and was often mixed into a paste and used to colour skin and hair. It is still widely used in cosmetology for its dyeing properties. Today henna is used in Ayurvedic medicine for the treatments of rheumatism, insect bites,

skin ailments, burns and wounds to name a few. It is also proven to have antifungal and antibacterial properties that are linked to the active component lawsone the same chemical that provides its colouring/dyeing properties [15]. See Figure 3 [13].

Figure 3: Henna [Lawsonia inermis].

Turmeric (*Curcuma longa*) has been used as an environment friendly colouring substance for both food and cloth for centuries. It is the brightest of naturally occurring yellow dyes although a rather fugitive and has been recognised as a powerful antiseptic, which revitalises the skin [6]. See Figure 4 [13].

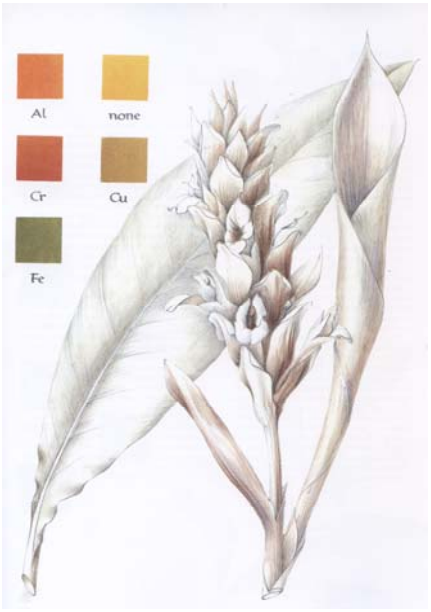

Figure 4: Turmeric [Curcuma longa].

Is it feasible that the chemicals present in these and other natural dyes and colorants of both plants and insect, which in the past have been exploited for their colour and possible magical qualities, could exhibit other properties that in the future will be understood and exploited for the health and wellbeing of Mankind?

Discussion

Many plants that are used for colouration purposes are often also classified with medicinal properties, and some have recently been shown to possess strong anti-microbial activity. Plant pigments such as anthocyanins and carotenoids have scientifically validated antioxidant and anti–inflammatory benefits [2,6].

The pomegranate (*Punica granatum*) along side many other common natural dyes are also reported as potent anti-microbial agents owing to the presence of large amounts of tannin in their chemical structure. While several other sources of plant dyes are reported to exhibit both anti-bacterial, anti-fungal, antiviral and antineoplastic activity [2] and these contain the colouring pigments naphthoquinones such as lawsone from henna (*Lawsonia inermis*), juglone from walnut (*Juglans niga*) and lapachol from alkanet (*Alkanna tinctoria*) [16].

According to Cannon and Cannon [13] the most important pigments that are used for producing colours on natural fibres can be classified as follows and these are the same chemicals that have been proven to have health giving qualities such as anti-microbial and anti-inflammatory.

Anthracenes include several pigments found in the madder family such *alizazin; mungistin* and *purpurin, emodin* is found in Persian berries and *polygonin* from Japanese Knotweed. The insect dyes cochineal, kermes and lac (*laccaic acid)* (Figure 5) [17] are also included here.

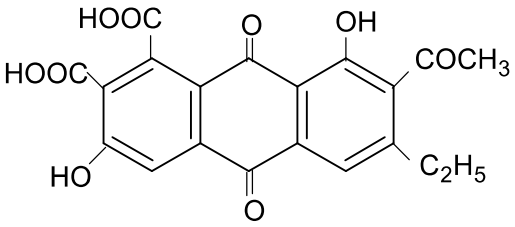

Figure 5: Anthraquinone – Laccaic acid [lac dye].

Nathoquinones are related compounds and include *juglone* from walnuts; *alkannin* from dyer's alkanet, *lawsone* from henna and *Hypericin* from St John's Wort is condensed *quinone* (Figure 6) [17].

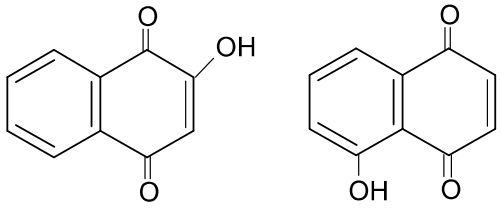

Figure 6: Naphthoquinones – (left) Lawaone and (right) Juglone.

Carotenoids are also colouring pigments and those in plants used for dyeing include *lutein* from Nettles, French marigolds and many other plants, *Bixin* from annotto and *crocin* from Saffron.

Within Flavonoids: the main group are anthocyanins and produce scarlet, reds, violets and blues of nearly all flower petals. They include *malvidin* and *cyanidin* both of which are found in several dye plant families. Others such as flavanols and flavones are responsible for the yellow colours in many plants. Flavanol pigments tend to fade somewhat in strong sunlight with *Fisetin* occurring in fustic, nettles and other plants. Flavones often produce a colour that is more permanent but paler that flavanols, *Apigenin* is common in the daisy family and *luteolin*, common in daisy and pea families is also found in weld (See Figure 7) [17].

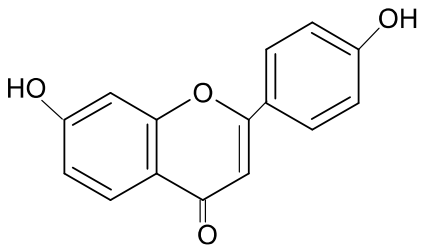

Figure 7: Flavone; Sandal wood.

There are a few unrelated pigments these include *indigotin* from indigo, woad and other blue dyeing species (Figure 8) [17], the diaroylmathane *curcumim* comes from turmeric, pterocarpans from sanderswood and the neoflavonoid *berberine* from barberry and mahonia. [13].

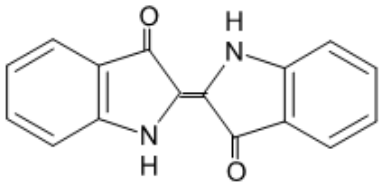

Figure 8: Indigotin, Indigo and Woad.

Tannins are found in small quantities throughout most plant tissues but are concentrated in the bark and in damaged tissues such as galls and wounds. They are formed from flavonoids, particularly anthocyanins. Chemically divided into hydrolysable and condensed tannins, the former give rather yellower colour to wool and include *gallotannins* found in oak galls and young fustic and *ellagitannins* found in the sumac. Condensed tannins tend to give more of a reddish tone and are found in numerous plant groups, particularly in oak and willow bark, cutch and water lily rhizomes.

Is it possible that the chemicals present in natural dyes, which are responsible for forming these pigments can if present in a dyed fabric move or rub-off from the fabric to the surface of the skin thus providing anti-bacterial and anti-inflammatory properties and help promote healing and well being?

The human skin forms a barrier to harmful chemicals and to the physical impact that the environment can provide; it also helps to protect the body from infection from viral, bacterial and fungal attack [18].

With modern medicine now accepting the fact that the skin as an organ has greater absorbency properties that was once recognised, drug manufacturers are developing new administrative procedures in which drugs such as Ibuprofen in the form of gels and nicotine or hormones as skin

patches can now be delivered through the skin. Skin absorption is a route by which substances can enter the body through the skin dermal absorption it is often a route of exposure for toxic substances but can also be a route for the administration of medication. Absorption of substances through the skin depends on a number of factors, the most important of which are concentration, duration of contact, solubility of medication, and physical condition of the skin and part of the body exposed [19].

Could such methods of drug administration via the skin through absorption instead of through the stomach via ingestion be applied to the healing properties of natural dyes if these were applied to the skins surface?

This is not a new concept or process, the monologue *Indigo* by Jenny Balfour-Paul [1], records that in countries in the southern Arabian Peninsula during the late 1980's Men were applying indigo healing treatments to their skin, sometimes choosing them in preference to available modern medicine. Some were convinced that wrapping an indigo cloth coated in beeswax and oil around a wound was more effective than modern antiseptic lotions (Figure 9) [1].

Figure 9: An indigo dyer who had bandaged a leg wound with an indigo rag as he was convinced it was a more effective antiseptic than modern.

Bioactive textiles are new innovative textile products that are being developed to extend the existing boundaries of textile application. Future textiles will act as 'repository' storing systems that are capable of continually releasing small doses of active substances from the fabric during wear which have a protective or therapeutic effect on the skin. This can be achieved through the creation of supermolecular host structures or other methods such as using aqueous solutions that are incorporated into nanocapsules, sol-gel layers or storing active substances in water-absorbing polymers with network structures, fixed onto the fibre [20]. By employing these new technologies to natural dyes and their colouring chemical components a possibility arises for enhancing the healing properties that these colours can provide.

Also the antibacterial activity of small ions like sliver, zinc, copper and quaternary ammonium compounds are well documented [21]. Could such ions be linked to natural dyes compounds through selective choice of mordants. Metallic salts have been employed as mordants through history to help

with dye fixation and improve dye fastness. If such links could be made, would by doing so enhance the antibacterial function of the natural dye used to colour the cloth.

Conclusions

There are no set conclusions within this paper. The paper was written to promote thinking and enquiry by asking the question: Is it feasible that the chemicals present in the natural dyes and colours of both plants and insect, which in the past man has exploited for their colour, could exhibit other properties that in the future will be understood and exploited for the health and wellbeing of mankind?

One aim of this paper is to stimulate discussion and inspire some form of collaboration across the fields of colour chemistry, natural dye practice and cultivation, anthropology along with modern and alternative medicine to take a closer look and research into the potential possibilities that the colouring pigments present in natural dyes could provide in terms of health and well being.

The mystic and magical properties that were once inferred upon natural dyes by our ancestry, recognised by many indigenous people and acknowledged for centuries by mankind, all without any kind of scientific understanding as to why these properties existed could provide today's society with more than nature's colours. Certain natural dyes and colorants have been proven to possess medicinal healing qualities, these could be exploited to provide mankind for more than just colour and initiate a return to wearing clothing dyed with natural colouration substances (dyes). The result of which would produce an added health bonus that has not thought to have existed in the western civilisation since the discovery of the first synthetic aniline dyes in 1856.

References

1. Balfour-Paul J (1998), *Indigo*, British Museum Press, London, 218-220.
2. Gupta D, Khare SK and Laha A (2004), Antimicrobial properties of natural dyes against Gram-negative bacteria, *Coloration Technology*, **120** (4), 167-171.
3. Chengaiah B, Mallikarjuna Rao K, Mahesh Kumar K, Alagusundaram M and Madhusudhana Chetty C (2010), Medical importance of natural dyes – A review, *International Journal of PharmTech Research*, **2** (1), 144-154.
4. Charlebois D (2007), Elderberry as a medicinal plant, *Issues in New Crops and New Uses*, Janick J and Whipkey A (eds.), ASHS Press, Alexandria, VA, 284-292.
5. Kumar Samanta A and Konar A (2011), Dyeing of textiles with natural dyes, *Natural Dyes*, Perrin Akcakoca Kumbasar E (ed.), InTech, 29-56.
6. Bhandari K (2011), Natural compounds and its medical activity, *Proceedings of the Vegetable Dye and its Application on Textiles National Workshop and Seminar*, India, 59-63.
7. Fletcher K (2008), *Sustainable Fashion and Textiles: Design Journeys*, Earthscan, London, 51-55.
8. Cardon D (2010), Natural dyes, our global heritage of colors, *Proceedings of the Textile Society of America Symposium*, Paper 12.
9. Fletcher K and Grose L (2011), *Fashion & sustainability: Design for Change*, Lawrence King Publishing, London, 33-44.
10. Quinn B (2010), *Textile Futures: Fashion, Design and Technology*, Berg, Oxford, 102-107.
11. Bryan C (1930), *The Papyrus Ebers*, Geoffrey Bles, London.
12. Pastoureau M (2001), *Blue: The History of a Color*, Princeton University Press, Woodstock.
13. Cannon J and Cannon M (2007), *Dye Plants and Dyeing*, A & C Black, London.

14. Thorne Research Inc. (2005), Sambucus nigra, *Alternative Medicine Review*, **10** (1), 51-55.
15. Prakash L and Majeed M (2008), Natural actives lend color to cosmetics and more, *CosmeticsDesign-Europe.com*, 1-16.
16. Siva R (2007), Status of natural dyes and dye-yielding plants in India, *Current Science,* **92** (7), 916-922.
17. Maulik SR (2011), Natural dye – an overview, *Proceedings of the Vegetable Dye and its Application on Textiles National Workshop and Seminar*, India, 172-176.
18. Elsner P (2003), What textile engineers should know about the human skin?, *Textiles and the Skin*, Elsner P, Hatch K and Wigger-Alberti W (eds.), Karger, Basel, **31**, 24-34.
19. Wikipedia (2007), Absorption (Skin), [http://en.wikipedia.org/wiki/Absorption_(skin) – last accessed 30th June 2013].
20. Swerev M (2003), What dermatologists should know about textiles?, *Textiles and the Skin*, Elsner P, Hatch K and Wigger-Alberti W (eds.), Karger, Basel, **31**, 1-23.
21. Wollina U, Heide M, Mülle-litz W, Obenauf D and Ash J (2003), Functional textiles in prevention of chronic wounds, wound healing and tissue engineering, *Textiles and the Skin*, Elsner P, Hatch K and Wigger-Alberti W (eds.), Karger, Basel, **31**, 82-97.