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Color & Care Design

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Abstract

The main issues raised by the Color & Care Design axis are the development of the polysensoriality of colors in relation to the medicinal virtues of plants and the physiological inclusion of the vibrations of dyed colors.

The purpose of this study is to revisit the corpus of the cross-utilization of tinctorial and medicinal plants in different cultures.

Within ancient and current traditional practices, certain colorants from plants are used for their curative, protective, cosmetic and aesthetic potential. Based on this knowledge and through a holistic approach, the ambition is to present interdisciplinary research with a goal to develop a range of colors for therapeutic purposes.

To highlight the potential of plants, the innovative approach here is to consider the skin as a sensitive or receptive vehicule when combined with textiles.

Color and sensory design make it possible to design colors not only in their chromatic dimension but also in their material reality. The colored material and the colorant contain a considerable number of properties that the skin and the body will permeate. Beyond the symbolic dimension from historical or anthropological texts, key questions revolve around the reaction mechanism and activation of plant properties. The chromatic diffusion does not only occur in the vegetable extraction tank, it also occurs in the body. From the plant to the skin, sensory receptors become activated by stimuli through natural dyes and coloring ingredients, thus creating multi-dimensional color for diverse uses. Examples such as indigo plants (*Indigofera Tinctoria* L., *Polygonum tinctorium* Aiton and *Isatis Tinctoria* L.), safflower (*Carthamus tinctorius* L.), saffron (*Crocus sativus* Linn.) or also Boraginaceae plants (*Alkanna tinctoria* Tausch and *Lithospermum erythrorhizon*) are the main focus of this project, especially for their known use in dyeing, cosmetic and curative properties around the world.

Keywords: colorants, natural dyes, medicine, sensory design, care design, tinctorial and medicinal plants, ranges of natural colors.

INTRODUCTION

Are clothes that have been dyed with plants good for your health? Could they solve skin problems, and even more, can they permeate the skin to heal diseases? Based on interdisciplinary research, can we prove the medicinal virtues of plants and dyed samples? This added value could help with the promotion of tinctorial and medicinal plants to manufacturers and users. In the realm of design, it is also an opportunity to think of new inclusive uses. This research implies the implementation of a certification label, similar to the protected designation of origin (PDO), to defend common values and compliance with the conditions of production and specified origin. such as respect for the soil, local cultures and plant diversity protection, without any kind of intensive farming. It could also be an interesting way to rely on plant diversity in terms of 'terroirs' to promote unique colors from all over the world.

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The genesis of this project took place in Madagascar in May 2017. The International Festival on Plants Ecology and Colors - Voajanahary, at Antananarivo in Madagascar, presented two key subjects: dye from plants and the medicinal properties of local flora. Workshops were put in place to study certain endemic plants and to make dyes and colorants by discovering the traditional medicinal properties of herbal plants we use. To understand the multiple properties of plants as potential for inclusive innovative uses, means to consider traditional manufacturing as unique and intelligent, a real key for the future. Ancestral traditions are models to consider in the development of our societies. From dye and medicinal plants, taking these simple facts as its starting point, the project Color & Care Design was created.

MATERIALS AND METHODS (experimental procedures)

Natural dyes, health and well-being

Recently, several researchers noticed the interest in natural dyes as agents with multiple properties which could help the daily life of human beings. The interest to discover the effects of plant dyed fabric on the body has come a long way and concerns many studies, as evidenced by the few excerpts quoted below:

"Plant natural pigments are widely used as alternatives not only because of their high availability as coloring agents, but also they exhibit abundance of health promoting values such as antioxidant and antimicrobial activity which favor human beings." (Mohd-Nasir et al., 2018).

"Dye yielding medicinal plants have been traditionally used and believed to improve complexion and skin disorders in India. However scientific validation has not been carried out so far for many of the metabolites. Here we discuss unexplored bioactive molecules from dye yielding plants on anti-tyrosinase and anti-melanoma activity on B16F0 melanoma cell lines." (Ramamoorthy, 2016).

"Many of the plants used for dye extraction are classified as medicinal and some of these have recently been shown to possess remarkable antimicrobial activity. (...) The current preference for naturally derived colorants is due to their healthfulness and excellent performance. Several synthetic colorants have been banned because they cause allergy-like symptoms or are carcinogens. Nowadays, natural dyes are commonly used in the cosmetic industry due to no side effects, UV protection and anti-aging properties." (Chengaij et al., 2010)

"Jordan fields during the spring season are very rich in various types of medicinal and colored plants. The attempt to use the natural dyes is recommended due to their non-toxic properties, fewer side effects, and having less cost. So far no serious efforts have been made to document and preserve the natural dyes associated with people. Thus, improvement of precise extraction and dyeing technique is important to make the natural dyes commercially successful like synthetic dyes. It is now evident that cotton and wool cloth are stained with different colors by using the medicinal plant extracts. Therefore it is likely to be concluded that using some of Jordanian medicinal plant extracts as natural dyes might be essential and this may be considered as good investment in different types of cloth and textile manufacture." (Shakhatreh, 2012)

From tinctorial and medicinal plants: development of Color & Care Design

This research in design is about a project for the future: make color recommendations for industrial environments and innovation-oriented companies (beauty/health, textiles, environment). Through an intercultural and interdisciplinary posture, several fields overlap in research (applied arts, history, design, health, science and technology) and different sectors of activity (textiles, beauty/

health, color industry). The first study concerns the analysis of dyed textiles on skin and an extension of the research could question the use of vegetable colors in sectors other than textiles and also verify the curative properties of these colors on the skin and in the air (cosmetics, architecture and paints).

As a first step, a corpus of use-cases is to be created, outlining all material and fabric dyed with plants used for their healing or protective potential and this, throughout history and in different cultures. The foundation could be based on the works of Dominique Cardon (2014). The point is to identify plants to study in a laboratory, carry out tests from textile samples and verify the potential virtues and impact on the body. That is why today, I am seeking partners in different scientific fields, such as ancient history, anthropology, organic chemistry and pharmacognosy to work with the Color and Care design team. The first plants to be studied would be safflower (*Carthamus tinctorius* L.), saffron (*Crocus sativus* Linn.), shikon (*Lithospermum erythrorhizon*), alkanet (*Alkanna tinctoria* Tausch) and indigo plants (*Indigofera Tinctoria* L., *Polygonum tinctorium* Aiton and *Isatis Tinctoria* L.). It would be particularly interesting to compare the studies carried out respectively on the alkanet (*Alkanna tinctoria*) and the shikon (*Lithospermum erythrorhizon*), used both as coloring substances and for curative purposes. As demonstrated in Europe (organic chemistry research at Thessaloniki laboratory, Greece) on the one hand and in Asia (pharmacognosy research at the Hokkaido laboratory in Japan) on the other, plants to accelerate the healing of wounds or sores have been very conclusive.

Secondly, design specific ranges of colors found in the medicinal and sensory character of plants. Currently, a group of Master and Doctoral students are focusing their work on this aspect of the project. For Color & Care Design, three PhD students are working on the following subjects:

- A.-C. Baudequin works in sensory and olfactory design. Her focus is on plants used for therapeutic purposes that produce color and perfume and on the elaboration of the corpus of plants;
- M. Pacheco works in sensory and digital design. The question of scent and territories and their digital cartographic translation, from the perspective of the effects of scent on the body;
- P. Munoz works in the design of colors and materials, mainly from recycling vegetable and organic waste.

Colorants used in medicine

The objective for us is to include the polysensoriality aspect of colorant materials considered as medicinals into design projects. We will cover the subjects of symbolic beliefs to true healing colorants. We will also explore the main traditional uses of certain colorants in different countries, such as saffron in Morocco used as talisman, abortion, fertilizer, aphrodisiac, spice in wedding meals, dye and the safflower in Japan, used for intimate textile dyeing, lipstick, talismanic buddhist paper for the new year. Designing inclusive color samples means to invest or transform these use cases into innovative projects.

What is wonderful about safflower (*Carthamus tinctorius* L.), is its real chromatic potential and how magical the process is to obtain colors like radiant pink or red sprinkled with gold glitter, found in traditional lipstick or fine lacquer for paper, all in colors from winter, requiring icy waters to emerge. The traditional talismanic papers made in Nara buddhist temples is one of the ancestral treasures one can find in Japan. Sachio Yoshioka made a complete study about Japanese use cases from natural colors that can be found in the exceptional *Japanese dictionary of colors* (Yoshioka, 2004). By collecting traditional paper and textile, used with natural dyeing techniques, he illustrates how these were carried out and how the ancient tradition prevails. The « Yoshioka Dyeing Workshop» in Kyoto is perpetuating this savoir-faire and skill under the leadership of his daughter Sarasa Yoshioka, 6th generation of dyers. For ages, the lipstick made with safflower has been known for its protective and moisturizing qualities. The medicinal aspect of *carthamin* should be noticed as a scientific support element to accompany this precious tradition.

"Carthamin is extracted from its flowers and it is used for treatment in the form of infusion for circulatory system related diseases. In addition to the coloring properties, safflower petals are used for curing several chronic diseases such as hypertension, coronary heart ailments, rheumatism, male and female fertility problems. The chief constituent Carthamin has uterine stimulating, coronary dilating and hypotensive. It also has the cytotoxic 25, antigenic and anti-platelet activities." (Chengaij et al., 2010)

Since four millennia, saffron (*Crocus sativus* Linn.), as a spice and as a dye, has been used in a multiplicity of human practices (pharmacopeia, culinary art, textile and body dyeing, perfumery, painting, calligraphy, literature...) and in a multiplicity of relationships with the body (saffron through our vision, olfactive, gustatory and tactile senses). J. Dupont (Dupont, 2000) studied the practices and use of saffron in two specific cultural fields: French culture and Moroccan culture. This research is based on the comparison of all the practices using saffron and to study the production and different aspects when using the same material. By studying saffron, he explores the creative process from the *poïetic* point of view, or the material aspect in the practice of the color. This exploration allows us to better understand the elaboration of material and the material aspect in the *poïesis* of the artistic color.

"Saffron (*Crocus sativus* Linn.) is used in folk medicine as an antispasmodic, eupeptic, gingival sedative, anti catarrhal, nerve sedative, carminative, diaphoretic, expectorant, stimulant, stomachic, aphrodisiac and emmenagogue. Its active constituents have anticonvulsant, antidepressant, anti-inflammatory and antitumor properties, radical scavenger as well as learning and memory improving properties and promote the diffusivity of oxygen in different tissues. *Crocus sativus* has been shown to have antidepressant effects; two active ingredients are crocin and safranal. Escribano et al showed that saffron extract and its constituents; crocin, safranal and picrocrocin inhibit the growth of human cancer cells (Hela cells) in vitro." (Chengaij et al., 2010)

Creating ranges of natural colors and materials

By identifying different plants for healing and with colorants, the polysensoriality of colors made from them is widely explored and allows us to develop new materials with many sensorial aspects which can be included in design projects. Plants are living organisms and react to the sun, to air and to pH..., some colorants continue this interaction with photosensitivity or by reacting to the skin. Traditional dyers in Mali have used their skills and experience with natural colorants to make patterns with photosensitive plants, such as *Bògòlanfini* or *bogolan* (litt. Bambara: "mud-dyed cloth"). A yellow dye is extracted from the sacred African birch tree *n'gallama* (*Anogeissus leiocarpa*). A couple key objectives of this research is the revaluation of the potential of certain dyes and local holistic practices and thinking about new uses of textiles or cloth, but also to impulse new dynamics in territories that need an economic revival.

A further step of this research is to make ranges of natural colorants as tools to promote the medicinal virtues of plants and the diversity of colors a plant can provide. These tools can help to better understand local identity, strengthen cultural values and preserve heritage. Creating a global awareness that specific areas producing colorants are unique because of the soil and climate and should be honored and respected. To consider colorants as living organisms and going beyond their symbolic value, just like humans, they too, need care.

In order to federate new developments of collections dyed with plants, and to propose new chromatic models, it is important to collaborate with trend forecasters and consulting agencies and to involve major brands in new practices. Disseminating the culture surrounding colors and pigments from vegetation implies modifying the relationship between mass-production and concentrated or focused production. We intend to invent new territories of identification for the consumer, to involve them by democratizing the very practice of dyeing, without devaluing it. Initiating new practices makes

it possible to raise awareness in people to the ecological aspects and questions of color. Understanding and reacting to the need for new textile coloring methods in the industry means:

- to collaborate with the socio economic world to change practices;
- to consider the big challenge of changing the paradigm for the textile industry, to switch from synthetic colors to colors derived from plants, in particular the operating model and the economic impact.

The following color ranges created by design students show the interesting aspects of considering dyes and pigments as precursor material for innovation. Collecting local plants induces a fresh look at the environment and its relationship to technical feasibility, thus an added value thanks to the research process and color experimentation in the workshop. Eucalyptus, with its specific characteristics, is a good example of a plant that allows experimentation to create stable and luminous colors. The exploratory work of India Flint (2008) testifies to the palette of colors that can be obtained with this plant.

Each dye from medicinal and tinctorial plants can be considered as a material with many properties which can be organized in a sensory map including different characteristics such as cosmetic (moisturizing, anti-oxydant...), olfactory (powdery, woody...), flavor (spicy, sweet...), as well as surface effects, color palettes, denomination and the relationship to magic or holy usage.

Seeing and naming shapes the way we conceptualize colors can convey subtle feelings. The greater the number of words to say a hue, the more open is the perception and the more precise is the translation of feeling. Moreover, to name the colors implies how one conceptualizes their chromatic environment, due to their culture, language and climate (Tornay, 1978). Exploring new names for color opens up the perception of brand-new hues by using tinctorial plants, rediscovering forgotten names for color from ancient pigments and opening one's eyes to the variety of subtle nuances that surround us. This process from a designer's point of view takes time, from the heart of the plant to the discovery of new, subtle colors. Designing a range of fresh flower dyed samples by looking, feeling, infusing/diffusing the effects of the colors on the body. Using basic "*garden of the simple*" colors made from simple plants to enhance their incredible rich virtues can reveal the secret potential of small flowers and wild, sunny and bitter, alchemical herbs. The simples and the knowledge of plants as medicinal resources create sensorial colors, originating from the garden to the body. Slow dyeing from olfactive flowers can create combinations of colors and fragrances. Furthermore, specific design methodologies must be defined in order to work with the complex chroma of natural dyes. Natural colors can be combined with the exploration of specific surface effects, such as powdered, velvety, radiant, shimmering... Translating the complexity of shades and hues from our different senses into specific color names allows us to conceptualize a sensory design that speaks to people and impacts their feelings.

For example, naming colors in relation to the human body allows us to translate and design new colors for the skin. Pink, nude, beige, blush...; colors close to the skin are natural colors, subtle for humans and even more so when combined with delicate fibers (Figure 1). Enhancing skin irregularities and chromatic evolution presents the skin as a sensitive interface and receiver of the virtues of plants through color dyes (Figures 2).



Faire corps



Blush



Frisson



Peau éthérée



Priveyance

Figure 1. Natural color range. F. Melul, M. Rabin, *The being-flower*, Univ. of Toulouse, 2022.



Figure 2. Natural color range. C. Belet, C. Grasset, *Significantly epidermal*, Univ. of Toulouse, 2022.

RESULTS AND DISCUSSION

To establish and define a certification label, certain ecological aspects and points of attention must be noted and taken into account. To highlight the added value, actions are needed to:

- Reduce mass textile production and ensure the quality of final products.
- Avoid any chemical treatments: from the plant, through the dyeing process, to the fabric.
- Adhere to an organic or even bio-dynamic or conceptual cultivation method based on acquired knowledge in ecosystem agronomy.

Color & Care Design and well-being : Open innovation call for advisory groups

Our aim is to create an innovation ecosystem by mobilizing and developing a team of cross-functional research and development specialists. We hope to answer questions posed by the innovation concept (healing colorants, materials), its effects on humans (sensory design and medicine) and the impacts on living things (reversing the overall curve towards a positive impact). We call on researchers in design, anthropology, ancient history, organic chemistry and pharmacognosy to work together on this interdisciplinary project and contribute to achieving strategic goals.

The first objective would be to set up an interdisciplinary study based on *ethnographic data* collection and historical data, and to define the first scientific protocols. Plants from the boraginaceae family (alkanet, onosma, murasaki) could be the first focus of study, since results have already been obtained within the Thessaloniki laboratory in Greece concerning the synthesis of alkannin and shikonin and a study of active molecules and the development of therapeutic agents (Assimopoulou et al., 2002). Other key sources are the Hokkaido laboratory in Japan, which conducted a study and development of the shikon plant and Dr. Cardon, CNRS/CIHAM, Lyon France, who has been studying the use, the types of plants from this family and the worldwide specialists involved in natural dyes.

Many chemical compounds exist in two variants, called *enantiomers*. These consist of the same elements but act as *mirror images of each other*. The history of the enantiomeric (i.e. mirror image of each other) naphthoquinone molecules, alkannin and shikonin is quite unique. Indeed, for centuries, root extracts from *Alkanna tinctoria* Tausch in Europe and *Lithospermum erythrorhizon* in the East were used independently, both as red dyes and for curative purposes, notably to accelerate the healing of wounds. It was not until the 20th century that the two active enantiomers were identified and the plants belonging to the family Boraginaceae, as well as their practices, were brought together.

In Europe, the S-enantiomer alkannin, extracted from the roots of *Alkanna tinctoria* also called *Anchusa tinctoria* (alkanet) is used as a food coloring (E103) and in cosmetics. Alkannin has a red color in an apolar medium (in oil) and a purple color in basic medium. The plant, already known in ancient Greece, was widely used for its dyeing properties but also for curative purposes on the skin, especially to treat ulcers and burns. An ointment containing extracts of *Alkanna tinctoria* roots has been formulated and patented (Histoplastin red® then Helixderm®); results in terms of granulation, epithelization and in quality are very good.

In the Far East, the R-enantiomer, shikonin, is commonly extracted from *Lithospermum erythrorhizon* (red gromwell). It is known in China under different names, tzu tsao, tzu-ken (purple root) and hung-tzu ken (red root). Its use for dyeing silk dates back several centuries, along with its use in traditional Chinese medicine. Nowadays, shikonin is widely developed in Japan, both for its dyeing properties and for its medicinal properties. The cultivation of the *Lithospermum erythrorhizon* plant proved insufficient for the production of shikonin (indeed 5 to 7 years are necessary before extraction of the natural product is possible and only 1 to 2% are obtained from the roots). Industrial manufacturing companies have turned to the development of biotechnologies to produce by cell culture, the secondary metabolites, one of which is shikonin. Today, the Hokkaido laboratory is working on the production of plants and the feasibility of extracting dye from the roots after 2 years of culture (Kojoma, IHC, 2022).

CONCLUSION

Color & Care Design, the challenges of collaborative research

This study allowed us to highlight the main issues involved in interdisciplinary research around the Color & Care Design axis. Here are the important points of such collaborative research as well as the major objectives in terms of actions to be carried out within the framework of this program.

The need to launch an international research team of specialists in relation to colorants from plants with medicinal properties. Test and prove the curative potential in dyed textiles in contact with the skin (perform laboratory tests). Define technical dyeing protocols favoring maximum conservation of the therapeutic virtues of plants (extraction processes: hot / cold, mother tinctures, etc.). The inclusion of all polysensory data of the plant in the dyed materials (smell, sensation, effects...) is essential in the overall program.

Color & Care Design, the challenges of design research

The designer's approach plays an essential and leading role in this project. We have defined numerous actions to support this research. The development of a range of colors to promote plant-based colorants to manufacturers and future users. The need to create a corpus of ancient and current uses of fabrics dyed with plants for curative and protective purposes (ex. Tuareg nomads of the Sahara and indigo clothing). Field studies in France, Japan, Madagascar, Morocco, Egypt, Greece, and England are currently in progress or envisaged.

In April 2023, a field exploration will be carried out with our design research team in Morocco to identify colorants and health and well-being practices with a focus on roses, indigo, henna, saffron, and safflower. A complete report on research-creation (RC) and the polysensory aspect of colors, including the olfactory aspects, and in particular understanding their effects on the body, will be published and shared among the participants.

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