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NATURAL DYE BASED SINDOOR

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ABSTRACT:

Sindoor is most important beauty item for wedded women, devotion and other purposes. Long-lasting use of synthetic dye-based sindoor has shown symptoms of hair loss, greying of hair, edema, erythema and even skin cancer. In view of above scenario, developed an alternative, safe, non-toxic, eco-friendly natural dye-based sindoor. The process provides an opportunity for the preparation of different shades of sindoor like orange, red, dark red, maroon, etc., using different dyes and their blends. The orange coloured herbal sindoor is quite suitable for worship and other purposes. It provides an option to replace synthetic dye-based sindoor.

KEY WORDS: Sindoor, Natural dyes.

INTRODUCTION:

Sindoor is an important cosmetic item during worship and other occasions by Hindus. During the last one and half decades, there is much concern at international level about the use of safe colouring agents and intermediates in processing of consumer products like dyed textile, foods, cosmetics etc. Considering the unwell effects of synthetic dyes on human beings and eco-system, Germany was the first to take initiative to put ban on numerous specific azo-dyes for their manufacturing and applications. The Netherlands, India and some other countries have also followed with a ban on similar lines (Anonymous, 2005; Clothline, 1996). Most of the countries have brought effective laws and regulations (Nimkar etc. 2006; Premi, 1996) related to the consumer health and safety. Traditionally, the red sindoor was made at home from turmeric and alum.

The turmeric powder which becomes red when mixed with lime juice or lime powder (calcium compound), moistened in water, or with alum, iodine and camphor, or with oil and

sea shell powder (calcium salts), or red ochres (geru), chandan and kasturi. It can also be made from sandalwood mixed with musk, or from a mixture of saffron ground with kusumbha flower (safflower). Another traditional ingredient used in making sindoor was raw rice in water heated in a pan until it formed into a glue-like red carbonaceous compound which solidified on cooling and finally powdered. It is also believed that in olden days, sindoor was also made with a special type of red marble stone, covered with turmeric and a little oil and left undisturbed for a few days, after which it turned into red powder (Banerjee). A variety of natural dyes obtained from different plant and insect sources (Gupta, 1992; Kapoor, 2005-06) or their blends can be used for preparation of herbal sindoors depending upon the colour and shades. Some of the prominent dyes and their sources are as follows:

SINDURI : *Bixa orellana* Linn. of Bixaceae family is a shrub or small tree that grows up to 5 to 10 m . It grows throughout South India and also found in some other parts of country. Seeds are the source of an orange-yellow dye. It contains 40 to 45% cellulose, 3.5 to 5.5% sucrose, 0.3 to 0.9% essential oil, 3% fixed oil, 4.5 to 5.5% pigments, 13 to 16% protein, as well as α- and β -carotenoids and other constituents. Oil is extracted from the seeds and is the main source of the pigments, Bixin, $C_{24}H_{28}O_4$; mol. wt., 380.5; Yellow-orange to orange;$E^{1\%}$ =2870 at 482 nm (0.1N NaOH); water soluble and Norbixin (Fig. II), $C_{25}H_{30}O_4$; mol. wt., 394.5; Yellow to orange-yellow;$E^{1\%}$=2870 at 502 nm ($CHCl_3$); oil-soluble, the main constituents of the pigment are classified as carotenoids; CI Natural 4. The dye exists under the list of permitted food colours in accordance with the rule 28 of Prevention of Food Adulteration Act (PFA) and also specified in the Food Chemical Codex of USA. The colour is "Generally Recommended As Safe (GRAS)" for human consumption in usage of food products. It is also used commonly for dyeing of wool, calico and leather.

MADDER:*Rubia* Linn. of Rubiaceae family, distributed in the temperate and tropical zones. The best known species are European madder (*R. tinctorum* Linn.), Indian madder (*R. cordifolia* Linn. sensu Hook. f.) and Naga madder (*R. sikkimensis* Kurz). *R. cordifolia*, commonly known as manjith or manjistha is a variable prickly hardy creeper, up to 10 m long, common throughout India, ascending to an altitude of 3,750 m. The principle colour constituent present in the roots of *R. cordifolia* is purpurine (trihydroxy anthraquinone) 0.37-0.5%. The roots also contain munjistin with small proportion of xanthopurpurin and pseudopurpurin. The main colouring matter in the roots of *R. tinctorum* is alizarine (dihydro anthraquinone) present in the form of a glycoside known as ruberythric acid along with a

related anthraquinone dye, purpurine. The yield and strength of colour in European maddar is considered superior in comparison to Indian madder. It has been used since ancient times as a vegetable red dye for leather, wool, cotton and silk. The dye is fixed to the cloth with the help of any suitable mordant like alum, tin, aluminium, iron, cream of tarter, calcium, ammonia, etc. It produces different shades like light and dark red, turkey red, bright orange, violet, etc. depending upon dyeing conditions and mordants. Madder is used in limited extent by natural dyers and hobby groups since the synthetic alizarine is commercially available in market at fairly less price.

BEET ROOT: *Beta vulgaris* Linn. of Chenopodiaceae family is a biennial herb which has been cultivated in most parts of India. It is an excellent source of red colour. The main pigment present in the beet root is betanin (red betacyanin; 75-90 %) along with other pigment, yellow betaxanthins; both are water-soluble. There exists several varieties and some of them contain up to 200mg/100g fresh weight of betacyanins representing 2% of the soluble solid. It is predominately used in ice-cream, yoghurt , dry mixes , sugar confectionary and for colouring sugar pastes, sugar coating and cream fillings.

CHILLI: *Capsicum annuum* Linn. of Solanaceae family, commonly known as red chilli, lal-mirch and mirchi, is an annual herbaceous crop cultivated throughout India. It is one of the prominent spices, used in food preparations for its flavour and colour. The main component of spice is oleoresin. Ripe fruits of chilli are responsible for its orange-red or red colour. Its use as a colour is limited due to its spicy flavour and purified flavour-free colour is expensive. The major pigment is Capsicum Red, which ranged from 0.1 to 0.8 %. It is a mixture of esters of capsanthin, capsorubin , zeaxanthin , cryptoxanthin and other carotenoids. The constituent proportions of pigments are different in green and ripen red fruits. In red pepper, the esters of capsanthin and capsorubin are mainly responsible for red colour having good tinctorial strength. Normally it is obtained through solvent extraction. It has good heat stability but possesses poor light and chemical stability. It is used in water-miscible or emulsion forms in meat products, soups, sauces, sweet products, etc.

CUTCH: *Acacia catechu* (Linn.f.) Willd. of Mimosaceae family, commonly known as Khair or Cutch tree, is a moderate sized tree 20 m in height, spiny with thorny branches and rough bark. The tree grows extensively in Uttar Pradesh, Himachal Pradesh, Madhya Pradesh, Gujarat, Bihar, Maharashtra and to a lesser extent in the southern states. It is also found in Nepal and Myanmar. The heartwood of the tree is a potential source of katha and cutch. The average yield of katha is 3.0-4.5 % of dry weight of heartwood and the average

yield of cutch is about 6-8 %. Katha predominately consists of a mixture of catechin and its isomers in 55 % (in good quality katha) whereas cutch contains 25-35 % of catechu tannic acid, 2-10 % ocetechin and small proportions of catechu red, quercetin and gum. Katha is used from ancient times in betel leaf chewing together with lime and now-a-days consumed in larger extent for the preparation of pan masala. The other uses of katha and kutch are textile colouring, tannery, and preparation of indigenous medicines. Cutch is used as a fast adjective dye giving brown and olive colours with different mordants. It is fairly used in many preparations for hair dyeing.

INSECT DYES: Lac, cochineal and kermes are the oldest insect dyes used in India and western world.

LAC DYE: Lac is the resinous protective secretion of tiny lac insect (*Laccifer lacca*) which is a pest on a number of plants. The insects secret a thick resinous fluid which envelopes their bodies and becomes a hard continuous encrustation over twigs. The twigs are harvested and the encrustations scraped off, dried and processed to yield shellac and the dye. Shellac is primarily used as a wood sealer and finisher today. It has the great advantage of being soluble in ethyl or denatured alcohol, an environmentally-safe solvent. The use of alcohol solvents render shellac a quick dry shellac coatings on wood which generally dry in about 45 minutes, as opposed to oil finishes which take many hours to dry. Lac dye is the bye-product of the shellac and its principle colour component is laccaic acid, a hydroxyl-anthraquinone carboxyl acid. It is not a permissible food additive but traditionally used for dyeing wool, silk and cotton. The dye requires prefixing treatment with myrobalan or other tannins and mordanting with alum. It yields crimson and scarlet shades with good fastness properties. The dye is easily available in India.

COCHINEAL AND CARMINE : Cochineal is the name of both an expensive crison or carmine dye and the cochineal insect, from which dye is derived. Carmine is a popular name of aluminium chelate of carminic acid. The carminic acid is the principle colour obtained from the dried female coccid insect, Dactylopius coccus costa (*Coccus cacti* L.). Carmine is also called Crimson lake and Natural Red, C.I. 75470 or E.I. 120. It is a pigment of a bright red colour obtained from the carminic acid and is used to provide deep red colour. Carminic acid (class: anthraquinone) is water soluble which provides colour shade orange at pH 3, red at pH 5 and purple at pH 7. Cochineals are extracted with hot water to extract carmine followed by treating the extract with alum, cream of tarter, stannous chloride or potassium hydrogen oxalate. Precipitation method is also employed to extract the colour. Cochineal and

carmine are widely permitted in EU and USA for wide variety of processed food stuffs with specified dose-levels from 50-500 ppm depending upon food items. It is widely used in the preparations of jams, preserves, gelatin desserts , flour confectionary, meat products, dairy products and soft drinks. It is not permitted in India for its application in food processing.

KERMES: Kermes or chermes is another red dye obtained from dried bodies of red female insects called *Coccus ilicis*. In the Persian language, Kermes meaning is "red insect". It is found on several species of oak near the Mediterranean, which is round, pea-sized, containing red colour analogous to carmine. The principle colour constituent is kermesic acid. The red dye is used for textile dyeing and colouring food**.**

MATERIAL AND METHODS:

A process for the preparation of herbal sindoor in following steps:

i) Preparing a homogeneous colour solution using one or more natural dye(s) by known methods, filtering the resultant colour solution followed by adding to the filtrate under stirring suitable amount of natural suspending agent(s) to obtain a dispersed dye solution. Preparing a homogeneous mixture of different natural bulking agent/fillers (food grade or I.P. grade), passing the said mixture through fine sieve followed by preparing a water/polar solvent based slurry of the sieved mixture. iii) Blending the slurry obtained in step (ii) with the dispersed dye solution obtained in step (i) at a moderate temperature under constant vigorous stirring for few hours to obtain a uniform coloured residue, filtering the said residue followed by drying and grinding to fine powder, optionally adding a fragrance agent.

RESULTS AND DISCUSSIONS:

The base materials are natural which are of food and/or I.P. grades. No salt of lead and mercury or any heavy metal has been used. Vegetable gum is used as a natural additive which works as a binding agent amongst dye and filler materials. The use of safe mordant imparts better fixation and fastness properties. The combination provides a powder material having soft and supple touch with good sticking capacity to skin. The blending of bulking agents/ fillers with activated natural dye solution with mordants in the presence of vegetable gum(s) provides a synergistic mixture of dry colour powder having desirable properties to be used for direct skin application.

Main advantages of the process are i) it provides an option to replace synthetic dye and heavy metal's salt based sindoor by natural ones, which is safe, stain-free and eco-friendly. ii) The

powder provides a synergistic mixture of coloured dry powder which has good sticking capacity to skin and can be easily removed by wash or water washing. iii) The dry colours are eco-friendly and can be prepared under eco-friendly processing without disturbing eco-system. iv) The dry colours provide ample opportunity for the utilization of regenerative plant resources and forest/agro wastes which ultimately enhance opportunity for self - employment for rural people. v) The process is novel as natural dyes have been exploited for the first time for the preparation of herbal sindoor.

CONCLUSIONS:

By using the process discussed here, red, orange, maroon, dark pink, dull red and other shades can be prepared using different amounts of natural dyes or their mixtures with natural ingredients in different proportions. The mixture of filler materials in specific proportions after blending with natural dyes in the presence of dye fixing agent and binding agent provides a combination which has a good sticking capacity to skin and can be easily removed by soft mop or aqua washing. However, long-term studies are needed to evaluate the risk of chronic toxicity and to prove our contention.

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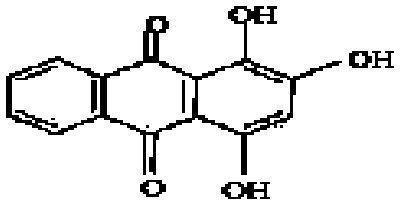
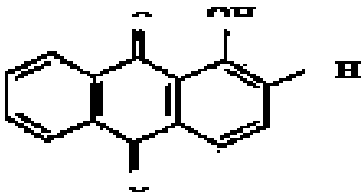
I. Bixin (Annatto)

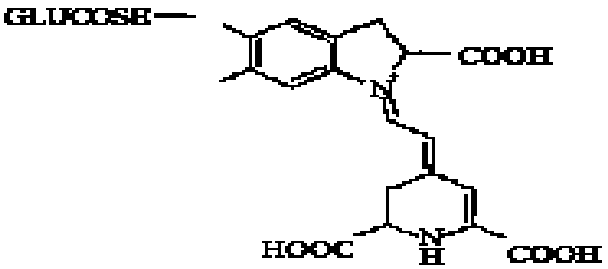
II. Nor-bixin (Annatto)



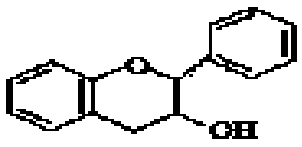
III. Purpurine (Indian madder)



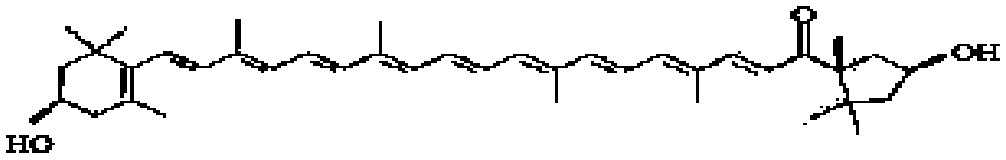
IV. Alizarine (European madder)

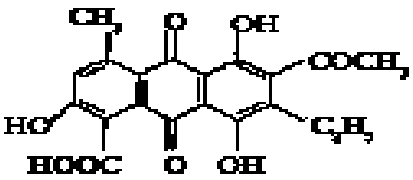


V. Betanin (Beet root)

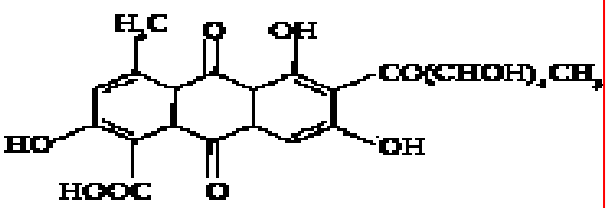


VII. Catechin(Cutch)

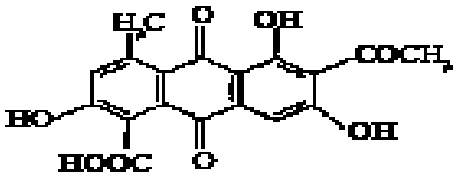




VIII. Laccaic acid (Lac dye)



IX. Carminic acid (Cochineal dye)



X. Kermesic acid (Kermes dye)