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Review

Health Risks of Synthetic Hair Dyes: Advantages of Natural Hair Dying Agents in Unani Medicine

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Abstract

Dying of hairs is customary cosmetic proceeding in all communities since immemorial time. There might be various reasons for hair coloring but the practice is very much alive in the society irrespective of creed and gender. The persons who are aesthetically sensitive give color to their hairs as per their choice.

There are various synthetic substances which are being used for dying hairs in requisite tones and shades but the Paraphenylene diamine (PPD) is the usual ingredient, utilized in preparation of these dyes. Studies revealed that use of these hair dyes related to allergic and respiratory disorders and even cancer. Whereas, the classical Unani medicine suggest considerable number of substances with promising results and safety. In this paper an attempt is made to highlight the health risks of the synthetic dying agents and presents various natural substances which are claimed to be safe and effective for toning and coloring of hairs according to Unani medicine.

Keywords: Synthetic hair dyes; Paraphenylene diamine; Health risks, Natural substances

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Introduction

Hair coloring is the practice of changing the color of hairs. The practice of hair dying has been prevailing in the society since immemorial time. The reason for coloring may be nature's diversity but this practice

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is alive in the global society irrespective of creed and gender. The first synthetic dye was invented by William Henry Perkin in 1856 [1]. However, there are various synthetic substances being used for hair dying in requisite tones and shades but the PPD (para phenylene diamine) is the usual chemical substance, utilized in preparation of these dyes. Systemic intoxication with PPD commonly occurs via the oral and trans-dermal route [2].

Natural hair dyes are less toxic, less polluting, less health hazardous and non-carcinogenic [3].

Studies reveal that use of these hair dyes related to various health hazards including allergic, respiratory disorders and even cancer [4].

The dying of hairs has been an interested topic a topic of interest of Unani physicians since the ancient time. The classical Unani medicine is replete with various medicaments to color the hairs in requisite tones and shades. Unani physicians have prescribed various herbomineral preparations to color the grey hairs as well as to change shades and tones of the hairs as per the requirements. These coloring agents are stated safe and effective. Therefore, the paper envisages the health risks produce by the synthetic dying agents and provide a safe alternative from the treatise of Unani system of medicine.

Natural hair color levels

The following are the natural shades of the hairs found in the human beings globally [5].

1. black
2. darkest brown
3. dark brown
4. brown
5. light brown
6. dark blonde
7. blonde
8. light blonde
9. very light blonde
10. platinum

Types of Hair colors

There are four most common classifications of hair colors [6] as

(i) Temporary hair colors

Temporary hair color is available in various forms including rinses, shampoos, gels, sprays and foams. Temporary hair colors are typically brighter and more vibrant then semi-permanent and permanent.

The pigment molecules in temporary hair colors are large and cannot penetrate the cuticle layer. Remaining colored particles adsorb to the hair shaft and easily remove with a single shampooing. It lasts for about a few hours to one day. [7,8]

(ii) Semi-permanent hair color

Semi-permanent hair color has smaller size of molecules than temporary dyes therefore, is able to partially penetrate the hair shaft. That's why the hair dye may last for 4-6 shampooing or a few weeks. Semi-permanents contain no or very low levels of developers, peroxide or

ammonia. However, it may contain the toxic compound like P-phenylenediamine or other agents. [7,8]

(iii) Demi-permanent hair colors

Demi-permanent hair colors are permanent hair colors that contain an alkaline agent other than Ammonia (e.g. Ethanolamine, sodium carbonate) and while always employed with a developer, the concentration of hydrogenperoxide in that developer may be lower than used with a permanent hair color. [7,8,9]

(iv) Permanent hair color

All permanent hair color products and lighteners contain a developer or oxidizing agent, and on alkalizing agent (most often Ammonia).

When the dye containing alkalizing agent is mixed with the developer, chemical reaction occurs that swells the hair, permitting the dye to enter the cortex, where the melanin is located. The Ammonia swells the cuticle of the hair to allow the color pigments to penetrate deep into the hair shaft.

Permanent colors are truly permanent and will not wash out, although these may fade. [7,8,9]

Adverse effect of synthetic hair colors on health

Hair coloring through synthetic chemical products can result in a range of adverse effects. p phenylenediamine (PPD) a key ingredient of many synthetic hair dyes is known to trigger allergic rashes in many people [10]. PPD also causes dermatitis, around lips, reddening and swelling of scalp and face etc [10]. The clinical features of hair dye dermatitis vary from mild contact dermatitis localized to one body site (hand dermatitis) or disseminated generalized dermatitis to severe life threatening complications such as contact urticaria/angioedema, rhinitis/ bronchospasm/asthma, and renal toxicity. [11] Hair dyes contains PPD at various concentrations ranging from 0.2% to 3.75% [2]. The European Commission Directive 2009 regulation directs that the maximum concentration of hair dye substances in oxidative hair dyes should not exceed 2% [7]. PPD is a potent contact sensitizer even in low concentration and considered a best indicator and useful patch test screening allergen for hair dye dermatitis [11]. The prevalence of positive patch test reactions to PPD among dermatitis patients is 4.4% in Asia, 4.1% in Europe, 6.0% in North America, and 11.5% in India.11 People who use synthetic dyes are exposed to greater risk of developing urinary bladder cancer and non-Hodgkin lymphoma [10]. Lin and Soloder reported that PPD become mutagenic only when it was oxidized. PPD is usually mixed with H_2O_2 for hair dyeing. Oxidized PPD becomes a diaminophenazines, which are extremely mutagenic. The reported contamination of PPD with carcinogenic 4-aminobiphenyl, would put PPD as a high risk compound to humans for commercial use [12]. 2-nitro-p-phenylenediamine and

4-nitro-o-phenylenediamine are currently banned in Europe and United states because they have been tested exclusively and proved that have high potential of carcinogenicity [8]. Epidemiologic studies have suggested the existence of positive associations with myelodysplasia, multiple myeloma, leukemia and preleukemia, non-Hodgkin's lymphoma and Hodgkin's disease [4]. A number of case-control studies and a meta-analysis have found links between personal hair dye use and bladder cancer. Hair dye use has also been suggested as a risk factor for non Hodgkin lymphoma, leukemia, multiple myeloma and myelodysplasia [13]. Rausher et al. concluded that longer duration of permanent dye use appears to increase the risk of adult acute leukemia. Rollison, et al. reported that there is an association between personal hair dye use and non-Hodgkin's lymphoma, multiple myeloma, acute leukemia, and bladder cancer in at least one well-designed study [12]. Two studies in a Japanese population reported associations between hair dye use and myelodysplastic syndrome [13]. Hair dye poisoning results in laryngeal edema, rhabdomyolysis, severe metabolic acidosis and AKI. The reported incidence of AKI following hair dye poisoning range from 47.4% to 90%, with rhabdomyolysis, hemolysis, the presence of hypovolemia as well as the direct toxic effect of PPD on the renal tubular cells being the cause; histological evidence of acute tubular necrosis had been repeatedly observed [2]. The hair coloring agent suggested by the classics of Unani Medicine

The classics of Unani medicine have suggested various medicaments to color the hairs. The colors have been described as under –

i) To color the hairs as black
ii) To color the hairs as yellowish red
iii) To color the hairs as reddish black
iv) To color the hairs as bluish black
v) To discolor the hairs as white or grey

The following applications have been advised for coloring the hairs.

Avicenna describes the following formulation [14]

(i) Henna (*Lawsonia inermis* Linn.) [15,16,17,18] and Wasma (*Indigofera tinctoria* Linn.) [19,16,20,21] are used.
(ii) Henna, Wasma, Aab-e-Anar (juice of *Punica granatum* Linn.) [15,16,17] and Aab-e-Sumaq (juice of *Rhus coriaria* Linn.) [16,19] are used with Dahi (curd).
(iii) Qaranfal (*Syzygium aromaticum* Linn.) [16,22] is added for more darken color.
(iv) Shibb-e-yamani (Alum (*Almunium hydroxide*) [15,23] Namak-e-Shahme Hanzal (salt of *Citrullus colocynthus* Linn.) [16,17,24] and Mazoo (*Quercus infectoria* Oliv.) [15,16,25,26] are used.
(v) Halela Siyah (*Terminalia chebula* Linn.) [17,22,27], Amla (*Emblica officinalis* Gaertn.) [16,19] Mazoo each 10 parts, Barge Aas (leaves of *Myrtus communis* Linn.) [15,16,19], Habbul Aas (fruit of *M. communis* L.) [15,16,17,18,19,28,29]

each 30 parts. Add Sumbulut teeb (*Nardostachys jatamansi* DC) [15,17,28,29,30] and Zeet (olive oil) [31] to the said drugs along with water and keep it for three days. After 3 days boil the composition in order to concentrate it and then it is applied.

(vi)Henna, Wasma, finely powdered Murder Sang (*Monoxide of lead*) [27], roasted Mazoo, Roskhtaj (*Copper oxide*) [15], Phitkari {Alum (*Almunium hydroxide*) } [15,23], Mitti (soil), Kateera (*Cochlospermum religiosum* Linn. [12,21] or *Cochlospermum gossypium* DC) and Qaranfal [22]. All drugs are taken in equal amount and the mixture is made.

(vii)Fresh Henna and Wasma 2 parts, Roskhtaj, Phitkari, Malah indrani (Nampak Lahori) [31] (impure *sodium chloride* (rock salt)) [15], roasted Mazoo and Khubsul Hadeed (*Iron oxide, ferric or ferrous oxide*) [32], each in equal amount. All the drugs are ground in vinegar and kept for few hours till it leaves the red color.

Razi states the following natural agents [33]

(i) Mazoo 200 gm roasted with Roghan Zaitoon (olive oil), Nuhas Sokhta (*copper oxide*) [15] and kateera each 5-7 gm, Namak Indrani (Namak Lahori) [31] 7 gm and Shibb-e-Yamani {Alum (*Almunium hydroxide*)} [15,23]. 3-5 gm. Fine powder of all the drugs is prepared and kneaded with hot water. It is kept for 4 hours for fermentation and applied for 6 hrs, then washed.

(ii) Murdar Sang and Lime Stone [18] each in equal amount is taken, six times water is added to them and kept in sunlight for 3 days. After 3 days, it is filtered, a piece of Roti (bread) is dipped in filtrate, if the piece of Roti (bread) turns black then it is right, otherwise murder sang and Lime 1/6th in quantity of the filtrate, is added to it. Again the piece of bread is dipped and checked whether it is turned black or not. If it is turned black, finely ground Henna is kneaded to the filtrate so that the filtrate turns red. After that it is used as khizab (natural hair dye in the form of paste that is applied over scalp) and the hairs will turn black.

Jurjani in Zakhira kharazm shahi states [34].

(i) Henna, Wasma, Aab-e-Anar and Aab-e-Sumaq are used.

(ii) Murdar Sang and Lime Stone in water is prepared or kept in sunlight. White silk is dipped in mixture to check, if it is turned black. Henna and Wasma is kneaded in this mixture and applied over hairs. If Qaranfal 3gms after grinding is mixed in the khizab, it not only colors the hairs but also prevent the brain from side effect of khizab.

Abu Mansoor al Hasan Al Qamri describes [35]

(i) Khosha-e-Akhrot (bunch of *Juglans regia* Linn.) [16,19,21,36,37] is ground in olive oil. In this paste Mia-e-Sailah (*Liq-*

uidamber orientalis Linn.) [15,18,28] and Murmakki (*Commiphora myrrha* Linn.) [15,19] are added.

(ii) Khubsul Hadeed and Jast (Zinc) [27] to be boiled in Sirka-e-Kuhna (senescent vineger) till it becomes concentrated then apply.

(iii) Mazoo 5 gm roasted with Roghan-e-zaitoon (olive oil), Shibb-e-yamani (alum (*almunium hydroxide*)) [15,23,27], Kateera and Roskhtaj each 50 gm, Namak Lahori 25 gm are ground finely to make powder and a paste is made with hot water. It is applied for 4 hrs then washed.

(iv) Gul-e Lala (flowers of *Papaver rhoeas* L.) [15,20,30,32], Amla and Post-e-Baqla taza (rind of *Vicia feba* Linn.) [15,22] each to be taken in equal proportion, add the vinegar and keep it for 20 days in sunlight till the vinegar is completely absorbed, if the vinegar is inadequate more vinegar may be added then it is applied.

(v) Murdar Sang and bebujha chuna (*calcium carbonate*) [15,18] each 2 parts, loamy soil 1 part and mur makki 3 parts, together are used for khizab and washed with water of luabiat (mucilaginous contents of the herbs) after 4 hrs of applying.

(vi) Barge Lalah Surkh (leaves of *P. rhoeas* L.) [15,20,30,32] 5 gm, Shibb-e-yamani 33 gms and Roskhtaj 25 gm. Mix and make pills, these pills should be kept in a bottle and buried in sand for few days. After some days these pills will leave a black colored liquid. This should be applied.

(vii) Mazoo 30 in number to be roasted with Roghan-e- Zaitoon (olive oil) and to be ground finely, add Roskhtaj 7 gm, Namak lahori and Shibb-e-yamani 3.5 gm each, Barge Henna 3.5 gm, then add Aab-e-Barge moored (juice of leaves of *M. communis* L.) [15,16,17,19,29]. and boil, cool it and apply. If this mixture is applied after cleansing the hairs by Aab e Angoor (juice of *Vitis vinifera* Linn.) [16,20,22,28] or Aab-e-Barge karamkalla (juice of leaves of *Brassica oleracea* var. *capitata*) [16,19,20] or Chuqandar (juice of leaves of *Beta vulgaris* Linn.) [16,19,37] the results will be better.

Akbar Arzani in Qarabadeen e Qadri stated that [38]

(i) Mazoo 4 parts, Sang e-Rasikh {Roskhtaj [31] (Copper oxide)} 4 parts, Naushadar (Ammonium chloride) [15,27] 1 part, Shibb-e-yamani 3 parts. Roasted Mazoo should be mixed with other ingredients, make a fine powder. This powder should be kept in an iron vessel with water for few hours then to be applied, after washing the hairs with Aab-e-Amla (juice of fruits of *E. officinalis* Gaertn)) [16,19].

(ii) Wasma 40 parts, Barge Henna 5 parts, make a fine powder, mix with hot water and Roghan-e-Gul (oil of rose (*Rosa damascenea* mill Linn.) [15,17,39] than apply on hairs at bed time, wash in morning with tapid water.

(iii) Murdar Sang and Lime Stone [18] each

in equal amount. Water to be added Six times and it should be kept in sunlight for 3 days, the filtrate should be tested with the help of white wool. If it colors black to the wool then apply, otherwise add Murdar Sang and Lime stone further 1/6th part of the filtrate and keep it for further 3 days in sunlight, now again it is tested with white wool if it is ready to use than add Henna powdered leaves and keep for a few hours then apply.

Some other formulations [40]

(i) Barge Neel 50 gm, Amla khushk 50 gm, Post Beroon-e-Akhrot (rind of *J. regia* L.) [16,19,21,36,37] 20 gm, Gule lala 20 gm, Barge Henna 10 g, Mazoo Sabz 5 gm 1.5 litre of water, keep the drugs in sunlight for 2hrs then boil, till it becomes concentrated, then apply. [40]

(ii) Qust sheereen (*Sassurea lappa* C.B. Clarke) [15,16,17,19,27,39] to be boiled in Roghan-e-Zaitoon and apply daily. The addition of Wasma (Katam) with Barge Henna turns the Redish tint to blackish. For this purpose, 50 gm Wasma is sufficient for 250 gm Barge Henna. [40]

(iii) Barge Henna is ground with Sirka (vinegar) and applied to the hairs. It gives dark brown shade to the hairs. [40]

(iv) It is reported that the native of Madinah used Barge Henna with Wasma and Waras (a substance like pulverised saffron used to dye the clothes, procured from Yaman) [31] during the prophet's time. [40]

Tables 1. Drugs of herbal origin used for hair dyeing

Scientific names	Common name	Local name	Used Plant part	References
Lawsonia inermis Linn.	Henna	Henna	Leaves	15,16,17,18
Indigofera tinctoria Linn.	Indian indigo, common indigo	Wasma	Leaves	19,16,20
Punica granatum Linn.	pomegranate	Anaar	Juice	15,16,17
Rhus coriaria Linn.	Japan wax tree	Sumaq	Juice	19,16
Syzygium aromaticum Linn.	Clove	Qaranfal	Flower buds	16,22
Citrullus colocynthus Linn.	colocynth	Shahme Hanzal	Salt	16,17,24
Quercus infectoria Oliv.	Green gall, dyer's oak	Mazoo	Fruit	15,16,25,26
Terminalia chebula Linn.	Black Myrobalan, Chebulic Myroblan	Halela siyah	Fruit	27,17,22
Emblica officinalis Gaertn.	Indian gooseberry	Amla	Fruit, Juice of fruit	16,19
Myrtus communis Linn.	common myrtle	Aas	Fruit and juice of leaves	,15,16,19 17,18,28,29

Nardostachys jatamansi DC	Muskroot/ Indian spikenard	Sumbulut teeb	Rhizome	15,17,30,28,29
Cochlospermum religiosum Linn. /*Cochlospermum gos-sypium* DC	Indian or Country Tragacanth	Kateera	Gum	12,20,32
Juglans regia Linn.	walnut	Akhrot	Bunch (Khosha), Rind	16,19,37,21,36
Liquidamber orientalis Linn.	Liquid Storax	Mia-e-Sailah	Resin	15,18,28
Commiphora myrrha Linn.	Myrrh	Murmakki	Gum resin	15,19
Papaver rhoeas Linn.	Corn poppy	Gul-e Lala	Flowers, leaves	15,20,30,32
Vicia feba Linn.	Faba bean/broad bean	Baqla taza	(Rind (Post	15,22
Vitis vinifera Linn.	Grape	Angoor	Juice of grapes (Aab e Angoor)	16,20,22,28
Brassica oleracea var. *capitata*	Cabbage	karamkalla	Juice of leaves (Aab-e-Barge)	19,16,20
Beta vulgaris Linn.	Beet	Chuqandar	Juice of leaves	19,16,37
Rosa damascenea mill Linn.	Rose	Ward	Oil	17,15,39
Sassurea lappa C.B. Clarke	Costus root	Qust sheereen	Root	15,19,16,27,17,39

Tables 2. Drugs of mineral origin used for hair dyeing

Scientific names	Common name	Local name	References
Almunium hydroxide	Alum	Shibb-e-yamani, Phitkari	15,23,27
Monoxide of lead	Massicot, Litharge	Murder Sang	27
Copper oxide	Burnt copper	Roskhtaj, Mis sokhta, Sang e-Rasikh	15,31
Iron oxide, ferric or ferrous oxide	Iron rust	Khubsul Hadeed	27
Copper oxide	Burnt copper	Nuhas Sokhta	15,27
-	Zinc	Jast	27
Calcium carbonate	lime	Chuna	15,18
Ammonium chloride	Sal Ammo-niac	Naushadar	27,15
Sodium chloride (impure)	Rock salt	Malah indrani, Namak Lahori, Namak indrani	15,31,27

Advantages of natural coloring substances over the synthetic dyes

The synthetic chemical substances produce a variety of health hazards including allergic and respiratory disorders, skin discoloration, hair breakage and even cancers, whereas the natural hair dyes do not produce any serious side effect. However, Avicenna has reported that a few natural dyes may produce coldness of the brain which lead to Nazla (coryza) and capability of apoplexy in certain cases. These conditions might be corrected by adding the substances having hot temperament like Qaranfal, Mushk (an aromatous substance produced by abdominal gland of Moschus moschiferous) and hot aromas. The physicians of Unani medicine have composed a balance formulation by adding these substances to avoid the possibility of any untoward reaction due to coldness. Therefore, these formulations are considered safer and promising also.

Conclusion

Dying of hairs is customary cosmetic measure in all communities since immemorial time. There might be various reasons for coloring the hairs. The main reasons for this are cosmetic to cover gray or white hair, to change to a color regarded as more fashionable or desirable, or to restore the original hair color after it has been discolored by hairdressing processes or sun bleaching. There are various synthetic substances in vogue for dying hairs in requisite tones and shades but most of the preparation contains PPD as usual ingredient, beside hydrogen peroxide and ammonia. Studies revealed that use of these hair dyes linked to various health hazards including allergic and respiratory disorders and even cancer. The classical Unani medicine suggests considerable number of natural substances with promising results and safety. However, there is a need to screen these substances for their efficacy and safety as per the GCP norms.

Conflicts of Interest

None.

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None.

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