Retention of colour intensity in henna paste during storage

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Abstract

Henna (*Mehndi*), ***Lawsonia inermis* Linn.** has been known as the natural source of dye, besides having medicinal properties. Henna powder is made into a paste in water and used for skin decorations, tattooing and hair dyeing. On drying, the paste imparts a dark brown -black stain. In order to help the users henna paste is supplied in the conical packing to facilitate several types of designs on the hands and other parts of the body.

Since the paste of henna is made in water, on storage in various types of packing especially cones loose its staining power. The present study was taken up as a case study to ascertain the reasons for loss of performance in many commercial products available in the market. The study includes the characterization and effect of various factors on the stability of henna paste and also suggests ways to ensure the desired performance during storage. The results revealed that to maintain staining power of henna paste in cones the *p*H of the paste should be below 4 in aseptically sealed cones. The paste made from irradiated henna powder in combination with citric acid and sodium methyl paraben has a long storage life and good retention of colour.

Keywords : Henna paste, Henna cones, Colour intensity, Gas generation, *Lawsonia inermis*.

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Introduction

Henna (*Mehndi*) is the Persian name of a shrub known as, ***Lawsonia inermis* Linn.** It is native to Asia and the Mediterranean coast of Africa, however, now it has spread to other parts of the world with warmer climate also. Henna leaves are harvested throughout the year, dried and ground to a fine powder for different applications including medicinal[1] but largely as a cosmetics. Henna contains a pigment called Lawsone (2-hydroxy-1, 4-naphthaquinone) that bonds with the collagen and skin cells, keratin of fingernails and hair imparting dark black-brown colouring[2].

The use of henna in India goes back to the ancient times and is well documented in *Shusrut samhita*, 1000 BC as a soothing agent for the palms and soles and also for dyeing the hairs[3]. There are some folk-lore methods as well, wherein fresh *mehndi* leaves are grinded along with chilly powder and mustard oil to produce a very sustainable colour mark in the skin of hand, etc. Henna is especially popular among ladies who use it for beautifying their hands and feet in an artistic way particularly during auspicious occasions like weddings and festivals. India is one of the largest producers of good quality henna which is sold in many forms such as: dry leaves, powder, extract, etc. for different applications.

Traditionally, henna powder is made into a paste in water and applied after a short while but, for convenience of users the ready-to-use pastes in the form of cones are available these days. These cones have better design maneuverability and ease of application on different body parts. Henna cones contain henna powder, natural oils, water and preservatives packaged in the sealed metalized plastic cones. Since, henna paste contains water, its stability on-shelf has always been a challenge and a matter of concern. The problems observed in these cones during storage include the generation of gas inside the cones causing swelling and bursting rendering them unfit for use. The destabilized paste of henna does not give any stain when used. Therefore, the study has been attempted to find out the possible reasons for colour deterioration, mainly to find ways by which the characteristic dark and bright stain of henna paste in cones is retained for longer period during storage.

Materials and Methods

Locally available henna powder meeting the specifications of Indian standards was procured. Preservatives including sodium methyl paraben, citric acid, potassium sorbate, dichlorophen, triclosan, etc. were arranged from M/s Loba Chemie and M/s S.D. Fine Chemicals and used as such in the studies. Locally available pine, eucalyptus and citronella oils were used as received. Municipal tap water, boiled municipal tap water and

Henna plant

distilled water was used for the preparation of henna paste.

Gamma irradiator of Shriram Applied Radiation Center (SARC) was used for decontamination of henna powder. Measurement of *p*H was done using *p*H meter model *p*H 361 from Systronics of India. Incubator model KI-261 from Khera Instruments was used for shelf-life studies. Locally available prevulcanised NR latex sheets with 0.12mm thickness were used for colour fastness studies and Grey scale in the range 1-5 from British standards Institution was used for the colour comparison among various stains of henna in latex sheets. RQG-129 stirrer from Remi Motors Ltd. was used for making the paste of henna.

The following parameters were studied to identify the reasons of colour fading in henna cones during storage: (i) Chemical and microbial analysis of henna powder, (ii) Irradiation of henna powder, (iii) Effect of preservatives on henna paste, (iv) Effect of quality of water on henna paste, (v) Effect of *p*H on henna paste, and (vi) Effect of sealing on henna paste.

Chemical / Microbial analysis of henna powder

Chemical analysis of henna powder was carried out to ascertain whether the quality of henna used for preparation of cones is as per Indian standards 1984[Ref. 4]. Microbial analysis of henna powder was carried out as per the standard protocols[5, 6].

Preparation of henna paste

Weighed quantity of henna powder was dispersed in water with continuous stirring to avoid lump formation. All other ingredients including oil and preservatives were added simultaneously during stirring for one hour. A uniform paste obtained was left at room temperature for 2 hours to facilitate the release of lawsone pigment and then filled in metalized plastic cones which were hermetically sealed for shelf-life studies.

Characterization of henna paste

Henna paste was characterized for colour darkness, consistency of paste, *p*H and microbial activity before and after two months of storage. The storage (shelf-life) studies were carried out at 25±1°C and 37±1°C and at 55% RH in the incubator and also at room temperature 28°C, RH 65% for 60 days. Henna stains were obtained after drying from henna paste uniformly coated on latex sheets. The dried henna layer was easily peeled off leaving behind the colour impression. The rectangular samples of dimensions 3.8×2.5 cm were cut from the sheets for comparison of colour stains.

Results and Discussion

The chemical analysis of henna powder is given in Table 1. Quality of henna powder plays a crucial role in the stability of henna paste and the brightness and darkness of the colour stains. Lawsone pigment content is a critical parameter and should always be more than 1% by mass. Levels of lawsone depends on the soil and moisture conditions; moist, fertile and cool conditions produce low lawsone levels while dry hot iron bearing soils produce high lawsone levels[7]. Henna powder should be essentially free from artificial dyes which are sometimes incorporated to increase its market value, despite of the fact that, most of these dyes

Table 1 : Chemical analysis of Henna powder

S. No.	Property	Value (% by mass)	Permissible limit
1	Lawsone pigment	1.6	More than1
2	Minerals	10.68	8-12
3	Extraneous sand	4.47	Less than 5
4	Presence of extraneous dye	Nil	Absent
5	Acid insoluble ash	5.57	3-6
6	Cold water soluble extract	30.0	25-32
7	Crude fibre content	10.0	10-15
8	Loss on drying at 105±2°C	4.9	Less than 10

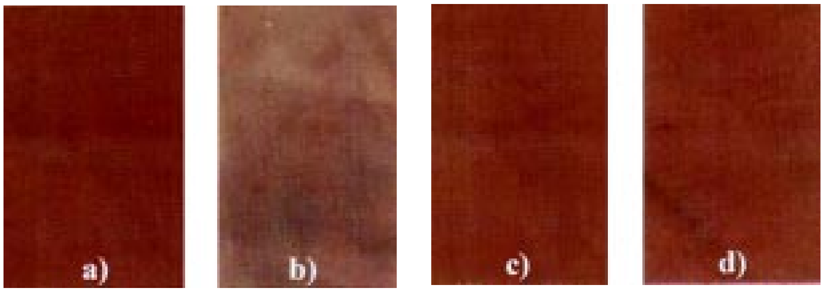

Fig. 1: Colour Stains of henna paste on the latex sheet
a) Unirradiated, b) Unirradiated after 2 months, c) Irradiated, d) Irradiated after 2 months

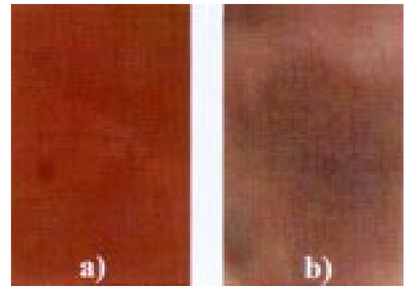

Fig. 2 : Stains of henna paste with tap water
a) Fresh paste, b) After 2 months

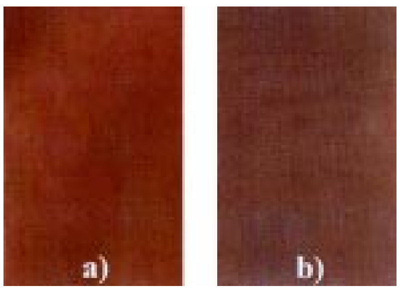

Fig. 3 : Stains of henna paste with distilled water
a) Fresh paste, b) After 2 months

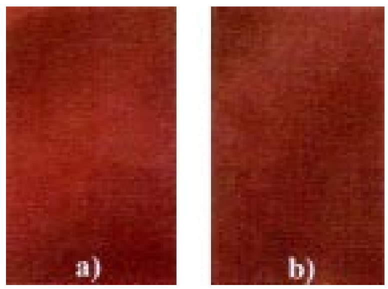

Fig. 4 : Stains of henna paste with boiled water
a) Fresh paste, b) After 2 months

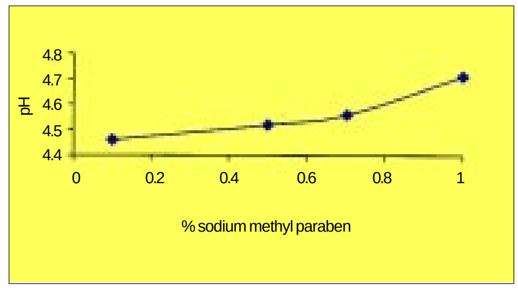

Fig. 5: Effect of Sodium methyl paraben on *p*H

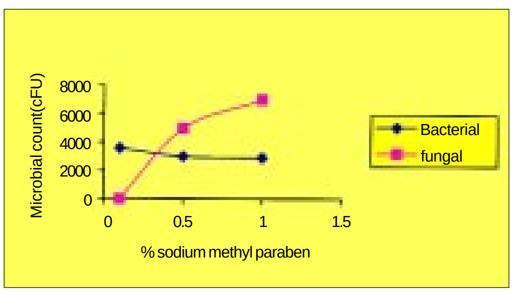

Fig. 6 : Effect of Sodium methyl paraben on fungal and bacterial count

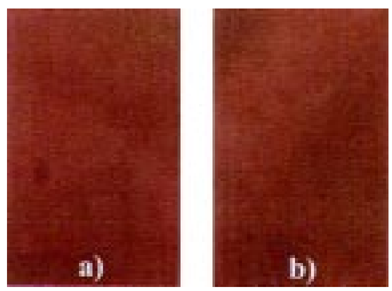

Fig. 7: Stains of henna paste with sodium methyl paraben
a) Fresh paste, b) After 2 months

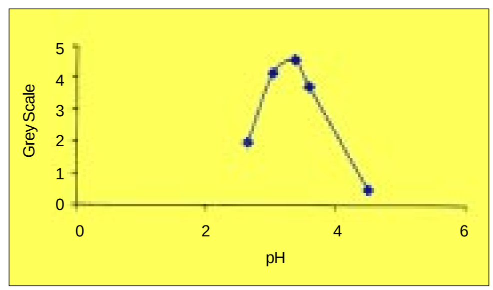

Fig. 8: Effect of *p*H on colour intensity

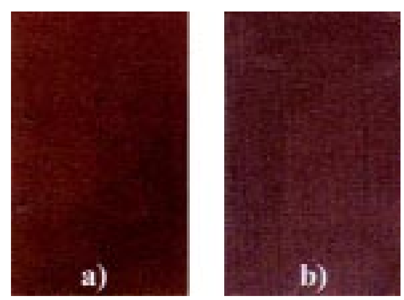

Fig. 9: Stains of henna paste with 5% citric acid: a)Fresh paste, b) After 2 months

e.g. phenylenediamine, diaminoanisole, etc. are carcinogenic[8].

The results of microbial analysis before and after irradiations are given in Table 2. The results showed that, henna powder was heavily contaminated both by bacteria and fungus before irradiation. The paste made from unirradiated powder was spoilt within 3 days with generation of gas and a total fading of colour as shown in Fig. 1 a,b. Irradiation at 1.5 Mrad has brought down the microbial load below 10CFU. The paste made from irradiated powder has uniform consistency, absence of gas generation and good colour stain, similar to the original as shown in Fig. 1 c,d. This explains that the colour deterioration and gas generation was taking place because of microbial attack.

Effect of quality of water

It was observed that, when henna paste was made in tap water, gas generation took place in cones making them enormously swell within 3 days both at room temperature and in the incubator, also the quality of colour imprint (Fig. 2 a,b) was poor. With distilled water gas generation and swelling of the cone was delayed and observed after fifteen days at room temperature and in the incubator. The colour imprints have deteriorated as shown in Fig. 3 a, b. With boiled municipal tap water the paste remained stable as none of the cones swell even after 60 days at room temperature and in the incubator. The quality of the colour imprints (Fig. 4) was good.

Effect of preservatives

Dichlorophen, triclosan, potassium sorbate and sodium methyl paraben were used as preservatives. Sodium methyl paraben was found to be most effective in retaining colour during storage while with other preservatives the original colour is either changed or became dull. Therefore, quantity of sodium methyl paraben was varied in the range 0.1-1.0% in the paste to prevent gas formation.

The effect of sodium methyl paraben on *p*H and microbial activity is given in Figs 5 and 6. Figure 5 depicts that with the increase in sodium methyl paraben content the *p*H was increased, which had inversely affected the colour intensity of stains. Figure 6 shows that by increasing sodium methyl paraben content the bacterial counts are decreased while the fungal counts are increased indicating the preservative system is only effective as a bactericide and is not efficient for containing the growth of fungus. The stains made from the paste containing sodium methyl paraben are given in Fig. 7. The intensity of stains was as good as in the original stain.

Table 2 : Microbial analysis of Henna powder

S. No.	Microbes	Before gamma radiation (Cfu/g)	After gamma radiation (Cfu/g)
1	Total Aerobic Bacterial Count	92×10^2	Less than 10
1	Yeast & Mould Count	38×10^2	Less than 10
3	Total Aerobic Spore Count	Less than 10	Less than 10

Effect of *p*H

*p*H studies were carried out in the range 2.0-6.0. It was found that henna cones in the *p*H 3 to 4 were most stable and impart dark stain. This was indicated by higher grey scale value (Fig. 8), suggesting maximum release of the lawsone pigment between 3 and 4 *p*H. Decreasing *p*H below 3.0 led to decrease in colour intensity, hence lower grey scale value. When *p*H was maintained by 5% dilute solution of citric acid, the stability and colour intensity further increased (Fig. 9). Adding pure lemon juice had given a very bright and dark stain with more than 60 days stability, as lemon comprises around 8% of citric acid of its dry weight[9].

Effect of sealing

Sealing studies were carried out by hermetically sealing the pouches in an air-conditioned room with controlled temperature and humidity. Different formulations were made using preservatives like sodium methyl paraben, dichlorophen, triclosan, potassium sorbate and citric acid in the range 0.1-0.3 per cent. All these preservatives were found to be highly effective in containing fungal and bacterial growth when packed properly. But when the packing was deliberately punctured by a sharp needle and left at room temperature, deterioration took place from the very next day indicating no preservative was effective and the paste in the cone continued deteriorating with gas generation and swelling indicating that proper sealing was essential.

Conclusion

It is concluded from the study that: (i) Deterioration of henna paste during storage was attributed to the microbial attack, (ii) Paste made from irradiated henna powder retained colour and gas generation was absent, (iii) Henna paste was stable below *p*H 4, for colour retention and better storage stability, (iv) Citric acid maintained the *p*H at 3 and retained colour stain similar in the original, (v) Boiled municipal tap water retained colour stain and prevented gas formation, (vi) Sodium methyl paraben was most effective for long storage and in retaining colour, and (vii) Sealing of cones is the most important factor for good storage stability.

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