



A REVIEW ARTICLE ON HAIR DYES AND CARCINOGENICITY AND MUTAGENICITY OF PARA-PHENYLENEDIAMINE

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ABSTRACT :

Hair dye is most commonly using hair cosmetic products. In The high demand for hair dyes is evident from the increasing number of hair salons. Examining the possible toxicities and risks associated with exposure to the chemicals found in hair coloring products is essential. Depending on their chemicals and chemical makeup, hair colors are divided into two categories: oxidative and non-oxidative. Para-phenylenediamine (PPD), a common permanent hair dye component included in more than 1000 hair color products, is one example. PPD containing hair dyes have been associated in studies to mutagenicity and cancer, with data from laboratory and clinical studies supporting this theory. This review focuses on the carcinogenic hazards and toxicities related to hair color use, including oxidative and non-oxidative hair dyes.

Keywords: Hair Dye, Types, Ingredients, Carcinogenicity and Mutagenicity

1 INTRODUCTION :

Hair is seen as a sign of a person's beauty and attractiveness. A natural or synthetic material called hair dye is used to alter a person's hair color. Because youth and beauty are valued so highly in today's society, hair coloring has grown popular among both men and women. For hair coloring, a wide variety of synthetic or natural chemical compounds are utilized. Permanent hair dyes are applied for extended periods of time; they are created by an oxidative process.

Hair dyes are currently being considered a public health concern, thus their toxicity and carcinogenicity need to be assessed. due to reports of toxicity and carcinogenicity caused by hair dye being documented around. We give a summary of hair dyes and their carcinogenicity and mutagenicity in this article.

2 CLASSIFICATION:

Systems for dyeing hair can be categorized as either oxidative or non-oxidative. Diffusion is the process by which molecules enter cuticle regions, migrate through non-keratinized areas, migrate to keratinized regions, reach microfibrils, and finally become a part of the matrix.

Non-oxidative dyes come in two varieties: semipermanent colors enter the hair cortex and remain in the hair for up to six washings, whereas temporary dyes simply interact with the cuticles of the hair. Oxidative dyes have longer-lasting color and are both demi-permanent and permanent. Their color is created through interaction with an oxidizing agent.

They are

- 1 Temporary

- 2 Semi permanent

- 3 Demi permanent

- 4 Permanent

2.1 Temporary

coloration Ammonia-unfastened dye, so don't break the quality, coloration and texture of herbal hair. Applied with out bleaching the hair and now no longer penetrate into the hair. Colour can rinse off water one shampooing due to the fact the molecular length is high. They to be had in specific paperwork like shampoo, gel, emulsion and solution. Examples: Hair chalk, Hair spray and Colouring conditioner.

2.2 Semi-everlasting dye

It does not anymore longer comprise peroxide and ammonia. Ionic interactions or Van der Waals forces. Colour simplest ultimate in hair until 6 shampoo washes. They provide a smooth and bright appearance to hair. They moisturize and enhance the hair. Cationic in nature. They comprise both Nitro phenylene diamines or Nitroaminophenes.

Examples: Clairol Natural Instincts Semi-Permanent Hair Colour, Clairol Professional Beautiful Collection, Semi-Perm Hair Colour

2.3 Demi-everlasting dyes

Does not anymore longer comprise no ammonia however carries a minor quantity of peroxide. Lasts round 24 shampoo washes. Colour is an alkaline and found in quite a few shades. Contain developer, which assist molecules to penetrate.

2.4 Permanent dye

Have ammonia to boom Ph and feature oxidizing agents, precursor agent and coupling agents. May harm cuticle and make hair hydrophilic. Para-phenylenediamine, para- toluene diamine, and para-aminophenol are fundamental components in dyes. These components react with hydrogen peroxides to free up oxygen. This response purpose penetration.

- Oxidation Permanent Hair Dye In this, hydrogen peroxides is used as the developer in permanent dyes, and the couplers are an ammonia solution containing dye intermediates and premade dyes.
- Progressive Permanent Hair Dye Progressive hair dyes are finished via the years and feature an impact at the hair coloration. In most cases, lead acetate, which complements coloration, is the energetic problem in the ones hair colour.

3 INGREDIENTS LISTS

- In a normal hair there need 3 main ingredients. They are primary intermediate, oxidant, and coupler.
- There are chemical and natural ingredients are using in current hair dyes
- For permanent hair dyes the main ingredient is Ammonia
- Following are list of some hair dye ingredients

Chemical ingredients	Natural ingredients
Para-Phenylenediamine (PPD)	Henna
. Aminophenol's	Noni
. Di amino Toluene	.Chamomile
Hydrogen Peroxide	Indigo
Ammonia	Coffee
Resorcinol	.Bixa Orellana

4.CARCINOGENICITY OF PPD

The International Agency for Research on Cancer has done various research on hair dyes and suggested that hairdressers constitute a high-risk demographic for cancer. In a meta-analysis, find that hairdressers had a higher cancer risk overall than the general population. People who use hair colour run a higher chance of developing multiple myeloma, non-Hodgkins lymphoma, and bladder cancer, prostate cancer and breast cancer. In an in vivo study, the administration of oxidized PPD to rats for a period of 18 months led to a statistically significant rise in the incidence of uterine, mammary gland, and malignant soft tissue tumours and shown that in addition to liver and kidney tumours, rats with PPD had increased rates of bladder, kidney, adrenal, thyroid, and lung cancer.

5 MUTAGENICITY OF PPD

The genotoxicity of PPD was assessed through the Ames test, micronucleus test in human lymphocytes, and mammalian cell mutation assay. The Ames Salmonella/microsome mutagenicity assay, for instance, is a bacterial reverse mutation test used to identify substances that cause genetic damage. In the case of PPD, it was found to be highly mutagenic to the Salmonella tester strain when combined with rat liver S-9 preparation. Additionally, when PPD was mixed with hydrogen peroxide alone, it produced positive results in the Ames test.

A recent study raised concerns about the impact of the solvent dimethylsulfoxide (DMSO) on the activity of PPD in the Ames test. The study suggested that while freshly prepared solutions of PPD in DMSO are not mutagenic, they may become highly mutagenic after being left at room temperature for 4 hours. Additionally, PPD has been found to cause chromosomal aberrations in hamster ovary cells.

A study was conducted to assess the genotoxic properties of PPD and its metabolites, N-monoacetyl-p-phenylenediamine (MAPPD), and N, N-diacetyl-p-phenylenediamine(DAPPD). PPD exhibited slight mutagenicity in Salmonella typhimurium strain when metabolite activation was present. The metabolites MAPPD and DAPPD showed non-mutagenic characteristics in the same strain. PPD was observed to induce micronuclei in human peripheral blood lymphocytes with or without metabolite activation, whereas MAPPD and DAPPD did not show any micronucleus induction.

6 CONCLUSION :

Hair dye formulations are typically divided into oxidative and nonoxidative categories. The safety evaluation conducted by the Cosmetic Ingredient Review (CIR) expert panel and the FDA has deemed several oxidative and nonoxidative chemicals safe for use in hair dyes. The concentration of these compounds in the hair dye plays a crucial role in ensuring safety.

While research in recent years has not provided a definitive answer regarding the link between hair dye usage and the risk of cancer development, it is important to note that maternal hair dyeing before or during pregnancy, as well as while breastfeeding, has been identified as a risk factor for leukaemia and brain tumours. Permanent hair dyes containing PPD, and their negative effects, such as allergies, mutagenicity, carcinogenicity and toxicity, have been a topic of debate for over ten years. The mutagenicity test reveals that PPD has only a slight mutagenic effect, whereas oxidized PPD exhibits strong mutagenicity. PPD increases the risk of cancer, but animal studies have shown an increased incidence of tumours. In summary, PPD poses health hazards to the human body, and it is not advisable to frequently use this chemical.

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