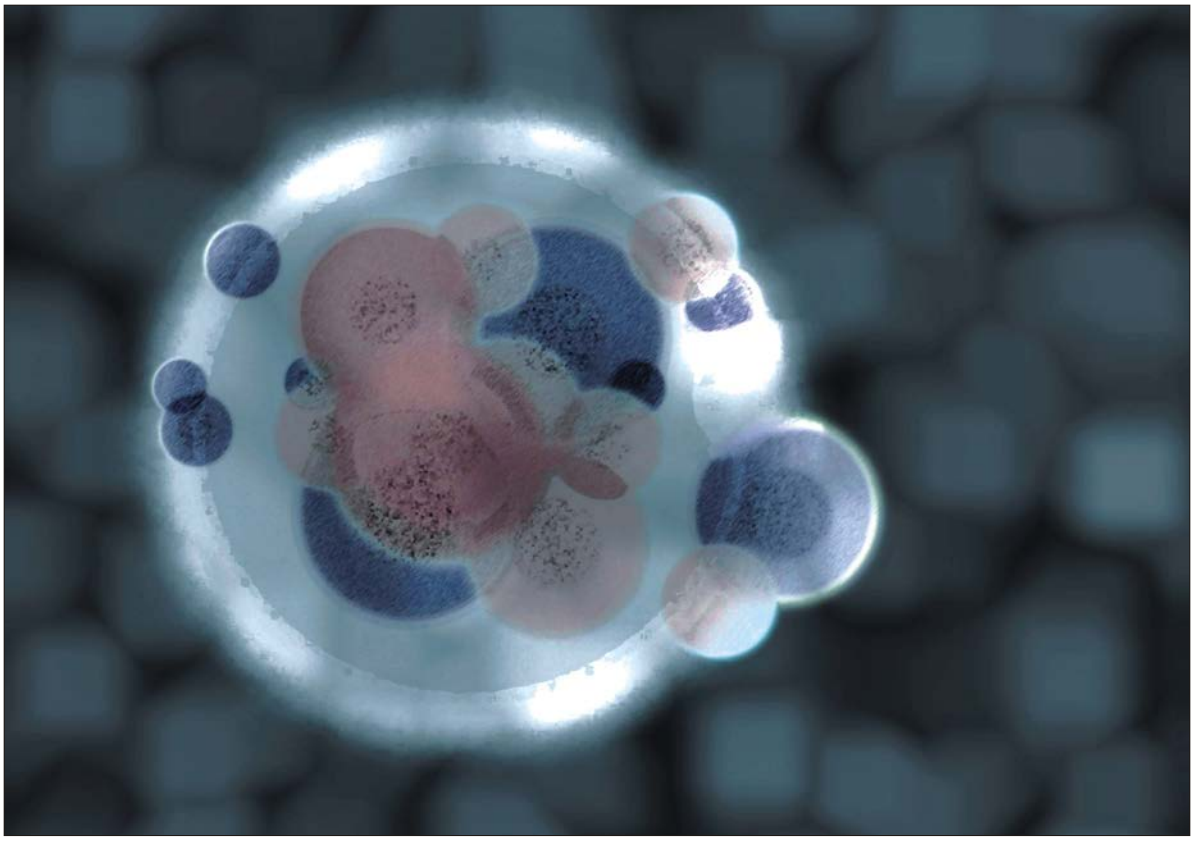

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Effect of an Oxidative Hair Dye on the Skin of Domestic Rabbits

Mohammad A.M. Wadaan and Mohammad Mubarak
Department of Zoology, College of Science, King Saud University,
P.O. Box 2455, Riyadh 11451, Saudi Arabia

Abstract: The present study aimed to elucidate the effect of an oxidative hair dye on the skin of domestic rabbits. The hair dye was applied to the hair on the back region, scalp and ears of the exposed rabbits at weekly intervals for 6 months. Skin sensitization was noticed from week 20 post-exposure. The exposed animals were dull and manifested decreased body weight. It was concluded that the oxidative hair dyes could provoke cutaneous sensitization and therefore more attention should be paid for the health hazards which might be induced by hair dyes.

Key words: Hair dyes, skin, rabbits

INTRODUCTION

Hair dyes have been used since 4000 years ago[1-3]. At the present time, millions of consumers use regularly one of the hair dyes to improve their appearance[4]. The majority of the female and steadily increasing part of the male population in the modern societies use hair colorants. Men use mostly such hair dyes to darken graying hair. If the frequency of an individual contact with hair coloring products is taken into consideration, the ingredients of those products must be safe[5,6]. The important hair dye ingredients (primary intermediates) include para-phenylenediamine (PPD), para-toluenediamine (PTD), para-aminophenol (PAP) and lawsone[7-9]. Oxidation of these substances and coupling with modifiers result in colored reaction products. Modifiers or couplers include meta-substituted aromatic derivatives such as m-phylene-diamines, m-amino phenols or resorcinol. The final shade of hair dye is determined by the reaction of couplers with the oxidized form of primary intermediates followed by further oxidative coupling reactions. Hair dyes also contain oxidants such as hydrogen peroxide, urea peroxide, sodium percarbonate or perborate. Alkalinizing agents in the hair dye involve ammonia, monoethandamine or aminomethyl propanol.

While some toxicological and epidemiological studies have indicated that hair dyes bear no or little risk to human health[10], some other studies have suspected some health hazards arising from the use of hair dyes[6]. For this reason, hair dyes represent a controversial subject among the different types of cosmetics. The present study was intended to provide an experimental evidence on the effect of a commercially available hair dye on the skin of domestic rabbits.

MATERIALS AND METHODS

Animals: Twelve adult white haired domestic rabbits (6 males and 6 females) of the same age and average weight (1050-1150 g) were used in the present study. The animals were acclimatized for two weeks and maintained separately in cages under standard experimental conditions, including temperature (25°C). Feed and water were available *ad libitum*. Additional group of age matched rabbits (n = 5) served as a control one.

Hair dye: One of the commercially available hair dyes was used. The dye consisted of two components which were mixed just before use. The two components differed in consistency, one was of pasty texture and the other was jelly-like and in color, one was whitish in color (jelly-like) and the other was of yellowish tint (pasty).

Experimentation: The two components of the hair dye were mixed in equal parts on a suitable brush, provided with the dye package and used to paint deeply and adequately the hair on the back region, scalp and ear of the exposed animals.

The process of hair coloring was carried out once a week for 6 months. At each time interval the dye was left for 15 min on the hair, then the hair was washed thoroughly by clean normal water. Control animals were

Corresponding Author: Dr. M.A.M. Wadaan, Department of Zoology, College of Science, King Saud University, P.O. Box 2455, Riyadh 11451, Saudi Arabia
Tel: 00966 1 4679517 Fax: 00966 1 4678514

not exposed to the hair dye. Body weight of exposed and non-exposed animals was recorded at the end of the experiment.

RESULTS

Hair on the back region, scalp and ear of the exposed animals was turned black after the first dying process and remained black-colored throughout the experimentation period (Fig. 1). From the week 8 post-exposure, the colored hair was apparently dried and easily detached from the skin (Fig. 2). Irregular areas of allopacia (hair loss) were noticed on the back region (Fig. 3) and scalp of the exposed animals from week 16 post-exposure (Fig. 4). Sensitization of the skin, evidenced by patchy hyperemia (Fig. 5) and excess crusts, was recognizable from week 20 post-exposure (Fig. 6). Exposed animals were comparatively dull and manifested slower response for stimuli. Feed intake of the exposed animals was obviously minimized and consequently their body weight at the end

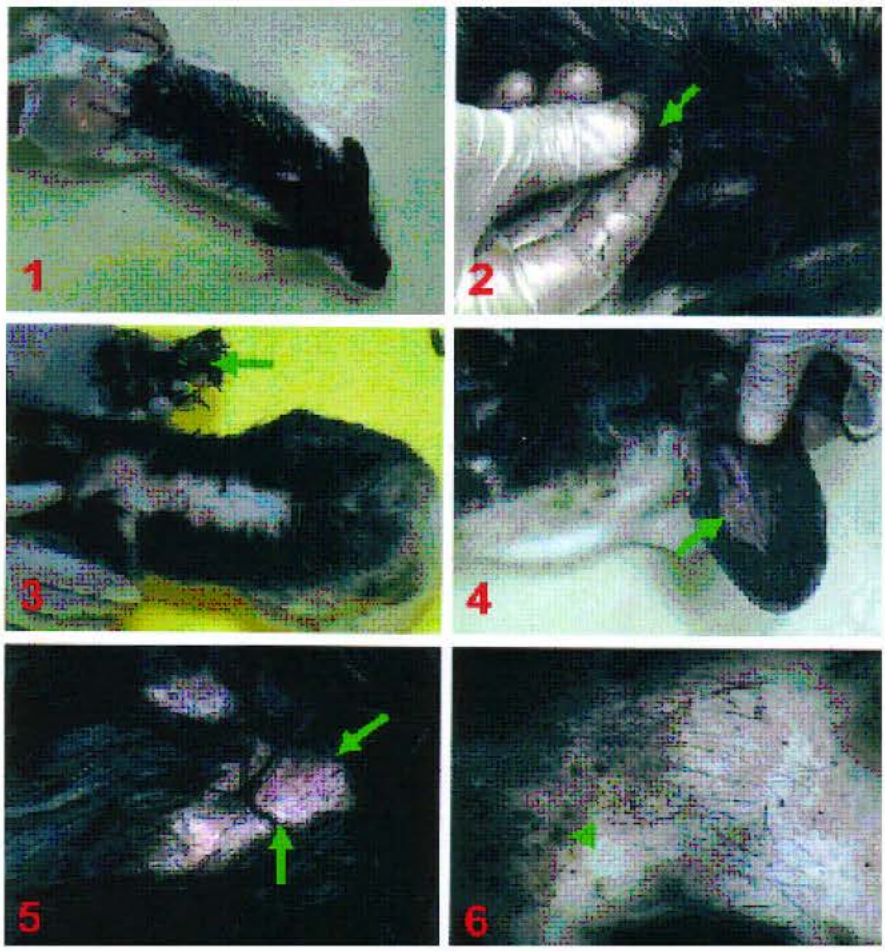

Fig. 1-6: 1: Exposed rabbit showing black colored hair on the back region, scalp and ear. The animal is relatively depressed. 12 weeks post-exposure
2: Exposed rabbit showing the easy detachment of hair (arrow) from the back region. 12 weeks post-exposure.
3: Exposed rabbit manifesting large area free from hair (arrow) which was easily detached from this area on the back region. 14 weeks post-exposure.
4: Ear of an exposed rabbit revealing area of hair detachment (arrow). 16 weeks post-exposure.
5 Exposed rabbit manifesting area of sensitization (arrows) in the skin of back region. The sensitized skin is hyperaemic (reddish in color) and allopacic (devoid from hair). 20 weeks post-exposure.
6: Area of skin sensitization on the back region of an exposed rabbit. The sensitized area reveals crusts (arrowhead) and only scattered hair shafts. 20 weeks post-exposure

of the experiment was significantly decreased (averaged 1800-1950 g) compared with controls (averaged 2850-3200 g).

DISCUSSION

The presently used hair dye is an oxidative one since it consists of two components that are mixed before use to generate the dye on the hair by chemical reactions. The content of primary intermediates, responsible for production of the color reaction, including para-phenylenediamine (PPD), para-toluenediamine (PTD) and substituted para-diamines, ortho- or para-aminophenols, in hair dyes ranges from 0.05% (light shades) to 1.5% (dark shade dyes)[11,12].

Safety of drugs is assessed by considering the risk-benefit relationship. In contrast cosmetics, including hair dyes and their constituting ingredients must not bear any risk to human health[3,13,14].

The relevant acute toxicity tests have shown that the major hair dye ingredients, such as PPD, PTD or resorcinol exert low to moderate a cute toxic effects[15-17]. Furthermore, some of these toxicity tests revealed that hair dye ingredients are non-toxic when applied topically on the skin[18]. The present experimental study extended for 6 months and the used hair dye was applied weekly to achieve a form of intensive application over a relatively short period. If the human use of hair dyes is considered, the present experimentation period is obviously short compared with the period during which an individual use hair dyes during life.

Human skin is permeable for the substances applied topically[16], this cutaneous feature may aid the absorption and penetration of applied ingredients involving those of hair dyes.

In the present hair dye-exposed animals, skin sanitization was noticed from week 20 post-exposure preceded by occurrence of allopacia which commenced at week 16 post-exposure. In this respect, contact allergy (contact sensitization) to oxidative hair dyes is largely due to the most common primary intermediate para-phenylenediamines (PPD) and its derivative (PTD) which have the potentiality to induce allergic skin manifestations[19]. Hence, the labels of commercial oxidative hair dyes bear warming that the ingredients can cause allergic reactions and adverse effects if come in contact with eyelashes or eye brows. PPD was found to be the 5th most frequent contact allergen after nickel, fragrance mix, balsam of peni and thimerosel[20]. Decreased prevalence of contact allergy to PPD can be achieved by carrying out the risk management measures including precautionary labeling and occupational safety measures such wearing protective gloves and minimizing the contact of the hair dye with the scalp during application[9,21-23].

Basing upon the present results and taking into account the widespread use and the huge number of consumers allover the world, it is recommended to pay more attention to the health hazards which could be provoked by hair dyes.

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