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## A Novel Study on Carpet-Dye-Induced Dermatitis and Other Changes in *Rattus norvegicus*

<sup>1</sup>Ashok Kumar, <sup>2</sup>V.M.S. Sriwastwa, <sup>3</sup>S. Lata and <sup>2</sup>R.K. Tiwari

<sup>1</sup>Department of Zoology, Nehru Gram Bharati University, Kotwa-Jamunipur, Dubawal, Allahabad, India

<sup>2</sup>Department of Zoology, K.N. Govt. Postgraduate College Gyanpur, S.R.N. Bhadohi, India

<sup>3</sup>Department of Zoology (MMV), Banaras Hindu University, Varanasi, India

**Abstract:** It is known that humidity enhances the growth of mites in carpets, mattresses and other household items. The association between exposure to house dust and diseases such as asthma, chronic rhinitis and atopic dermatitis has been shown in many individuals. Large quantities of carpet dyes are used in carpet industry located in Eastern Uttar Pradesh India. Nearly 90% of the carpets are manufactured in Eastern Uttar Pradesh and remaining 10% is produced in Kashmir and other places of India. Therefore, this area is important in huge dyeing and washing industry in which nearly 760 metric tons of dyes and dye supporting chemicals as well as washing chemicals are used per year. Present study has been conducted to see the adverse health effects of carpet dye black T supra which is being greatly used in carpet industry. In the present study, Gram mixed with 20 mg kg<sup>-1</sup> of b.wt. day<sup>-1</sup> sub-lethal dose of Black T Supra carpet dye was fed to *Rattus norvegicus* for three months and the symptoms of dermatitis in the form of hair fall in patches on surface of body started from fifth week onward. The area of patches of hair fall increased between 6-12th weeks. In controls, such effect was not observed. In addition, a little increase in body weight, cataract in eyes and desperate walking in experimental animals were observed after fifth week of feeding Black T Supra dye. In some cases, the correlation between exposure to carpet dye black T supra and symptoms is obvious.

**Key words:** Black T supra carpet dye, *Rattus norvegicus*, dermatitis, weight, desperate walking, cataract

### INTRODUCTION

Carpet dyes are used in large quantities in the carpet belt of Eastern Uttar Pradesh viz. Varanasi, Mirzapur, Sant Ravidas Nagar Bhadohi, Allahabad and Jaunpur district. In India, nearly 90% of the carpets are manufactured in Eastern Uttar Pradesh and remaining 10% is produced in Kashmir and other places of India. Therefore, this area is important in huge dyeing and washing industry in which nearly 760 metric tons of dyes and dye supporting chemicals as well as washing chemicals are used per year. Chromium compounds used in this industry induced chromium pollution due to carpet industry effluents which was observed by Handa *et al.* (1983) and Tripathi and Sriwastwa (1985). Its toxic effect has been observed by Srivastava *et al.* (1985) on pineal organ of *Mystus vittatus*, a fresh water fish of this area and Anderson (1960) studied chromium dye stress causing dermatitis. The chromium stress is also known to cause some unwanted problems such as ulcer, contact dermatitis (Skin infection), genetic mutation and cancer. Recently, the skin dermatitis following chromium stress (Srivastav, 2004),

ear dermatitis induced by Oxazalone (Shin *et al.*, 2005), atopic dermatitis induced by repeated topical application of 2, 4-dinitrofluorobenzene (DNFB) (Terakawa *et al.*, 2008) and potassium permanganate induced rough hair coat (Saganuwan *et al.*, 2008) on *R. norvegicus* and Swiss albino mice, were observed, respectively. This shows that the work on carpet dye induced changes is more on fish and meager on mammals. Therefore, carpet dye Black-T Supra has been selected to observe dermatitis, cataract and behavior in walking and changes in body weight to assess the toxicological effect of this dye.

### MATERIALS AND METHODS

**Model:** Fourteen mature *Rattus norvegicus* of either sex weighing 350±10 g maintained as per guideline of Institutional Ethical Committee, were taken for experiment by dividing them in two groups of 07 animals each. The animals were housed in Poly propylene cages [45 cm (length)×25 cm (width)×20 cm (height)] under standard rearing conditions at 25±2°C room temperature, 35-55 relative humidity and 12 h alternate light: dark cycle. First

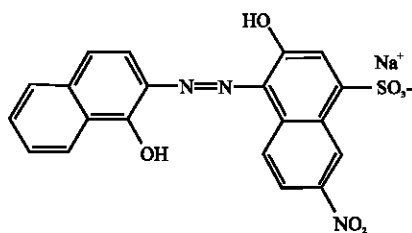


Fig. 1: Structure of Black-T Supra (Eriochrome Black-T) carpet dye

group of 07 rats including both males and females were used as control. They were fed normal gram pellets soaked in water and the second groups of seven rats were used as experimental animals. They were fed orally with gram pellets mixed with 20 mg kg<sup>-1</sup> of b.wt. per day of Black-T Supra carpet dye and tap water *ad libitum*. The observations were recorded for hair fall, dermatitis, cataract, weight and the behavioural changes for three months post experimentation.

**Experimental material carpet dye Black-T Supra (Eriochrome Black-T):** Carpet dye Black-T Supra was purchased from the site of carpet belt of Sant Ravidas Nagar Bhadohi, Uttar Pradesh region. This is synthetic azo dye used in textile, carpet, plastic and rubber dyeing industries (Fig. 1).

**Statistical analysis:** The data on weight gain/loss was analyzed using student's 't' test according to the method of Petrie and Watson (2002).

## RESULTS AND DISCUSSION

Carpet dye Black-T Supra (Fig. 1) has been extensively used in carpet belt of Sant Ravidas Nagar Bhadohi, Uttar Pradesh, India. Toxicological effects of dyes are known in different forms of changes on body of the test animals. Anderson (1960) and Srivastav (2004) observed chromium induced dermatitis in mammals. Eriochrome Black-T (Black-T Supra) is a kind of synthetic azo dye widely applied in dyeing industry. It can be decomposed into 20 carcinogenic aromatic amines which can cause changes in human body's DNA structure, pathological changes and many kinds of cancer after the activation effect (Tao, 2011). Various synthetic azo dyes induce variety of tumors in mice and rats and inhibit biosynthesis of RNA, DNA and protein (Miyadera, 1975). When dyes are orally administered, azo compounds are found to reduce mainly in liver and intestine.



Fig. 2(a-b): (a) Patches of hair fall in experimental rat and (b) No Patches of hair fall in control

There is significant effect of Black T Supra dye on b. wt. of *R. norvegicus* as variation between body weight of control and experimental *R. norvegicus* is highly significant (Table 1).

Contact dermatitis (Skin infection) was induced under stress of long-term exposure to hexavalent chromium as reported earlier. Shin *et al.* (2005) also investigated ear dermatitis in ICR female mice under Oxazalone stress. Saganuwan *et al.* (2008) found rough hair coat due to the stress of potassium permanganate in Swiss albino mice. Terakawa *et al.* (2008) examined atopic dermatitis in mice under repeated topical application of 2,4-dinitrofluorobenzene (DNFB) paint. The present study revealed that the carpet dye caused the appearance of small patches of hair fall in experimental rats from fifth week due to dermatitis which slowly increased in area and became in the form of large patches by 12th week (Fig. 2 a, b). The dermatitis in the form of hair fall under

Table 1: Effect of carpet dye Black T Supra on body weight of *R. norvegicus*

Day	Control (g)	Experimental (g)	t-test
1	450.0±1.24	483.6±1.81	18.612*
2	455.2±0.54	486.8±1.93	
3	453.5±1.37	484.3±0.23	
4	456.8±1.62	487.5±1.37	
5	458.3±1.86	488.8±1.42	
6	459.2±0.51	489.7±0.43	
7	460.0±1.25	490.8±1.25	
Mean	456.14±1.12	487.36±1.52	

\*p<0.001

stress of Black-T Supra carpet dye in the present study thus corroborates with the earlier finding. Kumar *et al.* (2011) found haemocytic anaemia under stress of Black-T Supra carpet dye which may be the reason of hair fall in experimental *R. norvegicus* causing dermatitis.

The data shown in Table 1 revealed highly significant increase in body weight of *R. norvegicus* (p<0.001) under Black-T Supra stress (456.14±1.12 control and 487.36±1.52 experimental). A similar result was also reported by Saganuwan *et al.* (2008) in Swiss albino mice under potassium permanganate stress which was non significant (p<0.05). But Al-Shinnawy (2009) found highly significant decline in body weight (p<0.01) of *Rattus norvegicus* with the high dose (75 mg kg<sup>-1</sup>) of Amaranth (red azo dye) due to hypocholesteremia. In the present experiment, it was observed that the urination is much less in experimental *R. norvegicus* than the control ones. The highly significant increase in body weight of treated rats may be due to retention of water and accumulation of food which may be due to catabolism and not by cholesteremia.

Further, Srivastav (2004) reported development of cataract in the eyes of *R. norvegicus* under chromium stress and the same was found in the same species under Black-T Supra stress after fifth week of experimentation. The development of cataract may be due to haemocytic anaemia and accumulation of carpet dye through blood into the eye ball (Kumar *et al.*, 2011). This may be due to inhibition of biosynthesis of RNA, DNA and protein.

In addition to, development of cataract, a desperate walking was also observed after fourth and fifth week respectively. Srivastav (2004) and Saganuwan *et al.* (2008) found imbalance in walking and dullness under chromium and potassium permanganate stress in *R. norvegicus* and Swiss albino mice. The cataract and desperate walking in the present study under Black-T Supra carpet dye stress may be due to blindness and muscular weakness respectively. The imbalance in walking may also be due to inhibition of required biosynthesis of protein in muscles. Thus, the stress of Black-T Supra in *R. norvegicus* causes dermatitis, cataract, increase in weight and desperate walking which indicate its toxic effect.

## CONCLUSION

Impact of carpet dye black T supra which is greatly used in carpet industry on *Rattus norvegicus* has been studied. Gram mixed with sub-lethal dose of Black T Supra carpet dye was fed to *Rattus norvegicus* for three months and the symptoms of dermatitis in the form of hair fall in patches on surface of body started from fifth week onward. The area of patches of hair fall increased between 6th to 12th weeks. In controls, such effect was not observed. In addition, a little increase in body weight, cataract in eyes and desperate walking in experimental animals were observed after fifth week of feeding Black T Supra dye.

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