



## Detection of formaldehyde in textiles by chromotropic acid method

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### ABSTRACT

**Background:** The common causes of textile dermatitis are formaldehyde resins and disperse dyes. There are various methods to detect the presence of formaldehyde in clothing. **Aim:** To detect the presence of formaldehyde in various types of textiles by the chromotropic acid method and to assess the effect of washing on the formaldehyde content. **Methods:** Twenty randomly selected textiles from a local cloth store were tested for formaldehyde by the chromotropic acid method. A purple ring indicated a positive reaction. The intensity of the purple ring was graded from 1+ to 3+ and reassessed after washing the clothes. **Results:** Eleven out of the 20 textiles tested positive for formaldehyde. The fully synthetic clothes were free from formaldehyde. After the first and second washes the majority did not show a reduction in the formaldehyde content. **Conclusions:** This is a simple and rapid test which can be used in the practical management of patients with textile allergy. Washing the clothes may not have an effect on the formaldehyde content.

**KEY WORDS:** Formaldehyde, Chromotropic acid, Textiles, Contact dermatitis.

### INTRODUCTION

Textile dermatitis, although not uncommon, is frequently misdiagnosed. The most frequent causes of textile dermatitis are disperse-dyes and formaldehyde resins. Formaldehyde resins are called as durable resins or permanent resins and have been used on fabrics since 1920s to impart wrinkle resistance to 100% cotton and to cotton/polyester blend fabrics.<sup>1</sup> Contact allergy to clothing containing formaldehyde is a matter of a concern. The chromotropic acid method is a simple method to detect formaldehyde in textiles.<sup>2</sup> This study was performed to detect the presence of formaldehyde in textiles by the chromotropic acid method and to assess the effect of washing on the formaldehyde content.

### METHODS

Twenty commonly used textile samples were randomly selected from a local cloth store and were tested for the presence of formaldehyde by the chromotropic acid method. The randomly selected textile samples were as follows:

1. Pure voile
2. 2x2 100% cotton
3. Spun (S)
4. 100% polyester (S)
5. Poplin 100% cotton
6. Cambrick 100% cotton
7. Raymond's tere wool (S)
8. Tere cotton
9. Polyester cotton mix

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10. Pearl silk (S)
11. Cotton voile
12. Artificial silk crepe saree (S)
13. Polyester cotton
14. Naar madi (S)
15. Hand loom cotton
16. Chiffon cotton (S)
17. Silicon chiffon (S)
18. Pure silk Banaras
19. Pure silk satin finish
20. Organdy

S = Fully synthetic clothes

Each cloth sample was cut into 1 square cm piece and boiled in 5 ml of distilled water in a test tube (1st test tube). A few crystals of chromotropic acid were added to 2 ml of 72% concentrated sulfuric acid in another test tube (2nd test tube). The cooled supernatant of the 1st test tube was added to the 2nd test tube and the mixture was heated over a flame. A red purple to violet color indicated a positive test (i.e. the presence of formaldehyde in textiles), while its absence indicated that the cloth sample did not contain formaldehyde. The intensity of red purple to violet color was graded as 1+, 2+, or 3+ (Figure 1). Clothes which showed the presence of formaldehyde were reassessed after washing. The textile samples were rinsed with detergent and water for 5 minutes and then washed with soap. After drying they were reassessed for formaldehyde. The intensity of red purple to violet color was noted after each wash. A decrease in the intensity



Figure 1: Red purple to violet color indicating presence of formaldehyde

of red purple to violet color indicated a decrease in the formaldehyde content after washing.

**RESULTS**

Of the 20 textile samples, 11 tested positive for formaldehyde (Table 1). These 11 clothes were reassessed after the first and second washes for the formaldehyde content.

Polyester cotton and organdy showed reduced formaldehyde content after washing. The other textiles showed no reduction in the intensity of the red purple to violet color after the first and second washes.

We found that most of the fully synthetic clothes (8) were free from formaldehyde and most of the cotton textiles contained formaldehyde. None of the textiles other than polyester cotton and organdy showed a reduction in formaldehyde after washing.

**DISCUSSION**

Textile dermatitis is clinically characterized by eczematous lesions at the sites of intimate contact with clothing. It is commonly seen over the trunk and thighs. Involvement of the axillary fold sparing the vault is a valuable clinical sign. In its early stage, textile dermatitis appears as a pruritic erythematous papulovesicular eruption which subsequently becomes chronic and lichenified if not diagnosed and treated.<sup>3</sup>

The common causes of textile dermatitis include dyes and resins. The resins may be either urea-formaldehyde or melamine formaldehyde and cyclized urea derivatives.<sup>2</sup> The main function of formaldehyde resins

Table 1: Textiles containing formaldehyde

Textile	Unwashed	First wash	Second wash
Pure voile	3+	3+	3+
2x2 100% cotton	1+	1+	1+
Poplin 100% cotton	2+	2+	2+
Cambrick 100% cotton	3+	3+	3+
Polyester cotton mix	1+	1+	1+
Cotton voile	3+	3+	3+
Polyester cotton	2+	1+	1+
Handloom cotton	1+	1+	1+
Pure silk Banaras	2+	2+	2+
Pure silk	2+	2+	2+
Organdy	3+	2+	2+



is to impart wrinkle resistance during wear and laundering to 100% cotton and more typically to cotton/polyester blends of fabrics.<sup>1</sup> The quality of wrinkle resistance results from the formation of covalent cross-links between formaldehyde resins and cellulose fibers in fabrics. There are two possible theories as to how formaldehyde sensitivity can result in contact allergy to permanent press clothing.<sup>4</sup> Formaldehyde release occurs either when there is incomplete cross linking of some resin, which allows degradation of the resin by chlorine bleach with release of formaldehyde, or by hydrolysis under warm moist conditions. The two most common methods for measuring formaldehyde in fabrics are the chromotropic acid method and the Schiff reagent method both of which generate formaldehyde from heated fabric samples, the former being more specific.<sup>2</sup> Other tests are clinitest reagent tablet test, Merck method and Japanese law 112 (i.e. acetyl acetone method).<sup>5</sup>

In this study, all the synthetic clothes were free from formaldehyde. In cases of unexplained dermatitis over the trunk, patients are generally advised to wear only cotton clothes and avoid fully synthetic ones. Although synthetic clothes do not absorb sweat and are uncomfortable in summer, our study has proven that they are free from formaldehyde and safe in formaldehyde allergic individuals. Patients who are

allergic to formaldehyde should avoid wrinkle resistant clothing and blended fabrics (polyester/cotton). It is generally recommended that these clothes should be washed before wearing to reduce the level of free formaldehyde.<sup>4</sup> But in our study the majority of the textiles did not show a reduction in their formaldehyde content despite two washes, implying that wearing washed clothes may not be entirely safe.

In conclusion, the chromotropic acid test is a simple office method for detection of formaldehyde in textiles and can be used in the practical management of patients with suspected textile dermatitis.

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