

# The Detection of Formaldehyde in Woven and Non-Woven Fabrics Found in Discount Markets and Online Shopping

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## Abstract

This research study fabrics to ensure that they are free from carcinogenic dyes. It has been observed that there are poor-quality fabrics and consumers go to buy them without paying attention to the risks of using prohibited materials in the manufacture of these fabrics, and the use of unknown dyes has proven that some of them cause diseases to humans, especially children, that cause cancerous diseases. With the study sample consisting of (7), the study results indicate the presence of toxic formaldehyde in all sample dyes obtained from discount markets and online shopping.

## Keywords

Fabrics, Harmful Dyes, Formaldehyde, Individual Health, Poor-Quality Fabrics

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## 1. Introduction

Many laboratory tests that allow for the detection of various hazardous compounds must be carried out in order to evaluate the safety of textile products. They need expensive equipment and specific sample preparation. For instance, absorbance measurements of water extracts of materials in the presence of Nash's reagent—which forms a color complex with free formaldehyde—are used to calorimetrically assess the formaldehyde level of the materials. A diode array detector (DAD) is used in liquid chromatography to detect amines and azo dyes. Atomic absorption spectrometry (AAS) is required for the detection of heavy metals, whereas gas chromatography can measure and quantify pesticides and pentachlorophenol by detection utilizing an electron capture detector (ECD) [1].

These techniques are undoubtedly highly accurate, but they are insufficient to tell us about the potentially detrimental effects of the chemicals under analysis on humans or about undiscovered substances that might be present in textiles. Only toxicological techniques might provide such information, which would make it easier to estimate the presence of dangerous materials in products while also demonstrating the actual risk [2] [3] associated with removing these materials from fabrics. In contrast to common analytical methods, which are unable to distinguish between fractions of substances that are available or non-available to biological systems, toxicological assays have the advantage of being able to react or detect only the available fraction of potentially hazardous substances, including their synergic effect.

Clothing is seen to be the first clue to a nation's personality and culture, acting as an early predictor of cultural and socioeconomic traits. Clothing plays a crucial role in people's lives and can influence their personalities, activities, and interactions with others. This is due to the fact that clothing is seen before a country's language, culture, or civilization is comprehended [4].

One of the compounds that poses the greatest risk to human health is formaldehyde, particularly at higher concentrations. Numerous laboratory animal trials that proved it causes cancer have been seized. We have to avoid wearing some fabrics that leak their dye when they perspire or come into contact with human flesh since it finds its way into numerous textile products. Its manufacture is often subpar, and we discover that it appears as soon as it comes out during washing [5].

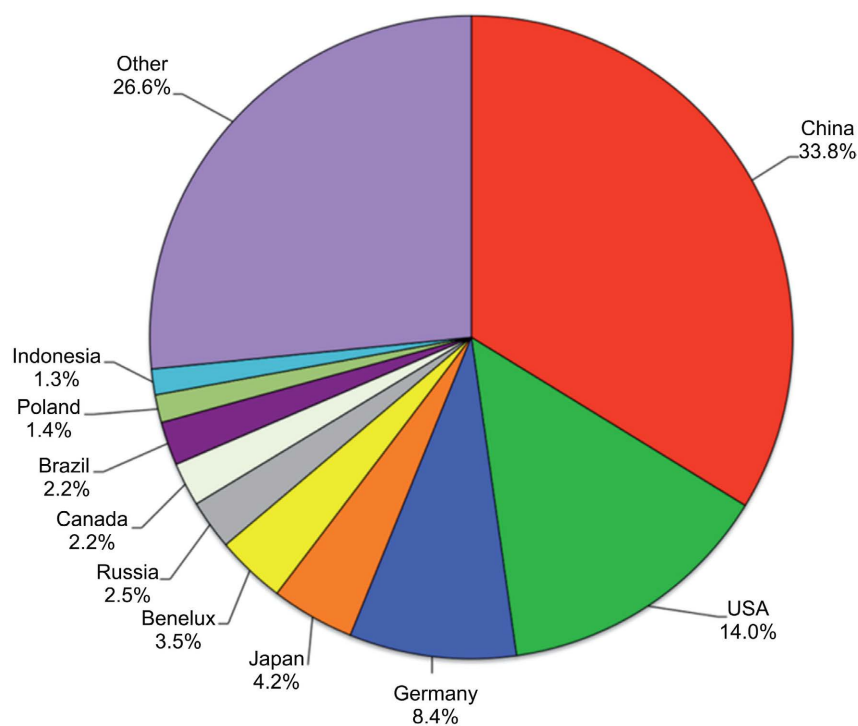
Certain clothing products have high concentrations of dyes and carcinogenic compounds that can excite cells in fabric tissues at a pace higher than is considered safe, thereby hastening the start of disease. In particular, formaldehyde, which is frequently used in garment colors, is known to be hazardous and carcinogenic in excess of recommended limits [6]. The selection of formaldehyde as a sample test material stems from its widespread use and established toxicity to humans and other living things [7]. This compound has been used for many years in the textile industry as a component of methylated or propylene urea-formaldehyde resins. For example, it can be used as a cross-linking agent in resist dyeing processes, which improve dye resistance, or as an fixing agent in resist dyeing processes, which create crease-proof woven fabrics from cellulose fibers [8] [9].

Studies have shown that this chemical poses a risk to both people and animals. For instance, the LD50 of formaldehyde for rabbit skin was determined to be 270 mg/kg of body mass, whereas the LD50 for rat oral was 100 mg/kg of body mass. Formaldehyde is thought to be carcinogenic, even though epidemiological examinations of its carcinogenic potential in people have produced no conclusive results. It was categorized as a carcinogenic chemical under Class 3. Given that this material can be released during the fixation process as well as during the usage of a finished product, it is believed to have even more detrimental consequences. Depending on the concentration, this may irritate the upper respiratory tract's mucous membranes and conjunctiva (this occurs more frequently in finishing rooms

due to gaseous formaldehyde release) and cause skin allergies (during long-term use of formaldehyde-containing clothing, which may be extracted from textiles by sweat) [10]. Formaldehyde's use has long been scrutinized due to its known toxicity, which has resulted in zero formaldehyde finishes. But typically, achieving such outcomes is more costly or results in lower performance [11]. For this reason, formaldehyde is still widely utilized in the textile sector. The goal of the compulsory [12], and facultative (Eco label, GPP, OEKO-TEX) regulations defining the limits for allowable quantities of this component in products is to decrease the application of formaldehyde in the textile sector and ensure the safe use of products. But upon closer inspection, several questions regarding the underlying assumptions that underpin these requirements and hence, the boundaries themselves—come to light. Furthermore, based on data from reports released by the RAPEX Monitoring System for Dangerous Products [13], With the trade inspection, one of the issues that arises increasingly frequently with the safety assurance of textile items sold on Polish and other EU markets is the exceeding of the allowable formaldehyde content. This is especially true for children's clothing, where the maximum formaldehyde content permitted under current rules [12], should not be more than 20 mg/kg of the item.

The range of free and hydrolysed formaldehyde on the fabric is between 16 mg/kg and 3500 mg/kg. The lower limit is 16 mg/kg Below this limit [14].

The total global output for formaldehyde was 31,940 kt in 2006. China alone contributed nearly 34% of Benelux including Belgium. The Netherlands, and Luxemburg, as shown in **Figure 1** [5].



**Figure 1.** Countries contributing to the output of formaldehyde worldwide.

## 2. Materials and Methods

Experimental work focuses on measuring the presence of formaldehyde in samples taken from discount markets and online.

### 2.1. Sampling and Number of Test Specimens

The researcher purchased study samples, with 2 samples from discount markets and 5 samples from online shopping, as shown in **Table 1**.

**Table 1.** Specifications of samples.

Sample number	Material fibers	Country of manufacture	Source	Price
1	100% Cotton	Bangladesh	Discount Markets	23 SAR
2	95% Cotton & 5% Melling	Bangladesh	Discount Markets	10 SAR
3	100% Cotton	Pakistan	Online shopping	18 SAR
4	100% Cotton	China	Online shopping	20 SAR
5	100% Cotton	China	Online shopping	23 SAR
6	100% Polyester	China	Online shopping	11 SAR
7	100% Polyester	China	Online shopping	23 SAR

### 2.2. Procedure of the Method

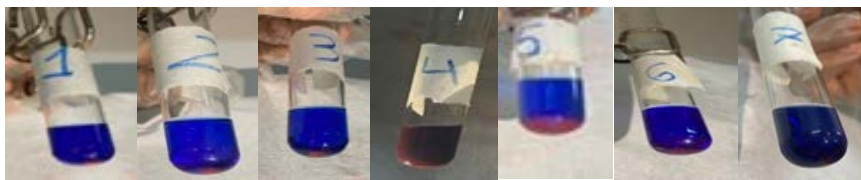
Three tests available for laboratory were used to detect the presence of toxic and carcinogenic formaldehyde, which are Fehling's Solution Test, Silver Mirror Test and Ultraviolet Ring Test, as shown in **Table 2**.

**Table 2.** Tests.

Test	Test Procedure	Test Result
Fehling's Solution Test	1 mL of the study sample solution + 1 mL of Fehling's solution A + 1 mL of Fehling's solution B are placed together. Then, they are heated for 3 minutes in a water bath.	Red precipitate ( <b>Figure 2</b> )
Silver Mirror Test (Tollens' Test for Silver Nitrate)	1 mL of the study sample solution + 3 mL of silver nitrate (Tollens' reagent) are mixed, then heated for 3 minutes in a water bath.	Silver mirror on the inner wall of the test tube ( <b>Figure 3</b> )
Ultraviolet Ring Test	1 mL of the study sample solution + 1 mL of concentrated sulfuric acid is added gradually to the inner wall of the tube + drops of resorcinol.	Purple ring ( <b>Figure 4</b> )

## 3. Results and Discussion

As evident from the results of the Fehling's solution test for the study samples, as shown in **Figure 2**, the sample with the highest formaldehyde content is Sample No. 4, where the red precipitate indicating a significant presence of formaldehyde was observed compared to the other samples.



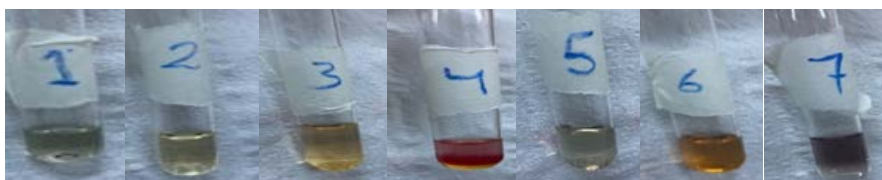
**Figure 2.** The samples after Fehling's Solution Test.

It is also evident from the results of the Silver Mirror Test (Tollens' Test for Silver Nitrate), for the study samples, as shown in **Figure 3**, that the sample with the highest percentage of formaldehyde is Sample No. 4, where the image of the silver Mirror appeared clearly, indicating the presence of a significant amount of formaldehyde compared to the other samples.



**Figure 3.** The samples after Silver Mirror Test (Tollens' Test for Silver Nitrate).

It is also evident from the results of the Ultraviolet Ring Test for the study samples, as shown in **Figure 4**, that the sample with the highest percentage of formaldehyde is Sample No. 4, where the image of the silver woman appeared clearly, indicating the presence of a significant amount of formaldehyde compared to the other samples.



**Figure 4.** The samples after Ultraviolet Ring Test.

#### 4. Conclusions

This study underscores the urgent need for stricter regulatory oversight on textile imports to prevent the distribution of fabrics containing hazardous chemicals like formaldehyde, particularly in products marketed for children, and to present important preventive methods against dye-related diseases. The research follows experimental analytical methodologies. In the experimental method, the study tool relied on observation and observation in practical experiments, with the study sample consisting of (7) samples of fabrics with harmful dye. In the descriptive method.

Across all tests (Fehling's solution, Silver Mirror, and Ultraviolet Ring), Sample No. 4 consistently showed the highest concentration of formaldehyde, as indicated by distinct color reactions, indicating the presence of toxic formaldehyde in all

sample dyes obtained from discount markets and online shopping.

The main purpose of this paper is to discover the presence of toxic formaldehyde in clothing, whether it exists in poor-quality clothes or not, and not to compare poor-quality clothes with those of trusted brands. This is because many people tend to buy clothes with excessive discounts without being aware of their risks.

### Author Contributions

The author conceived the work, prepared the samples and performed the experiments, conducted the sequence alignment and drafted the manuscript. The author read and approved the final manuscript.

### Author's Information

Sanaa M. Enany is assistant professor at University College of Samtah Governorate Previously, Jazan University, Jazan, Kingdom of Saudi Arabia.

### Availability of Data and Materials

The data sets used and analyzed during the current study are available from the author upon reasonable request.

### Acknowledgements

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### Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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