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The Printability of Wool Fabric with Synthetic Food Dyes

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Abstract:

Dyes used for textile dyeing and printing have many different, complex chemical structures and are produced using risky chemical methods from petrochemical sources, endangering both human health and the environment. Today, most synthetic food dyes are also derived from petroleum, but they are edible and less toxic than those used to dye textiles. The current study is an attempt to reduce the risks on human health and the environment that resulting from the usage of synthetic textile dyes via evaluating printability of wool fabric with three synthetic food dyes. The chosen colors are Brilliant Blue FCF (blue dye), Ponceau 4R (red dye), and Tartrazine (yellow dye). The effect of different factors on the color strength of the printed samples was studied, i.e. concentrations of acid donor, urea, solvent, and dyes. The impact of steaming time and temperature on dye fixation was investigated. Light, rubbing, washing fastness and ultraviolet protection factor "UPF" values of the printed woolen samples were evaluated. The printed samples gave high values of UPF and color fastness properties were ranging between moderate to excellent. Dyes are a class of food additives have no nutrition value but are added to foods with the objective of providing color to make the product more appealing and recognizable, so increasing its consumer acceptability. In ancient times, colorants were obtained from natural sources, but nowadays food colors are obtained from natural or synthetic ones. All synthetic dyes that are currently used in food have gone through testing for toxicity in animal studies and there is quite a bit of controversy regarding the safety of these dyes. Interestingly, some food dyes are deemed safe in one country, but banned from human consumption in another, making it extremely confusing to assess their safety. Synthetic food dyes are technically known as artificial food colors. To make them more identifiable, they have both a common name and an official number that may differs from country to another. Color is the main attraction of any fabric. Synthetic dyes used for textile dyeing and printing have many different, complex chemical structures and are synthesized from petrochemical sources through hazardous chemical processes pose threat to the environment and human health. Use of these dyes has an adverse effect on all forms of life. Their toxic nature has become a cause of critical concern to environmentalists. The present work is a trial to investigate the printability of wool fabric with three low-toxic artificial food dyes to minimize the health and environmental hazards associated with the use of synthetic textile dyes. Ultraviolet protection factor (UPF) values and color fastness to washing, rubbing, and light of the printed wool samples were assessed.

Methodology: Wool samples were printed with the three dyes via flat silk screen technique. Different concentrations of ammonium sulphate (0, 10, 20, 30, 40 and 50 g/kg) were added to the printing paste, as well as different concentrations of urea (0, 10, 30, 50, 70, 90 and 110 g/kg) and glycerin (0, 10, 30, 50, 70and 90 g/kg). After printing, the samples were dried at ambient conditions prior to steam fixation. Fixation step was done at different steaming temperatures (105, 110, 115,120, 125 and 130 ºC) for different intervals of time (10, 20, 30, 40 and 50 minutes). Effect of dyes concentration on the color strength of printed wool samples at the optimum conditions of printing was evaluated. After fixation, the substrates were rinsed with cold water, washed with 2 g/l non-ionic detergent at 65 ºC for 20 minutes, rinsed with hot water followed by rinsing with cold water, and finally dried at ambient conditions. Light, rubbing, washing fastness and ultraviolet protection factor "UPF" values of the printed woolen samples were evaluated.

Results: Ammonium sulphate concentration of 30 g/kg gave the best results for prints with blue and red dyes and 40 g/kg gave the best for the yellow dye. Urea concentration of 70 g/kg gave the best results for prints with red and yellow dyes and 110 g/kg gave the best for blue. It is observed that the optimum concentration for glycerin is 30 g/kg for yellow and red dyes and 70 g/kg for the blue . The optimum chosen steaming condition is at 120 ºC for 30 minutes. Color strength K/S of wool samples increases upon increasing the dye concentration in the range studied. All the prints achieved excellent protection category with UPF rating of 50+. Wash fastness ranged between average and excellent. Rubbing fastness ranged from good to excellent.

Conclusion: The present study confirms the possibility of printing wool fiber with three different food dyes. The printed samples acquire good overall color fastness properties and excellent protection category with UPF rating of 50+.

Keywords:

Textile printing, wool, food dyes

References:

1- A. I. Fathallah. “An easy all-in printing process for printing acrylic/ wool blended fabrics with reactive dyes”, International Design Journal, 4 (1), 25-34, 2010.
2- B. Tutunaru, C. Tigae, C. Spînu & I. Prunaru. “Spectrophotometry and Electrochemistry of Brilliant Blue FCF in Aqueous Solution of NaX”, Int. J. Electrochem. Sci., 12, 396 – 412, 2017.
3- C. Novais, A. K. Molina, C. Santo-Buelga, I. C. F. R. Ferreira, C. Pereira & L. Barros. “Natural Food Colorants and Preservatives: A Review”, a Demand, and a Challenge, J. Agric. Food Chem, 70, 9, 2789–2805, 2022.
4- D. M. Lewis. “Wool dyeing”, Society of Dyers and Colourists, England, 1992. (first edition)
5- D. Sharma. “Understanding Biocolor- A Review”, Int. J. Sci. Technol. Res. 3(1), 294-299, 2014.
6- F. A. Nagia & R. S. R. El-Mohamedy. “Dyeing of wool with natural anthraquinone dyes from Fusarium Oxysporum”,

Dyes and Pigments, 75 (3), 550-555, 2007.
7- https://apps.who.int/food-additives-contaminants-jecfa-database/Home/Chemical/4941
8- https://efsa.onlinelibrary.wiley.com/doi/10.2903/j.efsa.2015.4073
9- https://en.wikipedia.org/wiki/Brilliant_Blue_FCF
10- https://en.wikipedia.org/wiki/Food_coloring#:~:text=In%20the%20United%20States%2C%20FD%26C,do%20not%20exist%20in%20nature
11- https://en.wikipedia.org/wiki/Ponceau_4R
12- https://en.wikipedia.org/wiki/Tartrazine
13- https://iacmcolor.org/color-profile/tartrazine-fdc-yellow-no-5/
14- https://www.3dchem.com/ponceau4r.asp
15- https://www.healthline.com/nutrition/food-dyes#section2
16- K. Gomes, M. Oliveira, F. Carvalho, C. Menezes & A. Peron. "Citotoxicity of food dyes Sunset Yellow (E-110), Bordeaux Red (E-123), and Tatrazine Yellow (E-102) on Allium cepa L. root meristematic cells", Food Sci. Technol., 33(1), 218-223, 2013.
17- K. Haggag, A. Zaher, W. El-Sayed & M. Khodary. "Time/energy saving: microwave fixation of ecofriendly dye to textile", Lap Lambert Academic Publishing, Germany, 2013.
18- L. E. Arnold, N Lofthouse, & E. Hurt. "Artificial food colors and attention deficit/hyperactivity symptoms: conclusions to dye for", Neurotherapeutics, 9(3), 599-609, 2012.
19- M. A. G. Rubio, S. H. García, F. G. Carmona, F. G. Herrero, "Consumption of commonly used artificial food dyes increases activity and oxidative stress in the animal model Caenorhabditis elegans", Food Research International, Volume 169, 112925, 2023.
20- M. M. Silva, F. H. Reboredo & F. C. Lidon. "Food Colour Additives: A Synoptical Overview on Their Chemical Properties, Applications in Food Products, and Health Side Effects", Foods, 11(3), 379, 2022.
21- M. N. Micheal, F. M. Tera & S. A. Aboelanwar. "Colour measurements and colourant estimation of natural red dyes on natural fabrics using different mordants", Colourage, 50 (1), 31-42, 2003.
22- M. Tiron, I. Lucaciu, M. Nita-Lazar & G. Stefania. "Considerations on the Toxicity of Brilliant Blue FCF Aqueous Solutions before and after Ozonation", Revista de Chimie, 71 (4), 356-365, 2020.
23- M. Zahedi, A. Shakerian, E. Rahimi & R. S. Chaleshtori. "Determination of Synthetic Dyes in Various Food Samples of Iran's Market and their Risk Assessment of Daily Intake", Egyptian Journal of Veterinary Sciences, 51(1), 23-33, 2020.
24- N. Zahra, Al. un-Nisa, Z. Fatima, I. Kalim & K.Saeed. "Identification of synthetic food dyes in beverages by thin layer chromatography", PAK. J. FOOD SCI., 25(4), 178-181, 2015.
25- O.I. Lipskikh, E.I. Korotkova, Ye.P. Khristunova, J. Barek & B. Kratochvil. "Sensors for voltammetric determination of food azo dyes - A critical review", 260, 974-985, 2018.
26- O.K. Alebeid, & Z. Tao. "Review on: developing UV protection for cotton fabric", The Journal of The Textile Institute, 108 (12), 2027-2039, 2017.
27- O.K. Alebeid, Z. Tao & A. I. Seedahmed. "New approach for dyeing and UV protection properties of cotton fabric using natural dye extracted from Henna leaves", Fibres & Textiles in Eastern Europe, 23, 5(113), 60-65, 2015.
28- P. Barciela, A. Perez-Vazquez, M.A. Prieto. "Azo dyes in the food industry: Features, classification, toxicity, alternatives, and regulation", Food and Chemical Toxicology, 178, 113935, 2023.
29- S. S. A. Soltan & M. M. E. M. Shehata. "The Effects of using color foods of children on immunity properties and liver, kidney on Rats", Food and Nutrition Sciences, 3 (7), 897-904, 2012.
30- W. H. Li, D. Hao, C. Pei, Z. J. Bo, W. Di, and T. Jing. "Theoretical Risk Assessment of Dietary Exposure to Brilliant Blue FCF in Chinese Population", Biomed Environ Sci, 32 (2), 126-129, 2019.

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