



OPTIMIZATION OF DYEING PARAMETERS TO DYE COTTON WITH CARROT EXTRACTION

MIRALLES Verónica, BOU-BELDA Eva, BONET-ARACIL Marilés, DÍAZ-GARCÍA
Pablo, MONTAVA Ignacio

Universitat Politècnica de Valencia, Textile and Paper Department, Ferrándiz y Carbonell s/n, 03801, Alcoy, Spain.

Corresponding author: Bou-Belda. Eva E-mail: evbobel@upv.es

Abstract: *Natural dyes derived from flora and fauna are believed to be safe because of non-toxic, non-carcinogenic and biodegradable nature. Furthermore, natural dyes do not cause pollution and waste water problems. Natural dyes as well as synthetic dyes need the optimum parameters to get a good dyeing. On some occasions, It is necessary the use of mordants to increase the affinity between cellulose fiber and natural dye, but there are other conditions to optimize in the dyeing process, like time, temperature, auxiliary products, etc. In addition, the optimum conditions are different depends on the type of dye and the fiber nature. The aim of this work is the use of carrot extract to dye cotton fabric by exhaustion at diverse dyeing conditions. Different dyeing processes were carried out to study the effect of pH condition and the temperature, using 7, 6 and 4 pH values and 95 °C and 130°C for an hour. As a result some images of dyed samples are shown. Moreover, to evaluate the colour of each sample CIELAB parameters are analysed obtained by reflexion spectrophotometre. The results showed that the temperature used has an important influence on the colour of the dyed sample.*

Key words: *Natural dyes, pH, temperature, carrot, cotton*

1. INTRODUCTION

In the last century, the development of synthetic dyes reduced the use of natural dyes [1], [3] due to their cheap price and the fact that these dyes are generally easy to dye and have good fastness properties. But there are drawbacks about synthetic dyes, mainly toxicity and environmental pollution caused by the wastewater expelled from dye-houses [4].

Recently, the use of natural dyes has risen mainly due to the increased demand for these dyes by the food, pharmaceutical, cosmetic and the textile colouration industry [5]. They are considered to have several advantages such as non-toxic functions, biodegradability, eco-friendliness and the safety of most of the natural dyes, which can even have curative effects, like curcumin which has antibacterial properties [6], [7].

Some research has been done to study the influence of the conditions used during the dyeing process using natural dyes.

In this work, the effect of the pH used in the dyed bath and the temperature reached during the dyeing process were studied, using carrot extract as the dye material for cotton fabric. To evaluate the differences obtained, samples were analyzed by reflection spectrophotometer.

2. EXPERIMENTAL

2.1 Materials

The fabric used was a 100% cotton twill fabric with 210 g/m², which had been chemically bleached through an industrial process. A commercial dye of carrot extraction was used as natural dye, supplied by Irisem. Acetic acid and sodium hydroxide were used to get different pH of the dye bath, 7, 6 and 4.

2.2 Methods

Dyeing experiments were performed using M:L (material to liquor) ratio of 1:40 and 5% owf dye concentration. To study the influence of the dye bath temperature two different exhaustion dyeing systems were used, opened system to use 90 – 95 °C and closed system to avoid the bath evaporation reaching 130°C. In both cases, dye processes were carried out for 1 hour. In table 1 the different conditions followed in each sample are shown:

Table 1: Dyeing conditions

Reference sample	pH	Temperature (°C)
Carrot-7-95	7	95
Carrot-6-95	6	
Carrot-4-95	4	
Carrot-7-130	7	130
Carrot-6-130	6	
Carrot-4-130	4	

Dyed samples were prepared for colour measurement, which was carried out by following a standard procedure. Colour values were evaluated in terms of CIELAB values (L*, a*, b*, c*, h).

3. RESULTS

To compare the effect of using different pH in the dye bath and temperature in the dyeing process of cotton with carrot dye, images of dyed samples are shown in figure 1.

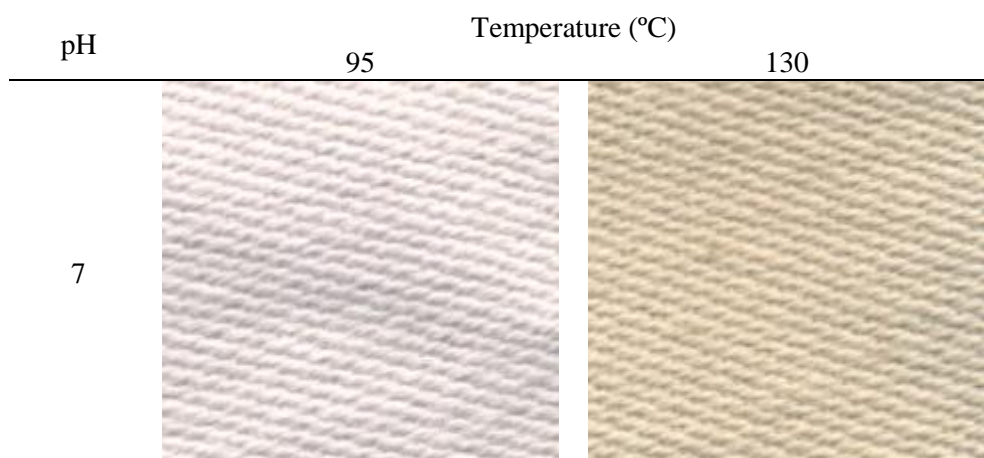




Fig. 1: Dyed samples images

Dyed samples using lower or higher temperatures show different colours, seeing that dyed samples at 95°C are pinker, however if the dye process is performed at 130°C, then colour samples are yellower. Moreover, there are some differences about the colour intensity of dyed samples using different pH in the process. To verify this fact, the spectofotometer results are analyzed.

Table 2 shows the effects of pH and temperature used on the characteristics values of colour, CIELab and CIELch, of cotton fabrics dyed with carrot dye.

Table 2: *Dyeing conditions*

	L*	a*	b*	C*	h
Undyed sample	90,4663	-0,296	1,6882	1,714	99,9454
Carrot-7-95	87,8897	0,4255	4,8189	4,8377	84,9539
Carrot-6-95	79,1773	8,5203	-0,5646	8,539	356,209
Carrot-4-95	79,2859	10,0819	-1,7894	10,2394	349,9358
Carrot-7-130	80,8252	2,5797	8,3814	8,7694	72,8922
Carrot-6-130	80,2854	2,9793	8,8312	9,3202	71,3579
Carrot-4-130	77,5515	3,8953	9,4787	10,2479	67,6596

The results demonstrate the important effect on colorimetric properties as marginal changes were observed in L*, a*, b*, c* and h values of samples dyed at 95 °C in comparison to samples dyed at 130°C, as seen in the images of the dyed samples (fig. 1). L* values refer to light-dark values from 100 to 0 representing white to black, a* values range from negative (green) to positive (red) and b* values range from negative (blue) to positive (yellow), samples dyed at 95°C show a* higher



value indicating the red colour and samples dyed at 130°C get b* higher value showing yellow colour.

5. CONCLUSIONS

In this work, carrot extraction to dye cotton fabric has been used getting good results. Conditions, like pH and temperature in the dyeing process were studied, and we conclude that the temperature used has an important influence on the colour obtained in the cotton sample. If the dyeing process is carried out at 90-95°C, then colour of the dyed sample is pinker, however, if it is performed at 130°C then the colour obtained is yellow.

The bath pH used has an important effect on the dyeing results too, because it has been seen that using acid pH, the intensity of the colour is higher in both cases.

REFERENCES

- [1] A. S. Hussain R. Nawaz, (2009) "*Optimization of alkaline extraction of natural dye from Henna leaves and it's dyeing on cotton by exhaust method*", Journal of Cleaner Production, vol. 17, pp. 61.
- [2] Duke J.A., (2006) "*Herbal medicine dictionary*", Translated by Z. Amouzegar, Rahe Kamaal Pub., Iran, 2006.
- [3] Fazly Bazzaz B.S., (1999) "*Microbial quality assurance in cosmetics, toiletries and non-sterilized pharmaceuticals*", Ferdowsi University Press, Iran, 1999, pp. 62-66.
- [4] Haji, A. (2010) "Functional dyeing of wool with natural dye extracted from Berberis vulgaris wood and Rumex hymenosepolus root as biomordant". Iranian Journal of Chemistry and Chemical Engineering (IJCCE), 29(3), pp. 55-60.
- [5] Ali, S., Nisar, N., Hussain, T. (2007) "*Dyeing properties of natural dyes extracted from eucalyptus*". Journal of the Textile Institute, 98(6), pp. 559-562.
- [6] Singh, R., Jain, A., Panwar, S., Gupta, D., Khare, S. K. (2005) "*Antimicrobial activity of some natural dyes*". Dyes and pigments, 66(2), 99-102.
- [7] Han, S., & Yang, Y. (2005) "*Antimicrobial activity of wool fabric treated with curcumin*". Dyes and pigments, 64(2), pp. 157-161.