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Research Article

The Effect of Blend, Mordant and Waste Ratio on Dyeing of Denim Products with Coffee Waste

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Abstract

Natural dyestuffs, which took the place of synthetic dyestuffs in the past, have started to be used consciously again thanks to the increasing understanding of 'environmentally friendly textile'. These natural dyestuffs are mostly obtained from plants or food waste. Coffee is the most consumed nutrient in the world after water. Therefore, there is a lot of waste of coffee in nature and it contains pigments that give it its natural color. In this study, products with different fiber contents (100% cotton, 98% cotton 2% elastane, 80% cotton 20% recycled cotton) were dyed using coffee waste, and different mordant substances (aluminum sulfate, chitosan, quetemary ammonium compounds). It has been tried to reduce the amount of coffee waste used by dyeing with coffee wastes at different rates by weight (1/1, 2/1, 4/1, 8/1). Thus, it is aimed to provide less waste to the environment and to increase the color efficiency by making a more sustainable dyeing process. In addition, it is aimed to give a new direction to the denim sector by improving the rubbing and washing fastness values of dyed products. As a result of the studies, products with a product weight/coffee waste weight ratio of 8/1 were obtained with high crocking and washing fastnesses and without major losses in color tone.

Keywords: Natural dyestuff, Cotton, Coffee, Food waste, Mordant

The Effect of Blend, Mordant and Waste Ratio on Dyeing of Denim Products with Coffee Waste

Öz

Geçmişte sentetik boyarmaddelerin yerini alan doğal boyarmaddeler, artan 'çevre dostu tekstil' anlayışı sayesinde yeniden bilinçli olarak kullanılmaya başlanmıştır. Bu doğal boyarmaddeler çoğunlukla bitkilerden veya gıda atıklarından elde edilir. Kahve, dünyada sudan sonra en çok tüketilen besin maddesidir. Bu nedenle doğada çok fazla kahve israfı vardır ve kahveye doğal rengini veren pigmentler içerir. Bu çalışmada, farklı lif içeriğine sahip (%100 pamuk, %98 pamuk %2 elastan, %80 pamuk %20 geri dönüştürülmüş pamuk) ürünler, kahve atıkları ve farklı mordan maddeler (alüminyum sülfat, kitosan, quetemary amonyum bileşikleri) kullanılarak boyanmıştır. Ağırlıkça farklı oranlarda (1/1, 2/1, 4/1, 8/1) kahve atıklarıyla boyama yapılarak kullanılan atık kahve miktarı azaltılmaya çalışılmıştır. Böylece hem çevreye daha az atık verilmesi hem de daha sürdürülebilir bir boyama işlemi yapılarak renk etkinliğinin arttırılması amaçlanmıştır. Ayrıca boyalı ürünlerin sürtünme ve yıkama haslık değerleri iyileştirilerek denim sektörüne yeni bir yön verilmesi amaçlanmıştır. Çalışmalar sonucunda, ürün ağırlığı/kahve atığı ağırlığı oranı 8/1 ile renk tonunda büyük kayıplar olmadan, yüksek sürtünme ve yıkama haslıklarına sahip ürünler elde edilmiştir.

Anahtar Kelimeler: Doğal boyarmadde, Pamuk, Kahve, Gıda atıkları, Mordan

1. Introduction

Mordant types used in dyeing made with coffee grounds, which is a sustainable resource, make a difference according to the fabric types used. Iron was used for cotton and linen, alum for silk, and copper for rayon [1]. It has been observed that another parameter affecting dyeing is the type and the roasting rate of the coffee. Greenish, brown and dark brown tones and good fastness results were obtained in cotton fabric dyeing made with raw, medium roasted and dark roasted Ethiopian and Congo type coffee extracts [2].

In another study; It was observed that some trials dyed with cotton fabrics, 40 different plants provided color efficiency and sufficient fastness values. Cationization of cotton fibers by pre-treatment with chitosan and improvement of dyeability with natural dyes were also investigated [3].

In this study, using natural dyestuff, coffee waste, products with different fiber content were mordanted with aluminum sulfate, iron sulfate, chitosan, quetemary ammonium compounds and dyeing experiments were carried out at different coffee waste rates.

2. Material and Method

Coffee wastes were collected, mixed homogeneously and dried at 60ºC for 8 minutes. and used in experiments. All dyeing processes were performed at 90ºC for 45 minutes.

Color fastness tests against home washing were carried out according to ISO-105 C06, color fastness tests against cracking were carried out according to ISO 105-X12 standard.

In order to examine the effect of fiber content on color tone, 100% cotton, 98% cotton 2% elastane, 80% cotton 20% recycled cotton woven fabrics were used and the differences in the color effects of the mixture change were observed.

In another trial set, the effects of different mordants on color tone and fastness values were investigated.

Dry-wet crocking and washing fastness tests of dyed products were carried out in order to improve the fastness properties of natural dyed products. As a result of the trials, when the fastness values were evaluated on the gray scale, it was observed that they were below the desired standards. In order to increase the fastness, aqueous crosslinker with cationic character and methylisothiazolinone-based resin application studies were applied on products.

With the use of food waste, a sustainable product with high added value emerges. However, even if it is waste, studies have been carried out to reduce the amount of waste coffee used in recipes in order to ensure that this resource is limited in nature and that resources are used efficiently.

3. Results and Discussion

As a result of dyeing the products consisting of fabrics with different fiber content with coffee waste, it has been observed that they meet the desired standards in terms of both color efficiency and fastness.

In the experiments we performed at the 1/1 coffee/weight ratio, color changes were observed due to the difference in fiber content (Figure 1).

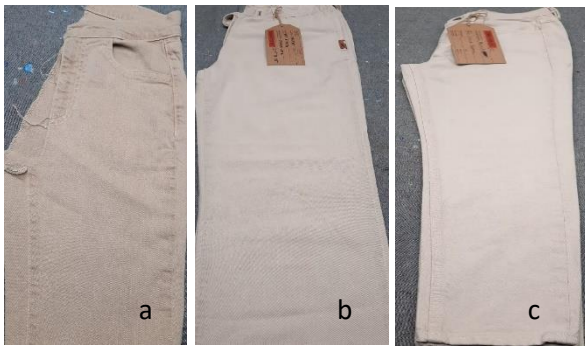

Figure 1. Dyed products which contais a) %98 CO %2 EL b) %100 CO c) 80% CO 20% RCY CO

Experiments have also been made with natural mordants. Their fastness tests are given in the Table 1. Related images are available in the Figure 2.

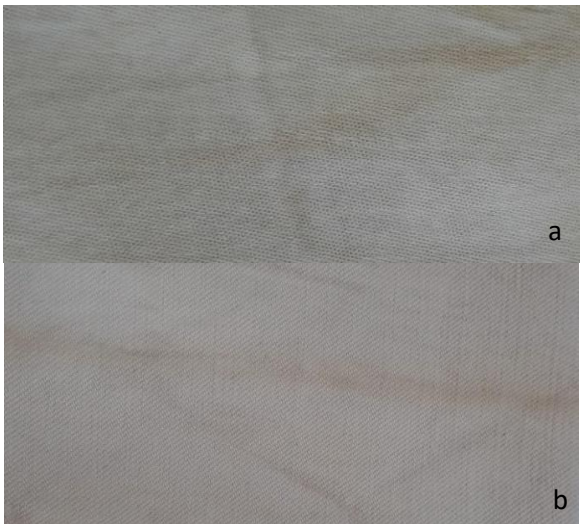

Figure 2. Product dyed with 1/1 product weight/coffee waste weight ratio and mordanted with a) quetemary ammonium compound, b) chitosan

Table 1. Fastness test results of the products dyed with 1/1 product weight/coffee waste weight ratios and different mordants

	Mordant Type	Quetemary ammonium compound	Chitosan	Aluminum sulphate
Color Fastness to Home Laundering	Color Change	1-2	1-2	4-5
	Acetate	5	5	5
	Cotton	5	5	5
	Nylon	5	5	5
	Polyester	5	5	5
	Acrylic	5	5	5
	Wool	4-5	4-5	4-5
Color Fastness to Crocking	Dry	4-5	4-5	5
	Wet	3	3	4-5

The coffee ratios were the same, and when the fastness values were examined as a result of dyeing using different mordants, it had been determined that the product using aluminum sulfate gave better results.

In addition, fastness values were tested by applying fixator and resin to the products dyed at 1/1 coffee ratio. It was observed that the use of fixator and resin provided improvements in fastness results without causing a negative effect on color (Table 2).

Table 2. The fastness test results of the products which fixator and resin was applied on

		dye	dye & fixator	dye & fixator & resin
Color Fastness to Home Laundering	Color Change	2	2-3	3-4
	Acetate	5	5	5
	Cotton	5	5	5
	Nylon	5	5	5
	Polyester	5	5	5
	Acrylic	5	5	5
	Wool	4-5	4-5	4-5
Color Fastness to Crocking	Dry	4-5	4-5	4-5
	Wet	4-5	4-5	4-5

The physical test results of samples dyed with different amounts of coffee using aluminum sulfate mordant are given in the Table 3 and the images of the products can be seen at Figure 3.

Table 3. Fastness test results of the products dyed with different product weight/coffee waste weight ratios and aluminum sulphate mordant

Product weight/coffee waste ratio (w/w)		1/1	2/1	4/1	8/1
Color Fastness to Home Laundering	Color Change	4-5	4-5	4	3-4
	Acetate	5	5	5	5
	Cotton	5	5	5	5
	Nylon	5	5	5	5
	Polyester	5	5	5	5
	Acrylic	5	5	5	5
	Wool	4-5	5	4-5	4-5
Color Fastness to Crocking	Dry	5	5	5	4-5
	Wet	4-5	4-5	4-5	3-4

When the visual and test results were evaluated, it was seen that the desired color tone and fastness values could be obtained even when the coffee ratio was reduced to one-eighth.

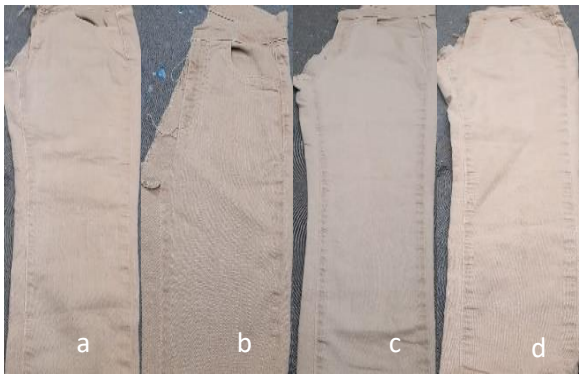

Figure 3. Products images dyed with a) 1/1, b)2/1, c)4/1, d)8/1 Product weight/coffee waste weight ratios

4. Conclusions and Recommendations

Today, as a result of the increase in environmental pollution and the preference of environmentally friendly and recyclable products, there is an increasing interest in natural dyestuffs that have lost their value in the past. It seems that there are studies on this subject today. However, when these studies are examined, the fastness values seem to be low. For this reason, we have done this work to improve fastness and achieve the desired color effects with less food waste. And as a result, we have reached the most suitable fastness values by using natural products. Thus, we have obtained an environmentally friendly product. In addition, we have obtained color effect products that meet the demands of the customers.

Different color tones were observed in the dyeing of fabrics with different fiber content. In addition, it has been observed that the desired color tone can be obtained when the coffee ratio is reduced to one-eighth. It has been observed that rubbing and washing fastness values can be improved with fixator and resin support.

5. Acknowledge

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