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Enhancing the dyeing efficiency and color fastness properties of wool fabric using coffee natural dye extract

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Abstract

Using natural dyes on textile materials has become more popular over the past years, maybe as a result of increasing demand for a green environment and decreased pollution of synthetic dyes., this study investigated the use of coffee to extract colors for dyeing wool fabrics using the heating method. Colorant was extracted from coffee using different concentrations at different times for different temperatures. Measurements have been done on the dyed samples and the fastness properties of samples dyed with coffee. Mordant copper sulfate, ferrous sulfate, and Aluminium sulfate were used to increase the color fastness of dyed wool samples. The samples were affected by some factors such as dye extraction, dye concentrations, temperature, pH values, and the time of dyeing. K/S was measured for dyed wool fibers. The fastness properties such as washing, rubbing, perspiration, and light of dyed fibers were measured.

Keywords; mordant; coffee natural dye; extraction

Introduction

Natural colorants have been used for a variety of tasks since ancient times, including dyeing fur, leather, and natural fabrics like wool, cotton, and silk. These dyes were also employed to make inks, water colors, artist's paints and to color cosmetic items. After the beginning of using synthetic dyes in 1856, the usage of natural dyes to colour textiles declined rapidly and disappeared by 1900. An increase in interest in natural dyes was brought about by a global consciousness of the environment, ecology, and pollution management in the mid-1960s. [1-2]

Recently the dye industry has been under increasing pressure to stop producing potentially hazardous dyes or pigments and to minimize toxic effluents. Natural dyes and colorants originating from plants and animals are considered non-toxic, non-carcinogenic, and biodegradable, making them safer alternative.[3]

Furthermore, compared to synthetic colors, natural dyes are more friendly to environment as they don't pollute the environment or create wastewater issues. It has also been noted that some of them contain anti-UV and anti-microbial qualities. Natural dyes have a global demand as the global trend today moves toward the use of environmentally friendly products.[4]

Wool

Wool is one of the most widely distributed natural polymers that possess an intricate surface structure. It is composed primarily of a morphological structure of proteins (around 70 %) and lipids (around 1%) and is derived from the skin of the sheep.[9]

The primary reason for felting shrinkage in wool fibers is the accumulation of scales on the surface, which also enhances the directional frictional impact. Wool is composed of keratin, a protein produced during the production of α-amino acids. Cell death is the process that forms wool fiber. Figure 1 illustrates the variety of architectures, morphologies, and characteristics of wool-forming cells.

Extraction of Dyes

Natural dyes consist of coloring substance and other elements. For example water-insoluble fibers, protein and. Extractions must be done for. production of purified natural dyes .

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Synthetic colorants have been associated with dermatological issues, diseases, and cancer. Concerns have been raised about the possibility of dermatitis in certain circumstances involving close skin contact with colorful textiles (such as leggings highly dyed with azo and anthraquinone dispersion dyes). Additionally, synthetic colors have also been linked to respiratory sensitivities. Numerous artificial coloring agents are deemed harmful when applied topically, and global customers demand safer apparel, particularly for infants and young kids. (Many natural dyes are also used to color food, and it goes without emphasizing that low toxicity is essential. Still, lists of approved food additives in the USA and EU include annatto, cochineal (carmine), saffron, and turmeric.[5-7].

Usage of natural dyes on natural fibers including cotton, wool, linen, jute, and flax has been reported in some recent research. When compared to synthetic colors, natural dyes are generally less harmful, nonallergic, and more environmentally desirable. They are also friendly and exhibit superior biodegradability [8]

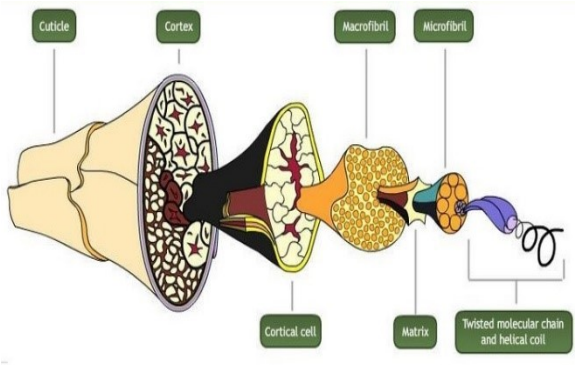


Figure (1) Structure of wool

Natural colors have a chemical coloring matter that extract with severl methods and combine with fibres . There for, extraction is essential to extract the color from the plant. There are several methods of extraction include wet extraction, acidic or alkaline extraction, and Fermentation, Enzymatic extraction , and Microwave Ultrasonic assisted extraction. [11,12]

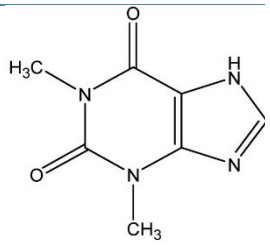
Mordant

The word "mordant" belongs to the "mordere," word . this word means to absorb onto the surface of a substance to fix color when it cannot be fixed directly on the fabric. Some rare natural dyes are combined easily with fabrics. Mordants are chemicals that bind the color to the fibers, enhance color, light fastness and boost the textile's ability to absorb dyes more effectively. Other natural dyes, like Madder, have a poor fastness and may stain color of dye during washing and light exposure, so using a mordant is crucial when dyeing with them. Other natural dyes, like indigo, will be fixed without using a mordant, which is called substantive dye. Historically, mordants have been discovered for[9]

As a consequence of making coffee, coffee is rich in chemical components with a variety of biological effects and antibacterial properties. To both functionalize and color materials, leftover coffee grounds were tested as a fabric dye [13-14]

The chemical constituents of coffee are caffeine (around 1–2%), coffee oil (around 10–14% and other constituents like cellulose substance , hemicellulose, trigonelline constituents and tannic acid (around 30%) [15]

Table (1) chemical structure of coffe

Name	Dye component	Chemical structure
Caffeine	$C_8 H_{10} N_4 O_2$	

this research study enchancing the dyeing properties of coffee natural dye extract that dyed wool with natural coffee dye with different mordants in three methods (pre-mordant, post-mordant, simultimus mordant).

Experimental

Natural coloring

Coffee powder (Coffee.) were sourced from a local coffee house

Fabrics

Mill-scoured and wool fabric , (30 g/m^2) were kindly supplied by fine wool Co. Egypt.

Mordant

Mordant of copper sulfate, mordant of ferrous sulfate, and mordant of Aluminum sulfate were used to enhance the color fastness and color yield of dyed fabric. They were very pure chemicals.

Result and discussion

Extraction of coffee

The coloring matter was extracted using the heating method. Extraction was performed in

1000 of diluted water at different temperatures and different time intervals At the end, the extraction bath of dye was filtered off and cooled down.

Using a dye bath that included 1000 ml of water with varying amounts of the dye materials (20-80- gm /L) at different temperatures(`40-90) at different times (20-100 min). the extraction bath of dye was filtered off and cooled down [14].

Dyeing processes

In a bath containing 80 gm/L dye using a liquor ratio of 1:50, a piece of wool fabric was dyed with the extraction of coffee at different pH (3-10) at temperatures between (40- 90 C) for times between (20, 120min.)

Finally rinsing the dyed samples with water, rinsed, then kept it to dry at room temperature then set the soaping bath with liquor ratio 1:50 with 3 g/L non-ionic detergent at 50ºC for 30 minutes.

Pre-mordanting (before setting the dye bath), post-mordanting (the mordant after finishing the dyeing bath), and simultaneous mordanting (setting the dye bath with mordant) are the 3 types that were used. Copper sulfate, ferrous sulfate, and Aluminium sulfate were employed as mordants.the concentration of mordant was 3% .

Pre-mordanting

The wool fibers were pre-mordanting, where they were submerged in an aqueous solution containing 3% of different mordants (ferrous sulfate, copper sulphate, Aluminium sulphate) for 60 minutes at 70 ºC in a water bath. Afterward, each sample was thoroughly rinsed with water. Subsequently, under ideal coffee dye conditions, the mordant fibers were dyed. Similar to the earlier procedure.

Post mordanting

In method of post-mordanting, the dyeing was carried out under optimal dye conditions without the use of mordants. After rinsing all dyed samples with water, they were mordant in three different baths: one with ferrous sulphate . one with copper sulfate, and the other with Aluminum sulfate at 70ºC for 60 minutes.

Finally rinsing the dyed samples with water, rinsed, then kept it to dry at room temperature then set the soaping bath with liquor ratio 1:50 with 3 g/L non-ionic detergent at 50ºC for 30 minutes.

Simultaneous mordanting

Using a dye bath that included dye and 3% mordant in the same bath . the dyeing bath was conducted under optimal condition.

Measurements

Colour strength

A spectrophotometer (Ultra Scan PRO) was used to measure degree of the reflectance of the dyed samples, the K/S was measured at 430 nm. Wave length . The K/S of all wool samples dyed with coffee was evaluated.

Fastness Properties

For testing the mordant dyed samples the standard methods were used. The specific tests were as follows:

- ISO 105-X12(1987): fastness of rubbing
- ISO 105-C02 (1989), fastness of washing
- ISO 105-E04 (1989), fastness of perspiration.
- ISO 105-B02 (1988), fastness of light

Color Extraction

To determine the optimal condition for color extraction, some factors were studied as following:

- Varying amounts of the dye materials (20-80- gm /L).
- different temperatures(`40-90) using
- Different times (20-120 min).

At the end the extraction process, the dye bath was filtered off and cooled down.

Dye extracted concentration

Figure 2 illustrates the effect of dye amount on K/S value of coffee natural dye by using concentrations (20-30-40-50-80 gm /L) (at 90 °C), for one hour.

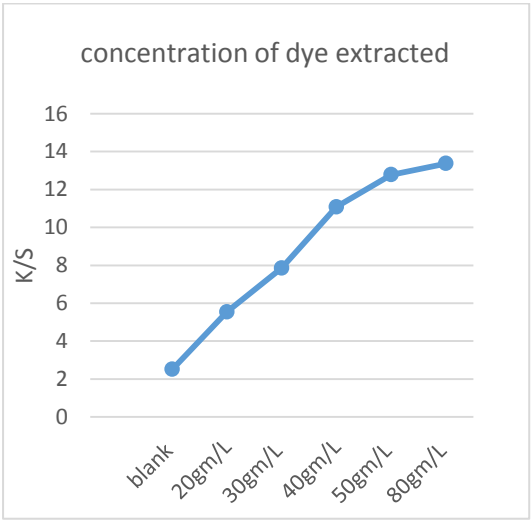


Figure 2 . Effect of extracted dye amount on K/S of dyed wool fibers

Figure 2 illustrates that with increasing the dye amount, the K/S value also increases. This phenomena holds true across all dye amounts. The concentration difference of the dye in solution and in the wool fabrics is the driving for the diffusion and adsorption [18] . This might be related to the increase of the natural color particles in the dye bath. and so on increase more color particles combine with fabrics in fabrics.

Figure 2 reveals that the best concentration for extracting coffee's natural colors to dye wool fabrics is 80 gm/L.

Figure 3 Effect of dye extract temperature on K/S value of wool samples by using different temperature (,90,80,70,60,50ºC), concentration was 80 gm./ L for one hour.

Figure3. Effect of extracted dye temperature on K/S of dyed wool fibers

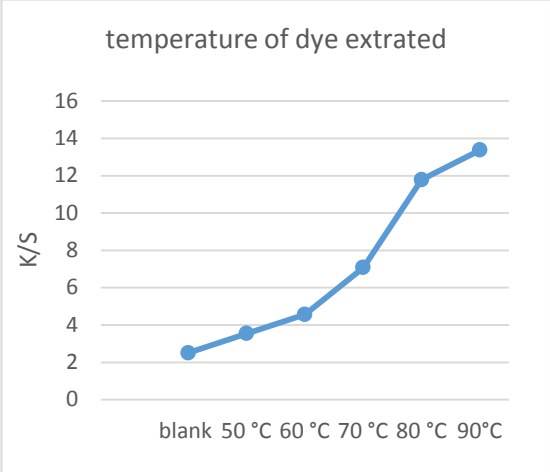
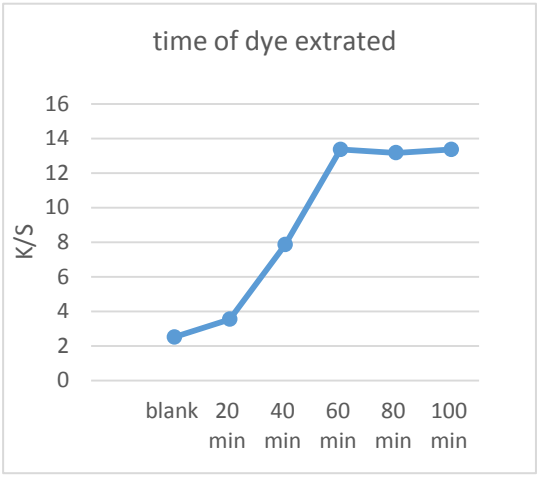


Figure 3 illustrates that whenever the temperature of dye increases the K/S also increases. Higher temperatures likely enhance dye dissolution and lead to an increased presence of color particles in the dye bath. Temperature is a very important parameter affecting the extraction bath. Different temperature affects to extraction coffee from (50 ºC to 90 ºC) are presented in Figure 3. The figure showed the K/S of extraction bath increased gradually by increasing the value of temperature from 50°C to 90 °C [19,20]. The reason of this phenomenon may be due to opening of o fabrics , accelerating the of the movement of molecules and penetration of the dye into the fabrics and thus increasing the diffusion of dye molecules in fabric and finally increasing the yield.

Figure 3 reveals that the best temperature for extract coffee's natural colors to dye wool fabrics is 90 ºC.

Figure 4 Effect of dye extract time on K/S value by using different time (20,40,60,80,100) (concentration was 80 gm./ L for 60 min.

Figure 4. Effect of extracted dye concentration on



K/S value of dyed wool fibers by coffee dye.

Figure 4 illustrates the different extraction time and its effect on uptake of wool fabric by using 80 gm./ L . The dye uptake by coffee natural dye reaches maximum dye extraction after 60 min when using a Concentration of 80 gm. After that the K/S was constant. This might be related to increasing the time of dye extraction was accompanied by an increase of color particles that react with fibers.

Figure 4 reveals that the best time to extract coffee's natural colors to dye wool fabrics is 60 min.

Based on the previous figures . the best condition for extracting coffee natural dye is to heat the extraction bath to 90ºC for 60 min using 80 gm/L..

Dyeing process

Effect of pH value of dyeing bath

Figure 5 illustrates the effect of dye pH on K/S value samples by using different PH (3,5,7,9,11) at 90ºC for 60 min..

Figure 5 refer to the different pH of dyeing bath and its effect on K/S of samples. As the pH increases, the K/S also increases. However, beyond a certain pH (around 5), the K/S value starts to decrease at all dye amounts.

The pH of dyeing bath is an important parameter affecting the color strength of dye bath. This paper's pH range was from (3-11). As shown in Figure 5 the highest color strength were found at PH 5

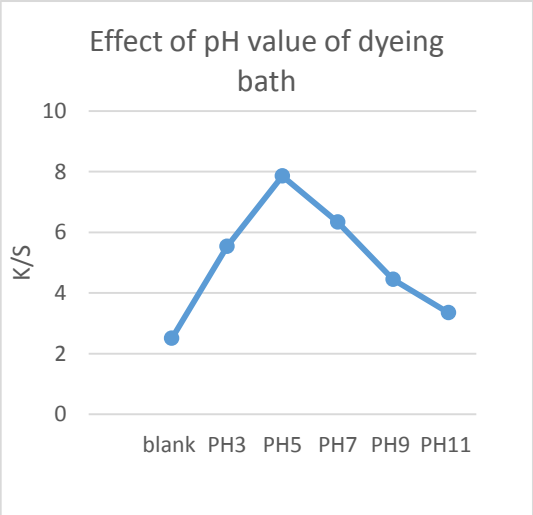


Figure 5 Effect of pH value of dyeing bath on K/S of wool fabric

The wool molecules in acidic PH is forming dissociation reactions (of the acid and amino acids in wool),

HX → H+ + X (1) Acid

HOOC-Wool- NH2→-OOC-Wool-+NH3(2) Wool

wool is is consist of an amphoteric molecule . in the acid condition , the molecule interacts with the acid,

OOC - Wool - +NH3 + H+ + -X → H+ -OOC - Wool - +NH3 -X (3)

This reaction phase means that the active amino groups of the wool, which become binding centers for the anions of the dye in the solution

H+-OOC - Wool - +NH3 -X + Dye - COO- H+ Activated wool + coffee → H+ -OOC - Wool - +NH3 -OOC – Dye + +H –X (4) [22-20]

Figure 6 illustrates the dyeing bath temperature, and its affecting on K/S value by using different temperatures(50,60,70,80,90ºC), concentration was

80 gm/L and time was 60min and the effect of temperature dyeing bath on K/S of dyed wool fabric with coffee.

Figure 6 illustrates that as temperature of dye increases the K/S value also increases. It reveals the effect of dye temperature on K/S value by using different temperatures (50,60,70,80,90, ºC), concentration was 80 gm/L and time was 60 min.

Another parameter is temperature when the temperature become more , that led to open the pores inside the fabric to be more accessible and the movement of the dye ions become more. Swelling of fabric affect within the internal structure of the fabrics, thus enabling the large dye molecules to penetrate further [22]. The best temperature was will be 90C.

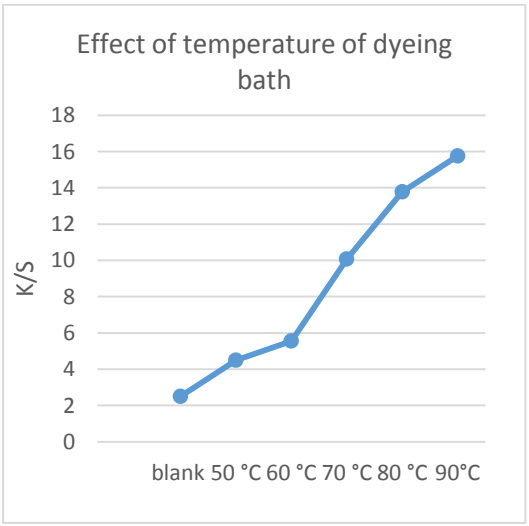


Figure 6 Effect of pH value of dyeing bath on K/S of wool fabric

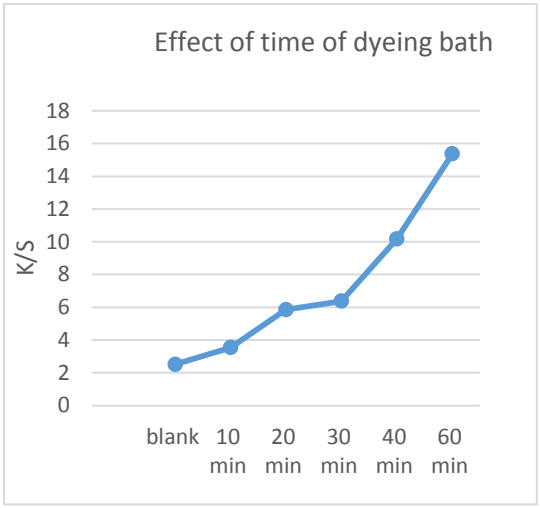


Figure 7 Effect of time of dyeing bath on K/S of wool fabric

Figure 7 reveals that the best time for dyeing bath with coffee natural dyes is 60 min.

Based on the previous figures. the optimal condition for a dyeing bath of coffee natural dye is dyeing with 90ºC for 60 min using, pH 5.

Mordant effect

For enhancing the K/S of samples dyed with coffee, there are three types of mordants were used; ferrous Sulphate copper sulfate, and aluminum sulfate. To show the effect of mordant type on the fastness properties, three mordanting methods were applied as mentioned before.

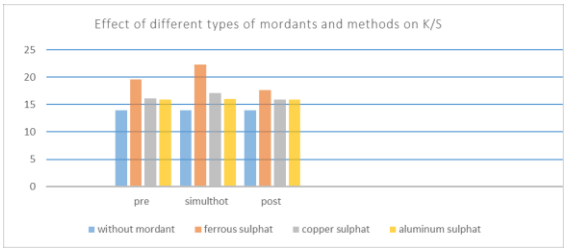


Figure 8 : Effect of different mordants on K/S of samples

The optimal results of K/S were found when the mordants were applied in the simultaneous dyeing bath. that was found in all types of mordants, the best mordant used was ferrous sulphat . ferrous sulfate as a transition metal having coordination this coordination site have a main role in dyeing reaction

Concentration: 80 gm /L,

90°C, 60 min , pH 5 and

L:R 1:50

Concentration of mordant was 3%

The three methods of mordants were applied in three different methods as mentioned before

Figure 8 illustrates the application of different types of mordant and its effect on color strength of dyed fabric

As a result, when coordination site react with the wool fiber, some coordination sites will be free, and the amino and carboxylic groups in wool molecules at that time can attach these free sites. Thus, ferrous sulfate can form a ternary complex compound on one site with the wool fiber and in another site with the dye. This strong coordination tendency can enhance interaction between the fiber and the dye

Table 2 reveals washing fastness (rubbing. washing ,perspiration and light) of wool samples dyed with coffee natural dye.

Conclusion

The rapid advancement of textile wet processing manufacturing has led to an increase in environmental concerns, which has sparked continued interest in the development of green production techniques for the creation of reasonably priced value-added textile goods.

The art of coloring dates back to the beginning of human evolution. Colored materials remnants found during antiquarian excavations at several locations around the universe attest to the use of coloring in ancient civilizations. Natural colorants have been used mostly for textile coloring from ancient times. Various types of textiles were colored using natural colored materials derived from natural resources such as plants, animals, minerals, and microorganisms. Different districts around the cosmos have their own inherent conventions based on the natural resources that are available in those districts.

Natural dyes from several plant sources have been produced recently for dyeing. .Establishing producers and consumers . [16-17]

It is necessary in recent researches to establish the best method and best condition for dyeing fabric with natural dye.

The purpose of this study is to enhance the dyeing efficiency and colour fastness properties of wool fabric coffee natural dye extract.

The best condition of dyeing wool fabric with coffee natural dye is:L:R 1:50, PH = 5, temperature 90, and time 60 min.

Table 2 reveals washing fastness (rubbing . washing ,perspiration) and light of wool samples dyed with coffee natural dye.

the best factors of extraction of coffee natural dye market . the best dyeing conditions of coffee natural dye , The best condition of dyeing wool fabric with coffee natural dye L:R 1:50, PH = 5, temperature 90, and time 60 min

Table 2. Effect of mordant on washing fastness of wool samples dyed by coffee extract

	Rubbing		Washing			perspiration						Light
	wet	dry	St. Cot .	St. Wol.	Color Change	Acidic			Alkaline			
						St. Cot.	St. Wo.	Rlt	St. Cot.	St. Wo.	color change	
Without	3-4	3-4	4	3-4	3-4	4	4	4	4	4	4	6
Pre Ferrous	4	4	3-4	3-4	3-4	4	4	4	4	4	4	6
Pre copper	2-3	2-3	4	3	3-4	4	4	4	4	4	4	6
Pre aluminum	3-4	3-4	4	3-4	3-4	4	4	4	4	4	4	
Simultaneous Ferrous	3-4	3-4	3-4	3	3-4	4	4	4	4	4	4	5-
Simultaneous copper	2-3	2-3	3-4	3-4	3-4	4	4	4	4	4	4	6
Simultaneous aluminum	3	3	3-4	3-4	4	4	4	4	4	4	4	5
Post ferrous	3-4	3-4	4	4	3-4	4	4	4	4	4	4	5-
Post-copper	2	2	4	3-4	4	4	4	4	4	4	4	6
Post aluminum	2	2	4	3-4	4	4	4	4	4	4	4	6

This study investigates the K/S value, color fastness (light, water, (rubbing. washing, perspiration), and light of three mordants (ferrous copper, Sulfate copper, and aluminum sulfate.

the best mordant was used 3% ferrous sulfate using simultaneous method.

References

[1]. AlAshkar, A. and Hassabo, A.G. Recent use of natural animal dyes in various field, J. Text. Color. Polym. Sci., 18(2) 191-210 (2021).

[2]. Diaa, M., Othman, H. and Hassabo, A.G. Printing wool fabrics with natural dyes curcuma and alkanet (a critique), J. Text. Color. Polym. Sci., 19(1) 11-16 (2022).

[3]. Hamdy, D.M., Othman, H.A. and Hassabo, A.G. Various natural dyes using plant palette in coloration of natural fabrics, J. Text. Color. Polym. Sci., 18(2) 121-141 (2021).

[4] Ebrahim, S.A., Othman, H.A., Mosaad, M.M. and Hassabo, A.G. Eco-friendly natural thickener (pectin) extracted from fruit peels for valuable utilization in textile printing as a thickening agent, Textiles, 3(1) 26-49 (2023).

[5] Shahid, M, and Faqeer M. Recent advancements in natural dye applications: a review. Journal of cleaner production 53 310-331 (2013):.

[6] Gupta, V. K.. Fundamentals of natural dyes and its application on textile substrates." Chemistry and technology of natural and synthetic dyes and pigments (2019).

[7] Zerin, I., Farzana, N., Sayem, A.S.M., Anang, D.M. and Haider, J., Potentials of Natural Dyes for Textile Applications Materials Science and Materials Engineering.2 873-883 (2020)

[8] Prabhu, K.H. and Bhute, A.S., "Plant Based Natural Dyes and Mordnats: A Review".journal of natural product and plant resourse, 2(6) 649-664 (2012).

[9] Ragab, M.M. and Hassabo, A.G. Various uses of natural plants extracts for functionalization textile based materials, J. Text. Color. Polym. Sci., 18(2) 143-158 (2021).

[10] Rana, S., Pichandi, S., Parveen, S. and Fangueiro, R., Natural Plant Fibers: Production, Processing, Properties and Their Sustainability Parameters, in Roadmap to Sustainable Textiles and Clothing, S.S. Muthu, Editor Springer Singapore Heidelberg: Hong Kong (2014).

[11] Menna. Z. , Hanan A. , Heba G., and Ahmed. G., valuable observation on natural plants extracts for valuable functionalization of cotton fabric (an overview), Egy. J. Chem., 65(4) 499 – 524 (2022).

[12] Ragab, M.M., Hassabo, A.G. and Othman, H.A. An overview of natural dyes extraction techniques for valuable utilization on textile fabrics, J. Text. Color. Polym. Sci., 19(2) 137-153 (2022).

[13]. Hong, K.H. Effects of tannin mordanting on coloring and functionalities of wool fabrics dyed with spent coffee grounds." *Fashion and Textiles* 5(1) 33 (2018).

[14]. Koh, E, and Kyung H. H.. Preparation and properties of wool fabrics dyed with spent coffee ground extract. Textile Research Journal 89(1) 13-19 (2019)

[15]. Lee, Y. Dyeing, fastness, and deodorizing properties of cotton, silk, and wool fabrics dyed with coffee sludge (Coffea arabica L.) extract. Journal of Applied Polymer Science 103(1) 251-257 (2007).

[16]. Ebrahim, S.A., Mosaad, M.M., Othman, H. and Hassabo, A.G. A valuable observation of eco-friendly natural dyes for valuable utilisation in the textile industry, J. Text. Color. Polym. Sci., 19(1) 25-37 (2022).

[17]. Saad, F., Mosaad, M. M., Othman, H. A., Mohamed, A. L., and Hassabo, A. G. Enhancing the opacity of the modified natural thickening agent with different metal oxides for covering dark dyed fabrics. *Fibers and Polymers*, *23*(9), 2626-2637. (2022).

[18]. Uddin, M.G. Extraction of eco-friendly natural dyes from mango leaves and their application on silk fabric. *Textile Clothing Sustain* **1**, (2015).

[19]. Herbach KM, Maier C, Stintzing FC, Carle R. Effects of processing and storage on juice colour and betacyanin stability of purple pitaya (Hylocereus polyrhizus) juice. European Food Research and Technology. 224(5):649- 58(2007)

[20] Ahmed Moussa, Asmaa Al-Amir, Alshimaa Hassen Gomaa, and Ragaa Elsayed El-Azabawy. "Valorization Beetroot Waste for Eco-Friendly Extraction of Natural Dye for Textile and Food Applications. Egyptian Journal of Chemistry 65.8725-736(2007).

[21] Popescu V, Blaga AC, Pruneanu M, Cristian IN, Pîslaru M, Popescu A, Rotaru V, Crețescu I, Caşcaval D. Green chemistry in the extraction of natural dyes from colored food waste, for dyeing protein textile materials. Polymers. 13(22):3867.(2021)

[22] Mane VS, Mall ID, Srivastava VC. Use of bagasse fly ash as an adsorbent for the removal of brilliant green dye from aqueous solution. Dyes and Pigments. 73(3):269-78. (2007)

تحسين خواص الثبات لاقمشة الصوف التي تم صباغتها بمستخرج القهوة الطبيعية

ريم أسامة احمد
جامعة بني سويف، كلية الفنون التطبيقية - قسم طباعة المنسوجات والصباغة والتجهيز – بني سويف – مصر

المستخلص:

يرجع استخدام الاصباغ الطبيعية منذ قديم الاول و زادت اهمية استخدام الصبغات الطبيعية في الاونة الاخيرة حيث ألنها غير سامة و صديقة للبيئة على المنسوجات و لزيادة الوعي البيئي من أجل تجنب بعض الصبغات الصناعية الخطرة والمسرطنة وهناك صبغات طبيعية كثيرة وطرق استخلاص كثيرة ، اجريت صباغة الاقمشة الصوفية بأصباغ طبيعية تم استخالصها من البن الداكن المطحون ، تم تحضير محلول الصباغة و استخدام مثبتات مختلفة .
بعد اجراء تجارب علي استخلاص البن بتركيزات مختلفة و درجات حرارة مختلفة و مدد زمنية مختلفة ، تم استخلاص البن المطحون في الماء الساخن عند *90* درجة مئوية بن خام ، لمدة ساعة بتركيز 80 جم وبن داكن التحميص تم وضع وغمر االقمشة الصوفية في مستخلص البن باستخدام الطريقة التقليدية عند درجات *PH* و مدد زمنية مختلفة وكذلك درجات حرارة مختلفة تم فحص شدة اللون اللون للاقمشة الصوفية المختلفة باستخدام جهتز الاسبكتروفوتميتر . تم التوصل الي ان افضل ظروف لصباغة الصوف بالبن المطحون هو *PH* :5 & درجة حرارة 90 درجة مئوية لمدة ساعة عند *L:R 1:50* تم استخدام ثلاث انواع مختلفة من المتبتات الومنيوم سلفات و سلفات الحديد و سلفات النحاس وتطبيق ثلاث طرق مختلفة للمثبت (قبل الصباغة و اثناء الصباغة وبعد الصباغة) وتم فحص شدة اللون اللون للاقمشة الصوفية المختلفة باستخدام جهتز الاسبكتروفوتميتر . وكذلك قياس خواص الثبات المختلفة للغسيل والضوء والاحتكاك ووجد افضل انواع المتبات لصباغة الاقمشة الصوفية بالبن المطحون هو مثبت سلفات الحديد وافضل طريقة هي تطبيق المثبت اثناء الصباغة .

الكلمات المفتاحية: المثبتات ، صبغة القهوة الطبيعية ، الاستخراج.