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Dyeing Of Cotton Fabric With Hibiscus Sabdariffa And Its Fastness Properties.

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ABSTRACT

Majority of synthetic or chemical dyes used locally has consequential health implication. Synthetic dyes used in research, teaching and learning are also expensive and are costly which made them difficult to access in both local and modern. Food and textiles need an alternative colourant such as dyes extracted from natural sources Ethanol was used as an extracting solvent during the process, The dye obtained from hibiscus sabdariffa was used on cotton fiber at different dyeing conditions, like dyeing with mordant and without mordant, mordant dyeing and aqueous dyeing, 81.1% was found to be the percentage yield of the dye extract. Based on the analysis carried out it was found that Roselle show good fastness to cotton when combined with chrome as mordant, thereby increasing dye affinity to the fiber.

Keywords: Hibiscus Sabdariffa, Natural Dye,Mordant,Cotton Fibre,Dyeing, Roselle.

INTRODUCTION

Natural dyes are colourants which are gotten from animal or vegetable matter without any chemical processing. Natural dyes are widely used in several sectors, such as colouring of food substrate, wood, leather, as well as natural fibers like silk, wool, cotton and flax since ancient times. Natural dyes have a wide range of shades that can be obtained from various parts of plants, including roots, bark, leaves, flowers and fruits (Gulrajni & Gupta, 1992).

Natural dyes obtained from mineral, plant and animal sources are attractive, beautiful and sometimes they brought a lot of challenges as compared with synthetic dyes, to researchers and educators (Emishili, 2001).

Most of them produce very colourful effects that are so amazing to behold. Natural dyes extracted from the roots, leaves, stems or barriers, and flowers of various plants have various exceptions and possess no substantive to textile fiber, have little or no colouring power when used alone, but in conjunction with mordants they produces shades of good to excellent properties. The beautiful colour that are obtained from natural dyes would initially appeared bright, but soon fade. The poor fastness produced mainly by natural dyes, resulted in the discovery of mordants substance which aid in the absorption of dyes (Evans & Stapleton, 1971).

Recently, a number of commercial dyers and small textile export houses have started looking at the possibilities of using natural dyes for regular basis dyeing and printing of textiles to overcome environmental pollution caused by the synthetic dyes (Collier & Tortora, 2001).

Natural dyes are mostly eco-friendly, biodegradable, less toxic, and less allergenic as compared to synthetic dyes. However, studies have shown that certain natural dyes may have detectable mutagenic effects e.g., elderberry colour and safflower yellow; others, like carmine, can cause asthma by continuous inhalation. But it can be said that most of the natural dyes are safe and

some even have curative effects e.g., curcumin in turmeric and walnut has antibacterial properties (Gulrajni & Gupta, 1992).

Roselle is a plant of the malvaceae family and is native to the tropical areas such as Indonesia. Along with agricultural technologic progress, anthocyanin compound is found in roselle petals and it also can serve as a source of antioxidants (Hayati *et al.*,2012).

Roselle is good for health because of its high antioxidant properties, and anthocyanin can be used as natural dye. Using natural dyes in food products is better and more safe compared to synthetic dyes. Synthetic dyes give a negative impact to our body's health, potentially being poisonous to our body's metabolism. The most dominant anthocyanins of roselle petals are delphinidin-3-sambubioside and cyanidin-3-siambubioside (Molyneux, 2004).

These compounds are the ones that give roselle petals their red colour. Anthocyanins are derivatives of the basic flavylium cation structure, which are highly reactive. The rate of anthocyanin destruction depends on many factors such as temperature, pH, ultraviolet light, and oxygen. Anthocyanin dyes can be applied to food and drink products, such as jam, soft drinks, milk, and yoghurt (Bhagwat *et al.*,2014).

However, the natural dyestuffs extracted from roselle petals are known as subjective dyes require some mordants to attach the colour on the fibers and form strong chemical bonds. The mordant enters deeply into the fibre and combines with dyestuff to form the colour (Chumsri *et al.*,2008).

Mordant help the fibre receive the dyestuff well and form bonding. Compounds of potassium alum,tannic acid, and ferrous sulphate are the safest choices, they combine with the dyestuff and are then permanently fixed onto the fibre. Intensity of the hue and the fastness of the resultant colour can be improved (Corbmer, 1959).

Therefore this research work is concern with determination of effect of mordant on the fastness properties of roselle dye extracts when used on cotton fabric, and determination of the optimum dyeing condition using roselle dye extract.

MATERIALS AND METHOD

APPARATUS:

- Round bottom flask
- Soxhlet
- Heating mantle
- Magnetic stirrer
- Thermometer
- Measuring cylinder
- Glass rod
- Desiccator
- Spatula
- Filter paper
- Hot plate
- Sodium sulphate
- Ethanol

- Sodium carbonate
- Potassium chromite
- Sodium hydroxide

SAMPLE PREPARATION

Cotton fabrics were obtained from Dutse, Jigawa state market and cut into pieces of specific weight. The cotton fabric was washed with warm water to remove oil, and alkali solution (NaOH) was used to removed other dirt and oil stain from the cotton material, it was then rinses thoroughly with water and dry under shade. The textile fabric was washed with soap and detergent so as to make the fabric lighter and to removed other undesirable substances from the cotton fiber in other to increase its affinity towards dye extract.

SAMPLE EXTRACTION

Roselle petals were obtained from Dutse local government, Jigawa state. It was dried under the sun for 5 days and kept in polyethylene bag to keep away from dust and moisture. It was then crushed into a fine particle using domestic blander, 50g of the crude dried powdered was weighed and mixed with 300ml of ethanol. The roselle dye exract was extracted from the resulting mixture using soxhlet extractor for a period of 4-8 hours. The dye extract solution was concentrated and evaporated using hot plate evaporator. The percentage yield of the dye extract obtained was calculated.

DYEING PROCESS

Dyeing Without Mordant

10g of dye extract were dissolved in beaker, containing 60ml of ethanol. The solution was warmed mixed thoroughly to obtained uniformity, 4g of cotton fabric was wet and then introduced in to the dye bath and subjected to stirring and boiling for about 60 minutes.

Dyeing With Mordant

About 3.0g of chrome (potassium chromate) was dissolved in a Beaker containing 60ml of ethanol and 10g of dye extract. The solution were warmed and 4g of the fabric sample, was wet and then introduced in to the dye bath and subjected to stirring and boiling for about 60 minutes.

Aqueous Dyeing

This dyeing process was carried out in bath containing of 60g/l potassium chromate and 4g/l sodium carbonate. 4g weighed fabric was immersed in the dye bath containing only the 10g of dye extract in 60ml of cool water, and subjected to stirring for about 30minutes, the dye bath was heated to 90°C for about 30 minutes, then 700ml of potassium chromate was added when the 90°C was reached, 20% sodium carbonate solution was then added in the dye bath. The temperature was maintain for another 60minutes with stirring .

COLOUR FASTNEES TEST

This test was used to measured the resistance of the textile fabrics when are exposed to various agencies, such as washing, high rubbing and other agencies. The most commonly tests are as follows

Fastness to Washing

Assessment of washing fastness is made by series of five washing test varying in severity from number 1 to number five. The degree of staining is assessed by matching the appropriate undyed piece of fabric to the specimen, it is assessed by the used of grey scale.

Fastness to Rubbing

A machine known as crockmeter is used to test the fastness to rubbing or crocking. A relatively simple test is to rub the dyed fabric with a piece of undyed fabric wrapped round the finger, the first with white dry and then with wet white fabric, which will stain the white fabric and the fastness to rubbing property is determined.

RESULT AND DISSCUSSION

Yield Content

The yield of roselle's extract was calculated as X = (weight of extract after evaporating/weight of dried roselle before extracting) x 100%. Based on the results of this study, the highest yield contents were obtained as:

weight of extract after evaporating = 28.48g

weight of dried roselle before extracting = 40g

Percentage yield = weight of extract after evaporating / weight of dried roselle before extracting × 100

% yield (X) = 40.55g/50g X 100

=81.1 %

Colour strength

Colour strength was calculated using kubelka-munk equation and was obtained as shown in table 1 bellow.

Table 1: Colour Strength of The Dyed Materials Under Difference Conditions.

Colour strength K/S for the samples		
Dyeing without mordant	Dyeing with mordant	Aqueous dyeing
4.54	11.81	15.42

From the above table the colour strength was found to be different due to mordant and varying of the dyeing medium. The result obtained indicates that, introduction of the mordant was found to produce colour strength higher than the one without mordant. This is because mordant creates a chemical affinity between the fibre and the dye and so enable the dye to retain on the fiber, while one without mordant can be easily wash away due to inability of natural dyes to be retain on textile materials in the absence of mordant. Aqueous dyeing medium has the highest colour strength than ethanol dyeing medium, because there is different in polarity between them, and dyeing in aqueous medium will be retain morethan that of ethanol medium, and only caused slight change to the colour strength obtained.

Fastness testing

Table 2: Fastness Properties of Fabric Dyed Without Mordant.

washing fastness		Dry rubbing		Wet rubbing	
Alteration	Staining	Alteration	Staining	Alteration	Staining
2	**4-5**	**2**	**4-5**	**2**	**4-5**

In table 2 dyeing was found to have poor fastness to washing and rubbing due to the absence of mordant in the dye bath, during the dyeing process , and the dye molecule where not fix on the available dye site on the fiber, and so can be easily remove.

Table 3: Fastness Properties of Fabric Dyed With Mordant.

washing fastness		Dry rubbing		Wet rubbing	
Alteration	Staining	Alteration	Staining	Alteration	Staining
3	**4-5**	**4**	**4-5**	**3**	**4-5**

In table 3 dyeing was found to have good fastness to washing and rubbing, due to the introduction of mordant in the dye bath, during the dyeing process , and the dye molecule where fixed on the available dye site on the fiber.

Table 4: Fastness Properties of Fabric Dyed In Aqueous Medium.

washing fastness		Dry rubbing		Wet rubbing	
Alteration	Staining	Alteration	Staining	Alteration	Staining
4	**4-5**	**4**	**4-5**	**3**	**4-5**

In table 4 dyeing was found to have very good fastness to washing and rubbing, due to the introduction of mordant in the dye bath, during the dyeing process , and the dye molecule where fixed on the available dye site on the fiber.

CONCLUSION

The percentage yield of the dye extract was found to be 71.2%, small portion of the dye extract was used to dyed fabrics under different dyeing conditions. The dyed fabrics were of different colour strength depending on the mordant and dyeing medium used.

Based on some analysis carried out the extract of the Roselle can be used in the dyeing of cotton fabric, Roselle dye extract has a very good fastness to rubbing and washing when mordant is applied in the dye bath and it was found that chrome mordant used increased the affinity of the extract on the fibre.

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