Application of Aloevera Gel as a Thickener for Reactive Printing of Cotton Fabric

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Abstract: Reactive dyes are most popular for printing of cotton. The conventional thickeners such as starch, CMC, guar gum etc. though commonly used for printing are not suitable for printing cotton with reactive dyes. Sodium alginate is most popular for printing cotton with reactive dyes. However, in Ethiopia there was be limitations in the use of sodium alginate thickener due to this there is need to find alternative thickener for reactive dye printing. Aloe vera is a natural product and available in plenty in Ethiopia. It contains a gel which can be used as a thickener. The aim of this paper is using of aloe vera gel as thickener for printing of cotton fabric with reactive dyes. From the result of this study, it can be concluded that the washing fastness properties of the printed cotton fabric samples showed that using combination of 20-gram aloe vera gel and 2.5-gram sodium alginate as a thickening agent yielded the best improvement in the fastness and staining properties of the printed samples. The use of aloe Vera gel as a substitute of sodium alginate thickener was very economical and since aloe vera is a wild plant in Ethiopia.

Keywords: Aloe Vera gel; thickener; color fastness; cotton fabric; reactive dye

1. INTRODUCTION

Printing, as an art, originated a few thousand years ago and its development continues till date. In this fast changing world, printing is most important of all the processes used at present to decorate textile materials (Pradhan et al., 2015). Textile printing is the most versatile and important of the methods used for introducing color and design to textile fabrics. The coloration is achieved either with dyes of pigments in printing paste. A successful print involves correct color, sharpness of mark, levelness, good hand and efficient use of dye; all of these factors depend on the type of thickener used. The thickener must be compatible with other ingredients present in printing paste (Chintan et al., 2016; Abo-Shosha et al., 1994; Perrin et al., 2000; Leslie, 2003).

Cotton is one of the major fibers in the textile industry because of their combination of durability, attractive qualities, and comforts their strength, softness, absorbency, and coloration ability and more than 70% of all printed substrates are cellulosic fabrics and cotton fabric is the most commonly printed substrate, and reactive dyes are the most commonly used dyes in cotton printing. Printing of cellulosic fabrics with reactive dyes continues to increase, as these dyes produce brilliant shades with very good wet fastness and levelling properties (Nahed et al., 2006; Wang et al., 2003; Zohar-Perez et al., 2004;

Kim, 2003; Mohammad et al., 2016; Townsend, 2007; Ioelovich et al., 2008; Wang et al., 2014; Šostar et al., 1998).

Thickening agents are generally high molecular weight polymeric substances that give the necessary viscosity of the color paste in water and impart stickiness and plasticity to the printing colors, thereby ensuring application to fabric surface without spreading as well as maintaining the design outlines, even under high pressure, without distortion. Textile thickeners available and used today can be broadly divided into two categories depending on their origin: natural (e.g., gum Arabic, guar gum (GG), alginate, starch, etc.) and man-made (i.e., based on modified natural polymers or wholly synthetic polymers) the most generally favored thickeners for cotton printing are modified natural products. The conventional thickeners such as starch, CMC, guar gum etc. though commonly used for printing are not suitable for printing cotton with reactive dyes. This is due to the fact that these thickeners contain free -OH groups. For this reason, the thickener should be free from -OH groups. Sodium alginate is the only thickener which meets this requirement. However, in Ethiopia there will be limitations in the use of sodium alginate thickener there is need to find alternative thickener for reactive dye printing is important (Ibrahim et al., 2003).

The aloes are perennial plants that comprise herbs, shrubs and trees (Newton, 2001). Aloe vera is a natural product and available in plenty in Ethiopia. There are 46 species of Aloe in Ethiopia in which about 66% of these Aloe species are endemic to the country. They are distributed in all floristic regions. Aloes are very important source of traditional medicine in Ethiopian communities to treat different ailments. In addition Aloes are used in soap production, jute sacks production, anti-microbial activities in cotton fabric, as thickening agent, degraded land rehabilitation and source of food for animals (Oda and Erena, 2017).

The active components with its properties of aloe vera plant are as shown in Figure 1. Aloe vera contains 75 potentially active constituents which are polysaccharides (acemannan, glactouronic acid), sugars (glucose, mannose, and galactose), Organic acids (glutamic acid, malic acid, citric acid), Enzymes (cellulose, car boxy peptidase, and catalase), Amino acids (valine, methionine, lysine, etc.), Group B vitamins and Minerals (copper, iron, potassium, magnesium, etc.) among these components polysaccharides (glactouronic acid) important used for as thickener because which is free from -OH groups. (Atherton, 1998; Amar et al., 2008; Enas, 2011; Josias, 2008; Maria, 2018; Yates et al., 2004).

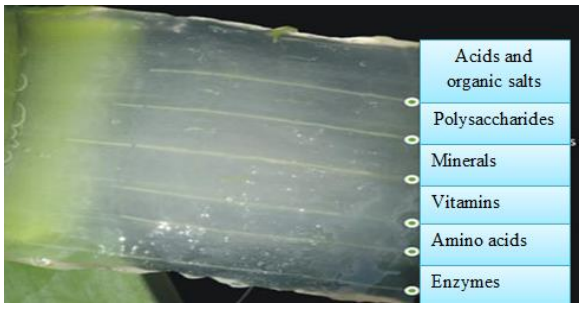

Figure 1: Components of Aloe vera plant

The aloe leaf can be divided into two major parts, namely the outer green rind, including the vascular bundles, and the inner

colourless parenchyma containing the aloe gel. The gel possesses some biological activities such as promotion of wound healing, antifungal activity, hypoglycaemic or anti diabetic effects, as well as anti-inflammatory, anticancer, immune modulatory and gastro protective properties (Chandegara et al., 2013; Tizard, 2004).

There are few studies related to the application of aloe vera gel as a printing thickener. Islam et al studied aloe vera gel a new thickening agent for pigment printing. They found that the properties of the printed fabric are good compared with conventional thickener (Islam et al., 2016). El-Zairy studied new thickening agent based on aloe vera gel for disperses printing of polyester. The results indicate that the properties of the printed fabric samples good (El-Zairy, 2011). Pradhan et al studied Printing of cotton fabric with reactive dyes using aloe vera gel as printing thickener. They found that all printed samples showed good results (Pradhan et al., 2015).

The novelty of this study is Sodium alginate is most popular for printing cotton with reactive dyes. However, in Ethiopia there will be limitations in the use of sodium alginate thickener such as it is imported product therefore its availability is limited and expensive. In order to overcome these problems, there is need to find alternative thickener for reactive dye printing. Since aloe vera is a wild plant in Ethiopia, using aloe vera gel as a substitute of sodium alginate thickener will be very economical and also being a wild plant, it will be available in plenty. Finally, the aim of the present work was undertaken using of aloe vera gel as thickener for printing of cotton fabric with reactive dyes.

2. MATERIALS AND METHOD

2.1. Materials

Cotton fabric: 100 % half bleached plain woven cotton fabric was obtained from Bahir Dar Textile Share Company, Bahir Dar, Ethiopia.

Thickener Agent: The thickeners used in the present study was natural thickener Aloevera gel which was obtained from aloe vera leaves (Bahir Dar, Ethiopia) and sodium alginate thickener which was obtained from wet processing laboratory, Textile Chemistry Research and Innovation Center, Ethiopian Institute of Textile and Fashion Technology, Bahir Dar University, Bahir Dar, Ethiopia.

Dye stuffs and other chemicals: The dye used for printing of cotton fabric was reactive dye (Remazol Red BB) and obtained from wet processing laboratory, Textile Chemistry Research and Innovation Center, Ethiopian Institute of Textile and Fashion Technology, Bahir Dar University, Bahir Dar, Ethiopia. In addition to this, urea (NH_2CONH_2), Sodium carbonate (Na_2CO_3), Soap and water were used in the present study.

2.2. Methods

2.2.1. Extraction of gel from aloe vera plant

The gel extraction from aloe vera leaves had been carried out by hand extraction technique. Figure 2 illustrates the general method of aloe vera gel preparation.

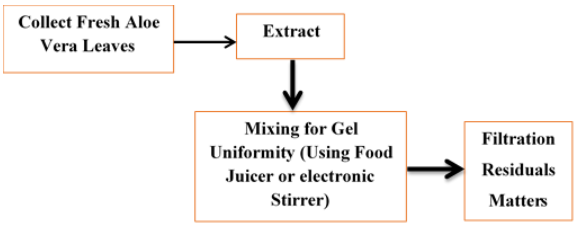

Figure 2: Preparation of aloe vera gel

2.2.2. Preparation of print paste recipe and method of printing

Three different types of thickeners combination were used; such as aloe vera gel (AG), Sodium alginate (SA) and Mixture of aloe vera gel and sodium alginate (AGSA). The printing pastes were prepared using the following recipes (Table 1):

Paste preparation: For this study the paste was uniformly mixed with a stirrer for 5 minutes at maximum speed. The actual quantity of water and viscosity of the solution was to be determined practically.

Printing: After preparing the paste and sample, the next process is application of paste on to the sample. In the study, the printing process was carried out by directly applied on cotton fabric using manual screen-printing method. After then the sample were drying and curing at a temperature of 100^{o}_{C} for 3 minutes and 150^{o}_{C} for 5 minutes respectively. Then the sample was washed, soaped at 60^{o}_{C} for 10 minutes using 5 gpl standard soap and dried using forced air-drying machine.

Table 1: Recipe for printing of cotton fabric using reactive dye

Chemical used	Concentration (%)
Recipe for only 30g aloe vera gel	
Aloe vera gel	100
Sodium carbonate	3.3
Urea	3.3
Reactive dye	3.3
Water	5ml
Recipe mixing for 20g aloe vera and 2.5g sodium alginate	
Aloe vera gel	100
Sodium carbonate	1
Urea	1
Reactive dye	1
Sodium alginate	12.5
Water	100ml hot water
Recipe for mixing 20g aloe vera gel and 5g sodium alginate	
Aloe vera gel	100
Sodium carbonate	1
Urea	1
Reactive dye	1
Sodium alginate	25
Water	100 ml hot water
Recipe for mixing 20g aloe vera and 10 g sodium alginate	
Aloe vera gel	100
Sodium carbonate	1
Urea	1
Reactive dye	1
Sodium alginate	50
Water	100 ml hot water
Recipes for 20g sodium alginate	
Aloe vera gel	0
Sodium carbonate	1
Urea	1
Reactive dye	1
Sodium alginate	100
Water	100 ml hot water

2.4. Fastness Testing

For this study washing fastness (visually evaluate change in color) was evaluated according to the ISO 105-A01 (ISO 105-A01:2010) standard.

3. RESULTS AND DISCUSSIONS

The ultimate goal of the present study was to evaluate the performance of aloe vera gel as thickener for printing of cotton fabric with reactive dyes as well as to search for the ideal optimum printing paste recipe for attaining shadier prints with better washing fastness properties, the results along with their appropriate discussion are as follows.

3.1. Different printed sample results

Printing involves localized coloration. This is usually achieved by applying thickened pastes containing dyes or pigments onto a fabric surface according to a given color design and the before and after treatment of the printed fabric sample results are as shown in Figure 3a-e.

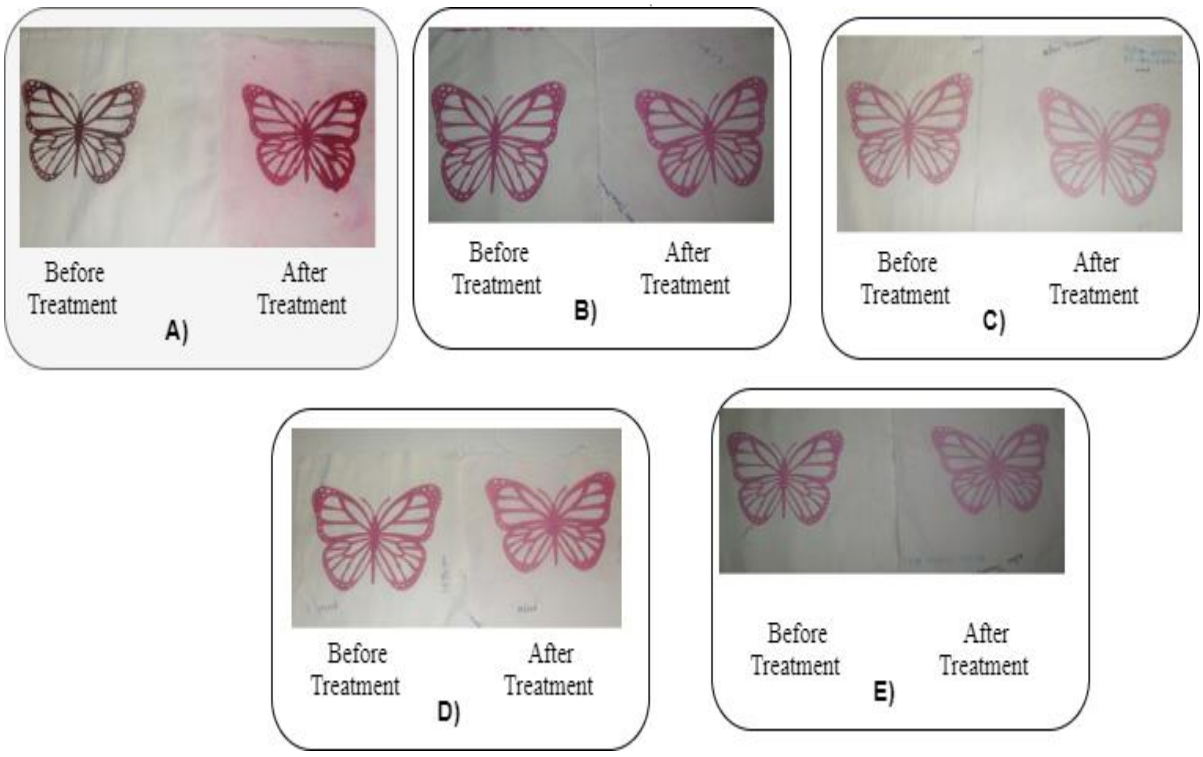

Figure 3: Printed sample using different types of thickener combination with before and after treatments A) with 20g aloe vera gel and 5g sodium alginate B) with 20 g aloe vera gel and 2.5 g Sodium alginate C) 20g aloe vera gel and 5g sodium alginate D) with 20 g aloe vera gel and 10 g sodium alginate E) 20 g Sodium alginate

3.2. Test Results of color fastness to washing

Color fastness to washing means, a specimen of the textile, in contact with one or two specified adjacent fabrics, is mechanically agitated under described conditions of time and temperature in a soap solution, then rinsed and dried. The change in color of the specimen and the staining of the adjacent fabric are assessed with the grey scales. The prints were subjected to wash, according to the standards; the results were shown in Table 2.

Table 2: Result of color fastness to washing

Sample fabric	Change value		Staining value	
	Numerical value	Remarks	Numerical value	Remarks
3a	3/5	Nearly Good	3/5	Nearly Good
3b	4/5	Good to very Good.	4/5	Good to very Good
3c	3/4	Fairly Good to Good	3/4	Fairly Good to Good
3d	4	Good	4	Good
3e	4	Good	4	Good

Figure 3 and Table 2 summarize that the effect of aloe vera and sodium alginate thickener on the wash fastness of the printed fabric. As it is clearly seen in Figure 3a, the use of 30 gram aloe vera gel as thickener results nearly good wash fastness property. Figure 3b used 20-gram aloe vera gel and 2.5-gram sodium alginate mixture and the washing fastness result is good to very good. Figure 3c also shows that when 20-gram aloe vera gel and 5-gram sodium alginate mixture were used, the result is fairly good to good. Figure 3d used 20-gram aloe vera gel and 10-gram sodium alginate; and the washing fastness result is good. Whereas Figure 3e shows fabric sample that uses 20-gram sodium alginate and the washing fastness result is good. Therefore, based on the standard range gray scale washing fastness tester best washing fastness results was obtained (Figure 3b) using mixing of 20 gram and 2.5-gram aloe vera and sodium alginate thickener respectively.

4. CONCLUSION

The present paper is using of aloe vera gel as thickener for printing of cotton fabric with reactive dyes has been investigated and the change concentration of the thickening agent of the aloe vera gel and sodium alginate has also been reported. From the basis of the experimental results, the ideal conditions for reactive printing using the new thickening system, replacing synthetic thickener, could be a combination of 20 gram aloe vera gel and 2.5 gram sodium alginate thickening agent obtained the optimum washing fastness result of the printed fabric. By physical observation and testing, the combination of sodium alginate and aloe vera gel thickener printed fabrics characteristics have good washing fastness, it is medium viscosity, it is good softness and hand feeling properties, it has high shade and color depth, after washing easily removed the chemicals and it is high color yield. Therefore, aloe vera can be used as a new thickening agent in reactive printing results in greater thickening efficiency as well as better depth and fastness properties of the obtained prints sample and also it can be considered as a substitute thickener for sodium alginate which is expensive and imported. The future study will entail on detail chemical structure of aloe vera plant and its components. The enzyme found in aloe vera gel will be identified and also the temperature that deactivates the enzyme has

to be known. The specific functions of aloe vera gel components will be investigated.

5. RECOMMENDATIONS

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