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***ALOE VERA* GEL AS A BIOMORDANT IN THE FINISHING OF VEGETABLE TEXTILES: A REVIEW**

BY

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Abstract. During the dyeing process, the color is maintained over time due to the mordant that creates a strong bond between the dye and the fiber. The most common chemical mordants are potassium alum, tartar cream, tin chloride, cupric sulfate, ferrous sulfate and potassium dichromate. The current trend of increasing nature protection requires the use of clean products for the textile finishing sector and the biodegradability of textiles. *Aloe vera* is known to be a natural mordant. Based on data from the literature, the authors of this paper aimed to identify several behaviors between *Aloe Vera* gel and textiles. *Aloe vera* gel macerated on *Sida rhombifolia* shows (with the residue in the oven) after IR analysis a disappearance of peak 1029 cm⁻¹ which indicated the degree of C-O-C bonds of cellulose present in the modification of *Sida rhombifolia*. The active ingredients of *Aloe vera* have also been shown to bind to the hydroxyl groups of cotton, which is a crosslinking agent for macromolecules.

Keywords: *Aloe vera* gel, finishing, vegetable textile, biomordant.

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1. Introduction

Mordanting, which consists of the addition of chemical substances, has the function of creating a chemical bridge between the textile and the dye. To mordant a textile, metallic salts, called mordants or fixers, are necessary (Ghaheh *et al.*, 2021). The most common chemical mordants are potassium alum, cream of tartar, stannous chloride, cupric sulphate, ferrous sulphate and potassium dichromate (Nsangou *et al.*, 2021). Textile effluents are a source of pollution of water and even of the environment in general (Ambomo, 2016). The current trend of increasing respect for nature requires biodegradability of textiles and non-polluting products for textile finishing. The protection and improvement of the environment is a matter of major importance that affects the well-being of people and the economic development of the whole world (Principle 2 of the United Nations Conference on the Environment (1972)) (Nsangou *et al.*, 2021). *Aloe vera* gel (Fig.1(a)) is the transparent mucilage contained in the parenchymal cells of the fresh *Aloe vera* leaf (Soriano, 2016). It is used in finishing (Nsangou *et al.*, 2021; Mosaad, 2021; Ibrahim *et al.*, 2017; Nsangou, 2020; Hetal *et al.*, 2020; Güneşoğlu *et al.*, 2014) because of its antimicrobial properties.

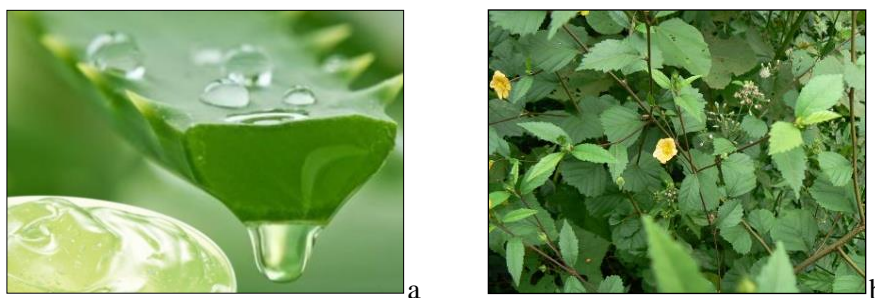


Fig. 1 – (a) *Aloe vera* plant and gel; (b) *Sida rhombifolia*.

Aloe vera gel is an antimicrobial due to fumaric acid (Nsangou, 2021; Soriano, 2016). It has been tested and shown to be effective against four common bacteria: *Staphylococcus aureus*, *Streptococcus*, *Escherichia coli* and *Salmonella*. It would therefore be effective against both gram plus and gram minus bacteria. The antifungal activity of *Aloe vera* has also been tested in different studies. It has been shown to be effective against various types of fungi, including the links with *Candida albicans* and *Trichophyton rubrum* (Ambomo, 2016; Jia *et al.*, 2008). The objective of the study is to identify a set of behaviors and connections between *Aloe vera* gel and textiles in the literature. Ultimately, the aim is to develop tools to take better advantage of biomordants to improve our environment, health and production yield.

2. Methodology

2.1. Data collection and knowledge synthesis

The source of information for this meta-analysis is a set of scientific articles, dissertations dealing with the issue of application of *Aloe vera* gel on plant textile. The databases used are Google Scholar, and ResearchGate. A series of keywords were used to carry out this information search. These keywords are:

- *Aloe vera* gel
- Plant-based textile
- Natural fixative
- Biomordant

2.2 Comparison criteria

The research studies that were selected for this meta-analysis are those dealing with the attachment of *Aloe vera* to plant-based textiles. These studies provide a formal methodology that allows the data from different studies to be brought together and analyzed according to transparent criteria.

3. Results

A total of 13 studies offered accessible results and all of them presented usable numerical data, *i.e.* evaluated the fixation of *Aloe vera* gel on textiles. This evaluation will be carried out through the pre-treatment of natural textiles, the analysis of the gel as a dispersing agent for textile dyes and as a natural textile fixative (Table 1).

This Table1 shows that out of eight (8) references, seven (7) present results on the fixation of *Aloe vera* on cotton textile and one on aids *Rhombifolia fibre*. It showed (Nsangou, 2020) through a Fourier transform infrared test on *Aloe vera* macerated on *Sida rhombifolia* that the disappearance of the 1029 cm^{-1} peak which indicated the stretching of the C-O-C bonds of the cellulose presents the modification of the *Sida rhombifolia* (Nsangou *et al.*, 2021).

It has been demonstrated and thus confirmed by experimental data of other researchers (Hetal *et al.*, 2020) that the active ingredients of *Aloe vera* bind to hydroxyl groups, which is a crosslinking agent of macromolecules (Hetal *et al.*, 2020).

The mordant creates a strong bond between the plant dye and the fiber to be dyed so that the dye color holds over time. The mordant is the fixative and *Aloe vera* is one such mordant. *Aloe vera* gel contains a salty substance that allows it to be used in natural and ecological dyeing (Mosaad, 2021; Ibrahim *et al.*, 2017; Srivastava, 2011).

Table 1
Comparison of Aloe vera gel on the different fibers mentioned above

Vegetable textiles	Natural textile fixative	Pre-treatment of textiles	Dispersing agent for textile dyes	References
Cotton	<i>Aloe vera</i> is used as a dye fixative in dyeing and printing because it contains a salty substance that allows its use in natural and ecological dyeing	<i>Aloe vera</i> is enzymatic (catalase, amylase) and gummy facilitating pretreatment and printing	<i>Aloe vera</i> is used in the dispersion of dye	Ibrahim <i>et al.</i> , 2017; Mondal <i>et al.</i> , 2021; Nsangou, 2020; Hetal <i>et al.</i> , 2020; El-Zairy, 2011; Srivastava and Shinyg, 2011
<i>Sida rhombifolia</i> Fig. 1(b)	the active ingredients of <i>Aloe vera</i> bind with hydroxyl groups which is a cross-linking agent of macromolecules			Nsangou, 2020

The same Table 1 shows that *Aloe vera* is used in the pre-treatment and printing of cotton fabric because of its succulent enzymatic and gummy characteristics. But this result from Table 1 confirms the reaction of *Aloe vera* on cotton and *Sida rhombifolia*. Can we generalize to other plant fibers (flax, hemp, rummy)? From this question comes new work:

- The test for the fixation of *Aloe vera* gel on flax plant textile fiber.
- *Aloe vera* gel fixation test on hemp plant fiber.
- *Aloe vera* gel fixation test on ramie plant fiber.
- The test for the fixation of *Aloe vera* gel on jute plant fiber.

4. Conclusions

Studies in the literature have revealed many connections between *Aloe vera* gel and textiles. Thus, it can be said that *Aloe vera* is a natural mordant. *Rhombifolia* macerated *Aloe vera* gel shows with the test in the infrared oven a disappearance of peak 1029 cm^{-1} which indicated the extension of the C-O-C bonds of the cellulose present in the modification of AIDS *Rhombifolia*. *Aloe vera* has also been shown to bind to the hydroxyl groups of cotton, which is a crosslinking agent for macromolecules. The mordant creates a strong bond between the vegetable dye and the dye fiber, so that the dyed color is maintained

over time. *Aloe vera* gel contains a salty substance that allows it to be used in natural and ecological painting. We hope to be able to generalize to other vegetable fibers (flax, hem, rummy), too.

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GELUL DE *ALOE VERA* BIOMORDANT ÎN FINISAREA FIBRELOR VEGETALE: REVIEW

(Rezumat)

Pe parcursul procesului de vopsire, culoarea se menține în timp datorită mordantului care creează o legătură puternică între colorant și fibră. Cei mai frecvenți mordanți chimici sunt alaunul de potasiu, crema de tartar, clorură de staniu, sulfat cupric, sulfat feros și dicromat de potasiu. Tendința actuală de creștere a protecției naturii impune utilizarea de produse curate pentru sectorul finisajelor textile și biodegradabilitatea textilelor. *Aloe vera* este cunoscut a fi un mordant natural. Pe baza datelor din literatură, autorii acestei lucrări și-au propus să identifice mai multe comportamente între gelul de *Aloe vera* și textile. Gelul de *Aloe vera* macerat pe *Sida rhombifolia* prezintă (cu reziduul în cuptor) după analiza IR o dispariție a vârfului 1029 cm^{-1} care a indicat gradul de legături C-O-C ale celulozei prezente în modificarea *Sida rhombifolia*. De asemenea, s-a demonstrat că ingredientele active ale *Aloe vera* se leagă de grupările hidroxil ale bumbacului, care este un agent de reticulare pentru macromolecule.