Exploring the Potential of Banana Sap as Dye for the *Adinkra* industry in Ghana

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Abstract

A study was carried out to explore the potential of banana sap as a dye for the Adinkra industry in Ghana. Pseudostem extract of banana and stem bark extract of *Bridelia micratha* were compared as dyeing stuff. A consumer preference study was also conducted to assess the acceptability of the products developed. The results revealed that a combination of banana sap and *B. micratha* dye ensures a high levelness on fabrics. It also showed that banana sap could serve as a good mordant. The result on consumer acceptability showed that product from 50% by volume of banana sap and 50% of *B. micratha* recorded a good acceptance by manufacturers. The colour of the cloth which was deep brown colour was also preferred by many people as a peculiar product used by royals. The results showed that dyes with no or little of *B. micratha* dye inclusion showed no sign of solidification. It could be concluded that equal volumes of banana sap and *B. micratha* dye could be used for the *Adinkra* industry as an alternative for the sole *B. micratha* dye that requires a mordant. This would reduce the cost of buying and using synthetic dyes. Further study should be conducted to explore the potential of other banana and plantain saps as a dyeing agent for the Adinkra industry in Ghana.

1. Introduction

Apart from its use as a desert fruit and for culinary purposes, the banana plant has multifaceted uses. The leaf is commonly used as a hygienic dining plate; the male flower is a favorite vegetable; the inner core at the pseudostem is a popular vegetable, with many therapeutic uses; the sap is used as an indelible ink in industry and the underground rhizome is exploited as animal feed in a composite mixture with other feedstuffs.

It is generally accepted that banana sap can be obtained from the pseudostem, the peels, or from the flesh. Banana sap has some special properties relating to various phenomena such as permanent staining of cloth and fiber and anti-bleeding and antioxidant properties. Analysis of banana sap using high performance of liquid chromotography-electrospray ionization- mass spectrometry (HPLC-ESI-MS) indicated the presence of phenolic and aromatic compounds (Pothavorn et al., 2010). These phenolics are known to be responsible for the astringency of banana before ripening, and for certain browning reactions (Robinson, 1999). Browning in banana is linked to enzymatic oxidation of phenolics of which dopamine is the main and polyphenoloxidase is the enzyme responsible (Stover and Simmonds, 1966; Jayaraman et al., 1983). The primary substrate for browning reaction, of which latex staining is commercially important is dopamine (Stover and Simmonds, 1966). The sensitivity of browning differs between cultivars (Jayaraman, et al., 1983).

It is a common phenomenon to get your dress stained with banana sap when your work on the plantation. The stain is often permanent and cannot be removed by any detergent or soap. It is evident that the staining does not often appear but becomes conspicuous when the fabric is washed with water. This characteristic shows that the sap has the potential as a dyestuff.

As a dyestuff, the molecule of banana sap is able to adhere to cloth that makes it stain very well. The use of banana sap as a cloth dye is eco-friendly. Nowadays, people are consciously concern about their health and the global environment, so they require safe and eco-friendly product (Ali, et al., 2008). With the use of synthetic dyes, during hydrolysis or a redox reduction, some arylamine compounds, carcinogic or allergic

to human beings are released (Bhattacharya, 1992).

Cloth dyed using banana sap produce a dark brown color that has a good colorfast. The local *Adinkra* textile industry depends on imported dye as well as on locally produced plant dye from *Bridelia micratha* for its survival. The unsustainable harvesting of the *B.micratha* has negative effect on the environment. Currently it known that users of the plant species have to travel to the Brong-Ahafo - Northern region fringes to harvest the plant. Inhabitants of Ntonso craft village who are into cloth dyeing in the kente industry rely on the use of synthetic dye to dye cloths and factory-produced fabrics to make *adinkra* cloth. *Adinkra* cloth is a colorful, hand painted and hand-embroiled cloth used for mourning by Akan people of Ghana and the Gyanmam of Cote d'Ivoire (Willis, 1998). The use of some synthetic dyes to dye cloths result in colour lose through bleaching when washed in water and crocking when rubbed. The coloured factory-produced fabric used by cloth dyers are costly and makes the price of *Adinkra* cloth high.

It is evident that Ghana is the largest producer of plantains and bananas in West Africa. The fruits are mainly harvested for food. The pseudostem and leaves are left to rot. It is known that the pseudostem can be used as fibre and other purposes but this is not exploited in Ghana. The use of banana sap as cloth dye can serve as attractive alternative to the synthetic dyes, Mordant (fixatives) and other addictives are imported and therefore relatively expensive. Banana sap does not also bleach in water when washed or crock when rubbed. The objective of this study was to explore the potential of banana pseudostem sap as a dyeing agent for the *Adinkra* industry and the acceptability of the product by consumers.

2. Materials and Method

The study was conducted at the *Adinkra* industry at Ntonso Kente Village in the Ashanti Region. The pseudostem of red banana was used. Fresh pseudostem of the red banana was cut from a garden using cutlass. The pseudostem was weighed using a weighing scale to obtain a mass of 15 kg. The 15 kg of the pseudostem was washed in a large pan to remove all debris. The pseudostem was chopped into small pieces. The small pieces of the pseudostem were pounded using a large mortar and pestle for 10 minutes. The pounded mixture was put into a nylon stocking and the top shut was tied hardly to extract sap into a stainless steel container. The quantity of sap extracted was weighed and a mass of 9 kg was obtained using a weighing scale.

The Bridelia dye was made by chopping the bark off a tree called *Bridelia migrant* of the family Euphobiaceae. The bark was normally boiled in water as done by the local people and the colour of the bark extracted into the water. About 10 kg of the Bridelia dye was obtained from the dye-makers. Plain white cotton cloth of a yard each was used for the dyeing process.

Two types of dyes, namely Banana sap and *Bridelia micratha* dye were used. In all five treatments were used. The treatments applied were 50% of Banana pseudostem sap and 50% of *B. micratha* Bridelia dye were mixed together (T_1), 30% of Banana sap and 70% of *B. micratha* dye were mixed together (T_2), 30% of *B. micratha* dye and 70% of Banana sap were mixed together (T_3), sole of Banana sap only (T_4), sole of *B. micratha* dye only (T_5).

The dye solutions were stored in transparent plastic containers set aside and used as the dye baths. The dyes were kept in a cool dry place and were prevented from the sun rays to avoid evaporation and any possible reaction. The dye baths were covered to prevent colour change resulting from an inclusion of any foreign substance.

The method of dyeing employed was batch dyeing. In this process of dyeing, the textile is circulated through the dye bath. The process has good flexibility in terms of colour selection and the cost involved in dyeing is low. The pieces of the cotton cloths were immersed separately into the dye solutions with a rubber glove on the hands. All portions were exposed to the dye solutions in the dye baths by circulating the cloths in the dye baths. The cloths were allowed to soak in the dye solutions for 12 hours to ensure that deep and rich colours were obtained. After 12 hours, the cloths were removed from the dye solutions and the two ends of the materials were held for 30seconds to ensure the excess dye solution in the materials drain into the dye baths. No squeezing excess moisture from the material after dyeing was done as this will introduce streaks and wrinkles that are difficult to remove. The cloths were later hanged in fresh air to dry. After drying, they were immersed again in the dye solutions for 2 hours and later hanged in the sun to dry. This operation of dyeing was repeated for seven days.

A consumer acceptability study was conducted in the Ntonso kente village. A total of ten *Adinkra* manufacturers were selected to evaluate the acceptability of the products. Questionnaires were administered after displaying the products for choice by the *Kente* and *Adinkra* manufacturers. Coded products were displayed for assessment.

3. Results and Discussion

The results showed that dyeing the piece of plane white cloth using a mixture of 50% by volume each of banana sap and Bridelia dye resulted in a blight dark brown colour. Dyeing cloth with a mixture of 30% of banana sap and 70% of Bridelia dye gave a deep brown colour. Also, dyeing the cloth

with a mixture of 30% of bridelia dye and 70% of banana sap produced a deep dark brown colour. Sole banana sap only resulted in a dark brown colour. Also, dyeing cloth with sole Bridelia dye only resulted in brown to black or nearly black colour (Table 1).

The result revealed that the presence of banana sap extended the shelf-life of Bridelia dye. The sole Bridelia dye could store for seven days whereas in combination with banana sap, it could store between 14 and 21 days (Table 2).

The result revealed that banana sap improved the levelness of the dyeing with Bridelia sap as all the streaks developed in sole Bridelia were absent in the sole banana and combination of banana and Bridelia. It could be deduced that that adding banana sap to natural dyes will ensure a high levelness on fabrics. The table also reveals that cloths with the deep brown, dark brown and deep dark brown colours did not bleed or lose their colours when washed in cold water. This might be resulted from the inclusion of banana sap in the dyes which serves as a good mordant. This makes the use of banana sap as a good mordant and as a direct or substantive dye. This is in assertion with Cegarra et al. (1992) that, direct dye are so called because they dye cellulosic fiber without the need for mordant; they are also known as substantive dye because they possess the property of being able to dye fibers without being removed by subsequent washing.

Table 1: Colour formation of banana sap dyeing agent

Treatments	Resultant colours
T_1	Deep dark brown
T_2	Deep brown
T_3	Blight dark brown
T_4	Dark brown
T_5	Brown to black (chocolate colour)

Table 2 : Longevity of banana and Bridelia dye

Dyes	Place of storage	Containers used	Number of days covered before solidifying
T_1	Cool dry place	White plastic container	14-21 days
T_2	Cool dry place	White plastic container	7-14days
T_3	Cool dry place	White plastic container	14-21 days
T_4	Cool dry place	White plastic container	14-21 days
T_5	Cool dry place	White plastic container	7 days

The results further showed that all the cloths produced did not lose their colours during storage and use. This might have been resulted from the addition of the slag added during the extraction of the Bridelia dye. Kodolph (2007), is of the view that colourfastness are dyes and prints that do not shift hue or fade when exposed to light and other environmental factors and that do not move into other fabrics or materials during storage, processing, use or care.

The slag is used as a mordant, a substance added to fix the colour or maintain the original colour of the dark. This finding also confirms that, the sap from banana pseudostem can serve as a good mordant. This ability of the banana sap when exploited can prevent hue or fade when dyed fabrics are exposed to light and other environmental factors. Also the colours would move into other fabrics or materials during storage, processing or use.

About 40% of the respondents selected the product of 30% by volume of the banana and *B.micratha* combinations as the best. They ascribe the reason that that particular colour was expensive on the market. The 50% by volume combination and the 70% banana sap products were ranked second. The respondents were of the view that those colours were no longer available and hence expensive. They stated these were colours that were often used in the past by the royals of the Ashanti kingdom for funerals. Currently, they no longer exist. They concluded that they were grateful for the study and the new revelation that they could use readily available material for the dyeing process.

4. Conclusion

Banana sap can serve as an alternative for the Bridelia dye used in local *Adinkra* cloth industry in Ghana. The banana sap is a good mordant for the dyeing local industry. It can also prolong the shelf-life of the local dyes developed.

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