IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252

Preparation of Heavy Metal Dyes Using Musa Sapientum Paradisiaca (Banana) and Study It's Fastening Property

Mandar D. Joshi[1], Yogesh A. Pawar[1], D. D. Godkar[1], D. B. Shinde[1], Ajay P. Nikum[1*]
Shri Pancham Khemraj Mahavidyalaya, Sawantwadi, Maharashtra, India
apnikum@gmail.com[1*]

Abstract: *Generally dye is a coloured substance that chemically bonds to the substrate to which it is applied. Dye is generally applied in an aqueous solution and may require mordant to improve the fastness of the dye on the fiber. Banana plants, which belong to the family of Musaceae, are native to the Malaysia-Indonesian region of South-East Asia. When the banana stem or leaf came in contact with our clothes banana leaf or stem or bark it stains our clothes. These stains are blackish or brownish in colour. This property of the staining the cloth we have to investigate the various metal complex of this banana stem and study their dying behavior for the fibre. The above study for the banana stem extract we have for the various metal complex i.e. copper, cobalt nickel, zinc, manganese, Titanium, aluminum at various pH depend on the complex formation behaviours of particular metal at particular phthises complex are study for the dying behavior for the fiber i.e. cotton and study their fastening property over the washing and sunlight, where we found that these various metal complex with banana stem extract shows the various shades of the colour. From this general observation we concluded that there is some dyeing ability in the bark of banana or in the stem of banana tree. 'The heavy metal dye by using Musa Sapientum Paradisiaca (banana tree) Stem'. Which shows different colour shade according to which metal ion solution to be used for the complex formation. The Various pH solution to be used for the Complex Formation according to heavy metal ion. Because every Metal forms the complex with legand at particular pH. The dye Shows Green, yellow, Brown, White colour with respect to metal ion. After staining these complex over the cotton it will stable at the shade but when treated with washing and sunlight the dye is found as temporary dye. On the basis of these result we can use these dye where the temporary dye is required such as temporary marker for the board.*

Keywords: Banana, Dye, Metal Complex, Fastening Property

I. INTRODUCTION

Until the 1850's virtually all dyes were obtained from natural source, mast commonly from vegetables, such as plants, trees. Solid evidence that dyeing method are more than 4000 yr old has been provided by dyed fabric found in Egyptians tombs ancient hieroglyphs describe extraction and application of natural dye from brightly coloured plants and flowers yet only a dozen or so natural dye found widespread use. Undoubtedly most attempt failed because most natural dye are not highly unstable, the successful separation of which would be unlikely by the crude method employed in ancient times nevertheless studies of these dyes in the 1800 provided a base for development of synthetic dyes which dominated the market by 1900 (1)

World appears an aesthetic place due to colours that are present around us. These are either natural or man mode. The lush green appears to our eyes, so does a blood red sports car since industrializations industries have strived to enhance the appearance of manmade product that surround us. Dye are primary responsible for the colour of clothes and fabric we use.(2) The colour of a dye is dependent upon the ability of the substance to absorb light within the visible region of the electromagnetic spectrum (380-750 nm). An earlier theory known as witttheory(3) stated that a coloured dye had two components, a chromophores which imparts colour by absorbing light in the visible region and an auxo chrome which serves to deepen the colour. This theory has been superseded by modern electronic structure theory which states that the colour in dyes is due to excitation of valence π-electrons by visible light.(3)

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252

Several methods can be used to extract cellulose fibers from their biomass sources, which are steam explosion treatment, alkali treatment, enzyme treatment, and liquefaction. The properties of alkali-treated banana stem fiber have been studied. The treatment of the fiber with 18% NaOH has enhanced the breaking elongation of fiber. This caustic treatment also resulted in length shrinkage, with the maximum shrinkage found to occur within 20 min of the alkali-treatment, after which there was only very little shrinkage. The length shrinkage has been found to be proportional to the weight loss. The weight loss is mainly due to the removal by caustic treatment of hemicellulose component and other substances. However, with an alkali-treatment, the banana stem fiber also experienced a decrease in dynamic modulus. This decrease can be related to structural change caused by alkali treatment. The diameter of the fiber increased by the caustic treatment by 15–100%, which resulted in bundle fiber bulk improvement.[4] All parts of the banana plant have some medical added values, such as the flower can be cooked and consumed by diabetics, bronchitis, dysentery, and ulcer patients. The banana pseudo-stem sap can be orally taken or externally applied for stings and bites. The young leaf can be used for skin irritations (as a poultice). The roots, ashes of leaves, peels, and seeds also can be used for medicinal purposes in some countries. In recent years, banana fruits have been the fourth most important fruit crop produced in the world. [5]

The most widely known banana plant species for its fibre is Abaca (*Musa textiles*). Its fibre is highly important among the leaf fibre group, whereas the most common banana that is consumed by humans is a member of *Musa acuminata* species the photograph of banana tree and its several parts. The pseudo-stem of banana plant is the stem of banana plant that provides and transports nutrients from the soil to the fruits. This pseudo-stem will be cut and become waste biomass after the banana fruit is ripe and harvested, because the banana plant is unusable for the next harvest for every ton of banana fruit harvested, about 100 kg of the fruit is rejected (i.e., rotten fruit) and approximately 4 tons of biomass wastes (e.g., leaf, pseudo-stem, rotten fruit, peel, fruit-bunch-stem, rhizome, etc.) are produced. This means, for every cycle of banana fruit production, four times of biomass wastes are also produced. Based on another literature, it can be estimated that one hectare of banana farm could produce approximately 220 tons of biomass wastes). These wastes are usually disposed of by the farmer into lakes and rivers or simply burned. The banana tree wastes if not properly managed can cause problem to the environment, because if they are dumped in wet conditions or burned can produce greenhouse gas, which can cause a problem to the environment. It is believed that this crop waste can be used in a more rational way, namely, as a source of cellulose fibre for further applications. Presently there is a great demand for the use of natural colours throughout the world due to non-biodegradable and carcinogenic nature associated with synthetic dyes [6] are not produce any undesired by-products and at the same time they help in regenerating the environment, therefore natural dyes are the safe dyes [7] of Germany was the first to take initiative to put ban on azo-dyes for manufacturing, dyeing and importing textiles and other consumer goods dyed with these dyes from January 1, 1995 by the act of German Legislation Netherlands followed a ban with effect from August 1, 1996 on similar lines. European Union is likely to impose ban on these toxic dyes shortly. India has also banned the use of specific azo-dyes and under notification ―sufficient legal teeth‖ had been given for taking panel action against those who use these dyes [8]

Natural dyes are important since they are better than synthetic dyes in many ways. Undeniably, the natural dyes are healthier products, purely because they do not comprise chemicals damaging to fitness.

The stability of metal complex generally means that it exists under favourable conditions without undergoing decomposition and has a considerable shelf life period.The term stability of metal complex cannot be generalized since the complex may be stable to one reagent/condition and may decompose in presence of another reagent/condition. The stability of metal complexes can be explained with the help of two different aspects, namely, thermodynamic stability and kinetic stability. Nevertheless, a metal complex is said to be stable if it does not react with water, which would lead to a decrease in the free energy of the system, i.e., thermodynamic stability. On the other hand, the complex is said to possess kinetic stability if it reacts with water to form a stable product and there is a known mechanism through which the reaction can proceed. For example, the system may not have sufficient energy available to break a strong bond, although once the existing bond is broken it could be replaced by new bond which is stronger than the older one.Stability of complex compound is assigned to be its existence in aqueous solution with respect to its bond dissociation energy Gibbs free energy, standard electrode potential, pH of the solution, and rate constant or activation energy for substitution reactions[8] pH Most legends are basic and bind to H^+ ions throughout a wide range of pH some of these H^+ ions are frequently displaced from the legends (chelating agents) by the metal during chelae formation. Thus, stability of metal complex is pH dependent. In the formation of metal complexes in an aqueous medium, equilibrium constant or stability constant is used to determine the strength of

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252

interaction between reagents that make the final product after the formation of bonds. In general stability means that a complex may be stored for a long time under suitable conditions or this compound may be existing under suitable conditions. Regarding how much is the concentration of complexes in solution, stability constant provides this information via calculations. These calculations are very much important in many areas of science like chemistry, biology, and medicine. During the complex formation in aqueous medium, two types of stabilities are considered: one is the thermodynamic stability, and the other is kinetic stability. Stability of metal complexes may be affected by various factors like nature of central metal ion and ligand, chelating effect, etc., and some parameters like distribution coefficients, conductance, refractive index, etc. are useful for the determination of stability constants. Various modern techniques are used to determine the stability constant of simple as well as mixed ligand compounds. [(9)]

Colourfastness definition is that the ability to keep original dye colour under the influence of other kinds of external factors in the use processes of dyeing textiles. Or we can define colour fastness like this: Colour fastness refers to the resistance of colour to fade or bleed of a dyed or printed textile material to various types of influences e.g. water, light, rubbing, washing, perspiration etc. It is an important indicator to measure the quality of dyeing products.[(10)]

As many dyes are in the form of glycosides, these can be extracted under diluteacidic or alkaline conditions. The addition of the acid or alkali facilitates the hydrolysis of glycosides resulting in better extraction and higher yield of colouring materials. An acid hydrolysis process is used for the extraction of dye from tesu (Buteamonosperma) flowers. Acidified water is also used for extracting someflavone dyes to prevent oxidative degradation. Alkaline extraction is suitable for dyes having phenolic groups as they aresoluble in alkali, which improves the dye yield. Dyes can be later precipitated bythe use of acids. Dye from annatto seeds can be extracted by this technique. This process is also used to extract lace dye from lace insect secretions and red dye from safflower petals. The disadvantage of this process is that some colouring materials may be destroyed under alkaline conditions considering the fact that some of the natural dyes are pH sensitive. Inasmuch as natural dyes are usually a mixture of different chemical constituents, changing the pH of the extraction medium by adding acid or alkali can lead to the extraction of different dye constituents which can lead to different hues upon subsequent dyeing and differences in colourfastness properties. Many researchers have studied the extraction of natural dyes under various pH conditions and compared the colour and fastness properties of dyed fabric to find out the optimum dye extraction conditions and further additions to this information continue to be made every year in the scientific literature.

The term “acid dye” derives from the dyeing process, which is carried out in an acidic aqueous solution (pH 2.6). Acid dyestuff is so called mainly due to two reasons. In the first place these classes of dyestuff were applied in a bath containing mineral or organic acids like sulphuric, acetic or formic acid and secondly most of them are sodium salts of organics acids. Acid dye was made by Nicholson in 1862 by treating an insoluble dye. They are commonly used for dyeing protein fibers (e. g. wool and silk) and **nylon fibers**. Acid dyes are anionic in nature, and their negatively charged anions are attracted by positively charged amino groups in wool under acidic conditions[(11)]. A common property of these dyes is their mechanism of interaction with the fiber polymers, which leads to strong binding of the dye to the material. The binding of the dye at least partly can be understood to follow an ion exchange mechanism. Ionic bonds are formed between charged groups present in the fiber polymer and the charged dyestuff molecule. The dyes are important for colouration of protein fibers (wool, silk) and polyamides, which contain ammonium groups at low pH. The amount of ammonium groups in wool can be assumed with 850 mmol/kg, in silk with 250 mmol/kg and in polyamide with 30– 50 mmol/kg.These cationic groups serve as binding anchor to build an ionic bonding with negatively charged groups, for example, sulphonate groups in the acid dye and metal complex dye

Basic dye, also known as basic group dyes, is the salt generated by aromatic bases reacting with acids (organic and inorganic acids), videlicet that is coloured organic base salts whose basic group is generally amino, which becomes -NH2 • HCl salt groups when the salt occurs. The groups dissolve in water, dissociated into dye cations and acid anions. Thus the dye is also known as cationic dyes.[(12)]

II. METHODOLOGY

2.1 Water Extract Preparation

The stem of banana wash carefully with distilled water to remove the dirt. chop the stem in to the small pieces and crush it. after crushing weigh exactly 10 gm of sample. transfer in to the beaker, add 1 test tube of particular buffer solution of pH 4-11 (buffer solution varies according to metal solution. because every metal make the complex at particular pH)Most

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252

legends are basic and bind to H^+ ions throughout a wide range of pH) Some of these H^+ ions are frequently displaced from the legends (chelating agents) by the metal during chelae formation. Thus, stability of metal complex is pH dependent. In the formation of metal complexes in an aqueous medium, equilibrium constant or stability constant is used to determine the strength of interaction between reagents that make the final product after the formation of bonds. In general stability means that a complex may be stored for a long time under suitable conditions or this compound may be existing under suitable conditions. Regarding how much is the concentration of complexes in solution, stability constant provides this information via calculations. These calculations are very much important in many areas of science like chemistry, biology, and medicine. During the complex formation in aqueous medium, two types of stabilities are considered one is the thermodynamic stability, the other is kinetic stability. Stability of metal complexes may be affected by various factors like nature of central metal ion and ligand, chelating effect, etc., and some parameters like distribution coefficients, conductance, refractive index, etc. are useful for the determination of stability constants. Various modern techniques are used to determine the stability constant of simple as well as mixed ligand compounds.[13][14]After addition of buffer solution add 100 ml of distilled water. heat the solution on wire gauze for about 10 min.

After heating, add 10ml of 0.1M metal solution. Transfer the solution in 250 cm^3 round bottom flask, shake well and attach the spiral condenser to the round bottom flask, reflux the solution for about 1 hour. To the hot Condition filter the solution and collect the extract.

Fig no. 1 application of banana

III. LITERATURE REVIEW

In the recent past, banana fibers had a very limited application and was primarily used for making items like ropes, mats, and some other composite materials. With the increasing environmental awareness and growing importance of eco-friendly fabrics, banana fiber has also been recognized for all its good qualities and now its application is increasing in other fields too such as apparel garments and home furnishings. However, in Japan, it is being used for making traditional dresses like kimono, and kamishimo since the Edo period (1600-1868). Due to its being lightweight and comfortable to wear, it is still preferred by people there as summer wear. Banana fiber is also used to make fine cushion covers, Necties, bags, table cloths, curtains etc. Rugs made from banana silk yarn fibers are also very popular world over. [15]

Dyes, particularly natural dyes, have held untold importance in our lives for thousands of years, providing not only aesthetic satisfaction but utilitarian uses as well. The oldest and most widely used dye is indigo, which has been used in india for the last four thousand years. Natural dyes are dyes or colourants derived from plants, animals, or minerals. Furthermore, biological sources such as vegetables and fungi provide the majority of natural dye production.

First, the colours produced by natural dyes and pigments are **vibrant**. Next, they are not only biodegradable but nontoxic and nonallergic too. This means that they are much better for the environment and for use around humans. It is easy to extract the natural colour from plants, fruits, or flowers. Many natural dyes also have antimicrobial properties, making them safer for kids in particular.[16]. Additionally, natural dyes neither contain harmful chemicals nor carcinogenic components, common to artificial or synthetic dyes. By using natural dyes over these other choices, you are helping preserve the environment and lowering human dependence on harmful products. When toxic runoff and residuals from the textile manufacturing and dying process often end up in our delicate oceans, we should do all we can to ensure we are using the nontoxic alternative, natural dyes.[16]. Another interesting advantage of natural dyes is that they provide **higher uv absorption** in the fabrics they are used on. By wearing clothes dyed naturally, you are able to more fully protect your skin from the sun's harmful rays. Natural dyes are considered to be eco-friendly as these are obtained from renewable resources

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252

as compared to synthetic dyes which are derived from non-renewable petroleum resources. These are biodegradable and the residual vegetal matter left after extraction of dyes can be easily composted and used as fertilizer. They produce soft colours soothing to the eye which are in harmony with nature In addition to these environmental benefits, natural dyes also offer functional benefits to the wearer and users of such textiles. Many of the natural dyes absorb in the ultraviolet region and therefore fabrics dyed with such dyes should offer good protection from ultraviolet light. Improvement in UV protection characteristics of natural cellulosic fibres after treatment with natural dyes[17]the treatment withtannins during mordanting itself improved the UV protection of fabrics, the extracts of tannin-rich pomegranate rind showed strong absorption in UV region and cotton fabrics treated with these extracts showed excellent UV protection which was durable to washingAs cotton andothercellulose's are frequently treated with tannins in the mordanting step during dyeing with natural dyes, it is likely that such dyed fabrics would also show goodUV protection. Many of the natural dye materials possess antimicrobial properties.Therefore, textiles dyed with such materials are also likely to show anti-microbialproperties and the same has been reported by many researchersboth UV protection and antibacterialactivity for polyamide 6 fabrics after treatment with natural dyes. Fabricsdyed with some natural dyes have been to be free of odourperhaps due to the antibacterial or bacteriostatic properties of natural dye materialsnatural dyed fabrics have also found such fabrics to be mosquitorepellent and/or moth repellent as perhaps the plant material from which thesedyes were derived might also have contained natural repellent substances. Inaddition, recently, cellulosic textiles treated with natural plant extract have beenfound to exhibit flame-retardant properties. Many natural dyes such as myrobolon fruits, turmeric, manjishth root, Arjuna(Terminalia arjuna) bark, and safflower florets, among others possess curativeproperties and have been used in various traditional medicinal systems. Textilesdyed with these materials may also possess healing properties by absorption ofmedicinal compounds through the skin. Textiles produced in Kerala, India bydyeing with herbs as per the traditional Ayurvedic system of medicine and knownas ''Ayurvastra'' have become very popular as health and well-being textiles and also as medicinal or curative textiles and are being exported to various countries.Various companies are now marketing naturally dyed textiles as health and wellbeing textiles.[18]

IV. Results and Discussion

'The heavy metal dye by using *Musa Sapientum Paradisiaca* (banana tree) Stem'. which shows different color shade according to which metal ion solution to be used for the complex formation which shows the various colour shades to the cotton fabric as shown in fig. 2

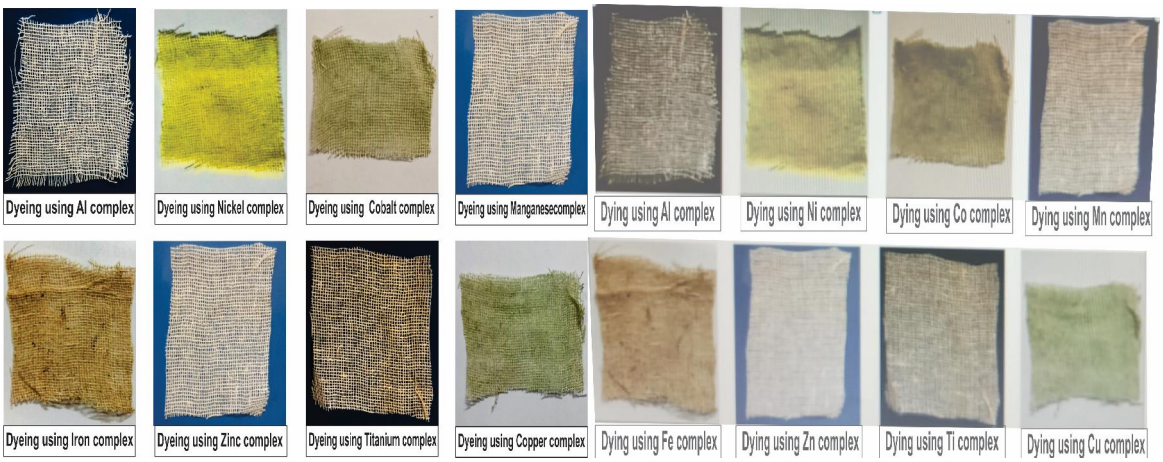
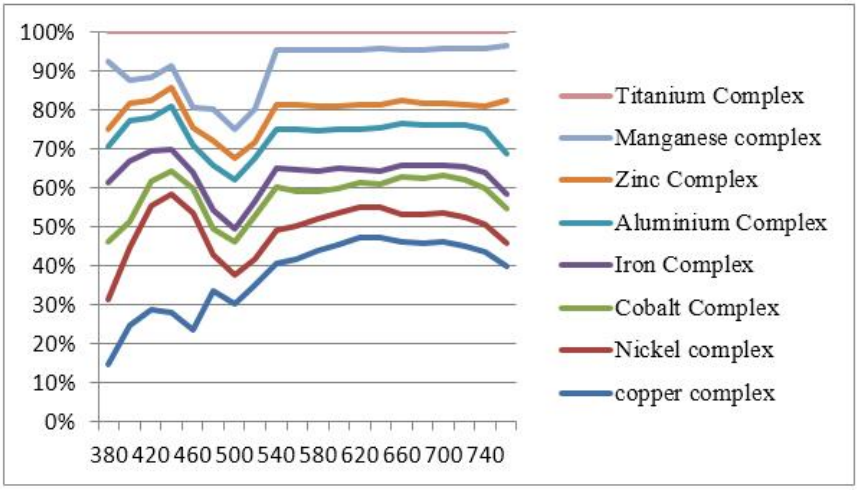


Figure 2 : Various shades of metal-banana extract complex with cotton fabrics(before washing)

Figure3: Effect of sunlight on shades of metal-banana extract complex with cotton fabrics.

Nickel Complex shows grater colour intensity and Aluminiumand Zinc shows very lesscolour intensity.when washed with the detergent, the complete colour of the fabrics is washed out. Whereas the sunlight treatment to this fabrics shows the fadedness of the colour shade found after 1 hr at 35°C (fig no.3).

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252



To determine the for all the colour shades we measures the absorbance of this colour shade solution for this the extract from the plant and metal complex solution is used to determine the maximum wavelength of particular shade. From which we found that most of the colour complex shows the maximum absorption at UV and near visible region as shown in fig no. 4 where we can see the least absorption shown by Cu-banana extract complex shows 400 nm as λ_{max}, also Al also shows the same λ_{max} but higher the absorption. whereas the Ti and Mg shows the highest absorption. Fe,Zn,Mn and Co shows the absorption at far UV region and having λ_{max}=380 nm. Whereas the Cu and Al shows the λ_{max}= 400 nm which is the border of UV and Visible region.

V. CONCLUSION

Thought the banana stem extract have the permanent staining property. on this basis our research shows that when we make the metal complex of this banana water extract at various pH obtained the various shade colour of the complex, along with this colour shades the banana extract and metal complex shows the absorption at border of the UV and visible region of of four metal-banana extract complex shows the maximum absorption at far UV region whereas Cu and Al metal shows the max. absorption at the border or UV and visible region i.e. 400 nm, only the major absorption of metal extract complex at 480 nm i.e. Ni complex. Though this property of absorption of the dye, but it is not the permanent dye that it got fade colouration after washing as well as with the treatment of the sun light. From the above study we can conclude the complex are not showing the permanent staining property on washing as well as the staining property of this dye having a poor ability against the sunlight.

ACKNOWLEDGMENTS

I express my thanks and gratitude towards our co-ordinator of our PG department of chemistry Prof. D. D. Godard constant source of encouragement to complete this project work his excellent guidance as well as Head of Department of Chemistry, Prof. G. M. Shirodkar, S.P.K. College, Sawantwadi also thankful to give me such opportunity to work on this project with Dr. A. P. Nikum assistant professor, Department of Chemistry.

REFERENCES

[1]. Booth, Gerald "Dyes, General Survey". Ullmann's Encyclopedia of Industrial ChemistryWiley-VCH. doi:10.1002/14356007.a09_073. ISBN 3527306730.(2000).

[2]. Different Types of Dyes with Chemical Structure Meghmani https://www.meghmaniglobal.com/different-types-of-dyes-with-chemical

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 4, April 2022
Impact Factor: 6.252

[3]. Booth, Gerald Dyes, General Survey". Ullmann's Encyclopedia of Industrial ChemistryWiley-VCH.doi:10.1002/14356007.a09_073.ISBN 3527306730..(2000).
[4]. Manali bhanushali,Characteristics And Properties Of Banana Fiberarticles,fibers and yarns.in depth Analysis,News and Insightes,Textiles Articles. Jun 23, 2021
[5]. Li K, Fu S, Zhan H, Zhan Y, Lucia L.Analysis of the chemical composition and morphological structure of banana pseudo-stem. BioResources.2010 vol5 .page no 576-585
[6]. Lizamoni Chungkrang and Smita BhuyanNatural Dye Sources and its Applications in Textiles: A Brief Review(2020)Volume 9,page Number 261-269
[7]. D.M. Akkewar National colour of commercial importance. Convention on Natural Dyes. 9-11th December, Department of Textiles Technology, IIT, Delhi. pp. 132. (1999).
[8]. Kapoor, V.P. and Pushpangadan, Use of natural dyes in preparation of Herbal-Gulals. In conventional proceedings natural dyes. Department of Textile Technology, December 17-18, IIT, Delhi. pp. 17-19. (2001).
[9]. Abhay N. srivastva "Stability Of Coordination compounds" 2020 , chapter no 2
[10]. What's Colour Fastness of Dyed Fabrics, How to Test Colour Fastness to Washing May 9, 2017
[11]. Reactive dye-Labelling Chemistry https:/w.w.w.thermofisher.com/reactive dye
[12]. https://w.w.w.chemicalbook.com/productCatalog_EN/161116.htm
[13]. AnastasiaFröseKarolinaSchmidtkeTobiasSukmannIrénJuhászJungerAndreaEhrmannApplication of natural dyes on diverse textile materials Volume, March 2019, Pages 215-219
[14]. Ashishkumar Samanta & Priti Agarwal: Application Of Natural Dye On Textiles Vol.34 page 384-399
[15]. IJSRD - International Journal for Scientific Research & Development| Vol. 6, Issue 02, 2018 | ISSN (online): 2321-0613
[16]. Uma Campbell. The Importance of Natural Dyes May 6, 2019
[17]. Ann-Kathrin Koopmann, Christian Schuster Jorge Torres-Rodríguez, Stefan Kain, Heidi Pertl-Obermeyer, Alexander Petutschnigg, and Nicola Hüsing Tannin-Based Hybrid Materials and Their Applications: A Review
[18]. https://www.colorfuldyes.com/news/which-fabric-is-suitable-for-each-dyeSep 08, 2021