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Eco-friendly Dyeing with Anti-microbial Activity on Soybean Fabric by Using leaves of Medicinal Herb Sida-Cordifolia (Bala)

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ABSTRACT

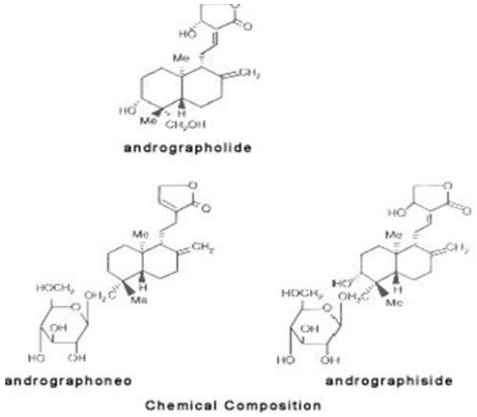
Colour has always been played a dominant role in human life since time immemorial. Since prehistoric time natural dyes is used for colouring of food substrate, leather as well as fibres, yarn and fabrics. The use of non-allergic, non-toxic and eco-friendly natural dyes on textiles have become a matter of significant due to the increased environmental awareness in order to avoid some hazardous of synthetic dyes. Natural dyes have better biodegradability and generally higher compatibility with the environment. They are non-toxic, non-allergic and non-carcinogenic as these are obtained from animals or vegetable matters without chemical processing. Most of natural dyes have low affinity for textiles and require the use of mordant. Mordanting of the fabric was carried out using three mordanting technique i.e. pre, meta and post-mordanting using natural mordants i.e. Turmeric powder, Tulsi leaves Powder; Neem leaves powder, Rose Petal Powder, Sandal Wood Powder, Dry Ginger Powder, Soap Nut powder, Merrigold Petal Powder, Sunflower Petal Powder, Cocunut Peel Powder. The Soybean Protein Fibre (SPF) is regenerated protein fibre with various applications in textiles because of its unique properties. Though, due to the lack of antibacterial properties of such protein comprising polymers, it is detained as drawback for its applications on hygienic textiles. Hence it is essential to make it antibacterial. Present research is an attempt to explore colouring behaviour with antimicrobial activity of medicinal herb namely sidacordifoliaon Soyabeanfabric. Sidacordifoliaherb show great affinity for the soyabeanfabric. The results also clearly suggested the advantages of using such natural mordants are beneficial in case of enhancing antimicrobial functionality as well as more shades on soyabeen fabric by eco-friendly dyeing with single-one “Sida-cordifolia” natural dyeing agent. Dyed samples were further analyzed for colour strength and fastness properties against wash, rubbing and light. Sidacordifoliagive a wide colour spectrum in yellow-green region with moderate to excellent fastness properties. Antimicrobial behavior of dye extract is excellent against both garm positive and gram negative bacteria showing extensive application in medical textile. Thus, findings of study showed that Sidacordifolialeaf extracts has potential to be used as natural dye with antimicrobial activity for colouration and finishing of textiles.

Keywords: Soyabean, Sidacordifolia, Natural dyeing, Natural mordant, antimicrobial properties.

INTRODUCTION

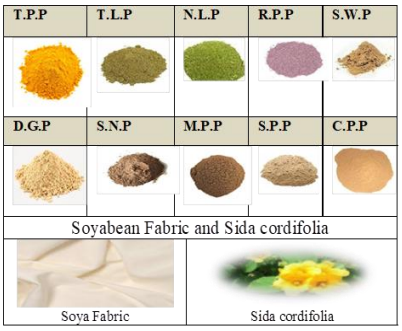
Natural dyes are non-toxic, non-allergic and non-carcinogenic as these are obtained from animals or vegetable matters without chemical processing. Natural dyes are great in demand these days because of the increasing awareness among people about the sustainability issues. Natural dyes have many limitations but due to their eco-friendly nature they are gaining popularity. Natural dyestuff can produce a wide range of colours by mix and match system. A small variation in the dyeing technique or the use of different mordants with the same dye can shift the colours of a wide range or create totally new colours, which are not easily possible with synthetic dyestuffs. For successful commercial use of natural dyes, the appropriate and standardized dyeing techniques need to be adopted without scarifying required quality of dyed textiles materials. Therefore, to obtain newer shades with acceptable colour fastness behaviour and reproducible colour yield, appropriate scientific techniques or procedures need to be derived from scientific studies on dyeing methods, dyeing process variables, dyeing kinetics and compatibility of selective natural dyes. Present research is an attempt to explore colouring behaviour with antimicrobial activity of medicinal herb namely sidacordifolia on Soyabean fabric. Extract of colourants from its leaves have potential to act as natural dye having medicinal properties for textile substrate.

Price: In the Indian Market price of sidacordifolia is 32 Rs of 100 gram.(In this present research sidacordifolia collected form the local agricultural area and campus of university).Chemical structure of sidacordifolia is as:



Chemical structure of Sida Cordifolia

Natural Mordants: T.P.P-Turmeric Peel Powder, T.L.P- Tulsi Leaves Powder, N.L.P-Neem Leaves Powder,R.P.P-Rose Petal Powder, S.W.P-Sandal Wood Powder, D.G.P-Dry Ginger Powder, S.N.P-Soap Nut Powder, M.P.P-Merrigold Petal Powder, S.P.P-Sunflower Petal Powder, C.P.P-Cocunut Peel Powder.



Objectives:

- To dye soya-bean fabric with selected medicinal herb Sidacordifolia .
- To study the dyeing effects of sidacordifolia .
- To assess colour fastness properties of the dyed fabric.
- To assess the antimicrobial property against gram positive and gram negative bacteria.

LITERATURE REVIEW

No literature found regarding colouring behaviour of sidacordifolia on soyabean fabric.

MATERIAL AND METHOD

a) Herbs collection: - Sidacordifolia collected from University campus and local agricultural area.

b) Mordants Powder: "Natural Mordant Powders" were purchased form Amazing Enterprises, Bangalore (Karnataka).

C) **Mordants:** T.P.P-Turmeric Peel Powder, T.L.P- Tulsi Leaves Powder, N.L.P-Neem Leaves Powder, R.P.P-Rose Petal Powder, S.W.P-Sandal Wood Powder, D.G.P-Dry Ginger Powder, S.N.P-Soap Nut Powder, M.P.P-Merrigold Petal Powder, S.P.P-Sunflower Petal Powder, C.P.P-Cocunut Peel Powder.

d) Textile substrate: Soyabean Fabric purchased from **Pahartah Fashion LLP Himachel Pradesh**.

e) Dye extracted by aqueous Extraction Method: Dry leaves of Sidacordifolia ---Grinding---boiled in water ---filtration ---oven dry –fine powder used as natural dyeing agent

f) Optimized Dying recipe of Sidacordifolia

Sr	Applying condition	Quantity

no	and material	
1	**M.L.R**	**1:30**
2	**Sidacordifolia**	20 % owf
3	**Natural mordant**	20 % owf
4	**pH**	**5-6.5**
5	**Temp**	90^0C
6	**Time**	60 Min

f) Applying method: Dye Applied by shaker method using water bath shaker machine.

RESULT AND DISCUSSION

In this present research study proteinous fabric namely soya was dyed using leaf of medicinal herb s. cordifolia, following pre, meta and post mordanting method.

- Natural mordants were used as a fixing agent and for shade development.
- Aqueous extraction method was followed for dye extraction.
- Natural Dye applied on fabric by water bath shaker machine at 65rpm speed.
- Dyeing recipe and conditions were optimized before final dyeing.

This research utilizes the Box-Behnken experimental design to create sample sets and investigate the influence of key process parameters such as dye concentration, time, temperature, fastness properties such as rubbing fastness, wash fastness, light fastness, L* a* b * values of colours and antimicrobial performance of soya fabric treated with sidacordifolia extract and with naturals mordants. Quality assessment includes standard tests like washing fastness (AATCC 61), rubbing fastness (AATCC 8), light fastness (AATCC 16), and antimicrobial testing (AATCC 100) to comprehensively evaluate the treated textiles.

Abbreviation

W.M-Without Mordant	R.F- Rubbing fastness
T.P.P-Turmeric Peel Powder	D.R-Dry Rubbing
T.L.P- Tulsi Leaves Powder	W.R- Wet Rubbing
N.L.P-Neem Leaves Powder	P.M-Pre-Mordanting
R.P.P-Rose Petal Powder	M.M-Meta Mordanting
S.W.P-Sandal Wood Powder	PM*-Post Mordanting
D.G.P-Dry Ginger Powder	W.F-Wash Fastness
S.N.P-Soap Nut Powder	C.C-Colour Change
M.P.P-Merrigold Petal Powder	C.S-Colour Stain
S.P.P-Sunflower Petal Powder	L.F-Light Fastness
C.P.P-Cocunut Peel Powder	S.C-SidaCordifolia

A. Rubbing Fastness

R.F		**P.M**		**M.M**		**P. M***	
Sr no	**Mordant**	**D.R**	**W. R**	**D. R**	**W. R**	**D.R**	**W. R**
1	W.M	**5**	**5**	**5**	**5**	**5**	**5**
2	T.P.P	**4**	**3/4**	**4**	**3/4**	**4**	**3/4**
3	T.L.P-	**4**	**3/4**	**4**	**3/4**	**4**	**3/4**
4	N.L.P	**4.5**	**3/4**	**4.5**	**3/4**	**4.5**	**3/4**
5	R.P.P	**4**	**3/4**	**4**	**3/4**	**4**	**3/4**
6	S.W.P	**4**	**3/4**	**4**	**3/4**	**4**	**3/4**
7	D.G.P	**4**	**3/4**	**4**	**3/4**	**4**	**3/4**
8	S.N.P	**4**	**3/4**	**4**	**3/4**	**4**	**3/4**
9	M.P.P	**4**	**3/4**	**4**	**3/4**	**4**	**3/4**
10	S.P.P	**4**	**3/4**	**4**	**3/4**	**4**	**3/4**
11	C.P.P	**4**	**3/4**	**4**	**3/4**	**4**	**3/4**

Result: Very good to excellent rating of Dry and wet rubbing. These three mordanting method equally best to got very good to excellent rubbing fastness properties.

B. Wash Fastness

W.F		P.M		M. M		P.M	
Sr no	Mordant	C.C	C.S	C.C	C.S	C.C	C.S
1	W.M	5	5	5	5	5	5
2	T.P.P	4	4/5	4	4/5	4	4/5
3	T.L.P	4.5	4/5	4.5	4/5	4.5	4/5
4	N.L.P	4	4/5	4	4/5	4	4/5
5	R.P.P	4.5	4/5	4.5	4/5	4.5	4/5
6	S.W.P	4	4/5	4	4/5	4	4/5
7	D.G.P	4.5	4/5	4.5	4/5	4.5	4/5
8	S.N.P	4	4/5	4	4/5	4	4/5
9	M.P.P	4.5	4/5	4.5	4/5	4.5	4/5
10	S.P.P	4.5	4/5	4.5	4/5	4.5	4/5
11	C.P.P	4	4/5	4	4/5	4	4/5

Result: Very good to excellent rating of colour change and colour stain. These three mordanting method equally best to got very good to excellent wash fastness properties.

C. Light Fastness

Light Fastness				
Sr no	Mordant	P.M	M.M	P.M*
1	W.M	6.5	6.5	6.5
2	T.P.P	5.5	5.5	5.5
3	T.L.P	5.5	5.5	5.5
4	N.L.P	6.5	6.5	6.5
5	R.P.P	5.5	5.5	5.5
6	S.W.P	5.5	5.5	5.5
7	D.G.P	6.5	6.5	6.5
8	S.N.P	6.5	6.5	6.5
9	M.P.P	5.5	5.5	5.5
10	S.P.P	6.5	6.5	6.5
11	C.P.P	5.5	5.5	5.5

Result: Moderate to excellent rating of light fastness .These three mordanting method equally best to got moderate to excellent light fastness properties.

D. Colour correlation matrix

Colour correlation matrix (Standard Soya fabric (undyed) and Dyed Soya fabric without mordant)			
Sr no	CCM Values	Standard Soya fabric (undyed)	Dyed Soya fabric (without Mordant)
1	L	75.896	75.139
2	A	0.566	-1.856
3	B	0.197	10.211
4	C	0.599	10.378
5	H	160.817	100.334
6	DL	-3.570	-4.327
7	DA	0.498	0.792

8	**DB**	**-6.041**	**3.973**
9	**DC**	**-5.729**	**4.050**
10	**DH**	**1.981**	**0.088**
11	**DE**	**7.035**	**5.927**

Sida Cordifoloianatural dye gives various shades in green yellow region on Soyabeanfabric with the help of various natural mordants.

E. Antimicrobial Behaviour: Antimicrobial behaviour of extracted leaf powder was evaluated using AATCC 100 test method against gram positive (S. aureus) and gram negative (E.Coli) bacteria.

F. Shade Card: Shade Card Development

CONCLUSION

Eco-friendly natural dyes are becoming significantly important due to increase in the environmental awareness. Organic dyes are well-suited with human and environment as they are non-hazardous, non-allergenic and biodegradable. The examination was commenced to discover the usage of leaves of medicinal herb s. cordifloia as dyeing of soya fabric. Research revealed that a diversity of colours on the proteinonous fabrics can be produced by making use of leaves of s. cordifolia external casing with distinctive type of natural mordant following three different techniques of mordanting (pre-mordanting, meta-mordanting and post- mordanting). In this research, the major aims of exploring target species of s. cordifolia as dyeing potentials have following findings: * A range of brilliant and acceptable shades have been developed on soya fabric by optimized dyeing parameters and mordanting.* The colour fastness of s. cordifolia extracts against rubbing, wash and light found very satisfactory/moderate to excellent.* Antimicrobial behavior is excellent against gram positive and gram negative bacteria showing extensive application in medical textile.Thus, it can be concluded from extensive study that dyeing of soyabean fabric with s. cordifolia has a potential of textile dyeing with antimicrobial activity. Ultimately Sidacordifolia leaf extract can be used as sustainable textile colouration and finishing. Sidacordifolia natural dye gives various shades in green yellow region.

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