



Design and Development of Sustainable Fashion using Khadi Fabrics dyed with Nutmeg Fruit and Indian Purple Yam Natural dye.

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Abstract: Khadi fabric, commonly known as khaddar, is really a cotton-based natural fibre which is manually woven. The non-violent Indian people were used Khadi, hand spun or hand woven Indian cotton cloth, for the weapon against the colonial rulers. Khadi fabric created manually from Indian communities with cotton yarn spun on a wheel called "charkha". Khadi is a unique craft that is strongly connected to the India's history. As significant in sustainable fashion, Khadi is really a type of eco-friendly clothing. The need for Khadi is increasing significantly. All the natural dyes can't be used as colour for every fabric. The best is to utilise the natural dye in natural material like cotton, linen, silk, wool for best result. Natural dyeing & colouring is not just a healthier for the wearer and the environment, but it is more environmentally friendly over the chemical solutions.

Khadi is facing problems due to lack of knowledge among people and businesses. GST's effect on khadi have raised the cost and reduced the sales and have increased cotton farmers' difficulty. This has led to research and innovation projects to enrich the sustainable product development using khadi. Khadi fabric maybe in off white color or the fabric will be bleached. In the present project effort is made to develop sustainable khadi fashion using Natural Dye from Nutmeg Fruit and Indian Purple Yam. The main aim of the project is to develop a sustainable fabric and development of shade card with natural dye on Khadi Fabric.

Sustainable fashion is now a new trend in the fashion business which seeks to reduce waste to the environment by textile industry. Today people are more aware about sustainable product and as per the survey report, people are preferring for sustainable product with comfort. In the present study, Khadi fabric is dyed with dye extracted from Nutmeg fruit and Indian purple yam. The mordant used are alum and myrobalan. The shade card was prepared with different concentration of dye. The dyed samples were tested for color fastness test. Nutmeg dyed fabric with alum mordant gave better result in both dry and wet rubbing fastness and wash fastness rating of 4.5.

Keywords: Sustainable fashion, Natural dye, Nutmeg dye, Indian purple yam dye, Khadi fabric, Shade card.

I. INTRODUCTION

Textile industry has very important role for environment pollution. For a single textile industry use around 2270 litre of water for making a single piece of fabric. In that from raw to single piece of fabric it uses more than 2,000 chemicals. It shows that the amount of chemical used in textile industry. Mostly the for dyeing, printing, sizing, finishing, bleaching, the water gets pollutant. By this water pollution by textile industry effects both living beings and environment by direct or indirect. The pollutant water may cause to different allergy and health issues like kidney stone, effect to liver etc. This pollution makes a wide gap between environmental regulations also. This water pollution can control in different ways. And it is very important that to control the textile water pollution for our future.

Planning to build a garment with natural dyes that is eco-friendly that sustainable to the environment in the world of chemical dye. Natural dyes studies say that are biodegradable and environmentally friendly when compared to chemical dyes. Chemical dyes contain carcinogenic qualities and can cause a variety of health issues, including lung ailments, irritations and other health issues. Natural dyes are safe, biodegradable & waste-free.

"Sustainability is the future of textile and fashion industry", because it's makes the social, the economic and environmental development. Most of the brands, sustainability is now a highest priority. Fabrics which are environmentally friendly, along with hemp, organic cotton and Merino cotton, can be used in sustainable clothing. The brands seek to provide fashionable & comfortable apparel without ignoring environmental factors

Khadi fabric, commonly known as khaddar, is really a cotton-based natural fibre which is manually woven. Silk & wool were two main types of Khadi fabrics. During the time of Swadeshi Movement, Mahatma Gandhi introduced about the Khadi fabric. Khadi also refer to every hand-spun or handwoven natural textile, which include cotton, jute, silk, or wool. Though mill-made cloth has been essential to fulfil the Indian market's textile needs, khadi is a unique craft that is strongly connected to the India's history. As significant in sustainable fashion. Khadi is really a light, breathable fabric that will keeps users cool throughout the summer. The unique quality of the comfortable khadi fabric is that to keeps the wearer warm in the winter & cool in the summer. The wide task is to improve Khadi institutes to keep up with changing seasons and trends. Also, innovative design development for those engaged in the Khadi sector. Today, 32 businesses contribute to the skill and training provided to the younger generation in order to develop knowledge among them. Khadi apparel is popular, warm and comfortable, and economical

Nutmeg fruit is seasonal plant which yield in the months between April, May, June and July. The fruit gets harvesting when the pericarp (outer covering) gets splits and opened. The fruit gets harvest after the 9 months of flowering. Maximum around 2000 nutmeg fruit will get from a good tree. Nutmeg tree want a warm humid condition which means not much dry climate or water logged conditions. Different types of bud plants are available now. In India, nutmeg mainly cultivated and harvested in Ernakulam, Thrissur & Kottayam districts in Kerala because of the humid climate. Nutmeg can yield all over the Kerala but we want to give proper treatment and watering to the plant and in Tamil Nadu parts of Kanyakumari and Tirunelveli districts.

Purple Yam and many other root or tuber variants were grown in India's tribal areas of Karnataka, Maharashtra, Odisha & Kerala. Indian purple yam has lots of benefits to our body. It is a underground plant. Its take 6-7 months for harvesting. During November to February we can harvest the vegetable.

2. PREPARATION

2.1 Dyeing of Khadi fabric using Nutmeg dye & alum as mordant.

Pluck the ripe nutmeg fruit from the nutmeg tree. Keep it for some time to remove the stain. Wash the fruit twice to clean and cut the nutmeg into small pieces to make grinding easy. After cutting the nutmeg, grind the nutmeg using a grinder. It should be in semi liquid format. (To make filtering easy). After grinding the next step is making the dye solution, for that we have to filter the grind nutmeg solution using a sieve. For a better result filter twice. Pre mordanting of khadi fabric using alum, keeping alum concentration constant (20 gm) for 1 hour. First step is to remove the starch and dust using normal plain water. Pre-mordant the sample in alum solution. Allow the washed fabric in mordant solution for 1 hour. After the pre mordant treatment, next step is cold dyeing for 6 hours. Immerse the fabric in the dye solution and stir it continuously in clockwise and anticlockwise for 30 minutes, after that randomly stir it for 6 hours. After pre mordanting and dyeing next step is adding fixatives. 5gm of salt is added as fixative to the dye bath and kept in it for 1 hour. After the mordanting, dyeing and fixative, the dyed fabric dried under shade condition.

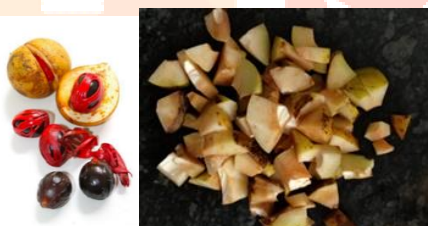


Fig. 2.1 Nutmeg fruit cut into small pieces



Fig.2.2 Immerse the washed khadi fabric to the dye solution

2.2 Dyeing of Khadi fabric using Nutmeg dye & myrobalan as mordant.

First step is to make mordant using myrobalan, mix myrobalan and water to make myrobalan solution. After making the myrobalan solution, boil the solution for 10 mins. Keep it for 15 mins to cool the solution. For extraction of dye, pluck the ripe nutmeg fruit from the nutmeg tree. Keep it for some time to remove the stain. Wash the fruit twice to clean and cut the nutmeg into small pieces to make grinding easy. After cutting the nutmeg, grind the nutmeg using a grinder. It should be in semi liquid format. (To make filtering easy). After grinding the next step is making the dye solution, filter the ground nutmeg solution using a sieve. For a better result filter twice. Filter the myrobalan solution and add to the dye solution as mordant. Sourcing of khadi fabric from the store for sampling. First step is to remove the starch and dust using normal plain water. Immerse the fabric in the dye solution and stir it continuously in clockwise and anticlockwise for 30 minutes, after that randomly stir it for 6 hours. After mordanting and dyeing simultaneously done, next step is adding fixatives. 5gm of salt is added as fixative and kept for 1 hour. After the mordanting, dyeing and fixative, the dyed fabric is dried under shade.

2.3 Dyeing of Khadi fabric using Indian Purple Yam & alum as mordant.

Indian purple yam is an underground vegetable, so first clean the Indian purple yam (removing the dust particles & small roots). Peel the outer cover of the vegetable carefully. After peeling, next step is to make the dye solution. Add required amount water to it and boil it for 30 mins. Into the solution add alum as mordant, continue the boiling for 30 mins. Stir the solution simultaneously. After boiling for 30 mins filter it to get the

dye solution. Sourcing of khadi fabric from the store for sampling. First step is to remove the starch and dust using normal plain water. Immerse the fabric in the dye solution and stir it continuously in clockwise and anticlockwise for 30 minutes. Continue for 6 hours without boiling temperature. Randomly stir the fabric for getting the evenness in the fabric. After mordanting and dyeing simultaneously done next step is adding fixatives. 5gm of salt is added as fixative and kept for 1 hour. After the mordanting, dyeing and fixative, the dyed fabric is dried under shade condition.

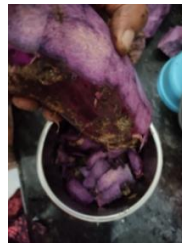


Fig. 2.3 Peeling of outer covering of the vegetable



Fig.2.4 Adding alum

2.4 Dyeing of Khadi fabric using Indian Purple Yam & using myrobalan as mordant.

Indian purple yam is an underground vegetable, so first clean the Indian purple yam (removing the dust particles & small small roots). Peel the outer cover of the vegetable carefully. Next step is adding myrobalan to the solution as mordant. Stir it continuously for 10 mins for making the myrobalan to dissolve. After boiled for 30 mins filter it to get the dye solution. Sourcing of khadi fabric from the store for sampling. First step is to remove the starch and dust using normal plain water. Immerse the fabric in the dye solution and stir it continuously in clockwise and anticlockwise for 30 minutes. Continue for 6 hours without boiling temperature. Randomly stir the fabric for getting the evenness in the fabric. After mordanting and dyeing simultaneously done next step is to add fixatives. Add 5gm of salt and keeping it for 1 hour. After the mordanting, dyeing and fixative, make the dyed fabric to dried under shade condition.



Fig 2.5 Preparation of Myrobalan

1. TEST AND RESULT

1.1 Shade card.



Fig.3.1 Shade card using Nutmeg Fruit in Khadi Fabric.

3.2 Colorimeter

Determination of concentration of the dye solution before and after dye in khadi fabric as follows.

Table 3.1 Concentration of dye solution before and after dyeing in khadi fabric.

Solution	Filter	Concentration	Dye solution before dye	Dye dolution after dye
Nutmeg + Alum	52 (520nm)	700 gm of nutmeg	4.09	-0.55
		500 gm of nutmeg	4.01	-0.51
		250 mg of nutmeg	3.05	-0.49
Nutmeg + Myrobalan	52 (520nm)	700 gm of nutmeg	4.50	-0.80
		500 mg of nutmeg	4.00	-0.77
		250 mg of nutmeg	3.05	-0.75
Indian purple yam + Alum	52 (520nm)	700 gm of Indian purple yam	5.00	1
Indian purple yam + Myrobalan	52 (520nm)	700 gm of Indian purple yam	5.05	-0.99

Before dyeing the concentration of the nutmeg dye solution in alum mordant were above 4 in filter 52nm. After the dyeing the concentration change into negative values like -0.55, -0.51. Coming to the nutmeg dye solution with myrobalan mordant the concentration is above 4 in filter 52nm. After the dyeing the concentration change into negative values like -0.80, -0.77. Coming to Indian purple yam with alum as mordant dye concentration is above 5 before dyeing but after dyeing the dye concentration is 1. Indian purple yam with myrobalan as mordant the concentration is 5.05, after dyeing the dye concentration is -0.99. As the amount of nutmeg increases, the concentration also increases before dyeing.

3.3 Crock meter test

Determination of colourfastness using crock meter result as follows

Table 3.2 Grey scale of dyed Khadi fabric.

Dyed fabric	Mordant	Grey Scale Dry condition	Grey Scale Wet condition
Nutmeg dye in Khadi fabric	Alum	4.5	4
Nutmeg dye in Khadi fabric	Mordant	4-4.5	4

Crock meter test done in both wet and dry condition. Crock meter test is used to do color fastness. In nutmeg dye, by using the mordant alum khadi fabric have very slight variation in color, which means grey scale between 4-5 in both wet and dry condition. But using the myrobalan as mordant, there we can see some wants color change in both dry and wet condition. Grey scale between 3-4. Coming to the Indian purple yam, khadi fabric there we can see a great change in color of the fabric, using both mordant alum and myrobalan. Compared to alum mordant, myrobalan fabric have more color fastness.

3.4 Weight of the fabric

The test result of GSM of the fabric using GSM cutter and weaving balance result as follows:

Table 3.3 Weight of Khadi fabric before and after dyeing.

DYE	MORDANT	GSM BEFORE DYEING	GSM AFTER DYEING
Nutmeg in Khadi fabric (750 gm)	Alum	0.88	0.96
Nutmeg in Khadi fabric (500 gm)	Alum	0.88	1.00
Nutmeg in Khadi fabric (250 gm)	Alum	0.88	1.02
Nutmeg in Khadi fabric(750 gm)	Myrobalan	0.88	1.00
Nutmeg in Khadi fabric (500 gm)	Myrobalan	0.88	1.02
Nutmeg in Khadi fabric(250 gm)	Myrobalan	088	1.05
Indian Purple Yam in Khadi fabric	Alum	0.89	0.95
Indian Purple Yam in Khadi fabric	Myrobalan	0.89	1.07

Weight of the fabric increased after dyeing in khadi fabric. While comparing with the mordant, myrobalan mordant have more weight compared to alum mordant. So mordant and dye have a role in increase in the weight of the fabric. After washing the fabric, the warp and weft yarns become closer. Weight of Khadi fabric before dyeing 0.88 but dyeing it is increased to 0.96, 1.00, 1.02, 1.00, 1.02, 1.05, which says that by the dye concentration and mordant the weight of the fabric increased in Khadi fabric.

3.5 Thickness of the fabric

Determination of thickness of the fabric using thickness gauge result as follows.

Table 3.4 Thickness of Khadi fabric before and after dyeing.

Fabric	Dye	Mordant	Fabric Thickness before dyeing (in -nn)	Fabric Thickness after dyeing (in-nn)
Khadi fabric	Nutmeg	Alum	0.24	0.245
Khadi fabric	Nutmeg	Myrobalan	0.24	0.25
Khadi fabric	Indian Purple Yam	Alum	0.24	0.242
Khadi fabric	Indian Purple Yam	Myrobalan	0.24	0.25

Thickness of the fabric has increased in khadi fabric. When compared with the mordant, myrobalan gives more thickness to the khadi fabric. Thickness of the fabric of Khadi fabric before dyeing was 24 but after dyeing there is slight variation which means 0.245 in alum and 0.25 in myrobalan for nutmeg dye. For Indian purple yam for Khadi fabric the thickness of the fabric increased by 0.242 using alum as mordant. Indian purple yam for Khadi fabric the thickness of the fabric increased by 0.25 using myrobalan as mordant.

2. CONCLUSION

So we can say that textile industry has very important role for environment pollution. For a single textile industry use around 2270 litre of water foe making a single piece of fabric. In that from raw to single piece of fabric it uses more than 2,000 chemicals. It shows that the amount of chemical used in textile industry. Mostly the for dyeing, printing, sizing, finishing, bleaching, the water gets pollutant. By this water pollution by textile industry effects both living beings and environment by direct or indirect. The pollutant water may cause to different allergy and health issues like kidney stone, effect to lever etc. This pollution makes a wide gap between environmental regulations also. This water pollution can control in different ways. And it is very important that to control the textile water pollution for our future. There are different ways to control this water pollution.

Studies conclude that textile industry has an important role in the environment pollution. So, for reducing these pollution people are aware about sustainable product and people are ready to accept the sustainable product and eco-friendly product.

The perception of our everyday fashion has now been rapidly changing due to the advancements in cloth manufacturing and colouring tactics. Natural colouring has been used since antiquity, employing a variety of colouring sources until synthetic dyes such as direct dyes, dispersion dyes, reactive dyes, azo dyes, and others were produced and commercialised. Because of the accessibility and economic benefits of synthetic dyes, the majority of textile businesses have switched to synthetic dyes. Even though these harmful chemical procedures presented a threat to environment and are non-eco-friendly, all synthetic dyes are made from petrochemical sources.

Synthetic dyes are not environmentally friendly and have a negative influence on the skin of the wearer. As a result, natural dye is regarded to be a viable option for sustainable textile production and colouring.

Customers are becoming increasingly interested in using textile materials that are dyed with natural and eco-friendly dyes as their awareness of environmentally organic products grows. Although the historical skill of dyeing fabrics with natural dyes has survived the test of time, natural dyeing has continued to diminish due to the widespread availability of synthetic dyes at a reasonable price.

From this research and survey we can conclude that people are aware and ready to accept the sustainable fabric. The research and testing results show that the Indian purple yam dye on khadi fabric gives less satisfactory rating in dyed fabric as the Indian purple yam dyed fabric has less color fastness. The nutmeg dyed fabric shows good result in all tests in khadi fabric. Mordant used were alum and myrobalan in both dye solutions.

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