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Fastness Properties and Acceptability of Fabric Dyed with Rice-Husk Resist Agent

Obiana, U. V.; [1], Igba, E. C. [2] & Nwosu, P. U. [3]

1. Department of Home Science, Federal University, Gashua, Yobe State.
2. Department of Home Economics, Ebonyi State University, Abakaliki. Ebonyi State.
3. Department of Home Economics, Federal College of Education, Kotangora, Niger State.

Abstract

The purpose of conducting this research was to assess the fastness properties and acceptability of Rice husk resist agent in fabric decoration. Two specific objectives and two research questions were raised for the study. Experimental research design using laboratory method was used. Sensory evaluation of sight was used to elicit responses from the judges. Total samples of 35 judges were drawn using purposive sampling techniques to respond to the score card items. Gray scale for assessing change in colour and staining was used as instrument for data collection. Mean and standard deviation were employed to answer the research questions. The result showed that the effectiveness and acceptability of fabrics decorated from rice husk resist agent is significantly high as mean is 3.0 and above. The study concludes that rice husk resist agent is effective and fabric dyed with rice husk were acceptable therefore rice husk can be used as a resource material for decorating fabric and teaching creative skills in Home Economics, textile designs and production of traditionally dyed fabric. This will help reduces the problem of waste management by clearing up the hips pilled around the environment. It will generate income to rice growers/miller's and reduce environmental hazards caused by burning and finally it will reduce cost of production of resist dyed fabric and increase marketability.

Introduction

Fastness properties refer to how the colour of dyed fabrics will react when exposed to different conditions. The question is, will it bleed or run colour? Technically, is the colour fast? Colour fastness properties are those characteristic of a fabric which determines its colour retention performance during usage. Colour fastness of dyed fabrics is always of interest to the consumers because the beauty of dyed fabric is of no value unless the dye is fast, under the conditions in which the fabric is to be used Nkeonye, (2009). The most suitable dyed for particular end users are those which will provide required fastness at the minimum cost. The performance of any dyed fabric is dependent upon the combinations of inherent dye properties and geometrical arrangement of the fibres and other dye materials. Moreover, Obiana (2011) opined the female perception of cloths is probably more concerned with appearance than

with comfort. These colour fastness properties can be accessed through the following parameters such as wash, pressing, sun, rubbing and perspiration. Therefore, measurement of the fastness properties of clothing materials will assist apparel manufactures, innovators and users in developing good performance fabrics that will serve their useful purpose to consumers' satisfaction. These fastness properties are affected by many attributes and can be assessed either subjectively or by objective measurement.

The Rice husk also called hulls or chaff is one of the most widely available agricultural wastes in many rice producing countries around the world. Rice husk is described as the outermost layer of protection encasing a rice grain. It is yellowish in colour and has a convex shape. It is slightly larger than a grain of rice, thus lengths up to 7mm are possible. Typical dimensions are 4mm by 6mm. It is lightweight, having a ground bulk density of 340kg/m^3 to 400kg/m^3 (Ajay, Devendra & Om, 2012). Rice husk waste has always been deposited beside the milling factories and no demand of it has been made by people around as it is neither good for animal feeding due to its low nutritional value nor for any other use as rightly stated by Warren and Farrell, (1990) that rice husk has no nutritional value for poultry as well as to other animals.

The well known use of rice husk in most rice producing countries is that it is usually dumped and burnt for heat or used as landfill. Burning of husk in ambient atmosphere leaves a residue, called Rice husk ash (Koteswara & Pranav, 2006). The disposal of rice husk has been a substantial problem for rice growers and rice millers, since the husk are not suitable for use as fertilizers and is disposed by open burning, burying or used as land fill. Burning of rice husk also releases Carbon-monoxide to the atmosphere (which is poisonous), creates undesirable atmospheric pollution. Rice husk and its ash is a great environmental threat causing damage to land and surrounding area where it is dumped. Therefore, commercial use of Rice husk and its ash is the alternative solution to disposal problem, and so this prompted the researcher to seek an alternative ways of utilizing the waste for useful purposes such as processing it as a possible resist agent for fabric decoration on cotton fabric (dyeing).

Resist dyeing is a term for a number of traditional and contemporary methods of dyeing textiles with patterns. Wada (2002) defines resist as "technique or material that creates patterns on cloth by impeding dye from penetrating fabric". According to (Vainker, 1990), a resist is a product or process that temporarily or permanently blocks fabrics ability to absorb another wet medium. Resist can be defined as a process of textile colour patterning "by preventing the uptake or fixation of a dye in a subsequent operation" (McIntyre & Daniels, 1997).

Textile/fabric decoration is the art of changing the appearance of natural and synthetic surfaces by the application of traditional, stylized, digitized, and illusionary techniques to embellish a product (Eric, 2015). Audubon (2009), states that some educators have described it as image, colour, texture, and pattern applied to surfaces within the man-made environment. Camila (2012) opined that Fabric decoration encompasses the

colouring, patterning, and structuring of fibre, yarn and fabric. This involves creative exploration of processes such as dyeing, painting, printing, stitching, embellishing, quilting, weaving, knitting, felting, and papermaking. The reasons for decorating fabrics vary with each individual, community or society and may be done for aesthetic, social, cultural, ritual, religious, political or economic reasons. These factors often determine the fabric type, processes, colour and motifs used. The word fabric is often used interchangeably with textile, cloth, and material.

Meinke (2012) opined that fabric decoration encompasses a wide variety of techniques for altering the surface of fabric, whether it is cotton, silk, wool or a synthetic fabric. Altered fabric surfaces can be accomplished by any of the following techniques, either individually or in combinations: dyeing fabric, stitching, either by machine or hand, painting on fabric, using a resist such as beeswax, soy wax or a water-based resist to separate colours and to create a design.

Colour is the most exciting design element, which has always attracted mankind. It is one of the most important elements of fashion design because it is the first thing noticed in a garment. Clothing is usually selected because of its colour. Colour is a property of light. It is a sensation which occurs when light enters eyes.

The term vat dye is used to describe a chemical class of dyes that are applied to cellulosic fibre (i.e. cotton) using a redox reaction. Vat dyeing is a process that refers to dyeing that takes place in a bucket or vat. Almost any dye, including fibre-reactive dyes, direct dyes, and acid dyes, can be used in a vat dye. Cotton, wool, and other fibres can be all dyed with vat dyes. The original vat dye is indigo, once obtained from plants but now produced synthetically. Some of its Advantages includes: Excellent colour fastness, Less impurities, Excellent solubility, High strength, High quality, Physical Properties:, Appearance : Powder/Grain, Properties: Good solubility in water, Usage: Mainly used in cotton and fabric etc. , Storage: Must be stored in shade ,dry and well-ventilated warehouse . Keep it away from sunlight (Price, Cohen, & Johnson, 2005). Dyeing can be done in the garment, fabric, yarn, fibre stage, and sometimes even before, which is called stock dyeing.

There are several ways to conduct the dyeing process. Dyeing is the process of adding colour to textile products like fibres, yarns, and fabrics. Dyeing is normally done in a special solution containing dyes and particular chemical material. After dyeing, dye molecules have uncut chemical bond with fibre molecules. The temperature and time controlling are two key factors in dyeing.

The researchers embarked on this study as a result of improper way of disposing rice husk by milling factory around residential areas which has been causing problem to the area especially during the raining season as running water will carry it away and scatters the waste at different places and as such dirty the environment. The researchers were stimulated to embark on this study in other to find an alternative ways of utilising the waste and also to generate wealth out of it for the good of the people and at the same time bring about new knowledge.

Furthermore, it is obvious that in most Nigerian schools and colleges, skill acquisition and innovation is the clamour of the federal government for our youths to reduce the problems of unemployment in Nigeria. Resist dyeing technique is one of the needed skills that can furnish youths with skills for entrepreneurship and reduce unemployment in the nation. If Nigerians are to patronize resist dyed Nigerian fabrics, it has to be colour fast, durable and acceptable by consumers. Fading of colour, is undesirable characteristics associated with resist dyed fabric and when resist dyed fabric can be proven to be satisfactory and acceptable through research like this, then we have some of our confusing problems in clothing selection, patronage and care solved. The researchers taught of so many means of generating another resist agent as an alternative resist agent by making use of rice husk which is a waste, and is always available at no cost. Interactions with most millers and the rice growers shows that rice husk have no commercial use; this research seeks to find an alternative solution to its indiscriminate disposal since its disposal posses a great threat to the environment and society at large, because it also releases pollutants which can cause respiratory problems to humans.

Objectives of the Study

The major purpose of this study was to access the effectiveness of rice husk as a resist agent for fabric decoration. Specifically, the study:

1. Access the fastness properties of fabrics dyed with rice husk resist agent.
2. Examine the acceptability of fabrics dyed with rice husk resist agent.

Research Questions

Two research questions were formulated to guide the study:

1. What is the effectiveness of fastness properties of fabrics dyed with Rice husk resist agent?
2. What is the acceptability level of fabrics dyed with rice husk resist agent?

Materials and Methods (Methodology)

***Design of the Study*:** Experimental research design using laboratory method was employed in this study.

***Materials*:** The following are the material and equipment that was used for this:

Antisol 4 table spoon full, Rice husk 12 milk cups, Fabric to dye, Sodium hydrosulphite, sodium hydroxide, dye.

***Equipment*:** Participant observation, judges, camera, enamel and plastic bowls, line pegs soap, gray scale for assessing change in colour and staining. Rubber gloves, Stencil different motifs drawn on a hard cardboard paper, Plastic containers, Plastic buckets, measuring cups and spoons, stirring spoon or stick.

Procurement Method

The materials listed were brought from the open market. Rice husk: This was obtained from a milling factory. Carboxymethyl cellulose (CMC) or cellulose gum also known as antisol a whitish powdered environmental free chemical made of wood pulp and cotton linters and other sources. This was gotten from chemical shop at Sabo-Gari Market in Zaria, is available at almost all the chemical shop and at affordable price.

Fabric to dye: The fabrics were gotten from Kwori market in Kano. The researcher used observation method to

identify cotton fabric (white brocade). This fabric was used to get better results since cold water dyeing method was used. Also vat dyes are used on cellulosic fibres and are very much available in different colours. Sodium hydrosulphite, sodium hydroxide: These are the dye fixer. Vat dyes of different colours, rubber gloves, plastic containers, plastic buckets, measuring cups and spoons, stirring spoon or stick, pencil, stencil. All these were gotten from chemical shop at Sabo-gari market in Zaria. Water (solvent) was fetched from college taps.

Preparation of the Materials

Conditioning of the Sample: The white cotton brocade fabric used for the experiment as well as the white cotton material for the composite were all desized by pre-washed and dried before the dyeing processes took place, this was to remove all the chemical treatment given to the fabrics in other to allow dyes to penetrate properly. They were then conditioned under standard condition of relative humidity of 65+26 and temperature of 20+ 2^0c for forty eight thousand prior to testing.

Procedure for making of the rice husk resist agent

Two and half (2.5) litres of water was measured into the bowl, 4 table spoon full of antisol was measured and poured gradually into the water stirring simultaneously. The antisol was allowed to soak in water for thirty (30) minutes to allow it swell, though stirred while still standing. 12 milk cups of rice husk was measured and added into the paste and stirred smoothly until a smooth paste was gotten.

Procedure for the application of the rice husk resist agents

Fabrics to dye: The researchers pre-washed and dried all fabrics before the commencement of the practical. When the fabrics was dried, they were spread out and a stencil was used (a hard card board paper with different motifs drawn and cut out) to obtain different patterns (Stencil techniques), the use of shapes of object to draw out different pattern is allowed. Broom was also used to splash the rice husk resist agents on the surfaces of another fabric (Splashing technique).The resist agent was applied with hand or spoon systematically at the places where the patterns are desired to appear and allowed to dry for minutes or hours depending on the intensity of the sun. When the rice husk is dry, the watery look of the resist agents on the surfaces of the fabrics turn to dry look showing clear brown colour of the rice husk and the areas where the resist agent was applied were bounded so well on the fabric making it impossible for fingers to peel of the resist agent from the surface of the fabrics.

Procedure for the preparation of the dye and the dyeing

Then after drying, the dye was prepared as follows: 4 tablespoons of Sodium hydrosulphite, 3 table spoons of sodium hydroxide, 4 table spoons of vat dye, 4 litres of water (cold water). All these measurement are poured in the plastic bowl and the measured cold water was added and stirred thoroughly. The fabric was dipped into each different colour of vat dyes bowls and allowed to stand for three to five minutes, depending on the intensity of the colour desired. They were

turned so as to have even colours after dyeing. This measurement was used on each piece of fabric dyed since cold water dyeing was used.

Instrument for Data Collection: Gray scale for assessing change in colour and staining was used to access fastness properties and acceptability level. The response option was a modified Likert scale with assigned nominal values as follows:

No fading /staining	NFS	Very attractive	VA	5
Fade/stain/negligible	FSN	Attractive	A	4
Fade/stain slightly	FSS	Modestly Attractive	MA	3
Fade/stain considerably	FSC	Slightly Unattractive	SUA	2
Fade/stain heavily	FSH	Unattractive	UA	1

The dyed fabrics were assesses for colour fastness test, to washing, heat/ light, soap, rubbing (mechanical action) according to Nkonye (2009). Who states that the beauty of a fabric is of no use unless the colour is fast. This is to determine the wash fastness properties of the fabric dyed with rice husk resist agent on repeated washing. The test were carried out in a washing bowl using hand washing which enable time and temperature to be controlled during the process.

Procedure for the Assessment of Fastness properties

***Fastness to washing*:** Two specimen each of 5cm by 4cm dimension were cut from the three different rice husk resist dyed fabrics (a total of 6 specimens) three of the specimen were used as control and are not treated while the other three were washed in washing solution contain 5g of domestic soap per litre of water for five minutes. The fabrics were thoroughly rinsed and dried and the specimens were exposed to repeated washing of five times. The change in colour was assed using the gray scale by the judges.

***Fastness to Light*:** A piece of each specimens were expose to direct sunlight for a period of 5-6 hours for 5 days and they were compared with another pieces of the same sample dyed fabrics which were left under room temperature (ageing) for the period of 10 days by the judges the result were compared and recorded according to gray scale for fading.

***Fastness to perspiration*:** Test specimens were wetted with human perspiration at body temperature for two hours each of two consecutive days and then assessed for change in colour by the judges after comparing them with the untreated.

***Fastness to Rubbing*:** Tests specimens were rub on a piece of white fabrics specimen wrapped round the finger for five minutes and two consecutive period. The degree of staining of the white fabrics was assessed using gray scale for staining change.

***Fastness to Pressing*:** Test specimens of the dyed fabrics were dry pressed for 15 to 30 seconds for five consecutive times. They were then assessed with samples that were not pressed from the dyed fabrics and the degrees of change in colour were assessed by the judges.

Method of Data Collection

Acceptability/Sensory Evaluation

35 judges were selected for the assessment of change in colour using gray scale instrument for assessing change in colour and staining to assess the fastness properties of the rice husk resist dyed fabrics and level of acceptability using sensory evaluation. The researchers used two groups of samples, the experimental group (treated specimens) and the control group (untreated specimens). Three fabrics sample dyed with rice husk resist agent using different method of resist i.e splashing stamping and stencilling were evaluated for: fastness effect to washing, light, rubbing, pressing and perspiration.

35 copies of the score cards item questions were distributed to the judges to respond to, using sensory evaluation of sight perception using the five point gray scale for accessing change in colour and staining, and five point Licker scale for accessing level of acceptability.

***Data Analysis*:** Data collected were subjected to analysis to determine the mean score, which was used to determine the extent of the perception of the fastness properties, extent of resist and other factors used to access acceptability.

Mean of 3.0 was used for decision making.

Findings

$\bar{X}$

Table 1: Effectiveness of rice husk as resist agent for fabric decoration (fastness properties)

S/N	fastness Properties	DNF	FS	FM	FH	FVB	N	FX	$\bar{X}$	Decision
1.	Fastness to Washing	26	6	2	1	0	35	162	4.62	Effective
2.	Sun	22	11	2	0	0	35	160	4.57	Effective
3.	Rubbing	27	5	3	0	0	35	164	4.68	Effective
4.	Perspiration	25	6	4	0	0	35	616	4.6	Effective
5.	Pressing	28	5	2	0	0	35	166	4.74	Effective

Table 1 indicates the perception of the judges on the effectiveness of physical properties of fastness of the dyed fabrics to parameters 1 to 6 above using the subjective measures through the sense of sight and feel. Table 1 showed that item 1, 2, 3, 4 and 5 with mean value of 4.62, 4.57, 4.68, 4.6 and 4.72 were respectively effective. This implies that rice husk resist dyed fabric were fast to water, soap, sun, rubbing perspiration and pressing. This shows that the dye does not fade upon exposure to these fastness parameters even after repeated exposure.

Table 2: Acceptability of Fabrics dyed with rice husk resist agent (sensory evaluation)

S/N	Items	VA	A	MA	SUA	UA	N	FX	$\bar{X}$	Decision
1.	Extent of Resist effect	25	8	2	2	0	35	167	4.77	Accepted
2.	Crackle effect	7	6	8	10	2	35	105	3.0	Accepted
3.	Attractiveness	20	10	4	2	0	35	156	4.45	Accepted
4.	Sharpness/precision	12	10	2	4	2	35	116	3.31	Accepted
5.	Fastness to washing	24	5	4	2	0	35	156	4.45	Accepted
6.	Colour Intensity	15	10	7	3	0	35	142	4.06	Accepted
7.	Cost efficiency	13	8	6	6	2	35	129	3.69	Accepted

Table 2 shows the mean sensory evaluation to sight on the acceptability of rice husk resist dyed fabric. The table shows that item 1, 2, 3, 4, 5, 6, and 7 with mean values of 4.77, 3.0, 4.45, 3.31, 4.45, 4.06 and 3.69 were respectively accepted. This implies that fabric dyed with rice husk resist agent has a good resist effect, crackle effect, attractive, sharp, good colour fastness to washing, good colour intensity and cost efficiency.

Discussion of Findings

The findings also revealed that fabric dyed with rice husk resist agent has good fastness properties to water, soap, sun, rubbing perspiration and pressing. This indicates that fabric dyed with rice husk resist agent can resist fading even after several exposures to these fastness parameters. The findings of this study is consistent with the findings of the Nwosu (2017) who found out that rice husk could be used as resist agent for fabric decoration.

Fabric dyed with rice husk resist agent has an acceptable esthetic visual perception in the areas of effective resist, attractive crackle effect, attractive colour, sharp and precised design effect, good fastness properties to washing, attractive colour intensity and cost efficiency. All these acceptable positive item attributes indicates that fabric dyed with rice husk resist agent is highly acceptable.

Rice husk is available at low and no cost in almost all milling centres and the binding agent is equally available at most chemical shops. This makes the raw material easily available at all times, and invariably making the end product that is the fabrics produced from this raw material cheap and affordable for the end users.

Conclusion

Based on the findings of the study, it can be inferred that rice husk as a resist agent is effective and acceptable as a resist agent for fabric decoration, since rice is planted and processed in Nigeria, it makes the rice husk available at all times and all season. Also the production of the resist agent was simple, easy, less time consuming and cost efficient, and it gave room for the application of other techniques of resist dyeing such as splashing, stencil, stamping and sketching.

Recommendations

In view of the results of the study the following are recommended:

1. Home Economics, other textiles science departments or practitioners of textile design could use the result of the study as a resource material for

teaching their students creative skills in textile design.

2. Non-Governmental Organizations, skill acquisition centres both public and private sectors involved in skills training and youth empowerment can engage their trainees in the production of rice husk resist agent for sustainable decoration of fabrics. These could also be prepared and sold to the immediate consumers which invariably will serve as a means of income to them.
3. The textile industries and factories (big and small scale) could use the results of the study as resource material for fabric decoration.
4. The rice farmers and rice millers could use the result of the findings to generate income by producing rice husk resist agent and selling to the immediate consumers.

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