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OPTIMIZATION OF PH AND CONCENTRATION OF DYE LIQUER OF NATURAL DYES

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ABSTRACT

At present research is focused to find out alternative dyes for food and clothing and it should be eco friendly , readly available , cost effective and safe to use both in food material and fabrics. The usage of the plant based natural dyes is traced back to ancient civilization . Due to the environmental and health hazards problems caused by the synthetic dyes.Now people are more concerned about the usage of natural dyes during the last two decades. Botanistists have identified more than 450 dyes yielding plants that naturalized in India. The natural dyes are fast in staining , long lasting , renewable , bio-degradable and eco friendly . Now a days , natural dyes have entered in to the textile , food , pharmaceutical cosmetics , fibre , leather and paint industries. In the present study, the usage of the dye obtained from tectona grandis plant leaves is evaluated.

KEYWORDS: Natural dyes ,pH, Concentration, Solvents, tectona grandis,Textiles.

I. INTRODUCTION

The sence of colors is as extracted as the sence of life. Color is the by product of the spectrum of light which is perceived by eyes as it is reflected as observed, received by the human eye and processed by the human brain. Color is a powerful tool that change mood and attitude as well as enhance everyday life. Colours can affects mans being and each colour has certain signals and each signals permeats through human neurological system and effect the mental and psychological state of the individual. It is believed that colors can change the opinions of human being and create a difference in the life.

The art of dyeing was as old as human civilization. India was forerunner in the art of natural dyeing . Our vedas carries description of natural dyes. In the epic period ,there are frequent references to “pitamber” a yellow garment used by Gods. Atharva Veda carries description of natural dyes. Bhrigu samhita is written using natural dyes. The use of natural dyeing material is evident from the wall paintings of Ajanta and Ellora. These paintings still demonstrate the efficiency of dyeing craft that had been inherited from ancient times of India. The frescoes are also evident of use of colorful garments by men and women alike.

Natural dyes are comprised of those colorants that are obtained from natural sources without any chemical processing. Thus natural dyes have been classified by many authors in three majors categories including plant and vegetable origin , animal origin and mineral origin but with the advancement of technology one more category has been added to this classification i.e. tissue or cell culture by DNA transfer technology.Natural dyes are less toxic, less polluting, less health hazards and non poisonous. They produce colors and create gentle ,soft ,subtle and restful effect. Moreover they are environment friendly and can be recycled after use. Although natural dyes have several advantages,there are some limitation as well.

II. MATERIAL AND METHODS

Tectona grandis plants leaves were collected. The leaves were dried and powdered. The extraction of the dye from powdered leaves of tectona grandis plant was obtained by using three different solvents at different pH namely alkaline solvents (Sodium hydroxide) for pH 8 and 9, distill water for pH 7and acetic acid for pH 6 and 5 , 1gm of sample was weighed and taken in a round bottom flask and 100ml of solvent was added to it. Two yarns namely cotton(cellulose) and wool(protein) were selected as substrate to see the effects of dyes in the present study.

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Optimization of variables for dyeing

Experiments were conducted to determine the medium of extraction and optimum concentraction of dye material. The optimum density of the dye solution was recorded at ʎ = 543nm both before and after dyeing and percent absorption was calculated by the following formula.

$$\text{Percent absorption} = \frac{\text{O.D. before dyeing} - \text{O.D. after dyeing}}{\text{O.D. before dyeing}} \times 100$$

Visual evaluation – A proforma was developed for the evaluation of dyed samples. Parameters for evaluation of dyed samples included lusture , evenness of dyes, depth of shades and overall appearance. A panel of 15 judges was selected for evaluation through purposive random sampling .Percentage of marks obtained by each dyed samples was calculated by using the following formula:

$$\text{Percentage Mark} = \frac{\text{Marks obtained}}{\text{Total marks}} \times 100$$

III. OPTIMIZATION OF PH OF DYE LIQUER

Acetic acid and soda ash were utilized for maintaining the acetic acid and alkaline ph respectively. Five dye bath of ph 5,6,7,8,and 9 were prepared by dissolving 5gm dye in 100 ml of distilled water.Subsequently one ml of dye solution was pipette out from each beaker and absorbence was recorded after dilution. Pre soaked cotton and wool yarns of 1 gm each were dyed in these solution respectively for 60 minutes at 80*c . Dyed samples were removed from the dye bath , rinsed under tap water and dried in shade. Optical densities of the residual solution were recorded. Best sample were selected on the basis of highest percentage absorption and highest marks obtained through visual evaluation.

IV. OPTIMIZATION OF DYE CONCENTRATION

Different dye solution were prepared by taking 1gm, 2gm, 4gm,6gm and 8gm of tectona grandis in 100 ml of distilled water with optimized ph and optical densities were recorded pre soaked cotton and wool yarns of 1gm were dyed in these solution separately for 60 minutes at 80°C . The dyed samples were removed from the dye bath , rinsed in the residual solution was recorded.The optimum concentration of dye material was determined in the same way.

V. RESULT AND DISCUSSION

The extracted dye was applied on cotton and wool yarns. Tectona grandis leaves extraction was found to be red and brown color. The colours of the dye also depends on the solvents used for the extraction . In the present study, colour variation was noted for different ph solvents and different concentration of solvents.The results are summarized in Table 1 and 2.

PH of Dye

The cotton and wool yarns were dyed with five dye liquors separately having different ph of 5,6,7,8 and 9. The wool and cotton yarns were dyed in the prepared dye liquor of different pH.. Result of percent absorption and percent marks secured by cotton and wool yarns with tectona grandis leave dyes are given in table -1(a) and (b) respectively.These results are also depicted in figure -1 and figure -2 for both the experimental yarns.

It is evident from the table -1 (a) and figure -1 that maximum value (51.50 percent) was exhibited by dyed cotton sample at pH 6 (acidic). This sample also obtained maximum percnt marks(86.00 percent) on visual evaluation. On further increase or descrease in the pH of dye liqure, decline in percent absorption was observed. Lowest percent absorption (39.71 percent) was observed when the pH of dye liqure was maintained at 8 and lowest percent marks (69%)was observed at 9 pH .Therefore ,pH 6 was selected as optimum pH for dyeing of cotton with tectona grandis leave dyes.

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Table- 1(a) : Percent absorption and percent marks obtained by cotton sample dyed with tectona grandis plant leave dye at different pH.

Tectona grandis leave dye (ʎ=543)					
Textile fibre	**pH**	**O.D. before dyeing**	**O.D. after dyeing**	**Percent absorption**	**Percent marks**
Cotton	**5**	**0.618**	**0.335**	**45.79**	**74**
	6	**0.631**	**0.306**	**51.50**	**86**
	7	**0.688**	**0.353**	**48.69**	**78**
	8	**0.710**	**0.428**	**39.71**	**73**
	9	**0.723**	**0.402**	**44.39**	**69**

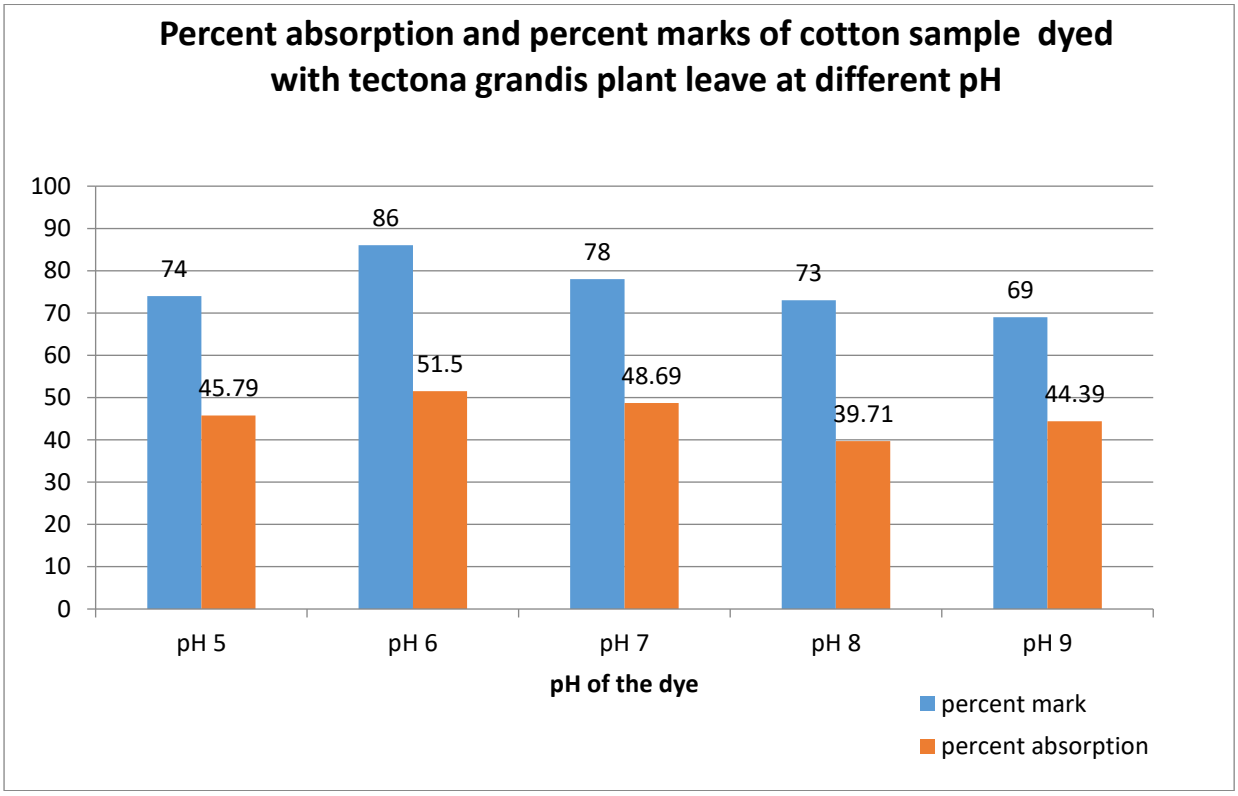

Figure .1

Table 1(b) Percent absorption and percent marks obtained by wool sample dyed with tectona grandis plant leave dye at different pH

Tectona grandis leave dye(ʎ = 543)					
Textile fibre	**pH**	**O.D.before dye**	O.D. after dyeing	Percent absorption	Percent marks
Wool	5	0.618	0.368	40.45	75
	6	0.631	0.315	50.07	81
	7	0.688	0.329	52.18	77
	8	0.710	0.459	35.35	78
	9	0.723	0.436	39.69	71

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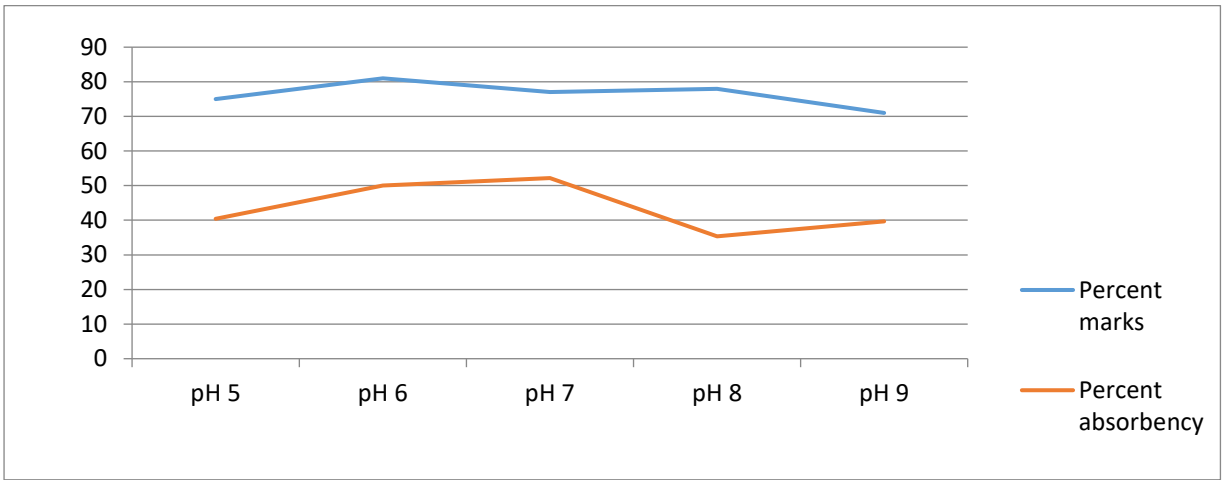

Figure 2 Percent absorption and percent marks obtained by wool sample dyed with tectona grandis plant leave dye at different pH.

It is exhibited in the table -1(b) and figure 2 that when the experimental sample were dyed with dye liqure of tectona grandis leave in pH 7 maximum percent (52.18 percent) absorption of was obtained by wool sample. Highest percent of marks was obtained by wool(81 %) when the sample was dyed with pH 6 (acidic medium). Although visual evalution is subjected approach yet consumer's preferences was given more weightage to evaluate coloured sample. Therefore pH 6 was selected as the optimum pH on the basis of visual evaluation of the dyeing of wool yarn using this dye.

VI. CONCENTRATION

Five dye liqures of different concentration. i.e. 1%, 2% ,3%, 4%, and 5% of the dyes were prepared with optimized wool and cotton yarns were dyed in the prepared dye liqure. Result of percent absorption and percent marks secured by wool and cotton yarns with tectona grandis leave dyes are given in table 2(a) and (b). The results are also depicted in figure 3 and 4 for the experimental yarns.

Table -2(a) Percent absorption and percent marks obtained by cotton sample dyed with tectona grandis plant leave dye at different concentration.

Tectona grandis leave dye(λ = 543)					
Textile fibre	Concentration	O.D. before dyeing	O.D. after dyeing	Percent absorbency	Percent marks
Cotton	1%	0.754	0.529	29.84	71.28
	2%	0.995	0.648	34.87	76.47
	3%	1.083	0.672	37.95	69.69
	4%	1.157	0.648	43.99	73.06
	5%	1.198	0.535	45.49	82.14

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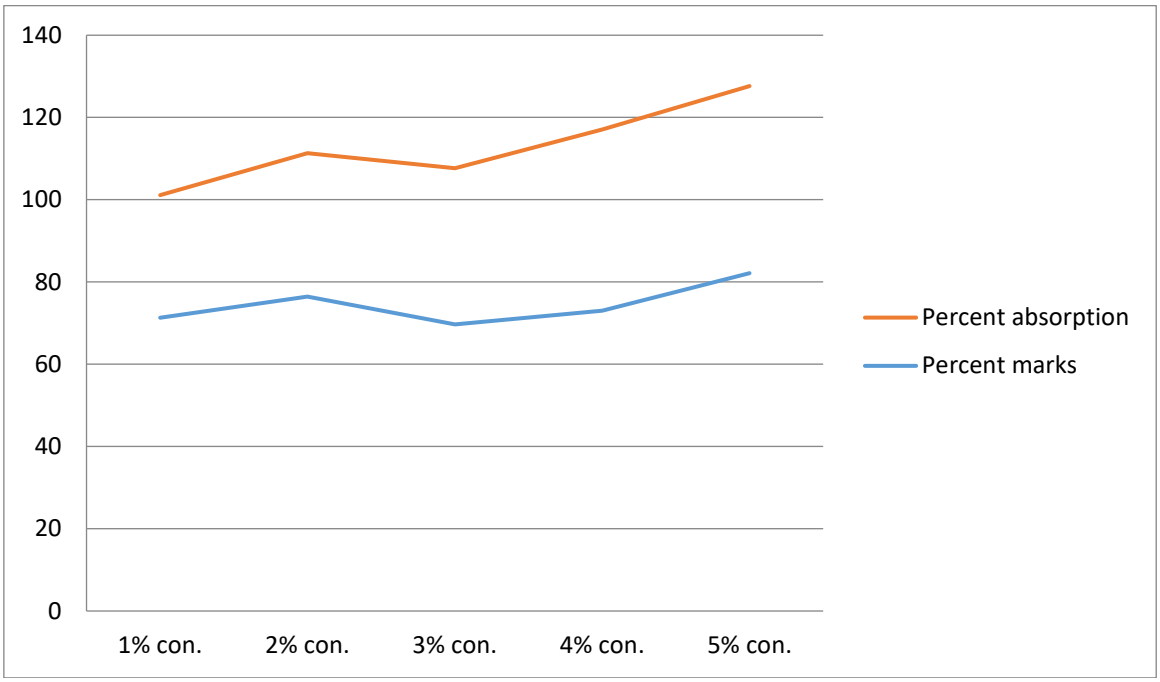

Figure 3 - Percent absorption and percent marks obtained by cotton sample dyed with tectona grandis plant leave dye at different concentration

Table-2 (a) and figure -3 reveals that the percent absorption of cotton sample increased with increase of dye concentration and found to be maximum (45.49 percent) when concentration was 5gm./100 ml. similar observations were recorded for both (wool and cotton) the sample . The reason behind this may be that when there is increase in the dye particles in dye solution . More dye molecules will be absorbed by the textile material. Mondal and Razzaque 2007 also stated that when there is increase of dye concentration number of dye particles in the liqure was increased. So absorption of dye is increased due to the vander wall's forces exist between the dye particles and the fibre molecules. This sample also obtained maximum percent marks (82.14 percent) on visual evaluation. So optimum concentration for the dye was selected 5gm/ 100ml.

Table -2(b) Percent absorption and percent marks obtained by cotton sample dyed with tectona grandis plant leave dye at different concentration.

Tectona grandis leave dye(ʎ = 543)					
Textile fibre	Concentration	O.D. before dyeing	O.D. after dyeing	Percent absorbency	Percent marks
wool	1%	0.754	0.546	27.58	62.08
	2%	0.995	0.684	31.25	75.67
	3%	1.083	0.637	41.18	73.07
	4%	1.157	0.649	43.90	79.07
	5%	1.198	0.535	55.34	69.89

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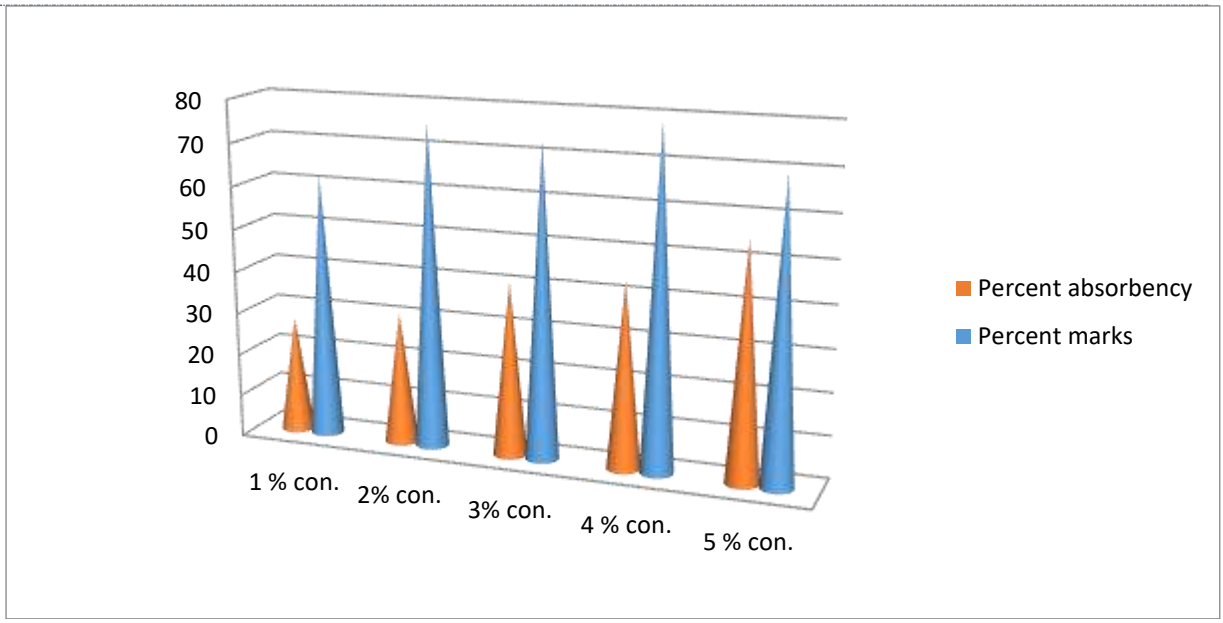

Figure- 4 Percent absorption and percent marks obtained by cotton sample dyed with tectona grandis plant leave dye at different concentration.

It is exhibited in the table -2 (b) and figure 4 that when the experimental samples were dyed with five percent concentration of dye, maximum percent absorption(55.34 percent) was obtained by wool sample .Highest percent of marks (79.07 percent) was obtained when the sample was dyed with 4 percent of dye solution. Consumers are the ultimate users of textiles and their preferences is formost criteria for the selection of dyed textile material. Thus result of visual evaluation were given more weightage for selection of coloured yarns which is carried out on the basis of lusture , evenness of dye , depth of shade and overall appearance. Since percent marks obtained through visual evaluation is a subject approach. The appearance of colours may or may not be related to maximum percent of absorption. Therefore 4 percent concentration was selected on the basis of visual evaluation as optimum for dyeing of wool yarns.

VII. CONCLUSION

The present scenario is focused more towards the utilization of the vast diversity of natural resources of colour pigments for their use in textile material, in place of their counterparts.Today when the world is shifting from synthetic to natural products, elaborate research and development work has been extensively started to assess the hazardous nature of synthetic dyes and other chemicals and develop natural dyes and eco friendly products. Ali et. al.studied that the pH of the extraction liquor has highly significant effect on the colour yield of pomegranate peels. The colour yield is very poor in the acidic medium, moderate in the neutral pH and significantly better in the alkaline pH of 12. The colour yield only slightly increased by increasing the extraction time from 30 minutes to 90 minutes and the effect of increase in time was not statistically significant. Similarly, the colouryield showed a slight decrease with increase in M:L from 1:20 to 1:50 and the effect of M:L was also not statistically significan

Now a days fortunatrly ,there is increasing awareness among people towards natural products due to their non toxic properties, low pollution and less side effects . Natural dyes are used in day to day food products. Although the Indian subcontinent possesses large plant resources, only little has been exploited so far. Due to lack of availability of precise technical knowledge on the extraction and dyeing technique, it has not commercially succeeded like synthetic dyes. Also colour value and longer time make the cost of dyeing with natural dyes considerably higher than with synthetic dyes.

It is time that steps are taken towards documenting these techniques of indigenous knowledge systems. Otherwise, we are bound to lose vital information on the utilization of natural resources around us. To conclude, there is an urgent need for proper collection , documentation ,assessment and characterization of dye- yielding plants and their dyes , as well as research to overcome the limitation of natural dyes.

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