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Assessment of colour fastness on different fabrics by Pea Nut Pod Natural Dyes using Pre Post and Simultaneous Mordanting Techniques

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ABSTRACT

Now-a-days, demand for natural dyes has been growing rapidly due to increased awareness on hazardous, toxic and allergic reactions associated with synthetic dyes. Natural dyes are obtained from natural sources such as plants, insects and minerals. Among all the plant based dye sources *i.e.* leaves, seeds, flowers etc. Seeds dye sources are more important for textile dyeing as it provides dye. Thus by keeping in v iew of above, in the present work, the peanut pods were used for the extraction of dye, dyeing of the selected fabrics at optimized conditions like boiling temperature and dyeing time using Ferrous Sulphate mordant and evaluate the resultant color fastness of the selected dyed samples to washing, rubbing, and sun light at Pre, Simultaneous and Post mordanting with seven fabrics as Cotton, Linen, Jute, Cotton Jute, Satin, Silk and Polyester.

Key Words : Natural dyes, Mordants, Peanut pods, Ferrous sulphate, Textile chemistry

INTRODUCTION

A renewed international interest has arisen in natural dyes due to increased awareness of the environmental and health hazards associated with the synthesis, processing and use of synthetic dyes. Textile processing industry is one of the major environmental polluters as the effluent from these industries contains a heavy load of chemicals including dyes used during textile processing. There are two main ways to limit the environmental impact of textile processing. One is to construct sufficiently large and highly effective effluent treatment plants, and the other way is to make use of dyes and chemicals that are environment friendly.

Natural dyes, when used by them have many limitations of fastness and brilliancy of shade. However, when used along with metallic mordants they produce bright and fast colours. Therefore, instead of using unsustainable technology for producing colours one can use mild chemistry to achieve almost similar results. The rich biodiversity of our country has provided us plenty of raw materials, yet sustainable linkage must be developed between cultivation, collection and their use. Natural dyes can produce special aesthetic qualities, which, combined with the ethical significance of a product that is environmentally friendly, gives added value to textile production as craftwork and as an industry

Thus by keeping in view of above, the present study has been undertaken so as to revive the age-old are of dyeing with natural dyes. In the present work, the peanut pods were used for the extraction of dye, dyeing of the selected fabrics at optimized conditions, using different mordants and evaluate the resultant colour fastness of the dyed samples to washing, rubbing, and sunlight.

Recently, a number of commercial dyers and small textile export houses have started looking at the possibilities of using natural dyes for regular basis dyeing and printing of textiles to overcome environmental pollution caused by the synthetic dyes.

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METHODOLOGY

Source:

The first part of this research work was to get the peanut pods. For this research work peanut pod were collected from local market of Beawar near Ajmer City, Rajasthan, INDIA and then classified it into two segments, dark and light color peanut pod then after this, peanut pods were dried into non sunlight area as shown in Fig. 1. After dried we grind them into mixer grinder. Preparation of the dye bath for dyeing using natural dye involves crushing, soaking and boiling are usually necessary to extract the dye from the vegetable matter. In general the coarser the material, the longer it should be soaked and boiled as shown in Fig. 1. In the process of crushing, grinder is used to make it in the powder form. When the powder form is ready, it is mixed with water solvent and heated on gas burner to extract the dye. The dyeing of cotton and other fabrics was carried out in three stages; Extraction of dyes from the plant sources, Mordanting and Dyeing.

Growing and cultivation:

The peanut is grown as an annual crop. It can grow up to 21/ 2 feet (75 cm) high and from 3 to 4 feet (90 to 120 cm) across. Peanut plants range in type from bunch plants to runner plants 6-8. Bunch plants grow upright. Runner plants spread out on or near the ground as they grow as shown in Fig. 1. Peanut plant grows best in light, well-drained and sandy soil. They need much sunshine, warm temperature, moderate rainfall, and a frost-free growing period of four or five months. Farmers prepare the soil by plowing it deeply and thoroughly. Loose soil is important so that the pegs can penetrate the soil easily. Farmers plant peanut seeds 2" to 3" (5 to 8 cm) deep at intervals of 3" to 6" (8 to 15 cm), and in rows 24" to 36" (60 to 90 cm) apart.

The dyeing of cotton and other fabrics was carried out in three stages; Extraction of dyes from the plant sources, Mordanting and Dyeing.

Fig. 1 : Peanuts found from the roots and the crushed powder of the Peanut Pods

Extraction of dye:

Various experiments were conducted for the maximum extraction of natural dye from peanut pods. The samples were collected and washed thoroughly with water to remove any dirt. After thorough drying at room temperature, the samples were ground into powder with the help of grinder and the powdered samples were used for the extraction of dyes. In order to find out the optimum extraction conditions, experiments were conducted in aqueous extraction at 80^0C temperature with M:L ratio 1:10.

Mordanting:

A few dyes can be applied by any of 3 methods (pre, simultaneous and post) but generally one of the processes gives better results than the other in case of most of dyes.

– Mordant- Ferrous Sulphate ($FeSO_4$)

Optimization of mordant concentration:-10% concentration of mordant was used. The mordanting was done and samples were dyed employing extraction time, dye, dyeing time, dyeing temperature. Optimum mordant concentration was decided on the basis of evenness, brightness and darkness of the colour. Mordanting can be carried out in three stages: Pre-mordanting, Simultaneous mordanting and Post-mordanting.

Pre-mordanting:

The fabric is mordanted first, rinsed thoroughly with water and then it is dyed with dye solution. It's being a two bath process, consumes more time, water, steam. This method gives most level results.

Simultaneous-mordanting:

It is one bath process dyeing and mordanting is done together in same bath. The fabric to be mordanted and dyed must be covered with water, so that can be stirred easily and dye and mordant can circulate thoroughly and reach each part quickly. Fabric should be properly checked and conformed that; mordant should be well dissolved before dyeing mixed with fabric.

Post-mordanting:

It consists of simple dyeing and since the lake is not formed at this stage, perfect penetration of dye takes

place. The subsequent mordanting fixed the dye through lake formation.

Dyeing:

The fabrics dyed with dye extract, keeping material it liquor ratio at 1:50 at 80°C boiling temperature for 75 min. finally the samples were washed thoroughly with cold water, squeezed and dried. In this present analysis instead of using all three mordanting techniques for dyeing, we have used only Post-mordanting method to dye the all seven fabrics by using pea nut pod natural dye.

Colour fastness of dyed sample:

Ability of dye is to retain the colour after exposure to sun, perspiration, atmosphere, washing or other colour destroying agent. The colour fastness of dye is very important from practical point of view for the manufacturer as well as consumer. It is essential to ensure that fastness of colour is sufficient to meet general and particular requirements.

Colour fastness is term used for the degree to which dye holds fast to the fibre or fabrics. A good or high fastness means that they does not fad in light, bleed or rush in washing, crock or rub off in wear. The following standard materials are needed for carrying out that the test or for assessing colour fastness ratings.

Gray scales for evaluating change in colour (IS768:1982):

It is a step scale which illustrates colour differences corresponding rating 5, 4, 3, 2 and 1. This scale may be augment to 9 step scales by the provisions of half step fastness rating 4-5, 3-4, 2-3 and 1-2.

Gray scale for evaluating staining (IS 769:1982):

It is also a step which illustrates the contrasts or perceived colour difference corresponding to fastness rating 5, 4, 3, 2 and 1. This scale by the provisions of half step fastness rating 4-5, 3-4, 2-3 and 1-2.

Determination of the colorfastness of dyed samples:

Colorfastness to washing:

BS1006, (03:1987, IS 03) was used. A specimen measuring 10cm×4cm of the material to be tested was cut out. Then specimen was placed between two pieces of undyed fabric measuring 10×4 cm and the three pieces were held together by stitching round the edges.

Some solution was prepared by dissolving 5 g detergent in 1 liter water. To the soap solution 2g/lt of anhydrous sodium carbonate was added. The composite sample was then treated in a wash wheel or laundrometer 60°C +2°C for 30 min in sufficient of the above solution to give liquor ratio of 50:1.

Specimen was removed, rinsed twice in distilled cold water and then in running tap water for 10 min and squeezed. Stitching was removed from three sides. Sample was opened and dried. Loss in colour of dyed sample and staining of white fabrics was assessed with grey scale no 1 and 2, respectively.

Colorfastness to sunlight:

Sample of 7"×2" and divide it into 7 equal parts. Cut a piece of black paper measuring 7"×2" and divide it into 7 parts. Black paper was placed upon dyed specimen leaving No. 1 part expose keep it's in sunlight from 9 P.M. to 3 P.M. next day the black paper was shifted to No. 2 exposed as same on 1st day. In this manner the black paper was shifted one mark below on each successive day till the whole fabric was exposed for one day only while the other end of the fabric for seven day.

Colorfastness to rubbing:

All the coloured matters fade when any material is rubbed to crock meter. The dyed (test piece) specimen was fixed to the rubbing device. Undyed cloth (white) was attached to the finger of rubbing device and rubbed to and from in the straight line along a track of 10 cm for 10 sec. with a downward force of 90 g. Degree of staining of white was assessed with help of scale and rating was assigned.

RESULTS AND DISCUSSION

Colorfastness on different fabric with peanut pod and mordants:

Good colorfastness continues to be major concern of the consumers. Beauty of color on any fabric is of no value to consumer unless the dye is considered fast under conditions, it will be used, and that's why in this study colorfastness of different chemicals on different fabrics was assessed. The fabrics are as follows: Cotton, Linen and Jute. The above discussed points can be understood by different analysis with five point gray scale, which is given by the four different tables.

It can be observed from the table 1 that cotton fabric is reacted with the ferrous sulphate mordanting agent

with 10% and 15% dyed solution. Here we have worked on three different conditions as Pre, Simultaneous and Post mordanting. In this we have observed that cotton fabric gives best result with the 10% and 15% in the pre mordanting condition at color change rubbing dry condition (all tests). The same procedure we have followed with the second sample Linen fabric can be shown in Table 2.

It can be observed from the Table 2 that linen fabric is reacted with the ferrous sulphate mordanting agent with 10% and 15% dyed solution. Here we have worked on three different conditions as Pre, Simultaneous and Post mordanting. In this we have observed that linen fabric gives best result with the 10% and 15% in the pre, 10% and 15% in simultaneous and 10% in post mordanting condition at color change rubbing dry condition. As it is declared that Linen fabric in pre mordanting 10% and 15% gives the best result in all tests. The same procedure we have followed with the third sample Jute fabric can be shown in Table 3.

It can be observed from the Table 3 that jute fabric is reacted with the ferrous sulphate mordanting agent with 10% and 15% dyed solution. Here we have worked on three different conditions as Pre, Simultaneous and Post mordanting. In this we have observed that jute fabric gives best result with the 10% and 15% in the pre mordanting.. The same procedure we have followed with

Table 1 : Cotton fabric with Ferrous Sulphate Post mordanting condition

Fabric	Specimen	Dye and Mordant	Dye %	Mordanting	Color Change Sun Light	Color Change Rubbing (Wet)	Color Change Rubbing (Dry)	Color Change Washing Fastness
Cotton		Peanut Pods (pp)	-	-				
	1	PP+ Ferrous Sulphate	10%	Pre	4/5	4/5	5	4/5
	2	PP+ Ferrous Sulphate	15%	Pre	4/5	4/5	5	4/5
	3	PP+ Ferrous Sulphate	10%	Simultaneous	4	4	4/5	4/5
	4	PP+ Ferrous Sulphate	15%	Simultaneous	4	4	4/5	4
	5	PP+ Ferrous Sulphate	10%	Post	4/5	4	4/5	4
	6	PP+ Ferrous Sulphate	15%	Post	4	4/5	4/5	4/5

Table 2 : Linen fabric with Ferrous Sulphate in Pre, Post and Simultaneous condition

Fabric	Specimen	Dye and Mordant	Dye %	Mordanting	Color Change Sun Light	Color Change Rubbing (Wet)	Color Change Rubbing (Dry)	Color Change Washing Fastness
Linen		Peanut Pods (pp)	-	-				
	1	PP+ Ferrous Sulphate	10%	Pre	4/5	4/5	5	4/5
	2	PP+ Ferrous Sulphate	15%	Pre	4	4/5	5	4
	3	PP+ Ferrous Sulphate	10%	Simultaneous	4	4	4/5	4/5
	4	PP+ Ferrous Sulphate	15%	Simultaneous	4/5	3/4	5	4
	5	PP+ Ferrous Sulphate	10%	Post	4/5	4	5	3/5
	6	PP+ Ferrous Sulphate	15%	post	4	4	4	4

Table 3 : Jute fabric with Ferrous Sulphate in Pre, Post and Simultaneous condition

Fabric	Specimen	Dye and Mordant	Dye %	Mordanting	Color Change Sun Light	Color Change Rubbing (Wet)	Color Change Rubbing (Dry)	Color Change Washing Fastness
Jute		Peanut Pods (pp)	-	-				
	1	PP+ Ferrous Sulphate	10%	Pre	4	4	5	4/5
	2	PP+ Ferrous Sulphate	15%	Pre	4	4/5	5	4/5
	3	PP+ Ferrous Sulphate	10%	Simultaneous	3/4	3/4	4	4
	4	PP+ Ferrous Sulphate	15%	Simultaneous	4	4/5	5	¾
	5	PP+ Ferrous Sulphate	10%	Post	4	4	5	4
	6	PP+ Ferrous Sulphate	15%	Post	3/4	4	5	4

the fourth sample Cotton Jute fabric can be shown in Table 4.

It can be observed from the table 4 that cotton jute fabric is reacted with the ferrous sulphate mordanting agent with 10% and 15% dyed solution. Here we have worked on three different conditions as Pre, Simultaneous and Post mordanting. In this we have observed that cotton jute fabric gives best result with the 10% in the pre mordanting with in all tests. The same procedure we have followed with the fifth sample Satin fabric can be shown in Table 5.

It can be observed from the Table 5 that satin fabric is reacted with the ferrous sulphate mordanting agent with 10% and 15% dyed solution. Here we have worked on three different conditions as Pre, Simultaneous and Post mordanting. In this we have observed that satin fabric gives best result with the pre, simultaneous and post mordanting in 10% and 15% with all tests. The same procedure we have followed with the sixth sample Silk can be shown in Table 6.

It can be observed from the Table 6 that silk fabric is reacted with the ferrous sulphate mordanting agent with 10% and 15% dyed solution. Here we have worked on three different conditions as Pre, Simultaneous and Post mordanting. In this we have observed that satin fabric gives best result with the pre, simultaneous and

Table 4 : Cotton Jute fabric with Ferrous Sulphate in Pre, Post and Simultaneous condition

Fabric	Specimen	Dye and Mordant	Dye %	Mordanting	Color Change Sun Light	Color Change Rubbing (Wet)	Color Change Rubbing (Dry)	Color Change Washing Fastness
Cotton		Peanut Pods(pp)	-	-				
Jute	1	PP+ Ferrous Sulphate	10%	Pre	4/5	4	4/5	4/5
	2	PP+ Ferrous Sulphate	15%	Pre	4	3/4	5	4
	3	PP+ Ferrous Sulphate	10%	Simultaneous	3/4	4	5	4
	4	PP+ Ferrous Sulphate	15%	Simultaneous	3/4	4	4/5	4
	5	PP+ Ferrous Sulphate	10%	Post	4	3/4	4/5	4
	6	PP+ Ferrous Sulphate	15%	Post	4	4	5	3/4

Table 5 : Satin fabric with Ferrous Sulphate in Pre, Post and Simultaneous condition

Fabric	Specimen	Dye and Mordant	Dye %	Mordanting	Color Change Sun Light	Color Change Rubbing (Wet)	Color Change Rubbing (Dry)	Color Change Washing Fastness
Satin		Peanut Pods(pp)	-	-				
	1	PP+ Ferrous Sulphate	10%	Pre	4/5	4/5	5	5
	2	PP+ Ferrous Sulphate	15%	Pre	4	4	5	4/5
	3	PP+ Ferrous Sulphate	10%	Simultaneous	4	4/5	5	4/5
	4	PP+ Ferrous Sulphate	15%	Simultaneous	4/5	4	5	4
	5	PP+ Ferrous Sulphate	10%	Post	4	4/5	4/5	4/5
	6	PP+ Ferrous Sulphate	15%	Post	4/5	4/5	5	5

Table 6 : Silk fabric with Ferrous Sulphate in Pre, Post and Simultaneous condition

Fabric	Specimen	Dye and Mordant	Dye %	Mordanting	Color Change Sun Light	Color Change Rubbing (Wet)	Color Change Rubbing (Dry)	Color Change Washing Fastness
Silk		Peanut Pods(pp)	-	-				
	1	PP+ Ferrous Sulphate	10%	Pre	4/5	4/5	5	5
	2	PP+ Ferrous Sulphate	15%	Pre	4/5	4/5	5	5
	3	PP+ Ferrous Sulphate	10%	Simultaneous	4	4/5	5	5
	4	PP+ Ferrous Sulphate	15%	Simultaneous	4/5	4/5	5	4/5
	5	PP+ Ferrous Sulphate	10%	Post	4/5	4/5	5	5
	6	PP+ Ferrous Sulphate	15%	Post	4/5	4	5	4/5

Table 7 : Polyester fabric with Ferrous Sulphate in Pre, Post and Simultaneous condition

Fabric	Specimen	Dye and Mordant	Dye %	Mordanting	Color Change Sun Light	Color Change Rubbing (Wet)	Color Change Rubbing (Dry)	Color Change Washing Fastness
Polyester		Peanut Pods (pp)	-	-				
	1	PP+ Ferrous Sulphate	10%	Pre	4/5	4/5	5	4/5
	2	PP+ Ferrous Sulphate	15%	Pre	4/5	4/5	5	4/5
	3	PP+ Ferrous Sulphate	10%	Simultaneous	4	4	4/5	4
	4	PP+ Ferrous Sulphate	15%	Simultaneous	4	4/5	4	4/5
	5	PP+ Ferrous Sulphate	10%	Post	4	4	4/5	4/5
	6	PP+ Ferrous Sulphate	15%	post	4/5	4/5	4	4/5

post mordanting in 10% and 15% with all tests. The same procedure we have followed with the seventh sample Polyester can be shown in Table 7.

It can be observed from the Table 7 that polyester fabric is reacted with the ferrous sulphate mordanting agent with 10% and 15% dyed solution. Here we have worked on three different conditions as Pre, Simultaneous and Post mordanting. In this we have observed that satin fabric gives best result with the pre , simultaneous and post mordanting in 10% and 15% with in all tests .This is the way have done analysis on seven different fabrics at three different mordanting condition with ferrous sulphate mordanting agent.

Conclusion:

In this paper, the peanut pods were used for the extraction of dye, dyeing of the selected fabrics at optimized conditions like boiling temperature and dyeing time using ferrous sulphate mordant and evaluate the resultant color fastness of the selected dyed samples to washing, rubbing, and sun light at three mordanting conditions – Pre, Simultaneous and Post mordanting with seven fabrics as Cotton, Linen, Jute, Cotton Jute, Satin, Silk and Polyester. Over all result is that peanut pod with ferrous sulphate gives good result in post mordanting process with color fastness in rubbing dry test. This research work could be beneficial for a number of commercial dyers and small textile export houses who have started looking at the possibilities of using natural dyes for regular basis dyeing and printing of textiles to overcome environmental pollution caused by the synthetic dyes.

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REFERENCES

Ahmed, Nahed S.E. (2005). The use of sodium edate in the dyeing of cotton with reactive dyes. *Dyes & Pigments,* **65** (3) : 221-225.

Bhuyan, R. and Saikia, C.N. (2003). Extraction of Natural colourants from roots of Morinda angustifolia Roxb their identification and studies of dyeing characteristics on wool. *Indian J. Chem. Technol.,* **10**(2) : 131-136.

Das, D., Bakshi, S. and Bhattacharya, P. (2016). Dyeing of EDTA-modified cotton with reactive dyes. *Clothing & Textiles Res. J.,* **34**(3) : 196-206.

Ghosh, P., Samanta, A.K. and Das, D. (1994). Effect of selective pretreatments and different resin post-treatments on Jute/ Viscose upholstery fabric. *Indian J. Fibre & Textile Res.,* **19** : 274-277.

Jothi, D. (2008). Extraction of natural dyes from African Marigold flower (Tagetus Erecta) for Textile coloration. *AUTEX J.,* **8**(2) : 1-6.

Kamel, M.M., Hemly, H.M. and Hawary, N.S. (2009). Some Studies on Dyeing properties of Cotton fabrics with Crocus Sativus (Saffron) flowers using an Ultrasonic method. *AUTEX Res. J.,* **9** (1) : 1-5.

Kulkarni, S.S., Gokhale, A.V., Bodake, U.M. and Pathade, G.R. (2011). Cotton dyeing with Natural dye extracted from Pomegranate (*Punica granatum*) peel. *UJERT J.,* **1** (2) : 135-139.

Kumari, Tanvi and Singh, Divya Rani (2018). Assessment of colour fastness of developed shades of Harsingar flower on Khadi silk yarn. *Internat. J. Appl. Home Sci*., **5** (4):

817-821.

Lewis, D.M. (1993). New possibilities to improve cellulosic fiber dyeing process with fiber reactive systems. *J. Society of Dyers & Colorists,* **109** : 357–361.

Li, Y.V., Malensek, N., Sarkar, A.K. and Xiang, C. (2016). Colorfastness properties of persimmon dye on cotton and wool fabrics. *Clothing & Textiles Res. J.,* **34**(3) : 223-234.

Mehta, P.V. and Bhardwaj, S.K. (1998). Managing Quality in the Apparel Industry. New Age International Publishers, 189-193.

Montazer, M., Malek, R.M.A. and Rahimi, A. (2007). Salt free reactive dyeing of cationized cotton. *Fibers & Polymers,* **8** (6) : 608-612.

Padma, S.V. and Rakhi, S. (2007). Dyeing wool and silk with Hibiscus mutabilis (Gulzuba). *Dyes Pigments,* **74**(2) : 464-469.

Patino, Alejandro *et al*. (2011). Surface and bulk cotton fibre modifications: plasma and cationization. Influence on dyeing with reactive dye. *Cellulose,* **18** (4) : 1073-1083.

Ristic, N. and Ivanka, R. (2012). Cationic modification of cotton fabrics and reactive dyeing characteristics. *J. Engineered Fibers & Fabrics,* **7**(4) : 113-121.

Samanta, A.K., Chakraborty, P. and Das, D. (1990). Some studies on quality performances of Jute/ Cotton furnishing fabrics. *J. Institution of Engineers- Textile Engineering,* **71** : 41-45.

Samanta, A.K. and Das, D. (1992). Studies on Quantitative colour measurement of direct dyed Jute Fabric in relation to computerized colour matching. *J. Institution of Engineers-Textile Engineering,* **73** : 49-53.

S., Adeel, Ali, S., Bhatti, I. A. and Zsila, F. (2009). Dyeing of Cotton fabric using Pomegranat (Punica Granatum) Aqueous extract. *Asian J. Chem.,* **21**(5) : 3493-3499.

Samanta, A.K., Sur, D., Chattopadhyay, D.P. and Ghosh, S.K. (1995). Some studies on mechanical properties and atmospheric dyeing of solvent pretreated polyester multifilament yarn. *Indian J. Fibre & Textile Res.,* **20** : 19-23.

Samanta, A.K., and Agrawal, P. (2009). Application of Natural Dyes on Textiles. *Indian J. Fibre & Textile Res.,* **34** : 384-389.

Sarkar, A.K. and Seal, C.M. (2003). Color strength and colorfastness of flax fabrics dyed with natural colorants. *Clothing & Textiles Res. J.,* **21** : 162–166.

Singh, Renu and Srivastava, Sangita (2017). Application of natural dye on silk fabric. *Internat. J. Appl. Home Sci.*, **4** (9 & 10): 805-809.

Swami, C., Saini, Sangita and Gupta, V.B. (2012). A study on green dyeing of cotton with ethanolic extract of Sesbania aculeate. *Universal J. Environ. Res. & Technol.,* **2** (2) : 38-47.

Vankar, P., Shanker, R. and Samudrika W. (2009). Utlizatation of temple waste flower – Tagetus erecta for dyeing of cotton, wool and silk on industrial scale. *J. Textile & Apparel, Technol. & Mgmt.,* **6** : 1-15.

Young, H.L. and Han, D.K. (2004). Dyeing properties and Colourfastness of Cotton and Silk fabrics dyed with *Cassia tora* L. extract. *Fibres Polymers*, **5**(4) : 303-308.

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