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Effect of Preparation Time of Two Kind of Natural Dye (Madder and Walnut) on the Shade and Physical Properties of Pile Yarns

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Abstract: Hand made Iranian carpet are made by silk and wool pile that dyed by natural dyes. The most important of natural dyes used in Iran are Madder and Walnut. In this paper the effect of wetting time of natural dyes has been evaluated on the fastness and colour shade. At the first, woolen yarns were mordent by $AlK(SO_4)_2$, $CuSO_4$ and $FeSO_4$ then dyeing by natural dyes was done. The results of colour shades under CIE $L^*a^*b^*$ system and fastness show that by increase in wetting time, the colour depth and fastness decreased. Consider to economy and results optimum wetting time for two dyes were estimated.

Key words: Natural dyeing · wool · madder · walnut · carpet

INTRODUCTION

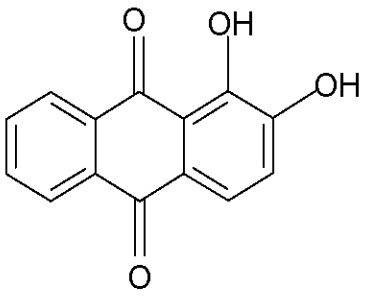
The importance of natural is obvious and irrefutable in Iran because of the industry of carpet weaving and other similar textiles based on natural dyeing. The significant factor of carpet industry is constant colour which is emphasized on carpet business [1].

Madder is used to achieve the red colour mostly in Iran and Turkey. Madder is a shrubby plant in which the root is peeled and powdered. Elegant colours between orange, red and purple is obtained from madder [2].

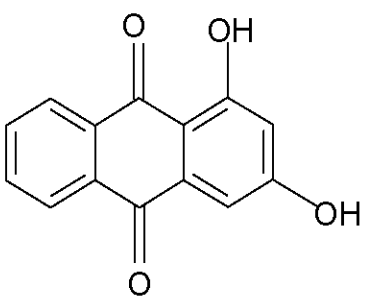
Dyes with different colour shades are reputed polychromic dyes. The colour of these dyes is affected with various factors. Madder and walnut are in this group of dyestuff. Herbal dyestuff divided in two groups according to dyeing process. In the first group of this dye the absorption is weak without mordant and in the second group the absorption is not depended on mordant or in the other term dyestuff is accompanied with mordant e.g. Walnut [3].

The mordant is also used as pre-mordant in dyeing with madder but the walnut sell has general fastness without using mordant.

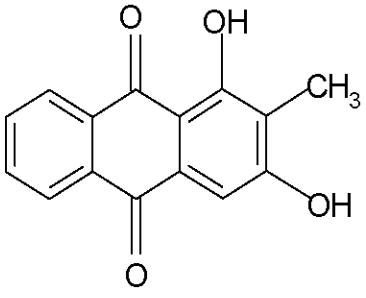
Madder: The scientific name of this plant is rubiatinctromand and the dyestuff called madder. Madder is natural red with C.I. natural red 6, 8, 9, 10, 11 and12. The root of this plant is the colour source of Antrquinon Alizarin. Other free Antraquinon hydroxides which are existed in this plant have the ability of dyeing fibers and some of them have not this capability. The most other important Antraqinons hydroxides in madder are Purpurin, PseuodoPurpurin, Xanthopurpurin, Rubiadin, Munjestin, Anthragllol, Lucidin, damncantal, Nordamncantal and [4].



Alizarin



Purpurin



Rubiadin

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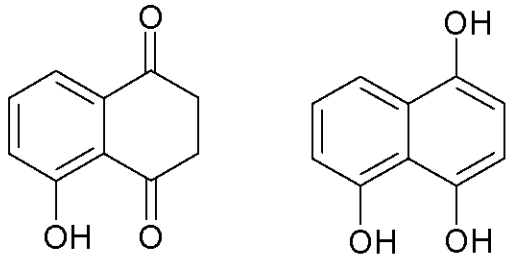
The straight root of madder which has the most Alizarin dyestuff is found in one meter depth of sand area. The most important factor of colour of the madder root is the age of the root. The longer lifetime of this plant result in deeper colour. Three year old roots give orange and six to seven years old roots give red and purple. Another important factor of madder colour is the growing zone of this plant. Madder growing in cold regions gives deeper colours than madder growing is desert regions. To prepare dyestuff for dyeing wool, madder powder soaks in water and adds into water, the mordanted wool put in the bath and dyeing proceeds heating the bath in boiled temperature [5].

The amount of madder harvest in Ardakan city in 2005 was 1500 tons which 30 percent were exported to Turkey, Japan, Pakistan and India.

Walnut: Walnut tree are mostly found in mild climate of north of Iran. Juglons is the premier dyestuff of walnut shell and mordant is found in all parts of walnut plenty. Walnut shell is used as dyestuff mostly in Iran. The amount of tannic substance in walnut shell is between 30 to 35 percent.

75500 C.I. Natural Brown

Common name: Juglon, Nucin or Regianin (6) α-Juglon



In the past juglone was applied for dyeing cotton and wool in tawny shades. Although this dyestuff is not attracted by customers it is fungicide and useful for skin diseases [7].

Some of the old carpets have black colours in their background which is obtained from iron oxide (II) mordant. Iron oxide corrodes the wool so the black parts of carpet decay very fast. The green colour of background of the carpet corners is gained from copper sulfate. The salt of copper cause corrosion and decays the surface of wool so brightness and strength of these areas is less [2].

In the research on dyeing silk with madder which has been done by the research institute of Iranian hand-made carpet it was found the order of samples brightness after mordanting and dyeing decrease the brightness without changing the order. In the comparison of dyed samples under CIE L*a*b* system it was found that the samples which are mordanted with tin chloride have more yellowness, With alum have more redness and with iron sulphates have more greenness and blueness after dyeing. So it infers that besides the physical factors which are a combination of dyestuff and mordanting, the energy induction phenomena, internal energy variation, electron spin diversion influence the process of mordanting and dyeing [8].

An investigation proved that mordanting and dyeing doesn't rise the length of dyed silk but decrease the strength 16%. Washing fastness and staining of silk which is dyed with madder and iron sulphate mordant is the most and the ones mordant with tin chloride and alum is the least. The superlative fastness to light is related to iron and copper and the least fastness to light is related to tin and alum mordant [9].

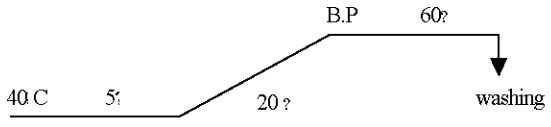
It has been proved that the fastness to light is less in the environment without mordant. Plants with mordant have more fastness to light in acidic environments than alkali and neutral environments. The spectrum which is obtained from the plants contain antraquinon has the most fastness to light than the plants contain antisyanin and flavonoeid [10].

2. MATERIALS AND METHOD

Wool yarn, 490/2 Tex, 144 T.p.m from white balouch race, madder powder from Ardakan city of Iran, Grinded Walnut shell from east azarbayjon of iran, Aluminum Potassium Sulphate and Copper sulphate (II) as mordant from merck company, Acitic acid and nonionic washer.

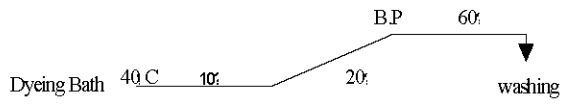
Experimental: Washing the wool yarn. Wool yarns are washed in 1% nonionic washer in 60ú for 30 minutes with L:G=40:1.

Mordanting of wool yarn for dyeing with madder. Three different mordants, Aluminum Potassium Sulphate, Copper Sulphate and Iron Sulphate, in a bath contain 10% mordant as the following graph is used. The acidity of mordanting bath is between "4-5".



Preparation of dyestuff. To examine the effect of time of dye preparation on colour shade and general fastness of wool yarns two herbal dyestuffs with 200% to the weight of yarns are chosen and have been soaked in three different temperatures 20, 60 and 95°C for 4 times of testing 10 min, 6 hr, 24 hr and 48 hr. Twice the volume of the powder water has been added to the powder. The mixture of the water and dyestuff has been filtered and put to the dye bath.

Dyeing the mordanted wool yarns with madder: The mordanted wool yarns have been dyed in a bath (L:G = 40:1) with 5% acitic acid and then washed. The acidity of the bath is near 5.



yeing the wool yarns with walnut shell solution: To dye the white wool yarns with walnut solution it was acted like dyeing the mordanted wool yarn with madder.

Coding the samples: To specify the samples and the condition of preparation and dyeing the samples have been coded as indicated in Table 1.

Type of dyestuff	Type of mordant	The heat of dye preparation (T)	Time of dye preparation
M: Madder	Al: $AlK(SO_4)$	T20=20°C	t0h=immediately
	Cu: $CuSO_4$	T60=60°C	t6h=6 hours
W: Walnut	Fe: $FeSO_4$	T95=95°C	t24h=24 hours
			t48h=48 hours

The apparatus of evaluation of samples properties: Evaluate the color: To determine the color and brightness of samples Data Color apparatus eye xth model base on the standard light source D65 and under the CIE L*a*b* system was applied.

Evaluate the strength of yarns: To assign the effect of preparation process on the strength of yarns Instron TM-SM apparatus base on the standard of ASTM with the Constant Rate Elongation (CRE) was used.

Table 1: Some example of samples coding

Samples code	Type of dyestuff	Mordant	Heat of preparation	Preparation Time
MAlT20t0h	M = Madder	Al: $AlK(SO_4)$	20°C	Immediately
MFeT95t24h	M = Madder	Fe: $FeSO_4$	95°C	24 hours
WT20t6h	W = Walnut	Without mordant	20°C	6 hours
WT60t48h	W = Walnut	Without mordant	60°C	48 hours

Evaluate the fastness of light: In this experiment samples have been put in standard condition according to the standard of ISO.105/B1984(E) and the fastness of light have been obtained base on comparison of the samples before and after exposing to the light of blue scale.

RESULTS AND DISCUSSION

Comparison of brightness L* between samples dyed with madder: in order rate of brightness of dyed samples that their have come in Table 2 and their graph are in Fig. 1 and 2 so it has follow results:

The heat of primary preparation dye (saturating) hasn't any effect on samples brightness. So by certain mordant and so that economical profit room temperature is suitable for primary preparation dye.

The time of primary preparation dye is effective on L* brightness. And about 3 mordant by increase preparation time from immediately to 48 hours the samples brightness comes up. In order hand it causes decrease of depth dye.

Type of mordants is directly effective on sample brightness rate as samples that dyed with white vitriol were the mast bright then cooper sulfate and in recent the least L* bright or most depth dye is belong to the samples that dyed with iron sulfate (II) in order to Fig. 2 upper results visible and confirmable.

Comparison of L* brightness between samples dyed with walnut: In order to amount sample's dyed brightness that is in Table 2 and Fig. 3; the follow results are comprehended:

With verifying of dye preparation times their brightness changes too. So that samples with preparation time between 24 hours and immediately contain least brightness and the samples with preparation time between 6 or 48 hours contain most brightness. In the other hand those have the least dyes amount.

By raising of preparation temperature amount of samples brightness hasn't very difference and in partly times the sample become more bright or light colour so in order to economical profit the room temperature is the best preparation temperature.

Comparison between shade and depth samples dyed with madder: a*, b* numerical in formations of mordanted samples and dyed with madder. by comparison of them are comes in Table 2 and Fig. 4:

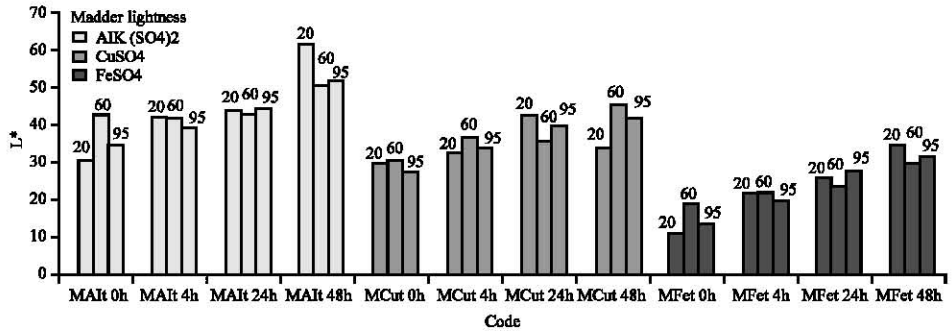


Fig. 1: The comparison of samples lightness (L*) dyed with madder(according to the kind of tannic)

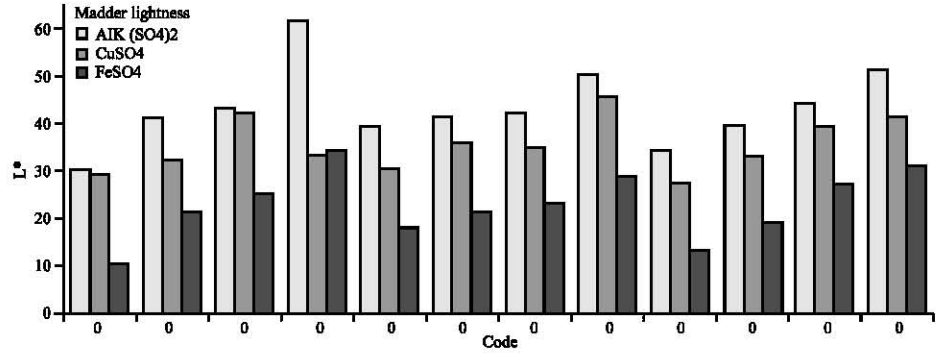


Fig. 2: The comparison of samples lightness dyed with madder(according to the temperature of preparation)

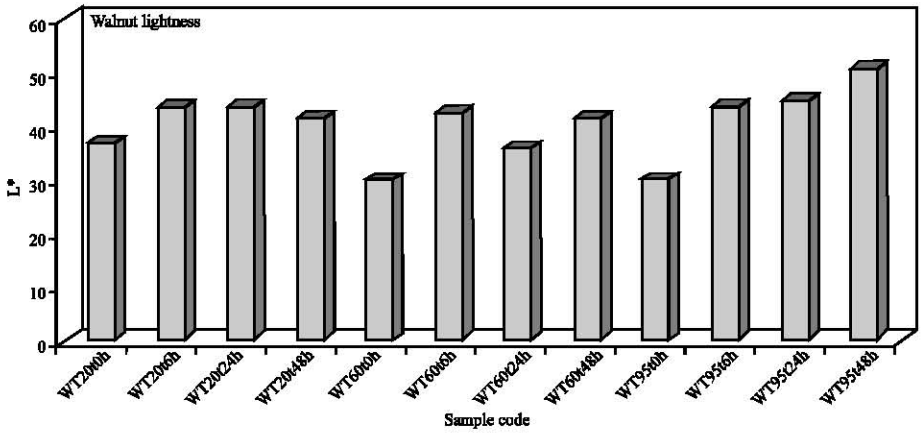


Fig. 3: The comparison of samples lightness (L*) dyed with walnut

In order to Fig. 4 indicated that 3 mordant that is used by increasing preparation time (soaking) amount of blue and redness have decreased and samples goes to yellow or center of graph that is white. In other hand the samples that mordanted with white vitriol and immediately have dyed are dark colour or dark red in compair of other samples.

In case of samples that mordanted with iron sulfate and immediately dyed are more dark colour and dark brown than the other samples.

In notice on Fig. 5 and 6 that shows compare between amount dye samples with mordant and dyed with madder is different preparation temperature, by confirming above results shows that by increasing soaking time of powder dye.

Depth and intensity of samples strongly comes down. on the whole above result is correct for every: three preparation time. So in order to economical profit the best temperature for preparation dye is room temperature and the most suitable time is immediately dyeing after soaking or preparation.

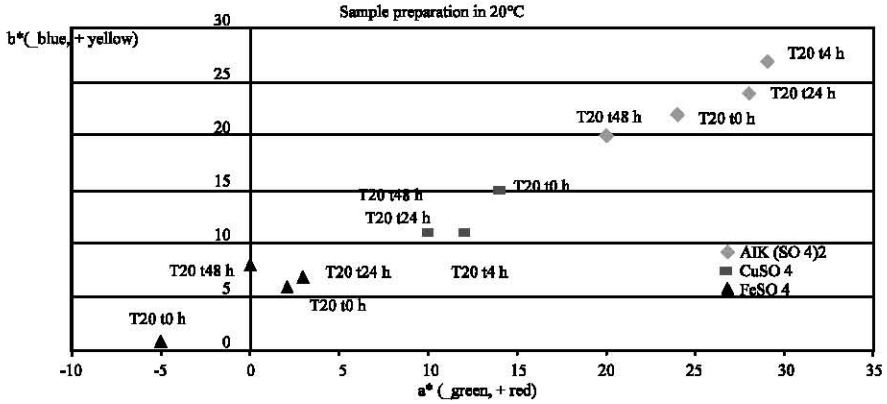


Fig. 4: The comparison of samples colour (a*b*) dyed with madder (in different time of soaki

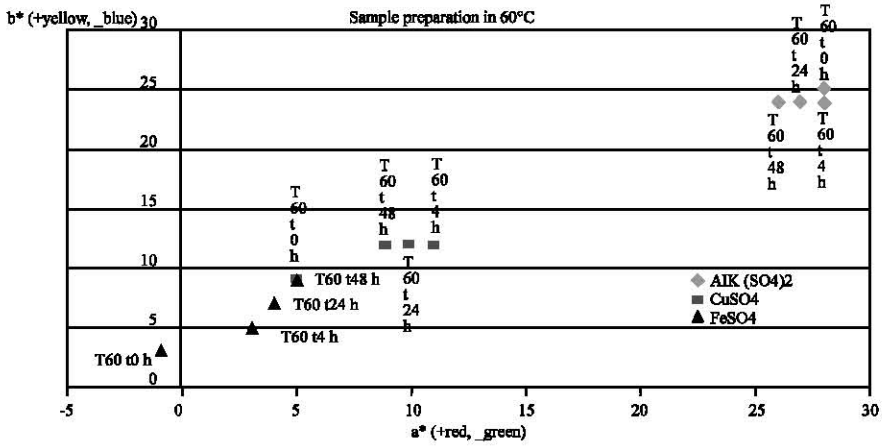


Fig. 5: The comparison of samples colour (a*b*) dyed with madder (In different time of soaking)

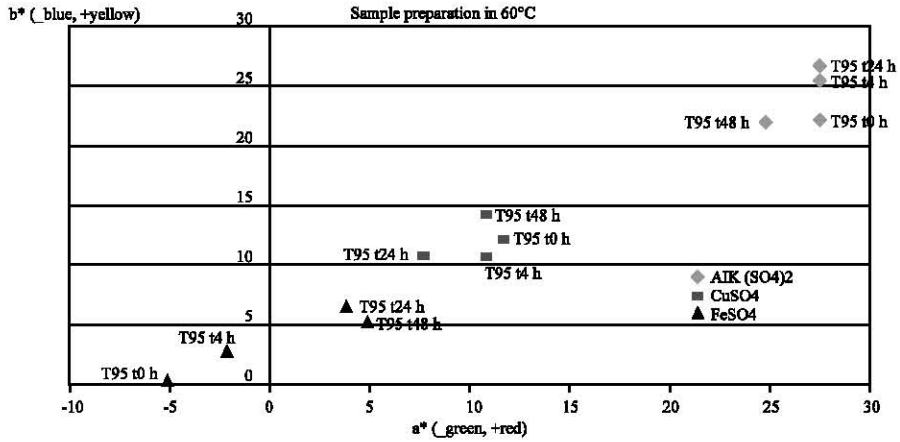


Fig. 6: The comparison of samples colour (a*b*) dyed with madder (In different time of soaking)

Comparison between shade and depth samples dyed with walnut: Numerical information of white wool samples that dyed with walnut and their preparation time difference shows in Table 2 comparison between those informations that performed in Fig. 7 shows that how much time preparation be low then samples shade and depth be more. In order to the samples that use immediately after preparation have most greenness and blue.

In spite of other samples. then the samples that their preparation time long 24 hours are more darkness and the

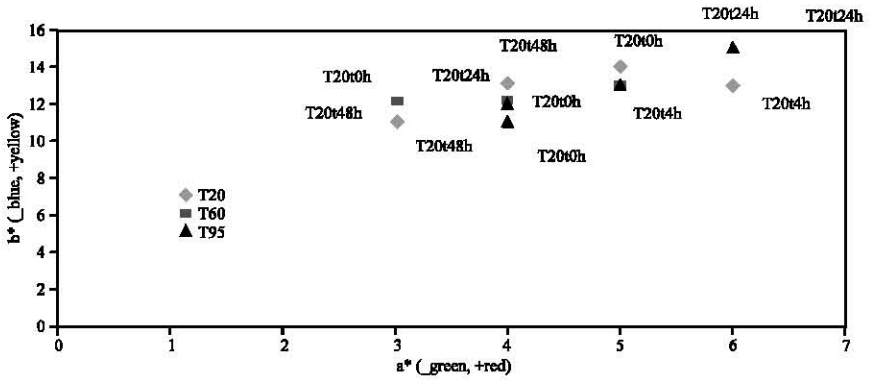


Fig. 7: The comparison of samples colour (a*b*) dyed with walnut

Table 2: The amount of L*a*b* of samples dyed with madder and walnut

Code	L*	a*	b*	Code	L*	a*	b*	Code	L*	a*	b*	Code	L*	a*	b*
MAlT20t0h	30	28	24	MAlT60t0h	42	28	25	MAlT95t0h	34	27	26	WT20t0h	37	4	13
MAlT20t4h	41	29	27	MAlT60t4h	41	28	24	MAlT95t4h	39	27	22	WT20t6h	44	6	13
MAlT20t24h	43	24	22	MAlT60t24h	42	26	24	MAlT95t24h	44	27	25	WT20t24h	44	5	14
MAlT20t48h	61	20	20	MAlT60t48h	50	27	24	MAlT95t48h	51	25	22	WT20t48h	42	3	11
McuT20t0h	29	14	15	McuT60t0h	30	5	9	MCuT95t0h	27	12	12	WT60t0h	30	3	12
McuT20t4h	32	10	11	McuT60t4h	36	11	12	MCuT95t4h	33	11	14	WT60t6h	43	4	12
McuT20t24h	42	12	11	McuT60t24h	35	10	12	MCuT95t24h	39	9	11	WT60t24h	36	5	13
McuT20t48h	33	10	11	McuT60t48h	45	9	12	MCuT95t48h	41	11	11	WT60t48h	42	4	12
MFeT20t0h	10	-5	1	MFeT60t0h	18	-1	3	MFeT95t0h	13	-5	0	WT95t0h	30	5	13
MFeT20t4h	21	2	6	MFeT60t4h	21	3	5	MFeT95t4h	19	-2	2	WT95t6h	44	4	12
MFeT20t24h	25	3	7	MFeT60t24h	23	4	7	MFeT95t24h	27	4	7	WT95t24h	45	6	15
MFeT20t48h	34	0	8	MFeT60t48h	29	5	9	MFeT95t48h	31	5	5	WT95t48h	51	4	11

Table 3: lightness stability of samples dyed with madder and walnut

Codes of samples	MAl	MCu	MFe	Wt0h	Wt6h	Wt24h	Wt48h
Degree of lightness stability	4.5	5.5	5	5.5-6	5.5-6	5.5-6	5.5-6

samples that their preparation time long 6 hours and 48 hours according to were least coloured. by increasing both temperature depth of dyes haven't very difference. Even partly samples were been lighter or brighter. So in order to economical benefit room temperature is the most suitable temperature for preparation dye consideration of samples

Light stability that dyed with madder and walnut: Numerical and comperative informations between light stability of samples with madder and walnut having arrived Table 3 and Fig. 8:

As is distincted in order to their all dyeing graphs is same and only their preparation time is different so samples varietys are less samples with walnut have light stability 5.5-6 that have more stability than madder.

The samples with madder and copper sulfate mordant have most stability, then iron sulfate and finally samples with aluminium and kalium have the least light stability.

CONCLUSIONS

L* lightness of variety wool raw yarn that dyed with madder shows that increasing preparation time (saturating) from immediately to 6, 24 and 48 hours cause increase of samples lightness amount, So depth and intensity of samples decrease, as samples that use immediately have hardly difference. White vitriol dyed with madder and Copper sulfate gives dark brown to light brown and iron sulfate (II) gives very dark brown.

In case of raw yarn with walnut and without mordant most intensity or least lightness belong to samples that their preparation time is immediately and preparation time long 24 hours. Preparation temperatures 20°C (room temperature), 60°C and 95°C for madder and walnut were experimented and showed it hasn't any considerable effect on depth and shade of samples. So in order to economical benefit and easy access the best temperature for dye preparation is room temperature. Finally for having

sample with highest stability and intensity dye powder immediately be should used after preparation.

So it is better the powder should be added to goods in dyeing bath without any time for preparation out of bath because intensity and light stability of samples will be strongly decreased.

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