Weaving Design Suggestions with the One-Bath Dyeing Method in the Context of Natural Dyeing With Allium Cepa L. and Natural Fiber Relations[1]

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ABSTRACT

This study is a woven fabric design method proposal in which the different stages of the process are reduced by using natural dyestuff in a single dyebath. Although a natural dye with low light fastness such as onion peel and an environmentally harmful metal mordant such as copper sulfate ($CuSO_4.5H_2O$) was used in one example, sustainable dyeing can be done by making the dyeing ingredients more suitable. The novelty of this study is that different fiber raw materials with different dyeing capacities, form a fabric surface with the weaving technique, and fabric designs that reach different colors or tones in one step by dyeing in a single dye bath are provided. In the study, the dyeing processes are an element that completes the weaving design. Within the scope of this study, it is also aimed to bring design proposals that support the concepts of natural production, waste management, and slow fashion, which are the subtitles of sustainability. Our dobby weaving design applications and three jacquard design simulations were carried out by using the data on the colour/texture effects obtained from the preliminary trials. Due to the use of yarns with different raw materials in weaving, it was possible to reach the most colour tones and therefore different pattern regions by performing a one-bath dyeing process. At the same time, sustainability was supported by preventing the loss of labour, materials, and time with this type of dyeing method. In the context of slow fashion practice; it is thought that this study, which is carried out with the aim of keeping traditional production methods alive and adopting production methods in which dyeing process steps are minimised, will set a innovative and creative example for dobby and jacquard woven fabric designs.

Keywords: *Sustainability, Natural Dyeing, Weaving Design, Innovative Fabric Design, One-Bath Dyeing, Slow Fashion.*

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Doğal Boyama ve Doğal Lif İlişkileri Kapsamında Tek Banyoda Soğan Kabuğu ile Boyama Yöntemiyle Dokuma Tasarımı Önerileri

ÖZ

Bu çalışma tek boya banyosunda doğal boyar madde kullanılarak işlem basamaklarının azaltıldığı bir dokuma kumaş tasarımı yöntem önerisidir. Soğan kabuğu gibi ışık haslığı düşük bir doğal boyar madde ve bir örnekte bakır sülfat ($CuSO_4.5H_2O$ gibi çevreye zararlı bir metal mordan kullanılmış olsa da boyama içerikleri daha uygun hale getirilerek sürdürülebilir boyamalar yapılabilir. Çalışmanın ortaya koyduğu yenilik, boya alma kapasiteleri farklı olan farklı lif hammaddelerinin dokuma tekniğiyle bir kumaş yüzeyi oluşturması ve tek boya banyosunda boyanarak tek adımda farklı renk veya tonlara ulaşılan kumaş tasarımları sağlanmış olmasıdır. Çalışmada boyama süreçleri dokuma tasarımını tamamlayan bir unsurdur. Çalışma kapsamında, sürdürülebilirliğin alt başlıkları olan doğal malzemelerle üretim, atık yönetimi ve yavaş moda kavramlarını destekleyen tasarım önerileri getirilmesi de hedeflenmiştir. Ön denemelerden elde edilen renk/doku etkilerine yönelik veriler kullanılarak dört adet armürlü dokuma tasarım uygulaması ve üç adet jakarlı tasarım simülasyonu gerçekleştirilmiştir. Dokumalarda farklı hammaddeli ipliklerin kullanılması nedeniyle tek bir boyama işlemi yapılarak en çok renk tonuna ve dolayısıyla farklı desen bölgesine ulaşılması mümkün olmuştur. Aynı zamanda, bu tür boyama yöntemiyle işgücü, malzeme ve zaman kaybı önlenerek de sürdürülebilirlik desteklenmiştir. Yavaş moda pratiği bağlamında; geleneksel üretim yöntemlerinin yaşatılması, aynı zamanda boyama işlem basamaklarının en aza indirildiği üretim yöntemlerinin benimsetilmesi hedefiyle gerçekleştirilen bu çalışmanın armürlü ve jakarlı dokuma kumaş tasarımlarına yenilikçi bakış açısı içeren yaratıcı bir örnek oluşturacağı düşünülmektedir.

Anahtar Sözcükler: *Sürdürülebilirlik, Doğal Boyama, Dokuma Tasarımı, Yenilikçi Kumaş Tasarımı, Tek Banyoda Boyama, Yavaş Moda.*

1. INTRODUCTION

Today, it is quite significant for textiles' raw materials and production methods to be both sustainable in terms of ecology and as a cultural heritage which is passed down.

While pre-industrial dyeing was carried out by natural raw materials in small workshops, "the factors like -the proliferation of the artificial dyestuffs as a result of the booming and developing technology, the arduous and time-consuming quality of the dyeing methods used on natural dyestuffs and the limited obtained colours- drove this tradition, which used to be carried out ably in Anatolia, as far as to perish (Etikan & Ölmez, 2014: 56). For example; when looked into, it is seen that the transition from natural dyeing to chemical dyeing in Denizli/Kızılcabölük was compulsorily and brought over dissatisfaction. It is known that the manufacturers in Kızılcabölük "switched to a European originated chemical dye which they named 'fading'. They changed due to the cut-throat competition in the market" (Önlü, 2008). But as it is understood from the name it was given by the public, chemical dyes were seen to be unhealthy and temporary, not fully functional dyes.

The discovery of the first synthetic dyesstuff in 1856 by William Henry Perkin is the main reason of the fading-away of natural dyeing as a tradition and the adaptation of the non-ecological dyeing methods.

Today, the chemical dyes are quite advanced in terms of the colour options and the colour-fastness they provide. Yet, "though the synthetic dyes acquired through chemical process provide enough satisfaction in most of the fields they are used, natural dyes do have some features that grant handcrafts commercially valuable" (Ölmez, 2004: 35). Regarding the concept of sustainability, which made its marks particularly after 1970, natural dyeing technics gradually gained importance and were resurrected. By eco-centred methods, reformative actions are carried out against waste, abuse and the pollution of natural resources. "Within the sustainable approach model; tinting the textile materials by dyeing and printing methods form a driving force especially for performing solution-oriented studies in waste management" (Kurtuldu Dönmez & Öğüt, 2023: 16). Beginning with 'slow fashion' movement under the sustainability title, in the individual or collective workshop practices, maintaining the weaving practices, rise in value with the natural dyeing methods, is also important both for environmental factors and for the sustainability of the tradition.

2. Natural Dyeing-Fiber Relations on Textiles

Natural dyeing that dates back thousands of years (Adeel et al., 2022) is based on tinting various surfaces by extracting dye from the natural substances such as bacteria, mushroom and lichen (Erdem İşmal, 2019: 42) as well as herbal, animal and mineral based resources. "Especially from the dyeing-printing methods aspect, it is seen that many organic substances in the nature have dyestuff features and are used as one" (Kurtuldu Dönmez & Öğüt, 2023: 116).

Eventually, the scope of natural colourant was expanded in order to make them fast as well, in order to increase variety. "Nearly all dyes 'become' better after a process known as mordanting, which also helps set the colour and makes it more fade-proof. And sometimes the process enriches the colour as well" (Ölmez & Kayabaşı, 2002: 32).

[$KAl(SO_4)_2 12.H_2O$], copper sulphate ($CuSO_4.5H_2O$), and ferric sulphate ($FeSO_4.7H_2O$) were used for mordant materials. The mordants have been the most widely used mordant material in natural dye extraction with water since ancient times. (Pars et al., 2022) Mordanting process, which enables dyestuff to hold on the textiles and sets the final colour, is thought to have originated in 2000s BC. Thus, the colour options in dyestuff process have increased. The chemical interactions of the same dyestuff with different mordants enabled getting various colours and shades on fabrics with a single dyestuff. However, considering the NODS (Natural Organic Dye Standard) list, it should be noted that some metal mordants such as copper sulfate ($CuSO_4.5H_2O$) are quite harmful to the environment (Karadag, 2023).

In terms of sustainable approaches based on the environmental consciousness and human health, apart from the primary concepts such as waste utilisation, recyclable or biodegradable raw material use, the secondary concepts such as being respectful towards the right to life for every living being, adding value to labour and production, finding practical and employee comfort based-solutions are also important. As well as providing infinite range in tinting, the relation between the natural dyeing and mordanting can also prevent labour and time wasting by enabling shortcut-solution potentials that can increase production steps.

By its use of volunteers and organic wastes, and dyeing processes developing without damaging the environment, natural dyeing practice is significant in terms of sustainability. Mordants, their use and quantity, can also contribute to this conception. Especially while the naturally acquired mordants such as vinegar and wooden ash and "protein-mordants such as bovine gelatine, yoghurt, soy milk" (Bozacı, 2016: 46) are environmentally compatible, some mordants can be ungreen. So, "while qualifying natural dyeing methods within the sustainability concept, not only the source of dyestuffs, but also their ability to offer a wide range of colour and be fast, whilst being in a mordant-free or low-mordant concentration, is also quite significant" (Kurtuldu Dönmez & Öğüt, 2023: 116).

The first field of experiencing and application of the herbal dyeing is the natural fibres. Dyeing formulas that originated in the past were acquired by the endemic or ecdemic plants that grew in the regions they were formed or by the compatible reactions of the natural endemic fibres. Anatolian carpets and rugs woven with yarns dyed with natural dyeing are important examples to this compatibility.

Today, when the studies -carried out through the collaborations (relations of fibre) of natural dyeing and weaving are analysed, it is seen that various design-oriented projects were developed in accordance with sustainability concept. Bojagi designs, a cultural heritage-passing practice carried out with fabrics woven with natural fibre yarns and dyed with natural dyestuffs extracted from domestic wastes such as cortex granati fructuum, banana skin, onionskin, sumac, hibiscus, artichoke skin, spinach (Kurtuldu & Öğüt, 2023) and encolouring wools with endemic dyestuffs and weaving carpets with a fabric hand feeling and producing clothing designs (Elbeyoğlu & Acar, 2022) and redesigning and producing Kizilcabölük traditional cotton fabrics by coloring them with natural dyes

(Acar, Yıldırım & Önlü, 2014) a slow fashion example, from these can be given as an example for natural dyeing-fibre relations.

2.1. As a Dyeing Method One-Bath Dyeing

Regarding dyeing fabrics manufactured from different raw materials in one-bath dyeing, different application methods are seen in literature. So, conceptional similarities and differences of these methods will be analysed in this study.

One-bath dyeing methods; Apart from it being applicable solely to the fabrics woven from natural fibre yarns, it is seen that its widest range of applications consists of fabrics made of natural and synthetic fibres (Yıldırım et al., 2019). One-bath dyeing method, employed especially on blended textiles to give a grainy, grizzled appearance, can also be used on fabrics woven with yarns, made of two different raw materials. Another example of one-bath dyeing practice is employed for cost reduction and creating visual effect on wool/acrylic blended fabrics (El-Shishtawy et al., 2010: 28). This method is used on polyester/cotton fabrics, too (Patil et al., 2016); "studies in the literature are focused on dyeing of polyester/cotton fabrics in one bath" (Maeda et. al, 2004; Ristic et. al, 2009; Najafi et. al, 2009; Bakıcı & Kadem, 2021: 307).

One-bath dyeing is also known as single-bath dyeing in literature. The most typical characteristic of the technic is that the process is carried out in a single dye bath whether there is one or more dyestuff. In short, in a single bath, while one type of dyestuff is applied to dye yarns with different raw materials, different dyestuffs can also be used to dye every fibre bunch. If more than one kind of dyestuff is used to dye more than one kind of fibres in a single dye bath, it is called one-bath union dyeing or union dyeing in a one-bath process. "Method, in which the two types of fibres are coloured simultaneously, is simpler, energy consumption is lower, dyeing costs are reduced and greater production efficiency is possible" (Zheng et al., 2008: 124).

Different from the one-bath process, there are also dyeing methods applied with more than one dye bath. They are called cross-bath dyeing, double-bath dyeing (Patil et al., 2016) or two-bath dyeing. Ellis (2016: 108), too, calls this method cross-dyeing and describes it: "A method of colouring fabric made with strategically placed yarns of 2 or more different fibres. A pre-planned effect becomes visible by dyeing the fabric in different dye baths, one for each of the types of yarn." For this method, there are more than one dye baths applied with different dyestuffs for different fibre raw materials. Union-dyeing method, on the other hand, is either applied in one bath for different dyestuffs, or different baths for every dyestuff application. In that sense, it has similarities both with one-bath dyeing and cross-bath dyeing (double-bath dyeing or two-bath dyeing) (Brainly, 2020).

In this study, the aim is to dye with as fewer steps as possible in one-bath dyeing process. Different from the studies in the literature, fabrics are made of natural fibres and also only one natural dyestuff is used as a colouring agent. Thus, local colouring is aimed through the principle of-out of the 4 different natural fibres, some have better dye-affinity while the others have less.

3. Weaving Design Suggestions with One-Bath Dyeing Method

3.1. Material and Method

In this study, raw yarns made of natural raw materials and natural dyestuff were used. Primarily, preliminary studies were planned in order to observe the colour effects of the same natural dyestuff agents on different fibre groups of the woven fabrics. Applications were carried out in two stage as weaving and natural dyeing. Out of 6 preliminary study, two different weaving structures were woven, three plain weavings and three twill weavings. During each 6 preliminary weaving study, four yarns with different raw materials were used and these were dyed with same natural colourant three different mordants.

In short, on 6 preliminary fabrics, a total of 96 different colour/structure part were acquired with a combination of two different weaving structure/yarn group with four different raw material/one natural colourant/three different mordant application.

Judging by the final colour/structure difference; the idea of -creating dobby weave and jacquard woven designs by using the parameters of the preliminary studies, manufacturing woven fabrics that acquired a pattern with weaving structure and colour through one-bath dyeing-sprung. With this plan, dobby weave applications and jacquard weave simulations were carried out and the results were analysed. First, the weaving and dyeing stages of the preliminary studies were shown in details below.

3.2. Preliminary Studies

The weaving and dyeing stages of the preliminary studies are shown in details below.

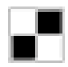
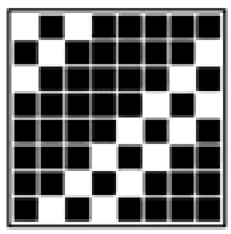
3.2.1. Weaving Data of the Preliminary Studies

Out of six weaves, three of them were woven in dobby weave with 40 sets of wool-silk-linen-cotton warps and 60 sets of wool-silk-linen-cotton weft yarns (Table 1) respectively. The other three preliminary weavings were woven in twill weaving with the same yarn sets. All weaving practices were carried out on wooden hand loom samples. The technical weaving details of the preliminary studies are given in Table 2.

Table 1: Warp and weft yarn sets of preliminary fabrics.

Warp/Weft	Warp/Weft	Warp/Weft	Warp/Weft
Wool / Wool	Silk / Wool	Linen / Wool	Cotton / Wool
Wool / Silk	Silk / Silk	Linen / Silk	Cotton / Silk
Wool / Linen	Silk / Linen	Linen / Linen	Cotton / Linen
Wool / Cotton	Silk / Cotton	Linen / Cotton	Cotton / Cotton

Table 2: Technical details of preliminary fabrics.

Loom Type	Dobby weaving
Reed number	120
Warp density	12 warp/cm
Weft density	10 weft/cm
Warp yarns	25 tex raw cotton
	55 tex raw silk
	38 tex raw linen
	50 tex raw wool
Weft yarns	25 tex raw cotton
	55 tex raw silk
	38 tex raw linen
	50 tex raw wool
Weaving structures	Plainweave (1/1)  Twill $\frac{5\ \ 1}{1\ \ 1}$ Z 

3.2.2. Dyeing Formulas of the Preliminary Studies

On six preliminary fabrics, direct natural dyeing was applied based on the "releasing the dyestuff of the plants based directly on temperature and time" (Karadağ, 2007: 13) notion with three different mordanting groups, these are copper sulphate, ferric sulphate and potassium aluminium sulphate from the onion skin (Allium cepa L.) from the waste/leftovers after domestic use. Although the light fastness of onion peel is low, it is found suitable for used in the method proposal due to its easy access as household waste and the variety of colors and tones it provides in fibers with different raw materials.

In dyeing bath, for 1 g. fabric 100 ml. water, 1 g. natural dyestuff (Allium cepa L.) and 0.2 g/L mordanting agent were used as a standard dyeing parameter. The three different mordanting groups are copper sulphate, ferric sulphate and potassium aluminium sulphate. The fabrics were wetted prior to dyeing process and, mordanting was applied together with the dyeing process. Onion skins were used as a whole, without grinding.

For dyeing, a 30°C bath in a ratio of 1:100 g/L was prepared. Although this dye ratio does not comply with the sustainability criteria in natural dyeing, it is possible to meet the sustainability criteria by changing the ratios in the method proposal. For this study, the dyeing time was reduced and fixed as 60 minutes, while in similar studies it was set as 30, 60 and 90 minutes. When the dyeing bath reached 1000C, the fabrics were dyed with dyestuff and mordanting for 60 minutes. After the dyeing process, the fabrics were rinsed in cold running water and dried in room temperature (Table 3).

Table 3: One-bath dyeing Formula.

Dyeing bath	100 ml. water
	1 g. fabric
	1 g. natural dyestuff
	(onion peel/ waste skin of Allium cepa)
	0.2 g./L mordanting agent
Dyeing method	One bath dyeing
Dyeing timetable and degree	60 min, 1000C
Mordanting groups	Ferric sulphate (green vitriol)
	Copper sulphate (blue vitriol)
	Potassium aluminium sulphate (alum)

3.2.3. Preliminary Studies Findings

Weaving structure / yarn raw material and sets / natural dyestuff / mordanting qualities of the six preliminary fabrics were given in Table 4.

Table 4: Weaving structure and dyeing qualities of the six preliminary fabrics

Structure	**Warp and Weft Sets**	**Dyestuff**	**Mordant**
Plain weave	wool-silk-linen-cotton	Allium cepa L.	ferric sulphate
Plain weave	wool-silk-linen-cotton	Allium cepa L.	copper sulphate
Plain weave	*wool-silk-linen-cotton*	Allium cepa L.	*potassium aluminium sulphate*
Twill weave	wool-silk-linen-cotton	Allium cepa L.	ferric sulphate
Twill weave	wool-silk-linen-cotton	Allium cepa L.	copper sulphate
Twill weave	wool-silk-linen-cotton	Allium cepa L.	potassium aluminium sulphate

It is possible to evaluate six preliminary fabrics visually, which differ from each other with their weaving structure and dyeing qualities. Each fabric consists of 16 parts, where four different raw materials interweaved with each other or with other raw materials as warp and weft sets. Four of the 16 parts' raw material mixture ratio is 100%, the other 12 parts' ratio is 50%-50%.

There is a clear fabric raw material-colour relation on 100% mixture woven parts. Depending on the dye-receptivity of different raw materials on 50%-50% mixture woven parts, halftone values occurred. (Figure 1,2,3,4,5,6). Acquired clear colours and halftones hinted the possibility of manufacturing patterned fabrics with clear colours and halftones by one bath dyeing.

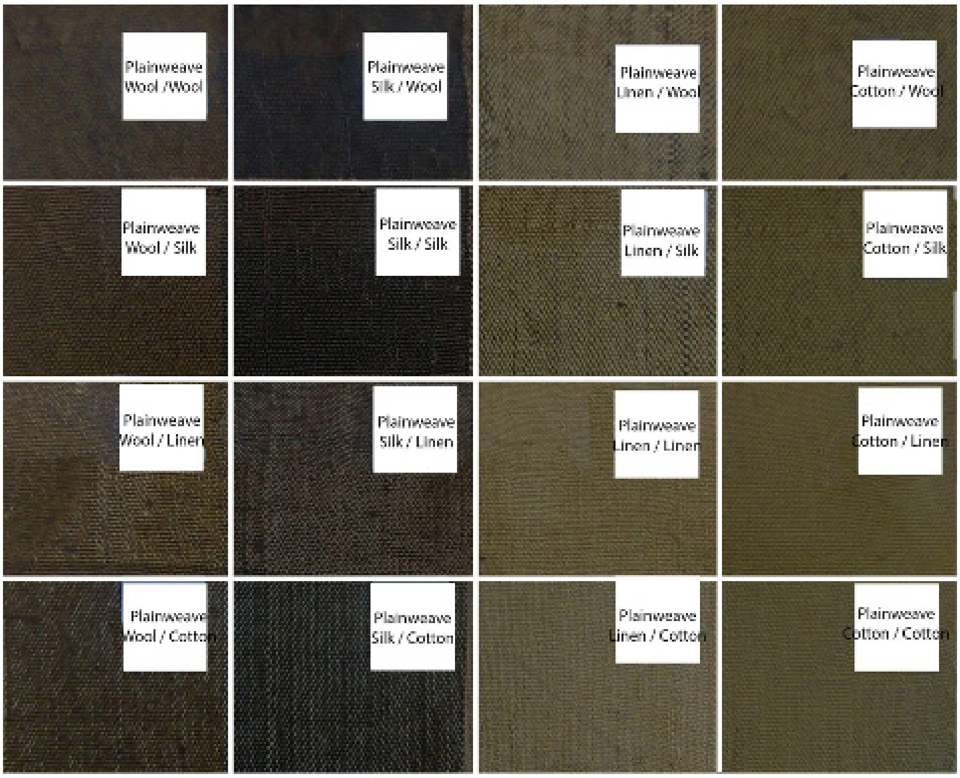


Figure 1. Sample 1, plain weave fabric sample dyed with onion peel and ferric sulphate, 2015.

Figure 2. Sample 2, plain weave fabric sample dyed with onion peel and copper sulphate, 2015.

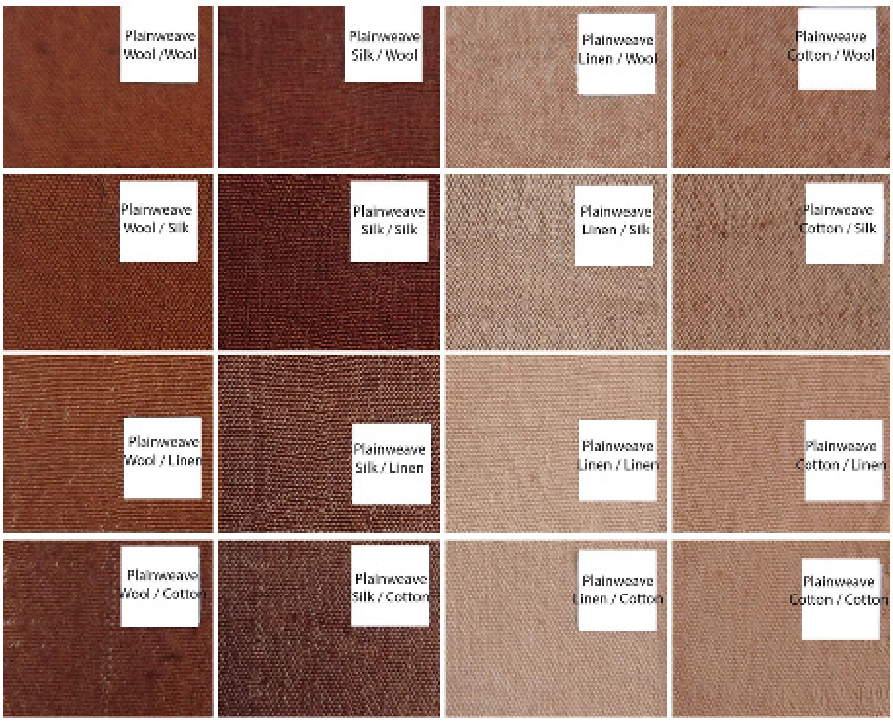


Figure 3. Sample 3, plain weave fabric sample dyed with onion peel and potassium aluminium sulphate, 2015.

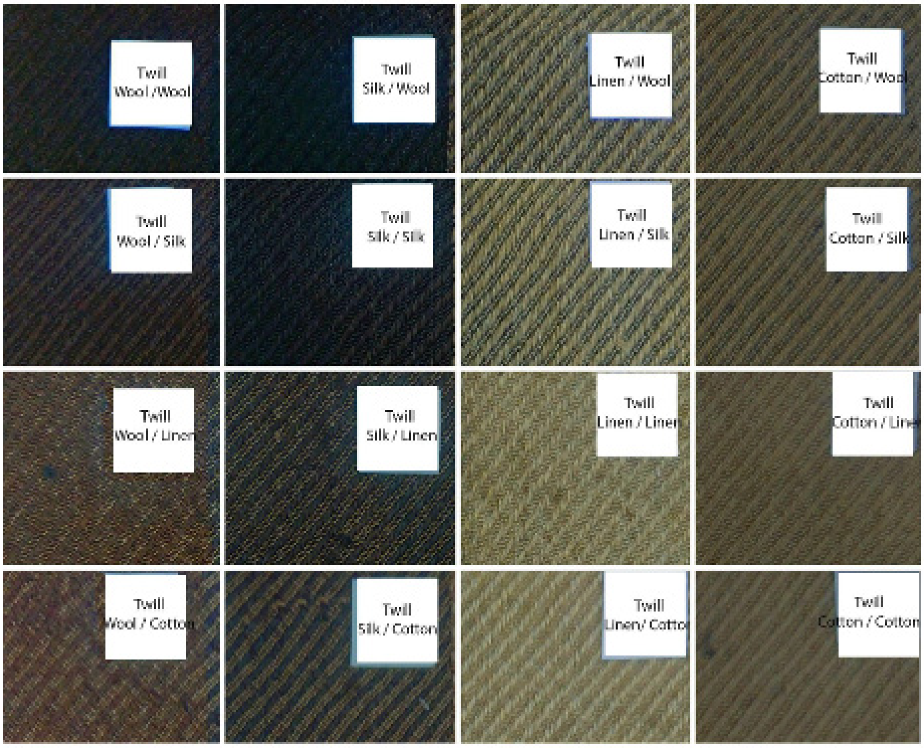


Figure 4. Sample 4, twill weave fabric sample dyed with onion peel and ferric sulphate, 2015.

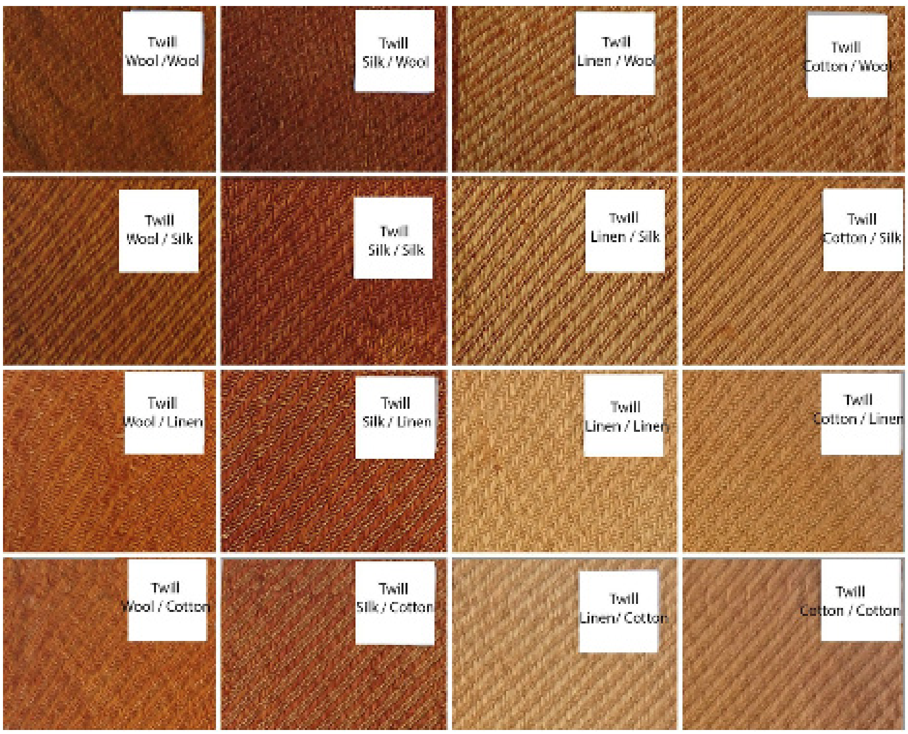


Figure 5. Sample 5, twill weave fabric sample dyed with onion peel and copper sulphate, 2015.

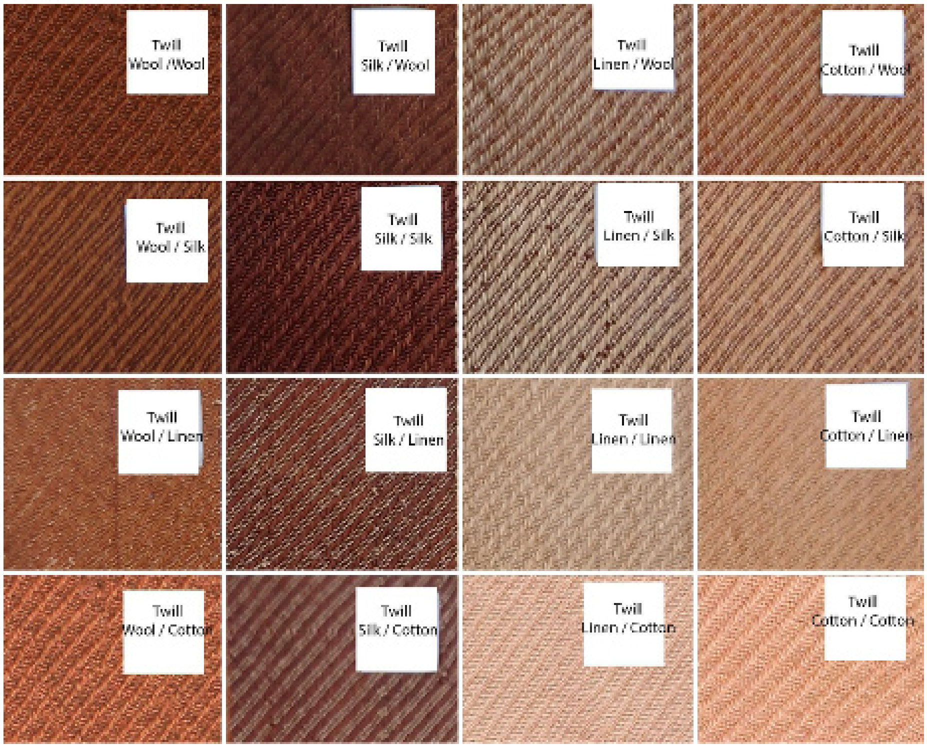


Figure 6. Sample 6, twill weave fabric sample dyed with onion peel and potassium aluminium sulphate, 2015.

4. Design Suggestions and Discussions

Visual diversities occurred on six preliminary fabrics consist of a total 96 different colour/structure parts acquired through the combination of two different weaving structure/fibre groups with four different raw materials/one natural dyestuff/three different mordanting method. With the idea of turning these visual colour and tone differences into an aesthetical factor on woven fabric design, woven fabric designs, patterned with dobby weaving were applied with similar parameters in terms of weaving structure, fibre raw material dyestuff, mordanting methods. Furthermore, with the help of preliminary fabrics data, jacquard-woven pattern computer simulations were carried.

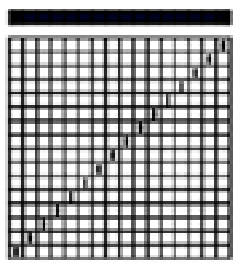
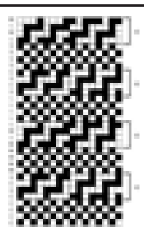
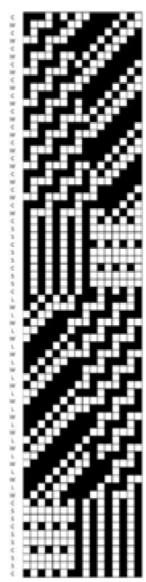
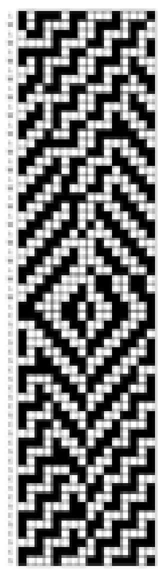
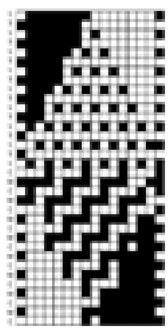
Technical details of the four designed and manufactured dobby fabrics are shown in Table 5. With new designs, weavings were formed with the same warp and the same weaving draft. Only 12 tex cotton yarn was used in warps and this is a much lighter yarn than the wefts. Weft yarns are the same as the ones used in both the warp and the weft during preliminary weavings.

Table 5: Technical Details of Dobby Weaving Fabric Designs

Loom Type	Dobby weaving
Reed number	100
Warp density	10 warp/cm
weft density	15 warp/cm
Warp yarns	12 tex raw cotton
Weft yarns	25 tex raw cotton
	55 tex raw silk
	38 tex raw linen
	50 tex raw wool
Weaving systems	Single and double layer structures

All of the four dobby fabric designs were woven with 16 row weaving drafts by methods such as single layer, extra weft and double face, and the weaving structures of Dobby fabric 1, Dobby fabric 2, Dobby fabric 3 and Dobby fabric 4 are given in Table 6.

Table 6: Common weaving drafts and weaving structures of dobby fabrics. *(Designed by Sedef Acar)*

	 Common weaving draft			
	Fabric 1	Fabric 2	Fabric 3	Fabric 4
STRUCTURES				

Same as the preliminary weaving, the four dobby fabrics were dyed by one bath dyeing method and with onion peel (Allium cepa L.) dyestuff and mordants, two of which are ferric sulphate and copper sulphate. Applications were carried out with preliminary dyeing formulas and with the two said mordants (Table 3). Dobby fabric 1, dyed with ferric sulphate mordant, was designed with double-face method and plain weaving structure. Since the cotton warp is 12 tex and the warp density is 10 warp/cm, only the wefts are seen on the surface.

If the fabrics on which a check pattern is created by the weaving zone that consists of four different materials are dyed; silk, wool, cotton and linen are seen to gradually tone down. The changing colour values of the patterns- on which protein fibres have darker colours than the cellulose ones- created a visual richness (Figure 7).

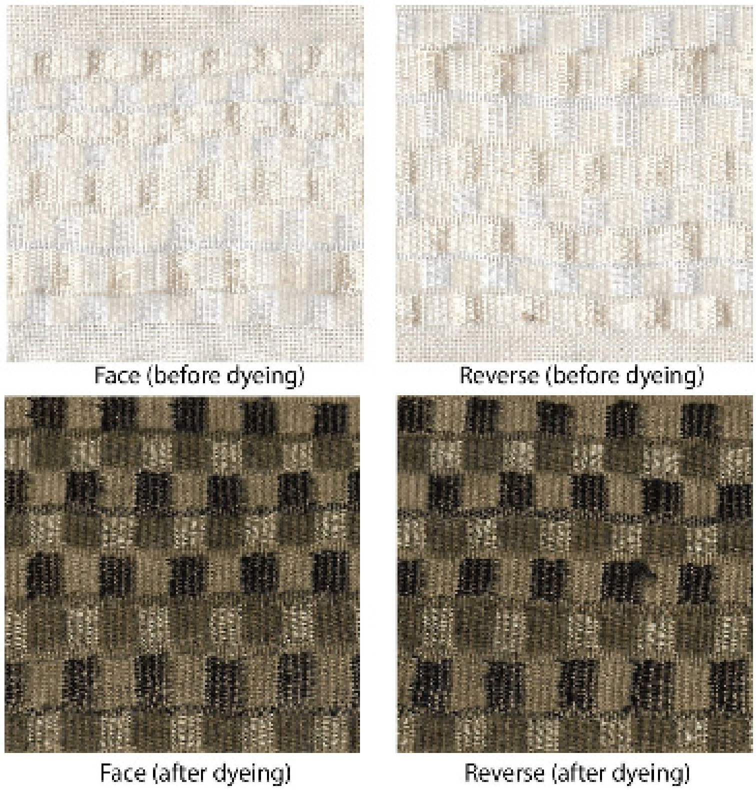


Figure 7. Dobby Fabric 1 (Designed by Sedef Acar)

Dobby fabric 2, dyed with ferric sulphate mordant, were designed with twill structure, double face and extra weft methods. Twill structure creates diagonal effect on the fabric surface and the silk wefts wave on this creates a relief effect. Same as the dobby fabric 1, the waving silk wefts had the darkest tones after dyeing. Although wool, cotton and linen wefts were applied on the double-faced and twill-structured surface areas, gradual colour change isn't visible since the wool weft was used more on weaving areas. This effect is related to the structure of the woven designs (Figure 8).

Figure 8. Dobby Fabric 2 (Designed by Sedef Acar)

On Dobby Fabric 3, which was dyed with copper sulphate mordant, visibility rates of four different wefts were effectively balanced on double faced twill structure areas. Thus, the colour transitions created by dyeing are much more visible. The design got depth following dyeing. Different colour/structure values occurred (Figure 9).

Figure 9. Dobby Fabric 3 (Designed by Sedef Acar)

Loose weft areas on Dobby Fabric-4, created by silk, wool, cotton and linen weft yarns, also dyed with copper sulphate mordant. Silk weft yarn is visible since it is much thicker and forms longer waves than other yarns. Though the one with the darkest colour after dyeing is silk, the weaving areas with other raw materials had also surface effect by having different shades (Figure 10).

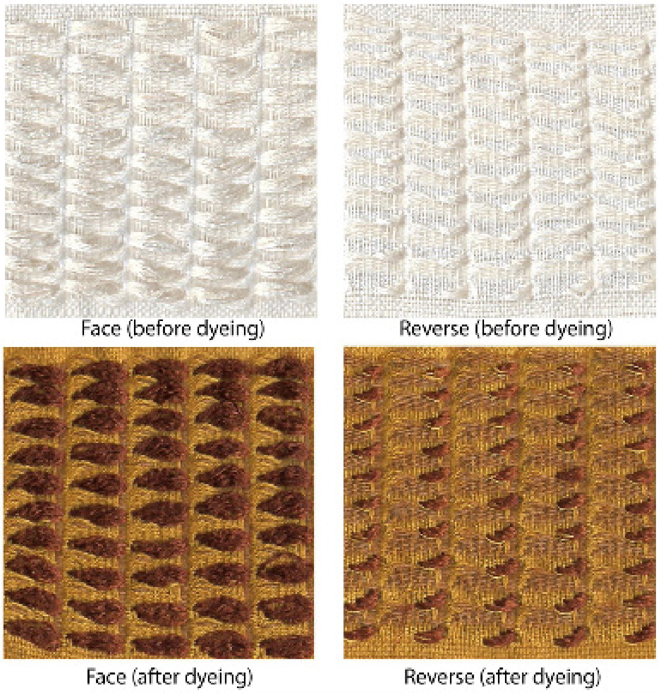
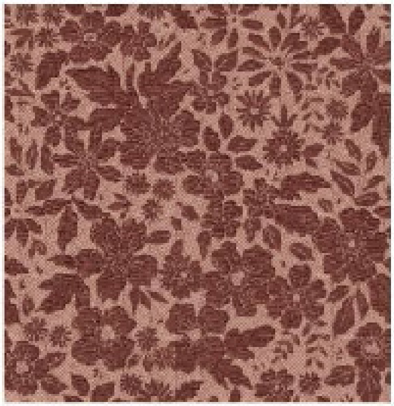


Figure 10. Dobby Fabric 4 (Designed by Sedef Acar)

It was reasoned that it was possible to manufacture jacquard weaving designs by utilising from the 96 color/structure images acquired from six preliminary fabrics. The technical weaving details on Table 2, and the dyeing details on Table 3, also apply to jacquard simulations. Simulations were carried out on computing environment. In real life productions, jacquard simulations can be woven by double face method. So, the densities given in Table 2 are to be perceived as single layer densities of the designed fabric simulations.

For Jacquard Design Simulation 1, potassium aluminium sulphate mordant dyeing formulas were applied and the colour/structure areas on preliminary fabric 3 (Figure 3) and preliminary fabric 6 (Figure 6) were used. When manufacturing, double-face method is to be used during weaving in order to form the effect of preliminary fabric 3 and preliminary fabric 6 on the fabric surface. So, the warp order should repeat in silk-cotton and the weft order should be repeated in wool-silk order. Floral pattern simulation was formed by using the areas where silk warp-wool weft interweaves in plain weave, silk warp-silk weft interweaves in twill structure, cotton warp-wool weft interweaves in twill structure. It was observed that visible patterns form on the surface as a result of the different dye-affinities of raw materials and, influence of two different weaving structures following dyeing (Figure 11).



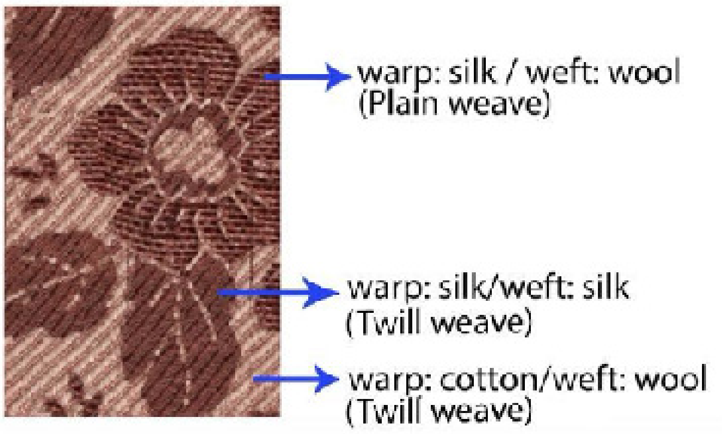


Figure 11. Jacquard Design Simulation 1 and clothing option (Designed by Ecem Tosun)

For Jacquard Design Simulation 2, the colour/structure areas of preliminary fabric 2 (Figure 2) and preliminary fabric 5 (Figure 5) were used by employing dyeing formulas with copper sulphate mordant. When manufacturing, double-face method should be employed for weaving as in the previous simulation. So, the warps should be in silk-cotton order and the wefts should be in linen-silk order. On simulation, there are areas where silk warp-linen weft, silk warp-silk weft and cotton warp-linen weft in plain weaving interweave. Furthermore, on the same simulation it utilises the areas where silk warp-silk weft and cotton warp-linen weft in twill structure interweave. As five different colour/structure areas are used, more visible patterns were got on the surface (Figure 12).

Figure 12. Jacquard Design Simulation 2 and clothing option (Designed by Ecem Tosun)

For Jacquard Design Simulation 3, dyeing formulas with ferric sulphate mordant of the colour/structure areas of preliminary fabric 1 (Figure 1) and preliminary fabric 4 (Figure 4) were used. When manufacturing, double face method should be employed for weaving as in other two simulations. So, the warps should be in cotton-wool order and the wefts should be in cotton-wool order, too. On simulation, there are areas where cotton warp-cotton weft and wool warp-wool weft in plain weaving interweave. Furthermore, on the same simulation, it also utilises the areas where cotton warp-cotton weft and wool warp-cotton weft in twill structure interweave. Four different colour/ structure areas were used on the pattern. On the surface, a dark colour ground was achieved and light-coloured pattern areas were more visible thanks to the effect of ferric sulphate mordant with wool on the surface (Figure 13).

Figure 13. Jacquard Design Simulation 3 and clothing option (Designed by Ec*em Tosun)*

CONCLUSION

Ensuring the continuity of traditional production culture and providing ecological approaches for production processes are the most important titles of sustainability. Within this context, it was concluded to conduct research to analyse the results regarding raw materials, weaving structures, dyeing method and mordanting agents. It was decided that design studies which support ecological production be carried out, waste management and slow fashion, which are the most significant sub-concepts of sustainability.

Attempts were made to support the above-mentioned sub-concepts by using yarns with natural raw materials and natural dyestuff, reusing onion skin -which is a domestic waste- in dyeing and making an effort to adapt manufacturing by hand. Moreover, in order to prevent labour force, material waste and time loss, it was aimed to get the most colour tones by one-bath dyeing during the natural dyeing process.

First, six preliminary woven fabrics were carried out and 96 different colour/structure areas were woven based on raw material, weaving, dyestuff application and mordanting differences. By using the acquired data, four dobby fabric and three woven design simulations were prepared.

It was observed that there were tone diversities between preliminary test and dobby fabric applications thought the same dyeing formulas were used.

By definition, natural dyeing has many variabilities. The fact that the principles of nature are changed not by human being but the nature's itself brings uniqueness in acquired colours. For these kinds of dyeing, "harvesting the materials and its time is significant because; the quality of dyestuffs reaches peak based on the ripening of plants" (Tüm Cebeci, 2020: 659).

"Also, ecological conditions (temperature, humidity, soil, rainfall) widely affect the final quantity of the material" (Arlı et al., 1993: 92; Tüm Cebeci, 2020: 659). On the other hand, in different researches it was stated that "based on the type of dyestuff, the temperature affects dyeing directly" (Sadov et al., 1978; Foulds, 1995; Ölmez, 2004: 36) and "according to researchers such as Meggy, Lipatov, Melkinov and Moryganov, solubility of the dyestuffs changes according to temperature" (Ölmez, 2004: 36)

As a result; when dobby designs and simulations that turned into final product were analysed, fabrics with raw materials-that got pattern by the weaving technic and dyeing these with three different mordanting including onion skin-a domestic waste- by one bath dyeing method, significant data were determined in terms of sub-concepts regarding production suggestions and sustainability.

It is thought that environmental benefits of this study results and visual diversities of the designs will be increased with future studies.

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