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Dyeing with Natural Colorants
A Research Method and an Ever-Changing Traditional Skill[1]

Abstract

This paper explores the use of dyeing with natural dyes in research, as well as a tool for retaining normality of life in crisis situations. Nowadays craftsmanship skills, and especially traditional crafts can double as a research object and a research tool. Dyeing fabrics with natural dyes is a traditional crafts skill which entails a high potential for creativity, and which is still practised in Latvia today. In the past, this skill often became a creative way for retaining the quality of daily life during wars and other crisis situations. Nowadays natural dyeing is not only a means of creative self-expression through traditional crafts, but the process also helps to study the value of colours, through understanding the complexity or simplicity of obtaining a particular colour, as well as the resulting colour palette, etc. The author of this paper has used her dyeing skills in researching various ethnographic sources from the 18th – 20th centuries. Dyeing experiments help to adequately assess descriptions of fabric colours in written sources from various historical periods, and to interpret historical guides about ancient dyeing techniques and methods.

Keywords: Natural dyeing, crafting knowledge, traditional craftsmanship, experimental ethnography, Latvia

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Introduction

The main subject of this paper is traditional craftsmanship as a set of skills that allow for the acquisition of new knowledge. It became a part of survival strategy during crisis situations, thus being preserved and handed down to the next generations, allowing it to be used in modern research. In modern era craftsmanship skills, and traditional crafts in particular, can double both as a research object and a research tool (Hopkins 2013; Botwid 2022). Dyeing fabrics and yarns with natural dyes, is a traditional craft skill which entails a high potential for creativity, and which is still practised in Latvia today. Nowadays the skill natural dyeing can provide new information when used in experimental research (Anderson Strand et al. 2009; Hartl et al. 2015). So far experimental research has mostly been used in archaeology, especially for interpreting the craft technologies used in archaeological finds (e.g., Damlien et al. 2018), but this method can also be useful in history or ethnology for studying historical information from written sources. In traditional crafts, including natural dyeing, it is equally important to have knowledge and practical skills. In addition, tacit knowledge (Polanyi 1966), which the apprentice can only obtain by working with a master craftsperson, is also essential when applying the acquired knowledge in practice (Gascoigne & Thornton 2014; Kikuchi 2015). In the field of natural dyes, the knowledge gained through observation and practical experience was very important for a long time. The dyers did not always fully understand the theory of the process and its rationale, but they knew what and how to do it to get the result. The descriptions of dyeing recorded in ethnographers' field studies, which list the actions to be performed (sometimes only the plant and the result to be obtained), but do not explain why these actions were necessary, allow us to judge this. In dyeing with plant dyes, which was practiced in a rural environment or inherited as a traditional skill, much of the knowledge was non-verbal, or, accordingly Michael Polanyi: "we can know more than we can tell" (Polanyi 1966: 4). Even today, inherited dyeing techniques are still practiced, but the principle of operation and the chemistry of the substances involved have not been fully investigated. For example, dyeing with a long fermentation process. However, the lack of this knowledge does not preclude the use of ancient dyeing methods and less frequently used plants with which these methods are used. One of the ways to preserve traditional knowledge is to accurately document and study it, clarifying all the components involved in the process and their operating principles. However, this is laborious work and not always possible. Therefore, there is another way: to learn this knowledge (even if you do not fully understand it), practice and pass it on. Essential to the acquisition of natural dyeing skills, as well as other traditional skills, is Polonyi's recognition that

> It brings home to us that it is not by looking at things, but by dwelling in them, that we understand their joint meaning (Polonyi 1966: 18).

For this reason, the longer these skills are continuously practised in a population, the better for their preservation in use and transmission to future generations. This paper will discuss two aspects related to the importance of craftsmanship skills: 1) Retaining the skillset of natural dyeing and using it during crisis situations. This aspect formed the basis for the use of these skills today, including in research; 2) The use of craftsmanship skills in research and for obtaining new information. Using examples of individual case studies, this paper will demonstrate how practical dyeing skills can be used in research work. The author has used her knowledge and skills in dyeing to study various ethnographic sources from the 18th to 20th centuries.

Research sources and methods

This research article is based on studying historical written sources, the results of practical experiments, as well as personal experience of practising natural dyeing for more than 15 years. To study the natural dyeing traditions in Latvia, mainly different types of written sources were used: such as press publications, records of ethnographic expeditions, and folklore materials. Written sources provide information about the existence and development of natural dyeing traditions in the territory of Latvia mainly after the invention of aniline dyes in the second half of the 19th century.[2] Different sets of sources reflect the dyeing traditions of different time periods.

Two repositories were mainly used for studying the unpublished sources – notes from ethnographic fieldworks – for this paper: 1) Ethnography Department of the National History Museum of Latvia, which houses notes from ethnographic expeditions to various parts of Latvia organised by the Latvian Council of Monuments between 1924 – 1943. These ethnographic materials, although in different numbers, are from all the cultural-historical regions of Latvia: Vidzeme, Latgale, Kurzeme, Sēlija and Zemgale. Information about natural dyeing can be found in descriptions from collection No 47, "*Krāsošana, mazgāšana, balināšana*" [Dyeing, Washing, Bleaching], as well as partly in documents from the collection No 35, "*Sieviešu apģērbs*" [Female Dress].

2) The second collection (curated in the Repository of Ethnographic Material, Institute of Latvian History of the University of Latvia), which mainly consists of materials gathered from ethnographic fieldworks during the Soviet occupation period in Latvia (the earliest dating from 1947), holds information about natural dyeing in documents about making and using textiles. Natural dyeing was not included in the list of main research themes for the fieldworks, and thus materials about it were only gathered if a member of the fieldwork was personally interested in the subject. Nevertheless, information

2 The first aniline dye was patented by H. V. Perkins in 1856 (Johnston 2009).

about natural dyeing was occasionally gathered during the whole Soviet occupation period from the late 1940s until the late 1980s.

The published sources – Latvian press – provide diverse information about natural dyeing in Latvia. The earliest publication is from 1768, in the periodical *Latviešu Ārste* [The Latvian Doctor], but more regular publications on the subject appear in the end of the 19th century. During the 20th century and especially the Interwar period the Latvian press published information about various public activities related to natural dyeing, as well as ethnographic materials such as lists of dye plants and dyeing guides. These publications demonstrate the public interest in this tradition and show the dynamics of its development (see more: Karlsone 2016).

Another significant source of information is Martha Bielenstein's (1861–1938) study *Die altlettische Färbermethoden* (Bielenstein 1935), as it is a compilation of both, previously published materials about the use of natural dyes in Latvia, and original, previously unpublished information on this subject, gathered by Bielenstein herself. This book also contains valuable ethnographic information about other related subjects such as leather tanning, the use of bast and nettle fibres for producing textiles, etc. Apart from written sources, this paper is also based on personal experience of regularly practising natural dyeing for over 15 years. Applying the practical knowledge for a specific purpose – to test or specify information from historical sources – results in gaining new, more detailed knowledge about the process of dyeing in particular and the traditional crafts in general, as well as more broadly about the producing and use of fabrics, including themes concerning the history of clothing.

Natural dyeing skills in crisis situations

In order to use crafts skills, including natural dyeing, to obtain new knowledge, a degree of existing, inherited knowledge in the subject is required. Inherited knowledge can be considered the set of skills that are learned from the previous generation of craftsperson or relatives through direct action, observing and participating in the process. Sometimes particular circumstances, such as economic crises, can help to preserve such knowledge. During war or other crises when the normal functioning of the economic system was disrupted, these inherited skills regained value and popularity. To illustrate this point, a brief overview of how traditions of natural dyeing developed in Latvia after synthetic aniline dyes is provided below.

Until the middle of the 19th century, natural dyeing was the only way to obtain coloured clothes and other textiles. After invention of synthetic aniline dyes, natural dyeing quickly became an alternative technique, losing its key role in the production of coloured fabrics. The Latvian intelligentsia became interested in traditional craft skills, including natural dyeing, as a part of national cultural heritage,

in the end of the 19th – beginning of the 20th century (Skrusits 1900; Skruzītis 1895; 1902). During that time natural dyeing was seen as a vanishing ancient skill with a need for preservation, and people began to appreciate its value. However, the use of this skill was dictated more by economic, rather than ideological, circumstances. According to the materials of the ethnographic fieldworks organised by the Latvian Council of Monuments, in rural areas, especially in the poorer region of eastern Latvia, natural dyeing was still practised even after the discovery of aniline dyes. In other regions of Latvia, both in the cities and countryside, the new dyeing techniques and the use of synthetic colours made a rapid advance after 1860. The main evidence for this can be seen in dealers' adverts in the Latvian press (such as *Mājas Viesis* [The Houseguest] 1864: 7, 11, 19, 23, 32; 1868: 3).

Ancient craftsmanship skills did not go out of use entirely. According to the materials from ethnographic fieldworks of the 1920s and 30s, housed in the repository of the National History Museum of Latvia, the first World War and its negative impact on daily life encouraged people to return to traditional craftsmanship skills, including natural dyeing. The fieldwork notes also mention when the dyeing took place:

> In the olden days, and also during the war, when dyes could not be bought, people dyed their fabrics and yarns with natural dyes, including tree bark, flowers, onion peels, and other plant materials (LNVM ZAE 47: 87, Cēsis district, written down in 1926, similar information can also be found in the following documents: LNVM ZAE 47: 120, Madona district, written down in 1928; LNVM ZAE 47:502, Tukums district, written down in 1930; LNVM ZAE 47: 12, Rēzekne district, written down in 1926).

References to the First and Second World Wars also exist in the materials from ethnographic fieldworks in Latvia gathered during the Soviet occupation after the Second World War, which are curated in the Repository of Ethnographic Material, Institute of Latvian History of the University of Latvia. In these materials the First World War is simply referred to as the World War:

> During the World War people dyed with natural dyes (E 12, 650, also E 12, 648; E 12, 2727, Limbaži district, written down in 1957).
> After the World War you could not get such [synthetic] dyes. So people used alder and other plants [for dyeing]. (E 13, 3280, Valka, written down in 1958.)

During fieldworks which took place in Latvia in the first decade after the Second World War (1947–1955), the narrators avoided mentioning the most recent war, as well as the poor economic situation during and after the war. This is because such information may have been perceived as criticism of the Soviet regime and could subsequently end in repressions. Only after 1960 the

narrators began to mention dyeing fabrics during the Second World War (during that time, the period from the 22nd of June 1941 until the 9th May 1945 was called the Great Patriotic War as per the official Soviet Union's rhetoric).

> The narrator's mother almost always dyed with plants when the narrator was young. The narrator also used plants for dyeing during the Patriotic War. (E 27, 4788, Balvi district., narrator was born in 1895, written down in 1963.)

> During the narrator's youth natural dyeing was very popular. In more recent times and nowadays the practice is rarely used. It was again used between 1940–45 when shops ran out of packaged [synthetic] dyes. (E 21, 1437, Krustpils district., narrator was born in 1879, written down in 1961. Similar information can also be found in the following documents: E 28, 379, E 28, 380; E 28, 381; E 28, 386 and E 31, 3423.)

Increased public interest into natural dyeing during this period can also be sensed when analysing publications in the Latvian press. (see Fig. 1) Between 1939 and 1944 (before the second Soviet occupation) there was a substantial rise in publications related to natural dyes. Most of these were practical guides for gathering the plants and using them for dyeing fabrics and yarns. As the war increasingly disrupted everyday life in the territory of Latvia, the publications gave direct hints that natural dyeing was advisable due to economic considerations:

> Natural dyeing was already known to ancient Latvians when they could not obtain the expensive dyes. Nowadays we also must turn to natural dyes which we obtain from flowers, berries, roots or tree bark. (Vīdnere 1944.)

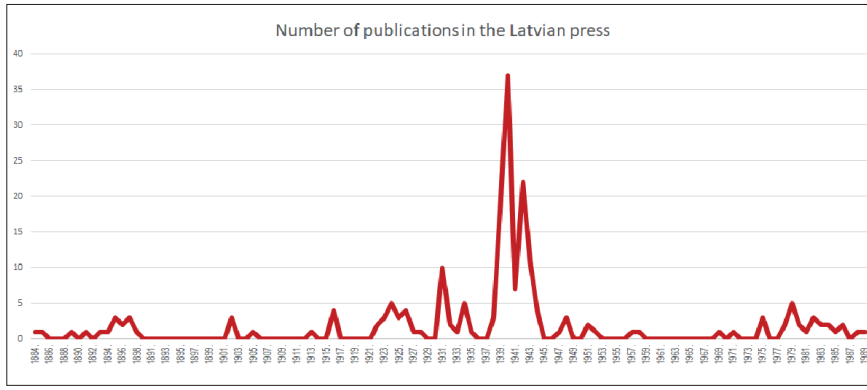

Figure 1. Number of publications in the Latvian press 1884–1989.

Sometimes the advice included substituting mordants (metalic sulphates) with locally available plants (Fricberga 1942). Mordants are substances that are necessary in the dyeing process so that the dye molecules can bind to the fibre. They were usually compounds of different metals: potassium aluminum salt or alum ($KAl(SO_4)_2 \cdot 12\ H_2O$), iron vitriol or iron sulfate ($FeSO_4 \cdot 7H_2O$), copper vitriol or copper sulfate ($CuSO_4 \cdot 5H_2O$). Nowadays, the use of copper is avoided because it is poisonous. However, in the historical tradition it was often used in Latvia (Karlsone 2016: 16).

The ability to use natural dyes for dyeing fabrics and yarns was among the crafts skills used to maintain the quality of life during economic hardships in the First and Second World Wars. Using traditional crafts skills as a part of survival strategy allowed them to be actively practised and thus handed down to the next generation who could learn through direct observation of how dyeing was done. This in turn increased the period of time during which the skills were actively practised.

Although today the economic situation in Latvia is stable and the skill of natural dyeing serves as a hobby to maintain the quality of life, this skill is still useful for helping others. For example, after the full-scale invasion of Russia into Ukraine in 2022, the skill of natural dyeing in Latvia is used for re-dyeing fabrics into natural colours, which are then used for making camouflage netting for the Ukrainian army (see Fig. 2). The shades acquired

Figure 2. The fabrics overdyed with oak bark and onion skins for camouflage nets dry in the spring sun. Photo: A. Karlsone.

from plant dyeing are more in harmony with nature's surroundings, and it is more economical/cheaper than buying dyes for dyeing a large amount of fabric. The spring 2023 was especially busy for this activity.

The opportunity to apply ancient skills today gives people more motivation to learn and preserve them. It is the practical necessity, not only the artistic quality of the result, that is a very important aspect for the maintenance and relevance of craft skills. Nowadays, however, knowledge of ancient skills and the ability to apply them practically can be used as a research tool.

The use of traditional craftsmanship skills in research

The use of natural dyeing in research can be regarded as a method of experimental ethnography, which in many ways resembles the method of experimental archaeology (Coles 1979, Andersson Strand et al. 2009). Both experimental methods are based on carrying out actions in modern times which are mentioned in historical sources but are no longer practised in modern times, to gain new knowledge about a process or a phenomenon. The method is especially important when an ancient traditional craftsmanship technique or skill is partly or fully forgotten (Hartl et al. 2015). Likewise, repeated experiments test the reliability of various ancient techniques, thus revealing the credibility of the source and adjusting the information about the achievable result.

Like experimental archaeology, this method has several drawbacks. Due to objective reasons, it is impossible to carry out the experiment in exactly the same circumstances as described in the historical source. The level of skill and experience of the master craftsperson who carries out the experiment is also of considerable importance. As it is with any crafts skills, in natural dyeing it is not sufficient to just know the theory of the process. The person must know how to do it, which means having practical skills or the ability to apply this knowledge, as well as the so-called tacit knowing which is difficult to express (Polanyi 1966).

The result of the experiment depends directly on the level of the craftsperson's practical skills. To lessen this subjective factor, ideally the experiment should be carried out by several craftspeople and repeated several times. However, nowadays when research into the use of natural dyes (and practical dyeing as a part of this process) often depends on the enthusiasm of particular craftspeople, verification of the results is up to a single craftsperson carrying out the experiment several times.

In the practical research process, it is not always possible to meet all preconditions. For example, when working on restoring a forgotten or partly

described technique, which might be called the study phase, it is not possible to repeat the experiment precisely the same way, as it is still being studied. The process is further complicated by the nature of ancient techniques which were influenced by various natural circumstances. Nevertheless, even the first stage of research, which is aimed at finding the lost pieces of information by means of practical dyeing experiments, is interesting and creative. Below is a description of several experiments which were carried out to find answers to various questions:

1) An attempt to reconstruct a forgotten technique of obtaining red colour by using *Origanum vulgare* L. in the dyeing process. So far, the full reconstruction of this ancient technique remains unsolved, and further experiments are necessary;
2) Verifying and adjusting a dyeing method described in historical sources by fermenting *Rubia tinctorum* L. in beer. As a result, a predictable, replicable method for obtaining the red colour, was achieved;
3) Verifying the process of dyeing to find out how to dye yarn in a clay pot and what result can be obtained, without the use of metal vessels. The result of the experiment confirmed that it was possible to heat a clay pot on a special furnace and to obtain a high-quality colour in the process, but that it required substantial time and resources.

Reconstruction of the dyeing recipe for obtaining red colour by using *Origanum vulgare* L.

In the study of traditional cultural heritage, including the application of natural dyes, the study of locally available resources is particularly important. In traditional culture the red colour is very important both in an artistic and symbolic way (Pīgozne 2020, 140–151; Kursīte 1996, 58–65). So far, *Rubia tinctorum* L., brazilwood, and cochineal remain the most widely globally studied sources of red colour. However, Latvian peasants also used alternative sources of red colour in their traditional dyeing techniques. Although these plant sources were mostly found in the local environment, not all have been thoroughly studied. One such plant was oregano, *Origanum vulgare* L., which has been mentioned in Latvian folklore and ethnographic sources as a red dye.

Scientific literature holds a vast amount of information about *O. vulgare* as a pharmaceutical plant which contains valuable essential and antioxidant oils (Oniga et al. 2018; Soltani et al. 2021; Teixeira et al. 2013; etc.). There is hardly any information about this plant's properties as a dye

and dyeing techniques using it. In 2016 the first studies were carried out about *O. vulgare* as a dye used in Latvian traditional culture, and the results were presented in an international conference "Dyes in History and Archaeology" in 2018 (Karlsone & Nakurte 2018). The experiment was based on linguistic, ethnographic and folklore sources as well as on the experience of the dyer.

In Latvian language *O. vulgare* is *parastā raudene*, where the word *raudene* is a derivative of *ruds*, which translates as reddish/ginger/rusty. Other colloquial names for this plant are:

- *sarkanes* (from Latvian *sarkans* – red)
- *dzīpari* (old Latvian name for fine, coloured yarn, usually used for embroidery)
- *sarkanā rauda* (the red *rauda* [reddish orange/ginger/ rusty])

Latvian folklore also holds information about the use of oregano as a dye. A large portion of folklore is folk songs or *tautasdziesmas* – short verses with mostly four, or sometimes more lines which follow a traditional style (rhythm, characters, language), created by the nation, and passed down to the next generations in spoken form. Folk songs tell about the Latvian peasants' ancient cycles of life and work, as well as their concepts of mythology. *Tautasdziesmas* cannot be dated with precision, but researchers believe that most were created during the 13th–16th centuries (Šmits 1912; Ozols 1961, 11–12). In some cases, the verses describe earlier phenomena, for example, archaeological material dating from the 12th century CE (Urtāns 1987). Likewise, much more recent realities of life from the 18th – 19th century have also been described in *tautasdziesmas* (Pīgozne 2011, 211, 216).

Folk songs also mention plants used in dyeing, and these include woad (*Isatis tinctoria* L.) for obtaining dark blue colour (LD 7137, 7181, etc.), bedstraw (*Galium* L.) for obtaining red colour (LD 7122, 7123, 7127, etc.), as well as alder (*Alnus* L.) for obtaining dark or black colour (LTDz 9174; LD 20555). Mentions without naming a particular colour include birch (*Betula* L.) (LTDz 10 711), as well as club moss (*Licopodium* L.) (LD 7139, LTDz 9205, etc.) with indirect reference to the yellow colour. Oregano (*O. vulgare*) has been mentioned as equivalent to bedstraw (*Galium* L.) (LD 7138, etc). As mentioned above, one of the common names of oregano in Latvian is *sarkane* (*sarkane* = from the Latvian word *sarkans* = red). Accordingly, this plant had been known and used as a red dye in the territory of Latvia for centuries. Folk songs only mention a small portion of natural dyes available in the region, possibly because these were particularly important compared to others. Indeed, archaeological material suggests that blue and

red colour adorned the clothing of Balts and Baltic Finns in the territory of Latvia from as early as 9th–13th centuries (Zariņa 1970, 44–45, 60, 90, tab. 26; Zariņa 1988, 31, tab. X–XII, XIV; Žeiere 2008, 34, 39–40, 55–61; Pīgozne 2020, 59–73, 78–89, 269–293).

Ethnographic sources also mention dyeing with oregano (*O. vulgare*). In total, 26 known descriptions have been written down from 1876 until 1942 that mention dyeing with *O. vulgare*. 10 of these are unpublished sources – fieldwork notes (LNVM ZAE 47, 35) but 16 are publications of ethnographic material. Seven are new publications (the rest repeat previously published information). Dyeing with oregano in the "usual" way when fresh or dried plants are soaked and heated, after which the yarn is immersed and heated in the dye bath, only results in different greenish-brown colour tones. To obtain red tones, a different technique is needed.

Only eight entries in ethnographic materials contain sufficiently detailed recipes or guidelines for dyeing with *Origanum*. Four of these mention fermenting. Obtaining the red colour by using *Origanum* together with apple tree (*Malus* spp.) leaves is also mentioned in four entries. Colours mentioned in the descriptions are red, dark red, bluish ('cold') red and brown. However, the description of the dyeing process itself is in most cases vague.

The most detailed description of the dyeing process, which mentions fermentation, as well as adding apple tree leaves to oregano, dates from 1876:

> The red yarn was dyed in "*sarkanes*" (a plant species) [oregano] and apple tree leaves. Apple tree leaves, especially those with red leafstalks, and *sarkanes* before flowering were gathered, chopped finely together and placed in lukewarm water, drained, and spread on a fabric to dry in the sunshine until reddish in colour, then placed in a pot, covered with warm water, adding yeast, and fermented for a day or more, then well-washed white wool yarn was added, and fermenting was continued for approximately three days; then everything was transferred to a pan and boiled for a long time, then the yarn was removed and the remains of the plants were shaken off, and the yarn was dried in the sun. (Blaus 1876, as cited in Ozoliņš 2017, 48–49.)

The information from the recipes was tested with practical experiments or the method of experimental ethnography.

Flowering ends of stems of *Origanum vulgare* L. and apple tree *Malus* spp. leaves were used in the experiment in a ratio of 3:2. The plants were chopped, dipped in the water, placed in the sunshine for one day on a black plastic sheet, and transferred inside for the night, with the approximate room temperature of 25°C. As a result of exposure to air, warmth, and moisture the

Figure 3. Fresh, chopped flowers of *Origanum vulgare* L. and leaves of *Malus domestica* Borkh moistened and placed in the sun, after exposure for two days. Photo: A. Karlsone.

plant mix obtained a reddish-brown hue (see Fig. 3). In Latvian this process is called "*sarcināšana*" [rosing]. This process took two days.

Fermentation was continued by pouring warm (40° C) water over the plants in a vessel and keeping the vessel in a warm place in the temperature about 35–40 °C. Afterwards two yarn samples (in ratio 2:1, plants to yarn) were added in the mixture, one of which was pre-mordanted with alum and tartar ($KC_4H_5O_6$ or potassium bitartrate; alum + tartar, weight proportion 8+7g/100g fibre), while the other was not mordanted. After six days the fermentation process was complete, but none of the yarn samples had obtained the expected colour. (see Fig. 4)

Considering previous experience of the dyer, the dyeing process was continued with heating. The temperature during this stage did not exceed 60°C. To intensify the process, previously drained plant particles were added. The resulting colours of the yarns were like those obtained during previous experiments – creamy brownish red. The mordanted yarn was visibly brighter than the untreated one (see Fig. 5), although in previous experiments a similarly bright colour was obtained without pre-mordanting.

The reconstruction of this technique requires further experiments. So far, the experiments have resulted in reddish-brown colour, rather than the bright,

Figure 4. The result of the first fermentation-dyeing stage. Photo: A. Karlsone.

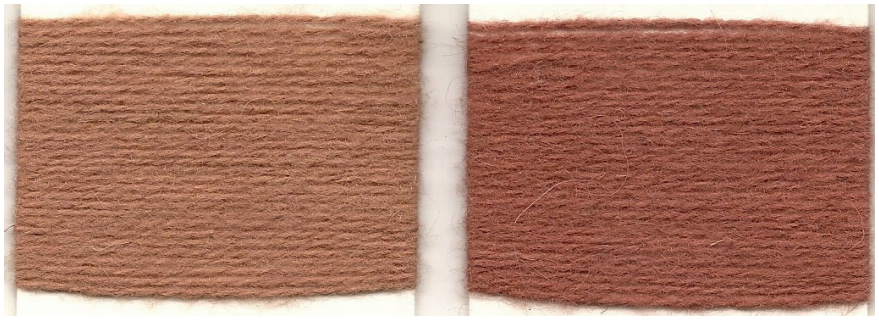

Figure 5. The result of the dyeing experiment by fermentation of *Origanum vulgare* L. and *Malus domestica* Borkh. On the left - yarn without mordant, on the right - mordanted yarn with alum. Photo: A. Karlsone.

or wine red, colour mentioned in the ethnographic sources. Accordingly, it is necessary to test additional components which might have been omitted from the sources, relying on personal dyeing experience with other plants, as well as intuition, as it turns out that historical written sources provide incomplete information about the dyeing process with *O. vulgare*.

Dyeing with bedstraw by fermenting in beer

The known Latvian written historical sources mostly provide incomplete and general information about natural dyeing (no dyers' books have survived here, unlike elsewhere in Europe, for example, [Anonim] 1768; Warg 1789; Mairet 1916). Even when the dyeing process has been described seemingly thoroughly, the question always remains: was it really the way? Has it been described in sufficient detail? To answer these questions, and to clarify what tones can be obtained with the described method, practical experiments are carried out. Not all historical entries can be used as guides for dyeing experiments. Often the information they provide is too general or incomplete, and as a result several sources have to be combined. The experimental method can also be used when a source is seemingly sufficiently informative, but more detailed information is necessary about the obtainable result, for example, the colour or its hue.

In 2019 an experiment tested the following dyeing description from 1935:

> Estonia. Red: dried, chopped bedstraw roots are placed in a clay pot, covered with sour small beer, and the pot is covered with leather and placed in a warm place where it must not boil, as this spoils the colour. After three days, mordanted yarn is added and turned once a day to prevent patches from forming. After three days the yarn is ready and beautifully red. – Here pre-made acid is used in the ancient fermentation process. (Bielenstein 1935, 147.)

The first time modern dyeing experiments using Estonian ethnographic material published by Martha Bielenstein with the roots of bedstraw *Galium* and small beer[3] to obtain red colour, were presented in Latvia during the scientific readings titled "August Bielenstein – 190"[4] organised by the Dobele Local History Museum on October 20th, 2016. Using her relative's published notes, the great granddaughter of A. Bielenstein (the granddaughter of M. Bielenstein's brother), textile artist Chistine Tilgner, née Bielenstein, presented the findings of her dyeing experiments. She demonstrated unspun woolen fiber samples which were bright, rich red in colour. Instead of small beer, which Tilgner could not find an equivalent for, she used both pale beer and *kvass* (a fermented cereal-based low-alcohol beverage), and the results were good in both cases. During the process she heated the dyeing vessels in the sun on the terrace of her house in Potsdam, Germany. Tilgner also talked about varied dyeing results when experimenting with the time of the dyeing process. Nevertheless, all colour tones obtained during her experiments were outstanding.

3 In Latvia there is no known equivalent to the traditional Estonian brew, however judging from its description it might have been a drink low in alcohol and thus it is called small beer in this study.

4 *Bielenstein August* (1826–1907) Baltic German Lutheran clergyman, linguist, and Latvian ethnographer, the father of Martha Bielenstein.

Figure 6. Yarn samples dyed with *Galium boreale* L. and *Rubia tinctorum* L.
Photo: A. Karlsone.

Tilgner's presentation inspired the author to achieve similar results. The ingredients mentioned in M. Bielenstein's notes are as follows: dried, chopped bedstraw (*Galium*) roots, sour small beer, and mordanted yarn. K. Tilgner had used common madder's *Rubia tinctorum* L. roots, although the original notes mention bedstraw *Galium*. Both plant species are related and contain similar dyes, except alizarin (Cardon 2007, 107–113, 122–127). Nowadays *R. tinctorum* is a cultivar and its roots are easily available to buy. During previous dyeing experiments when the dyeing liquid was heated on fire, the author obtained similarly intensive red colour both with the common madder *R. tinctorum* and the Northern bedstraw *Galium boreale* L. roots (see Fig. 6). Accordingly, to spare the local wild resources, roots of *R. tinctorum* were used in this dyeing experiment. The initial proportion of the dried roots and yarn was 1:1, but repeated experiments proved that it was possible to achieve good results when the weight of dye plants was smaller than the weight of the yarn.

Dyeing by fermenting in beer was repeated more than ten times over several years, in partly differential circumstances. Various brands of pale beer (alcohol content <4,8%), and homemade beer were used as the fermenting liquid. The quality of the mass-produced beer for the experiments was low, as the main selection criterion was "the largest volume for the lowest price". The dried, chopped dye plants were poured in vessels made of clay, metal (enamelled or with other coating), or plastic, and covered with beer.

The original description mentions that the yarn was fermented prior to dyeing (in ethnographic texts this term is used to describe mordanting the yarn before dyeing), without specifying the type of mordant. Other ethnographic sources suggest that this is a way of describing the use of alum to mordant woollen yarn prior to dyeing (nowadays tartar is often used together with alum). To achieve variation in colour tones, this experiment used both mordanted (alum + tartar, weight proportion 8+7g/100g fibre) and untreated woollen yarn.

For the fermenting process various environments were used: a warm shelf of a traditional ceramic woodburning stove in a country house, a warm water bath for the vessel containing the dyeing liquid, or a sunny, south-facing, sheltered spot by the house. The desirable temperature during heating, which had to be maintained constant for the whole dyeing process, was 35–45°C. When the temperature of the environment dropped, the vessel was covered.

The common madder's roots were soaked for approximately 36–42 hours until most of the plant particles had settled in the bottom and there was no more foam on top of the liquid. Afterwards washed and/or mordanted woollen yarn, which had been pre-soaked in warm water, was placed in the dyeing liquid containing the chopped dye plants. The fermentation process was continued, stirring the yarn occasionally. Parts of the yarn which were in closer contact with the plant

Figure 7. The dyeing process with *Rubia tinctorum* L. roots in the beer. Photo: A. Karlsone.

particles, yielded a brighter colour. If the yarn was not stirred, the resulting colour was distinctly patchy. Patchiness could be prevented by stirring and moving the yarn several times. The dyeing liquid had to fully cover the yarn. (see Fig. 7)

Depending on the amount of the dye plant and the temperature, after 48 hours the yarn had obtained a rich, bright colour. An intensely red yarn was obtained already in the first experiment. By varying the amount of the dye plant and the temperature of the liquid, a sufficiently intensive colour was obtained within 24 to 48 hours. Unmordanted yarn resulted in reddish-brown, orange colours, while the mordanted yarn was bright red.

The continuation of the experiment was based on previous practical dyeing experience of the author, or her specific craftsmanship skills. Since both common madder *Rubia tinctorum* and bedstraw *Galium* contain anthraquinone compounds which react to alkaline environment it is possible to obtain additional hues by rinsing (or immersing for 5–15 minutes) the yarn immediately after dyeing in very warm (40–50˚C) alkaline (pH 9–11) liquid. This causes rapid chemical reaction whereby the brown tones become dark-red and purple, while the red tones obtain cooler and slightly brighter hues. (see Fig. 8) After alkali treatment the yarn is only rinsed after thoroughly drying out. Wool and

Figure 8. Different shades of madder red. From left: 1) without mordant, 2) without mordant, rinsed in an alkali after dyeing, 3) mordanted with alum and tartar, 4) mordanted with alum and tartar, rinsed in an alkali after dyeing. Photo: A. Karlsone.

other protein fibers should not be exposed to alkali for long periods at high temperatures, as this can damage the fiber, but the drying process, which takes place at natural ambient temperatures, has practical no effect on the fiber.

The experiments with red colour by fermenting bedstraw/common madder roots in beer have proven that this is a secure and effective dyeing method. It always produces good results if the necessary conditions are provided. Repeating the experiments multiple times allows to discover potential variations for this dyeing method, which always result in good colour. Accordingly, it is safe to say that the archaic dyeing technique published by Martha Bielen-

stein is reliable and can be used to obtain several tones of red. These could be predicted when repeating the dyeing experiments. This dyeing method does not require constant dyer's attention and peasants of the past could therefore easily combine the dyeing with other daily activities on the farm.

Dyeing yellow in a clay pot

To obtain good quality results in the process it is important to use appropriate equipment, for example, the heating vessels. Nowadays dyers use metal vessels with enamel or other durable coatings, which has no impact on the resulting colour. However, such vessels were not always available in the past. If iron or copper salts were used as mordants (for the dark, grey, and green tones), then durable metal vessels would be suitable for the technique, but it is not clear if the same would be true for lighter tones, such as yellow. Metal vessels available for the past peasants may not have been suitable for obtaining the yellow colour. Indeed, while studying the ancient dyeing techniques the author found an interesting description about dyeing in a clay pot in the book by Martha Bielenstein (Bielenstein 1935):

> At the edge of a ditch or by a small slope they dug a vertical shaft approximately 45–50 cm deep, the top opening of which was exactly as wide as the pot intended for it; afterwards a horizontal tunnel was dug to connect the edge of the slope and the shaft. The tunnel was filled with firewood and a cooking pot was placed on top of the shaft. To ensure sufficient airflow for the fire and to allow the smoke to escape, a sloping draw tunnel was dug at the back of the shaft. (see Fig. 9) Such a furnace is outstanding, especially if dug in clay (we used to make such furnaces in my childhood). Even nowadays we find evidence for the incredible, that a clay pot can be placed on the fire and that it lasts for decades. (Bielenstein 1935, 120.)

This description was used as the foundation for a practical experiment. Two master dyer craftswomen with assistants participated in the experiment. Considering the existing circumstances, a clay-rich bank of a pond was chosen as the location. Digging was simultaneously com-

Figure 9. Dyeing in a clay pot. Drawing by Martha Bielenstein (Bielenstein 1935, 145).

Figure 10. Digging was simultaneously commenced for three entrances of the "stove": two from above and one below. Photo: D. Ievina.

Figure 11. On the left: the dyeing process, heating yarn together with leaves of *Malus domestica* Borkh. On the right: the result of dyeing experiment. Photo: A. Karlsone.

menced for three entrances of the "stove": 1) The horizontal heating tunnel, 2) the vertical heat shaft, 3) the sloping draw tunnel. (see Fig.10–11)

The horizontal heating tunnel. Approximately 50 cm down from the plateau of the bank, a horizontal tunnel was dug out. The layer of soil on top of the tunnel was 50–60 cm, and the diameter of the opening was approximately 30 x 33 cm.

The vertical heat shaft. A vertical shaft was dug following the line of the horizontal tunnel into the plateau of the bank, approximately 120 cm from the drop of the bank. The diameter of the opening was about ~17 cm.

The sloping draw tunnel. On the same line as the mouth of the heating tunnel and the vertical shaft, 60 cm from the top of the shaft a sloping tunnel was dug out. Its diameter was ~20cm. It joined the vertical shaft at ~40 cm depth from the top of the soil. Shovels of various sizes and even a long kitchen knife were used for digging.

During the digging process, which took the whole day, the dye plant – domestic apple tree *Malus domestica* Borkh leaves, was soaked in the pond water. This time a replica of a historical unglazed clay pot was used for the dyeing process. Such a pot was available for the participants of the experiment and corresponded with local historical heritage. The pot was made of clay strips, with shape and ornaments added on a potter's wheel (the so-called early wheel-thrown pottery). The mass of clay consists of clay and gravel (burnt, crumbled granite stone particles). This mass has a high heat capacity which reduces the possibility of splitting when the vessel is heated. Moreover, this type of pots had been used in the territory of Latvia over several centuries. The dimensions of the pot: h=24 cm, base diameter 15 cm, the maximum diameter 22 cm, capacity 8 l (the pot was made by Mg.hist., Mg.art. Baiba Dumpe, a potter, and researcher of ancient pottery).

After lighting fire in the horizontal tunnel, it became clear that there was not enough draw in the moist soil and that the smoke was not going where it should. To direct the airflow in the right direction, another fire was lit at the top of the sloping draw tunnel. This helped to achieve sufficient draw and heating of the underground passages. The dyeing experiment was continued on the next day.

The clay pot with apple tree leaves was heated on top of the vertical shaft. The liquid heated up very slowly, possibly because of the cold wind. To minimise the loss of heat, the pot was covered with another, inverted clay pot. When the temperature in the pot reached approximately 40˚C, washed, damp yarn was added. The weight of dry yarn was 150 g. With intensive heating the dyeing liquid reached a temperature of 45˚C. At this point the yarn was temporarily removed, and dissolved alum was added in the pot. Then the dyeing process was continued.

To maintain the temperature constant, intensive tending of the fire was required. Even though the maximum achieved temperature was only 50˚C, the yarn obtained beautiful, yellow colour. The dyeing process took all day. In the evening the heating was stopped, and the yarn was left in the dye bath with leaves overnight. In the morning the yarn was removed from the still warm

dye bath (the cooling process was very slow) and rinsed. The obtained tone was distinctly yellow. (see Fig. 11)

The conclusions reached during this dyeing experiment: it is possible to dye yarn in distinctly yellow colour by dyeing on a ground furnace in a clay pot. The drawback of this method: it requires substantial input of time and fuel. It is possible that the yellow yarn was more valuable if the work required to make it was considered together with its aesthetical quality. The weaknesses of the experiment: 1) The layer of soil above the heating tunnel was too thick. It was deliberately not dug to the recommended thickness because the soil in the location of the experiment was sandy clay and there was a risk of the sand disintegrating when heated. In soils with a higher proportion of clay the top layer of the soil can be thinner, which would reduce the distance between the heat source and the base of the pot; 2) The dyeing vessel can be placed deeper into the shaft thus reducing the loss of heat from the environment; 3) It is possible that using a finer clay pot without the mix of gravel would result in more intense heating of the dyeing liquid, and this should be tested in further experiments.

Conclusion

Traditional craftsmanship skills remain precious in modern times, as a continuous way of creative self-expression and a source of new knowledge. Their use in crisis situations also remains important. Any situation when traditional craftsmanship skills are used in modern times prolongs the active period of their use, thus increasing the possibility of passing the knowledge down. In previous periods of history economic crises caused prolonged necessity for the use of traditional craftsmanship skills. The economic hardship of the First and the Second World War created a demand for ancient skills that had not been entirely forgotten. Craft is both knowledge and skills, which are preserved, perfected, and used to obtain new knowledge through creating new material values. In crafts, the material is closely linked to the non-material, intangible.

Nowadays, practising the craft of dyeing is not only a creative self-expression and a field of traditional crafts, but it allows for a more successful study of the meaning of colours, providing undocumented, accurate knowledge about the complexity or simplicity of obtaining a particular colour, the available colour palette, etc. Only by being familiar with the dyeing process is it possible to adequately evaluate the written sources of different periods about textile colours, including interpreting the records of ancient technologies and dyeing methods. Evidence of dyeing with plant dyes found in ethnographic materials usually provides only fragmentary information about the entire scope of the

process. One of the reasons could be that the narrators could have told only a part of the dyeing process, because they took the rest (unsaid) as self-evident and well-known information, although from a nowadays point of view this is not so. Or something had already been forgotten. Therefore, dyeing experiments to restore ancient techniques are like detective work, tracing and uncovering ancient knowledge step by step. Experience gained from previous dyeing sessions, intuition and familiarity with ethnographic material are usually the determining aspects in restoring ancient knowledge.

In order to restore ancient skills in modern conditions, the essence of the process must be preserved - the use of natural dyes, mordanting, fermentation or other similar processes. Today we can use modern pots and other utensils, and modern stoves. We also use rubber gloves to protect our hands. To control the dyeing process, various temperature and pH determination aids are used for research purposes. However, the wonder of discovering the unknown remains ever-present. Natural substances contain a great diversity, which is impossible to fully predict. The composition and quality of the substances in the plant have been influenced by many conditions, such as soil and climatic conditions during the plant's vegetation, the conditions of harvesting and storage of the plant, and others. The dynamics of the time and temperature changes of the dyeing process can also be variable. However, the process as a whole creates a living sense of presence.

Engaging in crafts is a way of "breathing life" into historical texts and obtaining information about the practicalities of craftsmanship skills, such as the required time, amount of work and resources, and more. The results of any experiment, including the first one, are meaningful and can be used as the starting point for further experiments and for acquiring new knowledge.

AUTHOR

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SOURCES

Abbreviations

E – Repository of Ethnographical Materials of the Institute of Latvian History of the University of Latvia.

LD – *Latvju Dainas* [Latvian *Dainas (tautasdziesmas)*]. 2–3. 1903–1906. Edited by Krišjānis Barons and Henrihs Visendorfs, Pēterburga.

LNVM ZAE – Archive of the Ethnographic Department at the Department of History of the Latvian National History Museum.

LTDz – Latviešu tautasdziesmas. 2–3: "Darba dziesmas" [Latvian folksongs. Work songs]. 1980–1981. Edited by Anna Ancelāne et al. Rīga: Zinātne.

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