

Woad is more than blue...



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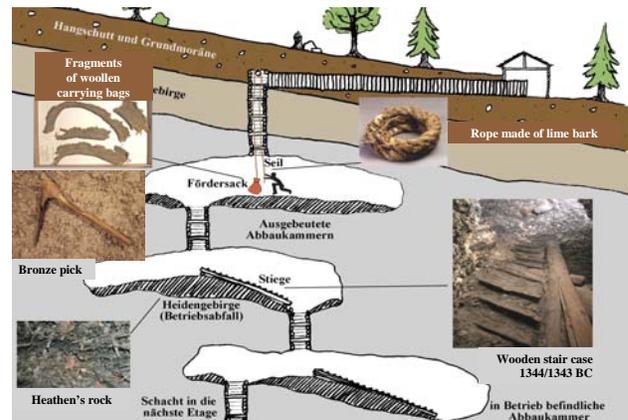
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Introduction

In the area of Hallstatt, Austria, a salt mine was exploited since 1600 BC. Due to the conditions of the mine (dry, dark and cold) many objects survived including a large number of textile fragments which are in remarkably good condition. Since 2002, several research projects were carried out to identify the dyes and other materials which colours the textiles. Based on dyestuff analysis of the prehistoric textile samples and archeobotanical literature, it is most likely that woad (*Isatis tinctoria* L.) was used in the majority of the dyed samples. The dyeing process with woad is very complicated. The dye itself is not present in the plant material but is formed via fermentation in a vat and binds to the textile fibre after an oxidation step. It is astonishing that this process was already known more than 3000 years ago.



Scheme of the salt mine and several findings, scheme and photographs NHM Wien



HT-100

HT-062

Some textiles in which woad was detected, photographs NHM Wien

Results

During our dyeing experiments a wide range of colours was obtained, of which a small selection is presented below. Chemical analysis indicated that the woad plant itself contained many components. In addition to the blue indigotin and the red indirubin, also yellow flavonoids were present and other red and blue components were found. Based on the vat created, one of the dyes predominates or mixtures of dyes were found resulting in as for example in green or violet.



photographs Anna Hartl



Research in woad dyeing techniques

The aim was to better understand the practical aspects of dyeing with woad and to achieve more knowledge of how this was done in Bronze and Iron Age. Since no written sources are available from prehistoric times, contemporary literature as well as historical sources available since Roman time were studied. Based on this, an experiment was designed in which different woad dyeing techniques were investigated. Subsequently, 18 series with 95 different vats were made.

Method	Series	Variants	Vats
Fresh leaves of woad	exp. 1 st cut	soaking time, temperature of soaking water / lye, pH, dipping (duration / number) + dyeing during pigment production.	7+1
	exp. 2 nd cut	6 soaking (duration, temperature), 4 pH, 2 dipping + dyeing during pigment prod.	24+1
	repro	1 soaking (duration, temperature), 1 pH, 2 dipping	1
Urine vat	V1	2 indigos; 2 recipe modifications	6
	V14	1 indigo; 1 woad pigment (1 st cut); 1 recipe	2
Madder-bran vat	V2	2 indigos; 2 recipe modifications	4
	V3	2 indigos; 2 recipes	4
	V7	2 indigos; 2 woad pigments (1 st + 2 nd cut); 2 recipe modifications	6
	V8	2 indigos; 2 woad pigments (1 st + 2 nd cut); 1 recipe	4
	V9	2 indigos (1 ♀), 2 woad pigments (1 st + 2 nd cut); 1 recipe	4
	V11 colour	1 indigo, 2 woad pigments (1 st + 2 nd cut), 1 zero variant; 1 recipe	4
	V13 repro	2 woad pigments (1 st + 2 nd cut); 1 recipe	2
Vat with green + couched woad balls	V4	1 woad pigment (1 st cut); 1 recipe	2
	V4	4 green (ferm. + fresh pulp, 1 st + 2 nd cut), 1 "waidkohle"; 1 recipe	5
	V5	4 green (ferm. + fresh pulp, 1 st + 2 nd cut), 1 couched 2009; 1 recipe	5
	V6	4 green (ferm. + fresh pulp, 1 st + 2 nd cut); 1 recipe	4
V10	V10	4 green (ferm. + fresh pulp, 1 st + 2 nd cut), 2 couched (fresh pulp 1 st + 2 nd cut); 1 rec.	6
	V12 colour	3 couched (ferm. pulp 1 st cut, fresh pulp 1 st + 2 nd cut); 1 recipe	3
Total No.	18		95

Conclusions

The wide range of colours obtained was a surprise. Although in later days woad (and indigo) were exclusively used to dye blue, a larger palette is possible based on the parameters in the dye vat. The colours obtained could be explained based on chemical analysis of the dyestuffs. It must be noted that in many woad dyed samples from the Hallstatt salt mine, mixtures of dye molecules were found, such as an equal ratio between indigotin and indirubin indicating a purple colour. So far, we are not able to determine if this is due to degradation of the indigotin which is normally present in abundance or to a specific vat used. It is unclear if woad was actually used to obtain such a large colour palette. These experiments showed that it is a possibility which needs to be examined further.

Acknowledgement

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