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SUSTAINABLE DYEING METHODS FOR MANAGING *TINEOLA BISSELLIELLA* (HUMMEL) INFESTATIONS OF WOOLEN FABRICS

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ABSTRACT

This work studies the possible functionalisation provided by natural dyes to wool fabrics against moths attacks. Wool flannel samples were dyed with extracts from *Daphne gnidium* L., *Helichrysum italicum* (Roth) G. Don, *Rubia peregrina* L., *Castanea sativa* Mill.. Tests on the textile resistance to mature larvae of *T. bisselliella* were performed together with the quantitative characterization of second metabolites of the plants extracts. The test allowed to preliminary elicit the contribute of natural dyes and mordants to protect wool textiles.

INTRODUCTION

T. bisselliella, the most important and widespread clothes moth throughout the world is mainly controlled by the use of insecticides containing synthetic pyrethroids. The multitasking role of the herbal flora is reported in literature (Giusti & Pieroni, 2009) as well as *D. gnidium* and *H. italicum* antibacterial and antifeedant activities. Sweet chestnut extracts are used since ancient times in the tanning process and as mordants or dyes for fabrics. Recent studies confirmed their antioxidant and antimicrobial properties (Buzzini *et al.*, 2008; Campo *et al.*, 2012). In this work the role of natural dyeing in possibly functionalising textiles has been studied. Wool flannel samples were dyed with extracts from *D. gnidium*, *H. italicum*, *C. sativa* and *R. peregrina* to test textile resistance to mature larvae of *T. bisselliella*. Samples were dyed being or not previously mordanted with potassium alum. The weight loss of fabric due to larvae feeding activity was measured following the AATCC Test Method 24-2004. Both the two groups of dyed samples were compared with controls (only washed wool fabric). The differences in fabric weight after *T. bisselliella* infestation were detected. A HPLC/DAD/MS analysis of the dyeing extracts was performed by method for polyphenolic characterization (Pinelli *et al.*, 2008).

RESULTS AND CONCLUSIONS

Data on sample weight loss together with data on the quantitative characterization of secondary metabolites of plant extracts and the percentage absorbed by the wool fabric during the dyeing procedure are reported in Table 1. Dyed samples mordanted with potassium alum showed a significant lower weight loss as a result of antifeedant activities whereas among no mordanted samples, chestnut tannins and *D. gnidium* extracts seem to be significantly active.

Table 1 Results of the tests on the textile resistance to mature larvae of *T. bisselliella* and quantitative analysis of total metabolites of plant metabolites absorbed by wool fabric samples.

	Weight loss (mg)	+/- Limits	Solution	PRE-solution of total compounds (mg/ml)	POST-solution of total compounds (mg/ml)	PRE-POST solution difference of total compounds (mg/ml)	% of total metabolites absorbed by fabrics
<i>Contrast</i>							
<i>Plant extracts and mordant vs standard</i>							
Castanea	* 11.4	9.4	T1:30+Al	0.82	0.341	0.478	58.4
Daphne	*23.8	9.4	D1:60+Al	0.51	0.343	0.173	33.5
Helichrysum	*20.6	9.4	H1:30+Al	0.14	0.024	0.115	82.7
Rubia	*29.8	9.4	R 0.67% +Al	0.01	0.007	0.004	36.4
<i>Contrast</i>							
<i>Plant extract without mordant vs standard</i>							
Castanea	*15.6	10.7	T1:30	0.85	0.321	0.536	62.5
Daphne	*18.	10.7	D1:60	0.45	0.217	0.232	51.6
Helichrysum	4.2	10.7	H1:30	0.13	0.078	0.053	40.4
Rubia	5.1	10.7	R 0.67%	0.01	0.007	0.004	36.4
Method: 95..0 percent Dunnett * denotes a statistically significant difference.							

Our data show that a possible functionalization of wool fabrics can be achieved by dyeing with plant extracts providing good perspectives for the development of innovative textile products. Nevertheless, the role of natural mordants, as well as the quality of single compounds involved, need to be better clarified.

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