

# Application of Forest Byproducts in the Textile Industry: Dyeing with Pine and Eucalyptus Bark Extracts

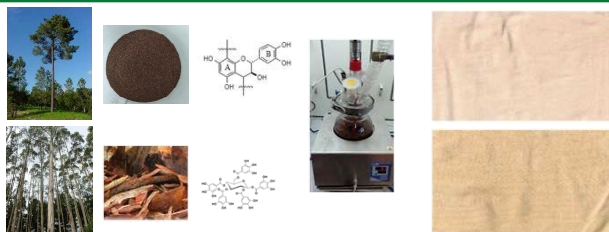
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## ABSTRACT

The main by-product generated in the forestry industry is bark, derived from the debarking process. Pine and eucalyptus are nowadays two of the most important tree species exploited by the forestry industry in southwestern Europe. This work investigates the application of Maritime pine (*Pinus pinaster*, Ait.) and the Eucalyptus (*Eucalyptus globulus* Labill.) barks as a source of high polyphenolic content extracts, to be used as natural dyes in the textile industry. This work demonstrated that it is possible to use the extracts obtained from both forest by-products as textile dyes without need for using any metallic mordant.



## RESULTS AND DISCUSSION

### ✓ Pine and Eucalyptus bark extraction

Extractions were developed using water as solvent. The material and water were mixed at room temperature, heated and, once the selected temperature was reached, the extraction agent was added and the contact time started. After the selected time, the suspension was vacuum filtered and the extracts were concentrated in a rotary evaporator.

Table: PB and EB extraction conditions tested

Raw material	Extraction agent		Temperature (°C)	S/L	Time (min)	Codification extracts
	NaOH(%)	Na <sub>2</sub> SO <sub>3</sub> (%)				
Eucalyptus Bark	1	1	95	1/15	60	EB <sub>E1</sub>
Eucalyptus Bark	1	1	80	1/10	30	EB <sub>E2</sub>
Pine Bark	5	2.5	80	1/5	30	PB <sub>E1</sub>
Pine Bark	1	2	60	1/5	30	PB <sub>E2</sub>



### ✓ Pine and Eucalyptus bark extracts characterisation

Pine bark extracts presented a absorption peak at low wavenumber region, characteristic of condensed tannins. However, the eucalyptus bark extracts showed a broad band that could be explained by the presence of a high proportion of gallotannins and ellagitannins that have an additional absorption maximum between 350 and 450 nm.

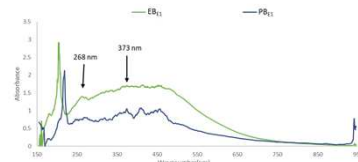
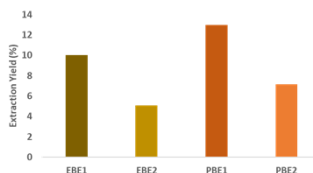


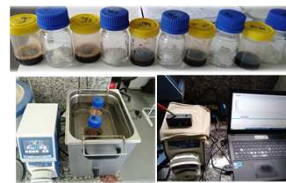
Figure. UV-VIS spectra of PB and EB extracts (150-950 nm)

### ✓ Extraction conditions influence

The influence of extraction conditions was higher when PB extracts were used as dyes than when EB extracts were used. Stains were observed in dyed textile samples. The samples dyed with extracts EB<sub>E1</sub> and PB<sub>E2</sub> showed an important number of stains.

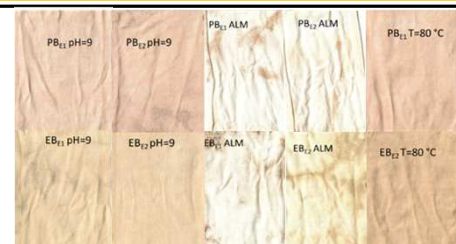
Table: Color evaluation of the textiles cotton samples dyed with the extracts of EB PB

Samples	L*	a*	b*
EB <sub>E1</sub>	95.4 ± 2.0	0.9 ± 0.3	-3.3 ± 1.4
EB <sub>E2</sub>	72.5 ± 9.3	16.1 ± 2.2	31.5 ± 4.0
PB <sub>E1</sub>	69.1 ± 0.9	19.4 ± 0.7	29.8 ± 1.7
PB <sub>E2</sub>	86.2 ± 4.9	19.79 ± 1.7	22.5 ± 4.6



### ✓ Dyeing conditions influence

PB<sub>E2</sub> extract presented the highest influence with the pH, followed by the EB<sub>E2</sub> extract. Alum, produced a poor distribution of the dye in the textile sample. Temperature has shown an important influence with the PB extract but not with the EB extract.



## CONCLUSIONS

It was demonstrated that the valorisation of by-products of forestry industry like the bark of Eucalyptus and Pine was possible in the production of extracts with high applicability in the textile industry. In addition, this work also demonstrated that it is possible to use the extracts obtained from both forest by-products as textile dyes without need for using any metallic mordant. This work could be the starting point for future development of new textile products with low environmental impact, based on the valorisation of forestry byproducts.

TINTEX NATURALLY ADVANCED

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