СЕКЦІЯ 2 – ТЕОРЕТИКО-МЕТОДОЛОГІЧНІ ЗАСАДИ ВИРІШЕННЯ ЕКОЛОГІЧНИХ ПРОБЛЕМ. ПРОБЛЕМИ І ПЕРСПЕКТИВИ ТРАНСКОРДОННОЇ СПІВПРАЦІ У ВИРІШЕННІ ЕКОЛОГІЧНИХ ПРОБЛЕМ

UDC 504.06
Maria Nazaré Coelho Pinheiro, Prof., PhD.,
Lyudmyla Symochko, Prof., PhD.,
Polytechnic Institute of Coimbra, Coimbra Institute of Engineering, Department of Chemical and Biological Engineering, Coimbra, Portugal
CEFT-Transport Phenomena Research Center, Faculty of Engineering, University of Porto, Porto, Portugal
Department of Life Sciences, University of Coimbra, Coimbra, Portugal

WASTE VALORIZATION: A CONTRIBUTION WITH A CASE STUDY

Abstract: The main objective of this study is to present a method for the valorization of waste generated during the production of a traditional spirit drink made from the fruit of the *Arbutus unedo L*. tree, as a potential source of (bio)dyes for the textile industry.
Key words: waste valorization; strawberry tree; natural dye

Introduction

Arbutus unedo L. (strawberry tree) is a typical shrub or small tree of the Mediterranean region (Figure 1) and is highly appreciated for its fruit, but it has also become increasingly valued for its ecological role, particularly in the recovery of degraded ecosystems.

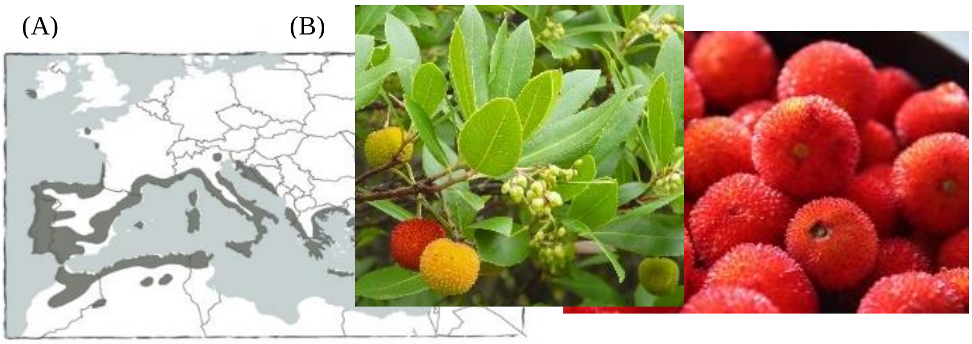

Figure 1 – Distribution of the strawberry tree in the Mediterranean region and in the Atlantic coast, including Portugal and Ireland (A) and the flowers and fruits in various stages of ripeness (B).

A rounded canopy and dark green, shiny, lance-shaped leaves characterize the strawberry tree. In autumn and early winter, small white flowers appear in clusters, and during this time, the fruits from the previous year ripen, acquiring their characteristic red color. It is therefore very common to see trees with white flower clusters and red fruits at the same time, as shown in Figure 1. The fruit color changes from yellow and orange to bright red as it ripens (Figure 1).

Recently, the ecological value of this species has been highlighted, particularly when the objective is the recovery and increase of the resilience of forest and agroforestry ecosystems to erosion and fire. Its rapid regenerative capacity helps in the recovery of degraded ecosystems. The strawberry tree is one of the recommended species to plant in protection areas and areas crossed by high voltage power lines. In this ecological aspect, it is also worth noting that the strawberry tree is an important source of food for pollinators during autumn and winter when there is less flower availability (food).

The fruit (*medronho*) is edible and very rich in vitamins, particularly in vitamin C [1, 2], with values similar to citrus fruits. It is used to make liqueurs and brandies. *Aguardente de medronho* is a typical spirit fruit drink produced exclusively by alcoholic fermentation and distillation of fleshy fruits. Recently, several other applications of the pulp obtained from macerated/crushed fresh fruits, such as the production of jams and ice-creams, have become common. However, a large volume of waste is generated as a result of these activity.

A possible valorization of the distillation mash waste resulting from the *aguardente de medronho* production was evaluated as bio-dyes source for the textile industry. The replacement of chemical dyes in the textile industry with natural dyes derived from bioproducts/residues is an up-to-date subject that promotes environmentally sustainable processes and a circular economy.

Material and Methods

Arbutus fruits waste were obtained from a small Portuguese industry and frozen separately (distillation mash and solid wastes). The mash waste, after filtration, was used directly in the dyeing assays with three different textile substrates: cotton; wool and cationized cotton. The assays (in duplicate) were carried out at 50 ºC with agitation (320 rpm) during 100 min and a control sample with water was also used for dyeing effectiveness evaluation. After dyeing, the samples were washed with cold water (20 ºC) and hot water (45 ºC) for 10 min, and then dried under natural light exposure to evaluate color fastness (half of the sample surface was protected by light exposure using a black card). Finally, color assessment was made according to the CIE (*Commission Internationale de l'Eclairage*) system measuring the L*a*b* coordinates. A colorimeter (Konica Minolta CR-20) was used to measure color coordinates of different locations on the textile samples, ensuring even distribution across the entire surface.

Results and Discussion

Colors reproduced for textiles dyed with mash waste from *arbutus* fruit distillation are illustrated in Figure 2, where ΔE^* is a parameter representing the color difference between samples and control. Values of $\Delta E^* > 5$ indicates that any observer sees two different colors [3] between tissue and the respective control.

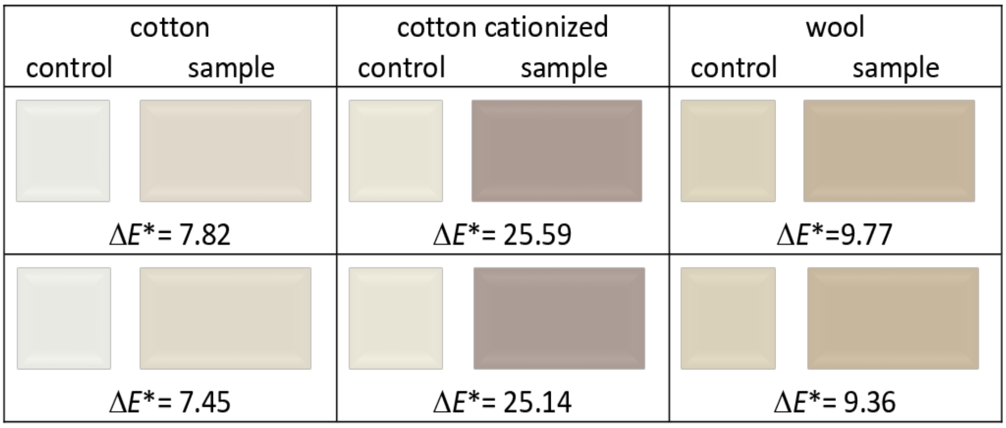

Figure 2 - Colors (reproduced from RGB coordinates) for the textile substrates dyed with mash waste from *arbutus* fruit distillation and correspondents values of □*E**, calculated using the respective controls as reference.

A palette of uniform earth tones was obtained ranging from intense brownish-gray (mean ΔE^* = 25.37) to light cream (mean ΔE^* = 7.64). The cationized cotton substrate presented the more intense color, corresponding to the highest ΔE^* value. When compared to the color obtained in cotton (natural), it is clear that the previous treatment of the cotton fibers improved the fixation of the (bio)dye onto the fibers.

Conclusions

The hues and tones obtained in the fabrics have shown potential for commercial acceptance, indicating that the proposed eco-valorization of the waste obtained from *arbutus* fruit manufacturing deserves further exploratory studies to consolidate improvements in color fastness properties.

References

[1] Martins, J., Pinto, G., Canhoto, J., 2022. Biotechnology of the multipurpose tree species *Arbutus unedo*: a review. Journal of Forestry Research 33, 377–390.
https://doi.org/10.1007/s11676-021-01369-x

[2] Salem I. B., Ouesleti S., Mabrouk Y., Landolsi A., Saidi M., Boulilla A., 2018. Exploring the nutraceutical potential and biological activities of Arbutus unedo L. (Ericaceae) fruits. Industrial Crops and Products 122, 726-731.
https://doi.org/10.1016/j.indcrop.2018.06.024.

[3] Wojciech, M., Maciej, T., 2011. Color difference Delta E - A survey. Machine Graphics and Vision 20(4).

Acknowledgments. The author is grateful to Tintex Textiles S.A. for the supply of textile substrates used in this work and for technical assistance.

UDC 504.06
Lyudmyla Symochko, Prof., PhD.,
Maria Nazaré Coelho Pinheiro, Prof., PhD.,
Department of Life Sciences, University of Coimbra, Coimbra, Portugal
Polytechnic Institute of Coimbra, Coimbra Institute of Engineering, Department of Chemical and Biological Engineering, Coimbra, Portugal
CEFT-Transport Phenomena Research Center, Faculty of Engineering, University of Porto, Porto, Portugal

SOIL MICROBIOME AND RESISTOME IN A CHANGING ENVIRONMENT

Abstract: The main objective of this study is to present the results of long-term monitoring of soil microbiome and resistome in natural ecosystems, with the aim of analyzing changes in the functional structure of soil microbial communities in a changing environment. Specifically, the study seeks to estimate the spread of antibiotic-resistant microorganisms in the soil environment, which is of great importance in the context of the global threat of antimicrobial resistance. By monitoring the microbiome and resistome over time, the study aims to provide insights into the impact of various environmental factors on soil microbial communities, as well as the potential for these communities to serve as a reservoir for antibiotic resistance genes. Ultimately, the findings of this study may inform strategies for the management and preservation of soil microbiomes and the prevention of the spread of antibiotic resistance in the environment.

Key words: soil; microbiome; resistome; changing environment, hot spots.

Introduction

The soil microbiome and resistome of forest ecosystems play critical roles in maintaining ecosystem health and function. However, in the face of changing environmental conditions such as climate change, deforestation, and pollution, these microbiomes and resistomes may be significantly impacted [1, 2].

One potential consequence of changing environmental conditions is a decrease in microbial diversity and abundance. This can have cascading effects on ecosystem processes such as nutrient cycling and carbon storage. Additionally, exposure to pollutants such as heavy metals and pesticides can select for resistant strains of bacteria, leading to an increase in antibiotic resistance genes in the resistome [3, 4].

On the other hand, some studies have shown that certain forest management practices, such as selective logging and prescribed burning, can actually increase microbial diversity and resistance to disturb-