Climate change and sustainability resources: making materials from biomass

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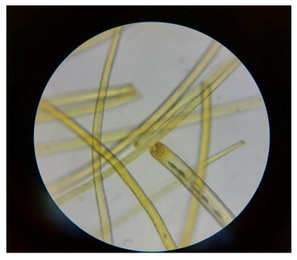
INTRODUCTION

Can the 3Rs approach combat the escalating waste problem and the climate change? Are bio-based products the solution for a sustainable future?

Through this project students from secondary school will learn about bioeconomy and the possibilities to produce bio-based material. Activities were co-designed with local industries that proposed some challenges to the students. They tried to give new life to obsolete materials using their STEM skills and the results of the laboratorial activities.

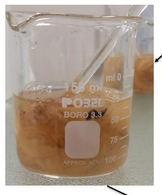
First Challenge – New products from WOOL

1. Microscopy



Sheep's wool has always been used as an agricultural product by pastoral communities, but in 2002 it went from agricultural product to waste.
In 2015 it has been calculated that around 200,000 tons of coarse wool are produced each year in Europe, the disposal of which is a great problem because it is no longer possible abandon the wool in the pastures or left to burn slowly, with the consequent release of toxic gases and carbon dioxide into the atmosphere.
To revalue the product and the market, there has been increasing academic and industrial research aimed at exploiting wool particles as textile materials, filtration adsorbents, cosmetic materials, and biomaterials.
In this framework, keratin-based materials are promising candidates due to their biodegradability and biocompatibility.
The activity proposed to the students was to explore the wool economy and the chemical composition, then to extracts keratin from wool and use it to prepare cosmetics.

2. Keratin extraction from wool



2.1 Adding NaOH 0.1 M

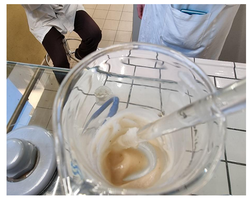
2.2 Adding Acetic Acid 0.1 M

2.3 Keratin flocculation

3. Hair Conditioner from keratin powder

3.1 Dried Keratin

3.2 Add glycerin and cetyl alcohol



3.3 hair conditioner

3.4 video of the preparation

METHODOLOGY
Project Based Learning

Meeting with experts
Entrepreneurs and their technical managers held meetings with students to present a problem connected to real life.

Design Thinking and collaborative work
Students manage the project by working in groups

New Products and evaluation
Students conduct a research on the chemical characteristics of different compounds and develop new products.

CONCLUSIONS

- ❑ Improve knowledge about the innovative research to create products with lower footprints.
- ❑ Enhance the students' awareness about the re-use of materials to reduce environmental impacts.
- ❑ Foster the development of GreenComp (critical and complex thinking, futures literacy and exploratory thinking)
- ❑ Develop a concrete orientation towards STEM Carrieers

Second Challenge - Re-use the Citrus Peel

Pectin is yellowish, odorless powder soluble in water. It is an important cell wall polysaccharide that allows primary cell wall extension and plant growth. Pectin is used for different applications in dairy, confectionary, pharmaceutical and food and the industrial application of it is increasing.
A factory producing flavor, near our school, proposed to the students the challenge to reuse the citrus peel coming from a strong extraction of essential oils.
Students analyzed the composition of peel and proposed to extract pectin using HCl solution and precipitation with ethanol.

1. Pectin extraction with different solvent composition

PECTIN EXTRACTION:
Boil for one hour 2 beakers with different volumes of water (250 mL and 500 mL) each containing 10 g of orange peel sample.
Then add HCl (0.1 M) until pH is between 1.5 and 3.
Perform hot Buchner filtration for both.
Add isopropanol to the filtered solutions (5 mL for the less concentrated and 10 mL for the more concentrated).
After pectin precipitation was achieved, pectin films were produced.

2. Pectin after Drying

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