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INSPIRING PRACTICES | POPULAR VOTE 2022 | BRAZIL

#ENVIRONMENT

Students create bioplastic gloves from plant residue

High school and technical school students created new methodologies to make the project possible. The results indicate the superior quality of the product.

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COMMUNITY/CITY
Araci, Bahia

SCHOOL
Centro Territorial de Educação Profissional (CETEP) do Sisal II

NAME OF THE PROJECT
Produção de luvas através de Bioplástico

STEM AREAS
Science and Technology

OTHERS AREAS OF KNOWLEDGE
Environmental Education

In the interior of Bahia, in the Brazilian Northeast, a group of students from the Clinical Analysis technical course developed an innovative technology that transforms the residue of sisal, a typical plant of the region, into bioplastic. From this material, they created disposable gloves with a short decomposition time. The project, entitled “Produção de Luvas através de bioplástico” (Gloves production with the use of bioplastics, in English), won the Solve for Tomorrow popular jury in the country, in 2022.

The idea came during practical classes at school, Centro Territorial de Educação Profissional (CETEP) do Sisal II, where laboratory studies in the health area are conducted. Five students in the first year of high school (the penultimate year of compulsory education) noticed that the volume of waste generated by the gloves was high at the end of just one day. Although latex gloves are important protective equipment to prevent biological contamination, they have a long decomposition time, which can be up to 400 years.

Teacher Pachiele Cabral, the project’s mediator, explains that the team’s intention was also to value the sisal production chain. The city of Araci, where the school is located, has a high production of this plant. “The city does not develop economically in sisal, because everything is taken to industries in other cities, which then export this material and the local producers do not

get rich. So we thought about possibilities of what can be done with sisal. Only 3% of it is used for fibers, 93% is discarded and the rest serves as feed for cattle during dry periods. Why not value this part that is thrown away, without disrupting the producers' industrial chain?" she asks.

The first challenge was to produce bioplastic from sisal. Based on scientific articles reporting the plasticization of other plant species, the team conducted several tests using different parts of the plant. They discovered that it was possible to produce bioplastic by mixing the extract of sisal discarded in rural areas with some chemical products, in a cooking and stirring process. Several materials were tested in the composition of bioplastic, but the formula obtained so far was composed of distilled water, acetic acid, sodium hydroxide, and glycerin.

Eureka Moment!

Obtaining the ideal texture for the bioplastic was a challenge. In the tests reported in scientific articles, the use of cornstarch in the formula was suggested, but when mixed with sisal, the consistency did not provide the malleability, comfort, and movement needed for the gloves. One day, while making vegan cheese with sweet cassava starch at home, teacher Pachiele Cabral noticed that the ingredient provided a good consistency and decided to share the idea with her students. They replaced the cornstarch with cassava starch in the bioplastic formula and finally achieved what they wanted.

"This result excited them; it was like turning a light on there. Because it was an innovative idea, there were no ready-made methodologies in the literature for developing bioplastic from sisal, much less gloves. So, it was a practical research project, where we created it all from scratch. The students had to 'rack their brains' on the methodology and material testing, developing this investigative approach,"

she says.

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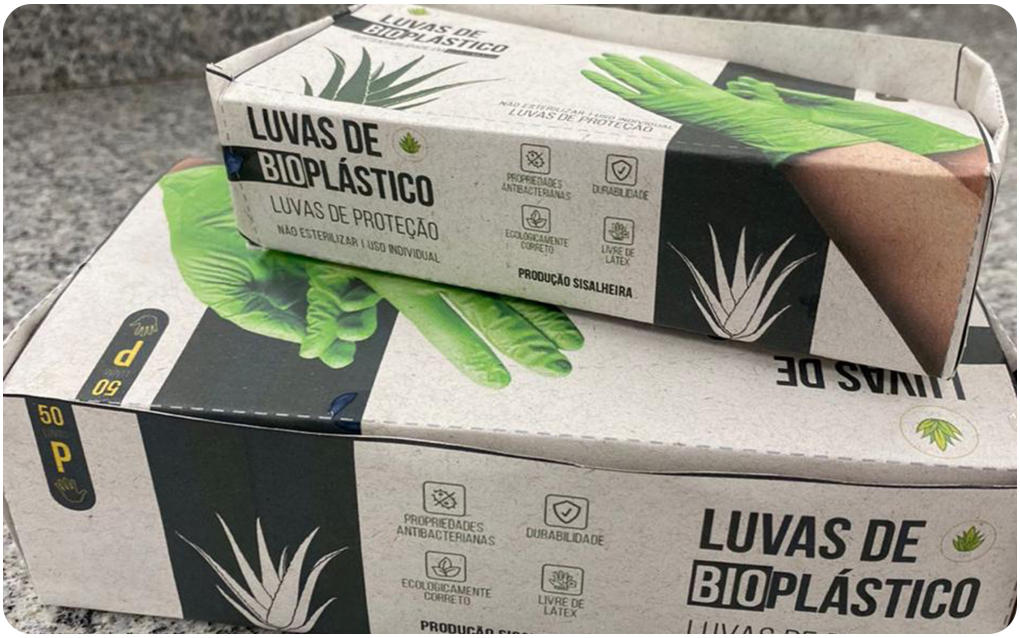
Hands-on to mold the glove

The next step was to transform the bioplastic into gloves. To do this, a hand-shaped mold was needed and it should prevent the material from sticking when unmolding. Without access to molds similar to those used by the industry – which is only manufactured outside of Brazil – the team tested plaster, metal, and plastic models, but the best result was obtained with a silicone one. “The material remains in the mold for 48 hours at room temperature. During this time, we add layers to achieve the ideal shape we want. Afterward, the gloves are waterproofed with talcum powder and sent for quality control tests”, she explains.

The students tested the glove’s traction, permeability, and biodegradability, with surprising results. The material made from sisal bioplastic can withstand heat of up to 190ºC, while latex gloves lose their properties at temperatures above 160ºC. Bioplastic is also more impermeable than latex, and it degrades quickly after disposal. “Sisal biodegrades in three to six months. However, in our tests, the gloves degraded in just one month. These discoveries were an extraordinary joy for us,” says the teacher.



Students developed the prototype and packaging, in an entrepreneurship exercise.

This year, the team is focused on evolving the prototype and conducting allergy and microbiological tests. Thanks to the visibility of the project with Solve for Tomorrow, the students were able to establish a partnership with the Federal University of Recôncavo da Bahia to conduct the tests in the second half of 2024. The National Health Surveillance Agency (Anvisa) recommends the tests so that the gloves can be used on a larger scale by health professionals.

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The students are also testing alternative materials, such as sisal residue and recycled paper, to develop boxes that can be used as packaging for the bioplastic gloves. “It’s incredible how students who were once shy and had no ideas now have their minds bubbling with new possibilities,” says Cabral.

Motivation

The student’s participation opened new doors and perspectives in life. The city of Araci does not have a developed industry or universities. The main employers are local businesses, municipal government agencies, and sisal plantations. However, the teacher believes that practical learning through science projects can change this reality.

“You have no idea of the transformative power that Solve for Tomorrow has had in our lives, in terms of giving us visibility. The city has a reality in which you don’t see many people succeeding, but you have to believe. The project was a response, to say that it wasn’t a waste of time and that it wasn’t just for a prize. The student’s performance in the classroom was exceptionally low, and after this project, they improved, the teachers called them to praise them, and the parents are immensely proud and are always participating”, she celebrates.

Thanks to the success of the bioplastic gloves, the school obtained new equipment for the laboratory. Seeing the need for investment, the state government provided a water distiller, a magnetic stirrer, and a semi-analytical balance to improve the production of the prototype. Another positive impact was the opening of borders, through awards, invitations to travel, and participation in scientific events in other states and countries.

At school, students continue on the path of science, developing new projects to solve problems they see in their daily lives. “They started to open their minds and today they are working on projects such as producing biofuel from tamarind, producing biodegradable sanitary pads using sisal, and producing insect repellents. Other students are joining the movement and are leading these projects themselves,” she says.

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Explaining!

Sisal (Agave sisalana) has long, fibrous leaves and is resistant to drier climates. Brazil is the world's leading producer of sisal, and 90% of the country's production is concentrated in Bahia, where the species is known as "green gold." The plant's value lies in its fibers, which are more resistant than those of other plants and even surpass synthetic fibers, with the advantage of being biodegradable. Sisal is used to make ropes, threads, rugs, carpets, handicrafts, and other objects. Despite this, rural workers often have a difficult routine with little financial return.

Focus on practice!

Take a look at the teacher's recommendations on how to produce gloves made from the sisal plant.

1 Empathy

During practical classes in the technical course in clinical analysis, students at CETEP Sisal II realized that disposable latex gloves generate a lot of waste but are essential to prevent biological infections. On the other hand, the large production of sisal vegetable fibers in the city of Araci only uses 3% of the plant, generating residue and adding little value for workers

2 Definition

The team thought about developing gloves that would be safe for healthcare workers and, at the same time, help reduce residue and increase the income of sisal producers. The idea came up to produce gloves with bioplastic made from discarded parts of the sisal plant.

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3 Ideation

The first challenge was to obtain the bioplastic. After much trial and error, the students arrived at the ideal mixture of sisal extract, distilled water, sweet cassava starch, acetic acid, sodium hydroxide, and glycerin. The result was a bioplastic with the ideal consistency to be transformed into gloves.

4 Prototype

The gloves were produced using silicone molds created by the team itself, after testing several materials. The bioplastic dries at room temperature for 48 hours and the silicone allows the material to be demolded without compromising the quality of the glove.

5 Test

The first quality tests indicate that the bioplastic glove is more heat-resistant and impermeable than the latex ones. Furthermore, when discarded, they decompose in one month, while conventional gloves can remain in the environment for up to 400 years. Now, the team intends to move forward with microbiological and allergy tests.