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SustainPads: Sustainable and affordable sanitary pads made from industrial by-products

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ABSTRACT

Basic sanitation is a human right and the basis for life. However, in practice, over 500 million women around the world have poor accessibility to tampons and sanitary pads during their menstrual period. It is Period Poverty. Besides this lack of access, synthetic tampons and pads have a negative impact on the planet, which is in environmental collapse. Most of these products' materials come from non-renewable sources requiring tons of liters of water to manufacture. In addition, women discard around 10,000 pads during their lives that take up to 500 years to decompose. Therefore, this research developed an affordable and ecological sanitary pad considering the sustainability tripod. First, the replacement of conventional cotton was done using the complete Factorial Design 2^2 with response surface methodology, where the variables alkali concentration and time were evaluated in the optimization of the production of absorbent materials, testing the fibers from banana pseudo-stem (BPS) *(Musa spp)* and fibers from *Juçara Açaí seeds (JAS)* (*Euterpe edulis Mart*). Afterward, to replace plastic, biofilms were developed with residues from the nutraceutical industry (RNI). Finally, the prototype was created with fabric scraps using the Upcycling concept. BPS and JAS showed absorptive capacities of 1274% and 1304%, respectively. The biofilms obtained with RNI showed an absorptive capacity of 87.3%. The final prototype was able to absorb 645%, while conventional ones 532%. Thus, the project proved to be a promising alternative to meet an urgent demand, demonstrating social, environmental, economic, and scientific relevance, meeting five of the 17 UN SDGs.

Key-words: Sanitary Pad. Accessibility. Period poverty. Industrial waste. Sustainability.

SUMMARY

1. INTRODUCTION

Menstruation is a natural process of the women's bodies that requires hygienic practices to enable them to continue with their regular activities during the period. Therefore, the United Nations (UN, 2014) has recognized menstrual hygiene as a public health and human rights issue. However, the alarming problems related to the lack of availability of period hygiene products for a large portion of the population are increasingly present. This situation, called Period Poverty, is intensified by the high price of sanitary pads, which are considered a privilege (BOROWSKI, 2011). It causes impacts that extend to several areas of women's lives, such as their physical and emotional health, education, and safety (GOLI, 2020).

Furthermore, the use of tampons and sanitary pads has also negatively influenced environmental issues. On average, women discard 10,000 sanitary pads during their lifetime. These products contain materials made from non-renewable sources - such as plastic components from petroleum – besides the presence of chemical additives, taking 100 to 500 years to decompose (STEWART et al., 2009).

Regarding plastic (material often used in tampons and sanitary pads), the problem is even more complex: in the last 65 years, there has been an increase in its production and its versatile application has outgrown any other material produced until then (GEYER, 2017). In the disposal stage, it needs to have a destination that, in most cases, is not appropriate. Society's high demand makes this issue get worse year after year. Experts have found that the number of single-use plastics is discarded at a speed that nature cannot absorb (VASCONCELOS, 2019). Despite the various applications and advantages, such as resistance and durability to degradation, when this material is in constant contact with the sun and/or over the years, it disintegrates into microparticles, which have a microscopic size and can cause numerous health problems (even though their absolute effects are not known yet) for Human Beings, soil pollution and, mainly, risks to Marine Life (GEYER, 2017). According to Vasconcelos (2019), experts are concerned about the impact of plastic on the oceans. About 8 million tons a year of this polymer reach the seas in the form of garbage.

In addition, tampons and sanitary pads end up demanding tons of liters of water to manufacture since their raw material comes from cellulose, which is among the most water-consuming industrial processes. It is estimated that for every kilogram of cotton produced, 10,000 liters of water are spent (GLOBO RURAL, 2021). That is, for each pad, 120 liters of water are spent only on cotton production.

Although there are currently more sustainable alternatives to synthetic tampons and sanitary pads, such as menstrual cups and reusable pads, they are not accessible to a large part of the population since they require greater investment when purchased (BUSSEY, 2015). Therefore, environment-friendly menstruation is still a luxury for thousands of women who quit doing their daily activities because they do not have the minimum conditions to deal with their period.

Considering these issues that are related to the sustainability tripod (environmental, economic, and social aspects), the justification of this research highlights the necessity and the importance of developing an affordable and eco-friendly pad. To provide this alternative, the use of industrial by-products is a promising option due to their low cost and the growth of waste generation during industrial processing which represents a threat to nature (SARAIVA et al., 2018).

Thus, rice husks, corn cobs, fibers from banana pseudo-stem, and Juçara Açaí seeds were the by-products chosen to replace the cotton used in sanitary pads. The pseudo-stem is a part of the banana plant (Musa sp) and looks like a trunk, consisting of a soft central core surrounded by sheaths of leaves from which the fibers are extracted (SUBAGYO and CHAFIDZ, 2018). The *Juçara Açaí* (Euterpe Edulis) is a native palm tree from the Atlantic Rainforest in Brazil. Its fruit pulp is used to make *Açaí,* and the seeds and their fibers are residues (CNCFlora, 2012). To replace the plastic, residues from the Nutraceutical and Cocoa industries were used to develop a biofilm. Hence, studying an alternative that is ecological and accessible from industrial by-products plays a fundamental role in helping the fight against menstrual poverty and in the struggle for a more sustainable society.

The study carried out in this project was based on the following problem: Is it possible to develop a sustainable alternative to tampons and sanitary pads accessible to low-income people? The general objective of this research project was to develop an ecological and low-cost alternative to current sanitary pads through industrial by-products. To achieve this, it was necessary to do the following specific objectives: i) developing absorbent materials with fibers extracted from agro-industrial residues; ii) producing biofilms; iii) analyzing the properties of biofilms and absorbent materials; iv) evaluating the performance of the prototype developed.

2. EXPERIMENTAL PROCEDURES

The methodology of this project covered applied research. The banana pseudo-stem (BPS) (Image 1), rice husks (RH) (Image 2), corn cobs (CC) (Image 3), and *Juçara Açaí seeds (JAS)* (Image 4) were collected in agro-industries of the North Coast of Rio Grande do Sul. Residues from the Nutraceutical Industry (RNI) (Image 5) were supplied by Vidora Farmacêutica Ltda. Cocoa fruit residues (CFR) (Image 6) were supplied by Cacau Show.

2.1 Development of the absorbent layer

IMAGE 1 - BANANA PSEUDO-STEM

Source: AUTHORS (2021)

IMAGE 2 – RICE RUSKS

Source: AUTHORS (2021)

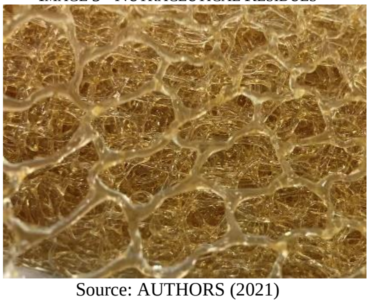
IMAGE 3 – CORN COBS

Source: AUTHORS (2021)

IMAGE 4- *JUÇARA AÇAÍ SEEDS*

Source: AUTHORS (2021)

IMAGE 5 - NUTRACEUTICAL RESIDUES



Source: AUTHORS (2021)

IMAGE 6 – COCOA FRUIT

Source: AUTHORS (2021)

The vegetable fibers from the BPS and *JAS* residues were extracted to prepare the absorbent material (Images 7 and 8). The CC and RH did not need the extraction process. All materials went through alkaline treatment with sodium hydroxide to remove hydrophobic components, such as lignin, waxes, and oils present.

The CC and RH residues were submitted to alkaline treatment according to Kenawy et al. (2021): (i) drying in an oven (80°C/24 h); (ii) immersion of the residues in an alkaline solution of NaOH 8%, 24 h; (iii) washing the residues to neutral pH; (iv) drying in an oven (80°C, 24h).

BPS and *JAS* were submitted to alkaline treatment according to Abdela (2020): (i) drying of residues in an oven (80°C; 24 h); (ii) immersion of these in an alkaline solution of NaOH varying the concentrations (Table 1); (iii) autoclaving varying the time (Table 1); (iv) washing the residues to neutral pH (Image 9); (v) drying in an oven (80°C; 24h).

IMAGE 7 – JUÇARA AÇAÍ FIBERS IN NATURA

Source: AUTHORS (2021)

IMAGE 8 – BANANA PSEUDO-STEM FIBERS IN NATURA

Source: AUTHORS (2021)

IMAGE 9 – WASHING THE RESIDUES

Source: AUTHORS (2021)

A 2^2 full factorial central composite design was used to evaluate the statistical significance of alkali concentration and treatment time on the alkaline treatment for BPS and *JAS* (NETO, SCARMINIO, AND BRUNS; 2001). The evaluated response factor (Y) was water uptake. Table 1 presents the Coded setting levels and Actual values of the experimental design. The software used to verify the model was Statistica 10.0 from Statsoft for Windows. Analysis of Variance (ANOVA) was used to assess the significance of the proposed model at 95% of reliability. The experiments were carried out in triplicate.

TABLE 1 - FACTORIAL PLANNING

Assay	Coded levels		Real levels	
	x_1*	x_2*	x_1*	x_2*
1	-1	-1	15	10
2	1	-1	45	10
3	-1	1	15	24
4	1	1	45	24
5	0	0	30	17
6	0	0	30	17
7	0	0	30	17
8	-1,41	0	5	17
9	0	-1,41	30	7
10	1,41	0	50	17
11	0	1,41	30	27

x_1* = time of treatment [min]; x_2* = Alkali concentration, NaOH [%]
Source: AUTHORS (2021).

One-way ANOVA was used to assess absorptive capacities. The Tukey test was used to identify which residue showed a significant difference in absorption capacity (MONTGOMERY, 2008).

2.2 Preparation of biofilms

The CFRs were initially ground to form cocoa mesocarp flour (CMF) (Image 10) using the methodology adapted from Nascimento et al. (2012). The steps were followed: (i) selection of the residues; (ii) washing of the residues in running water; (iii) cutting the mesocarp into smaller pieces; (iv) immersion of the residues in an aqueous solution with 200 ppm of sodium hypochlorite for 15 minutes; (v) rinsing; (vi) drying in an oven at 40 Celsius degrees Model Luca-80/64, Lucadema, Brazil until constant weight; (vii) grinding in a bench mill.

The casting technique was used to produce the biofilms. The solutes (residues) were dissolved in the solvent (water) and the solution was heated to 85°C, at 150 rpm on a magnetic stirrer for gelatinization of the solutes and evaporation of the solvent, giving rise to a polymeric matrix (MALI; GROSSMANN; YAMASHITA, 2010). After the solution was poured into Petri dishes and oven-dried at 35°C. In preparing the systematization of the preliminary tests, the quantities described in Table 2 were used.

IMAGE 10: COCOA MESOCARP FLOUR UNSIFTED AND SIFTED, RESPECTIVELY

Source: Authors, 2021

TABLE 2: PRELIMINARY TESTS

	Concentrations [%]		
Inputs	CMF unsifted	CMF sifted	NIR
Assay 1	4	-	26
Assay 2	-	4	26
Assay 3	-	2	27,5
Assay 4	-	8	-
Assay 5	-	-	13
Assay 6	-	-	23
Assay 7	-	-	26

CMF = cocoa mesocarp flour; NIR = residue from the nutraceutical industry
Source: AUTHORS (2021)

2.3 Characterization of materials

The absorption capacity of the absorbent materials was tested using the *in natura* and treated fibers. 1g of the material was immersed in 200mL of water for 20s. Afterward, the material was weighed, and the percentage of absorption was calculated according to IS 5405:1980 for sanitary pads and diapers (PMSN, 2020).

Biofilms were analyzed in triplicate to know their characteristics:

1) Thickness: a digital micrometer (Mitutoyo Corp. Tokyo, Japan; Model MDC-25) was used with a precision of 0.001mm and a resolution of 0 to 25 mm.

2) Humidity: it was determined by the gravimetric method (AOAC, 2005).

3) Biodegradability: the biofilms were buried in the soil for 16 days and exposed to the microorganisms present in it. Every 2 days, 20mL of water was added to maintain moisture (STOLL, 2015).

4) Water absorption capacity (Swelling): the samples were weighed and immersed in water where they remained for 2 min. Afterward, the film strips were placed on filter paper, to remove excess water, and weighed. The weight difference percentage was calculated (IAHNKE, 2015).

5) Mechanical Properties: From the thickness data of each strip, the mechanical properties of tensile strength [MPa], elongation at break [%], and Young's modulus [MPa] were determined using a Texture Analyser (TA.XT2i and Stable Micro Systems, UK), according to the American Society for Testing and Materials standard D882-12 (ASTM, 2012).

3. Results

3.1 Development of absorbent materials

To extract the fibers from the BPS, the material was cut into strips and pressed using the weight of the wheels of a car. The *JAS* fibers were manually extracted (QUIRINO, 2017) (Image 11). CC and RH did not have to go through such a process. The results of the absorption tests can be seen in Table 3.

Image 11 - Process of extraction of vegetable fibers

[SEQUENCE 1] – BPS fiber extraction;
[SEQUENCE 2] – *JAS* fiber extraction de.
Source: AUTHORS (2021)

Table 3: Results of absorption tests

Fiber tests	Absorption (%)
Pseudo-stem Fiber (*in natura*)	826,85
Pseudo-stem Fiber (treated)	1349,10
Juçara Fiber (in natura)	695,76
Juçara Fiber (treated)	1327,88
Rice husk (in natura)	364,11
Rice husk (treated)	535,09
Corn cob (in natura)	261,27
Corn cob (treated)	256,00

Source: AUTHORS (2021)

The CC and RH did not show promising absorption capacities, being below 500%, and therefore were discarded from the other processes. This fact can be attributed to the hydrophobic compounds present in greater quantities in these materials when compared to BPS and *JAS* (FERREIRA, MACHADO, ADEMAR, 2020; FILHO, 2021).

The 2^2 Factorial Design with Response Surface methodology and the one-way ANOVA showed promising results (Table 4). The superscript letters demonstrate the trials that statistically presented similar (same letter) and different behaviors. In the Image 12, it is possible to observe the difference between the BPS and *JAS* fibers. Its softness, after chemical treatment, is similar to commercially sold cotton.

Table 4: Results of absorption analysis

Assay	Absorption [%]	
	y_1*	y_2*
1	$1038,46 \pm 78,45^a$	$1113,28 \pm 31,15^a$
2	$1076,26 \pm 68,23^a$	$1316,00 \pm 66,29^b$
3	$1141,33 \pm 80,95^a$	$1223,23 \pm 117,06^a$
4	$1162,67 \pm 43,37^b$	$1377,59 \pm 32,74^b$
5	$1285,38 \pm 75,50^b$	$1293,85 \pm 70,86^b$
6	$1193,33 \pm 63,86^b$	$1310,67 \pm 23,63^b$
7	$1252,87 \pm 66,39^b$	$1299,49 \pm 74,52^b$
8	$1274,00 \pm 2,00^b$	$1224,00 \pm 52,65^a$
9	$1011,38 \pm 51,48^a$	$1304,00 \pm 42,83^b$
10	$1072,97 \pm 39,79^a$	$1176,92 \pm 58,16^a$
11	$1133,33 \pm 31,72^a$	$1155,13 \pm 25,38^a$

y_1* = absorption of pseudo-stem fibers [%]; y_2* = absorption of *juçara* fibers [%].
Source: AUTHORS (2021)

Image 12 – Fibers from pseudo-stem and Juçara *açaí* before and after alkaline treatment

[A] – in natura pseudo-stem fiber; [B] – treated pseudo-stem fiber (40% NaOH, 40min autoclaving).
[C] – in natura *juçara* fiber*;* [D]- treated *juçara* fiber (40% NaOH, 40min autoclaving)
Source: AUTHORS (2021)

Equation 1 for the BPS residue shows that when the treatment time is reduced and a lower concentration is used, a material with greater absorption is obtained. These results are in line with ANOVA, which showed that test number 8 (time of 5 min. and concentration of 17%) is more economical because it requires less production time.

$$Y = 1243{,}9 - 28{,}1x_1 - 39{,}8x_1^2 + 45{,}3x_2 - 90{,}7x_2^2 \qquad \text{Equation 1}$$

Referring to *JAS* fibers (where the interaction between the parameters was also significant), using smaller amounts of alkali and process times between 17 and 30 minutes, the best uptaking capacities were obtained. Equation 2 describes this behavior. This is also in line with the one-way ANOVA, showing that Assay 9 is the most suitable (30 min time and 7% concentration).

$$Y = 1301{,}1 - 36{,}44x_1 - 39{,}83x_1^2 + 4{,}81x_2 - 25{,}2x_2^2 \qquad \text{Equation 2}$$

3.2 Preparation of biofilms

The production of biofilms was performed according to Table 2. Table 5 shows the properties of the biofilms developed, and in test 4 there was no formation of biofilms.

TABLE 5: PROPERTIES OF BIOFILMS

Assay	Average thickness [mm]	Humidity (%)	Average absorption (%)	Traction resistance (Mpa)	Elongation at break (%)	MY [Mpa]
Assay 1	0,711 ± 0,148	29,99 ± 0,24	49,86 ± 2,19	0,8 ± 0,05	30,71 ± 1,14	8,24 ± 0,8
Assay 2	0,651 ± 0,136	12,74 ± 0,23	47,05 ± 5,53	x	x	x
Assay 3	0,758 ± 0,110	13,81 + 0,88	52,82 + 13,91	x	x	x
Assay 5	0,300 ± 0,079	14,59 ± 0,69	87,3 ± 15,21	x	x	x
Assay 6	0,514 ± 0.174	13,54 ± 0,16	45,29 ± 8,38	0,86 ± 0,09	106,9 ± 7,93	3,23 ± 0,36
Assay 7	0,560 ± 0,133	13,31 ± 0,23	43,52 ± 6,22	1,82 ± 0,36	232,48 ± 19,56	2,82 ± 0,35

x = films that didn't make it through assay
Source: AUTHORS (2021)

Biofilms using CMF showed intermediate absorptive capacities. In addition, the biofilms proved to be fragile and non-homogeneous. Thus, the best results were obtained using the nutraceutical residues (Image 13).

IMAGE 13: ASSAY 7 BIOFILM

Source: Authors, 2021

The average thickness of all films obtained in the tests was less than 1 mm, all following the D882 standard (ASTM, 2012). The results obtained in the moisture tests showed an average of 16.33%, being like those found by Silva (2011), providing adequate properties to the final product. Considering the application of biofilms, the best result for the lower layer was the one obtained in Test 7 (43.52%), as it had greater impermeability. On the other hand, the upper biofilm layer requires that the absorptive capacity be greater so that when the fluid meets the biofilm, it can be absorbed instantly. Thus, the best result was obtained in Trial 5 (87.3%).

The biodegradability results were promising, with an average of 49.92%, especially when compared to conventional plastics used in commercialized tampons and sanitary pads, which take 100 to 500 years to decompose (STEWART et al., 2009).

Regarding the mechanical properties, the best results of tensile strength [1.82 + 0.36 (Mpa)], elongation at break [232.48 + 19.56 (%)], Young's modulus [2.82 + 0.35 (Mpa)] were obtained with Assay 7. This is the most promising biofilm, as it has the smallest Young's modulus, therefore being the least rigid; and the best tensile strength and elongation results, demonstrating the flexibility and elasticity necessary for the prototype.

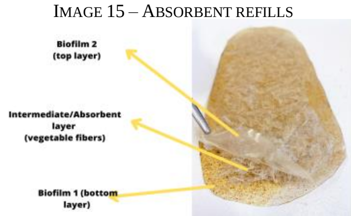
3.3 Absorbent prototype

Using fabric scraps made available by seamstresses in the region, the tissue casing to wrap the absorbent refill was developed (Image 14). 13 different types of fabrics were tested, with Viscolycra having the best and fastest absorption. Inside this casing is the absorbent refill (Image 15), composed of the union of plant fibers with biofilms. The final prototype can be seen in Images 16 and 17.

IMAGE 14 – CONFECTION OF THE CASING

Source: AUTHORS (2021)

IMAGE 15 – ABSORBENT REFILLS

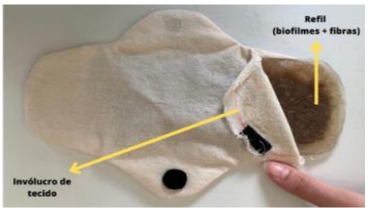


Source: AUTHORS (2021)

IMAGE 16 – REFILL + CASING

Source: AUTHORS (2021)

IMAGE 17 – PROTOTYPE OF SANITARY PAD AND ITS LAYERS:



Source: AUTHORS (2021)

In this way, the concept of Upcycling was used, which consists of using raw materials for transformation into new materials in a sustainable way (VIANA, 2021). The reuse of materials is essential, given the economic aspect. The “up” means that there is an improvement in the product, and the “cycling” refers to the cyclical use of materials. This initiative contributes to the Circular Economy being more present in society and production chains.

The sanitary pad production cost was calculated using the absorption costing method, based on the central point of the factorial planning of both fibers (17% of alkali concentration and 30min of time in the autoclave), while the selling price was calculated using the Markup method (MENDES, 2009) with a 4.5% increase in taxes and a 20% profit margin. The sale price established was R$ 0.02.

4. CONCLUSIONS AND/OR RECOMMENDATIONS

Through this research, it was possible to develop a product that contributes to a more circular society based on the sustainability tripod. In the social sphere, it has allowed access to an alternative sanitary pad for a greater number of women affected by the lack of these essential resources, promoting equality among all. In the economic sphere, it proposed the use of products that are discarded by industries, providing the appreciation of the circular economy and cleaner production in industries through the full use of manufactured products; hence, the cost of the product decreases and can also be seen as an alternative to the conventional ones. Finally, in terms of the environment, this research encourages the rational use of resources already used by industries, prioritizing the full use of inputs. Therefore, it is possible to promote a lower environmental impact by providing a new look at the production of raw materials that use a large amount of water, favoring conscious use throughout the production chain.

The results achieved so far have been promising. It has been possible to obtain, through vegetable fibers, absorbent materials to replace conventional cotton. Also, using residues of cocoa and the nutraceutical industry, biofilms were obtained to replace the plastic layer. The wrapper that surrounds the two layers mentioned above was made from fabric scraps. The cost of the product was R$ 0.02, being 95% more economically advantageous than conventional ones and, consequently, it is accessible to women in situations of vulnerability. Regarding the consumption of water, the pad developed uses 99,7% less water in the production process of the absorbent material than the commercial tampons and sanitary pads.

Therefore, the present research has environmental, social, economic, and scientific relevance since it provides an alternative to tampons and sanitary pads. The alternative is capable of reducing the pollution of water resources due to incorrect disposal of non-biodegradable absorbents and the materials discarded by industries. Thus, the research contributes to the Circular Economy. The project meets five of the 17 Sustainable Development Goals created by the UN (United Nations), which consist of ensuring health and well-being (number 3) - 3.8: “Achieve universal health coverage, including financial risk protection, access to quality essential health-care services […]”; gender equality (number 5) - 5.6 “Ensure universal access to sexual and reproductive health and reproductive rights [...]”; sustainable management of water and sanitation (number 6) - 6.2 “By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations”; reducing inequalities (number 10) - 10.3 “Ensure equal opportunity and reduce inequalities of outcome [...]” and ensuring consumption and production responsible (number 12) - 12.2 “By 2030, achieve the sustainable management and efficient use of natural resources”; 12.5 “By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse”; 12.7 “Promote public procurement practices that are sustainable, in accordance with national policies and priorities.

In the next steps, analyzes of the functionality of the prototype and a technological extension will be carried out to apply the product in the community. The technological extension aims to unite the project with what has been happening in the city of Osório, where the city hall is acting to fight against Period Poverty through a fundraising campaign and donation of hygienic materials. The proposal of a women's cooperative was then conceived so that it will be possible to replicate the production of ecological and low-cost sanitary pads, providing the generation of income, jobs, and, above all, the women’s belonging within the community.

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ANNEX A. QUESTIONS ABOUT THE PROJECT

1. **What are the major contributions expected with the implementation of this project in view of society, the economy, the environment and especially, water resources?**

The first contribution of this project is to the Period Poverty issue: the product costs only R$ 0.02, being 95% cheaper than disposable pads. Furthermore, the use of industrial by-products contributes to a nobler destination for these residues, avoiding their exacerbated disposal and consequent environmental wear. Hence, the solution presents itself as an alternative to current synthetic tampons and sanitary pads, which have a large part of their material from non-renewable sources and high consumption of water in production processes. These products can still end up in oceans and beaches, harming the ecosystem present there. It is in this matter that we highlight the great differential of our proposal: we have developed a product that, in addition to being accessible to consumers (a basic and essential right), is ecological (spending 99,7% less water in the development of the absorbent materials) and contributes to the concept of Circular Economy.

2. **What is the innovation being proposed? How does it relate to existing solutions?**

The importance of this product is related to providing greater accessibility to sanitary pads and at the same time contributing to the environmental issue. Disposable tampons and sanitary pads commercialized today have a huge environmental impact due to their plastic components and chemical additives. The cotton itself is an expensive and polluting product, given the high use of water and pesticides in its plantation. In this way, the research uses materials that would previously be discarded, thus contributing to a better destination for these residues. Currently, there are ecological alternatives, but these are not affordable. This situation makes clear the fact that ecologically correct menstruation is still a luxury for thousands of women who do not even have access to basic hygiene materials. Therefore, the innovative potential lies in the democratization of access to ecologically correct menstruation through a sustainable product that uses industrial by-products.

3. **For which region or situation does the project apply? Can it be replicated? Does it serve to in developing and developed countries?**

To make our product truly opportunistic for women and to make our contribution to the fight against Menstrual Poverty, we have idealized its application in our community through the creation of a women's cooperative, to democratize the access to this knowledge that we have developed and provide the generation of jobs, sustainable entrepreneurship, and their belonging within the community. We believe that this application is possible since our absorbent has replicability, as we have carried out analyzes with tests in duplicate or triplicate since July 1, 2021, going to the laboratory every day. More than 100 tests were carried out until we reached our best results, which were replicated through factorial planning. The production process is relatively simple, carried out until now on a laboratory scale, and we believe that it will be easier when scaled to an organization such as a cooperative.

4. What is the cost of implementing the project?

An enterprise has an important role, as it stimulates economic development, job creation, and wealth production, as an important source of innovation in societies (HENRIQUES, 2014). According to Enio Pinto:

> *"Entrepreneurship is anything that generates wealth for society, but you decide what wealth is. It could be employment, quality of life, GDP growth, or getting kids off the streets.”* (SANTOS, s.d.).

Observing such concepts, coupled with the fact that Laura takes the Technical Course in Administration Integrated to the EM and learned this in class. The idea of creating an enterprise came up: a cooperative for women to produce sanitary pads. The cost of implementing the project, regarding the constitution of the physical infrastructure of the cooperative, is approximately R$ 5,000.00. We will also need a minimum of 20 people for the development.

5. What would be or were the biggest difficulties for the development and implementation of the project?

At the beginning of the project's development, it was very difficult to find the correct process for extracting vegetable fibers, mainly because our school did not have the equipment for this, such as a press. Given this, we improvised the process using the weight of a car, passing it over the materials for pressing and subsequent extraction of the fibers. Although it was a great difficulty at the beginning, it was also a learning process, reinforcing the importance of persistence and teamwork. Our biggest challenge today is to implement our product through a women's cooperative in our community. To this end, we have already contacted the city hall of our city, where the first lady has shown full support for the initiative.

6. Which Sustainable Development Goal (SDG) and targets do your work most relate to?

The project contributes to five of the 17 Sustainable Development Goals (SDGs) created by the UN (United Nations). They are (UN, n.d):

- N°3: “Ensure healthy lives and promote well-being for all, at all ages.
- N°5 “Achieve gender equality and empower all women and girls”
- N°6: “Ensuring the availability and sustainable management of water and sanitation for all”
- N° 10: “Reducing inequality within and among countries”
- N°12: “Ensure sustainable consumption and production patterns.”.

7. What moved you to choose this theme?

It all started when, in a conversation, Camily discovered that her mother didn't have access to tampons and sanitary pads when she was younger. This was the first time that Camily had faced the issue of Period Poverty. It was then that she questioned whether it would be possible to have a sanitary pad that, in addition to being ecological, is accessible to women in vulnerable situations. She saw, through science, the opportunity to seek a solution to this problem. So, she invited Professor Flávia to be her advisor. At that moment, Laura joined the team, considering that it was already developing a project on the elaboration of biofilms using industrial waste in 2020. In this way, Laura could contribute with some knowledge (about the production of biofilms) and unite to provide a solution to such a recurring and serious problem that plagues thousands of women in society.