SustainaBug Project

Sustainable protein bar

Team: Bugs in My Plate

May 2022

DEMOLA
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I N D E X

From Ego to Eco, one bug at a time

Introduction

It is predicted that by 2050, the world population will reach 9,7 billion people. The pressures placed on the planet will be equally high, in the sense of generating enough resources to maintain it. The typical western food pattern, based on animal protein suppliers (cow, pork, chicken, turkey, fish, rabbit), will be one of the biggest sources of pressure. [1.2]

A possible solution, inspired by oriental food patterns, is the inclusion of insects.

Among the species authorized by the EU for human consumption are: *Acheta Domesticus, Alphitobius Diaperinus, Apis Melífera, Gryllodes Sigilatus, Locusta Migratory and Tenebrio Molitor*[3].

The advantages of insect production and consumption include: the reduced use of space per farm; ration based on agricultural surpluses or the activity of the hotel sector; production units that can be integrated in urban or remote areas and with few resources; relevant supplier of problem nutrients (iron, vitamin B12, calcium, full spectrum essential aa, n-3 fatty acids and fiber); 80% less production of methane than the bovine equivalent; lower susceptibility to diseases and risk of spreading zoonoses to human counterparts; 1/3 of the cattle's water consumption and 1/5 of the feed consumption vs. goats/sheep/pigs to produce the same amount of protein[4].

For all these reasons, this working group sees in crickets a viable and responsible answer to the dilemma that humanity will soon face.

Thus, it is intended to know the readiness of the market for the integration of these suppliers of 68g of protein per 100g of edible portion in their diet.

Entomophagy stands as the technical term for eating insects, which is not a new concept. Humans have harvested the eggs, larvae, pupae, and adults of certain insect species from forests or other suitable habitats to eat for thousands of years. Globalization has enabled us to experience other countries cooking habits. And Europe is currently importing ideas from Asian Countries such adding bugs to the menu.

From crickets to grasshoppers, from larvae to termites, they can all be the key to help reach several sustainable development goals until 2030, as proposed by the UN (United Nations, 2015):

#13 - climate action;

#2 - zero hunger;

#3 - good health and well-being;

#12 - responsible consumption and production.

In an attempt to find solutions to the environmental impact of food production, this project is focused on answering the question “how to induce a paradigm shift regarding insects as food?”. During the research for this report, we reached a few conclusions that helped shape our views on the whole area.

The “yuck factor” is still very present in western cultures as eating bugs is associated with poverty and lack of eating alternatives, as well as with unsanitary conditions.

A fine example of a food that has undergone similar prejudice was the lobster (labelled as the cockroaches of the ocean), which were fed to prisoners as a form of punishment, and today it is seen as an exquisite and gourmet plate. We believe insects could have a similar trajectory in the long run.

Thus, under the attentive orientation of two facilitator-teachers and an industry partner, during the last 7 months a team of 6 students was gathered with the aim of finding a way integrate bugs into the European eating habits.

Bugs in my plate is also a joint project with the Kajaani University of Applied Sciences that used the Demola methodology to reach attainable conclusions through question exploration and possible scenarios.

This workgroup believes insects can be both the key for todays and tomorrow’s agendas such as climate change, world hunger, food innovation, health, and well-being.

Thus, the project became a callout to the pioneers, to the open-minded, to the ones who want to be part of the change, to the ones who want to reduce their carbon footprint and understand that it needs to happen now.

The general goal of the Bugs in My Plate project pertains to promote the inclusion of insects into the human diet. Specifically, we proposed:

1. Writing a report that gathers the most up to date content on entomophagy;
2. Creating a population educational tool on this new eating pattern;
3. Developing new foods containing insects that have a wide market acceptance.

Market Analysis

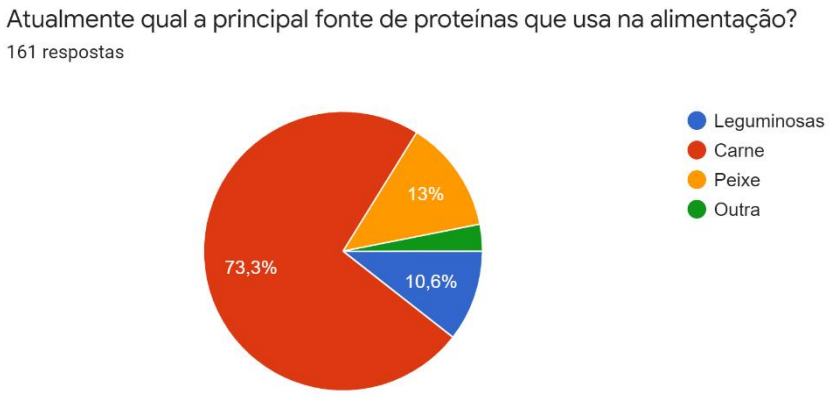
After carrying out several interviews to various stakeholders in the field, we concluded that the general public do not view insects as a feasible/pleasurable food source in their daily meals.
In order to run a simple market study around this new food source, the team developed 2 online questionnaires using the Google Forms® tool. These inquiries were applied to the academic population. For the first questionnaire there was an n=161 and the second one an n=122.
As a result, we found that:

- 63,2 % of the respondents is aware of the ecological footprint of their food choices;
- 66,1 % admits having a high or very high level of repulse around the thought of including bugs in their eating pattern;
- 84,5% recognizes being informed of the environmental impact of the cattle industry;
- **95,4% reveals being willing to change their diet in order to help reduce its impact on the planet;**
- 84,2% demonstrates being willing to switch their protein source according to its nutritional yield;
- 78,0% shared having preference for the adult insect vs. the larvae (2nd inquiry);
- 81,9% da of the 2nd sample indicates preferring snacks such as bar or cookies to start their introduction to entomophagy.

Unfortunately, half of the respondents seem to not be prepared for this bold experience. We also found that about 2/3 of respondents would be more interested in consuming the insects in processed products where they do not be visible, and willing to repeat the experience of consuming insects if the products look good and is appetizing.
Also, we asked the same audience if their feeling towards trying this new food source would change if they were told an insect-based diet was as rich or richer than a meat-based diet: about half of the enquired answered with only 20% inclined to switch.

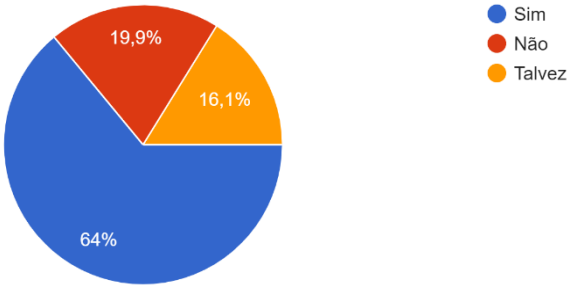
A - First batch surveys

1. Currently, what is the main source of protein of your diet?



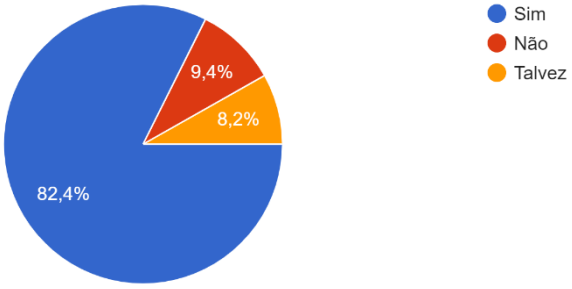
2. Do you know the ecological footprint of said protein source?

Conhece a pegada ecológica deixada pela utilização dessa fonte de proteínas?
161 respostas



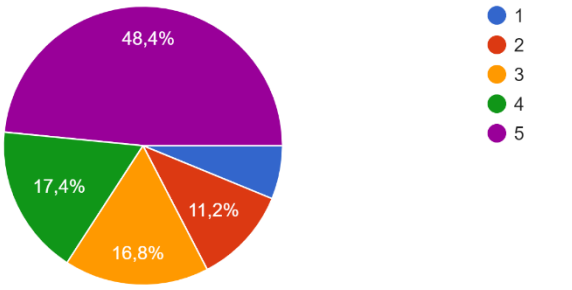
3. Have you ever considered alternatives to said protein source?

Já pensou se existem alternativas viáveis à sua fonte de proteínas?
159 respostas



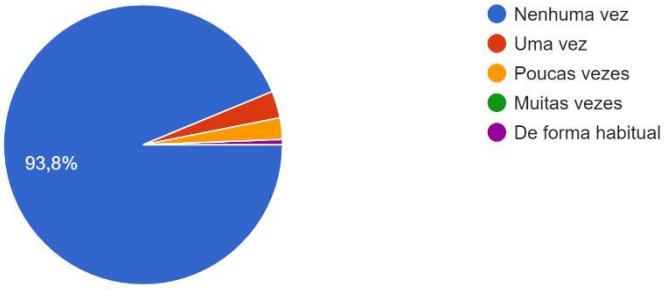
4. One of the alternative sources of protein are insects. On a scale of 1 to 5, what is your willingness to consuming insects: where 1 is no disgust and 5 is very disgusting.

Uma das alternativas a fonte de proteínas é a utilização de insetos. Numa escala de 1 a 5, que grau de repugnância teria ao consumo de insetos, em q... nenhuma repugnância e o 5 a muita repugnância.
161 respostas



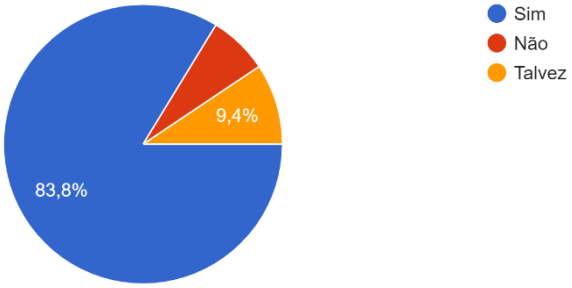
5. Have you ever used insects in your diet?

Já alguma vez utilizou insetos na sua alimentação?
161 respostas



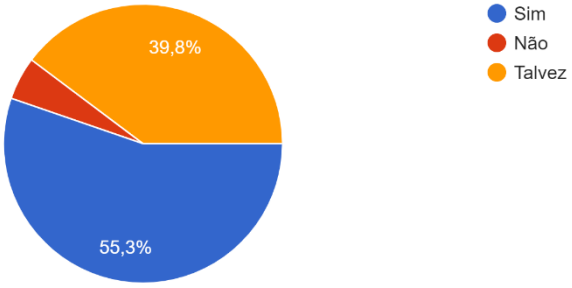
6. Do you know the environmental consequences for the environment of raising cows for meat production?

Conhece as consequências para o ambiente da criação de vacas para produção de carne?
160 respostas



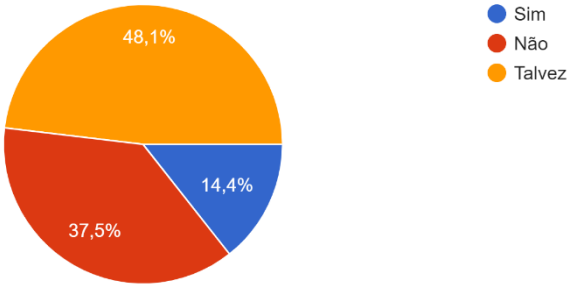
7. Considering the various problems caused by the emission of greenhouse gases in raising livestock for meat production, would you consider changing your diet?

Tendo em conta os vários problemas causados pela emissão de gases de efeito de estufa na criação de gado para a produção de carne seria c...cológica provocada pelo seu tipo de alimentação.
161 respostas



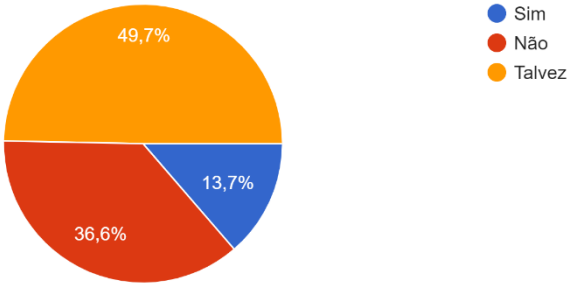
8. Knowing that the environmental impact of raising insects is significantly lower than the one of raising other kinds of cattle, would you be willing to switch your diet to benefit the environment?

Sabendo que o impacto ambiental provocado pela criação de insetos é significativamente inferior que o impacto provocado pela criação de outros ti...teica para insetos se isso benefiasse o ambiente?
160 respostas



9. If you were told that an insect-based diet was as nutritionally rich or richer than a meat-and-fish diet, would you be willing to switch?

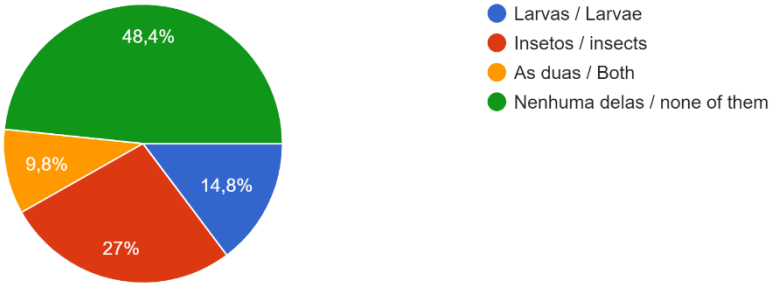
Se o informassem que uma alimentação baseada em insetos era tão ou mais rica que uma alimentação baseada em carne e peixe e mais barata seria capaz de trocar?
161 respostas



B - Second batch surveys

1. Considering the availability of adult insects or larvae, what would your preference be?

Supondo que os insetos estavam disponíveis na forma de insetos adultos ou na sua forma de larva. Qual a sua preferência? Assumi...nsects or in their larvae form. What is your preference?
122 respostas

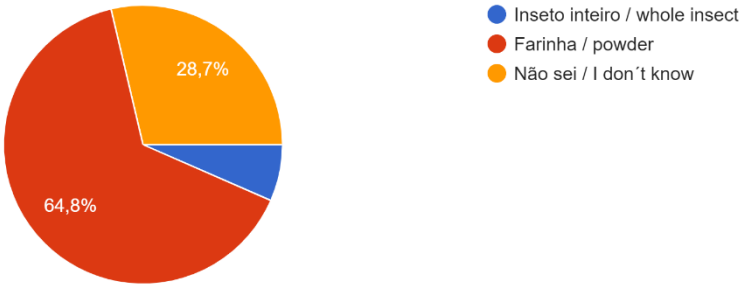


2. Assuming insects are available in their whole form or in powder, what would be your

preference?

Supondo que os insetos/larvas estão disponíveis na forma de inseto/larva ou na forma de farinha. Qual a sua preferência? Assuming the insec...a form or in powder form. What is your preference?

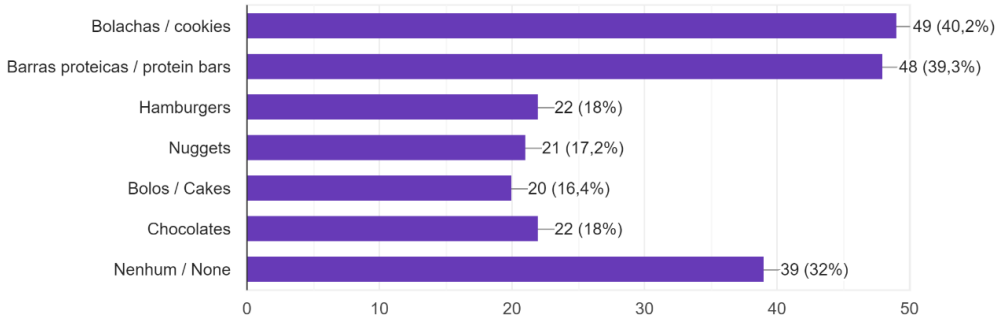
122 respostas



3. Assuming your going to your weekly supermarket visit and find several products containing insect flour, what would you prefer?

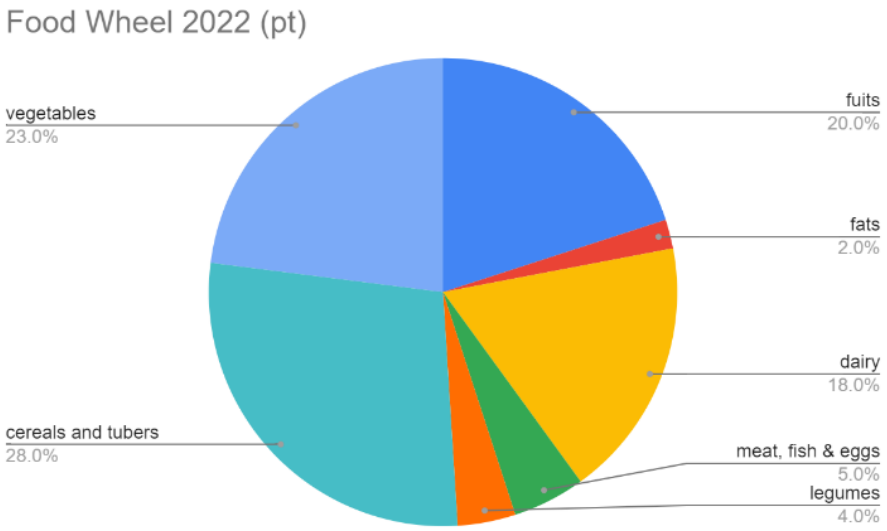
Supondo que existem produtos disponíveis nos supermercados, fabricados com base na farinha de insetos, qual a sua preferência? Assuming ...made from insect flour, what is your preference(s)?

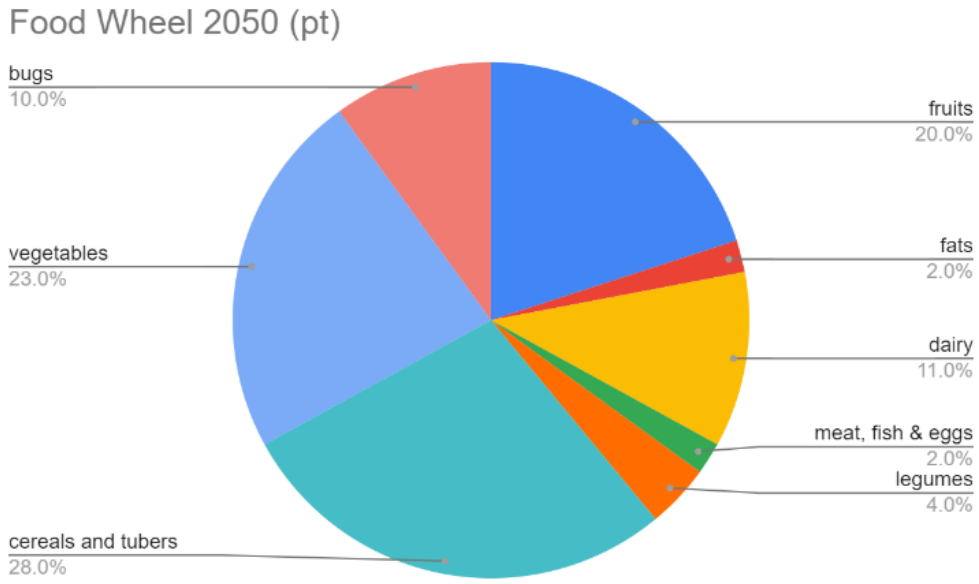
122 respostas



Prototype #1 - 2050's Food Wheel

We designed a food wheel for the year 2050, based on the current tool "The New Food Wheel"[5], on which the "meat, fish and eggs" and "dairy" sectors were reduced by 10%. 7% respectively), due to the new sector dedicated to insects.





Prototype #2 - SustainaBug protein bar

1. Product Development

As with food diversification in pediatric age, it was preferred to opt for an approach of gradual inclusion of this new food, thus reducing the repulsion factor.
Thus, we developed a snack in which the animal could not be distinguished from the rest of the food matrix, and which organoleptic characteristics were widely accepted.
Therefore, priority was given to locally produced ingredients to create the SustainaBug bar, reaching a recipe that provides: 21g of protein, 9g of fat, 21g of carbohydrates, 15g of Fiber/unit - values calculated by estimate, using the Food Composition Table.[6]
The SustainaBug brand name is the result of conjunction of the words: sustainability and bugs.
Thus, the **SustainaBug** bar was born, with 21 grams of sustainable protein from both lupin beans and cricket powder. Striving to gather ingredients harvested locally we opted for figs instead of Medjool dates, sunflower paste instead of coconut oil, and oatmeal instead of quinoa or across-the-Atlantic cereals.

SustainaBug - a high-protein snack

In an attempt to follow market trends in search of more sustainable and planet-friendly food sources, our team set out to change the perception that insects are associated with unhealthy environments. Thus, the SustainaBug bar was born.
This new food source (21g/unit) is the 1st snack of its kind on the Portuguese market, and we hope it can help reduce the damage created by the livestock industry. A source of vitamin B12, iron, and calcium, high in fiber (1/4 of the recommended daily intake), low in saturated fat, and providing the full spectrum of essential amino acids. For an ideal on-the-go consumption, suitable for the lifestyle of the active and eco-conscious young adult.
From its recipe to the wrapper, the SustainaBug bar prioritizes commodities with a low environmental impact by choosing locally produced ingredients, a kraft paper package coated with beeswax, as well as a monochromatic and inclusive design, focusing on the minimum use of resources along the entire production chain.

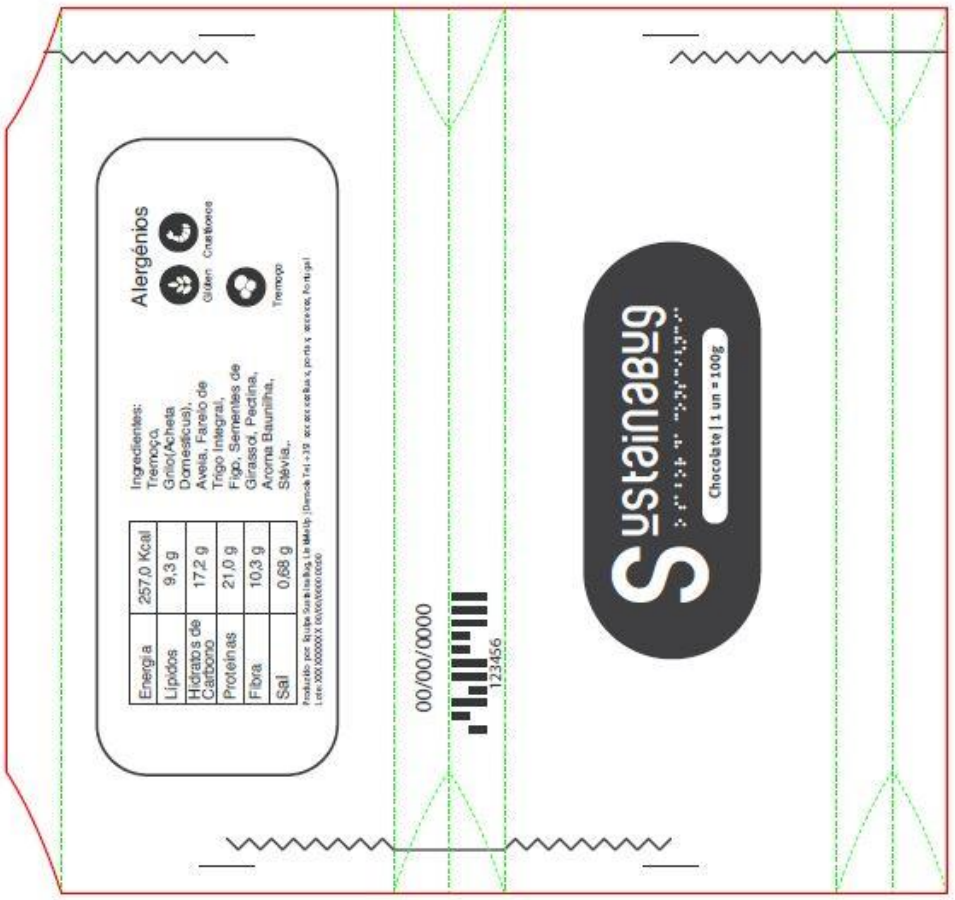
2. Marketing Plan

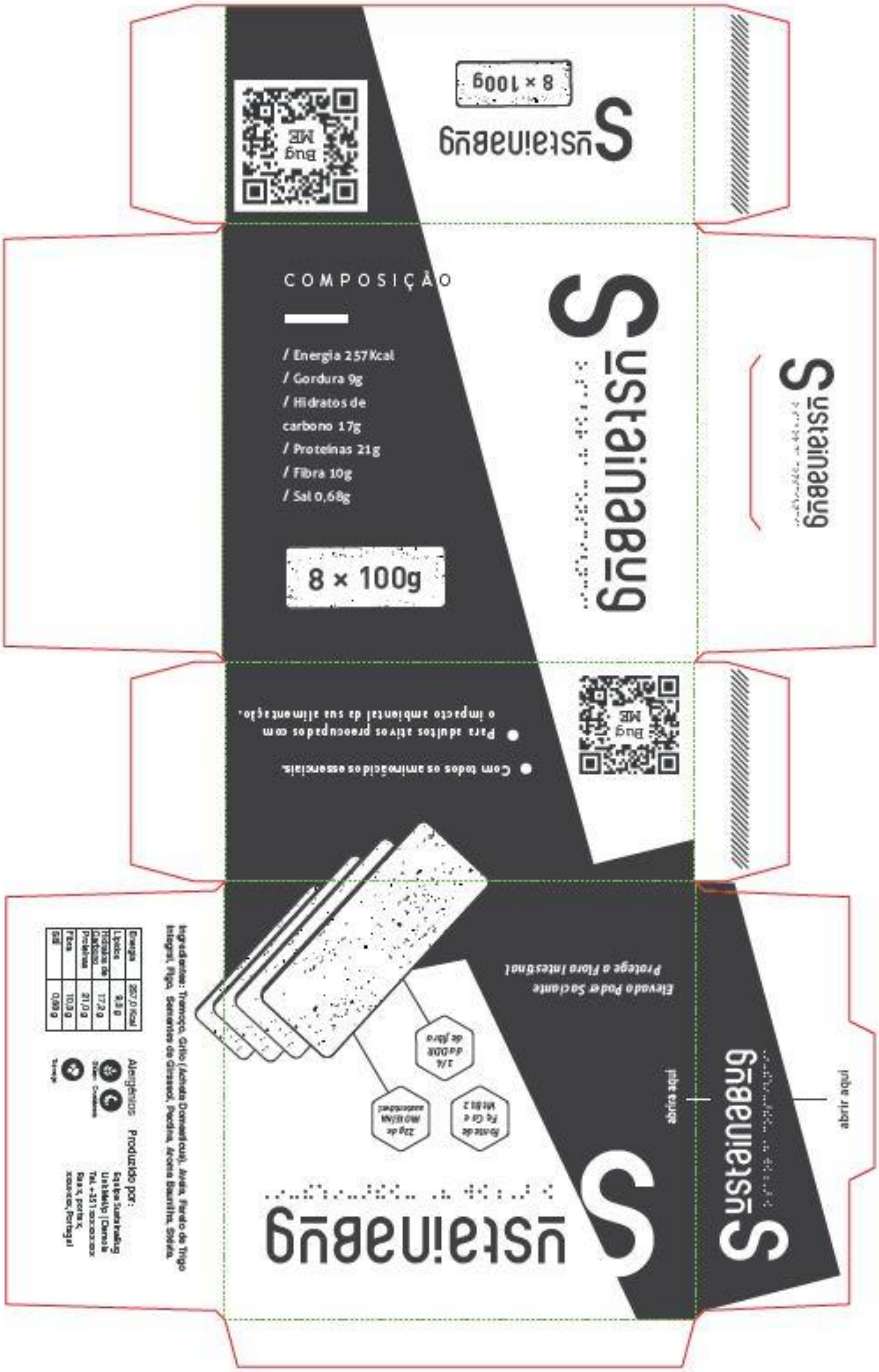
From the data collected through the surveys, we concluded there was a clear potential around this market, as the younger audience is more eager to try and broaden their horizons, as well as willing to train their tastebuds.
This movement could lead a food revolution that would widely accept insects as alternatives to our regular eating habits. In addition to this, we feel the need of normalizing insect-based products and we tried to do so by creating a promotional video advertising our protein bars, eating them casually after a cardio session in the wilderness. Our goal was to vulgarize their consumption so people could see it's not a big shock to eat these products. The forest impact allows us to accommodate the "environmental-friendly" and healthy lifestyle of the runner,

associating our brand with good practices in that regard.

As with all products that have a final sale destination, it is essential that it be promoted to make it known. Social media would be the first marketing outlet, collaborating with influencers, as most of the young adults populate social networks, we aim to make a call out to the importance of insect consumption *in lieu* of other protein sources.

Packaging was also developed considering the least environmental impact.




Sustainabug
8 × 100g
COMPOSIÇÃO
/ Energia 257Kcal
/ Gordura 9g
/ Hidratos de carbono 17g
/ Proteínas 21g
/ Fibra 10g
/ Sal 0,68g
8 × 100g
Sustainabug
Com todos os aminoácidos essenciais.
Para adultos ativos preocupados com o impacto ambiental da sua alimentação.
Elevado Poder Saciante
Protege a Flora Intestinal
abrir aqui
abrir aqui

3. Technological study

Animal well-being is considered to be high for industrial insect amounts of space, meaning that industrial farming schemes that raise large amounts of insects in small spaces are close to their natural conditions and thus, the micro livestock is not stressed from overcrowding. Furthermore, when living conditions are sanitary, industrial insect farming does not have an additional risk of disease beyond what is normally present for the respective species. In this way, by mimicking natural conditions, insect species do not require feed additives or medicines to prevent health consequences from their living conditions as do most traditional livestock breeds, which create a significant risk of contamination and animal stress.

Also, the most widespread industrial method of harvesting insect species is by chilling them to freezing temperatures. This process causes the insects to enter a coma-like state known as *diapause*. 6 weeks after hatching, they get to an extended period of being frozen, which varies by species but is generally 2–3 days, the insects die without regaining consciousness. After that, they are toasted and mixed into an industrial blender that turns them into well-known insect powder. As compared with modern methods of slaughtering traditional livestock, the pain levels are believed to be drastically lower than those of cows, pigs, and chickens. However, we lack the full understanding of the way insects experience pain or if they indeed do at all.

The ecological footprint with insect consumption is much larger than with, for example, meat consumption. The FAO reveals that to raise one kilogram of pork requires five kilograms of feed, and to raise one kilogram of insects only requires two kilograms of feed, and insects can also replace soybean meal in animal feed, which would lessen the impact of intensive agriculture. In addition, if we are talking about 15million crickets, it only takes 500kg of food to breed them, while other farming cultures like meat farming takes a lot more.

Feed handling for any kind of farm is an integral part of the overall system. Likewise, this is also true for industrialized edible-insect farming. Due to the perishable nature of some feeds used, especially for those with high water content such as those formulated from nonmarketable produce products, insect farmers have to work with tight time-gaps in order to reduce feed spoilage.

The industrial process includes fine grinding, dehydration and pressing.

Suppliers:

- Cricket powder – Cricket Farming Co.
- Oatmeal – Granosa A.G
- Lupin beans – Granosa A.G
- Sunflower Seeds – Corteva Agriscience, Granosa A.G
- Vanilla extract – Jean gazignaire SA
- Whole wheat bran – Granosa A.G
- Dehydrated figs – Manuel Tavares Lda
- Pectin – Condi alimentar SA
- Stevia - Azores?

Allergens: gluten, crustaceans and lupin beans.

4. Laws and Regulations

With the development of this project, and within the scope of legality, we were able to extract 4 insights that our product should consider. Being, consumer law, health and safety law, homegrown food legislation and import/export law.

Consumer law: The rights of consumers are enshrined in the Constitution of the Portuguese Republic and in Law nº 24/96, of 31 July.

Article 60 of the Constitution of the Portuguese Republic lists the rights of consumers in terms of protecting their quality of life, in relation to the good quality of goods and services, their competitive and balanced price, health protection, safety, disposal damage and to training and information itself.

These are the rights of citizens as consumers, which oblige the State to provide services and impose themselves on economic operators who supply goods, from production to fine distribution. (Direitos Dos Consumidores, 2021)

Health and Safety law: According to article 14 of Regulation (EC) No. 178/2002, of 28 January, no foodstuffs that are not safe will be placed on the market. (Portugal)

Foodstuffs will not be considered safe if they are understood to be:

a) Harmful to health and/or

b) unfit for human consumption.

All legal provisions provided for in the field of food hygiene must be considered, namely: Regulation (EC) No. 852/2004, of April 29 and its amendments, regarding the hygiene of Foodstuffs; Regulation (EC) No. 853/2004, of April 29 and its amendments, regarding the hygiene of products of animal origin; and Regulation (EC) No. 2073/2005, of 15 November and its amendments, regarding microbiological criteria applicable to foodstuffs. (*Requisitos De Segurança Dos Géneros Alimentícios*, 2017)

Homegrown food legislation: Portuguese Decree-Law No. 169/2012 Creates the Responsible Industry System, which regulates the exercise of industrial activity, the installation and operation of responsible business areas, as well as the process of accreditation of entities within the scope of this System. (Produzir Alimentos Em Casa – DGAV, 2021)

Import/export law: Commission Implementing Regulation (EU) 2021/405 of March 24, 2021 (Portugal) establishing the lists of third countries or regions of third countries authorized for entry into the Union of certain animals and goods intended for human consumption, in accordance with the Regulation (EU) 2017/625 of the European Parliament and of the Council. (*REGULAMENTO DE EXECUÇÃO (UE) 2021/405 DA COMISSÃO De 24 De Março De 2021 Que Estabelece as Listas De Países Terceiros Ou Re*, 2021)

5. Sustainability

With the current increase in food production, a lot of pressure is being put on resources that are already limited, such as land, oceans, water, energy, among others. If agricultural production continues to increase, it will continue to increase greenhouse gas emissions as well as

environmental degradation.
Environmental problems are increasingly important and require more sustainable alternatives, particularly the problems associated with livestock farming. In most countries the main sources of protein are livestock and fish. (Huis & Food and Agriculture Organization of the United Nations, 2013).
With that said, it is necessary to start thinking and implementing innovative solutions and stimulate the consumption of alternative foods. Here comes the opportunity for insects to help cope with the growing population and the need for food. (Huis & Food and Agriculture Organization of the United Nations, 2013)
The production of insects for food is undoubtedly a possible solution to 'feed' our planet. Insects, in addition to being very nutritious, are also sources of proteins more sustainable than meat and fish, are also more efficient, that is, on average two kilos of food arrive to produce one kilo of insects, while in cattle for example, eight kilos are needed. In addition, they release fewer greenhouse gases, require less water and less production area, and can be fed by-products which contributes to reducing waste and boosting the development of the circular economy. (Thunder Foods, 2021)
Given the immense advantages of the use of insects for food and the importance that insects may have both in the future of world food, or in an ideally greener, more circular and more efficient agriculture, it is extremely important to start betting and having an interest in more sustainable food alternatives, for us and for a healthier planet.

6. Financial study

Over the past decades, there has been a lot of discussion about the future and sustainability of the food industry. This lobby is being challenged to optimize and adapt processes, under the tutelage of their respective governments in order to contribute towards a more environmentally friendly world.
The Covid-19 outbreak has developed into a pandemic with unprecedented consequences. Major economic losses and income declines have posed a risk on food security. The current recession is expected to last much longer, even in high-income countries. With an increasing world hunger in the upcoming years, feasible solutions are now needed more than ever.
Regarding the economic/financial advantages to the edible insect's industry, which grants it with a great potential when compared to other industries we can list: the use of less resources than cattle (1kg of crickets = 1,7 kg of food whereas 1kg of cattle requires 10kg of food); being cold-blooded enables them to spend their calories on growth instead of warmth (Verge Science, 2019)
The damage done to the environment by producing a pound of beef is approximately 7 times the damage done by farming through robotic cricket farming capability - says John Chambers, Cisco's CEO, and an investor in Aspire Food Group, a robotic cricket farm operator.
The Market is expected to grow at 24% per year, over the next five years surpassing $1B worldwide. (Mekko Graphics, 2018)
In East Africa, more specifically in Kenya and Uganda, insect farming is a rapidly growing industry providing access to 'climate-smart' protein, other nutrients, and income. With the continental

drive to transform existing food systems that are becoming continuously unsustainable due to scarcity of arable land and water, and high ecological imprint, insect farming for food and feed with circular economy potential has gained remarkable interest. (Elsevier, 2021)
As we can see with the former information, it's in the best interest of the young populations and governments to look at the industry as maybe a turning point or a business opportunity that could spread/develop to the rest of Africa, which could be a great option to fight hunger in the continent.

7. Management

As a newborn project attempting to take its first steps in the edible insect industry, there are some pillars and principles that we do not plan on withdrawing from, which could lead to some general incoherence, if not fulfilled. Having said that, it's evident that environmental-friendly and sustainable feedstock all around our production process are fundamental matrices to our success, going from the protein bar itself, up until the packaging, either from the individual bars or the whole package.
Setting a horizontal timeline to 2025, our working methods will revolve around the very same principles that we consider to be crucial, adding to a constant state of unsettlement and will to innovate. So:

- We plan on trying new flavors and ingredients – and I believe its needless to say all of these will be centered around sustainability;
- We will get in contact with several connoisseurs of variate fields of expertise, such as marketing, communication, management of food-related companies, etc, in order to improve our know-how in the field;
- In terms of inner management, we plan on continuing our non-hierarchical way of handling work, which allows every member to voice their genuine thoughts, while being respected and taken into consideration as we believe a leader will appear naturally, depending on our areas of concern, at some moment in time.

8. Investment and its effects on Profitability

The main priority for the next few years regarding the cricket farming industry is bringing down ingredient costs which will require outsider investment, to accelerate the process of automation of the industry. Cost hurdles come in the form of economies of scale. Much of the farming is still done manually. Automation of the feeding, watering, and harvesting of insects could bring down costs.
"We need larger companies to invest in utilizing this ingredient at a larger scale, and then we can drop our price" - says entomologist Aaron Dossey (Food Business News, 2021)
One factor that could positively impact the profitability of this industry would be some government measures to reduce livestock consumption, which requires a lot of natural resources (land, feed, water), and emits far more pollutant gases into the atmosphere, when in comparison to insect-based products, which are far more environmental-friendly, in that sense.

9. Business Plan

Brief Summary:
Sustainabug will try to fill the void in the industry, regarding cricket-based edible products, and

join the few insect-based companies there are on the market;
Our target market is athletes that require high amounts of protein, without needing a whole meal to attain those needs.
Our team is constituted of 4 members, all from different areas of study/expertise (nutrition, industrial engineering, design/marketing, and accounting/economics/management). Adding all these areas up, we believe that we have a solid, complete and versatile group that could learn and apply good practices quickly, leading us to success;
Funding wise, we haven't commercialized our products yet, which means a bank loan will be necessary, initially.

SWOT Analysis:

- STRENGTHS: we have a unique product and a defined target audience that we want to please;
- WEAKNESSES: funding is an issue;
- OPPORTUNITIES: there is a gap in the market that we can fill, it is a growing industry, and "greener" alternatives to regular western eating habits are becoming more and more required;
- THREATS: Automation and technology upgrades are required in the next few years in order to take a "leap to new heights", producing in bigger volume.

What are realistic steps in the next few years?

- Getting in touch with small markets and specialized stores (Celeiro), to try and sell our product there;
- Depending on the public's feedback, we can eventually make our way into supermarkets, in the biological and environmental-friendly sections;
- Promotion of sensible campaigns of debunking stereotypes and prejudice regarding the consumption of insects - paving the way for a more open-minded society (as young athletes are our target audience, we expect them to be receptive to new food tendencies if they allow them to fulfill their nutritional needs).
- The marketing of the protein bars must be remarkable, and for that to happen, we could try and get in contact with a famous athlete that would be willing to be the ambassador of our project, expanding it to new horizons.

10. General Project Consistency

Technical Feasibility on an industrial scale

On an industrial level, it is clear that most of the production is still handmade, especially cricket farming, which doesn't allow companies to operate in mass.
"In temperate countries, processing technology is virtually nonexistent because edible insects are not recognized food and feed sources. If insects are to become a useful and profitable raw material in the food and feed industries, large quantities of quality insects will need to be produced on a continuous basis. This requires the automation of both farming and processing methods, which remains a challenge for the development of the sector." (Edible Insects – Future prospects for food and feed security, FAO, 2013)
As we can verify, this report is from 2013, and technology has progressed since then. A lot of

companies revolving around edible insect consumption have paved the way for others to come in. Foreign investment is still a crucial factor in the automation progress of these companies, especially considering the “yuck factor” still clogs the profitability in a short-term plan. Investment in this area has its stake of risks, as it is mostly a “gamble” on a future switch in western societies eating habits.

To conclude, investment is the keyword to talk about industrialization, in this matter. Until the sector is generally attractive to general consensus, companies could struggle to produce in mass quantities as their manufacturing process is still quite rudimentary.

Product characteristics and their adequation to the marketing plan

Our motto for this project has always been Sustainability. That approach is transversal to all parts of the product. The protein bar, the bar wrapping and the packaging.

So, our marketing plan consists of exploring that theme, and associating our brand with good environmental practices and healthy lifestyles. Our target audience is young athletes that want to meet their nutritional needs, so they’re a great example of health and well-being role models. The intricate characteristics of crickets, or insects in general, with their environmental advantages against livestock, such as the lower needs for land, water and feed, as well as the much inferior emission of greenhouse gases, allow SustainaBug to explore those competitive advantages and use them to their favor.

Innovation Protection Strategy

One of the biggest protection strategies for innovation is patenting our intellectual properties which, in this case, would apply to our bars. It isn’t something that has crossed our minds just yet but, in the future, with bigger financial security, it is something we could consider. In a fast-growing market, it’s fundamental that we start excluding competitors, so that they wouldn’t be allowed to commercialize similar products or services and, in that way, in a market that isn’t fully established, it could be important.

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