



Appetito*

BISCUIT FILLED WITH TOMATO

Project Dossier for Ecotrophelia

May 2023

Appetito's Concept

Appetito is a product consisting of a soft whole biscuit, filled with a contrasting tomato chutney and intended to offer an experience of astonishing flavours (Figure 1). This product aims to remind of flavours associated especially with main meals through the combination of tomato and spices, but in a different, innovative, and above all surprising shape while offering a pleasant experience of two distinct textures. Without added salt, all the flavour comes from the ingredients and the addition of salicornia. This is a product suitable for everyone, including vegans, that is a source of protein and has a high fibre content.

It also considers sustainability issues, which include having zero waste during its production, with the exploitation of the raw materials in whole. It contains nutritional yeast and has no additives or anything that cannot be composted. The package is designed with cartons originated from sustainable sources and with inks that allow a proper recycling of the package once the product is finished, closing the loop on Appetito's life cycle and creating a circular product. All the ingredients used are locally produced, which together with the recyclable packaging, make this biscuit a sustainable product that recognises the impact that food production can have on the environment. Appetito is versatile, as it is suitable for different occasions. After 17-24 minutes of baking, it can be taken anywhere and eaten as a snack, but it also works as a distinctive appetiser, designed to be shared with friends and loved ones, sharing a drink and creating special moments and new experiences.



Figure 1. Appetito product.

Marketing plan

Although there is a wide diversity of salty products currently in the market, the diversity regarding frozen salty products, namely biscuits, is not that big. Based on a market analysis it was possible to determine that within this category there are mostly pre-fried products, usually more associated with main meals, and not the type of products that can be placed in the oven and be easily transported to another place or consumed later. Therefore, Appetito has no direct competition, i.e., there is no product with the same characteristics, which is an advantage for the product in question. Moreover, although it is a frozen product, it is intended to be a snack, which is not the case of many other products of that type. In terms of indirect competition, products such as cheese bread, garlic bread, mini pizzas, and to some extent, the traditional *rissóis*, *croquetes* and codfish pastries can also be included. However, many of these products do not have characteristics close to the Appetito product, especially when it comes to nutritional value. Figure 2 shows some of the non-direct competition currently existing in the market.



Figure 2. Main indirect competition: Frozen cheese bread, mini pizzas, and garlic bread (from left to right).

The market segment of Appetito aims to target an audience of young-adults and adults, with an average monthly income, who not only have concerns with environmental problems, but also take into consideration the nutritional properties of the food they consume. It is thus targeted at all those people who seek better alternatives to salty products that can be easily prepared and that are widely available for purchase. Moreover, within this segment, this product also targets a specific niche market, people who follow restrictive diets, such as vegan diets, or even people who suffer from health problems and abstain from products with a high sugar, salt and/or fat content.

Previous research shows that there is potential for the introduction of Appetito in the market based on the characteristics that differentiate this product such as:

- Different concept, as it is a filled salty product.
- The familiar flavour, a result of the combination of tomato and spices, which reminds people of popular products such as pizza. These are usually fast-food products, unlike Appetito.
- It is not a fried snack.
- It is made with natural ingredients and does not contain additives. Flavour comes from the ingredients themselves and salicornia, making the product nutritionally more interesting with the sustainability advantages discussed in section 6 of this dossier.
- It has a high fibre content, is a source of protein, is low in fat and sugar, and has no salt added. The products of this category have mostly the opposite characteristics.
- The technology used for its formulation is simple and can be implemented in already existing production lines at a big scale.
- Its package can be fully recycled, which is not often the case with frozen products.
- It is easy to prepare (17-24 minutes in the oven).

The target segment and positioning addressed are one of the focal points of the marketing mix policy relative to the product, since they are the basis that supports the marketing strategy. The other three points are discussed below and include price, distribution/commercialization, and communication.

Price

As a comparison within the aforementioned competition, products that are vegan and come in packages containing 250 to 300 grams of product, have a current price between 3.69 - 4.75 €. However, none of them have the nutritional benefits, ecological aspects and packaging of the Appetito. As a result, there is a margin for price adaptation given its distinct characteristics. The estimated price is around 4.50 € (+ VAT).

Market entry will be as a differentiating product. The intention would be not only to capture the desired target audience, but also to grow the demand in new consumers. As shares are gained, the price could increase slightly to increase the profit margin, leading to discourage competition.

Distribution and marketing

In the first phase, distribution would be done in two ways. The first would be, using the HORECA channel, using catering services in congresses and events but also with hotel establishments and specialised stores that carry gourmet products. Additionally, the retail channel would be used for independent trade, where the product would be sold online through its own channel, from the official website of the Appetito product. It would also be marketed here from an integrated modern trade to surfaces directed at niche markets that identify with healthy and vegan eating, as well as those who seek sustainable or organic products.

In a second phase, the retail distribution would be expanded to supermarkets and hypermarkets at a stage where the product will be well established and where other product lines could be launched.

Communication

Concerning sales and promotion, this would include free deliveries and tastings at music and culture festivals, fairs and exhibitions, press kits and coffee breaks at conferences. Marketing through the HORECA channel would also serve to publicise the product.

Advertising will be done through the product's own brand site, in its social media channels, by the paid presentations in the form of ads throughout social media or YouTube and in search ads.

Appetito is thus an innovative product, which aims to convey the message that eating something healthy and whose production is more environmentally friendly, doesn't have to be boring... It sets a difference from the first impression with the packaging design that immediately transmits a sense of joy which is backed up by the intense flavour of the product melting through the mouth making a perfect contrast of a whole biscuit with an intense and above all tasty filling.

Appetito is the combination of the simple and complex, in a different but familiar-tasting product. It is not a product; it is THE product!

Formulation and process development

Different formulations were tested until the final composition of the product was achieved. It was determined, very early on, that the organoleptic quality of the product was only guaranteed for one week, with the texture of Appetito being the most affected as the time went by. In this way, to better understand the acceptance of the product a preliminary sensory analysis with potential buyers, i.e., people who usually consume salty products, was performed. Using a 9-point hedonic scale, different attributes of Appetito were evaluated, namely the overall appreciation, appearance, odour, taste and texture. In the questionnaire presented to the tasters (Annex 1), they were also asked if they would prefer the product to be spicier and if they would buy it if it was available in a supermarket.

The average global appreciation of the product was 7 (I like it moderately), as well as the other attributes, with the exception of texture. In terms of the questions asked, 62.5% of the people thought the product should not be spicier, and 87.5% said they would buy the product if it was available for purchase. From the comments it was possible to understand that what people liked the least was the texture, since it was doughy at the time of tasting, and what they'd liked most was the filling due to its intense flavour. As mentioned before, this analysis was somewhat preliminary, in order to identify what improvements could be made to the product. For this reason, in order to maintain the quality of the product and to avoid creating waste related to the loss of texture quality, it was decided that Appetito would be a frozen product.

Special ingredients

Nutritional yeast is an edible yeast from the *Saccharomyces cerevisiae* family. It's a source of vitamin B12 and trace minerals. One of its most important assets is that it contains all nine essential amino acids and trace minerals such as zinc, selenium, manganese, and molybdenum; which are involved in gene regulation, metabolism, growth, and immunity. This ingredient is able to provide a high content of protein with a lower carbon footprint than the animal sources (Parapouli *et al.*, 2020).

Salicornia on the other hand, is a plant from the family of succulents, known for its role in environmental preservation. It can be used as a food ingredient and salt substitute as it was the case for Appetito's formulation. Excess sodium intake is the main contributor to hypertension and an increased risk factor for cardiovascular illnesses so Salicornia's value, particularly as fermented food and seasoning, brings a promising novel and functional component (Alfheaid *et al.*, 2022).

Process flow chart

Appetito stands out from other products in the same category because it is a filled product, but with a salty taste, being the tomato chutney filling the product's main star. At a preliminary phase, it wouldn't be efficient to have two different types of production. Therefore, the production of the dough would be made in its entirety while the filling's base would be produced by a contracted company, under a confidentiality agreement. In other words, since the entire chutney formula was also developed from scratch, this supplier company would only produce a typical tomato paste and the chutney would be finalised (with all the secret combinations of spices that make it special) in the same plant as where the product is being prepared. Hence another production line for the filling wouldn't be necessary, allowing the secrecy of what is the surprise of the product to be maintained. Later, at a stage when the profit margin is stable, it would be expected to produce the whole product in the same plant. Figure 3 illustrates the process for the production of Appetito.

Following the sourcing of raw materials and storage of those in their optimal conditions, the production process begins with the dosage of all the ingredients. These are afterwards mixed and kneaded, with the help of an industrial mixer, and the humid ingredients are added. The product obtained is then stretched and cut into circles of 4.7 cm diameter. Once these circles are cut, a layer of filling of about 6g is added and a second layer of dough is overlaid, pressed and bonded, to create Appetito's signature shape.

The biscuits then undergo a pre-treatment that ensures that the dough is partially cooked, in order to improve its texture after baking. This heat treatment takes place in an oven at 180°C for 7 minutes and the product is then cooled for 5 minutes at 15°C to be later frozen at -18°C. The product is lastly packed in cardboard boxes with a sleeve containing 4 compartments, each compartment will contain 5 product units. The frozen final

product is stored, kept at -18°C until it is shipped from the factory by refrigerated transportation. Being a frozen product, as long as all the critical points are respected, the temperature can and should be maintained, which ensures that the consumption is safe. It is believed that since the product is consumed shortly after cooking, there is a lower risk of microbiological contamination on the product.

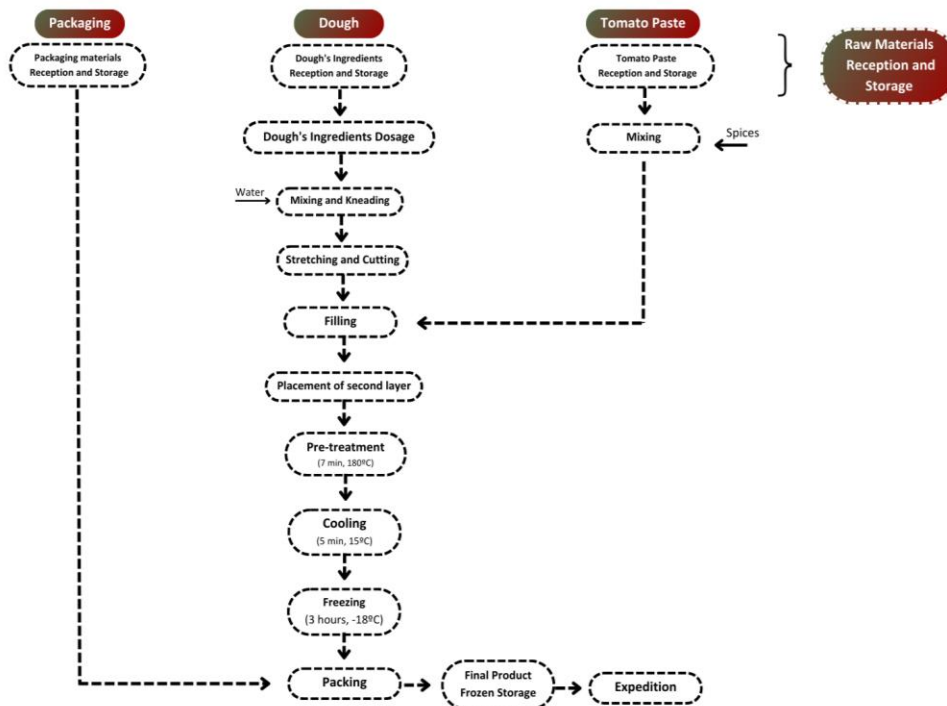


Figure 3. Process flow chart of Appetito.

Packaging

The packaging ensures the safety and quality of the product, and it will have all the characteristics necessary to protect Appetito's properties. It will consist of a sleeve design which adds additional protection to the product while having space to display branding and product information. The two-piece package will be made with carton material that are food grade safe, moisture resistant, suitable for freezing, and prevent any migration of inks or any exterior compounds into the food. The surface treatment of the carton will employ natural waxes or chitosan that will protect the paper from leaks and cracks while employing natural and non-toxic compounds.

To ensure optimal food safety, these boxes will come sterile and will have the option to be recycled to take part into other food chains that can maximise the value of these. Smurfit Kappa provides the packaging materials that would best suit the business principles of Appetito. They employ 100% paper that is certified FSC® or PEFC™ while working with inks certified SFI™, creating a sustainable package that ensures to protect the product from temperature fluctuations during transportation and to preserve the determined shelf life for this product.

For the design it was chosen to employ a very minimalistic but objective layout. With the chosen pattern it is expected to establish a clear idea that there is tomato in the product; the red tones represent the passion and strength behind this project while the cream background establishes elegance and sophistication, as this is a special product for a special occasion Figure 4. The art seeks to bring the consumer into thinking about the streets in the south of Italy, where food, aromas and greedy thoughts take over, and the next meal is always in mind. The package's shape was created explicitly to caress the biscuits on the inside, avoiding unnecessary empty spaces in between the package, which allow Appetito to fit easily in any freezer.



Figure 4. Appetito product packaging.

Industrial scale production

Potential suppliers were scouted keeping in mind that the ingredients to make Appetito should, whenever possible, come from the same region, namely Porto, with the aim of boosting local economy. The largest quantities of ingredients are the flours, which Cerealis Moagens, belonging to Cerealis Group, has a dedicated production and commercialization of whole wheat and rye. They are located in Maia. For nutritional yeast, one of the trendy ingredients used in Appetito, Auri Foods, located in Vila Nova de Gaia, could be a feasible supplier. They are a worldwide pioneer brand in the manufacture of flavoured nutritional yeast-based supplements. Dulfar is a renowned and recognized company for the transformation of olives into olive oil and their product is made in Figueira de Castelo Rodrigo, Beira Alta region. They have an organic farm which excludes insecticides and pesticides from their products.










In Aveiro, the company Horta dos Peixinhos, Lda. is one of the pioneers in the cultivation of salicornia in Portugal. Their production is organic as their salicornia grows spontaneously in Ria de Aveiro, while complying with all hygiene and food safety requirements. The tomato paste would be sourced from Frulact, based in Maia, and being a company that is considered to be an innovator in the supply of value-added ingredients for the food industry. Lastly, the product's packaging potential supplier is the company Smurfit Kappa, which is located in Santa Maria da Feira and produces packaging with the desired criteria for Appetito.

Process implementation

Once the market prices for the raw materials have been identified and production costs have been optimised, the production line of Appetito should be able to produce an approximate of 1185 packages of product (300 g) per day, with an average of 197 packages of twenty biscuits produced every hour for the first year on the market, considering 6 hours of work, what corresponds to 59,1 kg per hour.

The necessary equipment to achieve the large-scale production of Appetito is described in Table 1. The most important parameters of each equipment as well as the potential supplier are highlighted for an easier envision of the process at an industrial scale. It is also important to mention that the equipment number 9 is only an example of a machinery that could produce the tomato chutney in whole, but it is expected to source the base of chutney as previously discussed. Therefore, for the first phase, this last equipment is not necessary, and all the proposed equipment could be upgraded the following years based on the revenue and success that the product brings.

Table 1. Equipment necessary for the industrial production of the Appetito product.

No.	Name	Capacity	Specifications	Business holder	Image
1	Industrial dough kneader	25-500 kg	Professional equipment for making dough. The main function of this machine is to mix raw materials into a uniform paste	JunyuTec, China	
2	Filled cookie " SOL-COK-S-1"	2000-8000 pieces/hour	The filled cookie forming machine is suitable for fillings with different moisture content and viscosity and can produce cookies with different flavors.	Anko, Taiwan	
3	AirForce® Impingement Oven Jr.	Cooking area of 450mm x 950mm	A compact oven that uniformly cooks many different vegetable, snack, and baked foods.	Heat and Control, USA	
4	Isotemp Boiler	230V 750W	The tank and all parts in touch with water are built in stainless steel AISI 316 and welded with inert gas to avoid any corrosion risk.	Osculati, Italy	
5	Ambient Air Cooler	Brings product to 9.5°C of ambient air temperature	Cools foods to stop cooking and reduces temperature for packaging. Within seconds in most cases.	Heat and Control, USA	
6	Industrial Tunnel IQF Quick Freezer	100-2000 kg/H	This is a kind of tunnel structure relatively simple and highly efficient quick-frozen device, it has convenient operation and long service life.	INCHOI, China	
7	Vertical cartoner with continuous motion	150 packages/min	Smart functions for product and carton handling during the filling and closing phases. In case of product missing in the infeed flow, the "no product/no carton" function goes on.	Senzani, Italy	
8	Metal Detector THS/21-THS/MS21	Up to 500 scanned products	Provides unique detection capability and extreme sensitivity of magnetic, non-magnetic, and even stainless steel metal contaminants	Heat and Control, USA	
9	ProCut	5-50 kg	Designed with the aim to obtain a finished product, starting directly from the raw materials. It can cut, mix, cook up to 120° C or under vacuum, homogenize, concentrate and cool the product under a single working cycle.	INO-FER, Italy	

The layout of the factory that will elaborate the product is shown in Figure 3. The first floor will be destined fully to the production area, including a sanitary access to the production area with the production equipment arranged as follows: 1+2 correspond to the dough kneader and cookie making machine where the introduction of raw ingredients will take place and the biscuits will be formed and filled. Equipment 3 + 4 corresponds to

the oven and its gas boiler for it to perform a thermal pretreatment where the biscuits will be cooked and then cooled down with help of equipment 5 that is a cooler machine. Then the product will follow into the freezing tunnel that is equipment 6 to then be packaged into their box using equipment 7 and for a final quality assurance the finished product will undergo analysis under equipment 8 that is a metal detector. At this point it is considered that the product is ready for storage, so it will exit the production line and be taken to the storage room at -18°C. There will also be for raw ingredient storage, reception dock as well as a laboratory on the second floor of the plant to carry on quality assessments and raw material testing or sensorial analysis.

To explain the production process of Appetito it is important to follow the red arrows displayed on Figure 5. It would be expected that all the raw material and products inside the plant follow this flow in order to ensure the safety of the finished product and avoid risks of cross contamination. Once the product is finished it will be stored in the finished product room, following the FIFO (first in, first out) storage system to have it later shipped out of the plant through the finished product dock.

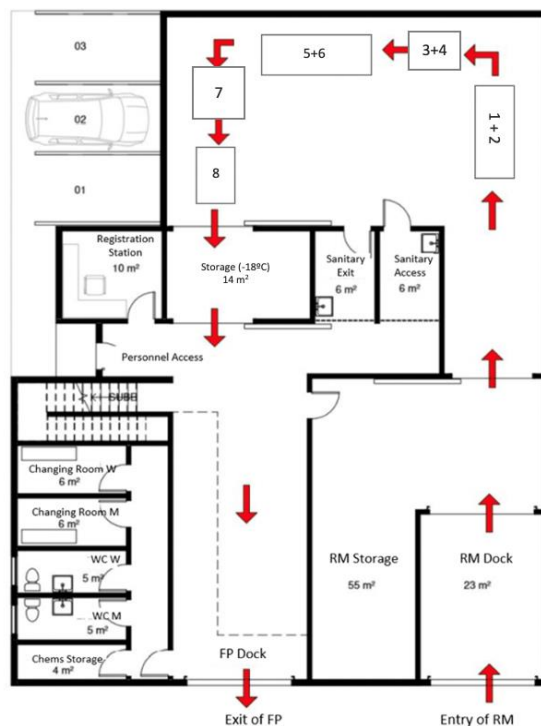


Figure 5. Production plant: 1+2 - dough kneader and cookie making machine; 3+4 - oven and boiler; 5+6- cooler machine and freezing tunnel; 7 - packaging; 8 - metal detector.

HACCP plan

The HACCP (Hazard Analysis and Critical Control Points) system identifies, evaluates and controls significant and possible hazards and risks in food products along the food chain, from primary production to handling, until reaching the final consumer.

Currently, Regulation (EC) No. 853/2004 of April 29 is considered a relevant legal instrument, as it addresses the good practices recommended by the General Principles of Food Hygiene, published in *Codex Alimentarius*.

According to the information provided by ISO/TS 22002-1: 2009, in order to prevent, reduce or eliminate hazards during the production process, the following prerequisites are considered:

1. **Construction and layout of buildings.** When planning/ restructuring food industry facilities and selecting equipment, food safety aspects should be considered such as: the layout of the establishment's internal areas, the equipment available and the circuits for raw materials, finished products, non-food products, staff and waste.
2. **Cleaning and sanitising.** The development of a Hygienization Plan to describe areas, structures and/or equipment that must be cleaned, chemicals to be used for cleaning/disinfection (detergent/disinfectant), hygienization frequency, equipment used for cleaning/disinfection and people responsible for the operation. The plan should be posted in a visible place and a record should be kept to prove its application. In this registration date, detergent/disinfectant used, cleaning accessories and the person responsible for cleaning must be included.
3. **Pest control.** This includes certain procedures, namely: a map with the location and maintenance program of bait or detection stations and insect electrocuting; provision of technical and safety data sheets for the products used in case of poisoning; recording of all pest control reports, preventive control actions planned and intervention actions to be applied if there is an infestation, the areas of pest activity, the application of any chemical products and the description of corrective actions. In addition, rules should be maintained, such as storing food on shelves or racks and keeping animals out of the surrounding area and inside the food processing facilities.
4. **Utilities — air, water, energy.** The quality of supply and distribution of utilities for processing and storage must be designed to minimise the risk of contamination. All water that is added to the process and/or comes into contact with food must follow the minimum requirements for water for human consumption. Requirements for filtration, humidity (RH%) and air microbiology need to be established.
5. **Waste Disposal.** Waste management operations include waste picking, transport, storage, sorting, treatment, recovery and disposal. The waste should be kept in closed containers and protected from pests and facilities' collecting circuits should be defined in order to minimise the occurrence of cross contamination.
6. **Food contact surfaces.** The legislation establishes mandatory rules concerning the manufacture and marketing of materials in contact with food (Regulation No. 1935/2004 of 27 October) and the transfer of substances to food in quantities that may represent a risk to human health (Regulation (EC) No. 1935/200). In addition, wrapping and packaging materials must not be a source of contamination, and their integrity and hygiene before use must be guaranteed (Annex II, Chapter X of Regulation (EC) No. 852/2004).
7. **Personnel hygiene and employee facilities.** Operators working directly with the food product should be instructed to handle hygiene as a way to protect their health and the health of consumers. Thus, rules of hygiene need to be applied in order to minimise the spread of cross-contamination, these include hand hygiene procedures, body hygiene, uniforms, glove use, procedures for measuring and reporting individual health status.
8. **Training programmes.** Managers have a responsibility to ensure food safety by ensuring that all staff have the appropriate skills and knowledge for the performance of their duties. Training plans should be prepared and

updated annually. All information associated with training shall be recorded and documented, so that it's available for consultation.

For the application of the HACCP plan, the 7 principles established by the *Codex Alimentarius* General Principles of Food Safety (CXC 1-1969) are used.

1. Hazard analysis to identify the significant hazards and control measures

Hazard analysis consists of identifying potential hazards and evaluating them to determine which are significant for each step of the process. For this the hazard needs to be classified and identified, describing it and its possible causes. To determine the possible causes, we use the cause-effect diagram (Annex 2), adapted from FIPA's (*Federação das Indústrias Portuguesas Agro-Alimentares*) General Guide for the Application of the HACCP System. Annex 3 refers to this data.

2. Determination of the Critical Control Points (CCPs)

Afterwards, considering the hazard's frequency and severity as well as the degree of risk is estimated, elimination or reduction to acceptable levels are essential.

To estimate the probability of occurrence, frequency data of identified hazards should be used, to analyse the severity we resorted to the table from the document "Modelos Genéricos de HACCP", which outlines the effect of different hazards on consumers' health (Annex 4). Thus, after multiplying the frequency by the severity, a risk matrix was built. Being the degree of risk greater than or equal to 4, indicates that the hazard should be analysed by the decision tree from the Commission's Communication on the implementation of food safety management systems, published in the Official Journal of the European Union (Annex 5).

Using the questions (Q1, Q2, Q3 and Q4) inherent to the decision tree approach, the steps that determine relevant process control points are filtered, evaluating whether or not they constitute Critical Control Points. Aspects to consider include: If the control measure cannot be used at a particular process step, it should not be considered a CCP for the significant hazard; if the control measure can be used at the step under analysis, but may be used later in the process, then the step should not be considered a CCP; if a control measure at one stage is used in combination with a control measure at another stage to control the same hazard, both should be considered as CCPs. The determination of the critical control points of the process can be consulted in Annex 5.

3. Establishing validated critical limits

The implementation of critical limits states if a CCP is under control and they can be used to separate acceptable products from unacceptable ones. Critical limits must be measurable. Frequently used criteria include minimum/maximum values for critical parameters such as pH, water activity (aw), temperature, time, relative humidity (%RH), among others. The occurrence of deviations from the critical limit indicates that it is most likely that unsafe food has been produced.

The validation of control measures is described in more detail in the *Codex Alimentarius* Guidelines for the Validation of Food Safety Control Measures (CXG 69 - 2008).

4. Establishing a system to monitor control of CCPs

Control and monitoring are the scheduled measurement of a critical control point regarding deviation from its critical limits. The frequency of monitoring and the type of method must allow early detection of any failure that doesn't remain within critical limits, to provide for timely isolation and appropriate adjustments. Staff performing monitoring must be instructed on the appropriate measures to be taken. If monitoring is not continuous, the frequency of monitoring must guarantee that the critical limit has been complied with. All documentation associated with CCP monitoring must be signed or initialled by the person doing the monitoring, reporting the results and timing of the activity performed.

5. Establishing corrective actions

Corrective actions must be developed for each CCP in order to respond effectively to deviations. These actions should include three steps: Present. What to do immediately to restore control; Past. What to do to the product that has deviated from critical limits; Future. Analysing the causes that generated the deviations to prevent future ones. A periodic review of corrective action should be conducted to identify trends and ensure that they are effective.

6. Establishing procedures for verification to confirm that the HACCP system is working as intended

The validation step occurs before the implementation of the HACCP plan and consists of ensuring that the following elements are capable of providing control of the significant hazards: hazard identification, critical control points, critical limits, control measures, frequency and type of monitoring of CCPs, corrective actions, frequency and type of verification, and the type of information to be recorded.

Following the implementation of the HACCP plan, procedures must be established to confirm that the system is working effectively. This considers procedures to verify that the HACCP plan is being followed and controlling hazards on an ongoing basis. Verification also includes reviewing the suitability of the plan periodically and, if necessary, when changes occur.

7. Establishing documentation and records, concerning all procedures and the application of these principles

Efficient and accurate documentation and record keeping is essential to implement a HACCP system. They should be documented, and their recording should be appropriate to the nature and size of the operation. A simple record-keeping system can be effectively and easily communicated to staff. Based on the HACCP principles, the plan was developed according to table 2.

It is important to note that for the tomato chutney the pH (4,25) and water activity (0,9372) values were measured. Considering these, simulations were performed using Combase, and it was established that there was no risk of microorganism development. This reinforces the need for traceability and assurance that this raw material is suitable for consumption and guarantees food safety. In terms of allergens, the only one present in Appetito is gluten and at industrial level, the equipment used for its production will be exclusive to the product in question, therefore there is no potential allergen contamination at the production level.

Table 2. HACCP Plan Worksheet.

CCP'S	Step	Significant Hazard	Critical Limits	Monitoring			Corrective Actions
				Frequency	Responsible	Record	
1	Raw Materials Reception and Storage	Presence of <i>E.coli</i> in whole wheat/rye flour. (Biological hazard)	For the whole wheat/rye flour to be considered satisfactory, only < 10 CFU/g <i>E. coli</i> may be detected, according to guide values of INSA (1).	Each time flour arrives at the factory.	Operator responsible for the reception and storage of raw materials.	HACCP Plan daily records.	Performing microbiological tests on raw materials; Auditing suppliers for food safety and quality.
2	Raw Materials Reception and Storage	Presence of <i>C. botulinum</i> in tomato paste. (Biological hazard)	For tomato paste to be considered safe, <i>C. botulinum</i> must not be detected. It needs to be preserved at a temperature between 0°C to 5°C.	Each time tomato paste arrives at the factory.	Operator responsible for the reception and storage of raw materials.	HACCP Plan daily records.	Performing microbiological tests on raw materials; Auditing suppliers for food safety and quality.
3	Mixing and Kneading	Presence of bacteria (<i>E. coli</i> ; <i>Cryptosporidium</i> ; <i>C. perfringens</i>) and Virus (Rotavirus) in water. (Biological hazard)	According to Council Directive 98/83/EC (2): for water to be considered safe, neither <i>E. coli</i> or <i>C. perfringens</i> should be identified per 100mL. In case of non-compliance with the parametric value for <i>C. perfringens</i> , the supply system should be investigated to ensure that the presence of <i>Cryptosporidium</i> isn't a danger to human health. Rotavirus should not be detected in drinking water.	Continuous control, before each use.	Operator in charge of quality control.	HACCP Plan daily records.	Performing microbiological tests on water; Water use interruption until chlorine disinfection is carried out.
4	Stretching and Cutting	Presence of foreign materials on the dough. (Physical hazard)	No foreign material should be detected in the dough.	Annual equipment maintenance.	Operator in charge of quality control.	HACCP Plan daily records.	Batch analysis if a product shows foreign matter coming from the equipment when passing through the metal detector.
5	Mixing	Presence of mycotoxins in spices. (Chemical hazard)	According to Commission Regulation (EC) No 1881/2006 (3), the maximum level of mycotoxins in spices is 10 µg/Kg.	Each time any of the spices arrives at the factory.	Operator responsible for the reception and storage of raw materials.	HACCP Plan daily records.	Auditing suppliers for food safety and quality.
6	Pre-treatment	Survival of bacteria after the heat treatment. (Biological hazard)	In order to decrease the probability of microorganism survival, the optimum oven temperature during heat treatment is 180°C. Tolerance is 3°C.	Continuous control.	Machine operator.	HACCP Plan daily records.	Equipment calibration.
7	Freezing	Growth/development of bacteria and/or mold. (Biological hazard)	This step should take place for 3 hours at a temperature of -18°C.	Continuous control.	Machine operator.	HACCP Plan daily records.	Equipment calibration.
8	Packing	Cross-contamination with bacteria and/or mold. (Biological hazard)	No bacteria or mold should be detected on the packaging. During the packaging stage the ambient temperature must be between -20°C and -18°C	Continuous control.	Process operators.	HACCP Plan daily records.	Disposal of the contaminated material; Calibration of environmental conditions; Auditing suppliers.
9	Final Product Frozen Storage	Growth/development of bacteria. (Biological hazard)	The storage of the final product must occur at a temperature of -18°C.	Continuous control.	Operator in charge of quality control.	HACCP Plan daily records.	Equipment calibration.
10	Expedition	Growth/development of bacteria and/or mold. (Biological hazard)	The shipment after storage must take place in frozen product transportation, at a temperature of -18°C.	Continuous control.	Operator responsible for the expedition .	HACCP Plan daily records.	Calibration of transport freezer equipment

(1) Instituto Nacional de Saúde Doutor Ricardo Jorge. Interpretação de resultados de ensaios microbiológicos em alimentos prontos para consumo e em superfícies do ambiente de preparação e distribuição alimentar - Valores-Guia. 2019. (2) Council Directive 98/83/EC of November 3 1998 on the quality of water intended for human consumption (3) Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs

Regulatory study - Legislation in force

The standardisation of labels aids citizens to be able to comprehend the given information in relation to the composition and the content proportions of the nutrients in it. Regulation (EU) 1169/2011 also establishes mandatory information to appear in a simple and understandable language. Appetito packaging information will ensure that labelling contains all the mandatory information described following in a visible and clearly legible word selection. The minimum font size established by the EC will be respected, keeping information in text and pictograms when possible. Front pack nutritional labelling will also make very clear that Appetito is a frozen product that needs to be cooked before consumption as well as their validity dates.

Labelling of foodstuffs

According to Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers, there are certain requirements that must be met so that the product can be properly marketed. The mandatory statements to appear on the product label are as follow:

- 1. Name of the food:** Appetito - Biscuit filled with tomato chutney. Frozen.
- 2. List of ingredients:** Tomato (67%), whole WHEAT flour (38%), whole RYE flour (19%), apple cider vinegar, brown sugar, inactive dry yeast (*Saccharomyces cerevisiae*), olive oil, shallot, salicornia, corn starch, spices.
- 3. Indication of allergens:** Contains gluten.
- 4. The quantity of certain ingredients or categories of ingredients,** which must be given in percentages and in parentheses in the list of ingredients. Only those ingredients that are part of the brand name of the item need to be listed as percentages.
- 5. Net quantity of the food:** 300 grams.
- 6. Date of minimum durability or the 'use by' date:** The date of freezing will be indicated in the primary packaging of the product as "Frozen on...", while indicating the day, month and year in an uncoded form (dd/mm/yyyy) to then indicate a "Best before...", where the date and month (mm/yyyy) are sufficient indication that product's quality will begin to decrease after. This date will be approximately 3 months.
- 7. Special storage conditions and/or conditions of use:**
 - Storage conditions: Product frozen. Keep in the freezer at -18°C until the expiration date indicated on the packaging. Do not keep it under refrigeration. After cooking, consume within a maximum of 5 days and store in a cool dry place.
 - Instructions for the use of the product: Remove the product from its packaging and place directly, without thawing, into a preheated oven at 180°C for 17 - 24 minutes.
- 8. Name or business name and address of the food business operator:** The company will be legally registered as: The Cookie Kooks Lda. *Rua Santo Ildefonso 271, Porto 4000-470 Portugal.*
- 9. Nutritional declaration:** The nutritional value of the final product has been calculated per 100 g and per serving, where one serving corresponds to 15 g (Figure 6).

- Nutritional values per serving (15 g): Energy: 187 kJ/ 45 kcal; Lipids: 0.83 g, of which saturated fatty acids: 0.12 g; Carbohydrates: 7.70 g, of which sugars: 0.14 g; Proteins: 1.35 g; Fibre: 1.21 g; Salt: 0.04 g.
- Nutritional values per 100 g: Energy: 1249 kJ/ 299 kcal; Lipids: 5.5 g, of which saturated fatty acids: 0.78 g; Carbohydrates: 51.3 g, of which sugars: 0.96 g; Proteins: 9.01 g; Fibre: 8.07 g; Salt: 0.29 g.

It is intended to implement Nutri-Score on the product label Figure 6. The nutritional declaration of the product provides an A score and to make this valid a registration on the platform of the entity responsible for the development of this labelling system, Santé Publique France, needs to be pursued.

NUTRITIONAL DECLARATION	Per unit (15 g)	Per 100 (g)	% RI (*)
Energy	187 kJ 45 kcal	1249 kJ 299 kcal	14,95%
Fat	0,83 g	5,5	7,86%
Of which saturates	0,12 g	0,78	3,90%
Carbohydrate	7,7 g	51,3	19,73%
Of which sugars	0,14 g	0,96	1,07%
Protein	1,35 g	9,01	18,02%
Fibre	1,21 g	8,07	-
Salt	0,04 g	0,29	4,83%



*Reference Intake (RI) - Reference intake of an average adult (8400 kJ/2000 kcal)

Figure 6. Nutritional declaration of the product per unit (15g), per 100g and reference intake present on the package (left), and the nutritional semaphore (left) of Appetito.

Nutrition and health claims

To determine the applicable claims legislation from Commission Regulation (EU) No 1047/2012 of 8 November 2012 and Commission Regulation (EU) No 116/2010 of 9 February 2010 were used, both amending Regulation (EC) No 1924/2006 of the European Parliament and of the Council. The developed product has the following nutrition claims: low in saturated fat (< 1.5 g/100 g); low in sugars (< 5 g/100 g); low in sodium (< 0.12 g/100 g); high content in fibre (> 6 g/100 g); source of protein (> 12% of the energy value of the product is provided by protein); lactose free.

According to Annex III of Regulation (EU) No 116/2010 of 9 February 2010, a significant amount of vitamins and minerals is at least 15% of the reference values of the nutrient provided in 100 g of product, consequently Appetito contains: phosphorus (37%), zinc (28.7%), thiamine (24.2%), vitamin B6 (23.8%), magnesium (23%), vitamin B12 (21.3%), potassium (20.6%), folic acid (20.4%), iron (20%), riboflavin (19%), vitamin E (16.11%) and niacin (15%).

In terms of health claims, according to Commission Regulation (EU) No 432/2012 of 16 May 16, 2012, establishing a list of permitted health claims made on foods, this product includes the following: This product should not replace a varied and balanced diet and a healthy lifestyle; Reducing saturated fat intake maintains normal blood cholesterol levels; Reducing sodium intake contributes to the maintenance of normal blood pressure; Fibre intake contributes to normal bowel function; Protein contributes to normal muscle function;

Certain vitamins and minerals contribute to normal cognitive function; The presence of riboflavin allows normal iron metabolism.

Within other nutritional claims there is a possibility to ensure that the product is vegan since the product does not include any materials of animal origin.

Packaging

The product packaging will have various symbols, these are explained in Figure 7. These serve to give more information to the consumer and to be an indication that the product and packaging respect the legislation in force.

1. Frozen product.
2. Legislation recycling/*ecoponto* symbol - Indicates that the packaging can be recycled and since it is paper/cardboard, it should be deposited in the blue recycling bin.
3. CE marking symbol - All products manufactured within the European Union should have this mark, which guarantees their compliance with European directives.
4. Symbol e - Optional symbol that is next to the nominal quantity intended to guarantee that a particular pre-packaged food has the average quantity of the weight it claims to have.
5. Traceability code - It allows the tracking and identification of the entire history of the product, from its origin as raw materials, to becoming a product and being distributed.
6. Vegan legislation - Identification that it is a product that does not contain any products of animal origin (meat, dairy products, eggs, honey...). This particular label (V-Label) would have to be recognized by the European Vegetarian Union.

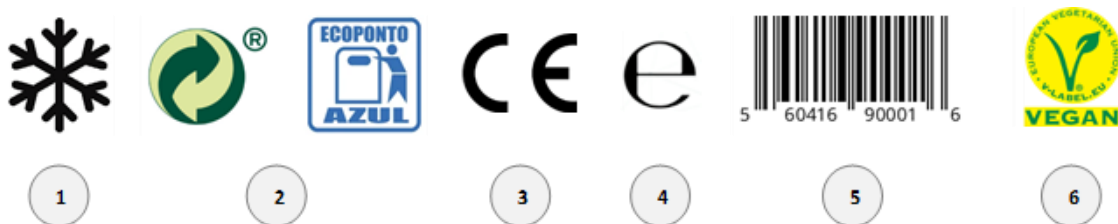


Figure 7. Additional legal requirements: 1-Frozen product; 2- Legislation recycling; 3-CE marking symbol; 4-Symbol e; 5- Traceability code; 6-Vegan legislation.

Advertising standards

All publicity related to the food product developed will meet the requirements established in Decree-Law No 330/90, where the Ministry of the Environment and Natural Resources approves the Advertising Code, of *Diário da República* nº 245/1990, Series I, October 23, 1990.

Sustainable aspects of the product

Appetito seeks to deliver a product that is produced with a superior purpose than just creating food. The product contains only natural products that, in combination with the packaging, seek to create a circular economy, closing the loop of Appetito's product life cycle from confection until its disintegration.

This circular approach implies a reduction of waste and the transformation of the materials into new materials that can take part in other chains whether industrial or ecological. With this product, all the ingredients employed are used in whole. For the dough there is a dense wholemeal flour base with grains and seeds, which is the same case for the chutney, prepared with produce in whole, leaving the seeds and skin. The packaging of the product adheres to the same principle of waste reduction where it aims to employ carton boxes produced with 100% paper with FSC® and the inks for the design of the package will also be certified for labelling SFI™.

By selling a frozen product, the nutritional and organoleptic qualities of the product are preserved for a longer period of time, and it is expected to reduce waste by providing the option of cooking only the amount of product that is intended to eat. The surplus of the cooked product can also take part of a different chain and become compost. The pH levels of the chutney provide an acidic medium that is favourable for the growth of special types of fungi that break down cellulose and lignin (Cornell, 2023). And by using salicornia, which has a low sodium content, the product as a whole can be added to compost bins without killing the microorganisms that are alive inside (Bosque, 2020). Lastly, when the product is finished its packaging can and should be placed in the recycling bins for it to become part of the upcycling process of the material. Appetito adheres to the locally sourced and produced line of food products. The geographical definition of this term establishes that the products used are coming from a 160-400 km radius (Gonzales *et al.*, 2016).

Lastly, the use of salicornia, as an ingredient in the product's formulation, contributes to achieve a more sustainable finished product. This plant belongs to the family of the halophytes, which are plants that possess the ability to survive in highly saline environments (GBNERR, 2020). Research also shows that these plant's oil and biomass can also be transformed into biofuels, conveying a great alternative to the current fossil fuel (Panta *et al.*, 2014). Salicornia has been demonstrated to block erosion while serving as a natural filter for pollutants in the water and soil, specifically heavy metals (Lin *et al.*, 2000). This phytoremediation capacity is what has brought so much attention to the plant in recent years. This plant acts as a low-cost biofilter that has proven to effectively restore ecosystems by taking up 56-61% of inorganic and organic nitrogen compounds (Shpigel *et al.*, 2013). It's by all these features that literature confirms salicornia to be a sustainable crop, allowing it to be used for human consumption (Cárdenas-Pérez *et al.*, 2021).

Financial Study

A cost structure considering the value of each raw material was calculated Table 3, per product package (300 g). For this analysis constant prices were considered, i.e., inflation was not allowed, and a zero stock was assumed; with all production being equal to the number of product packages sold. Based on these assumptions, it was estimated that the value of the Appetito product on the market would be 4.50 € (value without VAT).

Table 3. Raw material cost structure of Appetito product.

Raw materials	Quantity per package (300 g)	Industrial cost (€) per 300g
Whole wheat flour	112,4	0,049
Whole rye flour	57,8	0,037
Olive oil	12,1	0,035
Baking powder	1,3	0,005
Salicornia	6,4	0,410
Nutritional yeast	15,2	0,222
Piri-piri	0,9	0,0007
Tomato filling	120	0,638

In terms of sales, a forecast plan is presented on Table 4, where only the metropolitan areas of Porto and Lisbon were taken into consideration as these would be the places where the product would be sold in a first phase. Within these regions, only women were selected, since they are the ones who most often make monthly purchases. Within this group, those who would possibly be active (25-60 years old) were selected, in the sense of having enough income to buy the product. Based on the target indicated, a sales estimate was made, assuming that only 20% of the last-mentioned group would buy the product, in its first year of commercialization, obtaining a value of 260000 sales. In the second year, the defined target would double the purchase, with total sales of 520000 and, in the third year, this purchase would be doubled again, with the sales value of product packages being 750000.

Table 4. Sales forecast plan for Appetito product.

	1st year	2nd year	3rd year
Packages sold (300 g)	260 000	520 000	750 000
Gross sales (€)	1 180 400 €	2 360 800 €	3 405 000 €

A map of estimated results can be found on Table 5. The percentages found for utilities (10%), marketing (10%) and distribution (6%), were based on literature values and on the fact that the distribution of the Appetito product requires isothermal transportation, since it is a frozen product.

The investment map is presented in table 6, where all the necessary equipment to be purchased and their costs are indicated, as well as the value of the initial investment.

Based on the EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortization) values obtained, the NPV (Net Present Value) was determined for the various years, to assess the viability of the investment project (a discount rate of 3% was considered), obtaining the positive value of 994 705 €, presenting the Appetito project with a positive profitability.

Finally, the IRR (Internal Rate of Return) was calculated, which represents an interest rate such that if the invested capital is placed at this rate, exactly the same final profitability rate is obtained, making the NPV equal to zero. Therefore, the IRR value was approximately 91.38%, a fairly good indication of the project's viability.

However, it is important to remember that all the values presented were estimated and that regarding the investment (Table 6) the values may not be the most specific, given the confidentiality of this information by the industries.

Table 5. Map of estimated financial results.

		1st year	2nd year	3rd year
GROSS SALES	100%	1 180 400 €	2 360 800 €	3 405 000 €
DISCOUNTS	25%	295 100 €	590 200 €	851 250 €
NET SALES		885 300 €	1 770 600 €	2 553 750 €
Cost (RM + Packaging)	2,24 €	581 829 €	1 163 659 €	1 678 354 €
GROSS MARGIN		598 571 €	1 197 141 €	1 726 646 €
% of Gross sales		51%	51%	51%
Director labor		58 905 €	72 765 €	103 950 €
Utilities	5%	118 040 €	236 080 €	340 500 €
Other production costs		33 600 €	37 800 €	50 400 €
Other staff costs		71 033 €	97 020 €	123 008 €
Sub Total		281 578 €	443 665 €	617 858 €
INDUSTRIAL MARGIN		316 993 €	753 476 €	1 108 788 €
% of Gross sales		27%	32%	33%
Distribution cost	6%	70 824 €	141 648 €	204 300 €
Marketing cost	10%	118 040 €	236 080 €	340 500 €
EBITDA		128 129 €	375 748 €	563 988 €
Depreciation		35 938 €	35 938 €	35 938 €
MARGIN		92 192 €	339 811 €	528 051 €

Table 6. Investment map of Appetito product.

Equipment name	Price (€)
Industrial doubt mixer	9 200
Industrial cookie cutter	18 000
Filling machine	10 000
Industrial oven	50 000
Metal detector	4 000
Carton packaging stretcher	30 000
Air cooler	25 000
Boiler	30 000
Freezer	73 800
TOTAL	250 000

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Annexes

Annex 1. Sensory analysis questionnaire.

Sensorial Analysis of a Savoury Biscuit with filling

This study is part of a product development project for

The objective is to create a new savoury product with a different concept than the products available in the portuguese market.

This questionnaire is anonymous, under guarantee of privacy and confidentiality of the information provided.

I confirm that it is my free will to participate in this study and I understand that my participation is voluntary, having the right to refuse at any time, without any retaliation.

Gender: F M Other Age: _____

1) General

a) Do you normally consume salty products?

Yes ___ No ___

2) Evaluation of the product

Instructions:

Please taste the following sample, using the scale of Dislike extremely to Like extremely.

Sample 391

Please evaluate according to the following characteristics by marking with an X

	Dislike extremely		Neither like or dislike					Like extremely	
	1	2	3	4	5	6	7	8	9
Global appreciation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Appearance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Odor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flavor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Texture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

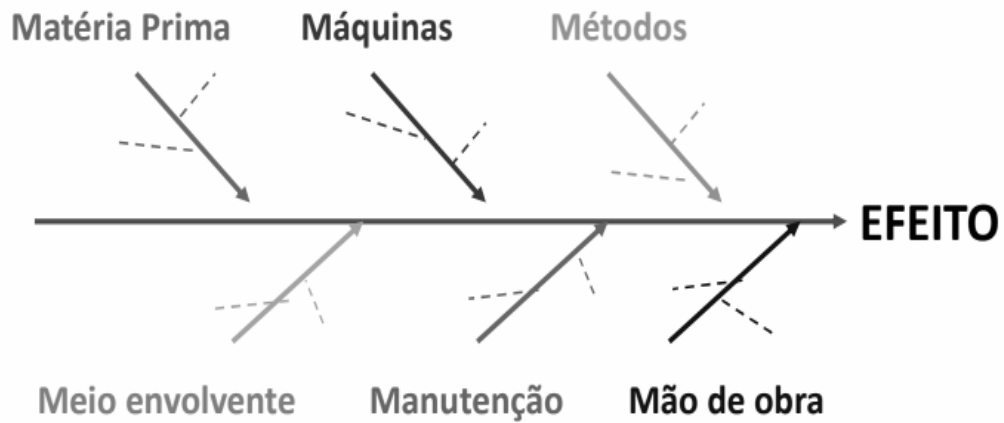
Would you like to have this snack spicier? YES NO

Would you buy this snack in the supermarket? YES NO

Comments: _____

Thank you for taking part of this sensory analysis!

Annex 2. Cause-effect diagram adapted from Guia geral de aplicação do sistema HACCP : Análise dos perigos e pontos críticos de controlo. Federação das Indústrias Portuguesas Agro-Alimentares. Lisbon : FIPA, 2002. 40 p.



Annex 3. Hazard analysis and description of preventive measures.

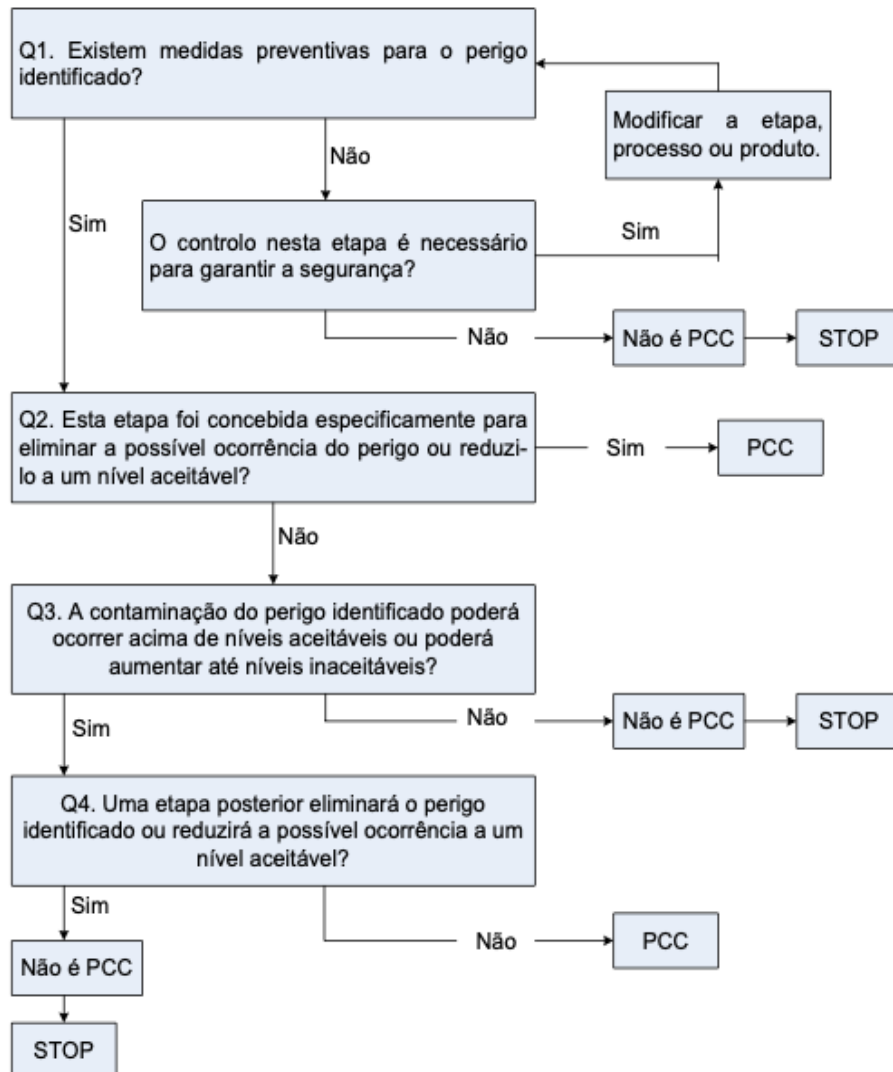
Step		B	P	C	Hazard Description	Potential Causes	Preventive measures
Raw Materials Reception and Storage	<u>Whole wheat/rye flour</u>	X			Presence of bacteria (<i>Bacillus cereus</i> and <i>Escherichia coli</i>) and fungi (<i>Aspergillus</i> , <i>Penicillium</i> and <i>Fusarium</i>).	Lack of responsibility for product quality by the manufacturer; Poor storage conditions; Cross-contamination; Pest infestation.	Separation of raw materials that are in poor condition; Ensure traceability and certification of suppliers; Follow hygiene standard; Proper storage conditions.
			X		Presence of impurities.	Lack of responsibility for product quality by the manufacturer.	Separation of raw materials that are in poor condition; Ensure traceability and certification of suppliers.
	<u>Tomato Paste</u>	X			Presence of bacteria (<i>Staphylococcus aureus</i> and <i>Clostridium botulinum</i>)	Lack of responsibility for product quality by the manufacturer; Poor storage conditions; Cross-contamination; Pest infestation.	Separation of raw materials that are in poor condition; Ensure traceability and certification of suppliers; Follow hygiene standards; Proper storage conditions (0°C<T<5°C).
Ingredients Dosage		X			Cross-contamination with bacteria and/or mold.	Lack of cleaning of the equipment responsible for dosing the ingredients.	Establishment of a hygienization plan with effective methods for sanitizing equipment and instruments.
Mixing and Kneading	<u>Ingredients</u>	X			Cross-contamination with bacteria.	Equipment and work environment improperly controlled and sanitized.	Establishment of a hygienization plan with effective methods for sanitizing equipment and instruments.
			X		Presence of foreign materials.	Bad conditions of the equipment in contact with the product can lead to inclusion of fragments.	Maintenance and calibration of equipment and instruments; Implementation of metal detection equipment throughout the process.
	<u>Water</u>	X			Presence of bacteria (<i>Escherichia coli</i> ; <i>Cryptosporidium</i> ; <i>Staphylococcus aureus</i> ; <i>Clostridium perfringens</i>), virus (Rotavirus) and protozoa and parasites (<i>Giardia Lamblia</i>).	Storage/use of contaminated water, without efficient chlorine treatment.	Ensure that the water is stored correctly and is suitable for consumption.
				X	Presence of residues of pesticides and/or fertilizers	Storage/use of contaminated water.	Ensure that the water is stored correctly and is suitable for consumption.
Stretching and Cutting		X			Cross-contamination with bacteria and/or mold.	Equipment and work environment improperly controlled and sanitized.	Establishment of a hygienization plan with effective methods for sanitizing equipment and instruments.
			X		Presence of foreign materials.	Bad conditions of the equipment in contact with the product can lead to inclusion of fragments.	Maintenance and calibration of equipment and instruments; Implementation of metal detection equipment throughout the process.

Mixing (Tomato Paste with spices)	<u>Spices</u>		X	Presence of mycotoxins.	Lack of responsibility for product quality by the manufacturer; Poor storage conditions.	Ensure traceability and certification of suppliers; Proper storage conditions.
			X	Presence of foreign materials.	Lack of responsibility for product quality by the manufacturer; Cross-contamination.	Ensure traceability and certification of suppliers; Proper storage conditions.
Filling			X	Presence of foreign materials.	Bad conditions of the equipment in contact with the product can lead to inclusion of fragments.	Maintenance and calibration of equipment and instruments; Implementation of metal detection equipment throughout the process.
Placement of Second Layer	X			Cross-contamination with bacteria.	Equipment and work environment improperly controlled and sanitized.	Establishment of a hygienization plan with effective methods for sanitizing equipment and instruments.
Pre-treatment	X			Survival or cross-contamination with bacteria.	Cooking process not following the established parameters (temperature, time); Poor hygienization of the equipment.	Adequate calibration of equipment; Establishment of a hygienization plan with effective methods for sanitizing equipment and instruments.
Cooling	X			Cross-contamination with bacteria.	Equipment and work environment improperly controlled and sanitized.	Establishment of a hygienization plan with effective methods for sanitizing equipment and instruments.
Freezing	X			Growth/development of bacteria and/or mold.	Freezing process not following the established parameters (temperature, time).	Adequate calibration of equipment.
Packing	X			Cross-contamination with bacteria and mold.	Inadequate cleaning of utensils and equipment; Improper hygiene practices.	Establishment of a hygienization plan with effective methods for sanitizing equipment and instruments; Efficient calibration of room temperature; Good handling practices.
		X		Presence of foreign materials.	Bad conditions of the equipment in contact with the product; Improper hygiene practices.	Maintenance and calibration of equipment and instruments; Good handling practices.
			X	Contamination of final product by inks or other components present in packaging materials.	Lack of responsibility for product quality by the manufacturer; Bad condition of packaging material.	Ensure traceability and certification of suppliers.
Final Product Frozen Storage	X			Cross-contamination/ development of bacteria and fungi.	Equipment temperature improperly controlled.	Maintenance and calibration of equipment and instruments.
Expedition	X			Growth/development of bacteria and fungi.	Bad storage conditions, namely concerning temperature, can affect the cold chain; Bad handling practices.	Efficient temperature calibration; Proper handling practices.

Annex 4. Hazard severity classification regarding consumer 's health, according to Batista, P., Oliveira, J., Saraiva, J. M. A., Noronha, J. F. (2003) Modelos genéricos de HACCP. Forvisão - Consultoria em formação integrada.

Classificação	Exemplos
Alta	<p>Biológico: toxina do Clostridium botulinum, Salmonella Typhi, S. Paratyphi A e B, Shigella dysenteriae, Vibrio cholerae O1, Vibrio vulnificus, Brucella melitensis, Clostridium perfringens tipo C, vírus da hepatite A e E, Listeria monocytogenes (em alguns pacientes), Escherichia coli O157:H7, Trichinella spiralis, Taenia solium (em alguns casos).</p> <p>Químico: contaminação directa de alimentos por substâncias químicas proibidas ou determinados metais, como mercúrio, ou aditivos químicos que podem causar uma intoxicação grave em número elevado ou que podem causar danos a grupos de consumidores mais sensíveis.</p> <p>Físico: objectos estranhos e fragmentos não desejados que podem causar lesão ou dano ao consumidor, como pedras, vidros, agulhas, metais e objectos cortantes e perfurantes, constituindo um risco à vida do consumidor.</p>
Média	<p>Biológico: outras Escherichia coli enteropatogénicas, Salmonella spp., Shigella spp., Streptococcus β-hemolítico, Vibrio parahaemolyticus, Listeria monocytogenes, Streptococcus pyogenes, rotavírus, vírus Norwalk, Entamoeba histolytica, Diphylobothrium latum, Cryptosporidium parvum.</p>
Baixa	<p>Biológico: Bacillus cereus, Clostridium perfringens tipo A, Campylobacter jejuni, Yersinia enterocolítica, toxina do Staphylococcus aureus, a maioria dos parasitas.</p> <p>Químico: substâncias químicas permitidas em alimentos que podem causar reacções moderadas, como sonolência ou alergias transitórias.</p>

Annex 5. Decision tree, adapted from the Official Journal of the European Union. Communication from the Commission on the implementation of food safety management systems. 2016.



Annex 6. Determination of the critical control points of the production process of Appetito.

Step		Hazard		Risk Matrix			Decision Tree				CCP
				F	S	R	Q1	Q2	Q3	Q4	
Raw Materials Reception and Storage	Whole wheat/rye flour	B	<i>Bacillus cereus</i>	1	1	1	-	-	-	-	-
			<i>Escherichia coli</i>	3	3	9	Y	N	Y	N	1
			Fungi (<i>Aspergillus</i> , <i>Penicillium</i> and <i>Fusarium</i>)	1	2	2	-	-	-	-	-
	Tomato Paste	B	<i>Staphylococcus aureus</i>	1	1	1	-	-	-	-	-
			<i>Clostridium botulinum</i>	3	3	9	Y	N	Y	N	2
			Impurities	1	3	3	-	-	-	-	-
Mixing and Kneading	Ingredients	B	Bacteria and/or mold	1	3	3	-	-	-	-	-
			Foreign materials	1	3	3	-	-	-	-	-
	Water	B	Bacteria (<i>Escherichia coli</i> ; <i>Cryptosporidium</i> ; <i>Clostridium perfringens</i>)	2	2	4	Y	N	Y	N	3
			Virus (Rotavirus)	2	2	4	Y	N	Y	N	
Stretching and Cutting		B	Cross-contamination with bacteria and/or mold	1	3	3	-	-	-	-	-
		P	Foreign materials	2	3	6	Y	N	Y	N	4
Mixing	Spices	C	Mycotoxins	2	3	6	Y	N	Y	N	5
Placement of Second Layer		B	Cross-contamination with bacteria	1	3	3	-	-	-	-	-
Pre-treatment		B	Survival of bacteria	2	3	6	Y	N	Y	N	6
			Cross-contamination with bacteria	2	3	6	Y	N	Y	Y	-
Cooling		B	Cross-contamination with bacteria	1	3	3	-	-	-	-	-

Freezing	B	Growth/development of bacteria and/or mold.	2	3	6	Y	Y	Y	N	7
Packing	B	Cross-contamination with bacteria and/or mold	2	3	6	Y	N	Y	N	8
	P	Foreign materials	2	3	6	Y	N	Y	Y	-
	C	Contamination with inks or other components	1	1	1	-	-	-	-	-
Final Product Frozen Storage	B	Growth/development of bacteria	2	3	6	Y	N	Y	N	9
		Cross-contamination with bacteria	2	3	6	Y	N	Y	Y	-
Expedition	B	Growth/development of bacteria and/or mold.	2	3	6	Y	N	Y	N	10

F- Frequency; S- Severity; R- Risk