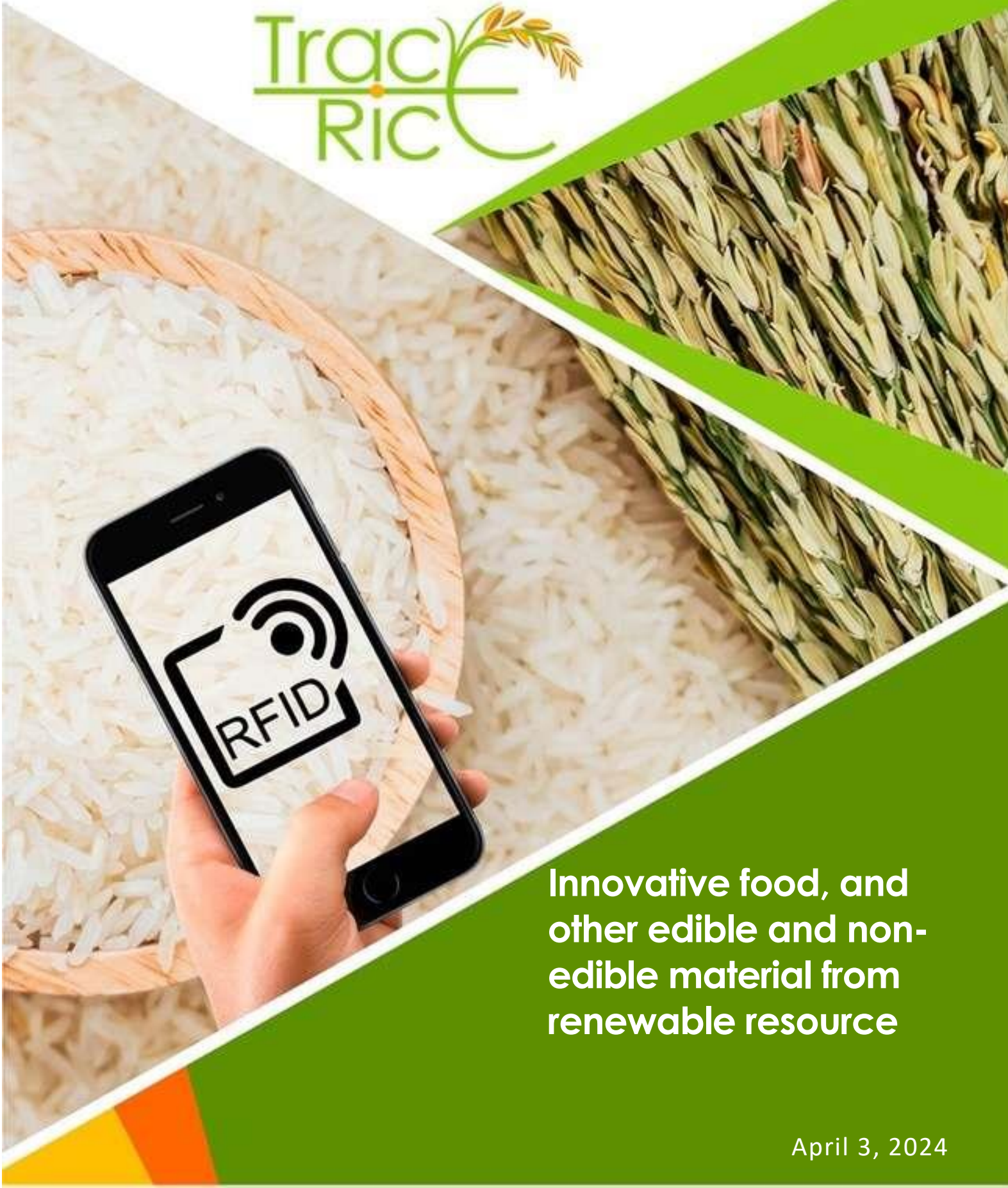


# Innovative food, and other edible and non-edible material from renewable resource

April 3, 2024

TRACE-RICE with Grant nº 1934, is part of the PRIMA Programme supported under Horizon 2020, the European Union's Framework Programme for Research and Innovation

PRIMA IN THE MEDITERRANEAN AREA

http://trace-rice.eu

# TECHNICAL REFERENCES

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|---|---|
| **Project Acronym** | TRACE-RICE |
| **Project Coordinator** | Carla Moita Brites |
| **Project Duration** | September 2020 – August 2024 (48 months) |

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| **Dissemination level*** | CONFIDENTIAL |
| **Work Package** | WP3 -CIRCULAR ECONOMY APPLICATIONS IN RICE CULTIVATION AND NEW HIGH-ADDED VALUE PRODUCTS |
| **Task** | T3.4- Developing innovative food and beverages by integrating rice-based ingredients |
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Written by: Joaquin Salvo Agramunt

Grupo Desarrollo

| HISTORY OF CHANGES | | | |
|---|---|---|---|
| Date | Beneficiary | Version | Change |
| 1 September 2023 | DPL | V0.1 | Document started. |
| 18 October 2023 | IATA-CSIC | V0.2 | First draft version. |
| 23 November 2023 | INIAV | V0.3 | Second draft version |
| 2 April 2024 | DPL | V0.4 | Revised version sent to Project Coordinator |
| 3 April 2024 | INIAV | Final | Final version approved by project coordinator |

# TABLE OF CONTENTS

# Executive summary

The objective of this task is to develop products based on rice by-products. In this case it is rice bran, which has traditionally been used for animal feeding. Firstly, there is the stabilization of the product to prevent its degradation by separating the fat from the fiber. In second place will be its conditioning for use. The resulting fiber will be used mainly for food and to obtain products rich in fiber without subtracting flavor thanks to sourdoughs and thanks to the use of enzymes we will obtain good kneading. The part of the fat will be used for cosmetics and skin care. For this reason, we have collaborated with a cosmetics laboratory to obtain commercial cosmetic products.

# 1-INTRODUCTION

In recent years everything related to the environment is in vogue. Ecofriedly products are gradually taking over the market, even displacing healthy foods. This is due to the fact that the media, national policies, educational laws, etc., are promoting everything related to caring for nature. Given the current dynamics, the use of by products that used to be discarded is becoming more and more common. Obtaining healthy products is increasingly linked to a greater respect for nature and the habits of using products that are organic as environmentally friendly are becoming more and more attractive. For many years the by-products of rice, in our case the bran that comes from it, were used in livestock feed because of its large amount of fatty matter, this product went rancid quickly, which meant that the product was not sufficiently valued due to its short shelf life. Thanks to the development of new industrial techniques for the stabilization of this by product, the value of this product is beginning to increase. The products that come from rice by-products are gradually beginning to be known in the market. Rice bran offers us a series of very interesting possibilities for both food and cosmetic lines. Given our experience in the bakery market we are going to try to incorporate rice bran in our formulations as a healthy way of fiber intake. We see this fiber as very interesting as it is gluten free which opens up a new market for us.

# 2-Objectives:

The main objective is to find novel products from rice or with rice by products.

# 3-Development:

Several tasks are going to be exposed. Some of them were done before the project, but they are important to outline them. It is important to have an overview of the process of choosing both, raw material and extractive process. This will allow to get several objectives that, at the time of selling our preparations, it could be interesting as, for example, the promotion of local products and the purity and quality of our extracts.

## *3.1. Considerations for choice rice bran supplier*

It is important to have the rice bran in an area not too far away (maximum 100Km). Although the product is cheap, as it is a rice by product traditionally used for animal feed, it would be very expensive to transport, because it is a very bulky product and its transportation would increase costs and would make the product more expensive. But, in our case, the extraction factory and our facilities are located within this desirable area of influence.

The price of moving a kilo from one place to another is very high for each transport, which is a problem similar to that suffered by wheat flour millers nowadays.

In the case of Spain, this would rule out the Ebro and Extremadura areas, among others, as well as abroad. That would reduce the scope of action to the province.

The second problem that arises is the availability. There are very interesting mills and with the seal of ecological, but these do not have the necessary quantities for an adequate production. It must be taken into account that our choice for the extraction of the oil by supercritical is very expensive compared to other alternatives, although the product is not damaged and maintains all its properties unalterable. The problem is that doing that is very expensive and the only way to lower the price is to defat a large amount of bran.

Each defatting process has a previous cleaning phase, before and after the process. Each cleaning lasts one day, so, whatever you do in the plant, the cleaning would take two days. It is not the same to dedicate five days to degreasing than one, since the more days the more it is compensated. This forces to look for companies with large production runs and varieties with a lot of use, since when it is manufactured, it is nedeed to have raw material in large quantities to not stop the production.

The other important handicap is the standardization of the product. It is preferred a lower quality but always the same. In the work of collecting data and information, there is communication with potential customers for the purchase of oil, cosmetic companies or intermediaries of cosmetic companies. All of them preferred highly standardized products instead of raw materials of high quality, but low standardization. This makes it necessary to focus on industries with customers who demand a very high standardization of the product.

After all the above, the choosen company was "Arroceras PONS", which is a nearby company, in Massanasa (Valencia). It is a company of considerable size, which produces rice to the commercial surfaces of the country. Some customers of Pons are the most demanding companies in Spain. All of that guarantees the product standardization that is looked for.

Arroceras Pons recommendation was to use the J. Sendra variety, because they would have that variety and it is very controlled. Their client demands it. As for the quality of the oil, it is more or less similar to the others.

## *3.2 Extraction with supercritical fluids*

The objective of this task was to obtain defatted rice bran and a rice bran oil by means of supercritical extraction technology, in sufficient quantity to be able to carry out the next phase of experimentation proposed in the project.

For this purpose, a scale-up was carried out at ALTEX (Company) Supercritical CO2 Extraction to process rice bran by means of supercritical CO2. It opted for this process for several reasons: the first one would be that through this process it is obtained a high quality product (which has not been affected by the extraction process); another reason is that it is obtained a "clean" product (because it is not used any chemical for extraction, like hexane type or others); finally, using this innovative process is a very attractive claim for sales.

An applied extractive process was used to obtain two separate fractions in each of the separators of the installation (Figure 1). On the one hand, the fat fraction was obtained in Separator 1 (S1), while a small proportion of aqueous fraction (1) was obtained in Separator 2 (S2). The extract obtained in S1, the fat fraction, did not require additional homogenization and separation processes to recover the oily fraction separately.

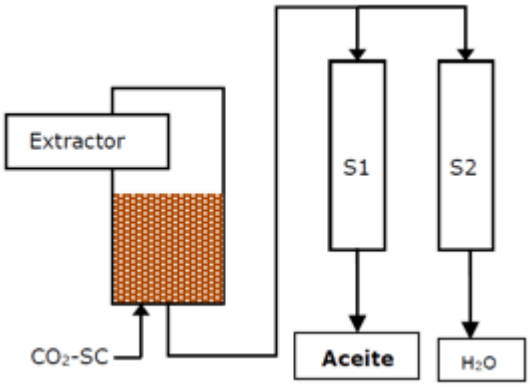



Figure 1: Schematic of extraction process

Specifically, the conditions of the applied process are shown in the following Figure 2.

| | Temperatura extracción (ºC) | Presión (bar) | Relación $CO_2$/materia prima |
|---|---|---|---|
| Proceso referencia | 55 | 300 | 80 |

Figure 2: Extraction conditions

All the extracts obtained (rice bran oil) and the refined (defatted bran) resulting from the extractive process were bottled.

The following tables show the data of the extracted oil, where the antioxidants and sterols can be seen. Here you can appreciate the richness in antioxidants.

| Nutrients (g/100 g) | Oil |
|---|---|
| Protein | <0,7 |
| Fat | 93,8 |
| Humidity | 5,5 |
| ashes | <0,1 |
| Carbohydrates | <0,1 |
| **Energy** | **844,0** |

Figure 3

| Vitamina E (mg/100g) | |
|---|---|
| Alfa-tocoferol | 16,93 |
| Gamma Tocoferol | 8,11 |
| Beta-tocoferol | 7,05 |
| Alfa-tocotrienol | 8,10 |
| Gamma Tocotrienol | 3,66 |
| Beta-tocotrienol | 1,50 |
| Total tocoferoles | 30,44 |
| Total tocotrienoles | 12,09 |

Figure 4

| Esteroles (mg/100 g) | |
|---|---|
| Esteroles totales | 1539,00 |
| Colesterol | 9,20 |
| Brasicasterol | 3,10 |
| 24 Metilen-Colesterol | 4,60 |
| Campesterol | 32,30 |
| Campestanol | 0,38 |
| Estigmasterol | 167,80 |
| Delta 7-Campesterol | 27,70 |
| Delta 5,23-Estigmastadienol | <1,50 |
| Clerosterol | 10,80 |
| Beta-Sitosterol | 727,90 |
| Sitostanol | 29,20 |
| Delta 5-Avenasterol | 27,70 |
| Delta 5,24-Estigmastadienol | 12,30 |
| Delta 7-Estigmastenol | 38,50 |
| Delta 7-Avenasterol | 33,90 |

Figure 5

The nutritional values of the resulting fiber are shown in the following table

| Nutrients (g/100 g) | |
|---|---|
| Crude fiber | 13,59 |
| Total dietary fiber | 33,16 |
| Soluble fiber | 20,88 |
| insoluble fiber | 12,28 |
| fat | 7,00 |

Figure 6

The defatted fiber phase will be used, at least in part, for the production of breads and the fatty phase will be used for cosmetics.

### *3.3 Adequacy of the extracts*

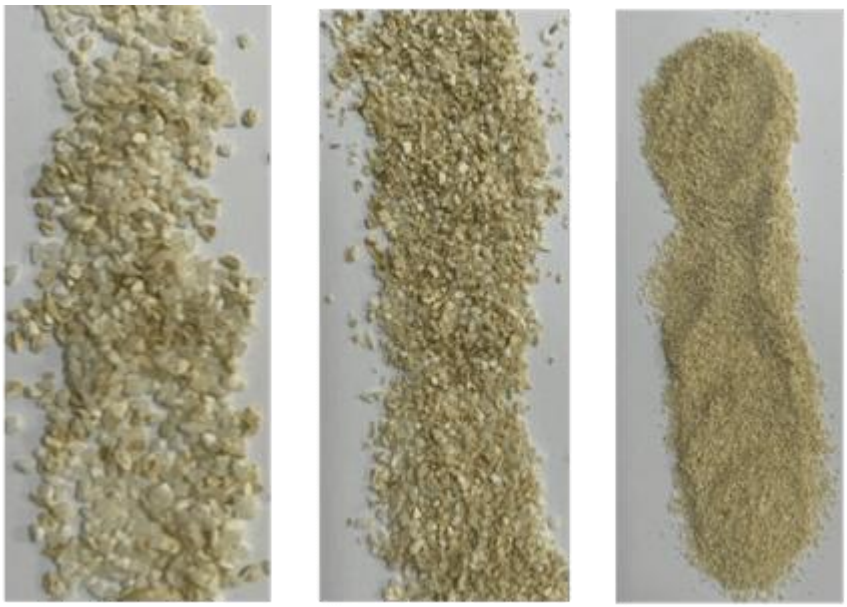
The defatted rice bran after the process looks quite coarse so it is decided to sieve and separate the finer parts from the coarse ones.

| Micras | Empty mass (g) | full weight(g) | fiber recovered (g) | % |
|---|---|---|---|---|
| Base | 240,040 | 241,400 | 1,36 | 1,369 |
| 105 | 322,400 | 341,900 | 19,5 | 19,626 |
| 210 | 341,800 | 364,500 | 22,7 | 22,846 |
| 400 | 339,100 | 376,500 | 37,4 | 37,641 |
| 1000 | 358,700 | 377,100 | 18,4 | 18,519 |
| 2380 | 379,800 | 379,800 | 0 | 0,000 |
| | | **TOTAL** | **99,36** | **100,000** |

Figure 7

For the production of bakery products, fiber with a particle size less than 400 microns was chosen because it is less perceptible on an organoleptic level.

From a sales point of view, this granulometry is more attractive for the exploitation of the product because, on the one hand, being so fine it has a magnificent dispersion, and, on the other hand, it is ideal for preparing mixtures. In any case, and taking into account the sales price of the product, the fiber could be crushed with a size less than 1000 microns to give it a finer granulometry. However, this would make the product more expensive since a hammer mill or industrial crusher would have to be incorporated into production to refine the fiber. In addition, it would be necessary to have energy to produce the product, which would increase production costs.

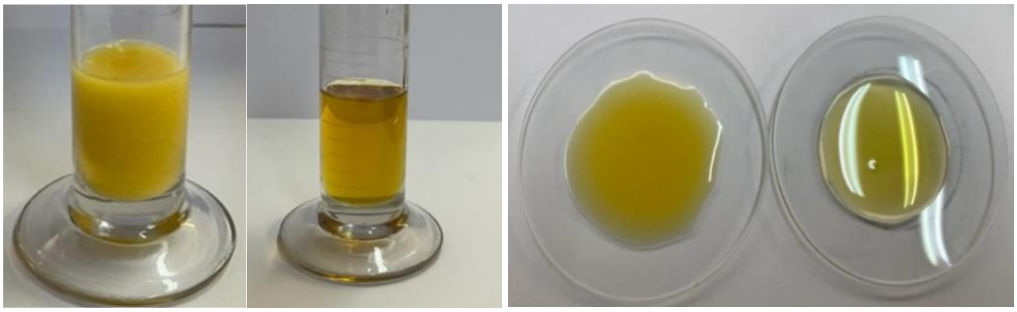


Figures 8,9,10

Finally, it was made three fractions: the coarsest (greater than 1000 microns), intermediate (greater than 400 microns) and final (the rest) as shown in the three illustrations above (Figures 8, 9, 10).

it would be used the finest one for the elaboration of bakery products. The middle and intermediate part would be used for cosmetics.

The oil obtained is cloudy, yellowish in color, silky to the touch and with a slight smell of cereal. Normally it is sold commercially filtered with a nice golden color (Figures 11,12,13).



Figures 11,12,13

| Essays | Oil |
|---|---|
| Acidity (8g A.oleic/100g sfg) | 8,93 |
| smoke point | 322 º C |
| Waxes (%) | 0,016 |
| Peroxide index (meqO2/kg sfg) | 22 |

Figure 14

It was decided not to filter it for our cosmetic products as there were no suitable filters for this purpose. however, we filtered a few milliliters through paper filters for some tests.

Such cloudy oil is not attractive, so It was decided to filter it to make it more attractive, even though the cost of this would be higher.

It is necessary to find several aspects of the oil, but with emphasis on two:

-Any heat treatment above 80ºC approx. produces that at the time of cooling it remains solid as solid fat due to the wax. The oil must be filtered to avoid this.

-If the product is not filtered, it would have to be stabilized because with time it divides into phases.

As will be seen later, the cosmetic products will be in the form of a paste, so their physical appearance is not important. The trend will always be to minimize processes to reduce product costs.

### *3.4 Fiber incorporation in bread basis to improve the Food properties*

The objective of this work is to evaluate the potential use of defatted rice bran as a food ingredient to enrich fiber products. For this, DESARROLLOS PANADEROS LEVANTINOS wascarry out the study to incorporate defatted rice bran (RBD) in 4 different bread matrices: bread, diet biscuits, pizza base for freezing and some special bread. For each of these matrices, it was also considered the evaluation of the incorporation of RBD in mixes with and without gluten, so f 8 matrices were treated. Firstly, the formulations and production processes of the control products were standardized (without incorporating RBD). Based on these simple controls, the fiber content was analyzed, so the percentage of enrichment necessary to obtain products with a "high level of fiber" can be calculated.

The addition of RBD in all the products will require an adjustment stage, with the formulation and the process variables, to improve the dough during all the stages. DESARROLLOS PANADEROS was developed the baking tests in pilot plant of the different matrixes, once defined the specific formulations for each matrix and was adjust the process to the fiber presence.

To analyze the influence of the RBD incorporation in the organoleptic Quality, an internal panel of tasters wascreate in order to perform sensory analyses with an hedonic scale (1 to 9). The results obtained allowed to valuate RBD incorporation and compare the sensorial attributes (texture, appearance, color, flavor, etc.), respect to the control samples.

#### *3.4.1 Preparation of the matrices*

##### *3.4.1.1 Bread Matrix*

The task were started developing the basis formula for bread in which DPL can use the RBD ingredient object of the study after that. By the same way, with the pertinent modifications, another one recipe was formulated that could be viable to be used in the production of gluten-free bread. In the following figure 15 are detailed the compositions basis selected, in 1 Kg bases, for both types of bread:

| Basic Gluten Bread Formula | Kg |
|---|---|
| Wheat flour | 0,527 |
| Rye flour | 0,050 |
| Freeze-dried sourdough | 0,020 |
| Improver 'bread with gluten' | 0,000 |
| Salt | 0,015 |
| yeast | 0,011 |
| Water | 0,376 |
| TOTAL | 1,000 |

| Basic gluten-free bread formula | Kg |
|---|---|
| Rice flour | 0,154 |
| Starch | 0,406 |
| hydrocolloids | 0,073 |
| Improver ' gluten gluten free' | 0,007 |
| bread flavour | 0,002 |
| Salt | 0,014 |
| yeast | 0,011 |
| Water | 0,333 |
| TOTAL | 1,000 |

Figure 15: Compositions in 1 Kg bases, for gluten and gluten-free breads

In the formulation of bread with gluten there was used flour and mother dough of rye with the objective of obtaining one product adapted to the fiber bread concept that the Spanish consumer knows. These ingredients would give flavor, color and proper qualities of an integral bread, often associated to a bread enriched with fiber.

The bread improver 'bread with gluten' used in the Basic Gluten Bread Formula was also used by the technicians of the company to this purpose. In the case of gluten-free bread formula there was used an improver specifically designed for "gluten free" breads. These components of the formula were made following the know-how internal of the company combining some enzymes and charging materials in the adequate quantity to the final purpose.

In both cases, the selected process was a direct process (Figure 16) in which there were stablished conditions of the beginning process to adjust after that according with the influence of the RBD ingredient up the stablished parameters. Due to the absence of proteins that develop gluten in the production of gluten free bread, in the processing of this type of bread is not necessary to make a fermentation stage in block intermedia.

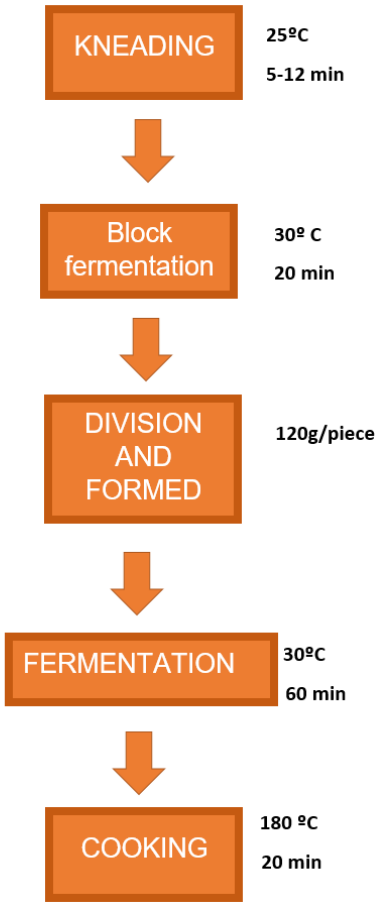



Figure 16: Process direct bakery

During the process there were data of temperatures, times and speed of kneading applied to adjust to the formula stablished. In the following illustration (Figure 17) there

are images of the process of bakery with which was elaborated the control bread with gluten: a) kneading, b) fermentation in block, c) fermentation in piece, d) cooking, e) final pieces aspect and f) bread crumb and overall aspect.

.


Figure 17: Bakery process of control bread with gluten: a) kneading, b) fermentation in block, c) fermentation in piece, d) cooking, e) final pieces aspect, f) bread crumb and overall aspect.

Once made the control bread, within and without gluten, there were formulated and processed as bread samples with the new fiber of RBD as there was necessary to obtain the final formula prepared for it consumption, adequate to the commercialization. At the following there are presented all the formula of de Bread RBD with gluten tested in pilot plat. However, the formulas are made in basis 1 kgand the kneading in the pilot plant were made with 15 Kg batches of dough.

| Basic Gluten Bread Formula 1 | Kg |
|---|---|
| Wheat flour | 0,377 |
| Rye flour | 0,050 |
| Freeze-dried sourdough | 0,020 |
| Rice fiber | 0,150 |
| Improver 'bread with gluten' | 0,000 |
| Salt | 0,015 |
| yeast | 0,011 |
| Water | 0,376 |
| TOTAL | 1,000 |

| Basic Gluten Bread Formula 2 | Kg |
|---|---|
| Wheat flour | 0,367 |
| Rye flour | 0,050 |
| Freeze-dried sourdough | 0,020 |
| Rice fiber | 0,160 |
| Improver 'bread with gluten' | 0,000 |
| Salt | 0,015 |
| yeast | 0,011 |
| Water | 0,376 |
| TOTAL | 1,000 |

| Basic Gluten Bread Formula 3 | Kg |
|---|---|
| Wheat flour | 0,357 |
| Rye flour | 0,050 |
| Freeze-dried sourdough | 0,020 |
| Rice fiber | 0,170 |
| Improver 'bread with gluten' | 0,000 |
| Salt | 0,015 |
| yeast | 0,011 |
| Water | 0,376 |
| TOTAL | 1,000 |

| Basic Gluten Bread Formula 4 | Kg |
|---|---|
| Wheat flour | 0,367 |
| Rye flour | 0,050 |
| Freeze-dried sourdough | 0,020 |
| Rice fiber | 0,160 |
| Improver 'bread with gluten' | 0,0002 |
| Salt | 0,015 |
| yeast | 0,011 |
| Water | 0,376 |
| TOTAL | 1,000 |

| Basic Gluten Bread Formula 5 | Kg |
|---|---|
| Wheat flour | 0,367 |
| Rye flour | 0,050 |
| Freeze-dried sourdough | 0,020 |
| Rice fiber | 0,160 |
| Improver 'bread with gluten' | 0,0003 |
| Salt | 0,015 |
| yeast | 0,011 |
| Water | 0,376 |
| TOTAL | 1,000 |

| Basic Gluten Bread Formula 6 | Kg |
|---|---|
| Wheat flour | 0,367 |
| Rye flour | 0,050 |
| Freeze-dried sourdough | 0,020 |
| Rice fiber | 0,160 |
| Improver 'bread with gluten' | 0,0004 |
| Salt | 0,015 |
| yeast | 0,011 |
| Water | 0,376 |
| TOTAL | 1,000 |

Figure 18: Bread formulas with RBD and gluten

In these formulations of RBD bread with gluten firstly was applied a percentage of fiber of 15%, quantity very high of this type of component in the formulation of bakery products. It was considered that incorporate this ingredient to the formula will become a difficulty in the maquinability of the dough during it processing so it was increased gradually (formulas 2 and 3) up to 17%. However, the bread valuation elaborated with the formula 3 was not satisfactory, selecting the Number 2 to continue with the study.

From the formula 2 it was decided to increase the quantity of improver used. So, it worked in pilot plant with other three formulations: n°4, 5 y 6. The quantity of water in the elaborations were adjusted at the end of each kneading according to the adequate manipulation. The ending formula selected of RBD bread with gluten to it commercialization was the n°5.

In the following Figuere 18, there are showed images of the baking process used in these assays with the bread with RBD and gluten: image a) fermentation in block, b) division, c) bowled, d) fermentation in piece, e) cooking and f) bread crumb and overall aspect.


Figure 19: Baking images of bread with RBD and gluten a) fermentation in block, b) division, c) bowled, d) fermentation in piece, e) cooking and f) bread crumb and overall aspect.

As can be seen in the following figures (figures 19,20,21), the choice of sample number five is justified among other things by a better fermentation obtaining a greater volume, in addition to better texture data. The addition of the improver to the formula is clearly noticeable

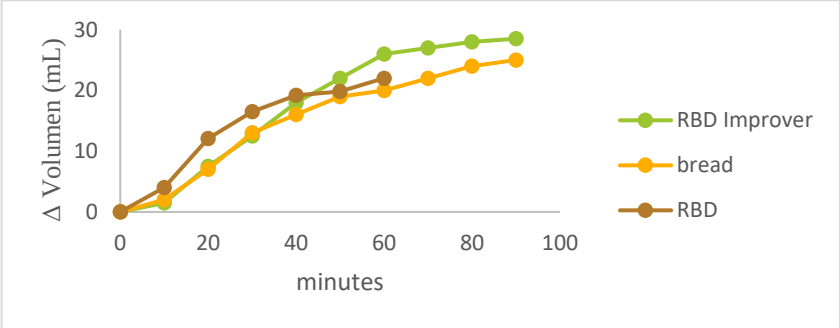



Figure 20: Increase in volume of formulated breads in function of fermentation time

| RBD | |
|---|---|
| Crumb | |
| Compression Strength (%) | 60,0 |
| Recovery (%) | 92,0 |
| DOUGH | |
| Mass relaxation (%) | 66,7 |

| RBD with improver | |
|---|---|
| Crumb | |
| Compression Strength (%) | 66,667 |
| Recovery (%) | 91,667 |
| DOUGH | |
| Mass relaxation (%) | 55,56 |

Figure 21: Dough and Crumb Data with and without improver

According to the formulation of RBD bread gluten free, the following Illustration 22 gets the formulas used in pilot plant to obtain the finally adjusted to elaborate a ready product to its commercialization. Due to the difficulty of working with gluten free products, there was decided to start working with a quantity of RBD fiber of 10% and increasing the quantity until find the optimum of employing. In this way, the formula n°3, we say, with a 15% of RBD, was selected according to the quantity of fiber RBD to follow with the investigations. Increasing the quantity of improver with this formula did not result into a getting better quality of the obtained breads. This situation made the technicians of the company to resume the employment of the formula n°4 in the study of the influence of the improver with the bread qualities and its processing characteristics. Nevertheless, there were not good results. The formula finally selected was n°3.

| Basic gluten-free bread formula 1 | Kg |
|---|---|
| Rice flour | 0,154 |
| Starch | 0,304 |
| Rice fiber | 0,1 |
| hydrocolloids | 0,073 |
| Improver ' gluten gluten free' | 0,008 |
| bread aromas | 0,001 |
| Salt | 0,014 |
| yeast | 0,011 |
| Water | 0,333 |
| TOTAL | 1,000 |

| Basic gluten-free bread formula 2 | Kg |
|---|---|
| Rice flour | 0,154 |
| Starch | 0,304 |
| Rice fiber | 0,125 |
| hydrocolloids | 0,073 |
| Improver ' gluten gluten free' | 0,008 |
| bread aromas | 0,001 |
| Salt | 0,014 |
| yeast | 0,011 |
| Water | 0,333 |
| TOTAL | 1,000 |

| Basic gluten-free bread formula 3 | Kg |
|---|---|
| Rice flour | 0,150 |
| Starch | 0,260 |
| Rice fiber | 0,15 |
| hydrocolloids | 0,073 |
| Improver ' gluten gluten free' | 0,008 |
| bread aromas | 0,001 |
| Salt | 0,014 |
| yeast | 0,011 |
| Water | 0,333 |
| TOTAL | 1,000 |

| Basic gluten-free bread formula 4 | Kg |
|---|---|
| Rice flour | 0,150 |
| Starch | 0,235 |
| Rice fiber | 0,175 |
| hydrocolloids | 0,073 |
| Improver ' gluten gluten free' | 0,008 |
| bread aromas | 0,001 |
| Salt | 0,014 |
| yeast | 0,011 |
| Water | 0,333 |
| TOTAL | 1,000 |

| Basic gluten-free bread formula 5 | Kg |
|---|---|
| Rice flour | 0,150 |
| Starch | 0,260 |
| Rice fiber | 0,15 |
| hydrocolloids | 0,073 |
| Improver ' gluten gluten free' | 0,009 |
| bread aromas | 0,001 |
| Salt | 0,014 |
| yeast | 0,011 |
| Water | 0,333 |
| TOTAL | 1,001 |

| Basic gluten-free bread formula 6 | Kg |
|---|---|
| Rice flour | 0,150 |
| Starch | 0,234 |
| Rice fiber | 0,175 |
| hydrocolloids | 0,073 |
| Improver ' gluten gluten free' | 0,009 |
| bread aromas | 0,001 |
| Salt | 0,014 |
| yeast | 0,011 |
| Water | 0,333 |
| TOTAL | 1,000 |

| Basic gluten-free bread formula 7 | Kg |
|---|---|
| Rice flour | 0,150 |
| Starch | 0,233 |
| Rice fiber | 0,175 |
| hydrocolloids | 0,073 |
| Improver ' gluten gluten free' | 0,010 |
| bread aromas | 0,001 |
| Salt | 0,014 |
| yeast | 0,011 |
| Water | 0,333 |
| TOTAL | 1,000 |

| Basic gluten-free bread formula 8 | Kg |
|---|---|
| Rice flour | 0,150 |
| Starch | 0,232 |
| Rice fiber | 0,175 |
| hydrocolloids | 0,073 |
| Improver ' gluten gluten free' | 0,011 |
| bread aromas | 0,001 |
| Salt | 0,014 |
| yeast | 0,011 |
| Water | 0,333 |
| TOTAL | 1,000 |

Figure 22: Formulas of Breads with RBD gluten free

The following figure 23 shows images of the process of baking to elaborate the **bread RBD gluten free**: image a) aspect of fiber RBD, b) kneading, c) detail of piece formed d) pieces after fermentation in piece and e) final aspect of the pieces.


Figure 23: Images of baking with RBD and gluten free: a) aspect of fiber RBD, b) kneading, c) detail of piece formed d) pieces after fermentation in piece and e) final aspect of the pieces.

In the following figures (Figures 24,25,26) it can be seen by graphic illustration why formulation number 3 (Figure 22) has been chosen; In fact the influence of improver in the increase of bread volume is practically not noticeable

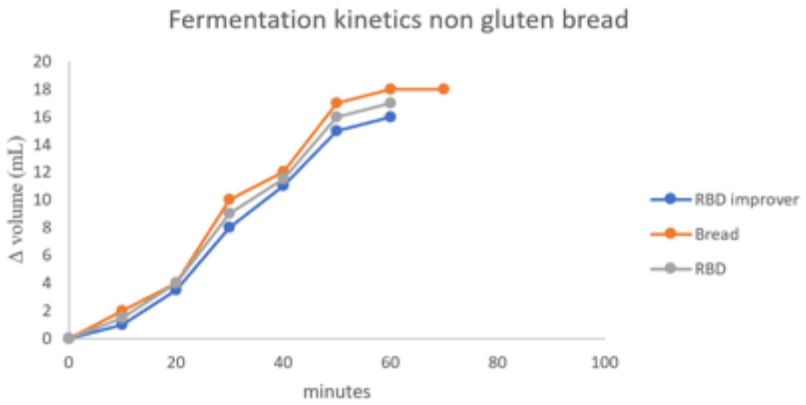



Figure 24 Increase in volume of formulated breads in function of fermentation time

| RBD | |
|---|---|
| Crumb | |
| Compression Strength (%) | 66,7 |
| Recovery (%) | 83,3 |
| DOUGH | |
| Mass relaxation (%) | 50,0 |

Figure 25: Dough and Crumb Data without improver

| RBD with improver | |
|---|---|
| Crumb | |
| Compression Strength (%) | 66,667 |
| Recovery (%) | 91,667 |
| DOUGH | |
| Mass relaxation (%) | 55,56 |

Figure 26: Dough and Crumb Data with improver

Following, in the figure 27, is presented the data of the variables of the process used in bakery and selected formulas.

| TEST: | | Control Bread with gluten | | | Gluten-free Control bread | | | RBD Bread with gluten | | | RBD Gluten-free bread | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables: | | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others |
| KNEADING | Initial | | | | | | | | | | | | |
| Equipament: Varimex | Final | 22 | 12 | | 23 | 16 | | 24 | 13 | | 23 | 17 | |
| BLOCK FERMENTATION | Initial | | | | | | | | | | | | |
| Equipament: Room Temperature | Final | 20-25 | 15 | | 20-25 | 12 | | 20-25 | 16 | | 20-25 | 15 | |
| DIVISION AND BALL | Initial | | | | | | | | | | | | |
| Equipament: manual | Final | 20-25 | 15 | | 20-25 | 12 | | 20-25 | 16 | | 20-25 | 15 | |
| FERMENTATION IN PIECE | Initial | | | | | | | | | | | | |
| Equipament: camera | Final | 30 | | | 28 | | | 30 | | | 29 | | |
| COOKING | | | | | | | | | | | | | |
| Equipament: Rotacional y Eurofred | | 181 | 19 | | 180 | 23 | | 170 | 19 | | 170 | 22 | |
| OBSERVATIONS: | | Two shots of steam at the beginning of cooking | | | Two shots of steam at the beginning of cooking | | | Two shots of steam at the beginning of cooking | | | Two shots of steam at the beginning of cooking | | |

Figure 27: Data of the variables of the process used in bakery and selected formulas.

### 3.4.1.2 Cookie Matrix:

Similar to the previous, the works started developing a Basic formula of cookies in which are tested the RBD ingredient object of study that, with the precise modification, is viable to be used to the production of cookies gluten free. It can be seen in the figure 28 the detail of the compositions of cookies used as control (basic biscuit formula) presented in basis of 1 kg.

| Basic biscuit formula | Kg |
|---|---|
| Wheat flour | 0,472 |
| Sunflower oil | 0,115 |
| whey milk | 0,017 |
| Sugar | 0,047 |
| Salt | 0,019 |
| enzymatic corrector | 0,001 |
| Lemon flavor | 0,001 |
| vanilla flavor | 0,001 |
| Pusher | 0,012 |
| Water | 0,317 |
| TOTAL | 1,000 |

| Basic gluten-free biscuit formula | Kg |
|---|---|
| Korn flour | 0,0896 |
| Sunflower oil | 0,1174 |
| Starch | 0,1141 |
| Egg powder | 0,1141 |
| Rice fiber | 0,1666 |
| Sugar | 0,0978 |
| Enzymatic Cocktel | 0,0261 |
| enzymatic corrector | 0,0002 |
| Lemon flavor | 0,0001 |
| vanilla flavor | 0,0001 |
| Pusher | 0,0130 |
| Water | 0,2608 |
| TOTAL | 1,000 |

Figure 28: Control cookie formulas, with and without gluten

The formulation of cookies was traditional using flavors, salt and sugar. The intention was design a formula that, with minimal modifications, could be used easily to make cookies with different tastes. Newly, the enzymatic corrector used were designed by the technicians of the company for this. This improvers of the formulas were also made following the internal know-how of the company combining enzymes and charging materials in enough amount to the objective.

The process selected was a direct process (Figure 29) in which there were stablished conditions at the beginning process to adjust after according to the influence of the ingredient (RBD) in stablished parameters.

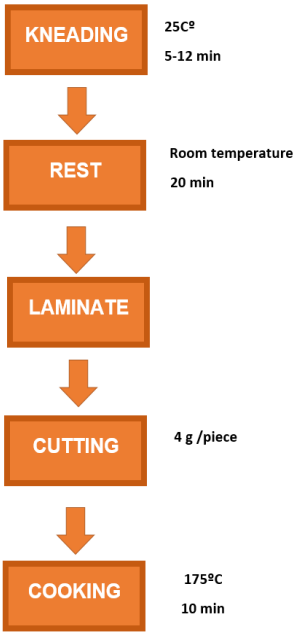



Figure 29: Process of production of cookies

During the process were token data of temperatures, times and speed of kneading applied to be adjusted to the ending formula used. In the following Figure 30 are showed images of the process of production with which were produced **control cookies with gluten**: image a) kneading, b) rest and laminated, c) split of pieces, d) baking, e) aspect of the final pieces.


*Figure 30: Images of production of cookies control with gluten: a) kneading, b) rest and laminated, c) split of pieces, d) baking, e) aspect of the final pieces.*

Simultaneously with the cookie 'control' production the cookie samples were formulated and processed with the ingredient under study (RBD). The following Figure 31 shows the formulas used in the study of RBD cookies with gluten.

| RBD Basic biscuit formula 1 | Kg |
|---|---|
| Wheat flour | 0,322 |
| Rice fiber | 0,150 |
| Sunflower oil | 0,115 |
| whey milk | 0,017 |
| Sugar | 0,047 |
| Salt | 0,019 |
| enzymatic corrector | 0,001 |
| Lemon flavor | 0,001 |
| vanilla flavor | 0,001 |
| Pusher | 0,012 |
| Water | 0,317 |
| TOTAL | 1,000 |

| RBD Basic biscuit formula 2 | Kg |
|---|---|
| Wheat flour | 0,314 |
| Rice fiber | 0,171 |
| Sunflower oil | 0,112 |
| whey milk | 0,017 |
| Sugar | 0,046 |
| Salt | 0,018 |
| enzymatic corrector | 0,001 |
| Lemon flavor | 0,001 |
| vanilla flavor | 0,001 |
| Pusher | 0,011 |
| Water | 0,309 |
| TOTAL | 1,000 |

| RBD Basic biscuit formula 3 | Kg |
|---|---|
| Wheat flour | 0,307 |
| Rice fiber | 0,191 |
| Sunflower oil | 0,110 |
| whey milk | 0,016 |
| Sugar | 0,045 |
| Salt | 0,018 |
| enzymatic corrector | 0,001 |
| Lemon flavor | 0,001 |
| vanilla flavor | 0,001 |
| Pusher | 0,011 |
| Water | 0,302 |
| TOTAL | 1,000 |

| RBD Basic biscuit formula 4 | Kg |
|---|---|
| Wheat flour | 0,306 |
| Rice fiber | 0,190 |
| Sunflower oil | 0,110 |
| whey milk | 0,016 |
| Sugar | 0,044 |
| Salt | 0,018 |
| enzymatic corrector | 0,0014 |
| Lemon flavor | 0,001 |
| vanilla flavor | 0,001 |
| Pusher | 0,011 |
| Water | 0,301 |
| TOTAL | 1,000 |

| RBD Basic biscuit formula 5 | Kg |
|---|---|
| Wheat flour | 0,306 |
| Rice fiber | 0,190 |
| Sunflower oil | 0,110 |
| whey milk | 0,016 |
| Sugar | 0,044 |
| Salt | 0,018 |
| enzymatic corrector | 0,002 |
| Lemon flavor | 0,001 |
| vanilla flavor | 0,001 |
| Pusher | 0,011 |
| Water | 0,301 |
| TOTAL | 1,000 |

| RBD Basic biscuit formula 6 | Kg |
|---|---|
| Wheat flour | 0,306 |
| Rice fiber | 0,190 |
| Sunflower oil | 0,109 |
| whey milk | 0,016 |
| Sugar | 0,044 |
| Salt | 0,018 |
| enzymatic corrector | 0,003 |
| Lemon flavor | 0,001 |
| vanilla flavor | 0,001 |
| Pusher | 0,011 |
| Water | 0,301 |
| TOTAL | 1,000 |

| RBD Basic biscuit formula 7 | Kg |
|---|---|
| Wheat flour | 0,306 |
| Rice fiber | 0,190 |
| Sunflower oil | 0,110 |
| whey milk | 0,016 |
| Sugar | 0,044 |
| Salt | 0,018 |
| enzymatic corrector | 0,002 |
| Lemon flavor | 0,001 |
| vanilla flavor | 0,001 |
| Pusher | 0,011 |
| Water | 0,301 |
| TOTAL | 1,000 |

| RBD Basic biscuit formula 8 | Kg |
|---|---|
| Wheat flour | 0,303 |
| Rice fiber | 0,188 |
| Sunflower oil | 0,118 |
| whey milk | 0,016 |
| Sugar | 0,044 |
| Salt | 0,018 |
| enzymatic corrector | 0,002 |
| Lemon flavor | 0,001 |
| vanilla flavor | 0,001 |
| Pusher | 0,011 |
| Water | 0,298 |
| TOTAL | 1,000 |

| RBD Basic biscuit formula 9 | Kg |
|---|---|
| Wheat flour | 0,296 |
| Rice fiber | 0,184 |
| Sunflower oil | 0,138 |
| whey milk | 0,016 |
| Sugar | 0,043 |
| Salt | 0,017 |
| enzymatic corrector | 0,002 |
| Lemon flavor | 0,001 |
| vanilla flavor | 0,001 |
| Pusher | 0,011 |
| Water | 0,292 |
| TOTAL | 1,000 |

Figure 31 : Formulas of RBD cookies with gluten tested in pilot design

As shown, it began using a proportion of 15% of fiber RBD, parallel as it was made with the bread formulations, that was increased in the finding of the Optimus employment. With this way it arrived up to 20% of RBD fiber. Because the qualities of the cookies produced with formulas n°2 y 3 did not variate substantially, it was decided to stop the increasing in addition of RBD fiber, and try to improve the qualities of the cookies, compensating the big charge that the new ingredient (RBD fiber) supposed with the combination of enzymes used.

It continued working with formulas n° 4, 5 y 6 increasing the quantity of improver since it was not possible to obtain an improvement in the quality of the cookies. In this way, the formula n° 5 obtained a better product than n°6.

At last, the technicians of DPL considerate the possibility of improving the characteristics of the cookies with fiber modifying the product format to a model of cookies type 'digestive' containing important fiber so they are formulated with a higher fat content. In this way the cookies with gluten were reformulated with 20% of fiber RBD, with the optimum quantity of enzymatic corrector and introducing increased quantities of sunflower oil: formulas n° 7, 8 y 9 (Figure 31). However, the result did not corroborate the hypothesis, obtaining doughs with difficult manipulation and did not improve the final product characteristics. After these tests, the formula finally selected was n°5

As for RBD gluten-free cookies, below are the formulas.

| RBD gluten-free biscuit formula 1 | Kg |
|---|---|
| Corn flour | 0,086 |
| Sunflower oil | 0,113 |
| Starch | 0,110 |
| Egg powder | 0,110 |
| Rice fiber | 0,200 |
| Sugar | 0,094 |
| Enzymatic Cocktel | 0,025 |
| enzymatic corrector | 0,000 |
| Lemon flavor | 0,000 |
| vanilla flavor | 0,000 |
| Pusher | 0,013 |
| Water | 0,250 |
| TOTAL | 1,000 |

| RBD gluten-free biscuit formula 2 | Kg |
|---|---|
| Corn flour | 0,084 |
| Sunflower oil | 0,110 |
| Starch | 0,107 |
| Egg powder | 0,107 |
| Rice fiber | 0,220 |
| Sugar | 0,092 |
| Enzymatic Cocktel | 0,024 |
| enzymatic corrector | 0,000 |
| Lemon flavor | 0,000 |
| vanilla flavor | 0,000 |
| Pusher | 0,012 |
| Water | 0,244 |
| TOTAL | 1,000 |

| RBD gluten-free biscuit formula 3 | Kg |
|---|---|
| Corn flour | 0,082 |
| Sunflower oil | 0,107 |
| Starch | 0,104 |
| Egg powder | 0,104 |
| Rice fiber | 0,238 |
| Sugar | 0,089 |
| Enzymatic Cocktel | 0,024 |
| enzymatic corrector | 0,000 |
| Lemon flavor | 0,000 |
| vanilla flavor | 0,000 |
| Pusher | 0,012 |
| Water | 0,238 |
| TOTAL | 1,000 |

| RBD gluten-free biscuit formula 4 | Kg |
|---|---|
| Corn flour | 0,080 |
| Sunflower oil | 0,105 |
| Starch | 0,102 |
| Egg powder | 0,102 |
| Rice fiber | 0,256 |
| Sugar | 0,087 |
| Enzymatic Cocktel | 0,023 |
| enzymatic corrector | 0,0002 |
| Lemon flavor | 0,000 |
| vanilla flavor | 0,000 |
| Pusher | 0,012 |
| Water | 0,233 |
| TOTAL | 1,000 |

| RBD gluten-free biscuit formula 5 | Kg |
|---|---|
| Corn flour | 0,080 |
| Sunflower oil | 0,105 |
| Starch | 0,102 |
| Egg powder | 0,102 |
| Rice fiber | 0,256 |
| Sugar | 0,087 |
| Enzymatic Cocktel | 0,023 |
| enzymatic corrector | 0,0003 |
| Lemon flavor | 0,000 |
| vanilla flavor | 0,000 |
| Pusher | 0,012 |
| Water | 0,233 |
| TOTAL | 1,000 |

| RBD gluten-free biscuit formula 6 | Kg |
|---|---|
| Corn flour | 0,080 |
| Sunflower oil | 0,105 |
| Starch | 0,102 |
| Egg powder | 0,102 |
| Rice fiber | 0,256 |
| Sugar | 0,087 |
| Enzymatic Cocktel | 0,023 |
| enzymatic corrector | 0,0004 |
| Lemon flavor | 0,000 |
| vanilla flavor | 0,000 |
| Pusher | 0,012 |
| Water | 0,233 |
| TOTAL | 1,000 |

| RBD gluten-free biscuit formula 7 | Kg |
|---|---|
| Corn flour | 0,076 |
| Sunflower oil | 0,154 |
| Starch | 0,096 |
| Egg powder | 0,096 |
| Rice fiber | 0,242 |
| Sugar | 0,083 |
| Enzymatic Cocktel | 0,022 |
| enzymatic corrector | 0,0004 |
| Lemon flavor | 0,000 |
| vanilla flavor | 0,000 |
| Pusher | 0,011 |
| Water | 0,220 |
| TOTAL | 1,000 |

| RBD gluten-free biscuit formula 8 | Kg |
|---|---|
| Corn flour | 0,071 |
| Sunflower oil | 0,206 |
| Starch | 0,090 |
| Egg powder | 0,090 |
| Rice fiber | 0,227 |
| Sugar | 0,077 |
| Enzymatic Cocktel | 0,021 |
| enzymatic corrector | 0,0003 |
| Lemon flavor | 0,000 |
| vanilla flavor | 0,000 |
| Pusher | 0,010 |
| Water | 0,206 |
| TOTAL | 1,000 |

Figure 32: Formulas of RBD gluten-free cookies tested in pilot plant

It was followed the same way of work that with previous formulas starting directly from a proportion of fiber RBD of 20% in the formulation. Because in the formulation of cookies the quality and quantity of gluten It is not as important as it is for bread making, it was considered that the gluten-free formulation could be favoured. In this way there were formulated the four fist formulations: nº1, 2, 3 y 4; reaching a substantial improvement of the quality of these cookies with each increment of RBD to the last formula.

After selecting formula No. 4 (which allowed maximum RBD fiber), work was carried out simultaneously on cookies with gluten, increasing the amount of improver and attempting a change in the format to a "digestive" type. In this case, the product was improved by increasing the amount of improver used instead of modifying the format. Therefore, the RBD gluten-free cookie formula finally selected was No. 6.

The Figure 33 shows the data variables of the process used in the production of control cookies and in the selected formulas.

| TEST: | | Control biscuits with gluten | | | Gluten-free Control biscuits | | | RBD biscuits with gluten | | | RBD biscuits Gluten free | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables: | | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others |
| KNEADING | Initial | | | | | | | | | | | | |
| Equipament: Varimex | Final | 21 | 6 | | 22 | 7 | | 23 | 7 | | 21 | 5 | |
| BLOCK FERMENTATION | Initial | | | | | | | | | | | | |
| Equipament: Room Temperature | Final | 20-25 | | | 20-25 | | | 20-25 | | | 20-25 | | |
| LAMINATE AND CUT | Initial | | | | | | | | | | | | |
| Equipament: manual | Final | 20-25 | | | 20-25 | | | 20-25 | | | 20-25 | | |
| COOKING | | | | | | | | | | | | | |
| Equipament: Rotacional y Eurofred | | 177 | 12 | | 176 | 13 | | 175 | 12 | | 176 | 12 | |
| OBSERVATIONS: | | | | | | | | | | | | | |

Figure 33: Variables of the process selected

### 3.4.1.3 Pizza base matrix

Like in the previous matrixes, it started developing the formula of the 'control' (basic formula) of the pizza bases in which we could use after that the RBD fiber. In the same way there was developed a basic gluten free formula of pizza bases also viable to be used in the production of gluten free bases with RBD fiber. At the following Figure 34 are detailed the compositions of the control bases selected, in basis of 1 kg

| pizza base | Kg |
|---|---|
| Wheat flour | 0,583 |
| Improver 'bread with gluten' | 0,005 |
| sun flower | 0,010 |
| Salt | 0,013 |
| yeast | 0,013 |
| Water | 0,376 |
| TOTAL | 1,000 |

| Gluten-free pizza base | Kg |
|---|---|
| Starch | 0,421 |
| Improver | 0,007 |
| hydrocolloids | 0,020 |
| bread Flavour | 0,000 |
| Olive oil | 0,020 |
| Salt | 0,012 |
| yeast | 0,013 |
| Water | 0,527 |
| TOTAL | 1,000 |

Figure 34: Formulas of bases of pizza control within and without gluten

Once again, the process used in the pilot tests was a direct process (Figure 35) in which there were stablished concrete conditions of the beginning process to adjust after that according to the influence of the RBD in the parameters stablished.

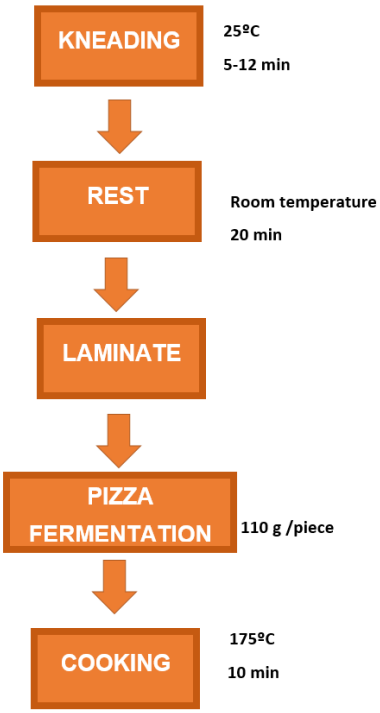



Figure 35: Process of production of pizza bases

During the production process, temperatures, times and other data variables details were get to adjust them to the end formula stablished. In the following Figure 36 are shown images of the process of production with which was elaborated the bases of pizza control with gluten: a) rest in block, b) manual laminating, c) pieces previous cooking, d) aspect of final pieces after cooking.

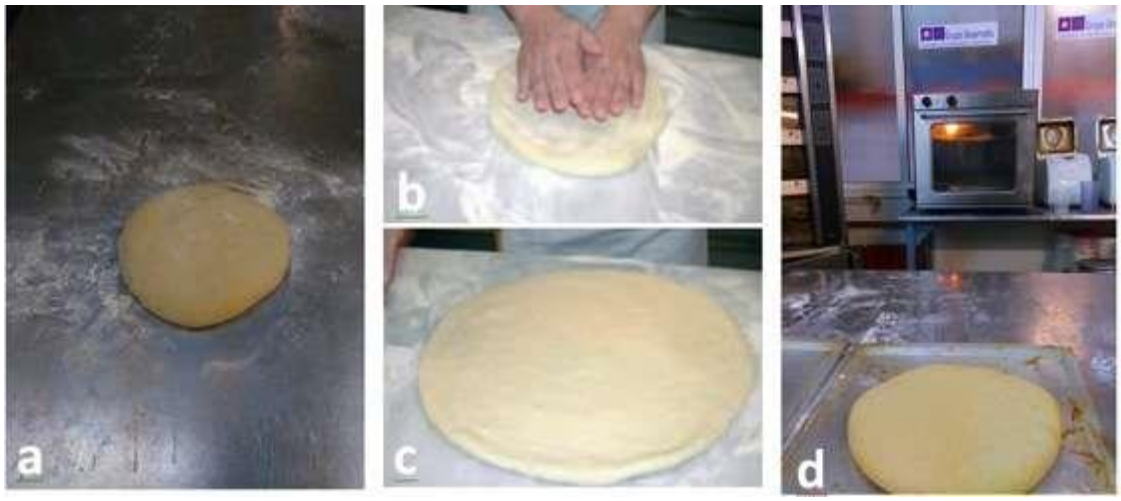



Figure 36: Images of production of pizza base control with gluten: a) rest in block, b) manual laminating, c) pieces previous cooking, d) aspect of final pieces after cooking

After this, there were elaborated samples of Bases of pizza RBD and gluten. In the Figure 37 are shown different moments of the processing.


Figure 37: Images of production of bases of pizza with RBD and gluten: a) weight of minority ingredients, b) piece weight, c) pieces collocation in cans previous to the fermentation, d) pieces after fermentation, f) aspect of pieces after pre-cooking and e) installations of the tests.

In the production of Bases of Pizza with fiber of RBD with gluten, samples were processed to some tests, and the formulas data are shown in Figure 38. As appreciated, it started using a low quantity of the ingredient object of study, lower of 10% (formulas n° 1 y 2) because the Technicians of DPL supposed that the RBD fiber would have negative influence in the dough development. However, it was possible to increase the proportion up to 15%, optimum point in the employment of this ingredient according to the results obtained

| RBD pizza base 1 | Kg |
|---|---|
| Wheat flour | 0,527 |
| Rice flour | 0,080 |
| Improver 'bread with glut | 0,005 |
| sun flower | 0,009 |
| Salt | 0,012 |
| yeast | 0,012 |
| Water | 0,355 |
| TOTAL | 1,000 |

| RBD pizza base 2 | Kg |
|---|---|
| Wheat flour | 0,527 |
| Rice flour | 0,090 |
| Improver 'bread with gluter | 0,005 |
| sun flower | 0,009 |
| Salt | 0,012 |
| yeast | 0,012 |
| Water | 0,355 |
| TOTAL | 1,000 |

| RBD pizza base 3 | Kg |
|---|---|
| Wheat flour | 0,527 |
| Rice flour | 0,100 |
| Improver 'bread with glut | 0,005 |
| sun flower | 0,009 |
| Salt | 0,012 |
| yeast | 0,012 |
| Water | 0,355 |
| TOTAL | 1,000 |

| RBD pizza base 4 | Kg |
|---|---|
| Wheat flour | 0,527 |
| Rice flour | 0,150 |
| Improver 'bread with gluter | 0,005 |
| sun flower | 0,009 |
| Salt | 0,012 |
| yeast | 0,012 |
| Water | 0,355 |
| TOTAL | 1,000 |

Figure 38: Formulas of pizza bases with RBD and gluten

The necessary tests to do the simples of pizza bases with RBD and gluten free were made following the same working schema. In the Figure 39 appear some moments of it processed: a) rest, b) perforation of pieces and c) fermentation.

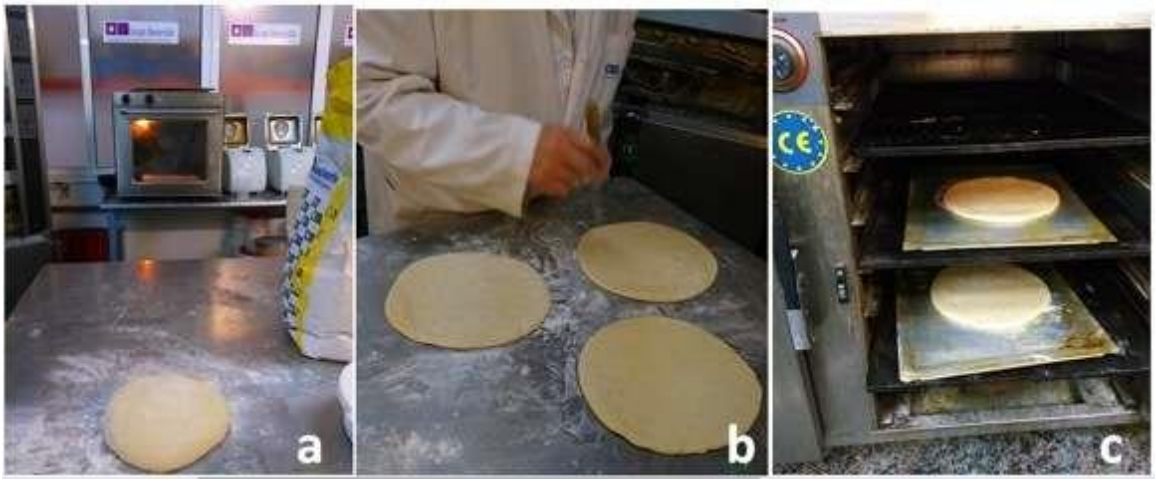



Figure 39: Images of production of pizza bases with RBD and gluten free: a) rest, b) perforation of pieces and c) fermentation.

The finding of the Optimus dosage of the employment of fiber RBD resulted more difficult in the case of the Pizza bases with fiber of RBD and gluten free. They were formulated and processed according to the Figure 40. As may be appreciated, we started in parallel to the work with Bases of pizza with RBD and gluten using a low proportion of the ingredient object of study (10%). However, seeing the good previous results, the DPL technicians increased the proportion up to 30%, despite of the optimum identified in the employment of this ingredient according to the results obtained in the formula nº2 was near to 20% (19,7%).

It continued studying the possible improvement in the bases due to the increment of the amount of improver made for this product. However, the results did not improve substantially in comparison with previously obtained. So, the selected formula were again nº 2.

| RBG Gluten-free pizza base 1 | Kg |
|---|---|
| Starch | 0,366 |
| Rice fiber | 0,100 |
| Improver | 0,006 |
| hydrocolloids | 0,018 |
| bread Flavour | 0,000 |
| Olive oil | 0,018 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,471 |
| TOTAL | 1,000 |

| RBG Gluten-free pizza base 2 | Kg |
|---|---|
| Starch | 0,321 |
| Rice fiber | 0,197 |
| Improver | 0,005 |
| hydrocolloids | 0,016 |
| bread Flavour | 0,000 |
| Olive oil | 0,016 |
| Salt | 0,010 |
| yeast | 0,011 |
| Water | 0,425 |
| TOTAL | 1,000 |

| RBG Gluten-free pizza base 3 | Kg |
|---|---|
| Starch | 0,293 |
| Rice fiber | 0,254 |
| Improver | 0,005 |
| hydrocolloids | 0,015 |
| bread Flavour | 0,000 |
| Olive oil | 0,015 |
| Salt | 0,009 |
| yeast | 0,010 |
| Water | 0,399 |
| TOTAL | 1,000 |

| RBG Gluten-free pizza base 4 | Kg |
|---|---|
| Starch | 0,293 |
| Rice fiber | 0,254 |
| Improver | 0,005 |
| hydrocolloids | 0,015 |
| bread Flavour | 0,000 |
| Olive oil | 0,015 |
| Salt | 0,009 |
| yeast | 0,010 |
| Water | 0,399 |
| TOTAL | 1,000 |

| RBG Gluten-free pizza base 5 | Kg |
|---|---|
| Starch | 0,293 |
| Rice fiber | 0,254 |
| Improver | 0,007 |
| hydrocolloids | 0,015 |
| bread Flavour | 0,000 |
| Olive oil | 0,015 |
| Salt | 0,009 |
| yeast | 0,010 |
| Water | 0,398 |
| TOTAL | 1,000 |

| RBG Gluten-free pizza base 6 | Kg |
|---|---|
| Starch | 0,292 |
| Rice fiber | 0,253 |
| Improver | 0,008 |
| hydrocolloids | 0,015 |
| bread Flavour | 0,000 |
| Olive oil | 0,015 |
| Salt | 0,009 |
| yeast | 0,010 |
| Water | 0,398 |
| TOTAL | 1,000 |

Figure 40: Formulas of pizza bases with RBD and gluten free

In the Figure 41 is shown the data variables of process used in the production of the control of pizza bases and formulas finally selected.

| TEST: | | Bases Pizza Control with gluten | | | Bases Pizza Control Gluten free | | | RBD pizza bases with gluten | | | Pizza Bases RBD Gluten free | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables: | | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others |
| KNEADING | Inicial | | | | | | | | | | | | |
| Equipament: Varimex | Final | 22 | 12 | | 23 | 16 | | 24 | 13 | | 23 | 17 | |
| BLOCK FERMENTATION | Inicial | | | | | | | | | | | | |
| Equipament: Room Temperature | Final | 20-25 | 5 | | 20-25 | - | | 20-25 | 6 | | 20-25 | - | |
| DIVISION AND BALL | Inicial | | | | | | | | | | | | |
| Equipament: manual | Final | 20-25 | | | 20-25 | | | 20-25 | | | 20-25 | 15 | |
| FERMENTATION IN PIECE | Inicial | | | | | | | | | | | | |
| Equipament: camera | Final | 28 | 42 | | 28 | 20 | | 30 | 43 | | 29 | 19 | |
| COOKING | | | | | | | | | | | | | |
| Equipament: Rotacional y Eurofred | | 195 | 12 | | | 23 | | 170 | 19 | | 170 | 22 | |
| OBSERVATIONS: | | | | | | | | | | | | | |

Figure 41: Variables of process selected

### 3.4.1.4 Matrix Stick "Rosquilleta"

Again the works were started developing a basic formula of stick (special bread) control to use the ingredient RBD object of study that, with the exact modification (basic formula stick gluten free), it could be viable to be used in the production of stick gluten free. In the Figure 42 are shown the compositions of stick control selected formulas (in base 1 kg):

| RBD Basic stick formula | Kg |
|---|---|
| Wheat flour | 0,596 |
| Improver | 0,001 |
| Sugar | 0,011 |
| Olive Oil | 0,127 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,242 |
| TOTAL | 1,000 |

| RBD Gluten-free basic stick formula | Kg |
|---|---|
| Starch | 0,348 |
| Rice flour | 0,100 |
| hydrocolloids | 0,033 |
| bread Flavour | 0,056 |
| Dextrosa | 0,017 |
| Improver | 0,010 |
| Sugar | 0,012 |
| Olive oil | 0,137 |
| Salt | 0,012 |
| yeast | 0,013 |
| Water | 0,262 |
| TOTAL | 1,000 |

Figure 42: Formulas of stick control with gluten and gluten free

The formulation of stick used was a traditional formula in which there was used olive oil to obtain a high quality product. At the same way as the previous matrixes, they were used improvers combining some enzymes and other ingredients in amount enough to the expected finality. The technicians of DPL were the responsibles of their design for each concrete finality using the internal knowledge of the company.

The process selected was a direct process (Figure 43) in which there were stablished concrete conditions of beginning process to adjust them after that according to the influence of the ingredient (RBD) with the stablished parameters.

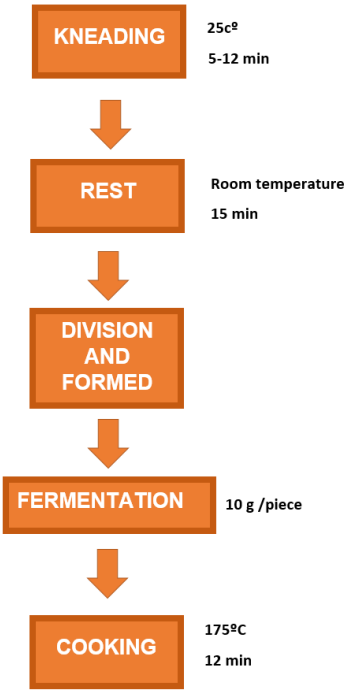



Figure 43: Process of production of stick

During the process the temperature, time and speed data of kneading applied were obtained by the adjustment to the final stablished formula. In the Figure 44 are shown images of the process of baking for elaboration stick control with gluten: image a) rest and division, b) beginning of the fermentation in piece, c) fermented pieces, d) and e) final aspect of the pieces.


Figure 44: Images of production of stick 'control' with gluten: a) rest and division, b) beginning of the fermentation in piece, c) fermented pieces, d) and e) final aspect of the pieces.

During the process of producing stick, similar as the other productions, data about temperatures, times and speed of knead applied were obtained by the adjustment to the final formula stablished. In the following Figure 45 are shown images of the process of baking which were elaborated the stick RBD with gluten: a) rest in block b) division of pieces, c) and d) aspect final of pieces.


Figure 45: Images of production of stick RBD with gluten: a) rest in block b) division of pieces, c) and d) aspect final of pieces.

Finally, according to the production of stick , in the following Figure 46 are shown images of the production process of stick control and RBD Gluten free: image a) rest in block b) after division and beginning of fermentation in piece, c) pieces in camera of fermentation, d) baking y e) final aspect of pieces.


Figure 46: Images of production of stick RBD with gluten and Gluten free

In the production of stick RBD with gluten, samples were formulated and processed for the tests that are shown in Figure 47. As it can be appreciated, it beginning using low proportion of the ingredient object of study, 10% in formula nº 1. The technicians of DPL consider that the RBD fiber could affect negatively the development of dough of stick and it was possible to increase the proportion up to 15%. However, the differences in

quality of the bread obtained and the difficulty in manipulation of dough imposed the technicians decision to select the optimum in the formula nº2 for 10% fiber of RBD.

It continues studying the possible improvement in the basis by the increasement of improver used for this product. According to the results, one small increasement of the quantity of improver up to 2% can increase substantially the qualities of the stick obtained respect to the previously formula. However, an increasement additional of improver up to 3% did not suppose any difference. So, the formula nº 5 was selected definitively.

| RBD Basic stick formula 1 | Kg |
|---|---|
| Wheat flour | 0,517 |
| Rice fiber | 0,090 |
| Improver | 0,001 |
| Sugar | 0,011 |
| Olive Oil | 0,124 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,236 |
| **TOTAL** | **1,000** |

| RBD Basic stick formula 2 | Kg |
|---|---|
| Wheat flour | 0,507 |
| Rice fiber | 0,100 |
| Improver | 0,001 |
| Sugar | 0,011 |
| Olive Oil | 0,124 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,236 |
| **TOTAL** | **1,000** |

| RBD Basic stick formula 3 | Kg |
|---|---|
| Wheat flour | 0,457 |
| Rice fiber | 0,150 |
| Improver | 0,001 |
| Sugar | 0,011 |
| Olive Oil | 0,124 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,236 |
| **TOTAL** | **1,000** |

| RBD Basic stick formula 4 | Kg |
|---|---|
| Wheat flour | 0,457 |
| Rice fiber | 0,150 |
| Improver | 0,0015 |
| Sugar | 0,011 |
| Olive Oil | 0,124 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,236 |
| **TOTAL** | **1,001** |

| RBC Basic stick formula 5 | Kg |
|---|---|
| Wheat flour | 0,457 |
| Rice fiber | 0,150 |
| Improver | 0,002 |
| Sugar | 0,011 |
| Olive Oil | 0,124 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,236 |
| **TOTAL** | **1,001** |

| RBD Basic stick formula 6 | Kg |
|---|---|
| Wheat flour | 0,457 |
| Rice fiber | 0,150 |
| Improver | 0,003 |
| Sugar | 0,011 |
| Olive Oil | 0,124 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,236 |
| **TOTAL** | **1,002** |

Figure 47: Formulas of stick RBD with gluten

In conclusion, to carry out the test with RBD in a gluten-free bar, the formulas shown in Figure 48 were prepared. As in the case of pizza bases, it was started using a small proportion of the ingredient under study, 10 % in formula No. 1. The DPL technicians started from the percentage of RBD fiber selected in the case of RBD in a bar with gluten and worked by increasing the proportion in the formula, up to 15 and 20%. However, the differences in the quality of the bar obtained between these two formulas (No. 2 and 3), as well as in the machinability and handling of the dough, were not substantial, so formula No. 2 was preselected with 13.6 % fiber. RBD.

It continues studying the possible improvement in the bases by increasing the quantity of improver designed for this product. According to the results obtained, a small increasing of the quantity of improver did not improve substantially the qualities of the stick obtained respect to the previously formula. So, The formula nº 2 was selected definitively.

| RBD Gluten-free basic stick formula 1 | Kg |
|---|---|
| Starch | 0,285 |
| Rice flour | 0,095 |
| Rice fiber | 0,095 |
| hydrocolloids | 0,031 |
| bread Flavour | 0,054 |
| Dextrosa | 0,016 |
| Improver | 0,010 |
| Sugar | 0,011 |
| Olive oil | 0,130 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,249 |
| TOTAL | 1,000 |

| RBD Gluten-free basic stick formula 2 | Kg |
|---|---|
| Starch | 0,272 |
| Rice flour | 0,091 |
| Rice fiber | 0,136 |
| hydrocolloids | 0,030 |
| bread Flavour | 0,051 |
| Dextrosa | 0,015 |
| Improver | 0,009 |
| Sugar | 0,011 |
| Olive oil | 0,124 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,238 |
| TOTAL | 1,000 |

| RBD Gluten-free basic stick formula 3 | Kg |
|---|---|
| Starch | 0,227 |
| Rice flour | 0,091 |
| Rice fiber | 0,181 |
| hydrocolloids | 0,030 |
| bread Flavour | 0,051 |
| Dextrosa | 0,015 |
| Improver | 0,009 |
| Sugar | 0,011 |
| Olive oil | 0,124 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,238 |
| TOTAL | 1,000 |

| RBD Gluten-free basic stick formula 4 | Kg |
|---|---|
| Starch | 0,227 |
| Rice flour | 0,091 |
| Rice fiber | 0,181 |
| hydrocolloids | 0,030 |
| bread Flavour | 0,051 |
| Dextrosa | 0,015 |
| Improver | 0,009 |
| Sugar | 0,011 |
| Olive oil | 0,124 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,238 |
| TOTAL | 1,000 |

| RBD Gluten-free basic stick formula 5 | Kg |
|---|---|
| Starch | 0,227 |
| Rice flour | 0,091 |
| Rice fiber | 0,181 |
| hydrocolloids | 0,030 |
| bread Flavour | 0,051 |
| Dextrosa | 0,015 |
| Improver | 0,010 |
| Sugar | 0,011 |
| Olive oil | 0,124 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,238 |
| TOTAL | 1,000 |

| RBD Gluten-free basic stick formula 6 | Kg |
|---|---|
| Starch | 0,226 |
| Rice flour | 0,091 |
| Rice fiber | 0,181 |
| hydrocolloids | 0,030 |
| bread Flavour | 0,051 |
| Dextrosa | 0,015 |
| Improver | 0,011 |
| Sugar | 0,011 |
| Olive oil | 0,124 |
| Salt | 0,011 |
| yeast | 0,012 |
| Water | 0,237 |
| TOTAL | 1,000 |

Figure 48: Formulas of stick RBD gluten free

At the following Figure 49 it is shown the data of the process variables used in cookie control production and in the formulas selected.

| TEST: | | Stick Control with gluten | | | Stick Control Gluten fre | | | RBD stick with gluten | | | Stick RBD Gluten free | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables: | | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others | Temp (ºC) | time (min) | Others |
| KNEADING | Inicial | | | | | | | | | | | | |
| Equipament: Varimex | Final | 22 | 10 | | 23 | 9 | | 24 | 10 | | 23 | 9 | |
| BLOCK FERMENTATION | Inicial | | | | | | | | | | | | |
| Equipament: Room Temperature | Final | 20-25 | 5 | | 20-25 | - | | 20-25 | 6 | | 20-25 | - | |
| DIVISION AND BALL | Inicial | | | | | | | | | | | | |
| Equipament: manual | Final | 20-25 | | | 20-25 | | | 20-25 | | | 20-25 | | |
| FERMENTATION IN PIECE | Inicial | | | | | | | | | | | | |
| Equipament: camera | Final | 28 | 15 | | 28 | 10 | | 30 | 16 | | 29 | 9 | |
| COOKING | | | | | | | | | | | | | |
| Equipament: Rotacional y Eurofred | | 185 | 12 | | 180 | 23 | | 175 | 19 | | 176 | 22 | |
| OBSERVATIONS: | | traditional format | | | Straight format. Manufactured together with RBD stick Gluten free | | | Straight format, half size | | | Round format. Manufacture together with Stick RBD with | | |

Figure 49: Variables of the process selected

### 3.4.2 Analysis sensorial

To validate the final selected products, it was made a test of analysis sensorial of all the samples produced, for that it was used a questionnaire previously designed with some questions about the product characteristics. The hedonic component of the Quality is very important and subjective and variable in the time. Because it is found in multiple specialities, it was needed to create rules and protocols to analyse the product correctly, specially fiber products.

Based on DPL's experience in this sector, some of the people participated in the testing, becoming a trained testing panel. They knew the descriptors of the company's internal product testing and through the participation in some R&D projects and final career projects. This panel of testers was formed with people between 25 and 69 years

old, and they shared their opinions equally with the general public who purchases in bakeries.

In the following Figure 50 it can be observed the attributes selected and the actions that should be done during the test to reach an harmonized sensorial perception:

| DESCRIPTORS | Definitions |
|---|---|
| APPEARANCE | See product |
| TASTE | product flavor |
| SMELL | smell the product |
| COLOR | See the product |
| AFTERTASTE | Residual taste perception |
| RECOVERY CAPACITY | Degree of recovery of the original shape when compressed up to 50% with the index finger |
| GUMMY | Degree to which the sample remains in the mouth and can be swallowed |
| BITE | Sensation perceived when taking the bite |
| CHEWABLE | Ease with which the sample is allowed to be chewed according to the product tested |
| CRUSHING | Nice fracture rate of the product |

Figure 50: Definition of sensorial attributes

For this sensorial evaluation it was used an hedonic scale from 1 (very bad) to 5 (very good).

It was chosen a quiet room with good illumination and with few distractions to avoid anomalies in results (Figure 51) and in addition was choose an adequate timetable (between 11:00 and 13:00 hours) to avoid the hungry and their influence on the results.

Figure 51 : Sensory analysis evaluation

Now, we present the obtained data in the sensory testing of the products:

### 3.4.2.1 Bread

| nº | product |
|---|---|
| 1 | Bread |
| 2 | Bread RBD Nº5 |

In the following Figure 52 we can appreciate the graphics of appearance and flavor, where the 1 is the control sample and 2 the fiber product, nomenclature adopted in all the graphics.

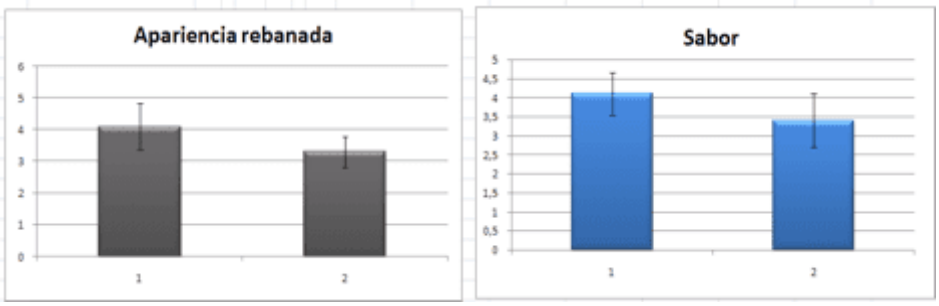



Figure 52: Appearance and taste

The formula 2 is a bread with fiber, and 1 is a normal bread, that explain the taste results. However, the difference is not quite significative and that is very positive because the valuation is similar in both cases.

In the case of the appearance of the slice, a good appearance can be seen thanks to the enzymes, since the excess fiber is converted into a very consistent and very little alveolated crumb.

In the Figure 53 we can observe the odor and color.

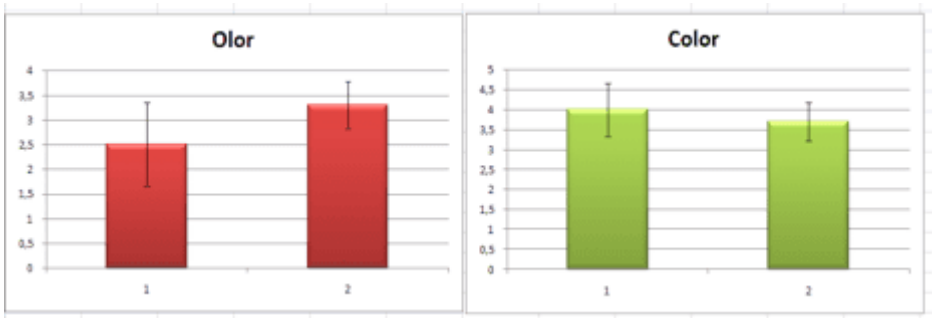



Figure 53: Odour and colour

Talking about odor it is better than normal bread, in several matrixes. So, the fiber apport good flavor. In the case of color there was not a very appreciable difference.

In the Figure 54 we see the gumminess and recuperating capacity.

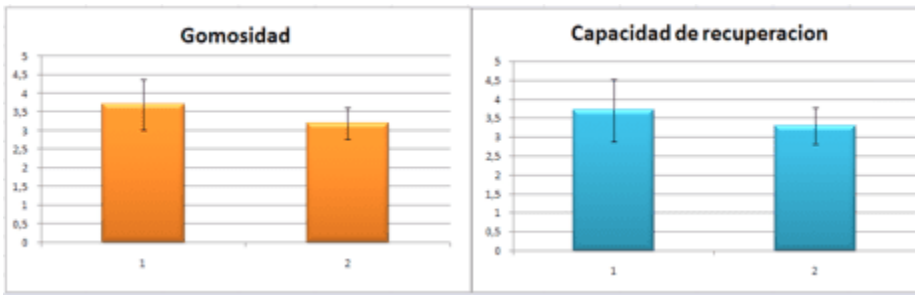



Figure 54: Gumminess and recuperation

As in the previous case, it was advised that although sample 1 (bread control) is larger; the difference is still significant as it should be in a "normal" bread instead of a whole wheat one.

In conclusion, for the bread it was seen that fiber does not affect significatively the baking, also we have to advice and insist that the data are very hidden by the enzymes because them make softer negative effect in the rheology and baking.

### 3.4.2.2 STICK

| nº | product |
|---|---|
| 1 | Stick wholemeal |
| 2 | stick RBD Nº2 |

In the case of stick, although it was still a bakery matrix, some descriptors are modified because the stickis are considered more a cookie tan a bread slice.

The data of the sensory attributes evaluated is shown in Figure 55 and 56.

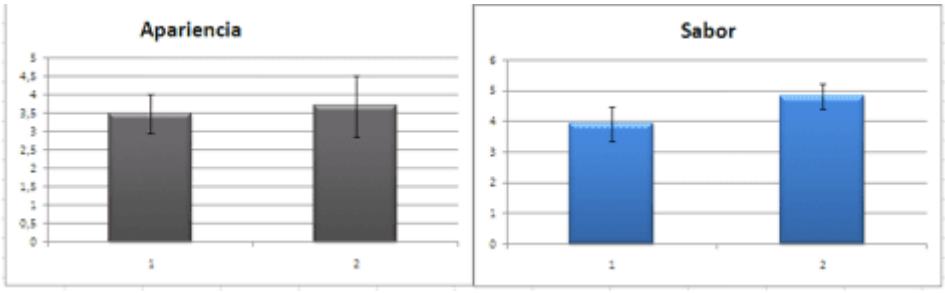



Figure 55: Appearance and taste

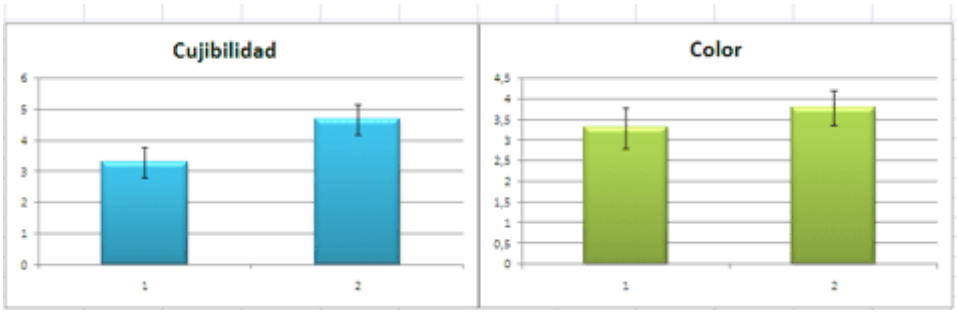



Figure 56: Crunchiness and colour

The principal characteristic is the taste, because the results are notable and the tester valued it well. In the sensory evaluation, the testers commented that the taste of "rosquilleta" was good. Also, the product was crunchy, although the fiber usually is hydroscopic and get water, doing the fiber product less crunchy, but in this case it was observed just the opposite, so the RBD fiber is very interesting for this special bread.

Respecting the colour and appearance, it was not seen big variability in the results.

### 3.4.2.3 Cookies

| nº | product |
|---|---|
| 1 | cookie fiber |
| 2 | cookie RBD Nº5 |

The evaluation of cookies was very similar to stick,the taste and odor were appreciated and also the crunchiness.

Seeing the data of Figure 57 and Figure 58 we verify the same tendence than in previous products.

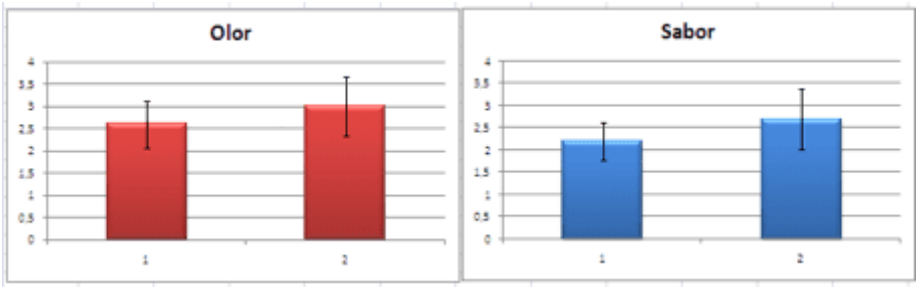



Figure 57: Odour taste

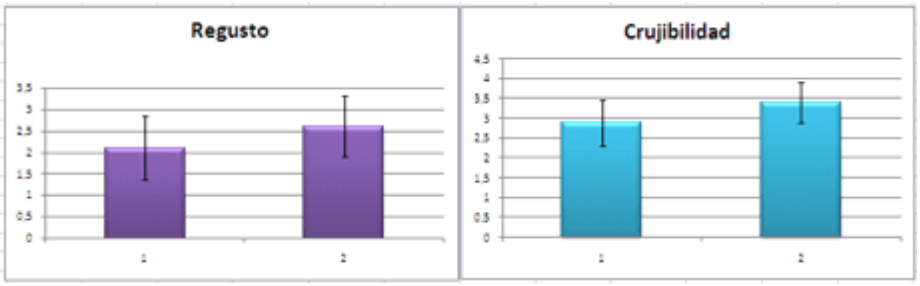



Figure 58: Retaste and crunchiness

Again, it was appreciated an improvement in the taste and odor. Other data interesting is the retaste, that was very good in comparison to other type of fiber, so that is an organoleptic improvement very interesting. Crunchiness is still higher, so this effect is due to the rice fiber.

The other descriptors are not very relevant, although they follow the same tendency than previous figures.

### 3.4.2.4 Base pizza

| nº | product |
|---|---|
| 1 | base pizza |
| 2 | base pizza RBD Nº2 |

This matrix should be between bread and snack. This product has the particularity that it is going to have in the surface some ingredients that would modify the idiosyncrasy of this product in bakery. This product does not need to have a very defined taste at the same amount tan others, but a good product would improve the organoleptic perception of this pizza. In this case, the bite and masticability are more interesting descriptors than others. The test was made in the base, without other ingredient, only the baked dough.

In the Figure 59 we repeat again the previously observed attributes of other figures.

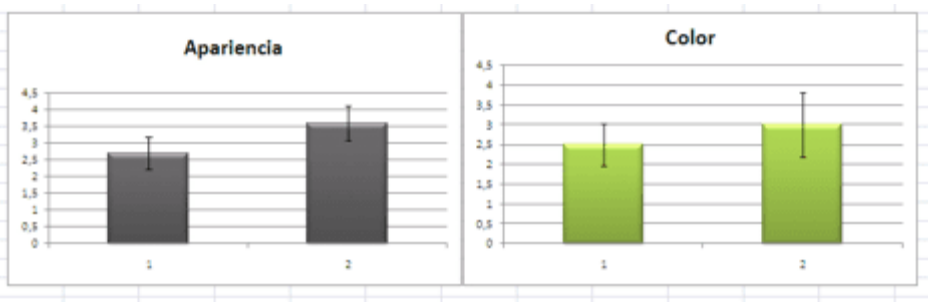



Figure 59: Appearance and colour

The data are more positive in the fiber bread (2) tan in control (1).

In the Figure 60 the results concerning masticability and bite.

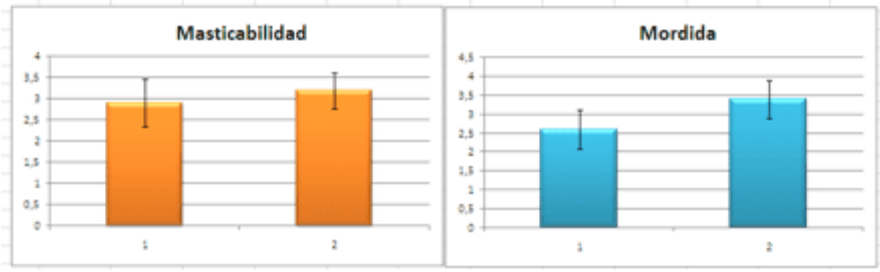



Figure 60: Masticability and bite

There is a better bite and Good masticability, but the data are not significative, descriptors that are very interesting for the bases of pizza. The rice fiber offers Good answer to this organoleptic requirements.

The Figure 61 shows the results of retaste and odour.

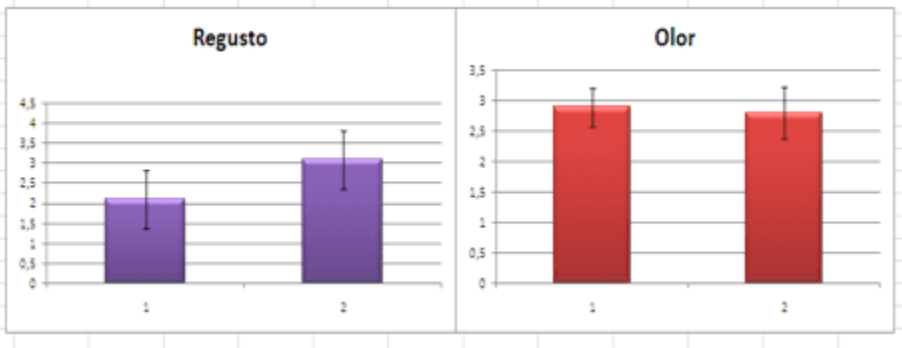



Figure 61: Retaste and odour

In the case of odour, the control is higher than the fiber product, but the difference is not significative. In the retaste, it was appreciated the base pizza RBD with better evaluation than control base.

In conclusion, it was appreciated that including fiber offer some improvements very interesting. Specially in dry products cookie and "rosquilleta". The rice fiber not only

give us a good taste, but also combine the original taste giving one more advantage to the incorporation of fiber.

Respecting to the rheology, it was seen good results, not as significative because the correct amount of fiber added minimize their negative effects in rheology. Anyway, the rice fiber is not to "bad" to the dough rheology as other types of fiber.

The data of sensorial analysis from the gluten free products are not very significative because those type of products are very complex and need testing panels more specialized than we have. Thi panels should be trained in gluten free products because the characteristics of these make them much more different than traditional baking products with gluten. A trained testing panel even professional if it do not know the idiosyncrasy of the gluten free products can fail in the sensorial analysis results.

## 3.5 Use of rice oil

The fatty part of the rice bran, which in this case is the oil, has for many years been used for cooking oil. Once filtered and refined this was a magnificent ingredient for all kinds of food, especially for frying, thanks to its very high smoke point, one of the highest (322 ° C), this makes the frying very soft and light specially to make tempura. The main problem is not the quality but the price, it could only be found in Japanese gastronomy or haute cuisine. In the last years, little by little the oil is penetrating in the cosmetics, as essential oil, tonics, ingredients of magistral formulas, etc.

After extraction, the raw oil exhibits subtle odors and colors that may not be particularly appealing, yet they are not unpleasant either. Therefore, it would be interesting to contemplate the conditioning of the oil, before the sale. While we've briefly discussed conditioning by-products, it's crucial to emphasize that conditioning is paramount in ensuring its quality.

It was said that rice oil was known, but that it had not yet been used, although some type of product was already going to be developed. In addition to the qualities mentioned above, the following positive aspects for using rice oil in cosmetic products were commented on:

- This oil is absorbed quickly and does not smear. So, products that help its absorption are not needed, at least not in large quantities.

- It is suitable for all skin types, including oily skin and especially mature skin.

-It can be used continuously. In principle, no adverse effects are observed.

-The product already has a cosmetic registration (when it comes to its industrial sale it is essential).

It is worth mentioning that the supercritical extraction is very respectful of the antioxidant properties.

Based on all the previous results, the next step was to specify which products were going to be proposed. And not only in relation to the final product, but also in relation to its packaging, as this conditions its application and use.

The development of two lines was considered: one line to find consumers of organic products and another for consumers of typical cosmetic products.

### 3.5.1 Organic Line

**Product 1: Natural stabilized oil**

A liquid mixture of the oil and its stabilized serum with *Sapindus mukorossi (*drupe also called "soap nuts" that contains saponin) and distilled water was elaborated. In this case, a bit of lavender essence was added to reduce the intensity of the cereal smell.

In order to stabilize the oil and prevent it from separating into phases, without using chemicals, it was introduced the pure oil in a mixer with all its phases previously shaken and it was added the *Sapindus* to stabilize it. It was added a natural balsamic essence if desired or not.

The product is very silky to the touch as can be seen in figure 62, applying a small amount with the roll on is sufficient for it to act correctly.

Figure 62: Natural stabilized oil

Packaging: roll on applicator for use on areas with blemishes, stretch marks, scars…

Figure 63: Natural stabilized oil in roll on applicator

These applicator bottles (Figure 63) are ideal for use and are small and can be carried in bags.

**Product 2: Crude oil**

This is the oil as we have extracted it by adding a natural essence of lavender.

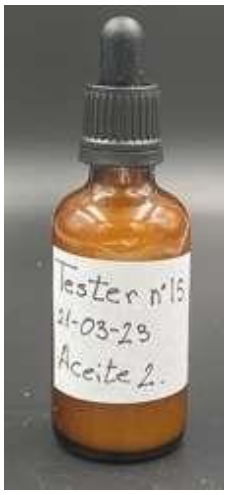



Figure 64: Crude oil in tester

It is indicated that at the time of application it should be homogenized before use, acquiring a particular aspect, as we can see in the figure 64

Figure 65: Crude oil

This product is the one it was been handed out to numerous users to see what effects they experienced. Mainly to people with age spots (large size) and skin disorders such as psoriasis. This product is intended for body applications of atypical skin as the application is all active ingredient, there is no mixture of any other ingredient.

To avoid interferences, it was decided to use the pure raw product. Thanks to its rapid absorption, it does not need products that help its assimilation, even so, its application is recommended after personal hygiene before dressing, if it is applied on the body, it is recommended to rub insistently for its faster absorption.

Packaging: Amber glass dropper bottle (laboratory). In order to avoid overdosage in its application, it was decided to put the dropper. As it can be seen in the figure 66.

Figure 66: Packaging: Amber glass dropper bottle

### 3.5.2 Cosmetic Line

**Product 3: Rice oil facial cream.**

It is incorporated the oil to a creamy base and add an aroma.

This format was decided to give it a traditional cosmetic appearance, a white and scented cream, as can be seen in figure 67.


Figure 67: Rice oil facial cream

The most practical way of applying the oil is shown in Illustration 68. However, there is less oil in each application and it is not the most recommended for atopic skin as it has less active ingredients in each application. It is therefore intended for areas such as the face, which at the same time nourishes the skin.

Figure 68: facial cream applied

Packaging: Elegant cosmetic line jar (Figure 69). It was wanted to give it a more luxurious product image to give it a more valuable image. It could come in a cardboard box with an attractive logo.

Figure 70: Packaging

**Product 4: Anti-aging face cream rice**

It is incorporated the oil into an anti-aging cream formula specially designed for DPL and add a specific smell.

Same concept as above, but in this case it can be used part of an anti-aging formula developed by Biotecma, but adding a part of crude rice oil.


Figure 71: Anti-aging face cream rice

The anti-aging effects of a product already tested on the market are enhanced with a large amount of vitamin E from rice. It continues with the white and perfumed cream format (figure 71). This cream is a little less curdled than the facial but very similar in application on the skin, as we can see in figure 72.

Figure 72: Anti-aging face cream rice applied

Packaging: Elegant cosmetic line jar. The same as in the previous case (figure 70). With the possibility of varying the lid.

***Product 5: Rice facial scrub***

In this case it will mix the intermediate part of the rice fiber and rice oil together with a base for exfoliating products in order to generate an exfoliating cream (figure 73).


Figure 73: Rice facial scrub

It has a viscous appearance (figure 74) similar to a "mucus" to the touch, it is rough due to the rice fiber and once applied it is absorbed faster than other exfoliants. In addition, the effect of the rice cream is quickly observed and it could extend these effects with some balsamic. It exfoliates thoroughly, removes dirt and dead cells, to obtain a perfect skin, it can be seen in the figure 74 how it looks on the skin.

Figure 74: Rice facial scrub rice applied

Packaging: Elegant cosmetic line. Normally these products come in tubes, but the price of the product is lower. The product contains an important percentage of rice oil.

**Product 6: Rice Body Scrub**

In this case it uses the fattest part of the rice bran, this has a much coarser granulometry than the previous one (greater than 1000 microns). It uses the same concept as the previous one, but for the whole body.

For this it will use the coarser fiber, rice oil and the base for body scrub. With this it will obtain an exfoliant very similar to the previous one, a little "coarser" but when applied on the body it has a behaviour similar to the previous one as it can be seen in figures 75 and 76.


Figure 75: Rice Body Scrub

Figure 76: Rice Body Scrub applied

The effect is similar to the facial scrub but this is at the body level, giving soft skin.

Packaging: Small jar elegant cosmetic line. But for this purpose it will need a larger jar, in order to be able to smear large areas of the body.

# 4-Conclusions:

As can be seen, rice is a very complete product. From the use of the polished grain to the whole grain. But its by-products are equally attractive, both its stabilized fibers and its fatty part.

It has been obtained products rich in fiber, but without undermining its organoleptic attributes. Moreover, in some cases they are superior to a basic formula.

As for the fatty part, it can be seen a very versatile product, since it can be used for food and cosmetics. Its qualities for skin care, we believe, have not yet seen their full potential, but for that, clinical trials will be needed.

From our commercial, industrial and sales point of view, it can only be seen one problem and that is the lack of publicity of these rice by-products, it is believed this is due to the fact that rice is something so basic in our lives that its value is not recognized.

For instance, consider a company offering products like rosehip and argan, which possess an exotic allure that adds a touch of sophistication. While claiming a product originates from rice lacks glamour, associating it with Himalayan berries piques more interest, despite both the fiber and oil far surpassing the qualities of those mentioned.

A good marketing campaign at international level telling all this would make the product gain value by placing it where it belongs to be.

Finally, the company would like to say the following:

It would be interesting to fully exploit rice as winemaking has done. There are companies like MATARROMERA that have a comprehensive exploitation of the world of wine (from drinking to gastronomy, the production of antioxidants (ABROBIOTEC) or rural tourism). It is an exploitation of the vine in multiple phases.

Could it be done the same with rice? There are other important rice by-products that lead to interesting studies such as rice straw and the first husk as an insulator.

Considering the increasing concern for the environment in today's society, the utilization of the resources offered by rice (which we know how environmentally friendly it is), makes it a product of great value.DPL has no intention of patent any of their developments, due to the characteristics of the products and also that our exploitation model is not viable to patent. Our experience patenting our developments has not been useful, because some information is usually filtered during the process. Our policy is not to give most information of the formula (inside the law), service, quality and prices.

# TRACE-RICE

## TRACE-RICE Consortium

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