

DEVELOPMENT OF NUTRITIONALLY ENHANCED PASTA WITH DIFFERENT ORGANIC POWDERS

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Abstract

*Nutritionally enhanced pasta was developed by adding powders freeze dried by tomato (*Lycopersicon esculentum* L. var. *Coeur de Boeuf*, wild garlic (*Allium ursinum* L.) and basil (*Ocimum basilicum* L.). This study wants to development, testing and evaluation of novel natural food additives, and their application in different products, including quality and sensorial assessment of their preserving functions. The aim of this study was to investigate the addition of organic powders to the pasta formulation, improving with powders freeze-dried by *Coeur de Boeuf* tomato, wild garlic and basil. In addition, the effect of powders on the sensorial properties, and cooking quality of the pasta samples was also determined in this study. The organic powders were added to the pasta formulations of 1% of the total weight of the wheat flour. The results showed that the addition of different organic powders to the pasta formulation resulted in a significant enriched in the colour, swelling volume, and weight gain.*

Key words: basil, pasta, sensory analyses, tomato, wild garlic.

INTRODUCTION

Pasta becoming popular in current lifestyle, because are healthy, tasty and convenient for transportation and preparation. The assortment range of pasta has had a beautiful evolution in recent years. On the market, the product offer has diversified by launching new brands and types of products, manufacturers have focused their attention on all consumer segments and added value to the raw material and consumers' perception of pasta has improved through a new approach (Dragomir et al., 2017).

With the diversification of supply, the lifestyle and increase of purchasing power, the consumption behaviour of pasta has changed (Bahaciu et al., 2019; Dragomir et al., 2020). The Romanian consumer tends to modernize, preferring quality products, easy to prepare, tasty and healthy. We can say that a very important role is played by the younger generations, who prefer light and innovative menus. Romanians abroad, who on their regular visits to the country, bring this habit of consumption from the country of adoption.

Pasta like dish, present three main advantages: it is prepared quickly; are very economical and healthy. These three main qualities make pasta

a product approved by more and more consumers and increase its potential in the future.

From an environmental point of view, pasta is a simple food that has a low environmental impact, with a carbon footprint that is much less than animal products. Life cycle analyses of pasta products, from production to retail, have shown that the most significant impact on the environment occurs during the phase of wheat cultivation - 80% of the ecological footprint, approximately 60% of the carbon footprint, and the entirety of the water footprint (Webb et al., 2019; Sustainable Farming, 2017).

Tomato (*Lycopersicon esculentum* L. var. *Coeur de Boeuf*) is an important vegetable crop grown in many countries across the world for fresh market and multiple processed forms (Mutari et al., 2011; Hassen et al., 2019). Tomatoes are widely consumed in the world and as a fruit of limited durability, short agricultural season. Much of the tomato produced for industrial purposes is transformed into concentrated pulp, which is reconstituted throughout the year, mainly during the off-season (Munhoz Silveira et al., 2019; Ochida et al., 2019; Demissew et al., 2017). But, fresh tomato has a limited storage life 2-3 weeks under ambient temperature and cannot be

stored over extended periods (Dobrin et al., 2019). To minimize after harvest losses, the tomato is processed in the forms of paste, juice, ketchup, sauce, and purée. One of the industry's biggest challenges is to produce in a sustainable and effective chain to simultaneously fulfill the cost reduction and quality improvement demands (Koufiotis et al., 2016; Munhoz Silveira et al., 2019). Possible preservation methods of tomato include physical (application of heat, freeze-dried, irradiation, and soundwave) and chemical preservatives or combinations of those different means of methods (Fellows et al., 2000). Among these preservation methods, thermal processing is one of the most common and effective means.

During the processing and subsequent storage of products the content of carotenoids falls down and the colour changes (Kumar et al., 2015). Recent studies have indicated the potential health benefits of a diet that is rich in tomatoes. Commonly consumed in daily diets, are a major source of antioxidants, which have a greater contribution to a well-balanced healthy diet with the right proportion of vital nutrients such as minerals, vitamins, essential amino acids, sugars, lycopene, and other carotenoids and dietary fibers (Jaramillo et al., 2007; Sgherri et al., 2008). Lycopene, a major carotenoid without pro-vitamin activity, present in red tomatoes, is considered responsible for their beneficial effects (Reboul et al., 2017; Kumar et al., 2015; Shi et al., 1999; Rao et al., 1998). Different studies have suggested a protective role for lycopene, an antioxidant carotenoid, in the prevention of stress including environmental stress. Tomatoes and tomato products are the major dietary source of lycopene (Kohlmeier et al., 1997; Charu et al., 1999).

Allium ursinum - known as ramsons, buckrams, wild garlic, broad-leaved garlic, bear leek, or bear's garlic - is a wild relative of chives native to Europe and Asia. Wild garlic is best picked in spring, before the flowers are too developed. Usually find it in shaded woodland near water. It's recognized by its specific, wild taste, a garlicky and very aromatic taste.

In European traditional medicine *Allium ursinum*, has been generally recommended as digestive stimulant, antimicrobial agent, removing toxins from the body, and to prevent

cardiovascular diseases (Treben, 1992; Macků & Krejča 1989; Leporatti and Ivancheva, 2003). It was often applied as a remedy in respiratory problems, such as common cold with fever or bronchitis.

In recent years there has been a growing interest in its use as a dietary supplement and food. It has become a practice for wild garlic leaves to use in cuisine. Fresh leaves can be eaten raw or cooked, and as a kind of pesto. They are often added to soups, gnocchi, risotto, ravioli, and as a spice to flavour hard cheeses or spreads based on cottage cheeses. Leaves and flowers can be used as a garnish to salads, while wild garlic bulbs can be used like common garlic (Sobolewska et al., 2015).

Researchers in the nutritional field and the food industry have rediscovered this plant, and are researching it due to its powerful antioxidant properties. These properties are due to many substances, including some vitamins, flavonoids, terpenoids, carotenoids, phytoestrogens, minerals and volatile compounds. Wild garlic contains polyphenolic compounds (Gitin et al., 2012), substances with antibacterial activity, use like an alternative preservative ingredient to protected against pathogenic bacteria in food (Jensen et al., 2014).

Basil (*Ocimum basilicum* L.) belongs to aromatic plants due to their volatile compounds presented especially in leaves and flowering tops. These basil parts are used since antiquity for food preservation, flavouring, and as medicine, because of high antioxidant, antibacterial and antifungal activity of volatile oils, being good sources of natural antimicrobial and antioxidant agents, with possible application in food industry, cosmetics or medicine (Avetisyan et al., 2017).

By freeze-dried basil retains the characteristics intense colour and flavour. Freeze-dried basil powder it is aromatic, slightly sweet, with spicy notes in taste. Because, it has a great capacity to rehydrate in the presence of water from the dough, the original character, such as the taste, colour and aroma specific to the basil, is present in the new preparation. Added the powder from the lyophilized basil aromatizes to the dough balances the taste and increases the preservation of final product. (Dragomir et al., 2020)

MATERIALS AND METHODS

Develop pasta products

The purpose of this work is to incorporate in pasta, powders from indigenous plants, with high aromatic, coloristic profile and nutritional value. The goal was to find a vector food that would bring to the consumer's diet the benefits of tomato *Coeur de Bœuf*, wild garlic (*Allium ursinum* L.) and basil (*Ocimum basilicum* L.) organic powders on studied.

Within the study, 4 assortments of organic pasta were obtained, presented in Table 1.

Table 1. Description of the pasta samples elaborated in the study

Sample	Main ingredients
P-WG	Pasta enriched with 1% wild garlic powders
P-B	Pasta enriched with 1% basil powders
P-T1	Pasta enriched with 1% <i>Coeur de Bœuf</i> tomato powders
P-T3	Pasta enriched with 3% <i>Coeur de Bœuf</i> tomato powders

The flour intended for obtaining pasta comes from organic common wheat varieties and tomato juice is bought from specialty stores. The ecological powders used in recipes were obtained at the Research Center for Studies of Food Quality and Agricultural Products within the University of Agronomic Sciences and Veterinary Medicine Bucharest, within the *SusOrgPlus: Intelligent food processing chains, natural additives and colourants*, which aims to develop advanced processing technologies for organic products and their by-products, in order to reduce raw material losses and increase their economic value.

Determining consumer acceptance.

Pasta samples were cooked in water to optimum cooking time, and after draining for 2 min, they were served to the panellists. The sensory test panel consisted of ten panellists who were trained academic staff. The sensory properties (appearance, texture, colour, flavour & smell, taste) of fresh prepared were evaluated by forty panellists. For the sensory evaluation, five-point hedonic scale was used, where 5: like very much, 4: like moderately, 3: neither like nor dislike, 2: dislike moderately and 1: dislike very much for each attribute. To achieve the sensory profile, the evaluator

completed a form for each test. After scaling the average values of the 5 attributes and their representation on a spider diagram (Lawless et al., 2010).

Stability of organic fresh pasta

Sensory analysis of innovative organic food products obtained during the study - was performed in the Laboratory of quality control of agri-food products, the Faculty of Engineering and Management of Animal Productions at the University of Agronomic Sciences and Veterinary Medicine of Bucharest.

The influence of organic ingredients on the sensory quality of the tested products was evaluated by the intensity of flavour and smell, taste and aftertaste attributes. Averages were made of the values recorded on the attributes of each evaluator, for each product.

The technological-culinary examination is performed by determining the boiling behaviours. The analysis of the boiling behaviours of pasta is a final criterion for their acceptance as food in current human diet. Regarding the boiling behaviours of pasta, some differences persist among researchers, industrial operators and consumers regarding the main factors for evaluating quality indicators (Mohan, 2002). The determination of the behaviour of boiling pasta is performed according to STAS 756/1/A2-1999, STAS 756/1/A1-1997.

During the evaluation of the stability over time of pasta chilled enriched with organic powders, the following were considered: increase the volume of pasta when boiling; the consistency of the pasta, respectively the tendency of agglomeration; the colour of pasta, during and after boiling.

Determining the nutritional and energy value of organic products

To determine the nutritional value of innovative organic food products, their energy value was calculated, depending on the composition in nutrients (proteins, lipids, carbohydrates, fiber), for each ingredient, for 100 g of product and the amount of finished product. The nutritional and energy value was calculated using a nutritional calculation tool, the Softfedima Program (<http://softfedima.ro/>).

RESULTS AND DISCUSSIONS

This study to development, testing and evaluation of novel natural food additives and their application in different products, including quality and sensorial assessment of their preserving functions. A new assortments of pasta enriched with freeze dried by wild garlic (*Allium ursinum* L.) and basil (*Ocimum basilicum* L.) and Coeur de Boeuf powder was made and investigate, the effect of powders on the sensorial properties, and cooking quality of the pasta samples was also determined in this study. A powder was obtained within the SusOrgPlus project at the Research Center for the study of the quality of USAMV agri-food products in Bucharest.

Develop pasta products

Pasta is a staple food in many countries all over the world. Many research studies have been conducted around the world to develop pasta products with nonconventional ingredients and added functional properties to meet the demand of health conscious consumers (Nilusha et al., 2019).

Pasta is a product obtained from fresh pasta dough, unfermented, shaped into various shapes and refrigerated. The dough is prepared from wheat flour and water, with or without additives (Adegunwa et al., 2012).

The technological process of obtaining the product includes the following steps (Figure 1):

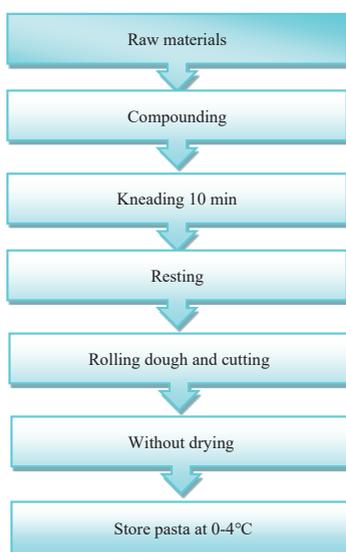


Figure 1. Conventional pasta production process

The innovative ingredients used in our study included:

- Organic wild garlic powder: it's a fine, green powder with a specific, characteristic, aromatic smell of onion and garlic.

- Freeze-dried organic basil powder: it's a fine powder, of intense green colour, with intense aroma, with specific notes of smell and taste.

- Organic *Coeur de Boeuf* tomato powder: it's a fine powder, of intense red colour, with flavour weak, with specific notes of smell and taste.

Within the study, a new assortment of organic pasta was obtained, presented in Table 2.

Table 2. Main ingredients

Sample/ingredient s (%)	Organic powders	Wheat flour, %	Water, %	Tomato juice, %
P-WG	1% wild garlic powders	66	33	-
P-B	1% basil powders	66	33	-
P-T1	1% <i>Coeur de Boeuf</i> tomato powders	61	12	24
P-T3	3% <i>Coeur de Boeuf</i> tomato powders	61	12	24

For the preparation of pasta enriched with tomato *Coeur de Boeuf* powder, part of the water was replaced with organic tomato juice and the percentage of added powder was increased by 1% and 3%.

Preparation of fresh pasta: organic wheat flour was properly prepared and the organic powders were dosed. Organic powders were previously hydrated in small amount of water, to be incorporated more easily in dough. The pasta dough was kneaded for 10 minutes until easy-to-shape dough is obtained. The dough is rest for a few minutes, and then is spread until a thickness of 2-3 mm is obtained; it is cut in the form of fidelities with a thickness of average 3 mm, and twist to form nests. The pasta thus shaped is spread in a layer and subjected to drying at room temperature for 2 hours. The pasta is packed properly and kept at a temperature of 4°C.

Organic *Coeur de Boeuf* tomato powder is very fine, incorporates very well, but requires a larger amount to be added if the goal is to obtain a more intense colour.

Determining consumer acceptance

The sensorial evaluation of product was carried out in order to observe the impact of organic powder incorporation in dough pasta, on its

sensory characteristics. The panellists evaluated the products for appearance, texture, colour, flavour and smell, taste and overall acceptability using a 5-point hedonic scale ranging from 5 (like extremely) to 1 (dislike extremely) for each sensory characteristic. After scaling the average values of the 5 attributes and their representation on a spider diagram, the following representation was obtained.

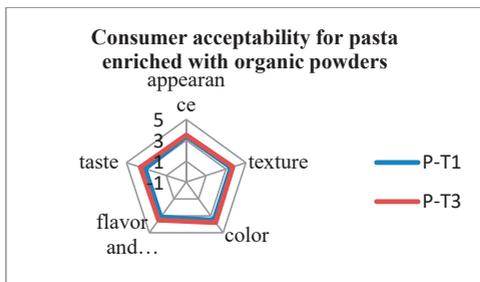


Figure 2. Consumer acceptability scores on a 5-point Hedonic scale for pasta enriched with tomato organic powders

Following the analysis of the P-T1 and P-T3 sample after boiling, the following aspects, were observed: the pasta has a slightly reddish, uniform color, the product shows no traces of flour, when boiling the product has increased its volume and the water has not colored during boiling, the boiling water is clear and free of starchy sediment.

At pasta enriched with tomato *Coeur de Bœuf* powders (P-T1) sample, the most appreciated attributes were texture, color and appearance. For P-T2 sample, the most appreciated attributes were color, texture and taste.

The taste of tomato, brought into the product by the addition of freeze-dried tomato powder was intense and felt on both the freshly boiled product and the cold product.

Sensory assessment results of pasta are given in Figure 2. The panelists gave the best scores to both products, sample P-T3 enriched with 3% tomato powder it was preferred. It is recommended to increase the level of tomato powder added in the pasta, so as to improve the color and taste.

The overall acceptability results indicated (Figure 4) that all pasta samples had a good sensorial score, but the most preferable one was the pasta enriched with 3% tomato *Coeur de Bœuf* powder.

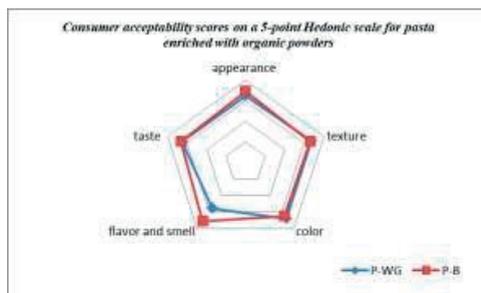


Figure 3. Consumer acceptability scores for pasta enriched with organic wild garlic powders (P-WG) and basil powders (PB)

Following the analysis of the P-WD sample after boiling, the following aspects, were observed: the pasta has a slightly greenish, uniform color, the product shows no traces of flour, when boiling the product has increased its volume and the water has not colored during boiling, the boiling water is clear and free of starchy sediment. The most appreciated features were the texture and color, each marked with 3.37. The taste of wild garlic, brought into the product by the addition of freeze-dried wild garlic powder was more intense on the freshly boiled product and became less pronounced on the cold product. This behavior was also dictated by the type of flour used in the preparation. Overall acceptability obtained an average value of 3.20. For pasta enriched with basil powders (P-B), the most appreciated characteristics were flavor and smell (3.54) and appearance (3.46). The taste of basil, brought into the product by the addition of basil powder was intense and felt on both the freshly boiled product and the cold product. Taste it was influenced by the what type of flour it was used. Overall acceptability obtained an average value of 3.37.

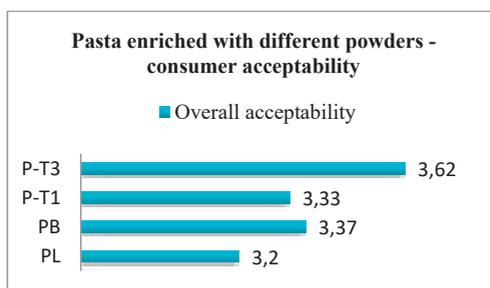


Figure 4. Overall acceptability obtained for pasta enriched with organic powders

Samples were selected on the basis of sensory and quality, it was subjected for assessing the storage stability. Prepared products were packed in high density polyethylene packs and stored at refrigeration temperature for shelf life study.

Color is one of the most important quality properties for the acceptability of food due to its relation with product freshness and flavor expectations and therefore has a direct effect on consumers' perceptions. Because of the positive impact on the consumers, production on colored pasta have gained attention in the recent years..

Because the reticent to the use of synthetic colorants in foods has increased, the use of natural colorants has the advantages of being readily accepted by the consumers, considered to be safe and not chemical.

Stability of organic fresh pasta

The optimum cooking time for pasta depends on the preferences and how the consumer is accustomed to consuming them. The main characteristic that must be maintained after boiling, for Western Europe, especially in Italy, is a certain consistency, called "*al dente*", which according to most consumers in Eastern Europe corresponds to insufficient boiling. In the tradition of the Romanian people, pasta is eaten with pleasure when it is softer. For this reason, each producer writes on the pasta packaging a cooking time recommended, respected or not by consumers, but which remains an indication for preparation (Iancu et al., 2014).

During the evaluation of the stability over time of fresh pasta enriched with organic powders, it was in considered the following: increase the volume of pasta when boiling; the consistency of the pasta, respectively the tendency of agglomeration; the colour of pasta during and after boiling.

Cooking quality: Weighed samples (10 g) of chilled pasta were cooked in 250 ml boiling water. Then, rinse with cold water. Optimum cooking time, firmness of pasta and solids lost to cooking water was assessed using standard method. Per cent water absorption and volume expansion ratio was calculated from increase in weight and volume, on cooking of pasta for optimum cooking time.

The optimum cooking time was established by boiling the pasta in distilled water until the white center core of the pasta strand disappears, indicating that the starch at the center has gelatinized. For the two samples taken in the analysis, the optimal boiling time was 10-14 minutes.

Overall acceptability of stored pasta was evaluated on the basis of sensory attributes (appearance, colour, texture, stickiness, flavour and smell, taste) by a panel of trained judges. Following the determination of the behaviour of the pasta during the analysis period, they behaved very well, they were stable.

Fresh pasta unprepared showed stability during storage. They developed a tendency to moisten after 10 days of storage in refrigerated conditions becoming very sticky and forming agglomerations after the 10th day of analysis. On day 14, the pasta showed a strong tendency to agglomerate and began microbiological degradation.

The storage period had no significant effect on the minimum cooking time of the enriched pasta stored as the storage period progressed; the time required for cooking the pasta increased, however, the increase was very small.

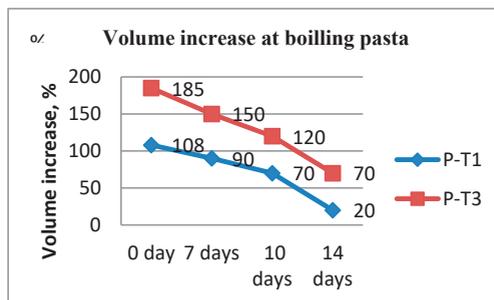


Figure 5. Volume increase at boiling pasta enriched with 5organic tomato powders

It is observe that the P-T3 sample shows a higher increase in volume compare to the P-T1 sample. According to color measurements and evaluations of the panelists, adding tomato powders in pasta provided an appealing reddish tone.

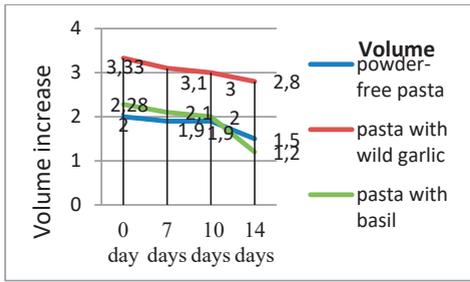


Figure 6. Volume increase at boiling pasta enriched with organic tomato powders

It is observed that the PL sample had a very good behavior during the preparation and corresponded to our expectations. The PB test had a good evolution, until day 10, after which there was a change in the characteristics of both unprepared pasta.

After cooking, it was observed color loss in boiling water, the pasta acquiring a brighter colors, a specific light yellow. Similar results were found by in specialty literature (Fradique et al., 2010; Zourai et al., 2011; Özyurt G. et al., 2015).

Shelf life is low, in the case of refrigerated pasta: simple storage for 14 days, and through packaging in modified atmosphere, extend storage period up to 2-3 months.

Nutrient Content. For the calculation of the nutritional value, technological losses were taken into account, so that the energy value kcal per 100g of pasta enriched with organic powders so that it is correctly calculated (Table 3).

Table 3. Nutritional declaration for pasta enriched with organic plant powders

Nutritional value for 100 g product					
	P-T1	P-T3	PM	PB	PL
Energy	906.7	921.9	931.1	972.5	872.5
	214.7	218.3	220.5	230.7	206.6
	kj	kj	kj	kj	kj
	214.7	218.3	220.5	230.7	206.6
	kcal	kcal	kcal	kcal	kcal
Total fat	1.3 g	1.3 g	1.3	1.7	1.2
Saturated fat	0.6 g	0.6 g	0.7	0.6	0.6
Carbohydrates	39.8g	39.9 g	40.4	41.1	38
Sugar	1.9 g	2.7 g	0.7	0.6	0,6
Fiber	8.3 g	8.5 g	8.8	11.5	8.1
Protein	7.4 g	7.5 g	7.4	7	6.9
Salt	0.1 g	0.1 g	0.1	0.1	0.1
Allergens: the product contains	GLUTEN				

The addition of powder in a higher percentage causes a change in the content of dietary fiber (fiber: P-T1-8.3g, P-T3 -8.5g) and an increase

in the percentage of protein (protein: P-T1 - 7.4 g, P -T3 - 7.5 g). These values show the influence of the addition of *Coeur de Bœuf* tomato powder, respectively high values of protein and dietary fiber. In terms of energy value, the values have not changed much, but there is a significant increase in energy value as the percentage of *Coeur de Bœuf* tomato powder increases.

The addition of basil powder causes an increase in the percentage of dietary fiber in pasta (PB - 11.5 g), compared to addition on wild garlic powders in pasta (PL - 8.1 g).

These values show the influence of the addition of organic plant powder, determine high values of protein and dietary fiber in freshly made pasta. The energy values for pasta enriched with basil powders increase very much, with the addition of powder .

CONCLUSIONS

Cooking quality of enriched pasta sample was good for the technological attributes. Pasta samples enriched with tomato powders had also desirable sensory properties as indicated by the panellists. Consequently, on the basis of these results, pasta enriched with organic powders may have a great potential for the industry to develop functional products.

Pasta with the addition of wild garlic powder and with the addition of lyophilized basil powder were highlighted by a specific colour, a light green in the PL sample and intense green in the PB. Each type of powder imprinted the original character of the product, such as specific taste, colour and aroma, attributes appreciated by evaluators. Pasta with organic freeze-dried wild garlic powder is recommended to be eaten plain or with different sauces. Pasta with freeze-dried basil powder is recommended to be eaten plain or with sauces (pesto sauce).

For a intense colour, it is recommended to add a percentage higher than 1% freeze-dried organic plant powders in dough. In the case of adding wild garlic powder in pasta dough, it must be taken into account that a higher percentage can influence the taste and aroma of the finished product. Basil powder is extremely versatile and can be added in percentages greater than 1%, but the taste and aroma will be

significantly highlighted. One thing worth noting is that when processing basil powder must take into account that due to the high fiber content it needs an additional amount of water in the preparation.

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