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APPLICATION OF HURDLE TECHNOLOGY AS A NOVEL APPROACH TO NEW DIETARY FIG-BASED PRODUCTS DEVELOPMENT IN RURAL AREAS OF ALBANIA

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Abstract

Application of hurdle technology even more is getting a special attention from food scientist and producers, due to its economical convenience, simplicity and flexibility in use. In Albania fig fruit is widespread, usually sold in summer in local markets as fresh fruit, and during the year could be found as dried figs, which is traditionally sun-dried, and a small amount is preserved with addition of sugar. A big challenge still facing rural areas in Albania is the lack of preservation methods and capacities, the high perishable nature of fig and the supply of local markets with imported fig products, which could lead in a stock creation of country produce. So the application of hurdle technology was the aim of this work, as a novel approach to new dietary dried fig-based products development, with the attempt to minimize stock creation of dried figs produce, and market diversification with a range of products competing imported fig products. This study may serve as suggestions for further development of dried fig-based products, also may have an impact for rural areas development in Albania.

Key words*: dried fig-based product development, hurdle technology, rural development.*

INTRODUCTION

Nutrition is strongly linked with people health and longevity, besides the need for consuming to meet minimal requirements for energy, and a good health is an asset for everyone.

One of the fruit that is known from antiquity as symbol of longevity is fig, being an excellent source of minerals, vitamins, dietary fibres and amino acids, and it's free of fat and cholesterol (Solomon et al., 2006; Veberic et al., 2008). Have potential health-promoting constituents as phytosterols (Jeong & Lachance, 2001), carotenoid (Su et al., 2002), anthocyanins (Solomon et al., 2008; Del Caro & Piga, 2008; Duenas et al., 2008) and polyphenols (Del Caro & Piga, 2008; Veberic et al., 2008).

The tree is deciduous in nature, it is earliest cultivated and ranked third among fruit trees cultivated in Albania, and is well-grown in regions of Berat, Tirana, Elbasan, Shkodra, Himara etc. (Hoxha & Kongoli, 2018).

Fruit is utilized by the rural people of the fig growing regions in Albania, where most of the local production is consumed fresh while the remainder goes for drying figs with traditional technique of sun-drying, also preservation with addition of sugar to jam and marmalade processing, also another a typical product produced is "*gliko*".

Hurdle technology is even more in the focus of food scientist and industries for application, due to its economical convenience, simplicity and flexibility in use, other than providing nutritious, tasty and stable products, and that is why is considered here as a novel approach for development of new products.

As promoters to our work for converting dried figs into new value added products with enhanced shelf-life, were the challenges faced yearly by farmers of rural fig growing areas, the lack of fig preservation techniques and methods, waste of fig due to high perishable nature, stock creation of dried fig, need for its utilization during winter months, in the meantime helping in development of rural areas, needs for diversified products and competing imported products in the market etc.

So the actual work may represent a preliminary contribution, filling the gap so far as no scientific work or documented data are available for development of new dietary dried fig-based products and suggesting their recipes for further implementation.

The actual study may serve as a true reflection of the importance and potential of this crop,

and would provide sustainable means to the development of rural fig growing areas in Albania, also would be useful to farmers and industries for utilization, adoption and development of new minimally processes based on hurdle technology application as novel approach to preserve figs during the winter months.

The actual conducted work, beside the aim to develop tasty, healthy, and nutritious new dietary dried fig-based products with added value, served as preliminary work for testing the product samples in-house and to a set of customers, prior launching in the market and commercial production.

MATERIALS AND METHODS

New product development

In this study was used 'Roshnik' sundried fig variety, which is an autochthonous variety mostly grown in Berat region, and well known for its suitability for drying.

The combination of preserving factors were based on the nature of dried fig for processing and converting into new value added products with minimal processes (Figure 1).

Collected and sorted dried figs, after were cleaned and washed, were blanched by dipping the fruits into hot water (temperature 88 ± 2°C) (1: 1 ratio) for 1 min and then cutting and grinding.

The dried fig grinded was thoroughly mixed in an open pan with continuous stirring with other ingredients. For recipes development were used different proportions of dried figs, including other locally available dried fruits and additives selected with intend to enhance nutritional, quality parameters, to prevent microorganism growth, and having low cost in the same time. Ingredient used were as follow: dried fig (59.5-96.5%), dried cranberry (till 35%), dried apricot (21-25%), walnut (7.3-22%), hazelnut (till 2%), unsweetened cocoa powder (till 1.5%), coconut flour (till 1.5%), oats (till 3.7%), finely grated orange zest (0.3-3.3%), grounded cinnamon (till 0.17%), grounded clove (till 0.017%), citric acid (lemon or orange juice) (till 3%), and vanilla extract (0.04-0.85%). In some of the products were used coats of: sesame seeds, coconut flour, pumpkin seeds and walnut.

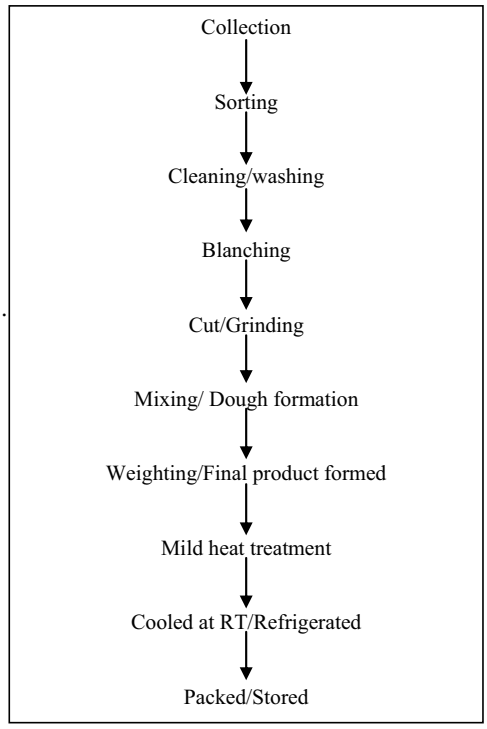

Figure 1. Flow chart for the development of new dietary dried fig-based products

Preparation of 11 recipes for each product from FP_0 to FP_{10} (are coded FP: fig-based product, and numbered in subscript to distinguish each product recipe from another).

Mixing process lasted 1 ± 0.5 h, till formation of dough, and immediately the final products were differently shaped, after equally weighted in portions of 25 ± 0.5 g and 100 ± 0.5 g.

Mild heat treatment (for 7 ± 1 h at 55 ± 1°C) was applied for further moisture content reduction. The final products after cooled to room temperature were kept in refrigerator until packaging and/or further quality parameters evaluation.

The final products packed with plastic wrap, were stored at ambient conditions.

Quality parameters evaluation

Dried fig fruits were evaluated for quality parameters, besides which was content of total ash (AOAC, ref. 942.05), total protein (AOAC, ref. 976.05), total fat (AOAC, ref. 963.15), total carbohydrates (Hedge & Hofreiter, 1962), reducing sugars (AOAC, ref. 925.36), crude fibre (AOAC, ref. 962.09), and the energy

expressed in kcal, was calculated using Atwater factors.

The methods used for evaluation of quality parameters of new developed dried fig-based products, were for moisture AOAC (ref. 934.06), for titratable acidity AOAC (ref. 942.15), and for pH AOAC (ref. 981.12).

Sensory evaluation

The sensory characteristics of the new products, including: appearance, aroma, color, texture, flavor, and overall acceptability, were evaluated by 10 semi trained panel members, in order to get the most acceptable level from the new developed recipes. To rate the products, to each panel member was given a sensory evaluation form of composite scoring (20 point for each characteristic), also was used fresh water for rinsing the mouth prior tasting the next sample.

Data processing

The analysis of Mean, Standard Deviation and bar diagram was used for the result obtained for each determined parameter, at least in three independent replicates.

RESULTS AND DISCUSSIONS

Data obtained from evaluation of quality attributes of dried fig fruit (Table 1), showed that dried fig variety 'Roshnik' possess nutrient content in such amounts that its consumption may provide a good source of energy till 298.57 kcal per 100 g product. Based on obtained results, dried fig evaluated could serves as a good source of nutrients which might play a beneficial role for a good health, especially for mineral content and fiber content respectively for total ash till 2.60 g/100 g and fiber till 8.85 g/100 g, which have resulted in greater amounts compared to similar study of Vora et al. (2017).

From the results for evaluated quality parameters, is noted that dried fig 'Roshnik' variety has attributes that make it suitable to be transformed into new products with added value, offering thus products with high nutritive value. Furthermore development of new products, other as an effective way for utilization of dried figs with added value during winter months, have further strengths, as provides gluten free, with no added sugar, and healthy products.

Table 1. Quality parameters of dried fig, as the main ingredient of new products developed

Quality parameters	Mean	SD
Carbohydrate (g/100 g)	69.34	0.107
Protein (g/100 g)	2.66	0.011
Fat (g/100 g)	1.17	0.001
Fiber (g/100 g)	8.85	0.023
Ash (g/100 g)	2.60	0.015
Reducing sugar (g/100 g)	59.58	0.081
Energy (kcal)	298.57	0.435

The results of quality attributes evaluated for new dried fig-based products developed, showed that for moisture content of new products ranged 14.85-20.98% (Figure 2), based on these values could be considered as safe interval for preserved product, but other supporting microbiological determinations are foreseen to be performed, as this is an ongoing study. Between different recipes, additions of other ingredients had an impact in lowering moisture content compared to FP_0, which is the product with the highest proportion of fig (almost 100%), and here we have considered as control for other recipes. From result it is noted that different ingredient had different impact in moisture content, especially in the case of addition of walnuts product FP_7, also for coated products with sesame seeds, pumpkin seeds, walnuts resulted to have lower moisture content.

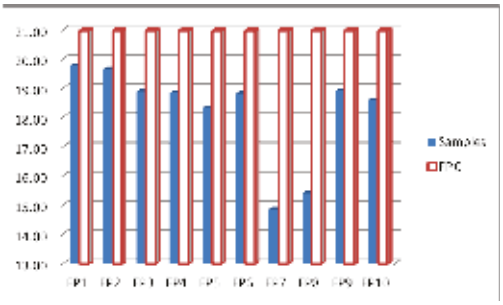

Figure 2. Moisture content of new products

Referring to Figure 2 products FP_7 and FP_8 results with lowest moisture content, maybe due to the ingredient used in their recipes, which can have more affinity to bind water,

and as result is expected a reduced water activity, which is one of the most important hurdle factors.

Titratable acidity parameter was found to be in the range 1.53-2.80% citric acid (Figure 3). Between products FP_9 resulted to have the highest total acidity values, maybe due to the presence in product of dried cranberry. Also, with an impact in total acidity value rising showed orange zest used in two recipes for product FP_4 and FP_{10}. Dried apricot used in product FP_8 and FP_{10}, showed to have similar effect in total acidity content, whereas there were not noted significant differences between other products.

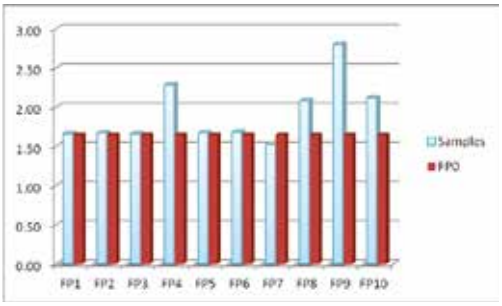

Figure 3. Titratable acidity content of new products

The pH of products ranged from 3.47 to 4.44 (Figure 4), which could considered as safe interval for microorganism growing, and is one of the most important hurdles for food preservation. The low pH value might be influenced by the presence of added lemon and/or orange juice, besides other ingredient used. Among different products, the highest pH content had product FP_7 (fig plus walnut), while with the lowest pH content had FP_9 (fig plus dried cranberry).

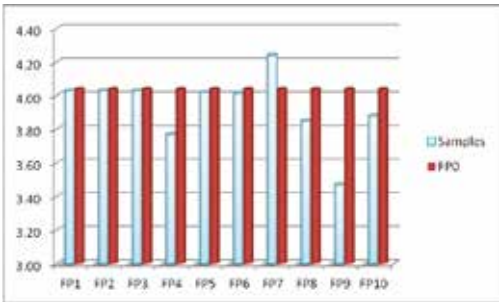

Figure 4. pH values of new dried fig-based products

An effect in lowering pH had presence of orange zest in products FP_4 and FP_{10}, and dried apricot in products FP_8 and FP_{10}. Usage of other ingredients had no effect in pH values, as between other products were not noted significant differences compared to FP_0.

The average results for appearance, aroma, color, texture, and flavor for different new products evaluated by panel members are listed in Table 2.

The highest score for appearance has product FP_6, for aroma has the product FP_4, for color has the product FP_5 and FP_9, which had the darker color by the presence of cocoa and cranberry respectively, for the texture there was no significant differences between products, where for the flavor was highly scored product FP_4.

Table 2. Sensory properties of new dried fig-based products

Quality attributes	Score	Products					
		FP_0	FP_1	FP_2	FP_3	FP_4	FP_5
Appearance	20	16	18.7	18.7	17.7	16.3	17.7
Aroma	20	16.4	16.7	16.4	17.7	19.4	17.7
Color	20	17.5	17.5	17.5	17.5	17.5	17.8
Texture	20	17.5	17.5	17.4	17.4	17.9	17.4
Flavor	20	16.4	16.9	16.7	17.8	19.5	18.1
Total score	100	83.8	87.3	86.7	88.1	90.6	88.7

Quality attributes	Score	Products				
		FP_6	FP_7	FP_8	FP_9	FP_{10}
Appearance	20	18.7	17.8	16	18.4	18.5
Aroma	20	16.7	16.7	16.4	17.8	18.2
Color	20	17.5	17.5	17.5	17.8	17.5
Texture	20	17.5	17.5	17.5	17.5	17.5
Flavor	20	16.7	16.7	16.4	17.8	18.7
Total score	100	87.1	86.2	83.8	89.3	90.4

According to the results of overall acceptability (Figure 5), product FP_4 resulted to be mostly accepted by panel members, as this product had the highest scores 90.6 out of 100, followed by products FP_{10} and FP_9. In general products with added value were highly scored compared to FP_0. Between product FP_8 and FP_0 was no differences in total score, noting that presence of dried apricot was not very distinguishable compared with that of fig, for the used proportions in that recipe. Whereas the coats

used were noted to have an impact in appearance of products, as those products FP_1 (sesame seeds), FP_2 (pumpkin seeds), FP_3 and FP_5 (coconut), FP_6 (walnut plus oats) have the highest score compared to FP_0.

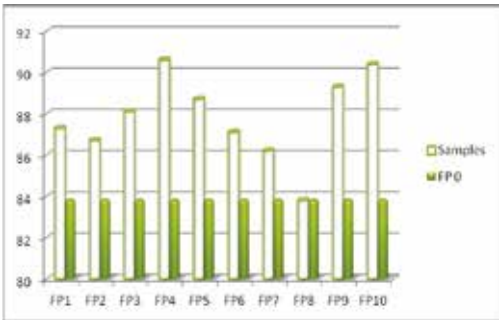

Figure 5. Overall acceptability scores of new dietary dried fig-based

Below are presented some of new dried fig-based products developed for this study, which resulted mostly evaluated and sensorially accepted by panel members (Figure 6), which might be attractive for consumers too, and for their success in the market further work would be suggested.

Figure 6. Some from the new dried fig-based products developed: a) fig+apricot (FP_8); b) fig+craneberry (FP_9); c) fig+orange zest (FP_4); d) fig+walnut (FP_7); e) fig+coconut (FP_6)

CONCLUSIONS

From this study can be concluded that Albanian dried figs possess considerable amount of nutrients, especially fiber and minerals, and may serve as good source energy. Due to its attributes is suitable to be effectively utilized for new dietary dried fig-based products, as one alternative way for adding value to the crop, in the meantime may serve as an income source to people that cultivate fig in rural areas of Albania.

Application of hurdle technology and development of new recipes provided tasty, natural, nutritive and healthy products, with low water content and pH, which are important hurdles for food preservation.

With regards to food stability of these new products, and since this is an ongoing study, further microbiological analyses are going to be performed in order to support our first results. Furthermore inclusion of cranberry, orange zest, also other additives in recipes added value to products, based on evaluation quality parameters and overall acceptability results, new products may be attractive to consumers as a potential for marketing as innovative products, which may compete other imported fig-based products in market.

The knowledge of new preservation method based on application of hurdle technology, and the quality parameters of these new products, may encourage the farmers to develop the products in a larger scale.

Further work is needed to be developed for new dried fig-based products success in the future.

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