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PRELIMINARY RESEARCH ON USING ORGANIC SEA BUCKTHORN POWDER IN BREAD MAKING

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Abstract

Bread is a food product that represents an important element in human nutrition, considered a convenient type of food, being consumed daily in large quantities in many parts of the world. Adding functional ingredients in bakery products was highly researched lately, because of their ability in the reduction of some chronic diseases besides improving of basic nutritional functions. The aim of the present paper was to obtain bread with different quantities of organic dried sea buckthorn powder (Sorana variety), as functional ingredient. For sample characterization, some phisico-chemical (dry matter %, aw) and nutritional parameters (antioxidant activity, total phenolic content) were determined, as well as sensorial analysis. The study obtained promising results regarding the use of sea buckthorn powder as ingredient in bread making.

***Key words**: bread, sea buckthorn powder, ingredient.*

INTRODUCTION

The growing demand for new food products with functional properties worldwide led to various research studies for the addition of new ingredients, such as nuts, fruits and fruit by-products or vegetables and vegetable by-products, ingredients rich in bioactive compounds like fibres, antioxidants or polyphenols (Villasante et al., 2022).

Bread represents one of the most consumed products worldwide, being a great part of the human diet (Stamatie et al., 2020). It is consumed since ancient times, being originally home-made, but once the microorganisms responsible for dough development were discovered and with the food science and technology development, the industrialization of bread was started (Canesin & Cazarin, 2021).

Due to the fact that is highly consumed at a global level, bread represents a good product for addition of various ingredients with bioactive compounds (Villasante et al., 2022), being also highly compatible with such products (Mitelut et al., 2021). After fruits and vegetables processing, a great number of by-products remains as waste which most of the time is considered garbage and rarely is processed into agricultural products. The rising trend of using natural products as sources of antioxidants and functional ingredients in bread making led to the use of edible seeds, spices or fruits and vegetables, which represents affordable products (Özcan, 2022), and their usage could lead to minimising food loss and waste. From the total global food waste and loss, fruit and vegetable are responsible for up to 66% (Magalhães et al., 2022). Therefore, there is an increasing trend in the valorisation of fruit and vegetable by-products, which can be used to produce highly valued bioactive compounds (Sharma et al., 2022) and also can lead to environmental protection.

Seabuckthorn (*Hippophae rhamnoides*) belongs to Elaeagnaceae family, being a hardy, deciduous shrub widely distributed through Europe and Asia (Ting et al., 2011; Ghangal et al., 2012; Drozińska et al., 2019). Seabuckthorn berries are known to be an excellent source of bioactive compounds such as carotenoids, polyphenols, tocopherols, ascorbic acid, organic acids (Attri & Goel, 2018; Ciesarova et al., 2020; Kumar et al., 2021) and also minerals (Ursache et al., 2018). The valorisation of seabuckthorn pomace is gaining more attention nowadays due to its content in health promoting bioactive compounds (Sharma et al., 2022). Therefore, the purpose of this study was to develop bread with the addition of different amounts of seabuckthorn powder and to characterize the newly developed product.

MATERIALS AND METHODS

Experimental design

In this study, Sorana variety organic seabuckthorn (SB) was used. First, seabuckthorn fruits were processed into juice and the resulted pomace was dried at 60°C for 6 h. Further, the dried pomace was grinded and passes through a 0.5 mm sieve in order to obtain the seabuckthorn powder (Figure 1). The characteristics of the obtained powder were: 2418.18 mg Gallic acid equivalents (GAE) per 100 g D.M.; 1171.83 quercetin equivalents (QE) per 10 0g D.M; a_w = 0.451; DM = 91.176%.

Figure 1. Sorana organic seabuckthorn - fresh, pomace and in form of powder

Further, white wheat flour without grain husk was used for bread production (Control sample). Seabuckthorn bread samples were obtained using 5% (5% SB) and 9% (9% SB). seabuckthorn powder reported to wheat flour.

Antioxidant activity

The effect of antioxidant activity on 1.1-dipheny l-2- picrylhydrazyl (DPPH) was estimated according to the procedure described by Villaño et al. (2007), with some modification presented further. Briefly, in 50 ml ethanol (75%) there were macerated 10 g of sample in the dark for 48 h in the dark, at room temperature. The obtained extract was mixed with DPPH ethanolic solution and homogenized. After incubation at room temperature in the dark for 30 minutes, the absorbance of the samples was measured at 515. Results were expressed as quercetin equivalents (QE) per 100g D.M.

Total polyphenolic content

Total content of polyphenols (TP) was determined using the Folin-Ciocalteu method previously described by Popa et al. (2019). Sample absorbance was measured at 765 nm. Total polyphenol concentration was expressed as mg/L Gallic acid equivalents (GAE) per 100 g D.M.

Water activity (a_w)

Water activity of tested samples was determined using NOVASINA equipment. Briefly, the sample was introduced into specific recipients of the equipment and the value of a_w was read when stable at 25°C.

Dry matter

The determination of the total dry matter (DM) was performed by weighing 5 g of bread sample, which was further subjected to drying at 105°C using the RADWAG MAC 50 thermobalance. The results were expressed as a percentage (%).

Colour

Colour assessment was conducted at room temperature using a HunterLab colorimeter, Miniscan XE Plus. Fruit colour was described using L*, a*, and b* CIE coordinates. L* axis represents the lightness with values ranging from 0 (black) to 100 (white), the a* axis is red-green with negative values for green and positive values for red, and b* axis is blue-yellow with negative values for blue and positive values for yellow (Palonen & Weber, 2019).

Sensory analysis

The sensory evaluation of the obtained bread samples was performed using a 5-point scale method, with untrained panellists, in order to determine the acceptability of bread with seabuckthorn powder. The criteria from Table 1 were used for the evaluation of the sensory attributes.

Statistical analysis

All determination was performed in duplicate. The obtained data was statistically analysed using Microsoft Excel 2017. In all tests, it was considered the significance level of $p < 0.05$.

Table 1. Criteria for bread sensory evaluation

Sensory Attributes	Product description	Scale
Exterior and interior appearance (no tasting)	Crust colour	1-very light … 5-very intense
	Core color intensity	1-very light … 5-very intense
	The uniformity of the core	1-very wet core … 5-dry core
	The uniformity of the pores of the core	1-dense pores, non-uniform … 5-uniform pores
	The shattering of the core	1-very fragile … 5-unbreakable
Surface texture (without tasting)	The roughness of the crust	1-rough crust … 5-smooth crust
	Moisture / elasticity of the crust	1-wet crust … 5-dry crust
	The crunchiness of the crust	1-elastic, non-crunchy crust … 5-crispy crust
First bite	The firmness of the crust	1-soft, fluffy crust … 5-firm crust
	Core stickiness	1-sticky core, soft… ..5-crispy crust
Flavor	Basic tastes – note the intensity of the tastes (bitter, salty, sour, sweet)	1-weak taste, imperceptible … 5-pronounced taste
After-taste	Persistence of taste after chewing	1-after-taste imperceptible … 5-after-taste very pronounced

RESULTS AND DISCUSSIONS

The obtained bread samples are presented in Figure 2.

Figure 2. Obtained bread samples

Antioxidant activity

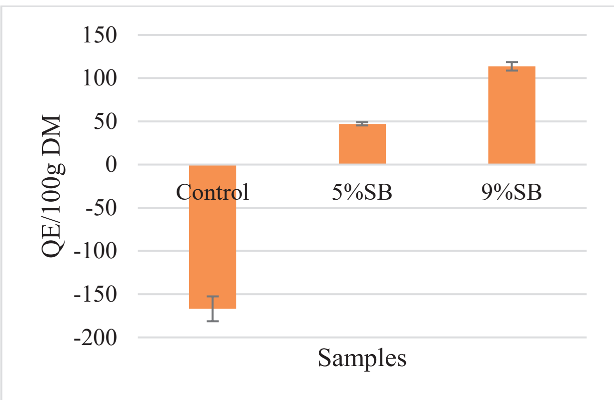

Figure 3. Antioxidant activity of bread samples

It is well known the fact that seabuckthorn berries contain various biologically active substances and their addition to food products could lead to an enriched product. Regarding the antioxidant activity, the Control sample presented a negative value (-166.92 ± 14.39 QE/100 g DM), similar results being reported also by Ghendov-Mosanu et al. (2020). The addition of 5% seabuckthorn powder improved the antioxidant activity (47.10 ± 1.86 QE/100 g DM), being obtained a positive value for this sample. The higher the amount of powder, the higher the antioxidant activity registered, thus for 9%SB sample it was obtained the highest value, namely 113.67 ± 4.93 QE/100 g DM.

Total polyphenolic content

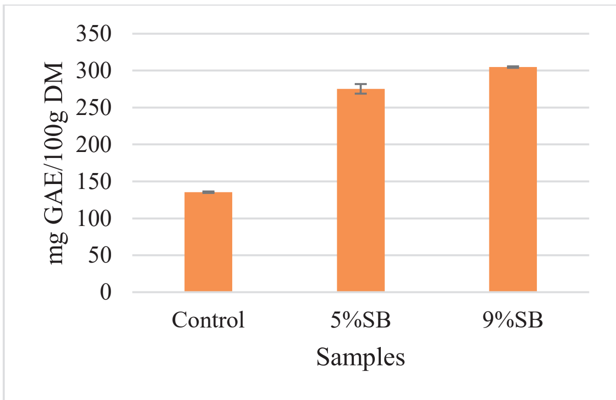

Figure 4. Polyphenolic content of bread samples

Phenolics represent one of the most studied secondary metabolites of plants due to their biological activity which are known to promote human health. The major contributors to this biological activity of seabuckthorn are considered to be phenolics like flavonoids, tannins and phenolic acids (Sne et al., 2013).

Total polyphenols were determined in this study for the three developed bread samples (Figure 4). A study performed by Ballester-Sánchez et al. (2020) determined a value of 13.90 mg GAE/g DM in wheat flour. Thus, the Control sample presented polyphenolic content, having the lowest value of this parameter (135.37 ± 1.01 mg GAE/100 g DM) compared to the other studied samples. The addition of seabuckthorn powder increased the polyphenolic content, reaching a value of 275.32 ± 6.49 mg GAE/100 g DM for 5%SB bread sample and 304.84 ± 1.03 mg GAE/100g DM for 9%SB bread sample. These results are correlated with the ones obtained for the antioxidant activity of the samples.

Water activity and dry matter

Table 2. Water activity (a_w) and DM content

Sample	a_w	DM (%)
Control	0.949 ± 0.010	69.65 ± 0.01
5%SB	0.946 ± 0.001	65.30 ± 0.01
9%SB	0.945 ± 0.002	68.00 ± 0.01

The results presented in Table 2 shows that the addition of seabuckthorn powder did not significantly influence the moisture content, similar values being obtained for all tested samples.
Water activity is an important index because its values could affect food shelf-life. Most food products have a a_w above 0.95 which will provide sufficient moisture to support the growth of bacteria, yeasts, and mould (FDA, 2014). Water activity values of the tested samples are lower for the samples added with seabuckthorn powder compared to Control sample, these results being correlated with the dry matter values.

Table 3. Colour characteristics of the obtained samples

Sample	L*	a*	b*
Control	75.45 ± 0.20	1.70 ± 0.01	20.02 ± 0.05
5%SB	54.76 ± 0.72	10.16 ± 0.07	36.55 ± 0.34
9%SB	50.06 ± 0.88	12.26 ± 0.09	38.17 ± 0.44

Regarding colour characteristics (Table 3), the values of L* (lightness), a* (redness) and b* (yellowness) varied between samples. The lightness of the samples containing seabuckthorn powder were lower compared to control sample, which is normal because the addition of the powder changed the colour of the bread to a darker tone. In contrast, the redness and yellowness of the samples presented higher values for 5% SB and 9% SB.

Sensory analysis

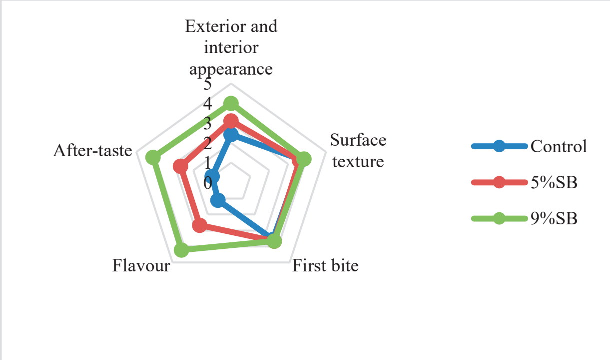

Figure 5. Results of the sensory analysis for the obtained bread samples

Sensory analysis (Figure 5) revealed that bread sample containing 5% seabuckthorn powder presented same values for surface texture and first bite and close values in terms of exterior and interior appearance, flavour and after-taste with the ones obtained for Control sample. Therefore, the acceptability test showed that 5% SB bread sample was preferred by the panellists, while 9% SB bread sample presented an intense bitter after-taste.
In addition to the performed analysis, bread samples were kept at room temperature for several days and the growth of rope spoilage was monitored. Mould growth was observed after 7 days on the surface of control sample and after 8 days on the surface of SB samples, regardless of the quantity of seabuckthorn powder in their composition (Figure 6). These results are promising, helping in further research approach. Similar results were obtained by Ghendov-Mosanu et al. (2020), the addition of seabuckthorn flour increasing bread shelf life by 24-72h.

Control - after 7 days

5%SB - after 8 days

9%SB - after 8 days

Figure 6. Bread sample aspect after 7, respectively 8 days of monitoring at room temperature

CONCLUSIONS

Sea buckthorn can be considered a functional ingredient to be incorporating in this staple food as bread is considered.

Therefore, this new functional food, bread containing antioxidant/phenolic compound could enhance the human health. This paper presents the potential of using of some by-products rich in antioxidants, resulted from buckthorn processing, to be incorporated in bread in order to obtain novel functional food.

From the preliminary research, the results shows that the addition of seabuckthorn powder brings a supplementary nutritional value and a percent of 5%SB was acceptable from the sensorial point of view.

Further research will be focused on the optimisation of the baking technology in order to improve the shelf life and physical-chemical characteristics of bread (such as acidity, volume, porosity, elasticity, etc).

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