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NETTLE BREAD, A POTENTIAL FUNCTIONAL PRODUCT

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Abstract

Stinging nettle (Urtica dioica) plants are considered plant superfood with medicinal properties. Stinging nettle plant can be found worldwide and were used to combat a wide range of diseases like: seasonal allergies, respiratory problems, arthritis, pain, anemia and lethargy, inflammations etc.), as textile or food since thousands of years. There are no informations regarding since when nettle started to be introduced in bread, but there are written food receipts since Roman times. The aim of this study is to present the possibility of using nettle powder (1, 5, 10%) of the total flour quantity, to improve bread taste and quality. Young nettle leaves were collected from a nonpolluted area (Bazos, Timis), dried under controlled environment, then powdered and stored at room temperature in stainless steel container. The bread with and without nettle powder (Control) was analyzed regarding moisture content, mineral composition using XRF analyzer, total antioxidant capacity and total polyphenol content. The results were statistically evaluated. By comparing plain white bread and bread enriched with nettle powder, it's observed the increase of mineral content, total phenolics and antioxidant activity.

Key words: *antioxidants, mathematical models, minerals, Urtica dioica.*

INTRODUCTION

The concern of consumers and producers of food products is to offer not only a safe, healthy food, but also to promote health. Due to this new trend the number of functional foods on the market is constantly growing (Maietti et al, 2021) (a growth rate of about 8–16% per year).

As bread and bakery products are amongst the most consumed food in the world (Gül et al., 2017), there is a high request of innovative functional products in this area.

Plant-derived bioactive compounds as functional food ingredients, capable to increase the mineral and antioxidants content, are some of the components that could be included in bread formulation (Maietti et al., 2021).

Stinging nettle (*Urtica dioica*) is an edible plant, highly valued for its nutritional and nutraceutical properties from the spontaneous flora of the world (Bhusal et al., 2022).

The nettle plant is rich in flavonoids, phenolic compounds, vitamins, minerals, organic acids, volatile compounds, fatty acids, carbohydrates isolectins, sterols, terpenes, and proteins (Said et al., 2015, cited by Bhusal et al., 2022).

The most representative minerals of the nettle plant are: calcium, potassium, magnesium, phosphorus, iron, sulphur, zinc, manganese, copper, and nickel (Pradhan et al., 2015).

Forêt, in 2021, mentioned that nettle bread is very rich in antioxidants and minerals and due to the fact that nettle powder is considered a low glycemic index food (Perez, 2022), its recommended to be added to the whole grains for obtaining a nutritious functional bread.

Nettle plants are very rich in minerals and compared "to wheat flour, nettle powder has much higher total ash content (0.57% for wheat flour and 17.67% for nettle powder), being probably, one of the richest sources of minerals among plant foods" (Man et al., 2019).

The addition of phenolic compounds affects dough's physical-chemical properties and qualities because of several interactions with flour ingredients and helps "to prevent the formation of carcinogens such as acrylamide during baking, thus functioning as an anti-carcinogenic agent in food systems" (Xu et al., 2019).

The aim of this study was to create a functional type of bread with nettle powder (1, 5, 10%) of the total flour quantity, and to verify if the bread quality is improved.

In order to appreciate the quality of the new proposed bread assortments, samples of each bread assortment were analyzed based on total antioxidant capacity, total polyphenols content and mineral content.

MATERIALS AND METHODS

Collection of nettle plants

The nettle plants were collected from Bazos Forest, a region from Timis County, Romania. The leafy parts of the plants were washed, cut, shade dried at room temperature. The dried leaves were pulverized, packed in airtight sterile bags, labelled and stored for further analyses and uses.

Bread making

Ingredients for the plain bread (Control) were: 0.5 kg of flour type "000"; 300 mL of water; 40 ml of extra-virgin olive oil; 10 g of yeast; 10 g of NaCl.

Nettle-enriched bread was obtained by adding 1%, 5% and 10% nettle powder and brings in all three cases to 0.5 kg with flour type "000".

All samples, plain and nettle enriched doughs (kneaded and fermented) were partially baked at 100 °C for 60 min. Final products were oven-baked at 180°C for 60 min.

From each bread assortment was cut one slice of bread, oven dried and fine grinded for future analysis. All samples were homogenized and analyzed in triplicate.

XRF mineral analysis

For XRF (X-ray fluorescence) analyses of samples powder were used Hitachi X-MET8000 portable spectrometer. Each mineral detected in the analyzed material produces a set of characteristic fluorescent X-rays ("a fingerprint") that is unique for that specific element (Thermofisher, 2020).

All analyses were performed in triplicate and the results were reported in ppm.

Total antioxidant capacity (TAC) and total polyphenols content (TPC)

TAC was determinate using CUPRAC method and TPC using Folin-Ciocalteu method as described by Bordean in 2016.

All measurements were performed in triplicate and the antioxidant capacity of each extract was expressed in (μM Trolox/100 g FW).

The total polyphenol content was expressed in mg Gallic Acid/100 g FW.

Statistical analysis

The data were statistically evaluated using the software PAST Version 2.17c (Hammer et al., 2001) and MVSP.

For modelling the data and to have a view regarding the mineral distribution in the bread samples we have used spatial interpolation technique, named Kriging (Veer, 2013), which leverages the spatial autocorrelation structure captured by the semivariogram (Badia-Melis, & Ruiz-Garcia, 2016) to make predictions at unmeasured locations (Castrignanò & Buttafuoco, 2020).

RESULTS AND DISCUSSIONS

Fortification is the process of adding certain nutrients to foods to increase their nutritional value.

Fortified bread is recommended because of the addition of certain nutrients that can be essential for overall health.

The influence of nettle powder addition to bread is presented in Table 1 and Figure 1.

Table 1. Presentation of Nettle - enriched bread assortments characteristics

Bread characteristics	Control (PB1)	PB2	PB3	PB4
Color	Yellow	Yellow green	Brown green	Dark brown greenish
Taste	Plain	Plain	Slight taste of nettle	Strong taste of plant
Acceptability	7	7	6	3
	(1 = dislike very much, 4 = neither like nor a dislike, 7 = like very much)			

Legend: PB1 = plain bread (Control); PB2= Nettle enriched bread (1% nettle powder); PB3 = Nettle enriched bread (5% nettle powder); PB4 = Nettle enriched bread (10% nettle powder).

The obtained bread types can be described as follows:

PB1 = Plain bread (Control) is a product which looks well developed, rectangular in shape with shiny surface, golden yellow color, well-flushed core, pleasant aroma, pleasant taste, characteristic of well-baked white bread.

PB2= Nettle enriched bread with 1% nettle powder appears like a well-developed product, rectangular in shape, glossy surface, yellow-green color, soft core, pleasant aroma, pleasant taste, presenting the characteristic of well-baked bread.

PB3 = Nettle enriched bread (5% nettle powder) is a well-developed product, rectangular in shape, matte surface, brown-green color, soft core, pleasant specific nettle aroma, pleasant taste, characteristic of baked bread.

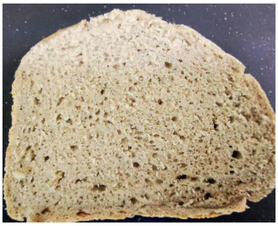
	**PB1**
	**PB2**
	**PB3**
	**PB4**

Figure 1. Bread assortments with nettle powder
Legend: PB1 = plain bread (Control); PB2= Nettle enriched bread (1% nettle powder); PB3 = Nettle enriched bread (5% nettle powder); PB4 = Nettle enriched bread (10% nettle powder)

PB4 = Nettle enriched bread (10% nettle powder) appears like a well-developed product, rectangular shape, matte surface, dark green color, dense core, pungent nettle aroma, specific taste of nettle bread.

In plant-based foods, especially in bread, the interactions between minerals, polyphenols, antioxidants, carbohydrates and fibers are very important because the functionality of each of the components might be affected (Schefer et al, 2021).

The mineral content and the variations between bread samples are presented in Figure 2.

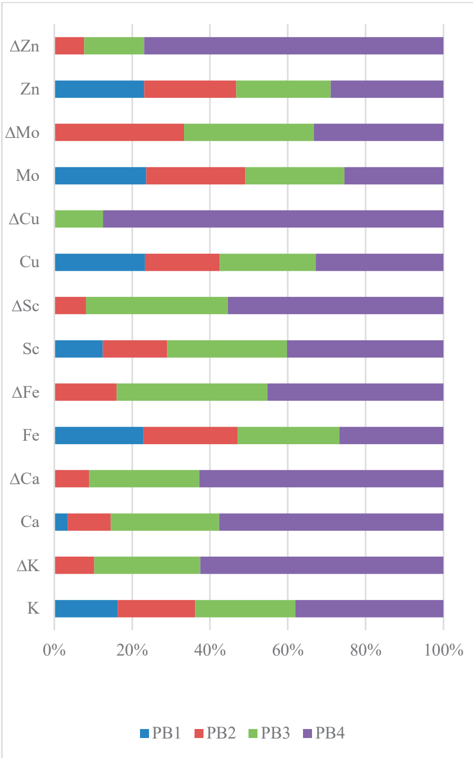


Figure 2. Mineral fingerprint of the investigated bread samples
Legend: PB1 = plain bread (Control); PB2= Nettle enriched bread (1% nettle powder); PB3 = Nettle enriched bread (5% nettle powder); PB4 = Nettle enriched bread (10% nettle powder), Δ = percentage change

As we can observe from Figure 2, most of the minerals show an increase of content (the percent is mentioned on the diagram).

The percentage of change $\Delta Ca > \Delta K > \Delta Sc > \Delta Zn > \Delta Cu > \Delta Fe > \Delta Mo$. The mineral content is increasing proportional with the increase of nettle powder content.

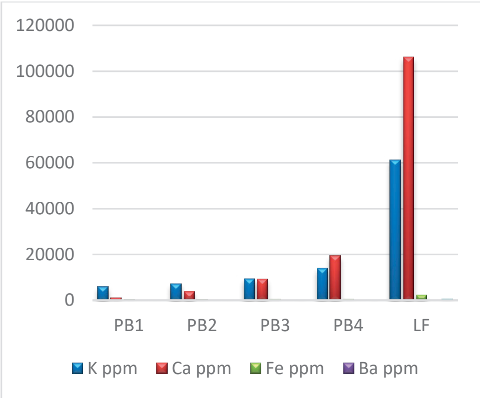


Figure 3. Mineral content of bread samples and nettle powder
Legend: PB1 = plain bread (Control); PB2= Nettle enriched bread (1% nettle powder); PB3 = Nettle enriched bread (5% nettle powder); PB4 = Nettle enriched bread (10% nettle powder), LF= nettle powder

As we can observe the minerals present in the nettle powder (LF) contribute substantially to the mineral content of the proposed bread types (PB2, PB3 and PB4) (Figure 3).
The spatial interpolation of data corresponding to the mineral composition of fortified bread samples is presented in Figure 4.

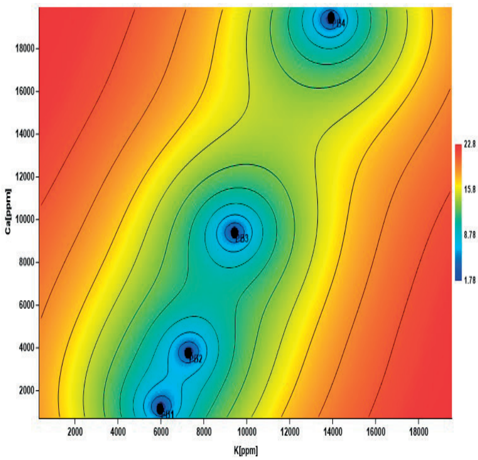


Figure 4. Spatial interpolation of mineral data of bread types
Legend: PB1 = plain bread (Control); PB2= Nettle enriched bread (1% nettle powder); PB3 = Nettle enriched bread (5% nettle powder); PB4 = Nettle enriched bread (10% nettle powder)

The figure shows the level of mineral composition optimization based on Kriging Algorithm and exponential optimized semivariogram.
The exponential semivariogram has the role to calculate the kriging weights for neighbouring sample points, in order to provide an estimate for the unmeasured areas of the bread samples.
The TAC and TPC values of functional bread are presented in Figure 5 and 6. The values are expressed as average values.

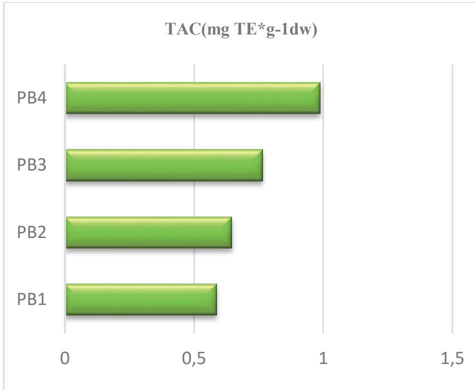


Figure 5. Representation of TAC of the investigated bread samples
Legend: TAC= total antioxidant capacity mg of Trolox equivalents (TE) per g of dry weight (dw).

As we can observe the total antioxidant capacity is increasing with the increase of nettle powder content. The bread with the highest content of nettle powder showing.

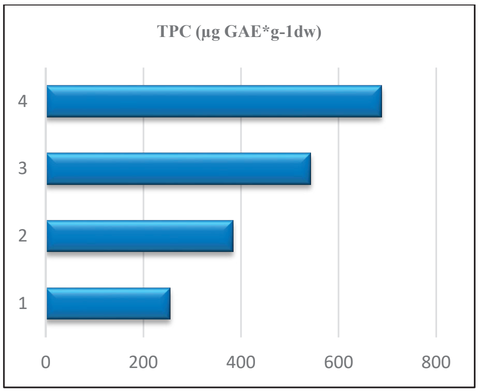


Figure 6. Representation of TPC of the investigated bread samples
Legend: TPC = total polyphenol content - µg of gallic acid equivalents (GAE) per g of dry weight (d.w.)

CONCLUSIONS

The increase of calcium, potassium and iron of the proposed bread assortments and the pleasant taste of the bread assortments (in special PB2 and PB3) recommends the use of nettles powder for optimization of bread mineral content.

The addition of nettle powder to the bread dough gives a special taste and texture to the bread and provides a large amount of easily assimilable nutrients, but will not provide the same amount of nutrients as conventional fortification.

The percentage of change $\Delta Ca > \Delta K > \Delta Sc > \Delta Zn > \Delta Cu > \Delta Fe > \Delta Mo$.

Although nettle fortification is not a common fortification, the high content of nettle powder recommends it for improving the iron, calcium and potassium content of bread.

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