ISSN: 2577-2996

PROGRESS IN MEDICAL SCIENCES, 2024
VOL 8, NO. 4, PAGE 1 – 4
DOI: doi.org/10.47363/PMS/2024(8)206

RESEARCH ARTICLE

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The Benefits of Incorporating Vegetables and Fruits Flours into Grain-Based Foods

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ABSTRACT

A study of food losses (flours) from vegetables and fruits obtained from production of juices from purple carrot, purple yams and red apple was conducted. The vegetables and fruits are with very good quality and good price. They are dried in a heat pump dryer, at an initial temperature of 45 ° C and circulating air with an initial moisture content of 20% at constant (5.6 m/s) and variable speed, in a thin layer, with transversely oriented air flow relative to the product layer.

The dried food losses are ground in a stone mill in the form of vegetable and fruit flours, intended for use in food products in order to give a specific taste and increase biological value.

Analyzes were performed on physicochemical indicators - dry matter (by weight),%; moisture,%; antioxidant activity determined by DPPH method and content of total polyphenols. Vegetable and fruit flours obtained from food losses of the processing industry are a rich source of biologically active substances and can be used in the development of food products with added nutritional and biological value. The pronounced antioxidant activity is high in the vegetable and fruit beetroot flour. The addition of vegetable and fruit flours with 20 % from purple carrot, purple yams and red apple to whole grain rye flour leads to products of high biological value.

ARTICLE HISTORY

Received July 02, 2024
Accepted July 08, 2024
Published July 18, 2024

KEYWORDS

Food Loss, Vegetables, Fruits Purple Carrot, Purple Yams, Red Apple, Good Quality, Biotechnologies

Introduction

The production of bread for specific health needs accounts for a large share of total production [1-4]. This is bread, which in addition to its normal nutritional value, convincingly shows that it has a healthy effect on one or more functions of the body. There is another large group of people who eat low carb bread. Diabetics are recommended bread with high fiber content and low content of easily digestible carbohydrates, usually the so-called black bread - whole wheat, rye-wheat and multi-grain bread. The formulas of this type of bread often use improvers such as sugar and enzymes that break down some carbohydrates into sugars, and in fact the consumption of this bread raises blood sugar [3,5-7]. The approach to finding the most successful formulas for this bread should be to reduce the carbohydrate content by increasing the fiber content of the finished products. To ensure the production of healthy bread with a high fiber content and without the use of artificial improvers, the technology of making bread with the addition of flours rich in fiber, such as vegetables, can be used. Nutritional losses / fiber are a rich source of biologically active substances: fiber, carotenoids, anthocyanins, vitamins, polyphenols and others. Figuerola et al, Makris et al. and by their use in food products they not only improve their sensory qualities, but also enrich their biological value [2,8].

In the present work, the nutritional losses of vegetables, physicochemical parameters dry matter and moisture were studied and the antioxidant activity was evaluated by determining the radical scavenging capacity by the DPPH method and the content of total polyphenols.

Plant losses / pressures (flours) are rich in essential nutrients and available for human consumption, they are used as nutrients in the development of functional foods [1,9,10].

In this aspect of the study, the flour obtained from food losses / pressures from vegetable and fruits processing in terms of antioxidant capacity (DPPH analysis) is characterized.

Materials and Methods

Raw Materials

Nutritional losses are obtained as a solid residue from the production of vegetable and fruits juices (Martins et al., 2011). Vegetables and fruits – purple carrots, purple yams and red apple. Raw materials: rye flour, salt, drinking water, dry yeast, dry rye sourdough, vegetable and fruit flour (sample 1 with 40% purple carrot flour, sample 2 with 40% purple yams, sample 3 with 40% red apple flour). Raw materials from the trade network for control

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and samples 1, 2 and 3 were used. The whole-grain rye flour type 1150, with which the experiments were performed, was delivered by Topaz Mel OOD - Karnobat. Dry baker's yeast was used by the company-manufacturer "Dr. A. Yotker Narungsmitel KD" - Germany, importer: "Dr. Yotker Bulgaria" EOOD. The table salt used was purchased from the trade network. All raw materials are accompanied by documents of origin and quality. Drinking water is suitable for use under Ordinance 9/2001 on water quality.

Drying Method

The drying was carried out in a heat pump dryer, developed by a team of IKKH-Plovdiv at an initial temperature of 45 ° C and circulating air with an initial moisture content of 8-10% at constant (4.6 m / s) and changing speed from 4.6 m / s to 3.6 m / s after the first 90 min), in a thin layer, with transversely oriented air flow relative to the product layer. During the drying process, the mass of the sample was measured for the first hour and a half every 10 minutes, then 30 min. At the end of drying, three times the same mass values of the product are taken.

Digestion of Dried Food Losses

After the drying process, the samples are ground in a stone mill with a flour particle size of 900 µm.

Samples of ground vegetable flour are packed in plastic bags without vacuum of 50 g.

Methods

4.1. Physicochemical Analyzes

- Dry matter, (by weight),% - BDS EN 12145;

- Moisture,% - BDS EN 12145.

4.2. The content of total polyphenols in vegetable and fruit flours was determined by the method of Singleton and Rossi (1965) in the following modification: In a 10 ml test tube, 0.1 ml of sample extract, ~ 7 ml of distilled water, 0.5 ml of Folin - Ciocalteu - reagent (diluted 1: 4 with distilled water) and 1.5 ml of 7.5% (w / v) aqueous sodium carbonate solution. Make up to the mark with distilled water. After resting for 2 hours at 20 - 25 ° C, the absorbance of the reaction mixture was measured at 750 nm. Similarly, a blank was prepared using distilled water instead of extract. The results obtained are presented as gallic acid equivalents (GAE) per 100 g of extract.

4.3. Determination of radical scavenging ability (DPPH test). Radical capture ability was determined by the method of Brand - Williams et al. in the following modification: 2250 µl of DPPH solution (2.4 mg of DPPH in 100 ml of methanol) and 250 l of sample extract pre-diluted with distilled water in a volume ratio of 1: 3 were dosed sequentially into the cuvette [10]. Similarly, a blank was prepared using methanol instead of extract. After keeping the closed cuvettes in the dark for 15 minutes at 20-25 ° C, the absorbance of the reaction mixture at 515 nm was measured. The results obtained are presented as Trolox (TE) equivalents per 100 g of extract.

4.4. Mathematical and statistical processing. All analyzes were performed in at least three replicates and the results are presented as averages.

4.5. Determination of fiber content (BDS ISO 5498: 1999).

4.6.Determination of ash content of bread - BDS ISO 2171: 1999.

4.7.Trial laboratory baking - single-phase method of kneading the dough [4].

4.8. Determining the volume and color of bread - a method described by Karadjov [4].

4.9.Determination of total protein content in bread - Keldal method (BDS 13490-76).

4.10.Determination of the fat content in bread - Soxtec apparatus (BDS 1671-89).

4.11. Nitrogen-free extracts in bread are calculated on the basis of chemical composition.

4.12.Energy value per 100 g of product kJ / kcal / - calculation based on the chemical composition.

4.13.Macro- and microelements have been determined with the help of Atomic emission photometer ICP-MS "Agilent" 8900.

Results and Discussion

The data from the conducted physicochemical parameters of the vegetable and fruit flours are presented in Table 1.

Table 1: Physicochemical Parameters of the Vegetable Flours

Raw materials	Moisture,%	Dry substance,%
Purple carrot flour	4,92	95,08
Purple yams flour	7,96	92,04
Red apple flour	6,68	93,32

When conducting the physicochemical parameters, the values of dry matter determined by weight of the tested vegetable and fruit flours (Table 1). In the case of vegetable and fruit flours, the lowest statistically significant value of moisture is in the case of purple carrot flour.

Table 2: Antioxidant Activity and Total Polyphenols of Vegetable Flours

Raw materials	Antioxidant activity, µmol TE/100 g	Total polyphenols, mgGAE/100 g
Purple carrot flour	45000,00	925,00
Purple yams flour	40989,67	340,00
Red apple flour	35683,33	1080,00

Antioxidant activity shows that the highest values are purple carrot flour, followed by purple yams flour. Red apple flour has the lowest values according to the cited indicators (Table 2).

Technological Preparation

Preliminary preparation of the rye leaven was made by pouring 30 ml of water with a temperature of 39 ºC, standing for 10 minutes to hydrate. Knead the dough from the flour and the other components with a water temperature of 39 ºC.

Figure 1 shows the appearance of the dough involved. The fermentation was carried out for 20 minutes at 38 ºC, stirring and fermentation for another 35 minutes. The final fermentation is 90 minutes. Figure 2 shows the appearance, and Figure 3 shows the section of the bread.

Characteristics of the Test After Kneading

Control - rye flour, rye sourdough, dry yeast, salt, water

normal texture, sticky, soft, puffy dough, light beige color

Sample 1 - rye and purple carrot flour 40%, rye sourdough, dry yeast, salt, water

normal texture, beautiful, well-developed, light beige color with an orange tinge

Sample 2 - rye and purple yams flour 40%, rye sourdough, dry yeast, salt, water

normal consistency, less sticky than sample 1, well developed, pale beige color with a reddish tinge

Sample 3 - rye and red apple flour 40%, rye sourdough, dry yeast, salt, water

normal consistency, less sticky than sample 1, well developed, pale beige color

Table 3: Quality Assessment of Types of Bread

Types of bread	Mass g	Volume sm^3	L mm	H mm	W mm	Moisture %	Dry substance %
Control	248,4	410	123	50	82	37,54	52,46
Sample 1	253,5	510	126	52	82	36,72	53,28
Sample 2	254,3	450	125	51	82	35,68	54,32
Sample 3	259,9	384	122	53	82	35,70	54,30

Table 3 shows the humidity of the control and samples 1, 2 and 3, which vary from 35.68% to 37.54%, with the highest mass is sample 3 (259.9 g), the volume of sample 3 is the most -low 384 cm3 and the volume of sample 1 is the highest 510 cm3.

Table 4: Physico-Chemical Characteristics of the Types of Bread

Types of bread	Acidity ◦H	Protein %	Fat %	Fiber %	Ash %	Carbohydrates %
Control	6,5	5,84	0,66	5,10	1,72	39,96
Sample 1	6,1	9,32	2,89	4,24	1,16	32,07
Sample 2	5,2	7,60	1,25	6,84	1,92	31,68
Sample 3	6,0	8,14	1,22	5,32	1,82	30,70

Table 4 shows the physico-chemical composition of the bread. In terms of acidity, the control (6.5◦H) has the highest acidity and sample 2 (5.2◦H) has the lowest content. There is no significant difference between the different samples. With regard to the proteins with the highest content is sample 1 (9.32%), respectively with the lowest content is the control (5.84%). Regarding the fats with the highest content is sample 1 (2.89%), and with the lowest content is the control (0.66%). With regard to the fibers with the highest content is sample 2 (6.84%), and with the lowest content is sample 1 (4.24%), which is 2.5 times less.

With regard to the ash content, sample 2 has the highest content (1.92%) and sample 1 (1.16%) has the lowest content. There is no significant difference between the different samples. With regard to carbohydrates with the highest content is the control (39.96%), and with the lowest content is sample 1 (32.07%).

When using vegetable and fruit flour, the carbohydrate component decreases.

Table 5: Energy Value of the Bread (kcal/100g Product)

Types of bread	Energy value kcal/100g product
Control	200
Sample 1	282
Sample 2	368
Sample 3	257

Table 5 shows the energy value, which varies from 200 kcal / 100g product to 368 kcal / 100g product, and in the control is the lowest (200 kcal / 100g product), and respectively in sample 2 with the participation of purple yams flour 40% increases to 368 kcal / 100g product. Figures 1 and 2 shows breads and slice of breads. They are with normal consistency, well done top and bottom crust and aroma.

Figure 1: Bread Control 1,2,3

Figure 2: Slices of Bread Control 1,2,3

Table 6: Antioxidant Activity and Total Polyphenols of Breads

Type of bread	Antioxidant activity, µmol TE/100 g	Total polyphenols, mgGAE/100 g
Purple carrot flour and rye flour	30020,00	1025,00
Purple yams flour and rye flour	20574,74	980,00
Red apple flour and rye flour	7583,36	796,00

Antioxidant activity shows that the highest values are bread with purple carrot flour and rye flour, followed by bread with purple yams flour and rye flour. The bread with red apple and rye flour has the lowest values according to the cited indicators (Table 6) [11].

Conclusions

The results of the conducted scientific experiments give grounds for the following conclusions:

- Vegetable and fruit flours obtained from food losses of the processing industry are a rich source of biologically active substances and can be used in the development of food products with added nutritional and biological value. The pronounced antioxidant activity is high in vegetable purple carrot flour, followed by purple yams flour.
- The finished products are free of GMOs, artificial colors and preservatives. The new assortments are suitable for the mass consumers and have significant benefits for their health.

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