JAP&T
TPA-Timişoara

Available online at http://journal-of-agroalimentary.ro

Journal of Agroalimentary Processes and Technologies 2017, *23* (4), 209-211

Journal of Agroalimentary Processes and Technologies

Total phenol, anthocyanin and flavonoid contents of whole wheat flour and white flour

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Received: 20 September 2017; Accepted: 30 Ocrober 2017

Abstract

In this study, total phanol, anthocyanin and flavonoids contents of whole wheat and white flours were determined. While total phenolic contents of whole wheat flour changed between 819 mg GAE/g (ND-C 134) to 4929 mg GA/g (E>14.5-145), total phenolic contents of white flour ranged from 313 mg GA/g (ND-d 111) to 4595 mg GA/g (SD-a 138). Anthocyanin contents of both flour types (whole wheat flour and white flour) were found between 0.007 µmol/g (MN-B 126) to 0.054 µmol/g (SD-A 138) and 0.054 µmol/g (PNW-A 141) to 0.061 µmol/g (ND-C 134 and SD-B 139), respectively. While flavonoid contents of whole wheat flours change between 7.0 (PNW-A 141) and 105.3 mgCE/g (SD-A 138), flavonoid contents of white flour ranged from 11.8 (PNW-B 142) to 25.6 mgCE/g (SD-C 140), respectively.

Keywords: white flour, whole white flour, total phenol, anthocyanin and flavonoid

1. Introduction

Wheat (*Triticum aestivum*) is an important agricultural commodity and a primary food ingredient world wide. It contains important beneficial nutritional components [1]. The concentration of biochemicals in wheat flour is genetically determined by the choice of cultivar and environmentally determined by soil, climate and management practices. Cereal grains contribute significant quantities of energy, protein and selected micronutrients to the animal and human diet [2]. The nutritional value of wheat is extremely important as it takes an important place among the few crop species being extensively grown as staple food sources. In addition the importance of wheat is mainly diet. The fact that it, seed can be ground in to flour [3]. This global crisis in nutritional health is the result of dysfunctional food systems that do not consistently supply enough of these essential nutrients to meet the nutritional requirements of high-risk groups [4]. Availabe research has demonstrated that micronutrient-enrichment traits are available within the genome of wheat that could allow for substantial increases in the levels of minerals , vitamins and other nutrients and health-promoting factors without negatively impacting crop yield [4,5]. The aim of current study was to determine the concentrations of macro and micro elements of selected 24 white and whole wheat flours obtaired from Fargo in U.S.A.

2. Materials and Methods

2.1.Material

Hard red spring wheat (HRSW) samples were collected by the National Agricultural Statistics Service offices in North Dakota, South Dakota, Minnesota and Montana USA. The samples were acquired from mid-August to the end of September, directly from wheat producers. The sample

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collection was determined based on county production histories. A portion of each sample was combined to produce composite samples for the 16 growing regions in Montana (MT-A, B, C, D and E), North Dakota (ND-A, B, C, D, E and F), South Dakota (SD-A, B and C), Minnesota (MN-A and B), Oregon, Washington and Northern Idaho (PNW-A) and Southern Idaho (PNW-B). Composites were also blended based on protein content (<13.5%, 13.5-14.5% and >14.5% protein) from the Eastern and Western halves of the 7 state growing region.

2.2. Methods

Milling

To produce whole wheat flour the samples were ground using a hammer mill with a 0.8mm screen. The white flour was produced according to AACC approved method 26-21.02. After cleaning, the wheat was tempered to 15.5 % moisture for 16 h. Five minutes prior to milling additional 0.5 % water was added. The humidity of the milling laboratory was maintained at 68 % and the temperature was between 22.2-23.3°C. The wheat was milled on a Bühler type MLU-202 laboratory mill. Straight grade flour was blended from the 3 break and 3 reduction streams before being rebolted through a 84 SS sieve [6]

Determination of Anthocyanins, Total Phenolic Contentsand Flavonoids

Anthocyanin contents of plant samples were analyzed according to Ticconi et al.,[7]. 0,5 g fresh weight (FW) were homogenized in a solution containing propanol, chlorhydric acid, and water (18 : 1 : 81). The resulting homogenates were boiled in a water bath for 3 min and then left in darkness for 24 h at room temperature. 3 mL of the supernatants were centrifuged at 6500 rpm for 40 min. Finally, the absorbencies of the samples were measured at 535 and 650 nm. The absorbance value was calculated and corrected by the following formula:

$$A = A_{535} - A_{650}$$

The phenols of the plants were determined according to Madaan et al. [8]. Absorbances were measured at 765 nm using UV/VIS spectrophotometer (Schimadzu, Japan) against blank.

Total flavonoids contents (mg Catechol equivalents (CE) per g of dry weight (mg CE/g DW) of plants were estimated according to Dewanto et al.,[9]. Methanol extracts were properly diluted with distilled water. 5% $NaNO_2$ solution was added to each test tube; after five minutes, 10% $AlCl_3$ solution was added and then after six minutes 1.0 M NaOH was added. Finally total volume was filled up to 5 mL with water and the test tubes were mixed well. Absorbance of the resulting pink-colored solution was measured at 510 nm versus blank. Calibration curve was prepared using Catechol as standard.

2.3.Statistical analyses

The average is calculated by analyzing the flours three times. Statistical analysis was performed using the SPSS 16.0 statistical software. Statistically significant differences and mean values±standard deviation (SD) were reported [10].

3. Results and Discussion

While total phenolic contents of whole wheat flour changed between 819 mg GAE/g (ND-C 134) to 4929 mg GA/g (E>14.5-145), total phenolic contents of white flour ranged from 313 mg GA/g (ND-d 111) to 4595 mg GA/g (SD-a 138). Generally, total phenol contents of ND-A 132, ND-B 133, EC 13-5-143, E.M.d. 144, PNW-B 142, ND-E 136, Largden CDC 32, Carrington stellan ND-3, W<3.5-146, SD-c 140, SD-A 138 and SD-B 139 samples were found high. Chlopicka et al., [11] reported that wheat flour contained 6.96 mg/g dw total phenolic content. The phenols in wheat flour were found partly similar level as shown by Holtekjolen et al., [12] and Chlopicka et al., [11]. Generally, total phenolic contents of whole wheat flour were found higher compared with results of while flour samples.

Anthocyanin contents of both flour types (whole wheat flour and white flour) were found between 0.007 µmol/g (MN-B 126) to 0.054 µmol/g (SD-A 138) and 0.054 µmol/g (PNW-A 141) to 0.061 µmol/g (ND-C 134 and SD-B 139), respectively. Anthocyanins in whole meal and flour were found between 0.5 mg/100g (rad wheat) to 16 mg/100g (blue wheat) and 0.2 mg/100g (nd wheat) to 2 mg/100g (blue wheat), respectively [13,14].

Generally, anthocyanin contents of whole wheat flour were found lower than those of white flour.

Table 1. Total phenol, anthocyanin and flavonoid contents of whole wheat flour and white flour

Samples (Whole Wheat Flour)	Total phenolics content (mg Gallic acid g-1 extracat)	Anthocyanins (µmol g^{-1}DW)	Flavonoid (mg CE/g DW)	Samples (White Flour)	Total phenolics content (mg Gallic acid g-1 extracat)	Anthocyanins (µmol g^{-1}DW)	Flavonoid (mg CE/g DW)
MT-A 127	2627 ± 189*	0.023 ± 0.009	11.3 ± 1.2	**MT-B 104**	3315 ± 165	0.059 ± 0.000	19.8 ± 1.7
ND-A 132	4015 ± 131	0.040 ± 0.011	9.9 ± 1.1	**MT-C 105**	3543 ± 84	0.058 ± 0.001	21.7 ± 0.6
MN-B 126	3190 ± 136	0.007 ± 0.000	14.7 ± 1.5	**ND-A 108**	3841 ± 169	0.060 ± 0.001	21.4 ± 0.8
MT-C 129	3618 ± 119	0.017 ± 0.006	20.2 ± 2.3	**MN-A 101**	3476 ± 145	0.060 ± 0.000	21.8 ± 0.9
MT-E 131	3488 ± 207	0.018 ± 0.007	16.0 ± 2.6	**ND-F 113**	3840 ± 119	0.058 ± 0.002	15.1 ± 2.3
ND-B 133	4108 ± 102	0.034 ± 0.003	17.9 ± 1.0	**ND-B 109**	4182 ± 32	0.059 ± 0.001	12.5 ± 0.1
EC 13.5-143	4052 ± 186	0.031 ± 0.008	17.2 ± 1.0	**ND-C 110**	4172 ± 42	0.059 ± 0.000	13.8 ± 0.7
E.M.d 144	4315 ± 56	0.048 ± 0.003	16.1 ± 2.4	**ND-E 112**	4308 ± 59	0.059 ± 0.000	18.2 ± 0.9
PNW-B 142	4249 ± 101	0.046 ± 0.003	20.0 ± 1.3	**5D-A 114**	4036 ± 57	0.059 ± 0.000	11.8 ± 0.1
ND-F 137	3836 ± 194	0.052 ± 0.002	18.7 ± 1.5	**MW-B 102**	3955 ± 104	0.059 ± 0.000	21.6 ± 0.9
ND-E 136	4223 ± 125	0.032 ± 0.002	9.9 ± 0.7	**MT-A 103**	3500 ± 117	0.058 ± 0.000	13.3 ± 0.2
W-M.d.147	3712 ± 90	0.032 ± 0.005	18.3 ± 0.5	**MT-E 107**	3913 ± 152	0.059 ± 0.001	16.6 ± 2.2
W>14.5 148	4025 ± 136	0.023 ± 0.003	18.5 ± 0.9	**SD-B 115**	3781 ± 191	0.059 ± 0.000	18.8 ± 3.3
ND-D 135	3248 ± 67	0.020 ± 0.007	12.7 ± 2.0	**ND-D 111**	313 ± 31	0.060 ± 0.000	12.4 ± 0.5
ND-C 134	819 ± 93	0.027 ± 0.003	8.7 ± 0.5	**East High Flour 121**	3417 ± 179	0.061 ± 0.000	20.4 ± 1.0
PNW-A 141	3836 ± 69	0.032 ± 0.001	7.0 ± 0.8	**5D-C 116**	4087 ± 92	0.054 ± 0.005	14.8 ± 0.1
W<13.5 146	4220 ± 53	0.034 ± 0.000	10.3 ± 0.3	**PNW-A 117**	4041 ± 116	0.059 ± 0.000	16.3 ± 0.5
MN-A 125	3675 ± 134	0.019 ± 0.003	14.4 ± 2.4	**PNW-B 118**	3538 ± 126	0.058 ± 0.001	16.0 ± 0.3
MT.B 128	3406 ± 163	0.043 ± 0.003	14.2 ± 1.5	**East Low Flour 119**	4158 ± 184	0.059 ± 0.000	22.2 ± 1.2
MT.D 130	2241 ± 122	0.025 ± 0.001	17.3 ± 0.5	**East Mid Flour 120**	1609 ± 55	0.058 ± 0.002	15.7 ± 0.3
E>14.5 -145	4929 ± 141	0.046 ± 0.005	11.2 ± 0.3	**West High Flour 124**	3790 ± 194	0.057 ± 0.004	18.3 ± 1.1
SD-C 140	4928 ± 147	0.044 ± 0.003	10.3 ± 1.5	**MT-D 106**	4311 ± 147	0.060 ± 0.000	25.6 ± 1.2
SD-A 138	4921 ± 85	0.054 ± 0.002	105.3 ± 4.4	**West Mid Flour 123**	4595 ± 167	0.059 ± 0.000	22.9 ± 0.7
SD-B 139	4377 ± 152	0.049 ± 0.002	14.5 ± 0.4	**West Low Flour 122**	3120 ± 185	0.061 ± 0.000	22.1 ± 0.5

mean±standard deviation

While flavonoid contents of whole wheat flours change between 7.0 (PNW-A 141) and 105.3 mgCE/g (SD-A 138), flavonoid contents of white flour ranged from 11.8 (PNW-B 142) to 25.6 mgCE/g (SD-C 140), respectively. When compared, flavonaid contents of white flour were found low acording to results of whole wheat flour. These differences can be probable due to bran of whole wheat.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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