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ORIGINAL ARTICLE

Total phenolic contents and antioxidant activities of various solvent extracts from whole wheat and bran

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Abstract Two wheat varieties grown in Upper and Delta Egypt were compared for their total phenolic content and antioxidant activities. Three solvent systems have been used to prepare the antioxidant extracts from whole wheat and its bran fraction. The three solvent systems included 50% acetone (*v*/*v*), 70% methanol (*v*/*v*) and 70% ethanol (*v*/*v*). Antioxidant activities were tested using DPPH radical scavenging activity and total flavonoid content. The results showed that the extraction solvents and wheat varieties significantly altered the total phenolics and antioxidant activity of whole wheat and bran, and 50% acetone is a recommended solvent for extracting phenolic compounds from the tested wheat and bran. Also data indicated that the bran fraction was rich in total phenolic content and high power for radical scavenging activity than whole wheat. These results showed that wheat bran could be considered as a potential source of antioxidant agent. Therefore, durum wheat variety (Beni-suef-3) showed high level of total phenol contact and antioxidant properties in bran fraction than common wheat variety (Gemiza-9). So, whole meal wheat products maximize health benefits and strongly recommended for use in food processing.

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Introduction

Common wheat (*Triticum aestivum* L.) is an important component of the human diet, and is used in the production of many food products, including bread, noodles, steamed bread, and cakes, providing energy based on the high contents of protein and carbohydrate. Wheat products contain high levels of antioxidants, which confer protection against cancer and heart diseases mostly coming from phenolics (Adom et al., 2005; Ward et al., 2008). Synthetic antioxidants, such as butylated

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hydroxyanisole (BHA) and butylated hydroxyltoluene (BHT), which are suspected of being carcinogenic and causing liver damage (Ratnam et al., 2006). It is believed that an increased intake of food, which is rich in natural antioxidants, is associated with a lower risk of degenerative diseases, particularly cardiovascular diseases and cancer (Perez-Jimenez et al., 2008).

In wheat grain, most of the phenolic compounds are located in the bran, which constitutes the outermost parts of the grain. Traditionally, the milling of the wheat grain aimed at removing the bran or outer layers of the grain to obtain the refined white flour. Nowadays, it is well known that the outer layers contain phytochemicals with potential bioactivities, suggesting the use of wheat grain as whole instead of refined (Hemery et al., 2007). On the other hand, phenolic compounds are secondary metabolites which synthesize in plants. They possess biological prosperities such as: antioxidant, antiapoptosis, anti-aging, anticarcinogen, anti-inflammation, anti-atherosclerosis, cardiovascular protection, improvement of the endothelial function, as well as inhibition of angiogenesis and cell proliferation activity. Most of these biological actions have been attributed to their intrinsic reducing capabilities (Han et al., 2007). Flavonoids are class of secondary plant metabolites with significant antioxidant and chelating properties. Antioxidant activity of flavonoids depends on the structure and substitution pattern of hydroxyl groups (Sharififar et al., 2008). The total flavonoid content of different solvent extracts from the studied wheat cultivars was measured using aluminum chloride colorimetric method (Hung and Morita 2008). The total flavonoid content was expressed as the rutin equivalent.

Antioxidant rich extracts have been obtained from wheat using various solvents including water, ethanol, methanol and an aqueous ethanol solution (Vaher et al., 2010; Zielinski and Kozowska, 2000). It is noted that a solvent system for extraction is selected according to the purpose of extraction such as preparation or analysis. Also, it was chosen according to the nature of interested components, the physicochemical properties of the matrix, the availability of reagents and equipments, cost, and safety concerns. Absolute ethanol and 50% acetone have been used to prepare antioxidant extracts from wheat and wheat-based cereal products and 70% methanol widely accepted solvents for extracting phenolic compounds (Yu et al., 2002).

The aim of the present study was determination of the phenolic content and antioxidant activity in the two varieties of whole wheat and bran fractions extracted by different solvent systems, as well as study the effect of growing locations on antioxidant activities.

Materials and methods

Materials

Egyptian wheat cultivars originating from two different eco-geographic areas were procured from Wheat Department Agriculture Research Centre. The two varieties were grown in conventional conditions. The cultivars were selected to represent the range of place of origin, i.e., Upper and Delta Egypt (Table 1).

Methods

Extraction of wheat antioxidants

The extraction of antioxidants assay was conducted according to (Moore et al., 2006). Two grams of whole wheat and bran samples were ground to 80 mesh and extracted for 15 h with 20 ml of 50% acetone (*v*/*v*), 70% ethanol (*v*/*v*) and 70% methanol (*v*/*v*) at ambient temperature, respectively. The antioxidant extracts were kept in the dark until further assays.

Total phenolics content

The total phenolic contents in the wheat extracts were estimated using Folin–Ciocalteu reagent (Yu et al., 2003). In brief, the reaction mixture contained 50 μl of whole and bran extract, 250 μl of freshly prepared Folin–Ciocalteu reagent, 0.75 ml of 20% sodium carbonate, and 3 ml of pure water. After 2 h of reaction at ambient temperature, the absorbance at 765 nm was measured and used to calculate the phenolic contents using gallic acid as a standard.

DPPH radical scavenging activity assay

1,1-Diphenyl-2-picrylhydrazyl (DPPH) radical scavenging capacities of wheat extracts were estimated by the reduction of the reaction color between DPPH solution and sample extracts as previously described by Huang et al. (2005). A final concentration of DPPH solution used was 0.15 mM for wheat phenolic extracts instead of 0.075 mM for wheat extracts. DPPH solution (3.9 ml) was mixed with sample solution (0.1 ml). The mixture was kept in the dark at ambient temperature. The absorbance of the mixtures was recorded at 515 nm for exactly 30 min. Blank was made from 3.9 ml of DPPH and 0.1 ml methanol and measured absorbance at $t = 0$. The scavenging of DPPH was calculated according to the following equation (Liyana-Pathiran and Shahidi, 2007):

$$\%\ \text{DPPH scavenging} = (\text{Abs t} = 0 - \text{Abs t} = 30)/\text{Abs t} = 0 \times 100$$

where Abs($t = 0$) = (absorbance of DPPH radical + methanol) at $t = 0$ min

Abs($t = 30$) = (absorbance of DPPH radical + phenolic extracts) at $t = 30$ min.

Total flavonoid contents

Flavonoid contents of wheat fractions were assayed using the aluminum chloride colorimetric method of Chang et al. (2002). The appropriate dilution of extracts (0.5 ml) were mixed with

Table 1 Wheat varieties investigated.

Variety	Type	Location	Thousand Kernel Weight (g)	Production yield (Ard./Fed.)[a]
Gemiza-9	Common	Delta region	36.44	18.61
Beni-suef-3	Durum	Upper Egypt	40.34	21.00

[a] *Source:* Agriculture Directorates of Governorates, Economic Affairs Sector, Ard./Fed. → Ardab/Feddan.

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