International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(6): 2153-2156

Received: 24-09-2017
Accepted: 25-10-2017

Himani
Department of Chemistry & Biochemistry, COBS & H, CCS HAU, Hisar, Haryana, India

Shashi Madan
Department of Chemistry & Biochemistry, COBS & H, CCS HAU, Hisar, Haryana, India

SK Sethi
Department of Genetics & Plant Breeding, COA, CCS HAU, Hisar, Haryana, India

Correspondence
Himani
Department of Chemistry & Biochemistry, COBS & H, CCS HAU, Hisar, Haryana, India

Variation in mineral micronutrient content in durum (*Triticum durum* L.) wheat genotypes under rainfed conditions

Himani, Shashi Madan and SK Sethi

Abstract
Durum wheat (*Triticum durum* L.) is tetraploid wheat known for its hardness, protein, intense yellow colour, nutty flavour and excellent cooking qualities. The crop was raised at the field of Wheat and Barley Section, Department of Genetics and Plant Breeding following Randomized Block Design (RBD) layout with three replications during the *rabi* season (2014-15).The availability of nutrients from a particular food depends on its chemical composition. 36 durum wheat genotypes were evaluated for micronutrient contents (Fe, Cu, Zn and Mn). Micronutrient concentration varied significantly among different genotypes of wheat grains. Maximum iron content was found in PDW 337 (51.0 µg/g) and minimum of 29.10 µg/g in HI 8749. Zinc content was observed maximum in MACS 3873 (46.93 µg/g) and minimum in 30.30 µg/g in HI 8498. Manganese was found maximum in UAS 448 (38.50 µg/g) and minimum in GW 1299 (22.40 µg/g). Copper was found maximum in PDW 335 (6.28 µg/g) and minimum value was observed in GW 1298 (3.12 µg/g).

Keywords: Durum wheat, micronutrients**,** pasta, quality

Introduction

Wheat is the major cereal crop grown worldwide and is an essential component of the global food security mosaic, providing one-fifth of the total calories of the world's population. It is the staple food for most of the countries in the world. India's wheat production is forecast to hit a record of high 96.64 million MT during 2016-17. Durum or macaroni wheat (*Triticum durum* L.) is the second most important cultivated species of the genus *Triticum* and falls next to bread wheat (*Triticum aestivum* L.) in respect of area and production. It is cultivated about 10 to 11 per cent of the world wheat areas and accounting about 8 per cent of the total wheat production (Ganeva *et al*., 2011) [4]. India is one of the major durum producers and almost entire produce of 2.5 million tons is used to meet domestic requirements (Shoran *et al*., 2004) [13]. It is well adapted to semiarid regions than bread wheat. Durum wheat encompasses high degree of resistance against various diseases as compared to bread wheat which is highly prone to insect attacks. Pasta products are becoming increasingly popular not only world-wide but also in the Indian subcontinent because of their ready-to-eat convenient form, availability in various shapes, designs, nutritional quality, palatability and long shelf life. Durum wheat has unique characteristics which have made it the most suitable raw material for the production of pasta products such as spaghetti, macaroni and vermicelli etc. The high protein content, excellent golden amber color, kernel hardness, kernel size, granular semolina and superior cooking quality of durum wheat makes it the most suitable wheat for manufacturing high quality pasta products and diverse range of foods (Motalebi *et al*., 2007; Soomro *et al*., 2014) [12, 14].

Over three billion people are currently micronutrient malnourished. The mineral elements play numerous beneficial roles due to their direct and indirect effects in both plant and human metabolism and the deficiencies or insufficient intakes of these nutrients leads to several dysfunctions and diseases in humans (Welch and Graham, 2004) [16]. Manganese (Mn) has been recognized as an essential mineral nutrient for acquisition of photosynthetic competence in higher plants (Gardner *et al*., 1988; Mukhopadhay and Sharma, 1991; Jhanji *et al*., 2014) [5, 11, 8] while copper plays an important role in photosynthesis as a part of chloroplastic enzyme plastocyanin in the electron transport system, oxidative stress protection (Gardner *et al*., 1988; Yruela, 2005) [5, 17]. Zinc is an essential element for human health and well-being.

It has a structural and functional role in a large number of macromolecules and is required for over 300 enzymatic reactions. Available research has demonstrated that micronutrient-enrichment traits are available within the genome of wheat (as well as other food crops) that could allow for substantial increases in the levels of minerals, vitamins, nutrients and health-promoting factors without negatively impacting crop yield. Therefore in the present study, 36 durum wheat genotypes were identified with highest micronutrient contents which may be used in future breeding programs to solve the problem of malnutrition.

Materials and Methods

Thirty six durum wheat genotypes viz. including four checks (two bread and two durum wheat) were grown under rainfed conditions during *rabi* season. The crop was raised in the field of Wheat and Barley Section, Department of Genetics and Plant Breeding following Randomized Block Design (RBD) layout with three replications during the session (2014-15). The field pot of each replication consisted of six rows (6×1.20 sq. meter.). The field trial was managed according to local field practices. No diseases were identified during the growth season. The grains of durum wheat genotypes were collected after harvest and stored in paper bags for the estimation of different micronutrient contents.

Estimation of micronutrients: One gram of finely powdered wheat flour sample was digested with 15 ml of diacid mixture (4HNO3 : 1 HClO4) in a conical flask by heating on hot plate in open space till clear white precipitates settled down at the bottom of the conical flask. The precipitates were then dissolved in 1per cent HCl prepared in double glass distilled water, filtered and volume of the filtrate was made to 50 ml with double glass distilled water. The contents of iron (Fe), zinc (Zn), manganese (Mn) and copper (Cu) were estimated, from the extract prepared, by Atomic Absorption Spectrophotometer (Model PERKIN-ELMER 2380).

Results and Discussion

The amount of micronutrients in the grains will depend on the amount taken up by the roots during grain development and the amount redistributed to grains from vegetative tissues via phloem (Garnett and Graham, 2005). These micronutrients are essential for various biological functions and are important as enzyme cofactors. The minerals of wheat flour are not quantitatively large but may have considerable effect on the quality and behavior of the flour. The iron content in wheat grains is vital among micronutrients due to its health benefits. It ranged from 29.10 to 51.0 µg/g with an overall mean value of 38.88 µg/g (Fig.1). PDW 337 (51.0 µg/g) showed maximum value of iron content followed by GW 1297 (50.0 µg/g) while HI 8749 (29.10 µg/g) showed minimum value. Copper plays an important role in photosynthetic and respiratory electron transport chains. (Yruela, 2005; Sramkova *et al*., 2009; Boorboori *et al*., 2012) [17, 15, 2]. Copper content ranged from 3.12-6.39 µg/g (Fig. 2). Similar findings have also been reported by Hajra *et al*. (2006) [7] and Moghadam *et al*. (2012) [9]. These results are of well in accordance with the results of El-Ghany *et al*. (2012) [3].

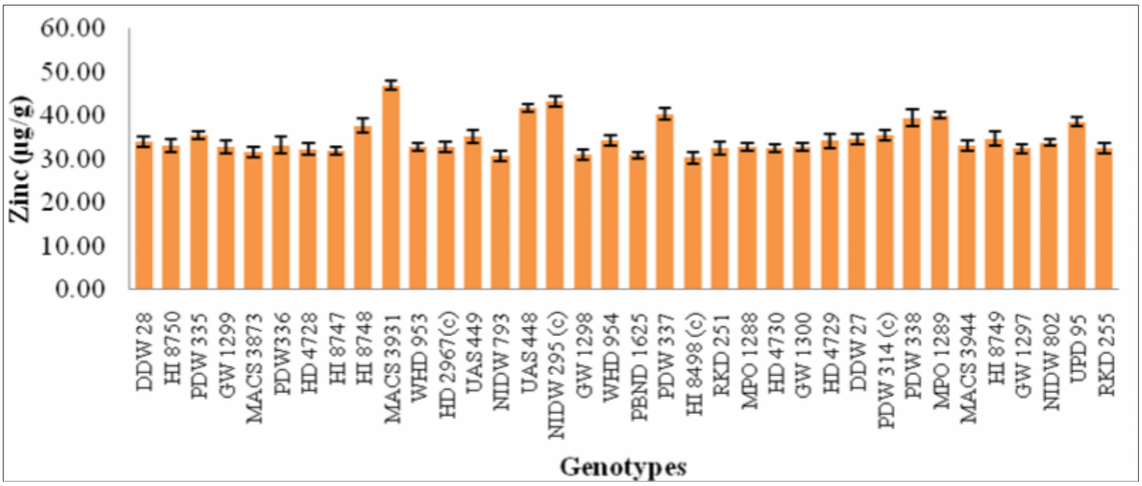

Fig 1: Iron content (µg/g dry weight basis) in durum wheat genotypes (C.D. at 5 per cent = 4.190)

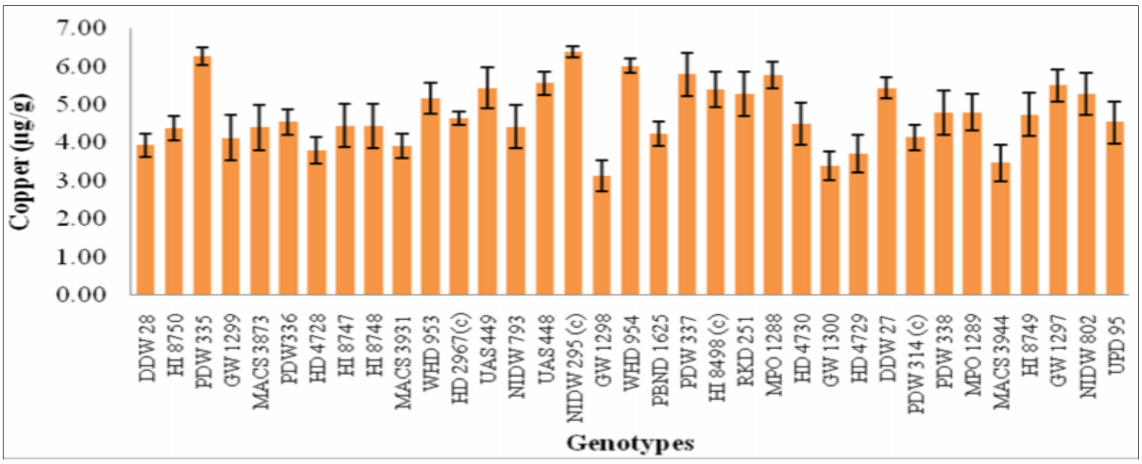

Fig 2: Copper content (µg/g dry weight basis) in durum wheat genotypes (C.D. at 5 per cent = 1.252)

Zinc plays an important role in CO_2 utilization, carbohydrate and phosphorus metabolism and is a component of numerous metallo-enzymes and transcription factors. The Zn content in wheat grains has no bearing on product quality but influenced by the soil structure and its characteristics that are so similar to the iron (Mohan and Gupta, 2008) [10]. Zinc content ranged from 30.30-46.93 µg/g (Fig. 3). Abdallah and Samman (1993) [1] observed that Zn may act as a biological antioxidant and further observed that high levels of Zn could also be pro-oxidant by eliciting a decline in the activity of erythrocyte Cu-Zn superoxide dismutase.

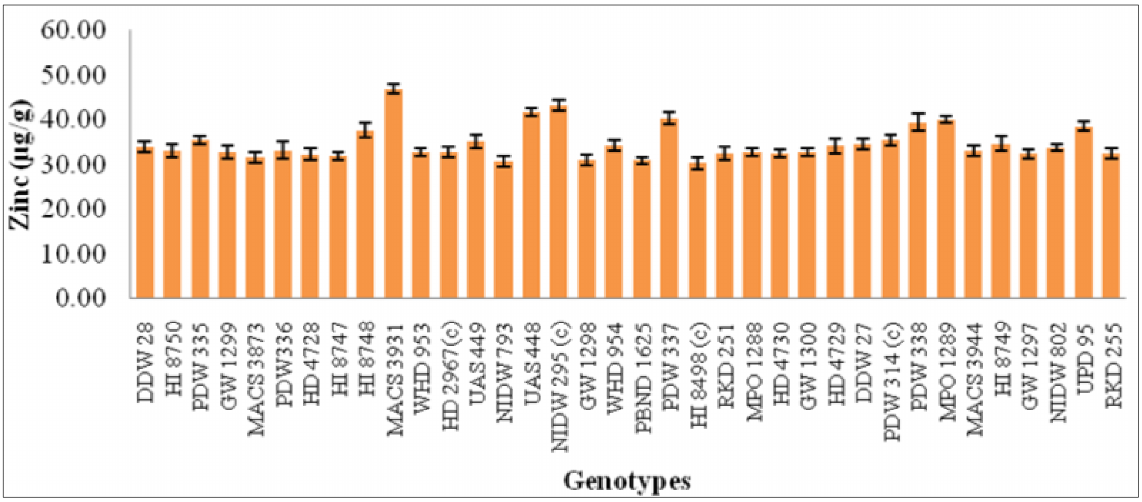

Fig 3: Zinc content (µg/g dry weight basis) in durum wheat genotypes (C.D. at 5 per cent = 3.541)

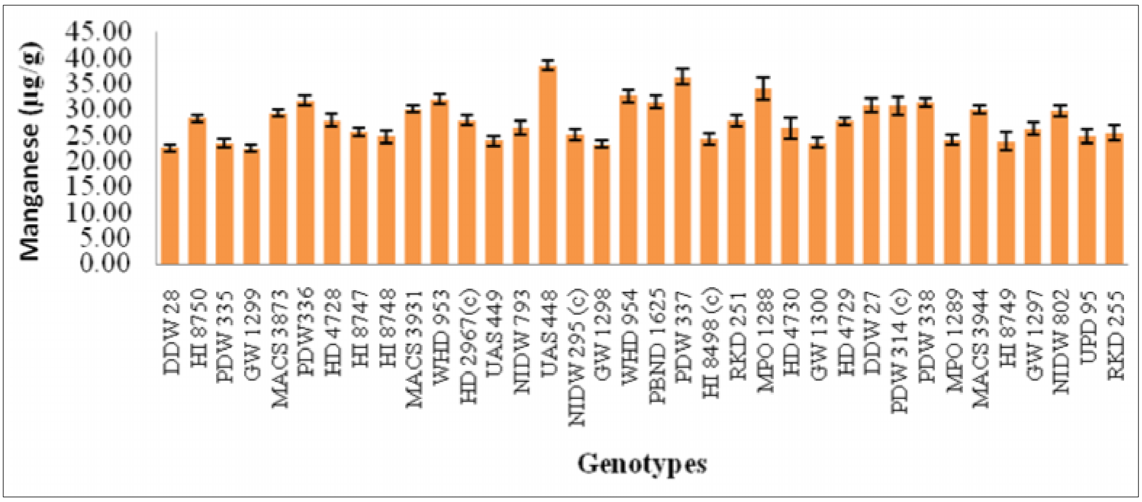

Fig 4: Manganese content (µg/g dry weight basis) in durum wheat genotypes (C.D. at 5 per cent = 3.294)

Manganese is an essential mineral nutrient for lignin, amino acid biosynthesis, CO2 assimilation and nitrogen metabolism (Mukhopadhay and Sharma, 1991; Jhanji *et al*., 2014) [11, 8]. Manganese content ranged from 22.40-38.50 µg/g (Fig. 4). El-Ghany *et al*. (2012) [3] conducted two field experiments in successive winter seasons of 2010-2011 and 2011-2012 at the newly reclaimed area to evaluate eight durum wheat (*Triticum durum*) genotypes for growth, yield and micronutrients use efficiency. It was observed that there was a significant difference in straw and grains micronutrients content among genotypes, which exhibited a wide variability in their ability to uptake and translocate Fe, Cu, Zn and Mn. The Fe content ranged from 32.0-79.0 ppm, Cu ranged from 1.0-4.5 ppm, Zn content ranged from 30.0-106.0 ppm and Mn ranged from 19.0-50.0 ppm. Thus, it was observed that a strong relationship of micronutrients with grain protein content which influences flour recovery. Therefore, genotypes UAS 448, PDW 337, WHD 954, HD 4730 and PBND 1625 were found promising and may be used in crossing programme in order to improve grain quality along with yield.

References

1. Abdallah SM, Samman S. The effect of increasing dietary Zinc on the activity of superoxide dismutase and Zinc concentration in erythrocytes of healthy female subjects. Eur. J. Clin. Nutr. 1993; 47:327-332.
2. Boorboori MR, Eradatmand Asli DM, Tehrani J. The effect of dose and different methods of Iron, Zinc, Manganese and Copper application on yield components, morphological traits and grain protein percentage of barley plant (*Hordeum vulgare* L.) in greenhouse conditions. Advances Environ. Biol. 2012; 6(2):740.
3. El-Ghany A, El-Saady HM, Khalifa RKM. Evaluation of some new durum wheat genotypes for growth, yield and micronutrients use efficiency under sandy soil conditions. Aus. J. Basic Appl. Sci. 2012; 6(10):494-499.
4. Ganeva G, Korzun V, Landjeva S, Popova Z, Christov NK. Genetic diversity assessment of Bulgarian durum wheat (*Triticum durum* Desf.) landraces and modern cultivars using microsatellite markers. Genet. Resour. Crop Evol. 2011; 57:273-285.

5. Gardner FP, Pearce RB, Mitchell RL. Mineral nutrition. *In*: Physiology of crop plants. Scientific Publishers, Jodhpur, Rajasthan, India. 1988, 98-131.
6. Garnett TP, Graham RD. Distribution and remobilization of Iron and Copper in wheat. Annals. Bot. 2005; 95:817-826.
7. Hajra K, Hassan Z, Maitto AA. Yield and micronutrient contents of bread wheat (*Triticum aestivum*) under a multinutrient fertilizer-half-tonic. Int. J. Agric. Biol. 2006; 8(3):366-370.
8. Jhanji S, Sadana US, Shankar A, Shukla AK. Manganese influx and its utilization efficiency in wheat. Ind. J. Exp. Bio. 2014; 52:650-657.
9. Moghadam MJ, Sharifabad HH, Noormohamadi G, Motahar SYS, Siadat SA. The effect of zinc, boron and copper foliar application, on yield and yield components in wheat (*Triticum aestivum*). Annals. Biol. Res. 2012; 3(8):3875-3884.
10. Mohan D, Gupta RK. Approach to harness genetic improvement in important quality attributes of Indian bread wheats. J. Wheat Res. 2008; 2(1):52-56.
11. Mukhopadhyay M, Sharma A. Manganese in cell metabolism of higher plants. Bot. Rev. 1991; 57:117-149.
12. Motalebi M, Keshavarzi M, Naghavi MR. Glutenin subunit composition in durum (*Triticum durum*) landraces and cultivars. Asian J. Plant Sci. 2007; 6:399-402.
13. Shoran J, Tyagi BS, Singh G, Singh RP. Genetic analysis of economic traits in durum wheat. Wheat Info. Service. 2004; 99:41-45.
14. Soomro AF, Nizamani FK, Ahadkolachi A, Soomro KB, Solangi KA. Evaluation of different durum wheat varieties under stress conditions (Brackish water & coarse textured soil). Int. J. Curr. Res. Aca. Rev. 2014; 2(7):11-17.
15. Sramkova Z, Gregova E, Sturdik E. Chemical composition and nutrition quality of wheat grain. Acta. Chimica. Slovaca. 2009; 2(1):115-138.
16. Welch RM, Graham RD. Breeding for micronutrients in staple food crops from a human nutrition perspective. J. Exp. Bot. 2004; 55:353-364.
17. Yruela I. Copper in plants. Brazil. J. Plant Physiol. 2005; 17:145-146.