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# Analysis of carbohydrate changes in durum wheat (*Triticum durum* L.) genotypes

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**Abstract**
Durum wheat (*Triticum durum* L.) serves as the main raw material for high quality pasta products and diverse range of foods. Its high protein content, gluten strength, kernel hardness, size, golden amber color, high beta-carotene content and excellent cooking quality makes it most suitable for preparation of wide range of products. Therefore the present investigation was carried out to identify durum wheat genotypes superior in carbohydrate content. The carbohydrates play an important role in synthesis of metabolic compounds, production of energy, stabilization of membranes, regulation of gene expression and as signaling molecules. The total soluble sugars, reducing sugars and non-reducing sugars were varied significantly among different genotypes of wheat grains. The total soluble sugars were maximum in UAS 448. Reducing sugar of 0.97 per cent was found maximum in HD 4728 and UAS 448. Non-reducing sugars were also found to be maximum in UAS 448 (2.85 per cent). Starch content was found maximum in PDW 337(70.47 per cent). The genotypes UAS 448, HD 4728 and PDW 337 showed better performance for most of the sugar content.

**Keywords:** carbohydrates, durum wheat, starch, quality

## Introduction
It is the most widely grown crop and an essential component of the global food security mosaic, providing one-fifth of the total calories of the world's population. Durum or macaroni wheat (*Triticum durum* L.) is a tetraploid species and 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. 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. (Motalebi *et al*., 2007; Soomro *et al*., 2014) [9, 13]. The availability of nutrients from a particular food depends on its chemical composition. 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. Quality is an important aspect of durum wheat and it demands specific quality traits as well as functionality. Various physico-chemical and quality parameters of wheat grains have been evaluated in different wheat varieties in order to assess their suitability for different purposes. Grain texture, protein content, carbohydrate content, gluten and starch composition in the endosperm are the major determinants of end product quality. The pasta quality of durum wheat is influenced mainly by the physical and biochemical properties of wheat kernels, which are in turn determined by genotype, environment and their interactions (Taghouti *et al.,* 2010) [14].

Carbohydrates are the most abundant constituents of wheat kernel, forming about 83 per cent of the dry matter. Starch, a major constituent of wheat endosperm plays an important role in determining wheat quality. Characterization of genes encoding starch biosynthetic enzymes along with better understanding of structure and properties of starch will help in manipulating starch functionality of different end-use products and nutritional quality. Sweetness of the product is related to simple sugars whereas nature of starch depicts the cooking quality (Labuschange *et al*., 2009) [6].

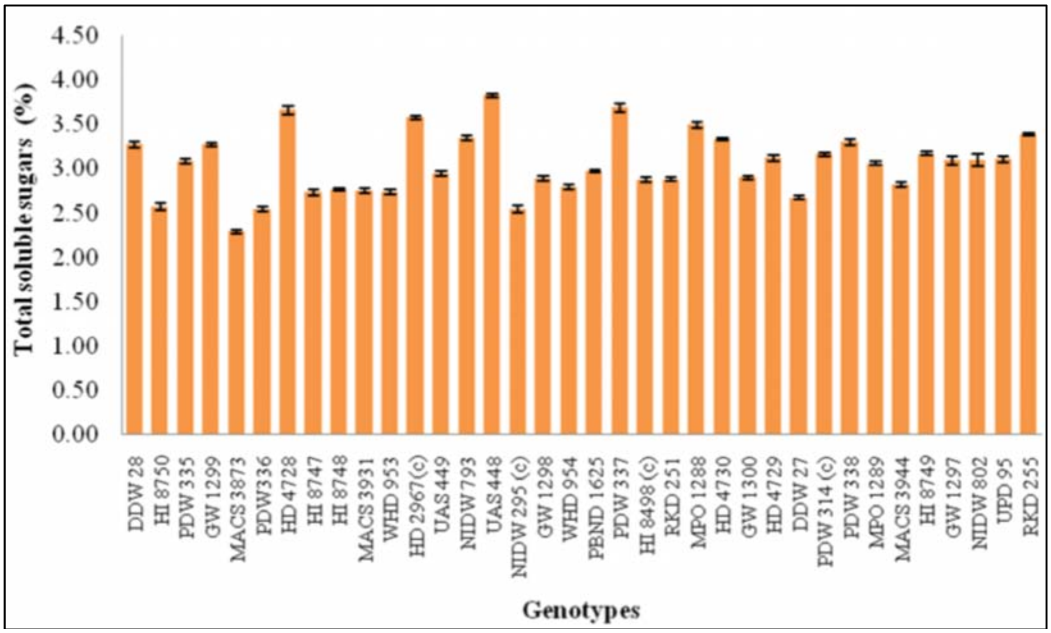
## Materials and methods
In present study, a field experiment was conducted during *rabi* season of 2014-15 in the field of Wheat and Barley Section, Department of Genetics & Plant Breeding, CCS Haryana Agricultural University, Hisar (Haryana) to evaluate the quality attributes of durum wheat

genotypes. The experiment was laid out in Randomized Block Design (RBD) with three replications. The varieties were sown with a plot size of 6×1.20 sq. meter. The experiment consists of 36 durum wheat genotypes including four checks (two bread and two durum wheat).The recommended cultural practices were carried out to raise good crop.

Total soluble sugars in wheat flour were estimated by the method described by Dubois *et al.* (1956) [3]. One ml of the diluted sugar extract was taken in a test tube. 2 ml of 2 per cent phenol solution was added followed by 5 ml of concentrated $H_2SO_4$ and the absorbance at 490 nm on UV-Vis spectrophotometer. Reducing sugars were estimated by the method described by Miller (1959) [8]. One ml of sugar extract was taken in a test tube and diluted to 4 ml with distilled water. 1 ml of DNS reagent was added to it and mixed well with vigorous shaking and then kept on boiling water bath for 10 min. and the absorbance was read at 540 nm. The content of non-reducing sugars was calculated from the difference between the concentration of total sugars and that of reducing sugars. Starch from sugar free pellet was extracted by the method of Clegg (1956) [2]. The residue obtained after the extraction of sugar was used for the estimation of starch.

## Results and discussion

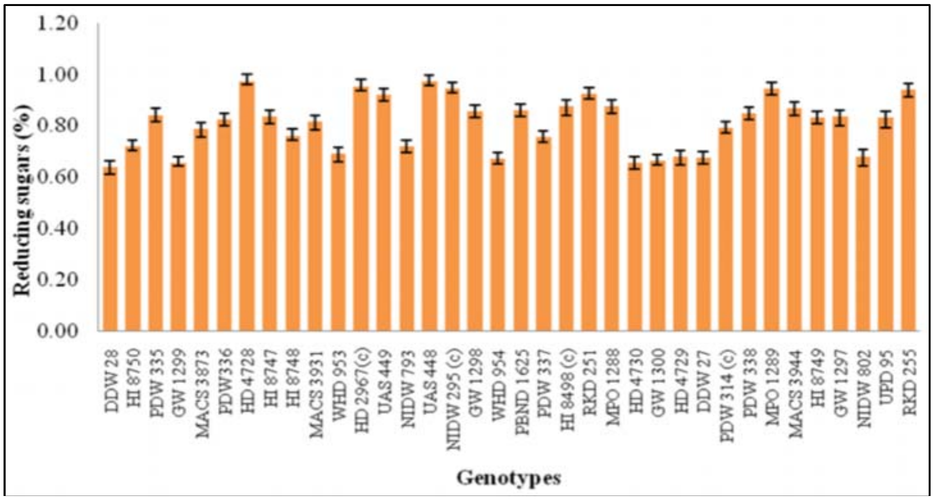
The carbohydrates plays an important roles in synthesis of metabolic compounds, production of energy, stabilization of membranes, (Hoekstra *et al*., 2001) [4] regulation of gene expression and as signaling molecules (Sheen *et al*., 1999; Smeekens, 2000) [11, 12] quantitative estimations of various carbohydrates like total soluble sugars, reducing sugars, non reducing sugars and starch were carried out. Total soluble sugar content of durum wheat genotypes is depicted in Fig. 1. It varied from 2.29 to 3.82 per cent with an overall mean value of 3.05 per cent. UAS 448 (3.82 per cent) was found with maximum total soluble sugar content followed by PDW 337 (3.68 per cent) and minimum was observed in MACS 3873 (2.29 per cent).




C.D. at 5 per cent = 0.086

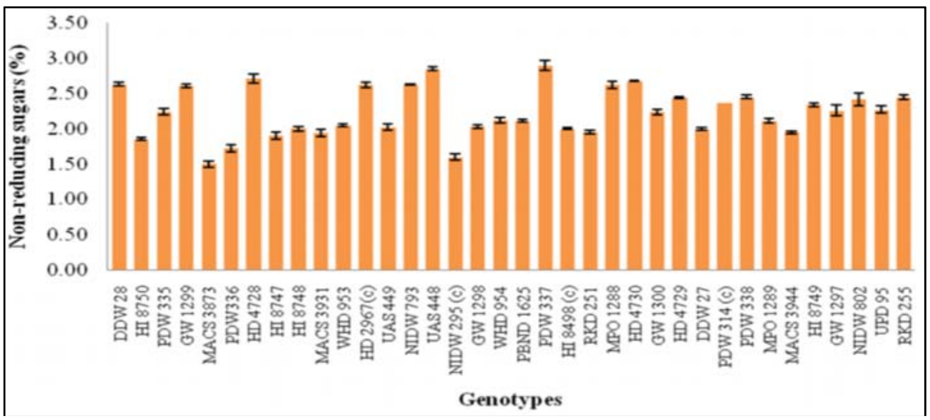
**Fig 1:** Total soluble sugars (per cent dry weight basis) in durum wheat genotypes

Reducing sugar content of durum wheat genotypes is depicted in Fig. 2. It varied from 0.64 to 0.97 per cent with an overall mean value of 0.81 per cent. Maximum reducing sugar content was observed in HD 4728 (0.97 per cent) and UAS 448 (0.97 per cent) followed by MPO 1288 (0.94 per cent) and minimum was observed in DDW 28 (0.64 per cent). Similarly Bakshi and Bains (1987) [1] had also reported that reducing and non-reducing sugars of durum and bread wheat flours were 0.36 and 0.27, and 1.80 and 1.50 per cent respectively. Thus it 45 may be concluded that the reducing sugar content varied significantly among different genotypes in the developing grains of durum wheat. The mean ash, β-carotene, reducing and non reducing sugars of *Triticum durum* and bread wheat flours were 0.65 and 0.45 per cent; 3.90 and 1.80 ppm; 0.36 and 0.27 per cent and 1.80 and 1.50 per cent, respectively. Non-reducing sugar content of durum wheat genotypes is depicted in Fig. 3. Non reducing sugars were calculated as the difference between the total and reducing sugars. It ranged from 1.32 to 2.85 per cent with an overall mean value of 2.24 per cent. Non-reducing sugar content of the grains followed similar trend to that of total soluble sugars. The highest value was found in UAS 448 (2.85 per cent) followed by PDW 337 (2.82 per cent) and lowest was in MACS 3873 (1.32 per cent). Reddy (1996) [10] observed that there has been variation in total sugar content of *T. dicoccum* (1.85 per cent), *T. durum* (1.45 per cent) and *T. aestivum* (1.39 per cent) varieties. It was reported that non reducing sugar content of *T. durum* and *T. dicoccum* was higher than that of *T. aestivum* varieties. The total soluble sugars, reducing and non-reducing sugars were ranged from 2.29-3.82 per cent, 0.97-0.64 per cent and 1.32-2.85 per cent, respectively (Fig. 1, 2 and 3). These results are well supported by Madan *et al*. (2006) [7] who reported that the total soluble sugar, reducing sugars and starch content ranged from 2.65 to 3.78 per cent, 0.66 to 1.60 per cent and 58 to 72 per cent, respectively.



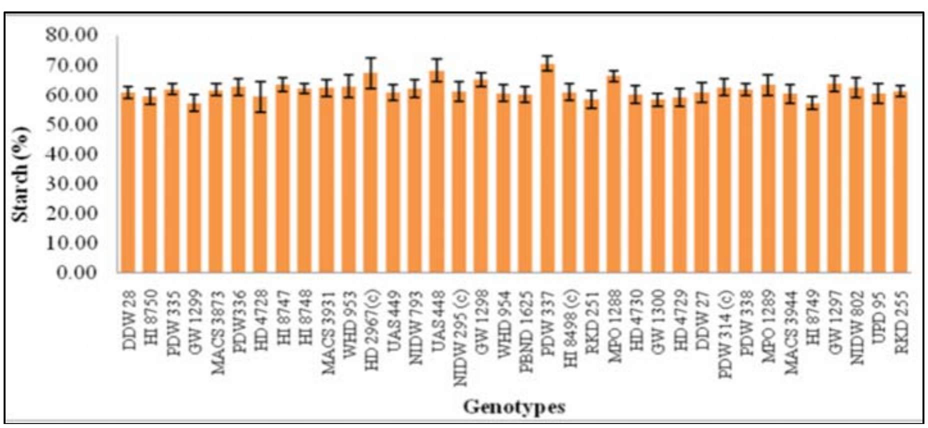

C.D. at 5 per cent = 0.069

**Fig 2:** Reducing sugars (per cent dry weight basis) in durum wheat genotypes




C.D. at 5 per cent = 0.115

**Fig 3:** Non-reducing sugars (per cent dry weight basis) in durum wheat genotypes




C.D. at 5 per cent = N/A

**Fig 4:** Starch content (per cent dry weight basis) in durum wheat genotypes

Starch content of durum wheat genotypes is depicted in Fig. 4. Starch content ranged from 54.40 to 70.47 per cent with an overall mean value of 61.80 per cent. Starch content was found to be maximum in PDW 337 (70.47 per cent) followed by UAS 448 (68.17 per cent) and minimum in HI 8749 (54.40 per cent). Since starch is the major reserve carbohydrate source in cereal grains, a quantitative estimation of starch might reveal its level of accumulation during grain developmental stage. Therefore starch content was estimated and found to be ranged from 50.40-70.47 per cent (Fig. 4). Jhuma *et al.* (2003) [5] selected the cultivars *viz*. C-360, HD-2009, WH-291 and WH- 542 differing in flour and cooking quality and the study revealed a progressive decrease of total sugars, reducing and non-reducing sugars in the developing grains and increase in starch content throughout the grain development. It may be concluded that 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.

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