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# THE CONTENTS OF ARABINOXYLAN (TOTAL AND WATER-SOLUBLE) IN EIGHT PAKISTANI HARD WHITE SPRING WHEAT (*TRITICUM AESTIVUM* L.) CULTIVARS

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## ABSTRACT

The total arabinoxylan (AXt) and water-soluble arabinoxylan (WeAX) contents in meal and flour from eight hard white spring wheat cultivars grown at two distinct locations in Pakistan were examined. AXt and WeAX ranged from 50-79 mg/g & 6.2-11 mg/g in meals and 12-22 mg/g & 3.5-8.2 mg/g in flours with the mean values of 60 mg/g & 8.0 mg/g and 15 mg/g & 5.0 mg/g, respectively. The ANOVA indicated that the wheat cultivars varied significantly in their AX contents and also confirmed the influence of genotype and environment on AX accumulation in Pakistani wheat grain. Overall, the whole meal flour contained ~3.6-4.2 times greater AX contents than white flour.

**Key words:** Arabinoxylans, Pakistani wheat cultivars, *Triticum aestivum*.

## INTRODUCTION

Pentosans are the constituents that are low in amount but known to play an important role in functionality of wheat flour. They dominate among non-starch polysaccharides (NSP) with the proportion of about 85% of total NSP in wheat grain (Mares and Stone, 1973). Their accumulation in cell walls for structural support to the mature plants increase its proportion in bran (9.9-28.4%) than in wheat flour (1.5-2.1%) (Lempereur *et al.*, 1997; Carpita and Gibeaut, 1993; Ciacco and Appolonia, 1982). Pentosans comprises arabinoxylan (AX) and arabinogalactan peptides. The main one is AX and sometime AX is synonymous to pentosan.

Many investigations revealed the genetic and environmental influences on the content of AX in cereals. Lempereur *et al.* (1997) described the influence of cultivar and environment on the content of total and water-extractable arabinoxylans in durum wheat. Hong *et al.* (1989) and Saulnier *et al.* (1995) studied common wheat and found that cultivar played an important role in the content of water-extractable AX, while Anderson *et al.* (1992) suggested that the environment had greater influence on the non-starch polysaccharides. In case of other cereals like barley, both cultivar and environment influences the AX (Henry, 1986). Similarly, year and location influences significantly the rye AX instead of cultivar (Saastamoinen *et al.*, 1989). Wooton *et al.* (1995) also studied the pentosan levels in 19 Australian and 12 North American feed grade wheats.. They found that the values ranged from 5.4-7.2% in the Australian and from 5.5-6.5% in the North American wheats which were not significantly different in the two regions.

Wheat grown in Pakistan is mainly hard white spring wheat for domestic consumption. Beside the traditional flat breads - naan, chapatti, roti, it is also used in making a variety of bakery items – pasta & noodles, biscuits, pan bread etc. The investigations on minor grain traits are neglected and there is no data available on the levels of AX in Pakistani wheat. The investigation on the neglected potential grain traits like pentosan may provide information for growers and producers to enhance the possibility of entering grain market channels and suitability for end-uses. The present study is therefore beneficial to generate information that may be used in formulating wheat flour of improved functionality.

## MATERIALS AND METHODS

Eight prevalent Pakistani hard white spring wheat (*Triticum aestivum*)cultivars TJ-83, Abadgar, Anmol, TD-1, Moomal, Imdad, SKD-1, and Mehran were grown at two locations Nawabshah and Tandojam during two crop years 2005-2006 and 2006-2007. All cultivars were grown under same irrigation conditions. They were planted from mid-November to the first week of December in each crop year and harvested during the first fortnight of May each year. The wheat cultivars were tested for their basic quality parameters.

Wheat grain was milled into flour using a Brabender Quadramat Junior Mill according to the procedure of AACC 26-50. Wheat was conditioned to 15% moisture for 18hr before milling. The feeding rate was about 100g/min.

A modified colorimetric method described by Finnie *et al.* (2006) was used for the determination of total arabinoxylan (AXt) and water-extractable arabinoxylan (WeAX) contents in meal and flour samples. White flour was obtained by using Quadramat Junior as described earlier while for whole-meal flour, the samples were ground in UDy cyclone mill fitted with a 0.5mm screen.

All tests were performed in triplicate and results are reported as average of two crop years with standard deviation. Statistical analyses were carried out for each measured parameter of analysis of variance (ANOVA) using MINITAB software.

## RESULTS & DISCUSSION

The mean values for AXt and WeAX were determined in Pakistani hard white spring wheat cultivars averaged over two crop years grown at two different locations i-e Nawabshah (NS) & Tandojam (TJ). Since the quality parameters of both meal and flour for particular end-uses are different, the AX contents were analyzed in meal as well as flour of the same cultivars (Table 1 & 2).

Table 1. Mean values for arabinoxylan contents (mg/g) of Pakistani hard white spring wheat cultivars averaged over two crop years grown for two environments.

| **Cultivar** | **Whole-meal flour** | | **White flour** | |
|---|---|---|---|---|
| | **AXt** | **WeAX** | **AXt** | **WeAX** |
| **TD-1** | | | | |
| Nawabshah | 51±3.2 | 6.2±0.9 | 13±1.2 | 3.7±0.3 |
| Tandojam | 79±5.3 | 11±1.1 | 22±2.1 | 8.2±0.3 |
| **Imdad** | | | | |
| Nawabshah | 61±2.2 | 8.3±0.8 | 16.5±1.4 | 5.9±0.6 |
| Tandojam | 63±4.3 | 8.2±0.8 | 15±1.1 | 5.6±0.3 |
| **Mehran** | | | | |
| Nawabshah | 56±1.7 | 7.3±0.5 | 15.3±1.1 | 5.3±0.4 |
| Tandojam | 61±3.6 | 8.2±0.7 | 14±1.6 | 5.0±0.5 |
| **Abadgar** | | | | |
| Nawabshah | 55±3.3 | 7.0±0.7 | 13.9±1.3 | 4.6±0.4 |
| Tandojam | 62±3.2 | 8.2±0.6 | 15±1.2 | 5.4±0.8 |
| **Moomal** | | | | |
| Nawabshah | 50±4.1 | 6.2±0.4 | 12±0.8 | 3.5±0.7 |
| Tandojam | 53±1.3 | 6.8±0.6 | 13±1.3 | 3.9±0.4 |
| **Anmol** | | | | |
| Nawabshah | 63±2.3 | 8.4±0.6 | 17±1.1 | 6.3±0.7 |
| Tandojam | 66±3.4 | 8.9±0.6 | 15.5±1.6 | 5.6±0.5 |
| **SKD-1** | | | | |
| Nawabshah | 52±2.8 | 6.7±1.0 | 13.1±1.7 | 4.1±0.8 |
| Tandojam | 56±3.4 | 7.2±0.7 | 14±1.4 | 4.0±0.8 |
| **TJ-83** | | | | |
| Nawabshah | 60±2.6 | 8.1±0.5 | 16.3±1.0 | 5.9±0.6 |
| Tandojam | 70±4.4 | 9.3±0.6 | 18±1.4 | 7.2±0.9 |

AXt = total arabinoxylan content; WeAX = water-soluble arabinoxylan

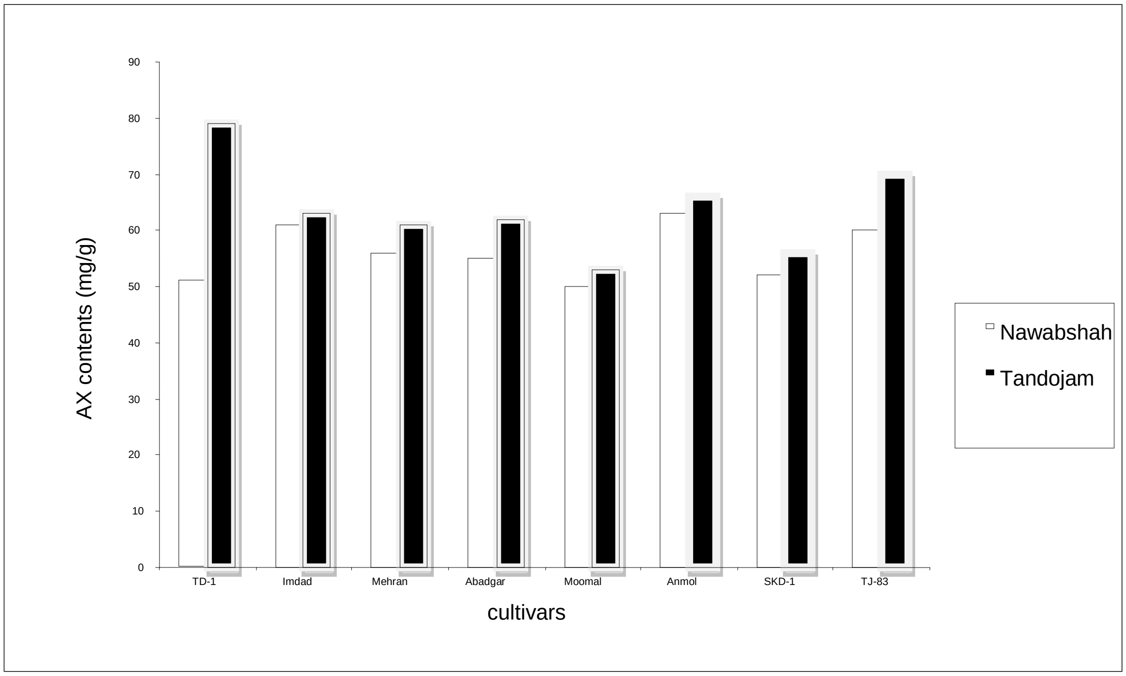


Fig. 1. Means of AXt contents in whole meal flour of eight Pakistani cultivars grown in two locations.

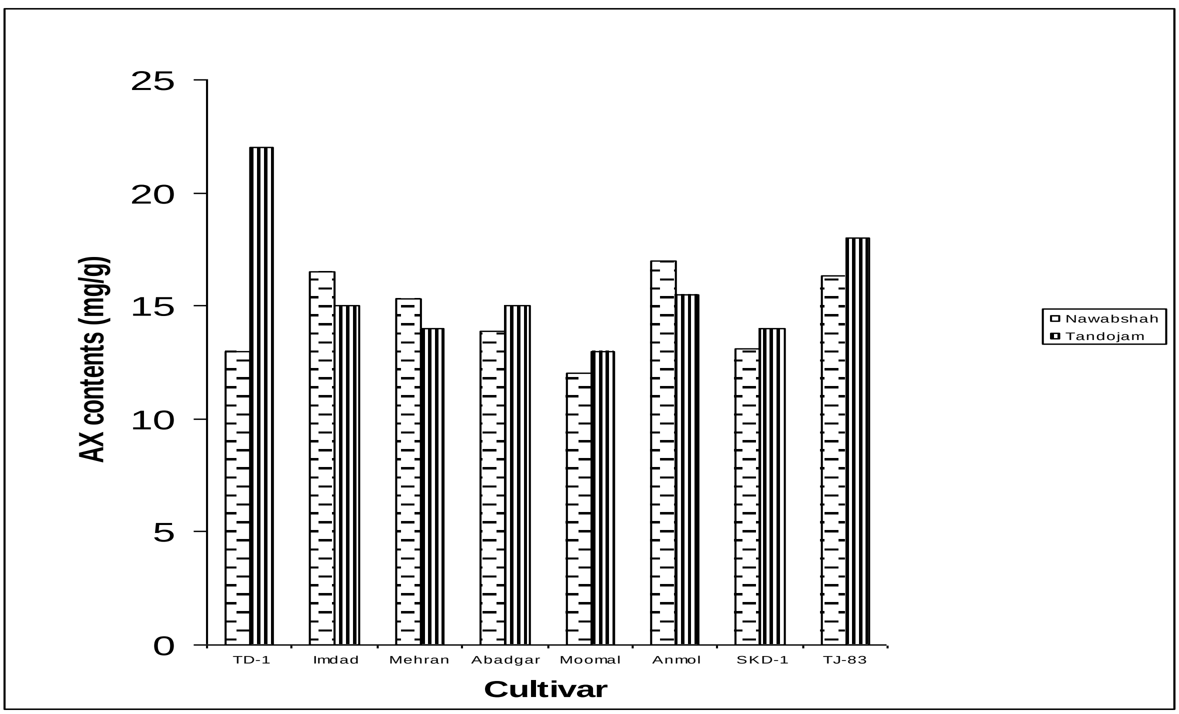


Fig. 2. Means of AXt contents in flour of eight Pakistani cultivars grown in two locations.

The cultivars grown at NS contained AXt and WeAX contents ranging from 50-63 mg/g & 6.2-8.4 mg/g in meal and 12-17 mg/g & 3.5-6.3 mg/g in flour, respectively. The highest and lowest AX contents in both meal and flour were found in Anmol and Moomal respectively. Anmol showed ~1.3 time greater AX contents than that of Moomal while the same cultivars grown at TJ had AXt and WeAX contents ranging from 53-79 mg/g 6.8-11 mg/g in meal and 13-22 mg/g & 3.9-8.2 mg/g in flour respectively. The highest AX content was in TD-1 which was ~1.5 times greater than that of Moomal. The cultivar – Moomal showed the lowest AX contents at both locations. The response of cultivars at different environment is clearly exhibited in Fig. 1 & 2, where, all the cultivars showed greater AX contents at TJ than those grown at NS.

The results were statistically analyzed in order to understand the genetic and environmental effects on the AX contents of Pakistani wheat cultivars. The ANOVA indicated that individual samples of wheat cultivars grown at two locations over two crop years varied in their AX contents. The effect of cultivars was found statistically significant. However, the difference was slightly more significant when the cultivars grown at NS ($F = 135.72$, $P < 0.001$) than TJ ($F = 20.42$, $P < 0.001$). A highly significant difference was found in the AX contents in meals ($F = 16.77$, $P = 0.001$) and flours ($F= 10.65$, $P = 0.006$) of the cultivars due to the change in environment. Thus, the evidence of genetic and environmental contribution towards the contents of AX was evident from the results and the findings were in agreement with the previous research. Lampereuer *et al.* (1995) have described the high genetic and agronomic variability for AX in durum wheat cultivars. QiJun *et al.* (2005) studied the variations of pentosan contents in Chinese soft wheat cultivars and found the significant differences in their pentosan contents ranging from 0.54-2.47% due to genotype and environment.

The meals contained significantly greater amount of AX than the flour samples of the same cultivars. Wang *et al.* (2006) reported the strong positive correlations between ash and total pentosan contents. In the present study, much higher (~3.6 – 4.2 time) contents of AX were found in the meals than flours from the Pakistani wheat cultivars. The greater amount of AX with the increase in ash content is due to the presence of more cell wall material in meal than flour.

The study generated the information about AX levels in Pakistani wheat cultivars that may be useful in trade as well as formulation of baked items. Being a principal component of dietary fibre, AX may helps to control the physiological effects such as laxation, blood cholesterol and glucose attenuation (Topping, 2007; Clearfield, 2006). However, it was found to be greater in whole meal flour than white flour. Therefore, it is better to consume cereal based foods prepared from whole meal flour instead of white flour. Further the significant difference in AX contents of Pak cultivars confirmed the influence of genotype and environment on AX contents.

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