Data Article

Data set of enzyme fingerprinting of dietary fibre components (arabinoxylan and β-glucan) in old and modern Italian durum wheat genotypes

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A B S T R A C T

The data presented are related to the research article entitled “Comparison of the dietary fibre composition of old and modern durum wheat (Triticum turgidum spp. durum) genotypes” (De Santis et al., 2018) [1]. This article provides details of the structures of the major dietary fibre components, arabinoxylan and β-glucan, in semolina and wholemeal flour of old and modern Italian durum wheat genotypes grown in two seasons, determined by enzyme digestion followed by high-performance anion-exchange chromatography (enzyme fingerprinting).

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Specifications Table

| Subject area                  | Agriculture and Biological sciences |
|-------------------------------|-------------------------------------|
| More specific subject area    | Genetic differences and Food Quality|
| Type of data                  | Tables                              |

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Laboratory analysis by High-Performance Anion-Exchange Chromatography (HP-AEC)

The structures of dietary fibre components were determined in wholemeal and semolina from old and recent Italian durum wheat genotypes grown in two field trials

Allowed the identification of relationships between fibre structure and the release dates of the genotypes

Foggia (Italy, 41° 28′ N, 15° 32′ E and 75 m a.s.l.), collected in June 2013 and June 2014

Data are available in this article

Details of the structures of arabinoxylan and β-glucan determined by the proportions of arabinoxylan oligo-saccharides (AXOS) and glucooligosaccharides (GOS) released by digestion with xylanase 11 and lichenase, respectively

Allows comparison of old and recent types of durum wheat: 8 modern cultivars, 3 old cultivars bred before 1949 and 4 old landraces

Includes comparison of wholemeal and white flour (semolina) fractions

1. Data

The datasets provide details of the structure of dietary fibre in grains of old and modern Italian durum wheat (Triticum turgidum spp. durum) genotypes, grown in two different crop seasons [1]. Table 1 presents the grain quality traits of the genotypes grown in two seasons while Tables 2 and 3

Table 1
Grain quality traits of old and modern durum wheat genotypes grown in two crop seasons.

| Genotype       | Year of release | 1000 kernel weight (g) | Test weight (kg hl⁻¹) | Grain protein content (% dm) | Semolina protein content (% dm) | Ash content (% dm) |
|----------------|-----------------|------------------------|-----------------------|-------------------------------|---------------------------------|-------------------|
|                | 2013            | 2014                   | 2013                 | 2014                          | 2013                            | 2014              | 2013                     | 2014                     | 2013                     | 2014                     |
| old            |                 |                        |                      |                               |                                 |                   |                          |                          |                          |                          |
| Dauno III      | 1900            | 47.8                   | 45.8                 | 77.4                          | 78.3                            | 15.9              | 14.3                     | 14.0                     | 13.1                     | 0.77                     | 0.80                     |
| old Saragolla  | 1900            | 49.2                   | 49.1                 | 80.7                          | 76.7                            | 15.4              | 16.4                     | 13.6                     | 15.3                     | 0.80                     | 0.76                     |
| Russello       | 1910            | 48.6                   | 54.9                 | 78.7                          | 79.1                            | 16.5              | 13.6                     | 14.5                     | 12.3                     | 0.85                     | 0.88                     |
| Timilia R.B.   | 1910            | 35.8                   | 34.5                 | 80.6                          | 79.2                            | 16.4              | 13.9                     | 14.8                     | 12.8                     | 0.70                     | 0.88                     |
| Cappelli       | 1915            | 54.4                   | 48.6                 | 81.3                          | 79.2                            | 16.8              | 14.5                     | 15.3                     | 13.5                     | 0.82                     | 0.80                     |
| Garigliano     | 1927            | 56.0                   | 64.1                 | 78.9                          | 76.1                            | 15.4              | 14.9                     | 13.8                     | 14.3                     | 0.83                     | 0.80                     |
| Grifoni 235    | 1949            | 53.4                   | 54.9                 | 80.4                          | 75.6                            | 15.6              | 13.1                     | 12.0                     | 11.1                     | 0.79                     | 0.86                     |
| modern         |                 |                        |                      |                               |                                 |                   |                          |                          |                          |                          |                          |
| Adamello       | 1985            | 55.6                   | 37.8                 | 79.6                          | 67.5                            | 14.0              | 16.0                     | 12.5                     | 14.8                     | 0.83                     | 0.87                     |
| Simeto         | 1988            | 47.7                   | 38.3                 | 79.8                          | 69.6                            | 15.4              | 13.4                     | 14.0                     | 12.1                     | 0.60                     | 0.82                     |
| Preco          | 1995            | 57.2                   | 31.7                 | 81.6                          | 66.7                            | 13.0              | 15.9                     | 11.6                     | 14.6                     | 0.87                     | 0.96                     |
| Iride          | 1996            | 54.1                   | 36.0                 | 82.2                          | 80.5                            | 13.0              | 11.5                     | 11.3                     | 10.8                     | 0.60                     | 0.86                     |
| Svevo          | 1996            | 45.8                   | 33.6                 | 82.2                          | 73.6                            | 16.1              | 15.0                     | 14.8                     | 13.8                     | 0.82                     | 0.73                     |
| Claudio         | 1998            | 50.8                   | 41.6                 | 84.5                          | 81.8                            | 12.4              | 11.7                     | 10.6                     | 10.8                     | 0.83                     | 0.60                     |
| Saragolla      | 2004            | 38.0                   | 43.8                 | 83.0                          | 79.9                            | 12.7              | 12.0                     | 11.2                     | 11.2                     | 0.74                     | 0.85                     |
| PR22D89        | 2005            | 57.0                   | 41.4                 | 83.8                          | 74.7                            | 12.6              | 12.9                     | 10.7                     | 12.2                     | 0.80                     | 0.87                     |

LSD⁎ 0.64 0.09 0.04 0.07 0.005

⁎ Least significant difference (LSD) at P ≤ 0.05.
Table 2
Structures of dietary fibre components in semolina from old and modern Italian durum wheat genotypes, grown in two crop seasons, determined as percentages of AXOS and GOS from enzyme fingerprinting.

| Genotypes        | x (%) | x₂ (%) | x₃ (%) | x₄ (%) | xa³x₂ (%) | xa³x₃ (%) | xa³x₄ (%) | xa²⁻³x₂ (%) | xa²⁻³x₃ (%) | xa²⁻³x₄ (%) | G3:G4 (ratio) | β-glucan peak area (nC) |
|------------------|-------|--------|--------|--------|-----------|-----------|-----------|-------------|-------------|-------------|---------------|------------------------|
|                  | 2013  | 2014   | 2013   | 2014   | 2013      | 2014      | 2013      | 2014        | 2013        | 2014        | 2013          | 2014                   |
| Old              |       |        |        |        |           |           |           |             |             |             |               |                        |
| Dauno III        | 17.5  | 17.5   | 18.0   | 16.0   | 8.2       | 8.7       | 12.6      | 11.0        | 13.9        | 15.0        | 4.0           | 4.5                    | 2.05 2.57             | 14,776 12,227       |
| old Saragolla    | 19.7  | 22.3   | 19.8   | 17.2   | 8.3       | 6.9       | 5.6       | 4.0         | 13.6        | 15.6        | 6.0           | 5.5                    | 2.6 2.9                | 17.2 17.5 4.2 4.9    | 2.9 3.2 2.25 3.08 | 14,041 10,262       |
| Russello         | 19.5  | 19.3   | 19.0   | 15.6   | 5.5       | 5.3       | 11.3      | 9.9         | 14.2        | 16.4        | 8.0           | 8.0                    | 2.3 2.6                | 14.0 15.7 3.7 4.3    | 2.6 2.8 2.40 2.74 | 13,027 15,141       |
| Timilia R.B.     | 19.7  | 18.7   | 14.2   | 12.7   | 6.8       | 7.1       | 9.5       | 7.5         | 15.9        | 17.1        | 9.1           | 9.1                    | 2.8 3.1                | 15.7 17.0 3.8 4.6    | 2.6 3.0 2.39 2.97 | 13,011 18,224       |
| Cappelli         | 18.9  | 19.9   | 13.2   | 16.1   | 7.6       | 5.3       | 13.0      | 10.1        | 15.5        | 14.8        | 6.7           | 6.4                    | 2.4 2.4                | 2.4 2.4 16.1 17.4    | 3.9 4.8 2.7 3.0     | 2.04 2.26 14,414 10,824 |
| Gariglano        | 20.5  | 17.8   | 15.9   | 15.3   | 4.4       | 6.7       | 10.9      | 10.1        | 13.5        | 15.4        | 6.7           | 6.5                    | 2.0 2.5                | 18.4 18.1 4.6 4.7    | 4.7 3.1 2.9 2.40 | 2.62 8,272 14,117   |
| Griffoni 235     | 19.0  | 18.7   | 11.5   | 13.3   | 4.2       | 4.4       | 14.1      | 10.7        | 11.9        | 13.2        | 6.0           | 6.0                    | 2.5 2.7                | 22.1 21.5 5.8 5.9    | 5.9 3.3 3.4 1.82 | 2.86 17,720 15,641 |
| modern            |       |        |        |        |           |           |           |             |             |             |               |                        |
| Adamello         | 19.3  | 20.7   | 12.9   | 16.1   | 6.3       | 7.3       | 15.6      | 10.9        | 13.8        | 13.9        | 5.0           | 4.1                    | 2.0 2.0                | 17.1 16.6 4.8 4.9    | 3.3 3.4 2.30 3.85 | 16,137 9,224        |
| Simeto           | 21.4  | 19.1   | 15.4   | 12.2   | 6.3       | 5.9       | 6.7       | 13.1        | 15.5        | 14.7        | 5.5           | 5.2                    | 2.2 2.5                | 18.3 18.9 5.1 5.1    | 3.5 3.3 2.12 2.79 | 12,152 10,389       |
| Preco            | 17.9  | 20.4   | 15.6   | 16.8   | 10.2      | 7.8       | 13.3      | 9.3         | 11.6        | 13.6        | 6.7           | 5.1                    | 2.3 2.0                | 15.6 16.8 4.0 5.0    | 2.8 3.3 2.22 2.36 | 14,297 14,460       |
| Iride            | 18.4  | 18.9   | 15.5   | 15.2   | 5.6       | 7.2       | 14.1      | 14.3        | 12.8        | 14.4        | 6.9           | 5.7                    | 2.5 2.1                | 16.6 14.6 4.3 4.4    | 3.4 3.3 1.98 2.72 | 16,059 21,937       |
| Svevo            | 19.2  | 20.5   | 17.6   | 14.7   | 6.8       | 8.0       | 12.8      | 12.8        | 13.5        | 13.6        | 4.5           | 5.1                    | 1.7 1.7                | 16.6 15.6 4.3 4.6    | 3.2 3.5 2.20 2.98 | 19,808 15,693       |
| Claudio          | 17.8  | 17.0   | 13.8   | 12.2   | 6.1       | 6.4       | 14.6      | 18.0        | 14.7        | 14.4        | 7.1           | 6.3                    | 2.4 2.4                | 16.1 15.7 4.5 4.5    | 3.1 3.0 2.17 2.73 | 23,185 22,402       |
| Saragolla        | 16.1  | 18.2   | 12.9   | 12.9   | 5.0       | 7.4       | 14.2      | 14.6        | 14.8        | 15.0        | 7.7           | 6.6                    | 2.5 2.7                | 17.8 14.9 4.1 4.5    | 3.7 3.2 2.02 2.64 | 25,275 21,052       |
| PR22D89          | 19.0  | 17.4   | 11.2   | 14.3   | 6.2       | 8.5       | 13.4      | 13.9        | 16.1        | 14.7        | 5.7           | 5.2                    | 2.2 2.1                | 18.6 15.8 4.5 4.8    | 3.0 3.2 2.17 2.71 | 21,540 20,181       |
| LSD              | 0.28  | 0.85   | 0.25   | 0.36   | 0.24      | 0.15      | 0.07      | 0.26        | 0.08        | 0.05        | 0.06          | 1,163                   |

⁎ Least Significant Difference (LSD) at $P \leq 0.05$. 

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Table 3

Structures of dietary fibre components in wholemeal flours from old and modern Italian durum wheat genotypes, grown in two crop seasons, determined as percentages of AXOS and GOS from enzyme fingerprinting.

| Genotype  | x_1 (%) | x_2 (%) | x_3 (%) | x_5 (%) | x_{a3} | x_{a3} | x_{a2} | x_{a2} | x_{a2} | x_{a2} | x_{a2} | G3:G4 (ratio) | β-glucan peak area (nC) |
|-----------|---------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------------|-------------------------|
|           | 2013    | 2014    | 2013    | 2014    | 2013   | 2014   | 2013   | 2014   | 2013   | 2014   | 2013   | 2014   | 2013   | 2014   | 2013   | 2014   | 2013   | 2014   | 2013   | 2014   |
| old       |         |         |         |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Dauno III | 25.1    | 23.9    | 19.6    | 37.3    | 10.0   | 7.5    | 5.0    | 4.3    | 17.6   | 11.7   | 4.1    | 3.2    | 2.6    | 1.2    | 0.7    | 1.1   | 0.8    | 3.0    | 1.9    | 3.2    | 2.4    | 2.30   | 2.82   | 39,190 | 21,236 |
| old Saragolla | 25.1   | 22.7    | 21.6    | 36.9    | 9.5    | 8.1    | 3.6    | 2.0    | 16.3   | 13.0   | 3.2    | 2.1    | 1.2    | 1.0    | 1.2   | 1.0   | 12.4   | 9.1    | 3.0    | 2.2    | 4.0    | 2.7    | 2.30   | 3.36   | 38,278 | 18,285 |
| Russello  | 25.6    | 27.3    | 21.2    | 30.9    | 9.3    | 6.5    | 5.0    | 4.6    | 15.9   | 12.3   | 4.1    | 3.8    | 1.0    | 0.9    | 11.3   | 9.1    | 3.0    | 2.1    | 3.6    | 2.4    | 2.44   | 2.72   | 40,881 | 23,568 |
| Timilia R.B. | 27.0   | 20.8    | 21.5    | 35.9    | 7.9    | 9.4    | 3.5    | 4.1    | 18.1   | 13.3   | 4.0    | 3.8    | 1.0    | 0.9    | 10.4   | 8.1    | 2.7    | 1.9    | 3.3    | 2.4    | 2.42   | 2.84   | 55,019 | 25,195 |
| Cappelli  | 26.3    | 21.6    | 20.9    | 36.2    | 10.7   | 8.8    | 6.0    | 4.4    | 15.3   | 11.6   | 3.4    | 2.7    | 1.0    | 0.8    | 10.7   | 9.1    | 2.7    | 2.1    | 3.0    | 2.5    | 2.36   | 3.79   | 30,867 | 14,613 |
| Gariglano | 25.6    | 21.4    | 21.5    | 33.9    | 7.5    | 7.4    | 5.5    | 4.8    | 16.3   | 13.3   | 3.8    | 3.0    | 0.9    | 0.9    | 12.5   | 10.4   | 2.9    | 2.3    | 3.4    | 2.5    | 2.70   | 3.11   | 33,440 | 20,228 |
| Grifoni 235 | 26.0   | 21.5    | 18.9    | 33.1    | 7.9    | 7.2    | 7.3    | 4.4    | 15.6   | 13.1   | 3.4    | 2.9    | 1.0    | 0.9    | 13.2   | 11.4   | 3.3    | 2.7    | 3.4    | 2.6    | 2.27   | 3.97   | 33,774 | 23,406 |
| modern    |         |         |         |         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Adamello  | 27.5    | 22.7    | 20.2    | 39.6    | 9.0    | 7.9    | 6.3    | 4.0    | 15.2   | 10.7   | 2.6    | 1.5    | 0.9    | 0.7    | 11.9   | 8.3    | 3.0    | 2.2    | 3.3    | 2.5    | 2.46   | 5.71   | 41,590 | 23,206 |
| Simeto    | 22.7    | 25.0    | 22.6    | 36.7    | 10.2   | 7.2    | 2.1    | 4.4    | 13.4   | 14.3   | 2.1    | 2.5    | 1.1    | 0.9    | 9.7    | 10.1   | 2.3    | 2.6    | 2.6    | 2.9    | 2.56   | 4.84   | 21,980 | 32,461 |
| Preco     | 24.3    | 24.1    | 18.2    | 37.9    | 8.4    | 7.6    | 5.7    | 3.0    | 15.5   | 11.3   | 3.9    | 2.5    | 1.2    | 1.7    | 12.3   | 9.2    | 3.2    | 2.5    | 7.3    | 2.5    | 2.43   | 3.98   | 63,886 | 22,179 |
| Iride     | 28.5    | 20.4    | 24.7    | 39.1    | 7.3    | 9.0    | 4.5    | 5.8    | 15.5   | 10.5   | 3.2    | 1.9    | 0.9    | 0.7    | 9.9    | 7.4    | 2.6    | 2.1    | 3.3    | 2.8    | 2.52   | 2.80   | 47,092 | 33,305 |
| Svevo     | 26.4    | 21.8    | 23.1    | 37.8    | 7.4    | 8.0    | 4.9    | 4.1    | 16.2   | 10.9   | 2.6    | 1.9    | 0.9    | 0.9    | 11.7   | 9.4    | 3.1    | 2.5    | 3.6    | 2.6    | 2.60   | 3.35   | 51,950 | 29,761 |
| Claudio   | 23.9    | 21.4    | 21.7    | 35.8    | 10.8   | 7.3    | 7.0    | 5.7    | 16.2   | 11.9   | 3.3    | 2.6    | 0.9    | 1.0    | 10.0   | 9.0    | 2.9    | 2.5    | 3.3    | 2.7    | 2.52   | 2.97   | 60,886 | 30,866 |
| Saragolla | 28.2    | 20.9    | 22.9    | 36.7    | 8.3    | 7.7    | 4.2    | 5.3    | 14.9   | 11.3   | 2.9    | 3.1    | 1.0    | 1.0    | 11.1   | 9.0    | 3.0    | 2.3    | 3.4    | 3.0    | 2.55   | 2.79   | 52,471 | 33,626 |
| PR22D89  | 25.6    | 20.2    | 20.3    | 34.9    | 8.8    | 9.2    | 4.8    | 4.2    | 16.8   | 12.5   | 3.3    | 2.8    | 1.0    | 0.9    | 12.5   | 10.2   | 3.2    | 2.5    | 3.5    | 2.5    | 2.46   | 3.57   | 57,894 | 24,381 |

⁎ Least significant difference (LSD) at P ≤ 0.05.
give details of the structures of arabinoxylan and β-glucan determined by enzymatic fingerprinting of semolina and wholemeal flours. Correlations between grain quality parameters and dietary fibre content and composition are reported in Table 4.

2. Experimental design, materials and methods

2.1. Plant material

Grain samples from fifteen Italian durum wheat (Triticum turgidum spp. durum) genotypes, comprising four old landraces (Dauno III, old Saragolla, Russello, Timilia RB), three old cultivars (Cappelli,

Table 4

| Grain parameters | YR | TKW | TW | Tot-AX | WE-AX | RV |
|------------------|----|-----|----|--------|-------|----|
| TKW              | −0.24 | 1.00 | 0.42 | −0.06 | −0.30 | −0.37 |
| TW               | −0.02 | 0.42 | 1.00 | −0.34 | −0.76 | −0.73 |
| GPC              | −0.50 | −0.08 | −0.27 | −0.36 | −0.33 | − |
| SPC              | −0.48 | −0.18 | −0.33 | −0.04 | −0.20 | −0.48 |
| Ash              | −0.06 | 0.03 | −0.21 | 0.36 | −0.17 | −0.19 |

| Semolina fibre components | Tot-AX | WE-AX | AX solubility | RV | %x | %x2 | %x3 | %x5 | %xa³xx | %xa²⁺³xx | %xa²⁺²⁺xx | %xa³⁺²⁺xx | %xa³⁺³⁺xx | %xa³⁺⁺⁺xx | %x3: %x4 | %xa³⁺⁺xx | %xa²⁺⁺⁺xx | %xa³⁺⁺⁺⁺xx |
|----------------------------|--------|-------|---------------|----|----|----|----|----|--------|-----------|-----------|-----------|-----------|-----------|-----------|--------|----------|----------|----------|
|                            | 0.05   | −0.06 | −0.34         | 1.00 | 0.44 | 0.27 |
|                            | −0.09  | −0.30 | −0.76         | 0.44 | 1.00 | 0.78 |
|                            | −0.17  | −0.29 | −0.68         | 0.04 | 0.90 | 0.72 |
|                            | 0.14   | −0.37 | −0.73         | 0.27 | 0.78 | 1.00 |
|                            | −0.20  | −0.07 | −0.36         | 0.08 | 0.19 | 0.23 |
|                            | −0.36  | 0.02  | −0.14         | 0.05 | 0.09 | 0.11 |
|                            | 0.03   | −0.23 | −0.16         | −0.02 | 0.27 | 0.47 |
|                            | 0.60   | 0.02  | 0.26          | −0.05 | −0.22 | −0.17 |
|                            | −0.29  | −0.16 | 0.07          | −0.18 | 0.04 | −0.08 |
|                            | −0.01  | 0.30  | −0.08         | 0.13 | −0.03 | −0.11 |
|                            | −0.41  | 0.05  | 0.45          | −0.14 | −0.19 | −0.34 |
|                            | −0.51  | 0.08  | 0.15          | −0.04 | −0.06 | −0.30 |
|                            | 0.24   | −0.06 | −0.34         | 0.18 | 0.17 | 0.06 |
|                            | 0.64   | −0.28 | −0.21         | 0.08 | −0.01 | 0.10 |
|                            | 0.04   | −0.47 | −0.75         | 0.17 | 0.64 | 0.56 |

| Wholemeal fibre components | Tot-AX | WE-AX | AX solubility | %x | %xa³xx | %xa²⁺³xx | %xa²⁺²⁺xx | %xa³⁺³⁺xx | %xa³⁺⁺⁺xx | %xa³⁺⁺⁺⁺xx | %x3: %x4 | %xa³⁺⁺xx | %xa²⁺⁺⁺xx | %xa³⁺⁺⁺⁺xx | %xa³⁺⁺⁺⁺⁺xx | %xa³⁺⁺⁺⁺⁺⁺xx | %xa³⁺⁺⁺⁺⁺⁺⁺xx |
|----------------------------|--------|-------|---------------|----|--------|-----------|-----------|-----------|-----------|-----------|--------|----------|----------|-----------|-----------|-----------|-----------|-----------|
|                            | 0.16   | 0.02  | 0.15          | 1.00 | 0.26 | −        |
|                            | 0.57   | −0.24 | 0.01          | 0.26 | 1.00 | −        |
|                            | 0.53   | −0.25 | −0.04         | −0.06 | 0.94 | −        |
|                            | −0.06  | 0.22  | 0.24          | −0.12 | −0.16 | −        |
|                            | 0.08   | −0.44 | −0.47         | 0.16 | 0.22 | −        |
|                            | −0.08  | −0.07 | 0.07          | −0.06 | 0.03 | −        |
|                            | 0.18   | 0.36  | 0.41          | 0.30 | 0.05 | −        |
|                            | −0.21  | 0.39  | 0.49          | −0.15 | −0.23 | −        |
|                            | −0.01  | 0.52  | 0.30          | −0.28 | −0.31 | −        |
|                            | −0.42  | 0.39  | 0.44          | 0.04 | −0.31 | −        |
|                            | 0.01   | −0.04 | −0.13         | −0.29 | −0.12 | −        |
|                            | 0.18   | 0.35  | 0.35          | −0.19 | −0.13 | −        |
|                            | 0.13   | 0.27  | 0.31          | −0.25 | −0.05 | −        |
|                            | 0.18   | −0.38 | −0.83         | −0.13 | 0.10 | −        |
|                            | 0.33   | 0.13  | 0.55          | −0.07 | 0.11 | −        |

YR, year of release; TKE, thousand kernel weight; TW, test weight; Tot-AX, total arabinoxylan; WE-AX, water-extractable arabinoxylan; RV, relative viscosity.
Garigliano and Grifoni (235) and eight modern cultivars bred after 1985 were analysed. These were obtained from the same two field trial (in 2013 and 2014) as reported in [2], but separate samples of grain were analysed. Plants were grown in a randomized complete block design with three replications on a clay–loam soil at Foggia (Italy, 41° 28’ N, 15° 32’ E and 75 m a.s.l.), as reported previously [2]. The two crop seasons were characterized by different amounts of rainfall during the grain development stage (54 mm and 153 mm respectively in 2013 and 2014).

Wholemeal and semolina flours were prepared using a Cyclotec Tecator 1093 sample mill (sieve 1 mm) and a laboratory mill (Bona, 4 cylinders, sieve 180 µm), respectively. Ash was determined by NIR using an Infratech 1241 Analyser (Foss, Hillerod, Denmark). Nitrogen was determined using the Dumas combustion method using a CNS Combustion Analyser (Leco Corp., St Paul, MN, USA) and % protein calculated as % N × 5.7.

2.2. Enzyme fingerprinting of arabinoxylan and β-glucan

Enzyme fingerprinting of AX and β-glucan was as described by [3]. 100 mg aliquots of semolina and wholemeal flours were digested with endo 1,4 β-xylanase (E.C.3.2.1.8) (a xylanase of the GH11 group) and endo 1,3(4) glucanase (lichenase) (E.C.3.2.1.73) (both enzymes from Megazyme, Bray, Ireland) to digest arabinoxylan and β-glucan, respectively. The oligosaccharides were separated by HP-AEC and the peak areas of the arabinoxylan oligosaccharides (AXOS) were expressed as percentages of the total peak areas of all AXOS. The two major gluco-oligosaccharides (GOS) released by enzymatic digestion of β-glucan by lichenase comprised three glucose residues (G3) and four glucose residues (G4). Total β-glucan was therefore calculated as the sum of the G3 + G4 peak areas and the ratio of G3 to G4 fragments calculated.

2.3. Relative viscosity

Aqueous extracts were prepared from semolina as described by [4] but with an additional centrifugation step at 10,000 × g for 10 min at room temperature before filtration. They were stored on ice prior to measurement of relative viscosity (ηrel = t/t0, where t0: flow time of distilled water, 72–74 s) at 30 °C using an automated viscometer (AVS 370, SI Analytics, Germany) fitted with an Ostwald capillary tube (2 ml, diameter 0.4 mm). Values are the means of two extractions with the flow time of each extract being measured five times.

2.4. Statistical analysis

Two-way analysis of variance (ANOVA) was carried out using as factors genotype and crop season. Least significant difference (LSD) was used at P ≤ 0.05. ANOVA and correlation analyses were performed with software JMP (Version 8.0.2, SAS Institute Inc., 2009).

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Transparency document. Supporting information

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