VARIABILITY OF LIPID COMPOSITION IN A *TRITICUM TURGIDUM* L. COLLECTION

Giovanni Maria Poggi[1,2*], Mara Mandrioli[2], Simona Corneti[1], Giampiero Cai[3], Iris Aloisi[1], Tullia Gallina Toschi[2]

*giovannimaria.poggi2@unibo.it

[1] Department of Biological, Geological and Environmental Sciences, University of Bologna, Bologna, Italy

[2] Department of Agricultural and Food Sciences, University of Bologna, Bologna, Italy

[3] Department of Life Sciences, University of Siena, Siena, Italy

BACKGROUND & OBJECTIVES

Durum wheat is a major staple food in the Mediterranean basin[1] and, along with modern varieties, in the last decades landraces and tetraploid subsp., e.g. *T. turanicum and T. carthlicum*, raised much attention for agronomic and nutritional reasons[2-3]. Wheat is a valuable source of fatty acids, sterols and tocopherols ensuring high nutritional levels[4]. The majority of the lipids in germ, aleurone, and pericarp are nonpolar[5] and of potential nutraceutical interest[6] and recently differences for fatty acid profiles between old and modern varieties were detected in small collections.

In this work, twenty-two accessions, including modern varieties, landraces, and *T. turanicum* and *T. carthlicum* accessions, were characterized for their total fatty acids amounts, monoacylglycerols (MAG), diacylglycerols (DAG), triacylglycerols (TAG), and minor lipids, free acidity and humidity. Moreover, nutritional characteristic were evaluated. Uni- and multi-variate analysis were used in order to unravel differences between landraces and cultivars.

METHODOLOGY

Plant Material

The plant material included 22 accessions, 13 cultivars (DWC) and 9 landraces (DWL) of durum wheat from the association mapping population UNIBO-Durum Panel assembled at the University of Bologna (UNIBO), representing a large portion of the genetic diversity present in durum wheat.

Determination of total fatty substances

The determination of the content of total fatty substances was performed according to the Italian official methodology[7]. Analysis of each sample was performed in triplicate.

Determination of Main Lipid Classes

Different lipid classes were determined according to well-established bibliography by Gas Chromatography equipped with a Flame Ionization Detection (GC-FID)[8].

Determination of total fatty acids

European official methods of analysis were used for the determination of total fatty acid value[9]. Results were expressed as percentage. Analysis of each sample was performed in triplicate.

Determination of free acidity

Flour free acidity was determined according to Acquistucci and co workers[10].

Lipid Quality Indices

The quality of lipid was determined using the atherogenicity (AI) and thrombogenicity (TI) indices[11].

Statistical analysis

Statistical analysis was performed in R statistical environment (R version 4.0.33).

RESULTS

Lipid content and lipid profiles differ among different accessions

The quantitative determination of total fat in flours was evaluated according to the gravimetric total fat method, resulting in a mean fat content of 3.5%. In average, fat content was significantly higher in DWL compared to DWC, 3.8% vs 3.2% respectively (Figure 1).

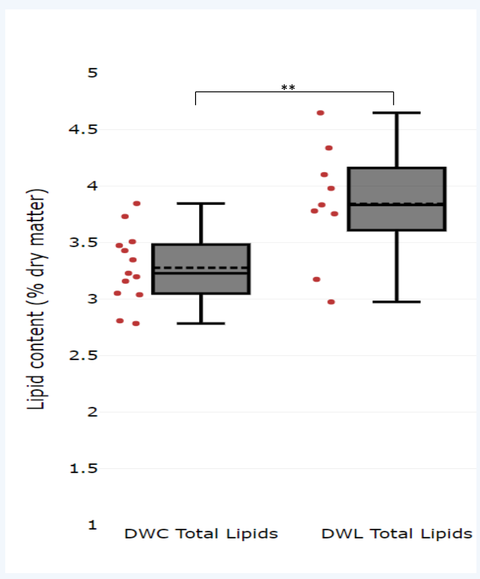

Figure 1. Total lipid content and free lipid content (% dry matter) in the wholemeal of the analyzed accessions. Dots represent single accessions, clustered in DWC and DWL. Boxes report median (straight lines) and mean (dotted lines) values. Results are mean values for each sample analyzed in triplicate. Means marked with ** are significantly different (p<0·01).

Among the neutral lipids, TAGs were the most abundant and accounted for the 83% of the neutral lipids. After TAGs, DAGs, FFA and MAG were the most abundant classes.

The total "minor" lipidic fraction, comprising hydrocarbons, tocopherols, sterols, and esters represented between 4.57% and 7.52% of the total lipids across the fractions studied, with the highest contents found in *carthlicum* DWL.

A PCA was performed to analyze the lipid composition and over 62% of the total variability among genotypes was given by differences related to PC1. In general, the prevalence in TAGs corresponded to a reduction in all other classes (FFAs, MAGs, and DAGs).

PC2, explained for over 69% by moisture and 15% by free acidity, was responsible for 16% of the overall variability observed among genotypes.

DWL-Turanicum and DWL-Carthlicum resulted significantly different from the other subspecies. In particular, DWL-Turanicum was characterized by a higher concentration of FFA, MAG and DAG, while DWL-Carthlicum showed a reduced humidity. Finally, DWL showed an enhanced variability in terms of lipidogram, compared to DWC, which instead showed more variability related to PC2 (Figure 2).

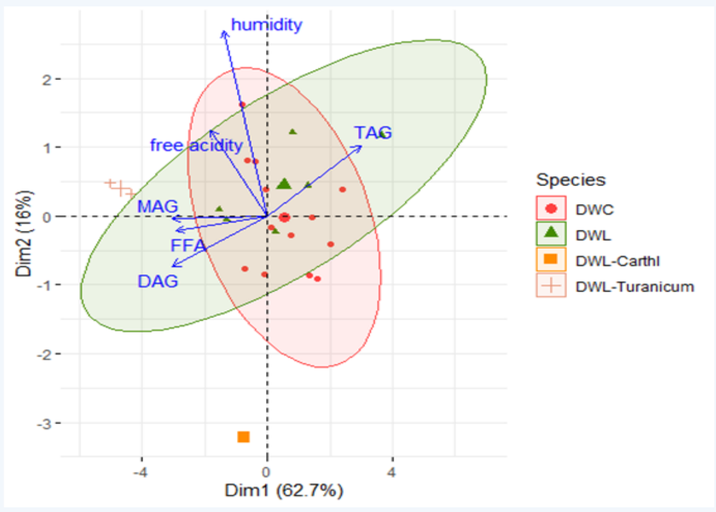

Figure 2. Principal Component Analysis (PCA) biplot of the lipidogram (TAGs, FFAs, MAGs, and DAGs), free acidity and humidity of the twenty-two wheat genotypes.

Wheat accessions differ in terms of nutritional characteristics

The nutritional characteristics, i.e. the ratio ω6/ω3, the ratio between polyunsaturated (PUFA) and saturated (SFA) fatty acids, the relative prevalence of unsaturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA), as well as the atherogenic (AI) and thrombogenic (TI) indices were calculated in order to unravel any significant difference among the accessions.

A PCA was performed to analyze the lipid-associated parameters related to nutrition. Over 63% of the total variability among genotypes was given by differences related to PC1. In particular, an increase in SFAs positively correlated with AI and TI and negatively correlated with the PUFA/SFA ratio. PC2 was responsible for 21.3% of the overall variability. An increase in the content of MUFAs positively correlated with the ω6/ω3 ratio. Plotting the accessions, in order to evaluate how they distribute in terms of nutritional characteristics, the DWL-Turanicum accessions resulted to be characterized by high AI and TI indices, and a high SFA content, while DWC were generally characterized by a high PUFA/SFA ratio, and low AI and TI indices (Fig. 3).

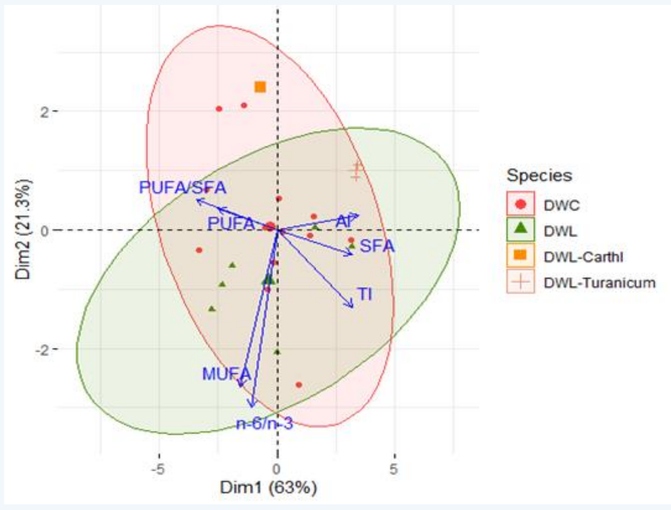

Figure 3: Principal Component Analysis (PCA) biplot of the main nutritional parameters of the twenty-two wheat genotypes under examination. Axes represent the principal components Dim1, explaining 63% of the variance, and Dim2, explaining 21.3% of the variance.

DISCUSSION & CONCLUSION

The here presented differences observed in terms of FFA, MAG, DAG and TAG composition among accessions were constitutive, and not due to different intensity of hydrolytic processes, given by a different storability.

DWL-Turanicum and DWL-Carthlicum resulted to be significantly different from the other subspecies: the former having higher concentration of FFA, MAG and DAG, the latter a lower moisture content. Compared to modern varieties (DWC), landraces (DWL) showed a more pronounced variability with respect to the lipidogram. SFA, AI and TI showed a positive correlation, whereas they were negatively correlated with PUFA/SFA. DWL-Turanicum accessions resulted to be characterized by high AI and TI indices, and a high SFA content, while DWC were generally characterized by a high PUFA/SFA ratio, and low AI and TI indices.

Differences in monounsaturated and ω6/ω3 were less decisive in defining differences among accessions, PC2 being responsible for 21.3% of the total variance.

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