FROM SEED TO PASTA IV

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INNOVATIVE PROCESSING PLANTS:
Technological and Nutritional quality of unrefined durum wheat air-classified fractions

A. Cammerata[1], B. Laddomada[2], R. Marabottini[3], E. Allevato[4], S. R. Stazi[5], F. Sestili[6]

[1] Council for Agricultural Research and Economics, Research Centre for Engineering and Agro-Food Processing, Via Manziana 30, 00189 Rome, Italy; **alessandro.cammerata@crea.gov.it**
[2] Institute of Sciences of Food Production (ISPA), National Research Council (CNR), Via Monteroni, 73100 Lecce, Italy; **barbara.laddomada@ispa.cnr.it**
[3] Department for Innovation in Biological, Agro-Food and Forest Systems (DIBAF), University of Tuscia, Via San Camillo de Lellis snc, 01100 Viterbo, Italy; **marabotttini@unitus.it**
[4] Department of Environmental and Prevention Sciences (DiSAP), University of Ferrara, Via Luigi Borsari 46, 44121 Ferrara, Italy; **enrica.allevato@unife.it**
[5] Department of Chemical, Pharmaceutical and Agricultural Sciences (DOCPAS), University of Ferrara, Via Luigi Borsari 46, 44121 Ferrara, Italy; **silviarita.stazi@unife.it**
[6] Department of Agriculture and Forest Sciences (DAFNE), University of Tuscia, Via San Camillo de Lellis snc, 01100 Viterbo, Italy; **francescosestili@unitus.it**

Introduction

In recent years, the agro-food research sector has developed new technologies to make the best use of the characteristics of the raw material. The development of these new technologies has made it possible to obtain products of excellent quality without compromising food safety. In fact, recent studies have shown that the particle size of the product obtained from grinding and the type of grinding can improve the quality of the product and, in some cases, even maintain its sensory properties.

Considering the composition of durum wheat grain, which contains several interesting bioactive compounds mostly found within the coating structure of the kernel, with the use of fine grinding technologies (microniser) and subsequent air-classification, it is possible to enhance the quality of the final product while limiting the concentrations of organic and inorganic contaminants, such as heavy metals, metalloids, and mycotoxins, while improving the concentration of the antioxidant compounds present in the kernels.

Methods

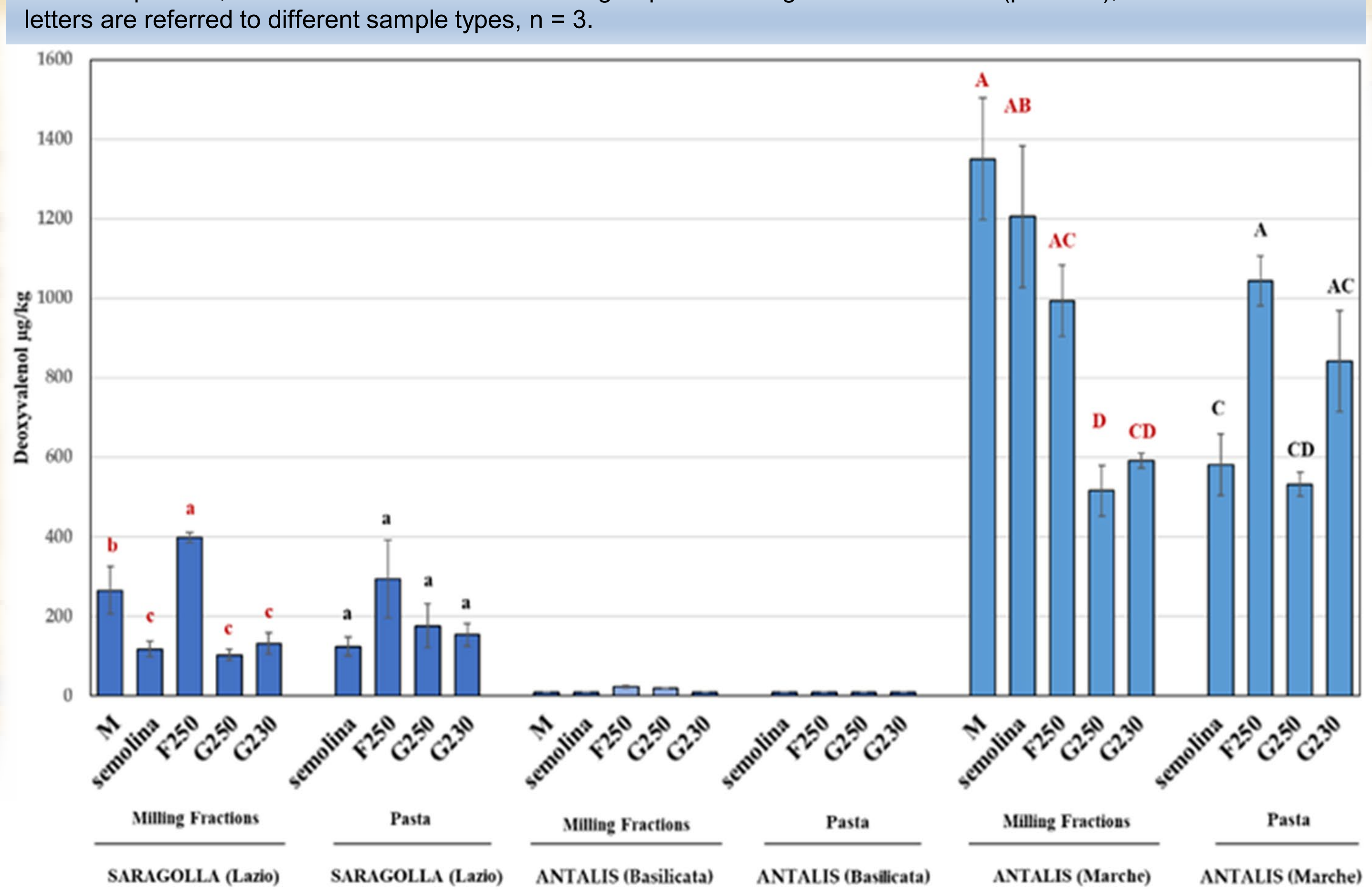
Durum wheat grain samples were micronized subsequently air-classified. More in detail, micronized aliquots of 2.0 kg were air-classified for each cycle (in total 3–5 cycles) at a time by setting the airflow inlet valve at 230 and 250. At the end of each cycle the fractions of type G (heavier gross particles) and F (fine particles) were collected but only G230, G250 and F250 were submitted to analysis because from a previous study they turned out to be the most interesting.

Phenolic acid, Antioxidant Activity Assayes and Deoxynivalenol analysis were performed on the raw materials and on uncooked pasta made using the F250, G250 and G230 air classification fractions and semolina as a control.

Micronised samples and all air-classified G and F fractions were processed to determine the concentrations of As, Cd, Pb, and Ni.

Results

Average content of DON in the micronised (M) and air-classified fractions (F and G) of the durum wheat samples tested as positive; same different letter within each group indicate significant difference ($p < 0.05$), different coloured letters are referred to different sample types, n = 3.



Average values ± standard error (SE) of arsenic (As), cadmium (Cd), nickel (Ni) and lead (Pb) contents in the micronised, semolina and selected air-classified fractions (F250, G250 and G230); d.m.: dry matter; LOD: limit of detection, different letters indicate significant difference ($p < 0.05$) n=3.

		As (µg/g d.m.) ± SE	Cd (µg/g d.m.) ± SE	Ni (µg/g d.m.) ± SE	Pb (µg/g d.m.) ± SE
cv Saragolla (region Lazio)	Micronised sample	0.100±0.002 ^{a}	0.01±0.002 ^{b}	< LOD	< LOD
	Semolina	0.053±0.002 ^{c}	0.002±0.000 ^{b}	< LOD	0.013±0.001 ^{a}
	F250	0.052±0.004 ^{c}	< LOD	< LOD	< LOD
	G250	0.025±0.001 ^{d}	0.01±0.000 ^{a}	< LOD	< LOD
	G230	0.063± 0.005 ^{b}	0.002±0.001 ^{b}	< LOD	0.008±0.003 ^{a}
cv Antalis (region Basilicata)	Micronised sample	0.111±0.05 ^{a}	0.01±0.001 ^{a}	< LOD	0.138±0.006 ^{a}
	Semolina	0.066±0.005 ^{b}	0.001±0.000 ^{a}	< LOD	0.144±0.026 ^{a}
	F250	0.039±0.001 ^{c}	0.001±0.000 ^{a}	< LOD	0.042±0.009 ^{b}
	G250	0.015±0.001 ^{d}	0.001±0.000 ^{a}	< LOD	0.016±0.002 ^{c}
	G230	0.062± 0.007 ^{b}	0.002±0.000 ^{a}	< LOD	0.038±0.004 ^{b}
cv Antalis (region Marche)	Micronised sample	0.164±0.016 ^{a}	< LOD	< LOD	< LOD
	Semolina	0.089±0.007 ^{b}	< LOD	< LOD	0.042±0.002
	F250	0.041±0.001 ^{d}	< LOD	< LOD	< LOD
	G250	0.034±0.002 ^{e}	< LOD	< LOD	< LOD
	G230	0.054±0.004 ^{c}	< LOD	< LOD	< LOD

Phenolic acid profiles (µg/g dry matter) and antioxidant activity (µeq Trolox/g dry matter) of cooked pasta made with air-classified fractions (F250, G250, G230) and semolina obtained from three durum grain samples (Saragolla_LA, Antalis_BA, Antalis_MA). Same letters within columns indicate not significant difference ($p < 0.05$).

Durum Wheat Grain Samples	Milling Product	*p*-Hydroxy Benzoic Acid	Syringic Acid	Vanillic Acid	*p*-Coumaric Acid	Ferulic Acid	Sinapic Acid	TEAC
Saragolla_LA	Micronized	4.37±0.50^{ab}	5.98±0.21^{abc}	8.51±0.48^{bc}	7.96±0.52^{cd}	502.19±8.05^{b}	51.04±1.64^{abc}	8.10±1.54^{cde}
	Semolina	1.12±0.01^{cd}	1.43±0.04^{fg}	1.50±0.42^{f}	0.14±0.01^{f}	80.32±2.79^{e}	8.28±0.66^{g}	2.67±0.18^{gh}
	F250	6.22±0.36^{a}	8.12±0.4^{a}	11.83±0.35^{a}	11.60±0.73^{ab}	498.04±5.08^{b}	61.72±3.83^{ab}	15.22±0.27^{a}
	G250	2.96±0.47^{bcd}	3.23±0.57^{defg}	5.07±0.83^{de}	3.52±0.62^{ef}	383.78±7.31^{c}	32.38±4.01^{bcde}	7.05±0.58^{cdef}
	G230	3.07±0.44^{bcd}	4.12±0.51^{cde}	5.59±0.65^{cd}	4.33±0.47^{e}	408.18±10.25^{c}	30.50±3.49^{cdef}	8.58±0.38^{bcd}
Antalis_BA	Micronized	3.36±0.75^{bc}	5.12±0.19^{bcd}	5.92±0.26^{cd}	8.59±0.11^{bc}	409.65±4.24^{c}	41.47±4.12^{bcde}	9.45±0.05^{bc}
	Semolina	0.76±0.15^{d}	0.76±0.18^{g}	0.73±0.09^{f}	0.09±0.00^{f}	63.52±3.32^{e}	9.81±0.47^{f}	2.47±0.06^{gh}
	F250	4.72±0.56^{ab}	8.15±0.20^{a}	7.53±0.62^{bc}	13.02±0.59^{a}	569.60±5.41^{a}	44.21±4.77^{bcd}	12.26±0.17^{ab}
	G250	2.07±0.08^{bcd}	1.60±0.75^{fg}	2.12±0.70^{f}	2.17±1.00^{ef}	240.90±6.59^{d}	25.36±1.38^{def}	5.03±0.15^{efgh}
	G230	1.53±0.12^{cd}	1.64±0.23^{efg}	2.22±0.28^{f}	2.81±0.74^{ef}	203.66±5.87^{d}	20.59±2.11^{ef}	5.48±0.17^{defg}
Antalis_MA	Micronized	3.12±0.01^{bc}	4.69±0.33^{cd}	6.76±0.15^{bcd}	8.49±0.30^{bc}	394.44±4.44^{c}	54.71±5.03^{ab}	9.07±0.39^{bc}
	Semolina	0.83±0.01^{cd}	1.01±0.01^{fg}	1.19±0.11^{f}	0.16±0.00^{f}	67.51±3.48^{e}	10.99±0.05^{ef}	2.07±0.10^{h}
	F250	4.04±0.11^{ab}	7.73±0.58^{ab}	9.09±0.49^{ab}	12.40±0.40^{a}	512.48±4.37^{b}	68.26±3.61^{a}	11.90±0.67^{ab}
	G250	1.91±0.01^{bcd}	4.49±0.53^{cd}	3.42±0.03^{def}	4.57±0.21^{de}	241.48±5.66^{d}	29.74±2.59^{cdef}	4.26±0.02^{fgh}
	G230	1.88±0.01^{cd}	3.49±0.04^{cdef}	3.18±0.27^{def}	4.28±0.35^{e}	214.11±4.38^{d}	25.47±1.62^{def}	4.32±0.17^{fgh}

Conclusions

Pilot micronisation and air-classification plants have been shown to be suitable grinding technologies for obtaining healthier end products and ensuring better exploitation of the raw material. Indeed, owing to the use of these technologies, it was possible to select unrefined milling fractions as a good compromise between the maintenance of bioactive compounds and the limited content of organic and inorganic contaminants.

References: Cammerata, A.; Laddomada, B.; Milano, F.; Camerlengo, F.; Bonarrigo, M.; Masci, S.; Sestili, F., 2021. Qualitative Characterization of Unrefined Durum Wheat Air-Classified Fractions. Foods 2021, 10, 2817. https://doi.org/10.3390/foods10112817; Cammerata, A., Marabottini, R., Del Frate, V., Palombieri, S., Sestili, F., Stazi, S.R., 2022. Use of Air-Classification Technology to Manage Mycotoxin and Arsenic Contaminations in Durum Wheat-Derived Products. Foods, 2022, 11(3), 304. https://doi.org/10.3390/foods11030304