FACULTY OF BIOSCIENCE ENGINEERING

ALTERBAKE

Lori Daelemans, Ingrid De Leyn, Melissa Camerlinck, Katleen Raes, Pieter Vermeir, Filip Van Bockstaele

NUTRITIONAL PROPERTIES OF ANCIENT WHEATS AVAILABLE ON THE BELGIAN MARKET

Introduction

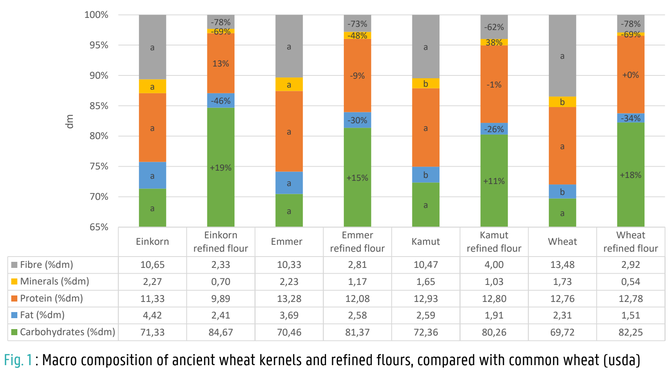
There is an increasing interest in ancient wheats from farmers, companies and consumers. To be able to apply these ancient wheats in bakery products, more knowledge is necessary on the quality, processability and nutritional properties of the cereals and derived meal or flour. The old wheats are believed to have a superior nutritional composition to the modern ones due to the "yield dilution phenomenon" causing lower micronutrient contents. However, information on the quality aspects and nutritional properties of ancient wheats in Belgium is scarce, especially of refined flour. In Alterbake, a research project, the application possibilities of ancient wheats are being investigated. A sample set of ancient wheats including einkorn (*T. monococcum*), emmer wheat (*T. dicoccum*) and khorasan wheat *(T. turgidum spp. turanicum*) was purchased from local suppliers. The aim of this study was to compare the nutritional composition of the ancient wheats to each other and bread wheat and gain insight on some functional properties, digestibility and the influence of milling,

Methods

Macronutrients were determined according to standard methods: protein content (Dumas N x5,7; ISO 16634-1), crude fat (ISO 6492), total dietary fibre (AOAC 985.29) moisture content (ICC 101/1) and ash content (ICC 104/1). Carbohydrates were calculated by difference. Mineral composition was measured with ICP-AES (ISO 11885). Vitamin B1 (NBN EN 14122), B2 (NBN EN 14152) and E (NBN EN 12822) were evaluated as vitamins in 2 whole meal and 2 refined flours per species. Nutritional properties of the ancient wheats were compared with data found in usda database. Some functional properties of the refined flour were also analyzed (Zeleny sedimentation (ICC 116/1), wet gluten content and quality (Glutomatic, ICC 155) and damaged starch (SD matic Chopin, ICC 172)) and compared with a commercially available flour (Epi B, Paniflower NV).

Results

Macro composition

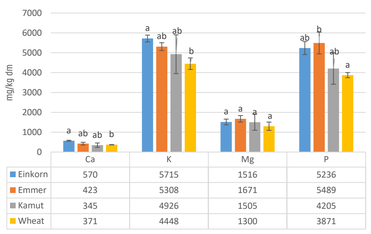


	Einkorn	Einkorn refined flour	Emmer	Emmer refined flour	Kamut	Kamut refined flour	Wheat	Wheat refined flour
Fibre (%dm)	10,65	2,33	10,33	2,81	10,47	4,00	13,48	2,92
Minerals (%dm)	2,27	0,70	2,23	1,17	1,65	1,03	1,73	0,54
Protein (%dm)	11,33	9,89	13,28	12,08	12,93	12,80	12,76	12,78
Fat (%dm)	4,42	2,41	3,69	2,58	2,59	1,91	2,31	1,51
Carbohydrates (%dm)	71,33	84,67	70,46	81,37	72,36	80,26	69,72	82,25

Fig. 1 : Macro composition of ancient wheat kernels and refined flours, compared with common wheat (usda)

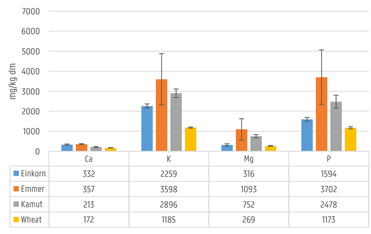
Einkorn and emmer showed significant higher values for ash- and fat content compared to Kamut and bread wheat, all other values were not statistically different ($p<0,05$). Milling (to refined flour) has a negative influence on fat-, dietary fiber-, mineral- and protein content.

Macro minerals



	Ca	K	Mg	P
Einkorn	570	5715	1516	5236
Emmer	423	5308	1671	5489
Kamut	345	4926	1505	4205
Wheat	371	4448	1300	3871

Fig. 2a : Macro mineral composition of ancient wheat kernels compared with common wheat (usda)

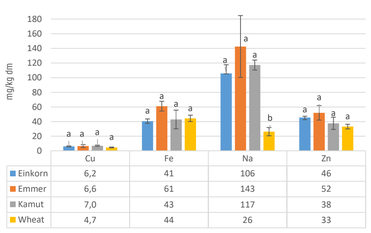


	Ca	K	Mg	P
Einkorn	332	2259	316	1594
Emmer	357	3598	1093	3702
Kamut	213	2896	752	2478
Wheat	172	1185	269	1173

Fig. 2b : Macro mineral composition of ancient refined flour compared with common wheat (usda)

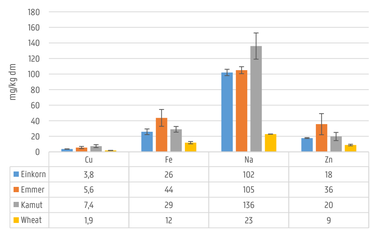
All ancient wheats have higher Ca, K, Mg and P content than bread wheat. Only einkorn has a statistical significant higher content of Ca and K, emmer has a higher P content ($p<0,05$). After milling, a large fraction of the minerals is lost, because they are mainly located in the bran.

Micro minerals



	Cu	Fe	Na	Zn
Einkorn	6,2	41	106	46
Emmer	6,6	61	143	52
Kamut	7,0	43	117	38
Wheat	4,7	44	26	33

Fig. 3a : Micro mineral composition of ancient wheat kernels compared with common wheat (usda)

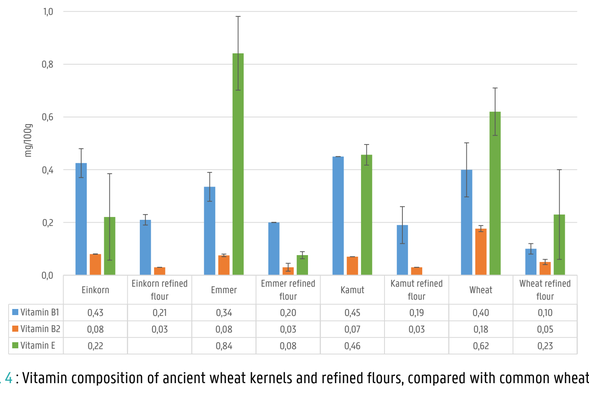


	Cu	Fe	Na	Zn
Einkorn	3,8	26	102	18
Emmer	5,6	44	105	36
Kamut	7,4	29	136	20
Wheat	1,9	12	23	9

Fig. 3b : Micro mineral composition of ancient refined flour compared with common wheat (usda)

No statistical differences could be found between the ancient wheats and common wheat for the micro mineral content, except for the sodium content which was higher in einkorn, emmer and kamut. The largest losses in mineral content due to milling can be found in wheat.

Vitamin composition



	Einkorn	Einkorn refined flour	Emmer	Emmer refined flour	Kamut	Kamut refined flour	Wheat	Wheat refined flour
Vitamin B1	0,43	0,21	0,34	0,20	0,45	0,19	0,40	0,10
Vitamin B2	0,08	0,03	0,08	0,03	0,07	0,03	0,18	0,05
Vitamin E	0,22		0,84	0,08	0,46		0,62	0,23

Fig. 4 : Vitamin composition of ancient wheat kernels and refined flours, compared with common wheat (usda)

Vitamin B1 content was similar in einkorn, kamut and bread wheat (ca. 0.4mg/100g), while emmer had a slightly lower content (0,3 mg/100g). Vitamin B2 was similar for all ancient wheats (0.08 mg/100g), but lower than the vitamin B2 content of bread wheat. Vitamin E was low in einkorn and kamut kernels and high in emmer kernels, compared to common wheat.

Functional properties

Table. 1 : Functional properties of ancient wheats and common wheat (refined flour)

	Zeleny sedimentation (ml)	Gluten index (%)	Wet gluten content (%)	Damaged starch (%)
Einkorn	<11	-	-	3,08±0,08
Emmer	13,00±0,43	45,08±0,49	33,13±1,22	6,74±0,07
Kamut	13,25±0,43	53,07±3,76	25,50±0,28	6,91±0,10
Wheat	38,25±0,43	94,89±0,68	28,88±0,37	5,20±0,12

Protein content of the ancient wheats was high, as described in literature. However, high protein content does not guarantee good protein quality. Zeleny sedimentation values of einkorn were < 11 ml, emmer and khorasan had higher values, yet still much lower than bread wheat (38 ml). Wet gluten content (WGC) and gluten index (GI) could not be determined for einkorn. This does not mean einkorn does not contain gluten, it does however suggest that the gluten present can't form a strong network. WGC of emmer and khorasan were similar to common wheat, but GI, respectively 45 and 53, were much lower than for common wheat (95). Finally damaged starch content of einkorn was lower because of their soft texture.

Digestibility

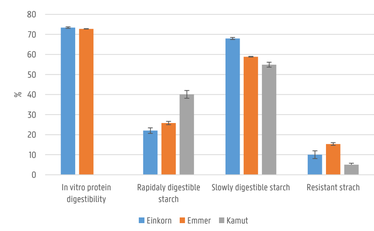


Fig. 5 : protein and starch digestibility of ancient wheats

Emmer showed the highest fraction of resistant starch (RS; 15,3%), while kamut showed a low fraction of RS (5%). Resistant starch is fermented in the large intestine, releasing short fatty acids which are considered as beneficial. Kamut consists of a high portion of rapid digestible starch (RDS), which causes a rapid increase in blood glucose level after ingestion. Slowly digestible starch on the other hand, releases glucose slowly and consistently over and extended time. Einkorn showed the highest values for this parameter of starch digestibility. No statistical difference could be found in protein digestibility between einkorn and emmer.

Conclusion

The ancient wheats have high mineral, but low fiber content when compared to common wheat. Vitamin B1 content of einkorn and Kamut was superior to bread wheat, while vitamin E content in emmer was higher than in bread wheat. When introduced into an normal diet, these small differences will not have great health beneficial effects. The high(er) resistant starch fractions in einkorn and emmer when compared to kamut, do not necessarily mean they are healthier as a large fraction of that RS vanishes when cooked. Einkorn in specific, but the ancient wheats in general, have weak protein quality (compared to bread wheat), which makes it difficult to use them for Belgian breads. Other techniques, e.g. sourdough, pre fermented dough, poolish,... could be used to produce breads with a light crumb structure and good volume.

Lori Daelemans
Lori.daelemans@ugent.be

www.Alterbake.be

Alterbake

www.linkedin.com/in/lori-daelemans

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