NOTE

Nutritional Profile of Three Spelt Wheat Cultivars Grown at Five Different Locations

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The absence of gluten-forming proteins, which trigger allergic reaction in some individuals (celiacs), and other nutritional claims have been made for spelt (*Triticum aestivum* var. spelta), a subspecies of common wheat. Spelt is widely grown in Central Europe. It was introduced to the United States in the late 1800s by Russian immigrants (Martin and Leighty 1924). However, the popularity of spelt in the United States diminished rapidly due to the limited number of adapted cultivars, and due to the major emphasis on common wheats, barley, and oats. In recent years, interest in spelt as human food has risen, primarily due to the efforts of some millers who actively contract and market spelt grain and processed finished products. In spite of this renewed interest, only a few cultivars are yet grown, and samples are difficult to obtain to properly document the nutritional profile of spelt.

In 1994, we analyzed a sample of spelt wheat for nutrients, including selected vitamins and minerals, and tested it for gluten. That study did not support the nutritional claims made for spelt (Ranhotra et al 1995). Such claims were also not supported in a subsequent study which analyzed eight spelt samples (Ranhotra et al 1996). Although spelt tested positive for gliadin—the gluten fraction implicated in celiac condition—in both these studies, Federmann et al (1992) suggest that gliadin differences do exist between spelt and common wheat.

To ensure that the information we are developing is meaningful and applicable to the entire class of spelt wheat, we analyzed (this study) 15 additional spelt samples that became available to us in 1995. These represent three selections grown at five different locations in Montana (MT) and North Dakota (ND); two common wheats grown at the same five locations were also analyzed. Samples were analyzed for macrocomponents and lysine; they were also immunoassayed for gliadin. Because of limited quantities, samples were not analyzed for micronutrients this time.

MATERIALS AND METHODS

Spelt and Common Wheats Tested

AltGold, MT Common, and Vita II were the three spelt cultivars tested (Table I). They were grown in test plots in three locations in MT (Havre, Huntley, and Billings) and two locations in ND (Williston and Carrington). Common wheat (hard red winter) tested included the cultivars Tiber (grown in Havre, Huntley, and Billings) and Roughrider (grown in Williston and Carrington). All samples tested were harvested in 1994. These samples were milled into a whole meal (≈40 mesh) on a Thomas Wiley laboratory mill and then sampled for analysis.

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Nutrient Analyses

Moisture, protein (Kjeldahl), fat (ether extract), and ash were determined by the standard AACC (1995) methods. Fiber (total, insoluble and soluble) was determined by the AACC (1995) method 32-07. Lysine content was determined by hydrolyzing samples in 6*N* HCl (in sealed and evacuated tubes, 24 hr, 110°C), evaporating to dryness, diluting in appropriate buffer containing norleucine as an internal standard, and then analyzing on a Beckman 6300 amino acid analyzer using a three-buffer step gradient program and ninhydrin post-column detection. Carbohydrate values were obtained by calculation; energy values were also obtained by calculation using standard conversion factors (4 kcal/ g for protein and carbohydrates each, and 9 kcal/g for fat).

Gluten Immunoassay

An assay kit (Ridascreen, R-Biopharm, GmbH, Darmstadt, Germany), based on an antigen-antibody enzyme test as developed by Skerritt and Hill (1990), was used to assay for gluten. The wells in the microtiter plate in the assay kit are coated with specific antibodies to gliadin. By adding the sample (spelt or common wheats) or standard solutions to the wells, present gliadin binds to the specific capture antibodies. The manufacturer's recommended procedures were followed, and gliadin values (estimated to be 50% of gluten) in the samples were determined photometrically.

Statistical Methods

Compositional data were analyzed statistically using SigmaStat (1995), with multiple comparisons performed by the Tukey test.

RESULTS AND DISCUSSION

Macronutrients

Protein content of spelt wheats averaged significantly higher than that of common wheats (Tables I and II). As designed, our previous two studies (Ranhotra et al 1995, Ranhotra et al 1996) could not make this distinction between the two classes of wheat. This distinction may be an important one. Protein content was also significantly affected by location (Table II); irrespective of the cultivar, spelt and common wheats grown at Huntley showed the highest protein content (Table I and II).

Fat and fiber values showed a different trend. Fat in spelt wheats averaged only about half the level in common wheats and was, thus, significantly lower (Tables I and II). This was primarily due to the MT Common, a feed grain selection, being low in fat as compared to the other two spelt selections (Table I). Like fat, total and insoluble fiber values also averaged significantly lower in spelt wheats as compared to common wheats (Table I and II); Abdel-Aal et al (1995) reported similar findings when comparing spelt with hard red spring and durum wheats. This distinction should hold true for soluble fiber values (not shown) as well. Location had no significant effect on fiber content (Table II).

TABLE I
Proximate Composition and Lysine Content of Spelt and Common Wheats, and Gluten Content of Spelt Wheats

Cultivar	Location	Proximates (g/100 g) Moisture	Protein	Fat	Ash	Total Fiber	Insoluble Fiber	Carbohydrates	Energy Kcal/100 g	Lysine g/100 g protein	Gluten[a,b] %
Spelt Wheat											
AltGold	Havre	10.6	17.4	1.8	1.7	9.2	7.9	59.3	323	2.66	10.6 ± 6.1
AltGold	Huntley	10.6	22.8	1.8	2.2	9.7	8.4	52.9	319	1.88	13.9 ± 6.9
AltGold	Billings	10.5	16.6	1.8	1.6	9.6	8.5	59.9	322	2.99	8.0 ± 1.9
AltGold	Williston	10.6	14.5	1.4	2.0	10.4	8.9	61.1	315	3.17	11.0 ± 4.2
AltGold	Carrington	10.6	15.3	1.9	2.0	10.2	8.9	60.0	318	3.49	7.2 ± 1.4
MT Common	Havre	10.3	15.6	0.9	1.5	9.1	7.6	62.6	321	3.11	8.3 ± 3.0
MT Common	Huntley	10.3	20.2	1.3	2.0	9.0	7.6	57.2	321	2.21	12.5 ± 4.8
MT Common	Billings	10.3	16.3	0.8	1.5	9.0	7.6	62.1	321	2.94	13.1 ± 2.9
MT Common	Williston	10.6	15.7	0.9	1.9	9.0	7.6	61.9	319	3.07	12.1 ± 1.7
MT Common	Carrington	10.5	14.5	1.3	1.8	9.4	8.0	62.5	320	3.36	11.3 ± 2.0
Vita II	Havre	10.4	15.7	2.0	1.7	9.0	7.7	61.2	326	3.11	7.4 ± 1.2
Vita II	Huntley	10.5	19.5	2.2	2.1	9.2	8.1	56.5	324	2.29	8.8 ± 1.4
Vita II	Billings	10.5	15.8	2.2	1.6	9.3	8.2	60.6	325	3.08	7.4 ± 3.2
Vita II	Williston	10.7	14.1	1.8	1.9	9.7	8.2	61.8	320	3.23	10.2 ± 2.0
Vita II	Carrington	10.7	14.7	2.4	1.9	9.2	8.0	61.1	325	3.35	10.7 ± 1.6
Average		10.5	16.6	1.6	1.8	9.4	8.1	60.0	321	2.93	10.2
Standard deviation		0.1	2.5	0.5	0.2	0.4	0.4	2.7	3	0.47	2.2
Common Wheat											
Tiber	Havre	10.6	13.1	2.5	1.3	12.0	10.3	60.5	317	3.27	
Tiber	Huntley	10.5	15.7	2.6	1.5	12.8	11.3	56.9	314	2.35	
Tiber	Billings	10.6	13.4	2.5	1.2	12.3	10.8	60.0	316	3.34	
Roughrider	Williston	10.6	12.0	3.3	1.8	11.2	9.6	61.1	322	3.66	
Roughrider	Carrington	10.6	12.8	3.1	1.7	12.1	10.5	59.7	318	3.42	
Average		10.6	13.4	2.8	1.5	12.1	10.5	59.6	317	3.21	
Standard deviation		0.0	1.4	0.4	0.3	0.6	0.6	1.6	3	0.50	

[a] Gliadin values × 2.
[b] Common wheats were not analyzed.

TABLE II
Statistical Analysis of Compositional Data[a]

	Component Protein	Fat	Total Fiber	Insoluble Fiber	Lysine
Variety					
Spelt	a	b	b	b	NS[b]
Wheat	b	a	a	a	NS
Cultivar					
AltGold	a	d	b	c	NS
MT Common	a,b	e	b	d	NS
Vita II	a–c	c	b	c,d	NS
Tiber	b–d	b	a	a	NS
Roughrider	d	a	a	b	NS
Location					
Havre	b	NS	NS	NS	a
Huntley	a	NS	NS	NS	b
Billings	b	NS	NS	NS	a
Williston	b	NS	NS	NS	a
Carrington	b	NS	NS	NS	a

[a] Within a category (variety, cultivar, or location), components in a column not sharing a common letter are significantly different ($P < 0.05$).
[b] Not significant.

Other components (moisture, ash, and carbohydrates) showed small differences due to wheat cultivar, location grown, or type (spelt or common) of wheat. Such was also the case for energy content which averaged 321 kcal/ 100 g for spelt wheats and 318 kcal/100g for common wheats (Table I).

Values for lysine, the most limiting amino acid in the triticum species, ranged widely in both spelt and common wheats (Table I). In spite of this, the effect of location on lysine content became apparent; all three spelt cultivars showed significantly lower lysine content when grown in Huntley, MT (Tables I and II). Variety or cultivar did not affect lysine content significantly (Table II). Protein content tended to be inversely related to lysine content; with wheats grown in Huntley showing the highest protein content but the lowest lysine content. The inverse relationship between protein content and lysine content has variously been reported, including by Clamot (1984), who tested 164 spelt varieties grown in Europe. Since lysine values differed widely, it is safe to presume that the biological value of protein also differed widely.

Gluten Content

In agreement with our previous findings (Ranhotra et al 1995, Ranhotra et al 1996) and a recent report (Abdel-Aal et al 1995), all spelt samples tested positive for gluten. Three runs of gluten immunoassay were performed. For several spelt samples, values differed appreciably between runs (Table I). This precluded our ability to assess the effect cultivar or location may have on gluten content. Common wheat samples were not tested for gluten because the presence of gluten in common wheats has repeatedly been confirmed (Hamada et al 1982, Gupta et al 1992, Abdel-Aal et al 1995).

CONCLUSIONS

Nutrient profile of the 20 wheat samples (15 spelt and 5 common wheats) tested was greatly influenced by wheat variety (spelt or common wheat), wheat cultivar and location grown. All spelts, as is well established for common wheats, tested positive for gluten. While spelt yields (grain after hulling) are generally less than common wheat, spelt yields tend to equal wheat when growing season environments are less than ideal.

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