NOTE

Lipid Composition of Flour and Quality Changes Associated with Sulfur Deficiency in Wheat

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Several field and glasshouse experiments have recently established that sulfur deficiency leads to changes in dough properties as well as loss of grain yield in wheat (reviewed by Randall and Wrigley 1986). In general, dough from sulfur-deficient wheat lacks extensibility, has a higher resistance to extension, and has modified baking properties compared to normal wheat of the same genotype and protein content.

These changes in grain quality have been attributed to a considerable redirection of protein synthesis, in favor of low-sulfur proteins, accompanying sulfur deficit (Moss et al 1981). However, there has previously been no attempt to examine possible changes in lipid composition, also known to influence grain quality (MacRitchie 1983). Those aspects of lipid composition shown to be associated with baking behavior (Chung et al 1982, Zawistowska et al 1984) were therefore studied in a set of flour samples that differed widely in sulfur content.

MATERIALS AND METHODS

Samples for analysis were milled to 72% extraction on a Buhler laboratory mill from grain of the cultivar Olympic, grown in the field under different levels of sulfur and nitrogen fertilization (Moss et al 1981). Sulfur contents of flours are indicated in Table I, determined as described by Moss et al (1981).

Lipid was extracted with either chloroform or light petroleum (boiling point of 40–60° C) from 10-g flour (13% moisture) samples (in duplicate) by the Soxhlet method (1 hr). The amount of lipid was determined by weight after evaporation of solvent (150 ml) in a rotary evaporator. After making up to 25 ml in hexane, 15 μl of solution was spotted on thin-layer chromatographic (TLC) plates (20 × 20 cm, Merck). A developing solution of chloroform, methanol, and water (90:20:2) was used. Plates were sprayed with a 10% solution of sulfuric acid in ethanol and heated at 160° C for 15 min for detection of spots (replicated four times). Densitometer measurements were made using a Shimadzu dual wave-length TLC scanner (CS-910) and a Hewlett-Packard 3390A integrator. Spots were identified using pure standards (glycerol trioleate, linoleic acid, glycerol monooleate, monogalactosyl diglyceride, digalactosyl diglyceride, and dipalmitoyl phosphatidyl choline, obtained from Sigma Chemical Co., St. Louis, MO). All compounds with mobility greater than monogalactosyl diglyceride were classed as nonpolar lipids.

RESULTS AND DISCUSSION

Table I indicates the spread of sulfur contents and lipid compositions for the flour samples extracted with either light petroleum solvent or chloroform (nine flours) and an additional eight flour samples with chloroform only. Although the samples varied in lipid composition, neither the proportion of lipid extracted with either solvent nor the polar to nonpolar ratio bore any significant relationship to the sulfur contents of the flour samples (correlation coefficients, Table I). Neither was there any significant relationship between lipid composition and nitrogen content; this tends to discount the possibility that a relationship between sulfur and lipid contents might have been obscured by an overriding effect caused by nitrogen fertilizer.

TABLE I
Relationship of Lipid Composition to Sulfur Contents of Olympic Flours

Flour Components[a]	Extractant: Chloroform (n = 17)	Extractant: Light Petroleum (n = 9)
Sulfur contents (% dry weight flour)		
Range	0.081–0.161	0.081–0.161
Mean ±SD	0.112±0.030	0.117±0.034
Nitrogen contents		
Range	1.14–2.09	1.14–2.09
Mean ±SD	1.54±0.42	1.43±0.50
Lipid extracted (% dry weight flour)		
Range	0.98–1.16	0.66–0.95
Mean ±SD	1.07±0.12	0.83±0.01
r with % S	−0.16	−0.35
r with % N	−0.04	−0.20
Polar lipid (% total lipid)		
Range	47.4–53.0	29.4–39.6
Mean ±SD	50.6±1.9	35.5±3.0
r with % S	0.15	−0.14
r with % N	0.21	−0.19

[a]SD = Standard deviation; r = correlation coefficient, none are significant.

The results provide further justification for the previously published conclusions (reviewed by Randall and Wrigley 1986) that the changes in flour quality associated with sulfur deficiency are primarily due to redirection of protein synthesis.

As the lipid analysis was confined to flour, there is still the possibility that sulfur supply might alter the lipid composition of the nonendosperm portions of the grain. However such changes are not likely to relate to dough quality.

LITERATURE CITED

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