

NOTE ON PROTEIN DISTRIBUTION WITHIN OAT KERNELS OF SINGLE CULTIVARS THAT DIFFER IN PROTEIN CONCENTRATION¹

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Studies on the distribution of protein in oat groats selected from several cultivars or selections differing in protein concentration show that changes in protein concentration occur both in the bran and in the starchy endosperm (1,2). Protein concentration in groats of a single oat cultivar can also vary considerably because of different fertilizer treatments and different natural environments. However, it is not known how the protein distribution within the groats of single cultivars varies under different growing conditions. In a study of two dwarf wheat strains, Abrol *et al.* (3) reported that the accumulation of extra protein at high fertility takes place in the flour only.

MATERIALS AND METHODS

The oat cultivar Nora was grown in Arkansas in one location with two rates (30 and 90 lb/acre) of five different types of nitrogen fertilizer: ammonium nitrate, urea, and three slow-release urea fertilizers. The pairs of samples (two application rates) from each fertilizer treatment differed in protein concentration. Three of the fertilizer treatments were replicated, so eight pairs of samples were analyzed in all. The higher fertilizer rate produced higher oat groat protein concentration. In an environmental study, the cultivars Beedee, Goodland, Holden, Orbit, and Multi M-72 were grown in Rock and Waupaca counties, Wis. Grain from cultivars grown in Rock County had lower protein concentration than grain from the same cultivars grown in Waupaca County. Two other cultivars, Portal and Vicland, grown in two locations in Dane County, also produced different grain protein concentrations within each cultivar. Fertilizer differences in this study, if they existed, were minor.

Samples were dehulled by hand, and the germ was removed as described earlier (1), except that the embryonic axis and scutellum were removed together. The degermed groats were milled in a Brabender Quadrumat Jr.[®] experimental flour mill. Three mill streams were obtained: bran, high-ash flour, and low-ash flour. The average yield of high-ash flour was only 3.6% of the total, so this stream was not analyzed further. The germ, low-ash flour, and bran were analyzed for nitrogen by the Kjeldahl method; a factor of 6.25 was used to convert nitrogen to protein. Results are reported on a moisture-free basis. All data reported or summarized were obtained specifically for this experiment.

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TABLE I
Protein Distribution and Average Protein Difference within
Single Cultivars having Different Protein Concentration^a

Sample	Fertilizer Study ('Nora') ^b			Environmental Study ^c		
	Protein % Average Low	Protein % Average High	Difference Percentage Points	Protein % Average Low	Protein % Average High	Difference Percentage Points
Groats	13.0	15.4	2.4	16.9	19.9	3.0
Germ	33.6	35.2	1.6	32.9	33.5	0.6
Bran	15.3	17.8	2.5	22.0	24.8	2.8
Endosperm	9.5	10.8	1.3	13.8	16.1	2.3

^aProtein values are expressed on a moisture-free basis.

^bEight pairs of samples.

^cSeven cultivars, each grown at two locations.

RESULTS AND CONCLUSIONS

A summary of the results is shown in Table I. In the fertilizer study, the average difference between eight low-protein samples and the corresponding eight higher protein samples was 2.4 percentage points. Generally, when groat protein concentration increased, the germ, bran, and starchy endosperm fractions all showed an increase in protein, not just the flour (endosperm) as previously reported in two dwarf wheats (3). Bran actually showed a greater increase in protein concentration than starchy endosperm in six of the eight trials.

In the environmental study, changes in protein concentration in the groats and fractions within high- and low-protein pairs of each of the seven cultivars were similar. Again, bran showed the greatest increase in percentage points, with bran increase exceeding the endosperm in five of the seven trials. In all samples, the largest amount (g) of the total groat protein was found in the bran fraction (data not shown).

From these data it appears that, in single cultivars, protein deposition within oat groats of different protein concentrations is different from protein deposition in wheat under similar circumstances. Because of current interest in the high-quality protein in oat groats, this information may be helpful in future uses of oat groats as food or feed. Amino acid analysis of hand-separated oat groats (4), expressed as g amino acid/100 g amino acid recovered, showed the endosperm to be chemically lower in lysine and threonine than the bran and germ. It is conceivable then, that the bran fraction or bran and germ combined would be high in protein quality and quantity, rich in fiber, and could be made available simply by milling oat groats. However, further data are necessary on amino acid composition of bran and germ of different cultivars, digestibility of bran, the nutritional effect of phytase present in oat groat bran, and economic uses of the starchy endosperm.

Acknowledgments

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Literature Cited

1. YOUNGS, V. L. Protein distribution in the oat kernel. *Cereal Chem.* 49: 407 (1972).
2. YOUNGS, V. L., and PETERSON, D. M. Protein distribution in the oat (*Avena sterilis* L.) kernel. *Crop Sci.* 13: 365 (1973).
3. ABROL, Y. P., UPRETY, D. C., AHUJA, V. P., and NAIK, M. S. Soil fertilizer levels and protein quality of wheat grains. *Aust. J. Agr. Res.* 22: 195 (1971).
4. POMERANZ, Y., YOUNGS, V. L., and ROBBINS, G. S. Protein content and amino acid composition of oat species and tissues. *Cereal Chem.* 50: 702 (1973).

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