DEUTSCHE GESELLSCHAFT FÜR QUALITÄTSFORSCHUNG
(PFLANZLICHE NAHRUNGSMITTEL) E.V.
XXXII. Vortragstagung, Wädenswil, 1997

Sulfur in wheat from biodynamic agriculture

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Introduction

At the beginning of the 80's most agricultural sites were sufficiently supplied with sulfur through SO_2-deposition from household fireplaces, cars and industries. Then S-deposition was drastically reduced by the installation of desulphurisation plants and S-poor fuels. Until 1990 S-deposition was reduced in Northern Germany by 60% from about 35 to 14 kg S/ha * year. While at the beginning of the mentioned period the S-demanding oilseed rape showed no severe and only a few (24 %) cases of hidden S-deficiency, in 1991 most examined samples showed severe S-deficiency (SCHNUG and HANEKLAUS 1994). Though wheat has far lower demands in sulfur, BLOEM et al. (1995) observed yield reductions caused by S-deficiency up to 30 %. Inadequate S-content of wheat also reduced baking quality of wheat (HANEKLAUS et al. 1992, BYERS et al. 1987) by too tough doughs. A survey exists about the S-content of wheat from the German conventional agriculture (HANEKLAUS et al. 1992). But up to now no examination of wheat from organic agriculture has been done. This paper reports about samples from biodynamic agriculture and wants to give a first contribution to this topic.

Material and methods

61 wheat samples (almost completely winter wheat, different varieties) from biodynamic agriculture (harvest 1995) were examined. Nitrogen in whole grain (DM) was determined according to Kjeldahl method (N x 5,7), sulfur by x-ray-fluorescence-spectroscopy (SCHNUG and HANEKLAUS 1992). From 6 samples (variety Bussard) and 11 samples (variety Rektor) the maximum resistances of glutenextensogramms according to KIEFFER et al. (1981) were determined.

Results and discussion

The crude protein content of all samples was very low. 44.3 % of the samples ranged below 10 % crude protein, only 8.2 % of the samples had protein contents above 11.5 %. The mean was 10.0 %. This figure was much lower than the figures of 10.5 and 11.1 %, which were found by BRÜMMER and SEIBEL (1991) and VÖLKEL and POHLMANN (1994) who examined wheat samples from farms and variety trials from organic agriculture and which protein content they already judged as being much too low. This difference certainly is caused by the fact, that for the above mentioned scientific projects conciously very well managed organic farms are choosen.

N-content and S-content in the grain were positively correlated. The average S-content was 0.127 %. Concerning the N:S-relation the classes 11-<12 and 15-<16 were strongly emphasized. The N:S-relations were normally distributed though. So future examinations have to clarify, if this phenomenon is really caused by two groups of samples with different factors (soils, manure, groundwater access).

Wheat sufficiently supplied with nitrogen ist regarded deficient in sulfur, if the S-content of the grain is below 0.12 % resp. if the N:S-relation is wider than 17:1 (BYERS and BOLTON 1979, RANDALL et al. 1981). 42.6 % of the samples examined showed S-contents below 0.12 %. Future research must examine, if this limit of 0.12 % holds true also for wheat samples from organic agriculure being poor in protein and also, if in these cases the organic farmer achieves better yields and qualities through an appropriate S-fertilization. Looking at the N:S-relation of the whole grain, only 6.6 % of the samples were located above this critical value of 17:1. Usually the baker using such flour must face additionally to a reduced kneading tolerance and baking volume (BRÜMMER and SEIBEL 1992) further quality reductions, as flour low in sulfur produces tougher doughs and lower baking volume (SCHNUG et al. 1993, MOSS et al. 1981). Looking at the values for maximum resistance, this supposition was not confirmed. Even at high N:S-relations of 16-17, resistance of the variety Rektor was not correlated to this parameter ($r=-0.06$, $n=11$). The variety Bussard even showed a negative tendency ($r=-0.41$, $n=6$).

In a previous examination of wheat samples derived from different sites of conventional agriculture in Germany, samples grown near urban or industrial areas on average showed N:S-relations below 17:1, while samples from the countryside lay above 17:1 and thus showed sulfur deficiency (HANEKLAUS and SCHNUG 1992). A comparison of 7 biodynamic samples from the relative small and hardly industrialized region Schwäbisch-Hall and Crailsheim showed with N:S-relations between 11.02-17.73 (mean=14.43) a high variability. This phenomenon continued even into the localy very restricted area of the sites of several farms. So for the realization of the S-content of wheat from biodynamic agriculture not only the closeness to urban or industrial centers comes into consideration, but also further aspects as access of the plants to ground water, sulfur craving preceeding crop and the potential of the soil to mineralize sulfur.

Summary

61 wheat samples from biodynamic agriculture (harvest 1995) were examined. The mean crude protein- and S-contents were 10.0 and 0.127 %, the mean N:S-relation 14.1. As the N-content of the samples increased, so did the S-content. 42.6 % of the samples showed S-contents below the limit of 0.12 %. 6.6 % of the samples had N:S-relations higher than 17:1. A distinct variability of the N:S-relations even of samples from the same farm was observed. The maximum resistence (gluten extensogramm) from samples of the variety Rektor was not influenced by differing N:S-relations (r=-0.06, n=11), and with the variety Bussard even a negative tendency (r=-0.41, n=6) was observed.

Acknowledgement

We are indebted to Dr. R. KIEFFER, Deutsche Forschungsanstalt für Lebensmittelchemie, Munich, for the possibility of measuring maximum resistance of gluten.

The complete German version of this article will appear in „Getreide, Mehl und Brot" (1997, accepted).

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