Viscosity of water and buffer extract as a new tool in selection of oat genotypes for specific end-uses

Damian Gołębiewski and Danuta Boros

Institute of Plant Breeding and Acclimatization - National Research Institute
Radzików, 05-870 Błonie, Poland, d.golebiewski@ihar.edu.pl

key words: oat, viscosity, β-glucan

Oat is recognized as a beneficial dietary component that protects against cardiovascular diseases, diabetes and obesity. Besides lower content of starch, high amount of valuable protein and lipids, oat is rich source of dietary fibre, especially of β-glucan, in human diet. In epidemiological study it has been proved the lowering effect of β-glucan on blood cholesterol level and postprandial glucose response (Braaten et al., 1995; Jenkins et al., 2002; Queenan et al., 2007; Granfeldt et al., 2008). Oat is also used for livestock feeding, but its amount in the feed is often limited, depending on the animal species, due to a high content of hulls and fibre, that have negative effect on nutrient density and digestibility (Aimonen and Nasi, 1991). Taking into account significant variability in chemical composition, it indicates therefore, that the same cultivars might have different usefulness either for food or feed purposes and the content of β-glucan is crucial in this respect. For these reasons, selection of oat breeding materials with either high or low content of β-glucan, depending on their future use, is a necessity nowadays.

In order to attain better utilization of existing cultivars and also to achieve substantial progress in breeding, it is necessary to provide appropriate tool to facilitate selection of the appropriate genotypes for these two major end-uses of oat. Such tool seems to be a viscosity assay, which needs modification and validation adapted for specificity of oat and conditions of their processing and it was the purpose of our study.

Material for the study comprised of two hulled and one naked oat cultivars, grown at the same location in 2013 harvest year. Optimization of the viscosity assay was performed using intact as well as dehulled grains. Extracts were prepared from finely ground whole grain (a screen with 1.5 mm openings) with distilled water and HCl-KCl buffer of pH 1.5, used as a solvent. The following factors were examined: dilution rate of grain to solvent (1:3w/v, 1:5w/v, 1:10w/v, 1:20w/v), extraction temperature (30°C, 35°C, 40°C, 45°C, 50°C, 60°C), centrifugation speed of resultant suspension (1000 rpm, 6000 rpm). These factors were examined at the same time of extraction (1h) and were measured on Brookfield Cone/Plate Digital Viscometer, with a 0.8° cone spindle and shear rate of 225 sec applied at 30°C. We also determined components which might have a significant influence on the viscosity value, by analyzing content of β-glucan, protein, lipids and starch in both types of extracts.

Extraction of grain with water at a dilution of 1: 5w/v and with acid buffer at a dilution 1:20w/v gave the lowest error between replicates, a very wide variation between samples. In these conditions, the resultant extract was also sufficiently watery, and seemed to guarantee a maximum extractability of components responsible for viscosity. The optimum temperature of extraction, that gave the best repeating and a high values of viscosity, was 30^{o}C. Higher temperature, in range 35-45°C and 50-60°C, indicated the involvement of endo-enzymes and starch gelatinization on measured viscosity, respectively. Centrifugation speeds did not have any impact on viscosity of both types of extract. Extract produced from every grain sample of oat was very cloudy, thus differed significantly from extract prepared from the other cereals. The overall

finding demonstrated that β-glucan provided the major contribution to viscosity of either extract, moreover lipids and protein evidently participated at it. The study will be continuing to validate these two assays on a greater number of oat samples. We assume, that at the end of our study we will be able to propose two viable protocols, appropriate for selecting oat genotypes for food or feed uses.

References

Braaten J.T., Wood P.J., Scott F.W., Wolynetz M.S., Lowe M.K., Bradley-White P., Collins M.W. 1994. Oat beta-glucan reduces blood cholesterol concentration in hypercholesterolemic subjects. Eur. J. Clin. Nutr.48: 465-474.

Granfeldt Y., Nyberg L., Björck I. 2008. Muesli with 4g oat ß-glucans lowers glucose and insulin responses after a bread meal in healthy subjects. Eur. J. Clin. Nutr. 62: 600-607.

Jenkins A.L., Jenkins D.J.A., Zdravkovic U., Wursch P., Vuksan V. 2002. Depression of the glycemic index by high levels of b-glucan fiber in two functional foods tested in type 2 diabetes. Eur. J. Clin. Nutr. 56: 622-628.

Queenan K.M., Stewart M.L., Smith K.N., Thomas W.R., Fulcher G., Slavin J.L. 2007 Concentrated oat β-glucan, a fermentable fiber, lowers serum cholesterol in hypercholesterolemic adults in a randomized controlled trial. Nutr. J. 6: 6

**Research was carried out as the task no 32, within the program PBR, financed by the Ministry of Agriculture and Rural Development*