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SHORT COMMUNICATION

WATER SOLUBLE VITAMINS B_1, B_2 AND B_3 IN TRITICALE AND HULL-LESS BARLEY GRAINS

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Abstract

Whole cereal grains contain nutritionally significant quantities of vitamins that are important for health. The aim of this study was to assess the amount of vitamins B group in mature and immature triticale and hull-less barley. All grains were obtained from the experimental farm of Latvia University of Agriculture in immature (use the scale of Zadoks, GS75) and mature conditions (GS93) in 2016. The vitamins were determined by AOAC official methods. The highest content of vitamin B_1 (thiamine) was found in mature triticale (0.52±0.01 mg 100 g^{-1}). The amount of vitamin B_2 (riboflavin) was higher in immature triticale (0.40±0.01 mg 100 g^{-1}) compared with other grains mature or immature conditions. Vitamin B_3 (niacin) amount was higher in immature hull-less barley (7.11±0.01 mg 100 g^{-1}) than other grains mature or immature conditions. According to the results of the study can be seen that the immature grains can be used to enrich foods with water soluble B group vitamins. Immature triticale grains are great source of vitamins B_2 and B_3. The mature triticale and hull-less barley and immature hull-less barley, accordingly has potential for the use in production of functional foods and increasing nutritive value of products.

Keywords: immature and mature grains, thiamine, riboflavin, niacin.

Introduction

Human health is closely related with food used in their diet. It is well known that lack of vitamins causes serious violations, the nervous system, skin diseases, type two diabetes (Liu et al., 2000), also some cancers type and more.

For the harmonious function of the human body, it must be provided with vitamins daily. Consumption of wholegrain cereals in their diet can reduce the risk of disease and contribute to the preservation of health.

Therefore, the interest in cereals as a source of bioactive and functional ingredients has increased (Awika, 2011). Recent evidence suggests that the complex mixture of bioactive components gained of whole grain food may be more healthful than individual isolated components (Lui, 2004). Good potential for research is the whole grain triticale and hull-less barley.

Triticale (× *Triticosecale*) is a type of small grain created by genetically combining wheat (*Triticum*) and rye (*Secale*), which grows well in Latvia. Triticale can be used not only for the production of alcohol and animal feed, but also for the enrichment of food products with vitamins. Triticale grains, flour, and products made from this type of grain for consumers are available through both health food and commercial trading places, but, unfortunately, on a limited choice of range of products (Kalnina et al., 2014).

Hull-less or "naked" barley (*Hordeum vulgare* L. var. *nudum* Hook. f.) is a form of domesticated barley with an easier-to-remove hull. Barley has always been present in the human diet, and recent studies have shown that during the ripening of barley part of vitamins disappear in the mature kernels. In the last years appearing more publications about the possibility of using advantage of immature barley. For example, immature and mature hull-less barley is possible to use in the preparation of yogurt to increase their nutritional value, including B group's vitamins (Zagorska et al., 2015). Increased knowledge of the health-protective potential of the outer grain layers urges to re-think the way of using and processing grains for food, therefore hull-less barley role in the human food chain is growing more and more (Poutanen, 2012).

The aim of this study was to assess the amount of B group vitamins in mature and immature triticale and hull-less barley, growing and prevalent in Latvia.

Materials and Methods

The analyses were performed at the scientific laboratories of the Institute of Biology, University of Latvia, Salaspils.

Materials

Triticale (*Triticosecale)* and hull-less barley (*Hordeum vulgare* L. *var. nudum* Hook. f.) grains from the experimental farm "Peterlauki" (56° 30.658´ North latitude and 23° 41.580´ East longitude) of Latvia University of Agriculture was harvested at immature conditions (milk stage, use the scale of Zadoks, GS75) and mature conditions(GS93) in 2016. In experiments used grain varieties: triticale 'Ruja' and hull-less barley 'Irbe'. All grain samples with initial moisture content of 65% were dried in a microwave-vacuum dryer at 45–50 °C temperatures till moisture content 11.1%. For determination of B group vitamins, approximately 100 g of sample was ground in a laboratory mill Cyclotec 1093 (AB Foss Analytical, Sweden) and immediately used for analysis.

Methods

The vitamins were determined by AOAC official methods: vitamin B_1 (thiamine) – AOAC 986.27, vitamin B_2 (riboflavin) – AOAC 970.65, vitamin B_3 (niacin) – AOAC 975.14.

Statistical analysis

Statistical analysis was performed with statistical program SPSS 23.0 package for Windows 10. Mean value and standard deviation were calculated. ANOVA analysis was applied in order to see if there are

significant differences between the mature and immature wheat kernels ($p<0.05$).

Results and Discussion

Changes in chemical characteristics during ripening of triticale and hull-less barley are reflected in the diagrams below. The content of vitamin B_1 in the immature and mature triticale and hull-less barley samples are shown in Figure 1. The highest content of vitamin B_1 was found in mature triticale (0.52±0.01 mg 100 g^{-1}).

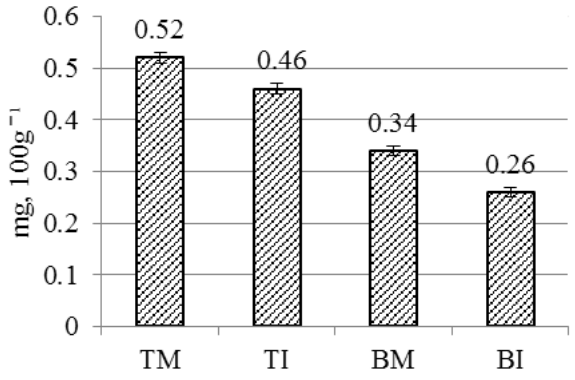

Figure 1. Content of vitamin B_1 (thiamine) in analysed grain samples

TM – triticale, mature grains, TI – triticale, immature grains, BM – hull-less barley, mature grains, BI – hull-less barley, immature grains.

The amount of vitamin B_2 was higher in immature triticale (0.40±0.01 mg 100 g^{-1}) compared with other grains mature or immature conditions in Figure 2. Difference between hull-less barley mature and immature grains is not so pronounced, however, immature grains has a higher vitamin B_2 content (0.25±0.01 mg 100 g^{-1}).

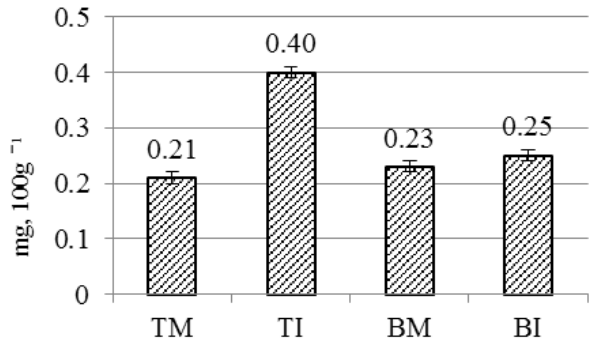

Figure 2. Content of vitamin B_2, (riboflavin) in analysed grain samples

TM – triticale, mature grains, TI – triticale, immature grains, BM – hull-less barley, mature grains, BI – hull-less barley, immature grains.

The results of vitamins B_1 and B_2 in mature triticale 'Ruja' presented by Kalnina et al. (2014) were lower (vitamin B_1 (0.36±0.20 mg 100 g^{-1}) and B_2 (0.10±0.02 mg 100 g^{-1})) than in this study. It could be explained by the annual variation in climatic conditions, also agricultural practices, soil, and technological practices applied. This only confirms that the chemical composition of grain depends on many factors, including the growing place, the weather, and the number of sunny days during harvest, and the storage of samples.

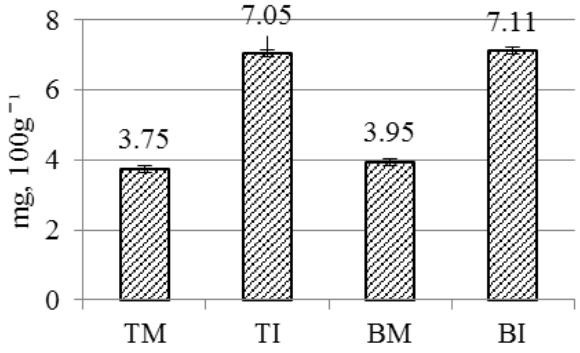

Figure 3. Content of vitamin B_3, (niacin) in analysed grain samples

TM – triticale, mature grains, TI – triticale, immature grains, BM – hull-less barley, mature grains, BI – hull-less barley, immature grains.

Vitamin B_3 (niacin) content was higher in immature hull-less barley (7.11±0.01 mg 100 g^{-1}). The vitamin B_3 content decreased more than by 46% for triticale, for hull-less barley 44%, findings clearly indicated that vitamin B_3 content decreased during the cereal ripening. In the immature grains are significantly higher (on basis of weight of the product) vitamin B_2 (riboflavin) (0.40±0.01 mg 100 g^{-1} in triticale; 0.25±0.01 mg 100 g^{-1} in hull-less barley) and vitamin B_3 (niacin) (7.05±0.01 mg 100 g^{-1} in triticale; 7.11±0.01 mg 100 g^{-1} in hull-less barley) content ($p<0.05$), but amount of vitamin B_1 (thiamine) in triticale and hull-less barley is higher in mature grains (0.52±0.01 mg 100 g^{-1} in triticale; 0.34±0.01 mg 100 g^{-1} in hull-less barley).

Conclusions

The amount of B group vitamins in triticale and hull-less barley is significantly affected by grain development stage at the time of harvest.

In the present research concentrations of B group vitamins (thiamine, riboflavin, and niacin) in immature triticale and hull-less barley compared to mature triticale and hull-less barley were established. The highest vitamin B_1 (thiamine) content is in mature triticale. Immature triticale and hull-less barley grains are good sources of the B group vitamins: B_2 (riboflavin) and B_3 (niacin), therefore could be representing a valuable ingredient for production of functional foods.

Acknowledgment

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References

1. Awika J. M. (2011) Health promoting effects of cereals and cereal products. **In:** *Fruit and Cereals Bio actives. Sources, Chemistry and Applications*. O. Tokusoglu & Cl. Hall. New York: Taylor & Francis Group, p. 9–17.
2. Kalnina S., Rakcejeva T., Gramatina I., Kunkulberga D. (2014) Investigation of total dietary fiber, B_1 and B_2 vitamin content of flour blend for pasta production. **In:** *The 9th Baltic Conference on Food Science and Technology "Food for Consumer Well-Being" FOODBALT 2014 Conference*. Jelgava, LLU, p. 133–137.
3. Liu S., Manson J., Stamfer M., Hu F., Giovannuocci E., Colditz G., et al. (2000) A prospective study of whole-grain intake and risk of type 2 diabetes mellitus in US women. *American Journal of Public health*, Vol. 90 (9), p. 1409–1415.
4. Lui R. (2004) Potential synergy of phytochemical in cancer prevention: Mechanism of action. *Journal of Nutrition*, Vol. 134, p. 3479–3485.
5. Poutanen K. (2012) past and future of cereal grains as food for health. *Trends in Food Science and Technology*, Vol. 25(2), p. 58–62.
6. Zagorska J., Karklina D., Cinkmanis I., Vecstaudza A., Skudra L. (2015) Immature hull-less barley grain application in functional dairy product. **In:** *The 8th International Congress "Flour- Bread `15"; 10th Croatian Congress of Cereal Technologists Brašno-Kruh Conference Proceedings*, Croatia, Osijek, p. 67.