DOI: 10.34101/ACTAAGRAR/1/8671

Comparison of chemical parameters of enzyme active and inactive malt types

Vivien Nagy[1,3] – Endre Máthé[2] – Szintia Jevcsák[1] – Zsolt Fülep[4] – Ádám Fülep[4] – Gerda Diósi[1]

University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management
[1]Institute of Food Technology
[2]Institute of Nutrition
[3]Doctoral School of Nutrition and Food Sciences
[4]Balmaz-Sütöde Kft.
nagy.vivien@agr.unideb.hu

SUMMARY

*Nowadays there is an increasing emphasis on the use of raw materials. Typically, raw materials – in this study malt – are used in animal feeds and used in the brewing industry. However, in terms of quality (eg. high fibre content), these can be included in human nutrition, we have limited information on this possibility. The aim of our work was to compare different malt flours and examine the possibility of using malt in the baking industry. We were to investigate some of the most relevant parameters, such as dietary fibre content, crude protein content, fat content, carbohydrate content, dry matter content, moisture content, salt and energy content. In the future, we aim to conduct a research on some of these parameters with different malt types as the brewing industry uses novel ingredients different cereals, pseudocereals such as amaranth (*Amaranthus spp.*), oat (*Avena sativa *L.), quinoa (*Chenopodium quinoa *Willd.) in addition to the spring barley (*Hordeum vulgare *L.) or wheat (*Triticum aestivum *L.). Based on brewing studies, malt has a high fibre and protein content. Having these advantageous qualities, malt should be part of humans' healthy diet. Using malt flour in the baking industry can be a new direction which can lead to creating a healthier lifestyle and healthier eating habits than suggested by the WHO (World Health Organization).*

Keywords: *malt; enzyme inactive malt; fibre; beer; baking industry*

INTRODUCTION

Today, brewing is in its heyday, and several researches are being carried out on every step of the process, from which malt production can not be left out. It is well known that the brewing industry uses various cereals to produce malts (Ciosek et al., 2019; Blazewicz and Kawa-Rygielska, 2018). As a major source of starch brewing industry use in addition to the usual and mostly used barley (*Hordeum vulgare* L.) and wheat (*Triticum aestivum* L.), furthermore corn (*Zea mays* L.), rice (*Oryza sativa* L.), oat (*Avena sativa* L.), millet (*Panicum miliaceum* L.) and rye (*Secale cereale* L.) are also used. However, the list of cereals that may be used is not exhaustive, it should be mentioned sorghum (*Sorghum bicolor* L.), spelt wheat (*Triticum spelta* L.), quinoa (*Chenopodium quinoa* Willd.), buckwheat (*Fagopyrum esculentum* Moench), millet (*Panicum miliaceum* L.) and amaranth (*Amaranthus spp.*) (Tarko et al., 2018; Trummer, 2018; Baloghné Nyakas, 2013). In order to achieve the right recipe, it is common to use different malt blends, which not only influences the parameters of the final product, the beer but also affects the by-products (brewers' spent grain) (Poreda and Zdaniewicz, 2018). Based on the results of had used brewers' spent grain in 2019, it can be stated that there is a possibility of using a by-product of the brewing (Nagy and Diósi, 2020; Nagy and Diósi, 2019).

Pedrotti (2008) discussed the easy digestibility of barley malt. The author mentioned that in many cases, malt is also used in products for young children, and its boil has a digestive stimulating effect (Pedrotti, 2008). Changing eating habits is extremely difficult both in Hungary and in the world. It can be stated that dietary fibre is a key element of a healthy and balanced diet (Szűcs et al., 2016; WHO, 2003). A diet rich in fibre can prevent the development of certain diseases such as obesity, type 2 diabetes, cardiovascular disease, cancer (Kendall et al., 2010; Szendrei and Csupor, 2006). There are studies on food plants and food by-products which have high antioxidant dietary fibre content eg. cereal grains, coffee bean or grape pomace (Mézes and Erdélyi, 2018; Ragaee et al., 2006; So et al., 2002).

The aim of our work was to compare different malt flours and examine the possibility of using malt in the baking industry. In order to determine its chemical parameters, we examined dietary fibre content, crude protein content, fat content, carbohydrate content, dry matter content, moisture content, salt and energy content. Enrichment with malt flour can have a positive effect on the content parameters of wheat flour bakery products.

MATERIALS AND METHODS

The examinations were carried out in Hungary, at the Institute of Food Technology, Institute of Food Science and Institute of Nutrition of the University of Debrecen. The laboratory tests were carried out in 2020, included determination of dry matter content, moisture content, crude protein content, fat content, carbohydrate content, dietary fibre content, salt and energy content of different malt types. The malt samples for this study can be divided into 4 groups according to the origin. Samples from ZS1 to ZS4 were Hungarian products and samples from ZS5 to ZS7 were imported products, each samples were enzyme active. V1 was from a previous brewing

DOI: 10.34101/ACTAAGRAR/1/8671

scientific work at the University of Debrecen (enzyme inactive), E1 was a sample from a Transylvanian brewery (enzyme inactive) (*Table 1*). The powder malt samples were stored at 15–20 °C in a cool dry place (*Figure 1*). Samples from ZS1 to ZS7 are available on the market.

Table 1. **Table of code of samples**

	ZS1	ZS2	ZS3	ZS4	ZS5	ZS6	ZS7	V1	E1
Code of samples	Hungarian products				Import products			University sample	Transylvanian sample
	Enzyme active							Enzyme inactive	

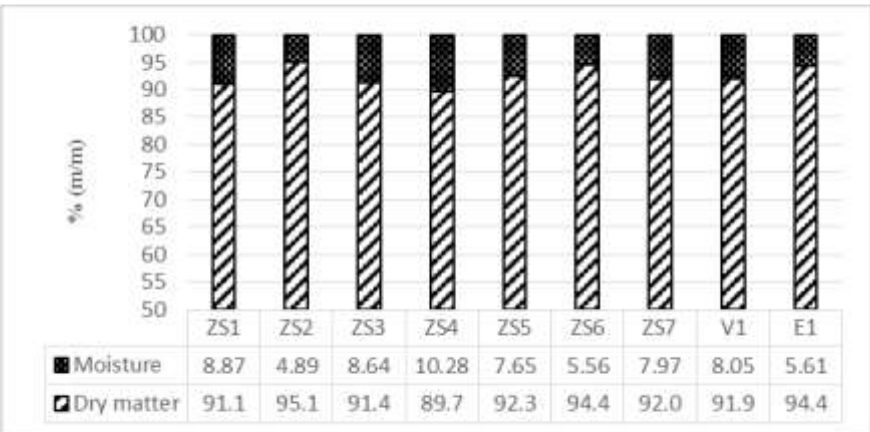
Figure 1. **Different malt samples**

RESULTS AND DISCUSSION

In terms of salt content, it was described by the Hungarian Standard (MSZ 20501-1:2007 3.2.). It can be stated that we measured very low values, each sample had a salt content less than 0.1%.

Dry matter content was determined according to the method described by Hungarian Standard (MSZ 20501-1:2007/2.). In the case of dry matter content, it can be stated that the results are variable, ranging from 89% to 96%. Dark brown malt (ZS2) had the highest dry matter content with a value of 95.1%. Moisture content was a calculated value from the dry matter content. Figure 2 shows that ZS4 had the highest moisture content (10.2%) as this sample contained the lowest dry matter content (*Figure 2*). Comparing the lowest moisture content was achieved by the sample with the highest dry matter content (ZS2).

Figure 2. **Dry matter and moisture content**



Carbohydrate content was determined according to the method described by Lásztity et al. (1987). In terms of sugar content, it was described by Hungarian Standard (MSZ 20501-1:2007/8.1). It is noticed that the values are similar, showing small differences. In terms of carbohydrate content, ZS3 (medium brown) malt had the highest carbohydrate content, which was 75.0% followed by ZS6 (roasted barley) malt with a value of 74.9%. In the case of sugar, we recorded results between 4% and 15% (*Figure 3*).

Crude protein content was determined according to the method described by Hungarian Standard (MSZ 20501-1:2007/7.). Analyzing the crude protein content results, it is clear that E1 malt sample had the highest protein content with 17.2%. For the other malts, values between 7–11% were recorded (*Figure 4*).

DOI: 10.34101/ACTAAGRAR/1/8671

Figure 3. **Carbohydrate and sugar content**

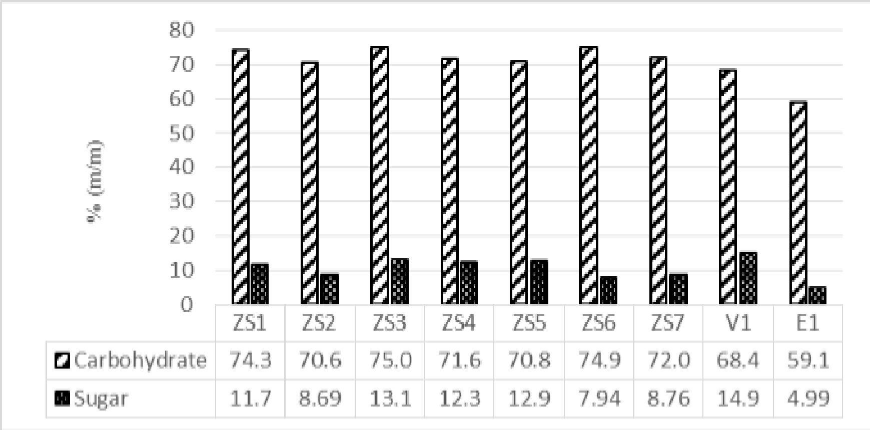
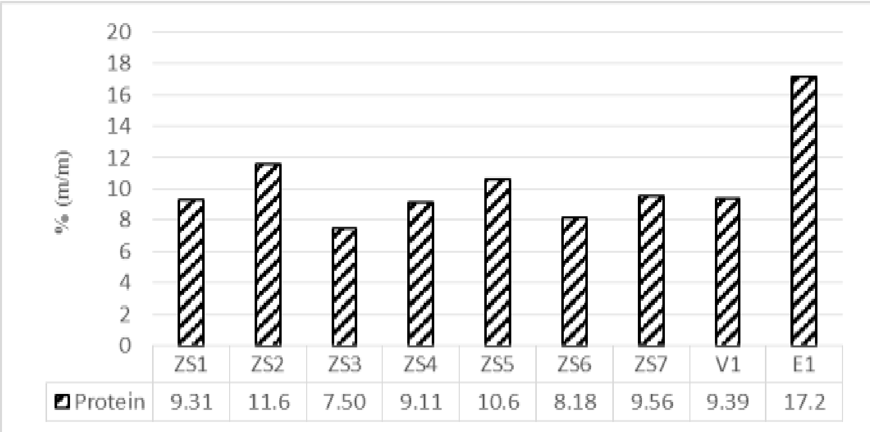
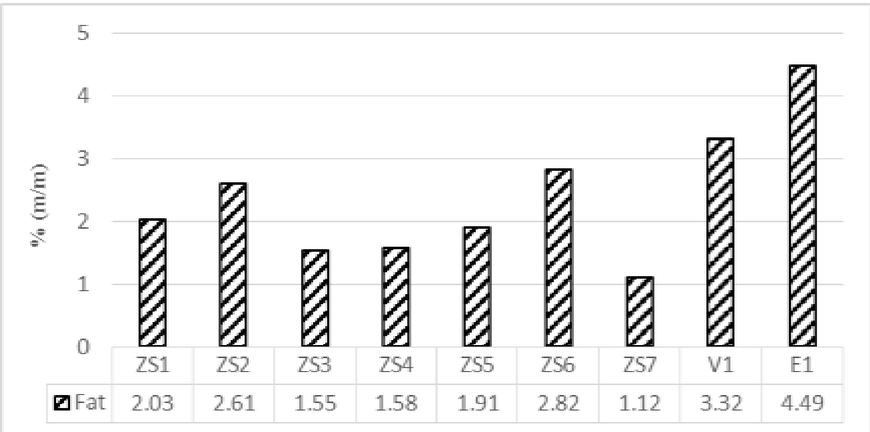


Figure 4. **Crude protein content**



Fat content was determined according to the method described by Hungarian Standard (MSZ 20501-1:2007/4.1.). In terms of fat content, the results range from 1% to 4.5%, with E1 malt sample having the highest fat content at 4.49% (*Figure 5*).

Figure 5. **Fat content**



DOI: 10.34101/ACTAAGRAR/1/8671

Dietary fibre content was determined according to the method described by *Codex Alimentarius Hungaricus* (MÉ 3-2-2008/1.). Based on the results of dietary fibre content, we should also highlight the E1 malt sample, as with a 75.0% dietary fibre content we can observe an exceptionally high result compared to the result of other malt samples (*Figure 6*).

Energy content was calculated by 1169/2011/EU, it can be stated that all malt types exceeded the value of 1500 kJ 100 g^{-1} (358 kcal 100 g^{-1}), the highest energy content of E1 malt sample had with a value of 2063 kJ 100 g^{-1} (493 kcal 100 g^{-1}) (*Figure 7*).

Figure 6. **Dietary fibre content**

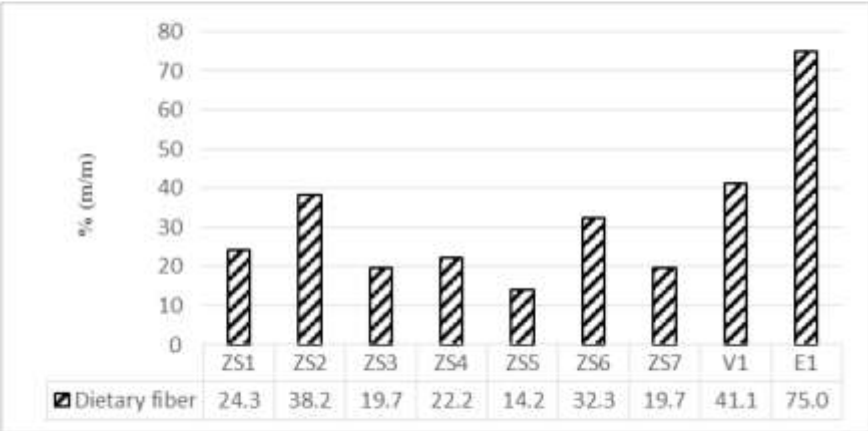
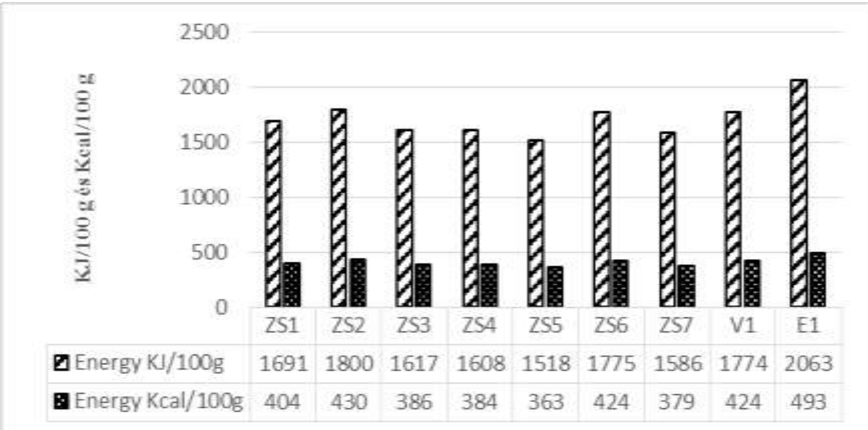


Figure 7. **Energy content**



Product development

One of the samples (LM=V1) was already used for product development. A popular Hungarian snack recipe was chosen and was enriched with the V1 malt sample. Ingredients were the following: wheat flour (BL55), baking powder, salt, egg, butter, sour cream. The snacks were baked at 150 ºC under 45 seconds with an electric waffle-iron. *Figure 8* shows the enriched products where LM means 'light malt' and the numbers shows the content of the V1 malt in the product (V1). Comparing the chemical parameters of the malt and the enriched product, we can determine that the crude protein, the dietary fibre and the fat content which were increased in the enriched product compared to the control sample (*Table 2*). This effect was considered positive by an organoleptic analysis which was performed in 2019 (Nagy and Diósi, 2019).

DOI: 10.34101/ACTAAGRAR/1/8671

Figure 8. **Enriched snacks with light malt (LM=V1)**

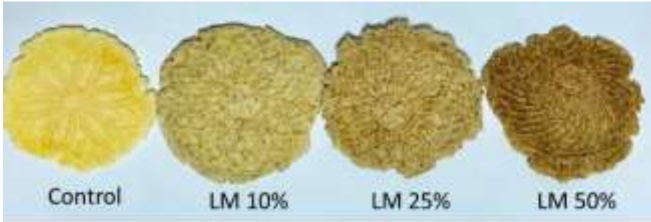


Table 2. **Comparison of malt (V1) and enriched product chemical parameters**

	University malt sample (inactive)	Control snack	Enriched snack		
	V1	**C**	**LM 10%**	**LM 25%**	**LM 50%**
Dry matter (m/m)%	91.9	93.42	93.06	92.15	91.82
Crude protein (m/m)%	9.39	10.5	11.03	11.57	13.04
Total carbohydrates (m/m)%	68.4	57.7	56.68	54.73	49.11
sugar (m/m)%	14.9	0.7	0.98	1.26	2.62
Fat (m/m)%	3.32	19.08	19.55	20.49	23.4
Dietary fibre (m/m)%	41.1	14.78	17.39	19.24	27.87
Salt (m/m)%	< 0.100	2.5	2.28	1.52	1.18
Energy kJ 100 g^{-1}	1774	1984	2014	2039	2145
Energy kcal 100 g^{-1}	424	474	481	487	512

CONCLUSIONS

Based on the results of our experiments, it can be stated that the hypothesis established for our research has been confirmed: according to the valuable content parameters of the different malt types, its can be used in baking products. Enrichment with malt flour can have a positive effect on the content parameters of wheat flour snacks and bakery products (eg. high fibre content, low carbohydrate content). For this, their future use is recommended in bakery industry. In addition the use of other fortifying agents, which have a positive influence on the enrichment of the raw material is recommended, therefore it is beneficial for the consumer (especially elderly people). A diet rich in fibre can prevent the development of certain diseases, combined with proper exercise.

ACKNOWLEDGEMENTS

Thank you for the cooperating work Balmaz-Sütöde Kft. and 2018-2.1.3-EUREKA-2018-00004 project: Innovative composite and fortified flours to improve the nutritional quality of bakery products.

REFERENCES

Baloghné Nyakas, A. (2013): Mezőgazdasági növénytan alapjai. Debreceni Egyetemi Kiadó, Debrecen, Hungary, p. 223.

Blazewicz, J.–Kawa-Rygielska, J. (2018): Dried sprouts as a raw material in brewing. In: Advances in brewing and malting technology. (Edited by Poreda, A.–Zdaniewicz, M.) Uniwersytet Rolniczy im. Hugona Kollataja w Krakowie, Kraków, Poland, pp. 101–111.

Ciosek, A.–Nagy, V.–Szczepanik, O.–Fulara, K.–Poreda, A. (2019): Wpływ nachmielenia brzeczki na bakterie kwasu mlekowego (The Effect of Wort Hopping on Lactic Acid Bacteria). Przemysl Fermentacyjny i Owocowo-Warzywny (Fermentation- and Fruit- & Vegetable Processing Industry), Numer 12/2019, pp. 4–8. DOI:http://dx.doi.org/10.15199/64.2019.12.1

Codex Alimentarius Hungaricus 3-2-2008/1. sz. irányelv 1. sz. melléklet – Dietary fibre (m/m) %, enzymatic hydrolysis

Hungarian Standard 20501-1:2007 2. fejezet – Dry matter content (m/m) %, weight measurement

Hungarian Standard 20501-1:2007 3.2. szakasz – Salt content (m/m) %, titration according to Mohr

Hungarian Standard 20501-1:2007 4. 1. szakasz – Fat content (m/m) %, extraction, weight measurement

Hungarian Standard 20501-1:2007 7. fejezet – Protein content (m/m) %, Kjeldahl method

Hungarian Standard 20501-1:2007 8.1 szakasz – Sugar content from carbohydrate (m/m) %, titration according to Bertrand

Kendall, C.W.–Esfahani, A.–Jenkins, D.J. (2010): The link between dietary fibre and human health. Food Hydrocoll., 2010, 24 (1), pp. 42–48. https://doi.org/10.1016/j.foodhyd.2009.08.002

Lásztity, R.–Törley, D. (1987): Az élelmiszer analitika elméleti alapjai I. 3.7.2.3. fejezet – Szénhidrát (m/m) %, fenolkénsavas módszer, Budapest, Hungary

Mézes, M.–Erdélyi, M. (2018): Az élelmiszerek rosttartalmának antioxidáns hatása. Orvosi Hetilap, 159. évf. 18. sz. pp. 709–712.

Nagy, V.–Diósi, G. (2019): Sörgyártás alapanyagainak és melléktermékének hasznosítási lehetőségei a sütőiparban. In:

DOI: 10.34101/ACTAAGRAR/1/8671

Harmadik SÁNTHA-FÜZET. A 2018/2019-es tanév Tudományos Kerekasztal előadásainak absztraktkötete. (Szerk. Tóth P.) Debreceni Egyetem, Debrecen, Hungary, pp. 123–124.

Nagy, V.–Diósi, G. (2020): A sörtörköly, mint sörgyártási melléktermék hasznosítási lehetőségei a sütőiparban. Master Thesis, University of Debrecen, Debrecen, Hungary, 2020. 04. 27. Debreceni Egyetem elektronikus Archívum: https://dea.lib.unideb.hu/dea/handle/2437/285146 (Accessed 20 November 2020)

Pedrotti, W. (2008): Gabonafélék: Legfőbb energiaforrásaink. Kossuth Kiadó, Budapest, Hungary, p. 125.

Poreda, A.–Zdaniewicz, M. (2018): Advances in brewing and malting technology. Uniwersytet Rolniczy im. Hugona Kollataja w Krakowie, Kraków. Poland, p. 453.

Ragaee, S.–Abdel-Aal, E.M.–Noaman, M. (2006): Antioxidant activity and nutrient composition of selected cereals for food use. Food Chemistry. 2006; 98/1. pp. 32–38.

Regulation (EU) No 1169/2011 of the European Parliament and of the Council: provision of food information to consumers.

So, Y.B.–Woong, B.J.–Dong, S.K.–Hwa, Y.H.–Young, W.S. (2002): Antioxidant activity and total phenolic compounds in grain extracts of wheat, barley, and oat. Korean Journal of Crop Science. 2002; 47/2. pp. 102–107.

Szendrei, K.–Csupor, D. (2006): Egészségünk megőrzésére fogyasszunk több rostgazdag növényi élelmiszert! De mi az „élelmi rost” és mik a bizonyított előnyei? Családorvosi Fórum, 2006/5, pp. 74–77.

Szűcs, V.–Harangozó, J.–Guiné, R.F. (2016): Consumer knowledge about dietary fibre – Results of a national questionnaire survey. (Az élelmi rostokkal kapcsolatos fogyasztói ismeret – Hazai kérdőíves felmérés eredményei.) Orvosi Hetilap, 157. évf. 8. sz. pp. 302–309.

Tarko, T.–Jankowska, P.–Duda-Chodak, A.–Kostrz, M. (2018): Value of some selected cereals and pseudocereals for beer production. In: Advances in brewing and malting technology. (Edited by Poreda, A.–Zdaniewicz, M.) Uniwersytet Rolniczy im. Hugona Kollataja w Krakowie, Kraków, Poland, pp. 303–319.

Trummer, J. (2018): Grains usable for malting and brewing: A practical overview. In: Advances in brewing and malting technology. (Edited by Poreda, A.–Zdaniewicz, M.) Uniwersytet Rolniczy im. Hugona Kollataja w Krakowie, Kraków, Poland, pp. 6–-87.

WHO (2003): Diet, nutrition and the prevention of chronic disease. Report of a Joint WHO / FAO Expert Consultation. WHO Technical Report Series 916. Geneva, 2003.