Research Paper Home Science

The effect of addition of malt flour on the dough, volume and sensory properties of bread

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ABSTRACT

A use of barley malt as improving agent has been known for a long time. Improvers of natural and biological origin are generally preferred over that of chemical substances. Addition of malt or legumes flour has a positive impact on processing technology, nutritional and sensory properties of bread. The aim of this study was to determine the effect of the addition of natural malted barley flour (commercial designation of non-roasted diasta) and roasted malt flour on the specific volume and other quality characters of wheat bread. Commercially obtained diasta was roasted at 85, 100 and 130°C for purpose of this work. A dose of diasta to bread was 0.5; 1; 1.5%. Bread specific volume as well as its sensory quality was improved using roasted diasta. The best assessed bread was supplemented with 1% diasta roasted at 100°C.

KEYWORDS bread properties; dough properties; malt flour; sensory quality

Introduction

Due to the increasing requirements on a wide range and high quality of bakery products it is necessary to look for their improvement. There are many possibilities how to make some modifications: by the addition of other flours, by addition of improvers, changing technology, the acceleration of the whole production process, etc. If some improvers are added to the product, materials of natural origin are preferred. For example malt and legumes flour are included among such improvers. Their addition has a positive effect on technological, nutritional and sensory properties of bread.

Except of sensory characters, loaf volume plays an important role for producers and also for consumers. Bread volume is primarily affected by components of flour and other ingredients which are used for the production of bakery products. Quality and percentage of protein, starch, activity of enzymes and dietary fiber content and its composition as a part of non-starch polysaccharides play important role in flour. Biological and chemical leavening agents, emulsifiers and water hardness can be significant too. Flours from other cereal than wheat (including barley malt) and non-cereal sources (legumes, pseudo cereals) have minor effects.

In the past barley malt was added in a small amount (often less than 1%) to bakery products as a source of enzymes, leading to faster starch hydrolysis and better leavening of dough without influence on crumb flavor or color. As a result of starch hydrolysis a sufficient amount of fermentable sugars (mainly maltose and in small amount also low molecular weight dextrins) is obtained that can be further metabolized by yeast. Besides faster fermentation the addition of malt decreases proofing time, improves machinability and extensibility, enhances browning of crust, and there are little or no flavor contributions.

In case of low α-amylase activity in flour the malt addition leads to higher amylase activity and proper dough development. Bread with α-amylase addition has higher volume, better crumb texture and coloration of the crust (Begić *et al*. 2014). Lower dose of yeast can also be compensated by addition of malt flour.

Malt flour (0.1-0.25%) was added to the strong wheat flour. The added malt flour made moderate proteolytic activity in the dough, which assisted in gluten development and dough conditioning. It also led to improving bread texture and crust color and to prolongation bread shelf life (Nechita *et al*. 2009). The same results as in the work Nechita *et al*. (2009) showed research from Stamenova and Vangelov (1984), namely prolonging bread shelf life with addition of malt flour. In bakery products, diastatic malts (containing active enzymes) are used as dough conditioners at very low levels (1–3 %), imparting a unique flavor and crumb color (Arendt & Zannini, 2013).

In Europe relatively high sprouting damage of cereals has occurred. In these cereals, especially wheat, the major detrimental factor is a high α-amylase activity. Zawistowska *et al.* (1988) tried to add an inhibitor to wheat flour with high α-amylase activity. The high α-amylase activity of wheat flour was prepared with addition of malted barley flour.

Khalil *et al.* (2000) found, that addition of malt flour to the

mixture of wheat-cassava flour did not affect water absorption and kneading time, but it increased activity of α-amylase. The dough stability, strength of flour and dough weakening of composite flour were improved by the addition of 1% malt. Loaves volumes obtained from composite flours at 20 and 30% cassava flour and 1% malt were not significantly different to that of control bread from wheat flour.

Veluppillai *et al.* (2010) studied the addition of various sprouted (malted) rice flour in different amount to wheat flour. Their results showed that the addition of malt after 3 days malting is most suitable. Bread with higher addition of rice malt flour showed lower specific volume and protein content than the control. In contrast, the content of all parts of dietary fiber TDF (total dietary fiber), SDF (soluble dietary fiber) and IDF (insoluble dietary fiber) as well as free amino acids and α-amylase content were increased. Higher α-amylase activity caused only mild increase of bread volume in a small addition of rice flour.

Analytical studies of malt show, that the content of compounds with a strong antioxidant effect is significantly increased (Příhoda *et al.* 2010).

Materials and Methods

Sample of barley diasta was obtained from Zeelandia Ltd., Malšice at Tábor, the Czech Republic. Malt flour is cream-colored powder resembling flour. Diasta is obtained from barley that is sprouted, dried at maximum 50°C and separated from the germ. This malt has a high enzymatic activity. Generally, malt flour can be prepared from other (less traditional) cereals even such as sorghum. The quality of malt flour is dependent on the possibility of growing cereals in the climatic conditions of the country and local customs.

Roasting diasta

Four samples of about 100g were processed. One sample was left untreated; other samples were roasted on a laboratory pan under constant mixing. Roasting temperatures were set to 85, 100 and 130°C, while the temperature inside of diasta cake was detected by means of contactless thermometer.

Dough preparation

Dough was kneaded in farinograph-mixing bowl under standard conditions (weight of flour 300g, temperature of water and mixing bowl 30°C).

Dough was prepared direct way by basic recipe Institute of Carbohydrates and Cereals for ordinary wheat bread.

Wheat flour	100%
Salt	1.5%
Oil	3%
Yeast	3%
Diasta	0.0; 0.5; 1.0; 1.5%
Water	addition to the final consistency 500 FU

As control sample standard wheat flour (T530) from the mill Perner Svijany was used. Used flour was the usual Czech commercial quality predetermined for a standard use in bakeries (Příhoda *et al.* 2010).

Processing of dough

Mixing time of dough in farinograph mixing bowl was 5 minutes. Dough was then put into box with covered top and left 15min to mature. Matured dough was divided into dough pieces 60 ± 0.1g, which were than manually rolled. From one batch of dough 7 loaves were shaped. Loaves were placed on a baking tray and were placed for 35min in the proofing box. Meanwhile, the oven was preheated at 245 ± 3°C and approx. 15 minutes before the first baking it was steamed. Simultaneously with every insertion of tray, oven space was steamed approximately 50 ml of distilled water. Loaves surface after proofing was wetted using water from spray bottle and put in preheated oven. Decreasing temperature profile, which is used in bakeries for common wheat bread, was used.

Baking time was approximately 19 minutes with continuously decreasing temperature approximately down to 210°C at the end of baking. After removing from oven loaves were again wetted with water from spray bottle. The loaves volume, diameter and height and its weight were measured two hours after removal bread from the oven and sensory evaluation was done.

Volume measurement

The volume was measured differentially for every of six baked loaves using rapeseed. From the volume measured and weight determined for every loaf, the specific volume, which is defined per 100g of bread, was calculated. The average of the six results was considered as a definitive specific volume for each of diasta doses.

Furthermore, diameter and height of bread were measured and the average index number was calculated. Sensory evaluation included assessing of shape, crust (color, shiny, hardness, parceling), crumb (elasticity, porosity, adhesion, feeling during chewing), flavor and aroma.

Three points scale was used for sensory evaluation of bread, where 3 points means very good and 1 point unsuitable (Honců 2009).

Analysis

Wet gluten was determined using ICC Standard 106/2 and for determination of rheological characters farinograph ICC Standard 114/1 was used. Correlation between bread volume, diasta addition and roasting temperature was carried out using Microsoft Excel software.

Results and Discussion

Farinographic characters and wet gluten content of wheat flour are given in Table 1.

Tab. 1 Selected characters of wheat flour

Type	Wet gluten content (% in dm.)	***Farinographic values***				
		Absorption (%)	Peak time (min)	MTI (FJ)	Stability (min)	Quality number (min)
T 530	29	57	3.5	35	10	14

Basic data describing breads quality are shown in Table 2. They indicate, that not only bread volume, but also its shape are influenced by roasting temperature and the percentage of added diasta.

Tab. 2 Basic characteristics of baked samples

	Control sample	**Raw malt**	**Roasted at temperature (°C)**						
			85	**85**	**85**	**100**	**100**	**100**	**130**
Malt content (%)	0.0	0.5	0.5	1.0	1.5	0.5	1.0	1.5	0.5
Water absorption (%)	52.5	53	53	52.5	52.5	53	53	52.5	52.8
Specific volume (cm^3/100g)	***316***	***328***	***331***	***359***	***358***	***347***	***364***	***364***	***332***
Dough weight (g)	471	472	475.4	479.5	477.4	473	474	477.4	476.2
Bread weight (g)	379.2	389	388.2	387.6	382.4	381	382.2	391.8	389.9
Loaf diameter (cm)	7.3	7.4	7.7	7.8	7.4	7.6	7.5	7.6	7.4
High (cm)	5.4	5.4	5.4	5.2	5.2	5.2	5.0	5.1	5.3

Addition of 0.5% malt flour, both unroasted and roasted, resulted in significantly higher specific volumes than the control sample without diasta. These results are in agreement with Mäkinen and Arendt 2012; Ceglinska and Haber 1997. In their work bread volume after malt flour addition without roasting was also increased. The best volume was achieved with addition of 1% diasta roasted at 100°C. Volumes of breads with added of 0.5% diasta roasted at 85 and 130°C were very similar. Consequently, the higher addition of diasta roasted at 130°C was no more monitored. With addition 0.5% of diasta roasted at 100°C bread achieved better results than with 85°C. On the other hand, differences between samples with higher additions of 1.0 and 1.5% diasta were not significant.

Using Microsoft Excel software was obtained slightly positive correlation effect roasting temperature on bread volume (0.44) at diasta dose 0.5%. By roasting temperature 85 and 100°C bread volume significantly correlated with dose of diasta. Correlation factors were 0.91 for roasting temperature 85 °C and 0.94 for roasting temperature 100°C respectively.

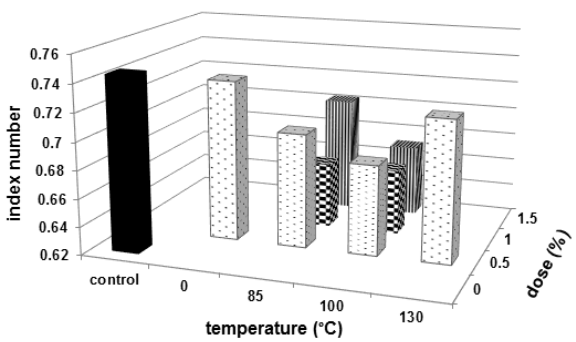
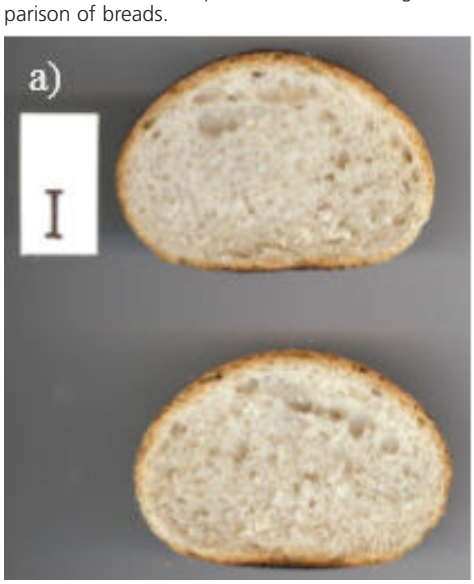
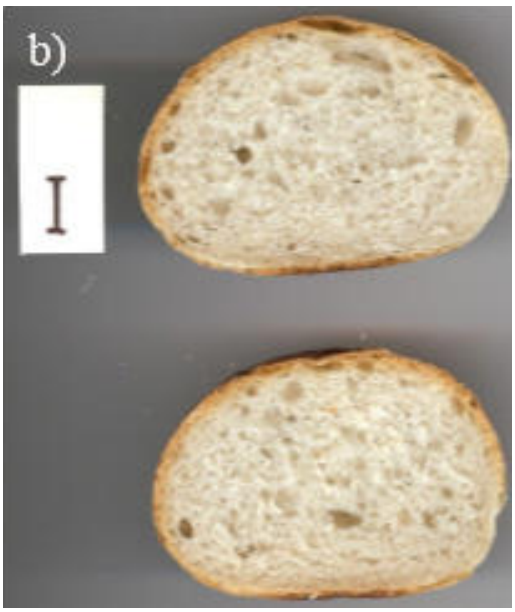
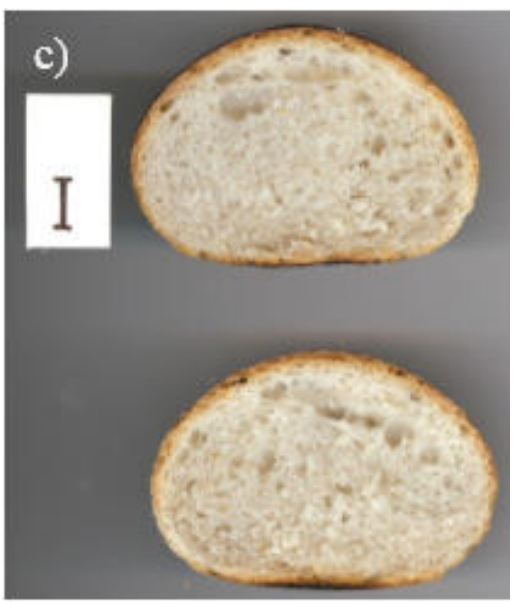


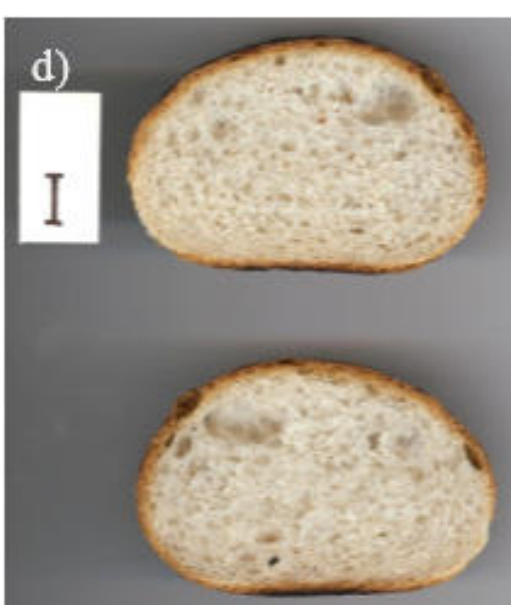
Fig. 1 Bread index numbers with roasted diasta

Influence of diasta samples on the bread shape was compared by means of index number calculated as a ratio of height to the diameter of loaf (Fig. 1). As is seen from table 2 bread height slightly decreased with addition of diasta about 2-4 mm and on the contrary diameter of bread was increased approx. on 0-5mm. From decreased index numbers and increased bread volume with addition of diasta we can suppose slightly softer (looser) dough. This was also confirmed during dough processing. Especially doughs with the addition of 1 and 1.5% diasta were stickier, which was reflected in the stickiness of the final product crumb. On Fig. 2 is shown comparison of breads.









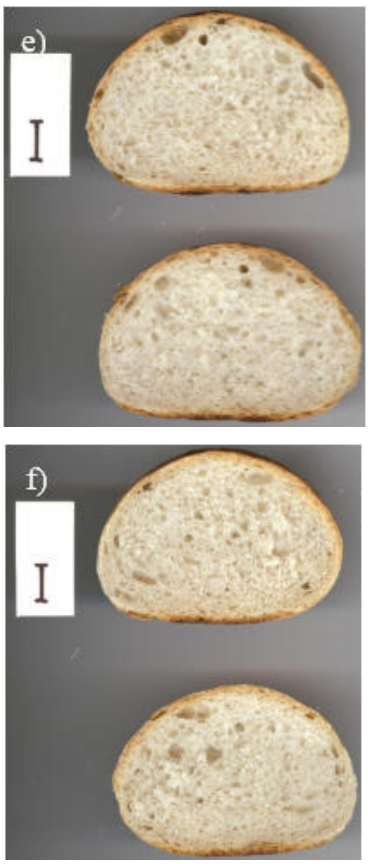


Fig. 2 The comparison of bread samples: a) control; b) 0,5% unroasted diasta; c) 0,5% diasta roasted at 85°C; d) 0,5% diasta roasted at 100°C; e) 0,5% diasta roasted at 130°C; f) 1% diasta roasted at 100°C

Sensory evaluation did not show significant differences in the bread shape. All breads had properly arched shape on the top with a well-defined crust allotment. Only the samples with unroasted diasta and one sample with diasta roasted at 85°C had not the allotment on the part of surface. Crust color varied from light to dark. That was mainly due to an inhomogeneous temperature profile in the laboratory oven. Crust hardness was appropriate and by pushing always crunchy.

Crumb elasticity was lower in the samples with addition of 0.5% diasta roasted at 85 and 100°C. For the other samples elasticity was good. All samples were easy to bite and chew. But samples with addition of 1.0 and 1.5% diasta were stickier while chewing.

The diasta addition in any quantity affected the smell and taste of the product. Samples with lower diasta addition had a sugary, stronger bread to grain taste. On the other hand, samples with diasta roasted at 130°C had a slightly bitter taste. In samples with higher diasta addition greyish crumb color was observed.

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