TECHNOLOGICAL EFFECTS OF SOME XYLANOLYTIC PREPARATION ON WHITE FLOUR

— research paper —

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Abstract: arabinoxylans (AX) play an important role in breadmaking and the use of xylanases to convert water unextractable arabinoxylans (WUAX) in water extractable arabinoxylans (WEAX) are an usual practice. The xylanases could increase or reduce the viscosity of extract prepared from flour and could Solubilise a larger or smaller quantity of AX, depending on their sources. A strong positive correlation is established between the viscosity of flour extracts and breads volume. When the viscosity decreases the breads specific volume was are low. Positive correlation were established between the H / D ratio and crumb porosity (R^2 0.8929 and respectively 1) on a hand and the increases of AX content in flour extracts. When the AX content in flour extracts is high the crumb porosity is better.

KEYWORDS: bread, arabinoxylans, xylanases, viscosity, flour extracts

INTRODUCTION

Arabinoxylans from wheat flours represent only a small quantitative part but they play an important role in breadmaking (Courtin and Delcour, 2002) (Autio, 2006). Arabinoxylans are classified according with their solubility/extractability in water as water soluble or extractable (WSAX/WEAX) and water insoluble or unextractable (WIAX/WUAX). In wheat flour total AX represent about 1.5 to 2.5%, WUAX 0.4 to 0.8% while WUAX 1.1 to 1.9% (Courtin and Delcour, 2002). AX, as many other fibers, could bind a large quantity of water. According to different researcher one part of AX could bind 6.5 to 15 part of water (Bushuk, 1966) (Autio, 2006) (Maeda and Morita, 2003). Because their affinity to water AX compete with

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gluten protein for water and retard the dough development. This property is common to WEAX and WUAX but in many other ways they influence the breadmaking process different (Graybosch et all, 1993) (Labat et all, 2002) (Dervilly-Pinel, 2001) (Izydorczyk, 1991). WEAX have positive effects in breadmaking, especialy because they increase the viscosity of aqueous solutions (Gan et all, 1995). According to Gan et all (1995) the viscous pentosans solutions seals the gas cell from dough and increase the gas retention in dough especially during the first part of baking. Their positive effects in breadmaking have been explained through oxidative gelation. AX contain ferulic acid (Sarker, 1998) (Cauvain, 2003) (Wang, 2002 and 2003). WUAX have negative effects in breadmaking because they stimulate the gas cell coalescence (Courtin, 1999). WUAX are part of discrete fragments of cell walls ant these fragments interfere with gluten film and reduce their stability (Goesaert et all, 2005) (Tuncer, 2000). AX reduce the staling of bread crumb, WEAX having a greater capability to reduce the bread staling (Devesa and Nartinez-Anaya, 2003) (Gudmunson et all, 1991) (Biliaderis, 1995).

WEAX have positive effects in breadmaking while WUAX have negative effects or smaller positive effects than WUAX. The conversion of WUAX in WEAX it is possible through enzyme hydrolysis (Courtin and Delcour, 2002) (Goesaert et all 2006). The positive effect of xylanases was accidentally observed in fungal amylolytic preparation with xylanase side activity. On arabinoxylans act different hydrolytic enzymes but only endo (1→4)-β-xylanase had technological application in breadmaking now (Grootaert at all, 2007). Xylanses have different specificity for WSAX and WIAX and just xylanase with specificity for WAX have positive effect in beadmaking while xylanases with specificity for WSAX have application in biscuits and wafers manufacturing.

The aim of this study is to investigate the technological potential of some commercial emzymatic preparation and correlations between the bread characteristics and the capacity of xylanases to modify the viscosity of flour slurry or to solubilise the WUAX.

MATERIALS AND METHODS

Materials

Three commercial enzymatic preparation of xylanase was used for this study, Depol 333P, from Biocatalysts Ltd, UK, Veron 393 provided by AB Enzymes GmbH and Xila L from Belpan with 265.8 IRV/g (Inverse

Reciprocal Viscosity), 3.7 IRV/g and respectively 13.8 IRV/g endo-xylanase at a pH 5.5.
For experiments have been used two white flours, F1 and F2, with 0.64% and respectively 0.65 ash content, 13.5% and 13.8% moisture, 29.5% and respectively 29% gluten content. The total AX content was 2.3 and 2.51% for F1 and respectively F2 and the soluble AX content 0.52 and 0.54%. The flour, unsupplemented, was purchased from a local mill (Cibin Mill, from Sibiu).

Methods
The xylanase activity was determined by viscometric method proposed by Megazyme with soluble wheat xylan as substrate, at pH 5.5.
The measure the liquefying capacity of xylanases 5 g of flour was vigorously mixed with 25 ml of water and an amount of xylanase to reach 25 IRV/100 kg of flour. The mix was kept at 30ºC with constant stirring in a water bath and after that was centrifuged for 10 minutes at 1000 x g. The viscosity of supernatant was determined with a Ubbelohde type glass viscometer. To measure the capacity to solubilize WUAX was determined the amount of AX from supernatant by orcinol method described by Hashimoto et all (Hashimoto et all, 1987) and modified by Delcour et all (Courtin and Delcour, 1998). Previously 1 ml of extract was diluted with 14 ml of water and 1 ml of this dilution was analyzed. The results were compared with the control probe, prepared in the same way but without xylanase.
The baking of heart bread sample were prepared according to AACC method 10-09.The mixing was made with the Farinograph until the consistency of dough decrease with 10 U.F. No sugar, oxidants, malts or yeast food. Fungal α-amylase was added (0.2g of Clarase to 300g of flour).
The xylanase preparations have been added to reach 12.5, 25, 50, 100 and 200 IRV/100 kg of flour, to reach the dosage recommended by producer for each preparation.
The specific volume of bread was measured by rape seed displacement. The elasticity of bread crumb was measured by height recovery of a crumb cylinder after his compression at half of height for 1 minute followed by 1 minute to recovery. The porosity of crumb was measured by differences between the volume of a bread crumb cylinder and the volume compressed crumb cylinder measured by oil displacement with a graduated cylinder. The H/D ratio was determined also (height / diameter).

RESULTS AND DISCUSSIONS

In figure 1 the characteristics of bread obtained with different xylanases added, at different xylanases activity, are showed.

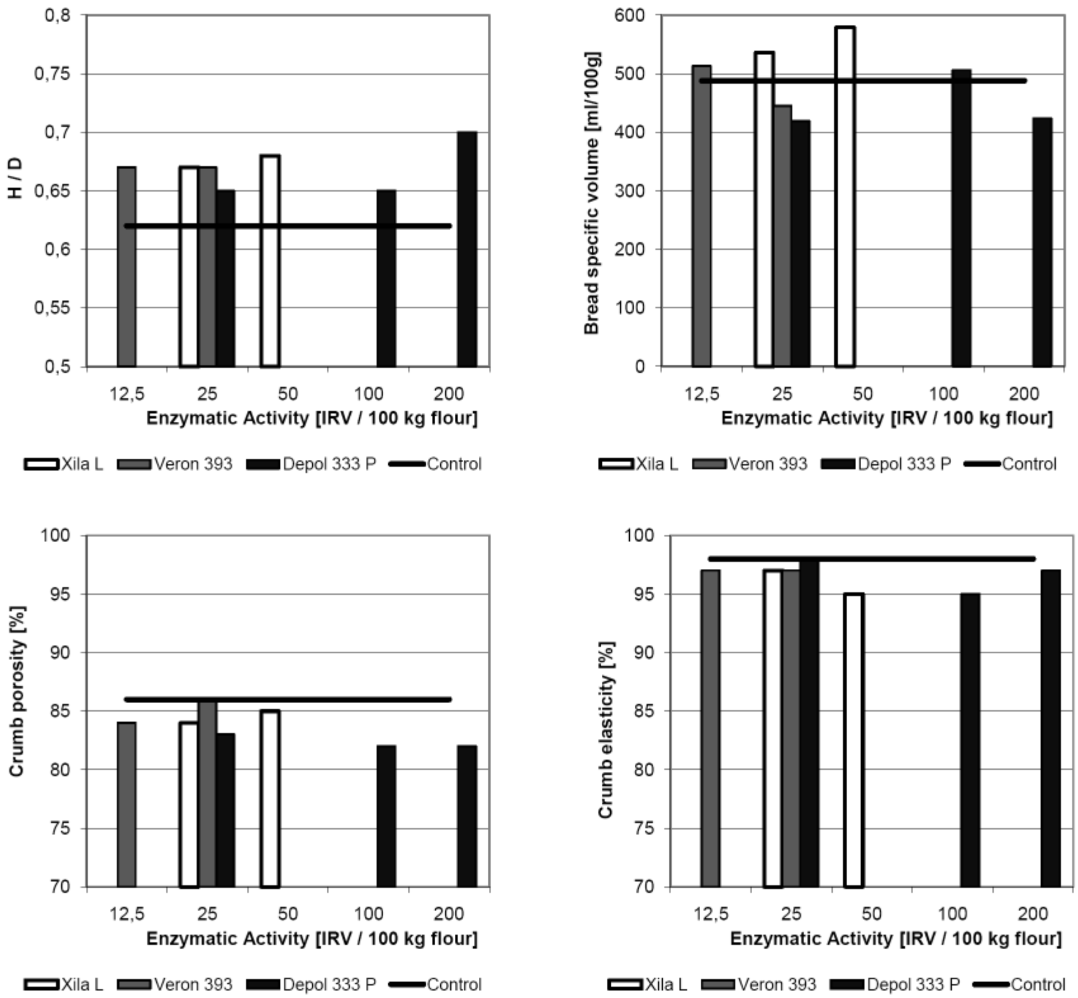

Figure 1. The characteristics of bread prepared with several enzymatic preparation with xylanolytic activity

The xylanases activity have been selected for each preparation individual to cover the range of dosage indicated by producer and a value equal to 25 IRV / 100 kg of flour, a common value for all preparation. The ratio H / D was improved for all preparations, at all dosages but the specific volume of bread was improved only at around the dosages indicated by producer. At over or under dosages the specific volume was lower than the specific volume of control samples. The Xila L preparation had the higher improvement effects at all dosage.

Despite the specific volume was generally improved the crumb porosity was lower than control. The lower value of crumb porosity is associated with the hole under the upper crust. In general the pores of samples with xylanases were larger and more uniform in section than for control.

The crumb elasticity of samples with xylanases added was slightly lower than for control but in limit imposes by Romanian standards. The method are imprecise and subjected to different errors. At a sensorial evaluation the crumb of samples with xylanases was softer than control and the softness increases with dosage. The preparation Depol 333 P at 200 IRV/100 kg of flour led to a crumb not so soft as preparation Xila L at 50 IRV / 100 kg of flour.

The variances of bread characteristics were compared with the effects of xylanolytic preparation on flour extract. The activity of preparations toward WEAX and WUAX was measured by theirs capability to modify the viscosity of flour extracts. The viscosity of slurry increases or decreases, for the same xylanolytic activity (25 IRV/100 kg of flour), according to preparation used. Also the capability to convert WUAX in WEAX was measured as the increases of AX content in flour extract.

A better correlation was observed between the variance of flour extracts viscosity and the variance of bread characteristics. The correlations curves are presented in figure 2.

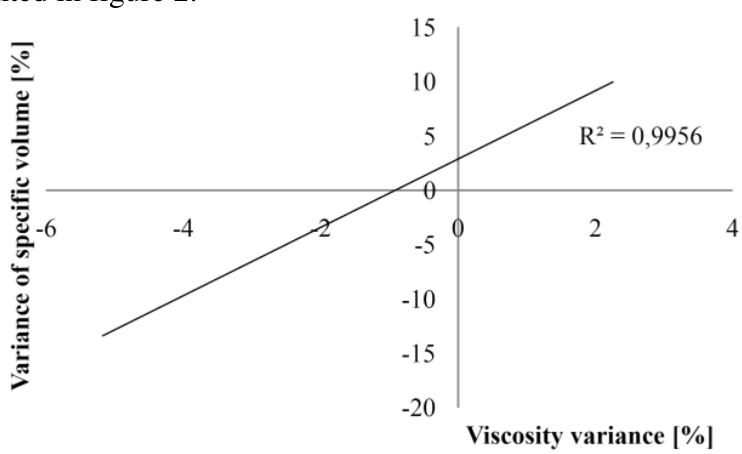

Figure 2. The variance of bread specific volume with viscosity of bread extracts

A batter correlation was observed between the variance of AX content in flour extract and bread characteristics (see figure 3). A weak correlation was observed with the elasticity of crumb (R^2=0.5714) but strongest correlation were observed with H / D ratio and bread porosity. The elasticity of breads crumb slightly decrease when the AX content in wheat extract increases, when a larger quantity of AX was solubilised. When the quantity of AX solubilised increases also increase the H / D raport and crumb porosity.

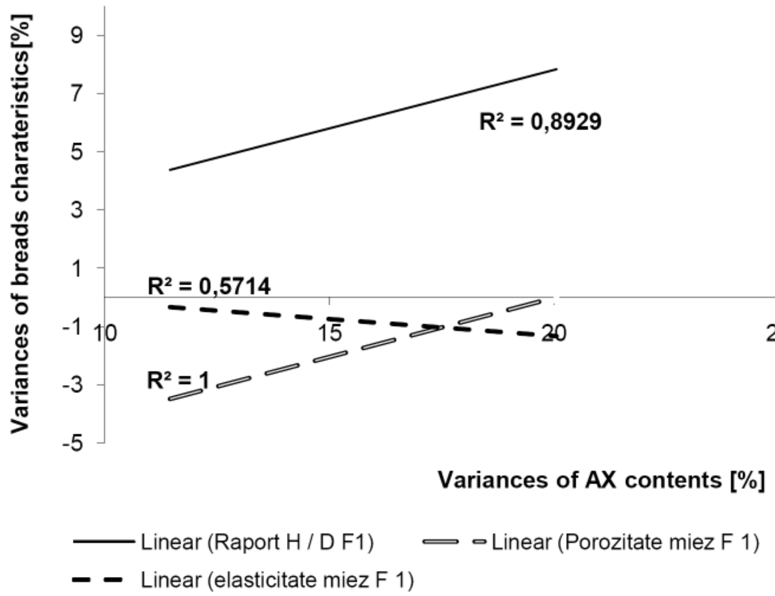

Figure 3. The correlations between the bread characteristics and AX content from flour extract

CONCLUSIONS

We can say the solubilisation of WUAX lead to breads with higher volume. When the enzymatic prepataions lead to extracts with low viscosity the volumeof breads was smaller. We can say that in breadmaking we need xylanases which can extract AX to increase the viscosity of aqueous phase from dough. The bread characteristics are improved if we can solubilise a greater quantity of AX.

ACKNOWLEDGMENTS

This work was cofinanced from the European Social Fund through Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/89/1.5/S/63258 ”Postdoctoral school for zootechnical

biodiversity and food biotechnology based on the eco-economy and the bio-economy required by eco-san-genesys"

This paper was presented at the Jubilee International Conference "Agricultural and Food Sciences, Processes and Technologies" 9 – 12 December, 2010, Sibiu, Romania

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