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NITROGEN FRACTIONS CONTENT IN CEREAL EXTRACTS BY DIFFERENT CONDITIONS OF THERMAL DIGESTION

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ABSTRACT
In this study was examined composition and content of nitrogen fractions in extracts of different grains mixtures, in different conditions of thermal digestion of extracts. Reaction mixtures were prepared out of barley malt and of certain portion (by 30%) of adjuncts: raw barley, corn grits and rice. The control sample was 100% barley malt. Lower concentrations of α-amino nitrogen (FAN) in the extracts prepared of grains replacement are the result of the: lower content of proteins in these grains, unfavorable pH-values for decomposition of particular proteins, but because of the weaker enzyme effects of barley malt peptidases, as well. Studying the concentration of nitrogen fractions in extracts treated in different conditions of thermal digestion, it is noted that concentrations of these decomposable products are lower in fermentable extracts treated by overpressure thermal digestion, in relation to the termal digestion by STP.
We suggest decreasing initial teemperature of extraction to 38°C and holding the extract at the same temperature for a half an hour. This results shows that with this procedure of extraction it is possible to get extracts with optimal composition and satisfying content of nitrogen fractions. The mixture of maize grits and barley malt show the most favourable content of nitrogen fractions in extracts.
Key words: grain extracts, overpressure thermal digestion**,** STP thermal digestion**,** nitrogen fractions

1. INTRODUCTION
The importance of thermal digestion of fermentable extract is, among others, separability of highmolecular proteins by coagulation. Proteins are important biopolimers in grains. The content of proteins varies depending on species of grains, bat it also depends on a different types of the same specie. Proteins in grains are: glutelins, prolamins, albumins and globulins. [1] Ther is only one part of soluble proteins from total soluble proteins in grains that have managed to extract. Proteins in fermentable extract are: highmolecular, mediummolecular and lowmolecular protein fractions. The most important thing for fermentable extract quality is content of a free amino nitrogen (FAN).

2. MATERIAL AND METHODS
In this study is worked the extraction of different reaction mixtures of grains with addition of comercial enzymes, studies in different conditions of thermal digestion of extracts (thermal digestion under overpressure and thermal digestion by STP). The aim was production fermentable extracts with optimal composition of protein fractions. Fermentable extracts are prepared from the following reaction mixtures of grains: 80% barley malt + 20% raw barley (Extract 1), 70% barley malt + 30% maize grits (Extract 2), 70% barley malt + 15% raw barley + 15% maize grits (Extract 3), 70% barley malt + 20% maize grits + 10% rice (Extract 4) i 100% barley malt (Extract 5-control sample). Extraction (temperature: 52-63-74-100-75°C) and determination of examined parameters are worked

with recommended methods in beer production. [2][3] Extraction of ingredients from grains is worked in acid pH (5,6-5,8), which reduced solubility of determined protein fractions.
Temperature of extraction procedure is fit for optimal work of amylolytics enzymes, and for enzyme hydrolysis of proteins important thing is length of temperature pause at 50° C, where peptidases from barley malt are still operating.

3. RESULTS AND DISCUSION

This study shows that the biggest content of total proteins is in the barley malt (10,06%), and than in the: raw barley (9,0%), maize grits (7,76%) and rice (6,85%). The protein values in analyzed grains are suitable with other references (raw barley 8,5-11,5%; barley malt 16%; rice 6-8%; maize grits 7-9%). [4] Content of the soluble and free amino nitrogen in grains directly depends on total protein content (Figure 1). Procentual composition of nitrogen fractions in the fermentable extract is: lowmolecular nitrogen - 60% (FAN - 22%), mediummolecular nitrogen - 15% and highmolecular nitrogen - 25%. [5] The results of the total nitrogen analysis in examined frmentable extracts show the biggest content in Extract 5 (1153 mg/L). That is understandable, because barley malt enzymes have done partly decomposition of proteins during malting and effected on their solubility.

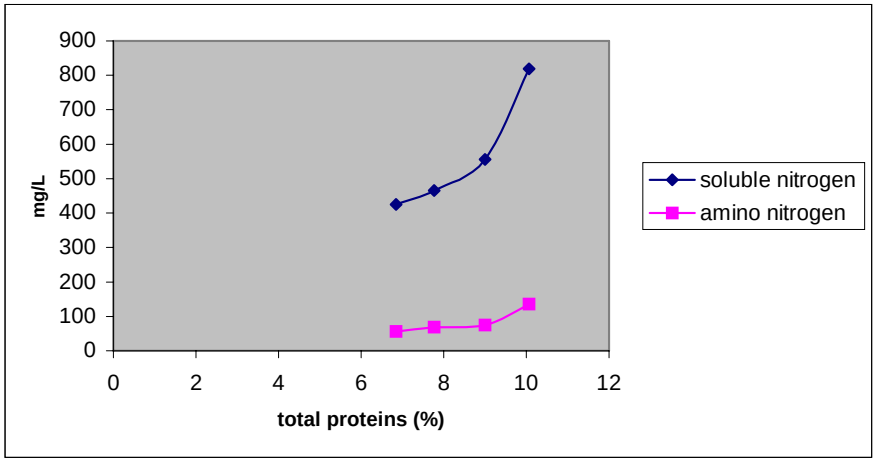

Figure 1. Dependence the soluble and free amino nitrogen concentration of protein content in examined grains

Comparation of total nitrogen values in other extracts have shown that addition of maize grits and rice effects on reduction of total nitrogen quantity in Extract 2 (869 mg/L) by STP ; (807 mg/L) by overpressure, and Extract 4 (832 mg/L) by STP; (775 mg/L) by overpresure. It has also shown that total nitrogen values are lower than regulated values for fermentable extract (900 – 1100 mg/L). This results are cosequence of rice protein content (glutelins - 80%, soluble in alkaline pH) and maize (prolamins- 50% - soluble in alcohol). [6][7] Amounts of highmolecular nitrogen in all extracts are under regulated values (200-240 mg/L) for fermentable extract of good quality, wich is very important for beer foam forming. [8] Study also shows that amount of some nitrogen fractions in examined extract are mostly correlated with amount of total nitrogen. Extract 2 shows some variations where we can find very low amount of mediummolecular nitrogen (85,76 mg/L) by STP; (76 mg/L) by overpresure. This values are correlated with references data where we can find, that maize doesn' t load fermentable extract with potential problematic fraction, which is mostly made of proteins with middle molecular mass. The amount of FAN, in the same extract, is bigger than in Extract 3, in which total nitrogen is bigger. Probable reason is bigger viscosity value of Extract 3 and that is the consequenze of bigger content of raw barley β-glucan.
Bigger amount of FAN in Extract 1 is consequence of bigger amount of total nitrogen in the same extract, but it is also the consequence of raw barley amount 20% in reaction with malt. It is shows that the percentage of highmolecular and lowmolecular fractions are satisfying in all extracts. However,

percentage of free-amino nitrogen in lowmolecular fraction is lower than optimal. Content of nitrogen fractions in fermentable extract treated with overpressure is lower, because of intensive separation of the secondary reactions (Maillard`s reactions) on higher temperatures. But percentage contents of the same, in relation to total nitrogen are homogenized in both procedures of thermal digestion of extracts. (Figure 2, and Figure 3).
It is obvious that grains protein content, which are used reaction mixtures and amount of total nitrogen in fermentable extracts, are determinative factors for production fermentable extracts with nitrogen fractions proportions of a good quality (especially with highmolecular nitrogen and FAN). The addition of commercial enzyme contributes better decomposition of total protein in extracts. [9]

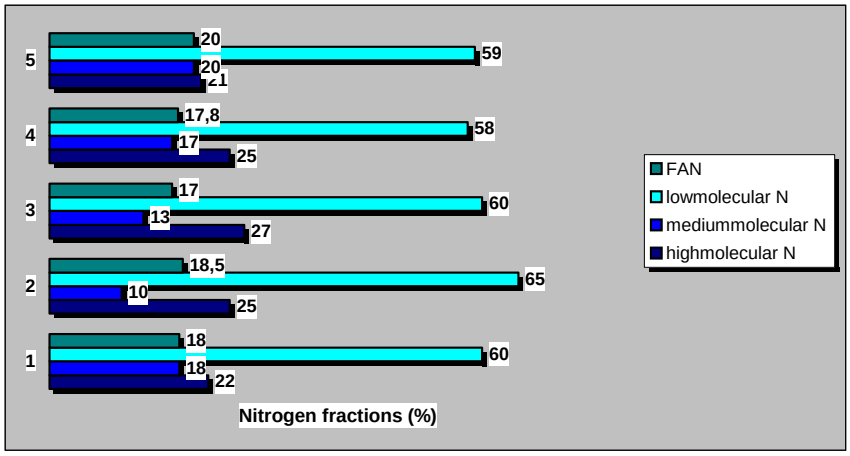

Figure 2. Percentage of nitrogen fractions in extracts treated with thermal digestion by STP

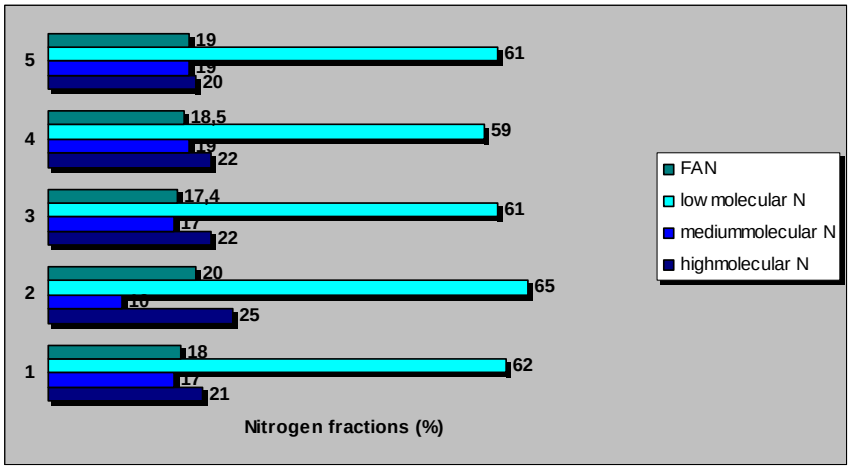

Figure 3. Percentage of nitrogen fractions in extracts treated with overpressure thermal digestion

We also have weaker enzyme peptidases activity of barley malt here. Percentage of FAN in barley malt (Extract 5) which is lower than optimal, confirms that. However, we can say that fermentable extract from 100% barley malt (Extract 5) has the most favourable content of nitrogen fractions.
In extracts, that we got from grains mixtures and malt, Extract 2 has the most favourable content of nitrogen fractions. It could be consequence of lower gelatinisation temperature of maize grits, and it also makes possible favourable conditions for better activity of barley malt endopeptidases.

4. CONCLUSIONS

Conditions of thermal digestion affect the content of nitrogen fractions in extracts. In conditions of overpressure thermal digestion comes to the intensive coagulation of proteins and proceedings of secondary reactions (Maillard`s reaction), which is conditioned by lower values of nitrogen fractions in tested extraxts. The results of the study shows that commercial enzymes addition effects the level of hydrolytic decomposition of proteins of diferent grains mixtures. We suggest decreasing of the initial temperature of extraction to 38° C, and holding the extract at the same temperature for a half an hour. Temperature procedure effects on better activity of barley malt endopeptidases.

The most favourable content of nitrogen fractions in extract is found in the mixture of maize grits and barley malt.

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