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BIOENZYMATIC CATALYSTS IN BISCUIT MANUFACTURING: PROTEASE AND ASPARAGINASE ENZYME APPLICATIONS

*Assoc. Prof. dr. Ioan David[1], Lect. Gabriel Bujancă[1], Ovidiu Claudiu Ion[1], Alexandru Adrian Nicolae[1]
[1]*U.S.V.T "Regele Mihai I", Faculty of Food Engineering, Calea Aradului 199, Timisoara, Romania, corresponding author: ioandavid@usvt.ro*

Abstract: *This study presents the impact of protease and asparaginase enzymes on the rheological properties of dough made from white flour for biscuit production. By using the alveographic and falling number methods, we determined the dough's rheological attributes and evaluated the effects of protease and asparaginase at varying dosages on both the flour and the end products. The addition of these enzymes in the biscuits production process increases health and efficiency by improving dough manageability, as well as the volume and texture of the biscuits. Proteases facilitate the hydrolysis of peptide bonds between amino acids, which weakens the gluten network in the dough. Meanwhile, asparaginase converts asparagine and water into aspartic acid and ammonia, thereby preventing acrylamide formation. Results from the falling number and alveograph tests indicate that adding protease and asparaginase increases the final product's quality, making the biscuits crisper, more porous, and tender. Proteases also increase dough viscosity while reducing stability and kneading tolerance.*

• Introduction

Biscuits, created from a pliable dough and baked into various shapes and flavors, benefit from a wide array of ingredients and their proportions, in addition to differing technological processes. Due to their high fat and carbohydrate content, biscuits are a vital energy source. Proteases facilitate the hydrolysis of peptide bonds between amino acids in proteins, weakening the gluten structure within the dough. Rahil et al. investigated wheat flour treated with proteases and carbohydrases at different doses, aiming to partially break down dough polymers and induce molecular rearrangements to enhance dough rheology and the dimensional properties of biscuits. Gazi et al. demonstrated the efficacy of asparaginase in reducing acrylamide formation in bakery products, depending on dough type and properties. Tamba-Berehoiu et al. showed that proteases can be used in baking to manage certain rheological parameters in flours with strong gluten or normal flours and can be applied in the technological processes for producing biscuits and wafers.

• Material and method

The rheological characteristics were determined using alveographic method and falling number method. The first sample does not contain any enzyme, the other three samples have different dosages of enzymatic compound based on protease and asparaginase(P&A): 16g, 22g and 32g per 100kg flour.

The Falling Number measures the time a stirrer sinks through the gelatinized starch in order to determine the viscosity of a suspension that contains flour and water, which is heated close to the boiling point. The indicator is expressed in seconds and the optimal values should be between 220 - 280sec.

The alveographic method measures the strength and deformation characteristics of dough during the mixing and fermentation processes. The alveograph records various parameters during the test, including the maximum resistance the dough can offer (indicating its strength) and the ability of the dough to stretch and expand (indicating its extensibility). The rheological parameters recorded by the alveograme are: P- resistance to deformation (mm H2O); L - extensibility (mm); G - expansion index; P/L - ration of dough strength and extensibility. W - water absorption capacity of the dough (Joule); Ie - elasticity index. The optimal characteristics for flour used in the manufacturing of biscuits are doughs with a low specific resistance (low P values) and extremely extensible (high L values).

• Results and discussions

Sample with the most intense enzymatic activity is sample A - no enzymes. Addition of protease and asparaginase enzyme compound increased falling time by 12 seconds for Sample B - with 16g P&A/100 kg flour, by 30 seconds for Sample C - with 22g P&A/100 kg flour and by 72 seconds for Sample D - with 32g P&A/100 kg flour, suggesting that the samples have decreased enzyme activity, making the dough more dense in correlation with the dosage of protease and asparaginase used.

The alveographic test shows that sample D - with 32g P&A/100 kg flour has the most suitable values for the manufacture of biscuits. The resistance of the dough to deformation (P_D) is low, the elasticity index (Ie_D) is higher than that of sample A, and the curve configuration ratio (P/L_D), as well as the total amount of energy absorbed by the dough when stretching (W_D) are low compared to the control sample.

• Conclusions

The falling number analysis indicates that Sample A, which does not contain enzymes, exhibits the highest enzymatic activity. However, the addition of a protease and asparaginase enzyme compound increased the falling time by up to 72 seconds, as seen in Sample D with 32g P&A per 100 kg of flour, showing a reduction in enzyme activity and resulting in a denser dough. According to the alveograph test, when adding 32g P&A per 100 kg of flour into the biscuit dough reduces the dough's resistance to deformation and enhances its elasticity compared to other samples. Adding 16g P&A per 100 kg shows minor improvements in dough extensibility compared to Sample A. Introducing protease into the dough elevates the quality of the finished product, making the biscuits crispier, more porous (easily melting in the mouth), and more tender. Proteases increase dough viscosity while reducing its stability and kneading tolerance, also improving dough extensibility; hence, they should be added cautiously and in controlled amounts. They have irreversible effects on gluten, making them suitable for treating strong flours, and aid in gluten softening during extended fermentation at a low pH for biscuit dough. Asparaginase in certain foods lower the asparagine content because under specific cooking conditions, asparagine can interact with carbohydrates in foods to