The variation of protein, sugars, and organic acids in oat hulls after bioprocessing with enzymes

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FOOD DEVELOPMENT

INTRODUCTION

Production of oats (*Avena sativa*) is steadily increasing due to growing awareness of its health benefits and a shift towards plant-based diets. This rise in production generates a significant byproduct in the form of oat hulls (OH), often discarded as waste. This study focused on exploring a green method to improve the extraction of nutrients in oat hulls for their potential in the application of innovative food products. To accomplish this goal, enzymatic hydrolysis was employed. Eventually, the research aims to enhance the efficiency of utilization of food resources and promote sustainability of the food system

METHODOLOGY

Enzyme treatment (ET) - Viscozyme (V), Alcalase (A), Feruloyl esterase (F),Cellulase (CL) , Combination (CM-V,CL,F), Protamex (P)

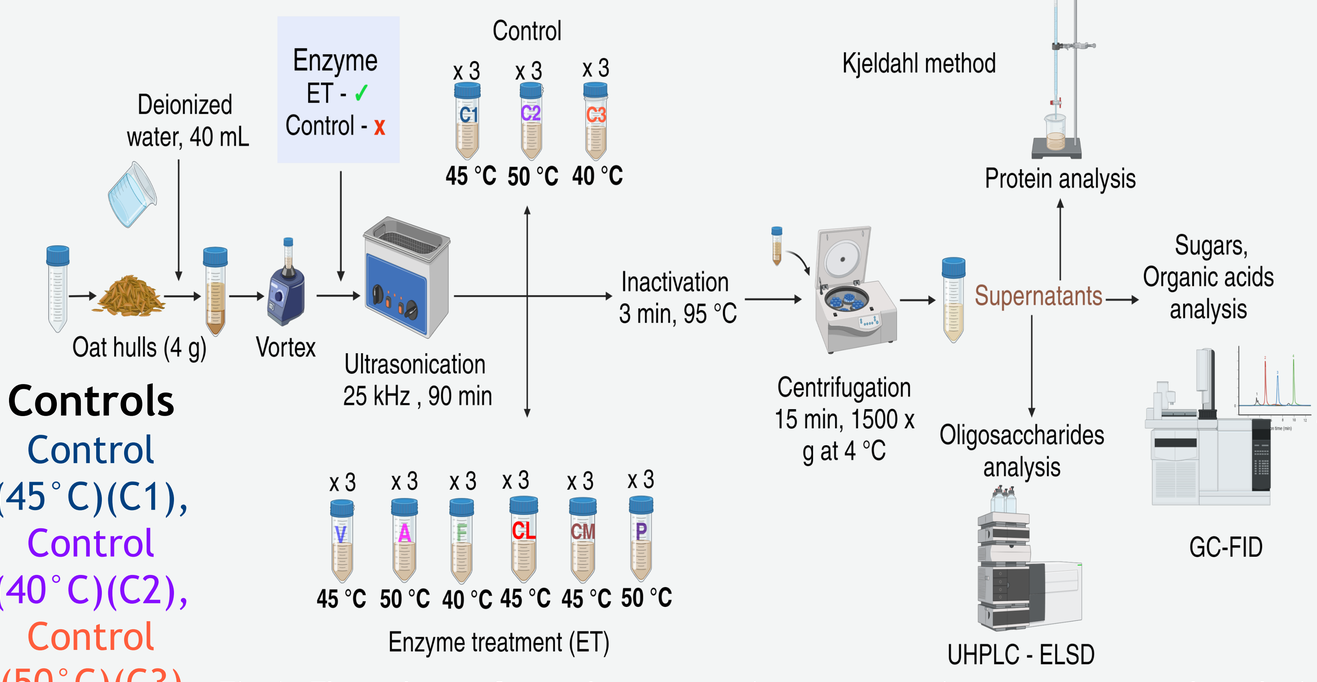

Fig 1. Flow chart of sample preparation, enzymatic treatment, and analysis

RESULTS AND DISCUSSION

Protein content analysis

Compared with controls, ET increased protein extraction

Combination treatment showed higher protein content compared to all individual enzymes

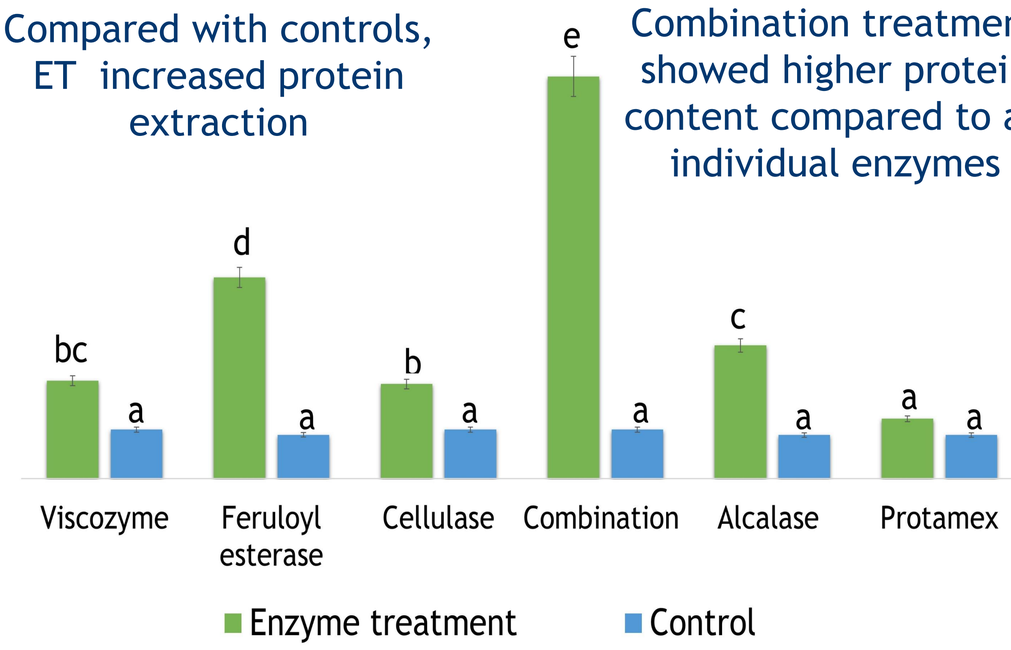

Fig 2. Protein content in different enzymatic treatments and their controls. Different alphabets denote significant differences at ($p<0.05$). Statistical analysis was conducted by one way-ANOVA and Tukey's post hoc test

Sugars, organic acids analysis scores plot

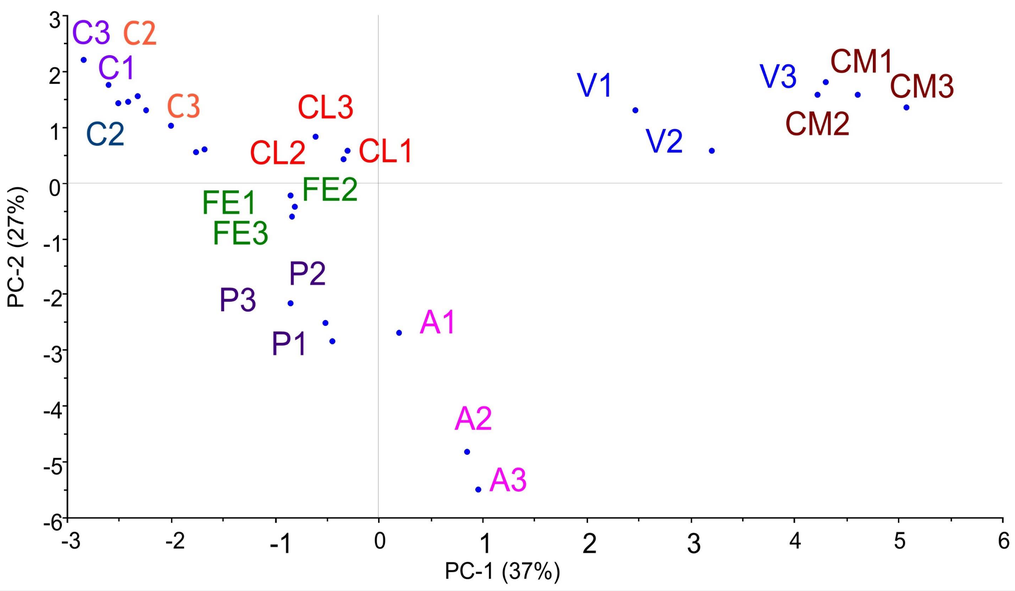

Fig 3. PCA model for comparison of different enzymatic treatments with soluble proteins, sugars, and organic acids

Combination treatment and viscozyme treatment are more effective in extracting sugars, soluble proteins

Oligosaccharides analysis (tentative)

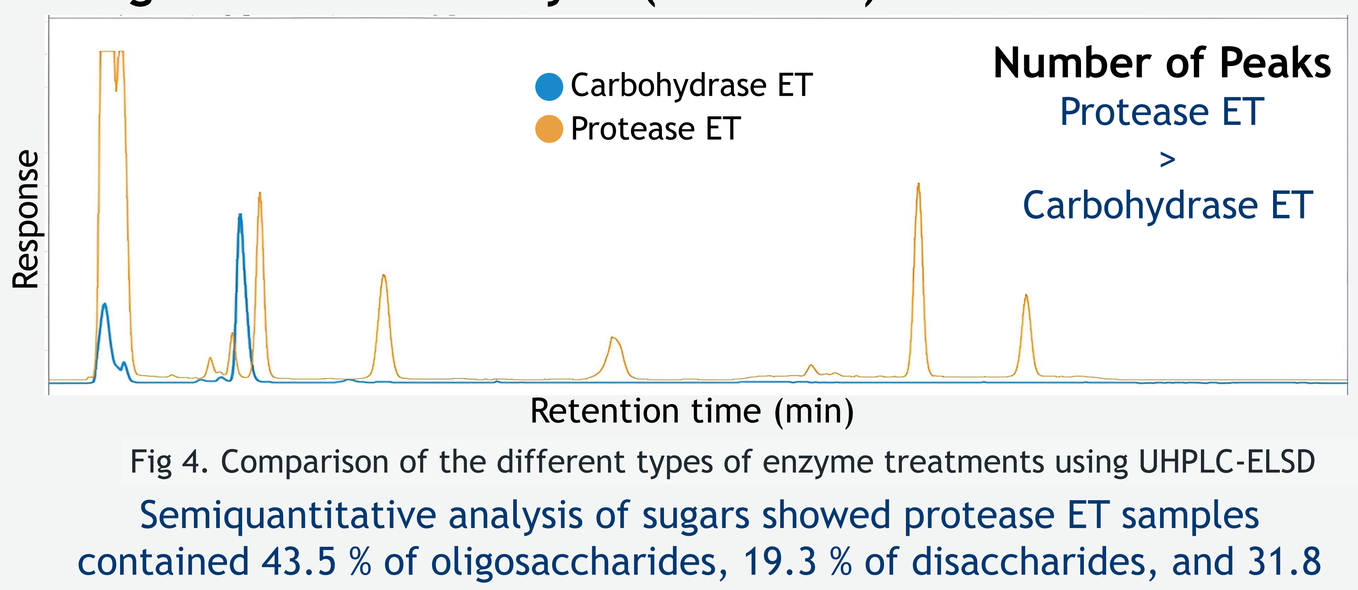

Fig 4. Comparison of the different types of enzyme treatments using UHPLC-ELSD

Semiquantitative analysis of sugars showed protease ET samples contained 43.5 % of oligosaccharides, 19.3 % of disaccharides, and 31.8 % of monosaccharides whereas carbohydrase ET samples contained 100 % of monosaccharides

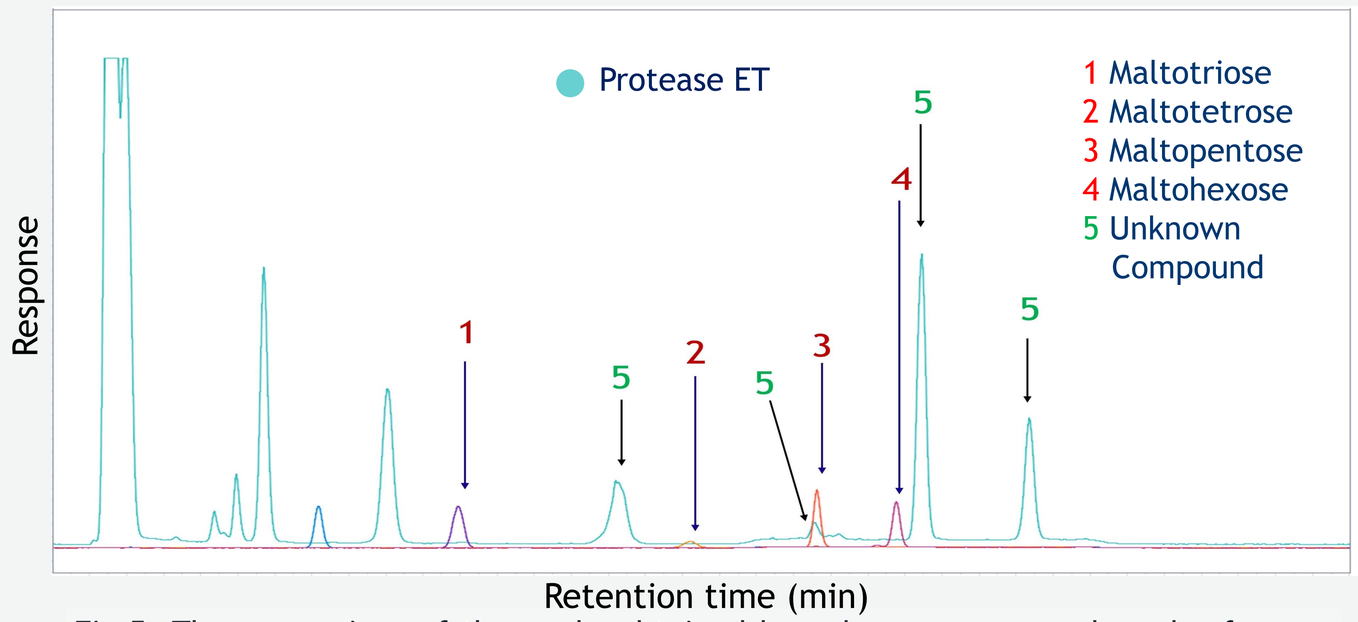

Fig 5. The comparison of the peaks obtained by unknown compounds and reference standards in protease enzyme treated supernatants

Unknown compound peaks obtained after the maltotriose peak should have the same molecular weight or more than that which supports the idea of oligosaccharides existence in protease enzyme treated supernatants

CONCLUSIONS

- Combination of enzymes (viscozyme, cellulase, feruloyl esterase) treatment is more effective than individual enzyme treatments in the extraction of sugars, soluble proteins
- Oligosaccharides analysis using different types of enzymes showed, some compounds could be tentatively identified as oligosaccharides
- Protease enzymes have the potential to be used in fractionating the different types of fiber content in oat hulls compared to carbohydrase enzymes

References

- Schmitz, E., Nordberg Karlsson, E., & Adlercreutz, P. (2020). Warming weather changes the chemical composition of oat hulls. Plant Biology, 22(6), 1086-1091.
- Zhou, Y., Tian, Y., Beltrame, G., Laaksonen, O., & Yang, B. (2023). Ultrasonication-assisted enzymatic bioprocessing as a green method for valorizing oat hulls. *Food Chemistry*, *426*, 136658.