Protein Extraction from Cold-Pressed Hempseed Press Cake – from Laboratory to Pilot Scale

Amanda Helstad[1], Erica Forsén[1], Cecilia Ahlström[1], Inger-Cecilia Mayer Labba[2], Ann-Sofie Sandberg[2], Marilyn Rayner[1], and Jeanette Purhagen[1]

Background/introduction/summary

Industrial hempseed (containing less than 0.3 % THC) contains mainly two storage proteins, edestin and albumin, which are easily digested and have a good amino acid profile (1).

From 1 kg cold-pressed industrial hempseed 350 g hempseed oil and 650 g hempseed press cake (HPC) is generated.

HPC contains high amounts of protein (30-50 %) (2), which can be extracted.

Phytic acid, which is a potent inhibitor of iron absorption, is present in HPC (3). The phytic acid levels were therefore measured in the produced hemp protein precipitates.

Objective: to optimize a protein extraction on HPC with no pre-treatment (e.g. defatting step or enzyme treatment), suitable for future larger scale production of hempseed protein with reduced levels of phytic acid.

Materials and Methods

1. 50 g HPC was milled and dispersed in tap water (1:10).
2. Alkali extraction, tested parameters:

pH	9.0, 10.0, 10.5, 11.0, 12.0
Temperature	Room temperature (approx. 20 °C), 30 °C, 50 °C
Monitoring of pH	Non-constant pH, constant pH
Time	1 h, 2 h, 3 h, 4 h

3. Centrifugation
4. Precipitation, tested pH values: 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5
5. Centrifugation

Pilot trial: 2 kg HPC was alkali extracted at a constant pH 10.5 in room temperature for 4 h. The first separation step was performed with a decanter. Precipitation pH 5.5.

Results

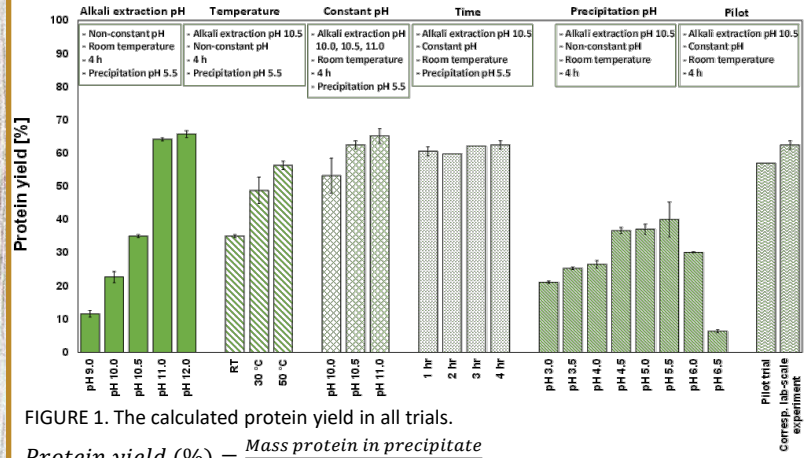

FIGURE 1. The calculated protein yield in all trials.

$$Protein\ yield\ (\%) = \frac{Mass\ protein\ in\ precipitate}{Mass\ protien\ in\ HPC}$$

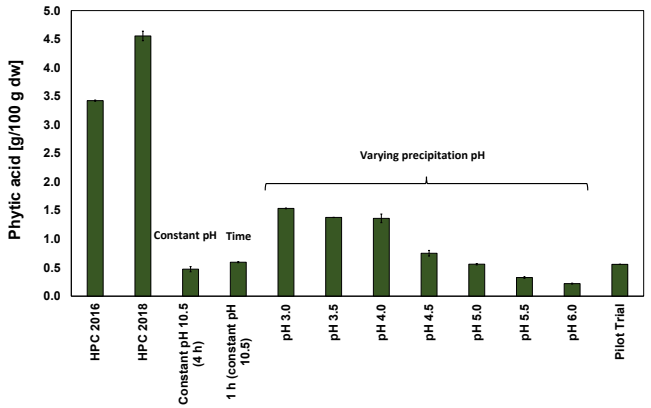

FIGURE 2. Phytic acid content in HPC from two different harvest years and precipitates from different trials. Higher precipitation pH reduced the level of phytic acid.

Conclusions

The optimal process parameters were concluded to be:

- ✓ Alkali extraction pH 10.5
- ✓ Room temperature
- ✓ Constant pH
- ✓ Alkali extraction time 1 h
- ✓ Precipitation pH 5.5

The phytic acid content was significantly reduced by the protein extraction process.

FIGURE 3. Precipitates from time trials, 1 h (top), 2 h (middle), 3 h (below).

Reference

1. Callaway, J. C., (2004a). Hempseed as a nutritional resource: An overview. Euphytica, 140(1-2), 65-72.
2. House, J. D., J. Neufeld & G. Leson, (2010). Evaluating the Quality of Protein from Hemp Seed (Cannabis sativa L.) Products Through the use of the Protein Digestibility-Corrected Amino Acid Score Method. Journal of Agricultural and Food Chemistry, 58(22), 11801-11807.
3. Pojic, M., A. Misan, M. Sakac, T. Dapcevic Hadnadev, B. Saric, I. Milovanovic & M. Hadnadev, (2014). Characterization of byproducts originating from hemp oil processing. J Agric Food Chem, 62(51), 12436-12442.

Acknowledgements

Special thanks to Mossagården EKO AB who provided the hempseed for this research, and to Gunnarshögs Gård AB who pressed the hempseed producing the hempseed press cake.

This research was financially supported by EIT Climate-KIC, in the project Sustainable Hemp Based Dairy Analogues: ICE-GREEN (190935).

Contact

[1]Department of Food Technology Engineering and Nutrition, Lund University, Lund, Sweden
[2]Food and Nutrition Science, Department of Biology and Biological Engineering, Chalmers University of Technology, Gothenburg, Sweden

Food Science Sweden

Chalmers | LTH | RISE | SLU | OrU