EFFECT OF TIME AND LEGUME TYPE ON GERMINATION-INDUCED PROTEOLYSIS OF LENTILS AND FABA BEAN

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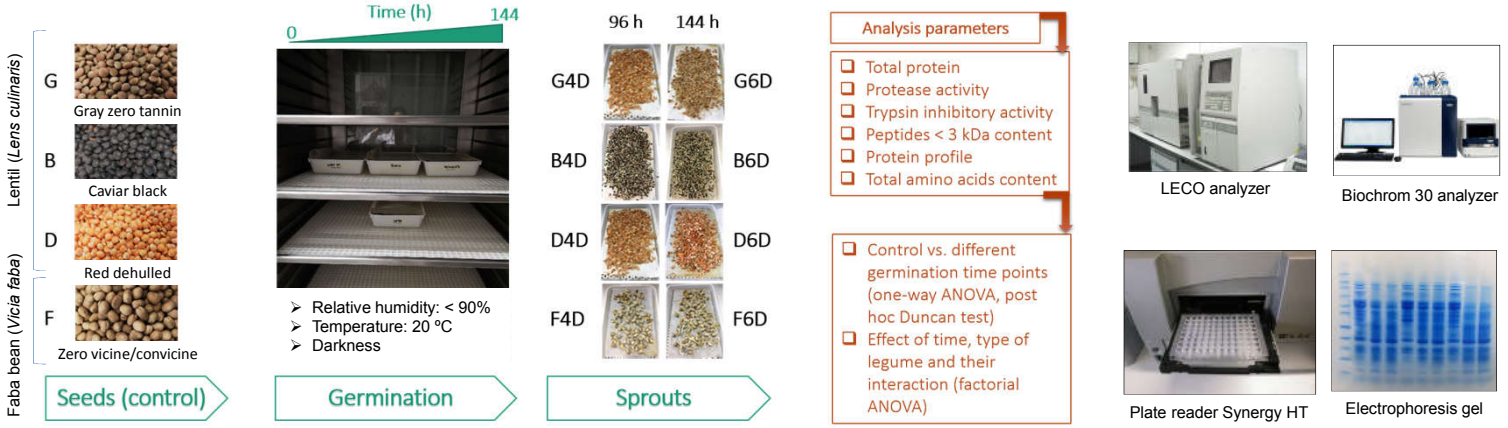
INTRODUCTION

There is an increased interest in seeking new plant-based protein sources motivated by the global awareness on environmental sustainability and food security (1). Mordor Intelligence has forecast a 9.5 billion (USD) plant protein market in 2024 (2). Among most potential plant sources, pulse crops are of particular interest because of their high protein contents (18–32%). Nutritionally, pulse proteins are generally deficient in the S-containing amino acids (cysteine and methionine), but unlike cereal grains, their lysine content is adequate. Additionally, the digestibility and bioaccesibility of legume proteins are impaired by the complex microstructure and presence of interfering compounds in the seed matrix such as trypsin inhibitors. Germination is a promising sustainable and effective process to improve protein quality in terms of digestibility, amino acid composition and bioaccesibility of small peptides and amino acids (3).

OBJECTIVE

The objective was to study the potential of germination in three types of Canadian lentils ("gray zero tannin", "caviar black", and "red dehulled") and faba bean ("zero vicine/convicine") for enhancing the quantity and quality of legume proteins in terms of digestibility, amino acid composition and bioaccesibility of small peptide fragments and amino acids.

MATERIALS AND METHODS



LECO analyzer

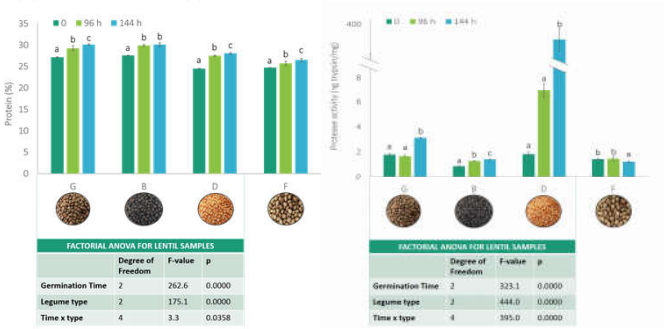
Biochrom 30 analyzer

Plate reader Synergy HT

Electrophoresis gel

RESULTS

Figure 1. Effect of germination time, legume type and their interaction on total protein, protease activity, trypsin inhibitory activity (TIA) and peptides (<3kDa) in gray ZT (G), black (B) and dehulled (D) lentils and faba bean (F).

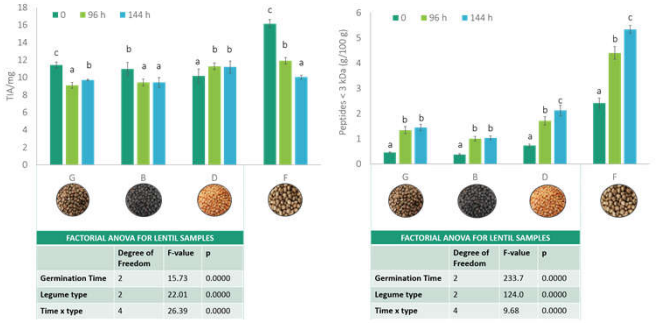


FACTORIAL ANOVA FOR LENTIL SAMPLES

	Degree of Freedom	F-value	p
Germination Time	2	262.6	0.0000
Legume type	2	175.1	0.0000
Time x type	4	3.3	0.0358

FACTORIAL ANOVA FOR LENTIL SAMPLES

	Degree of Freedom	F-value	p
Germination Time	2	323.1	0.0000
Legume type	2	444.0	0.0000
Time x type	4	395.0	0.0000



FACTORIAL ANOVA FOR LENTIL SAMPLES

	Degree of Freedom	F-value	p
Germination Time	2	15.73	0.0000
Legume type	2	22.01	0.0000
Time x type	4	26.39	0.0000

FACTORIAL ANOVA FOR LENTIL SAMPLES

	Degree of Freedom	F-value	p
Germination Time	2	233.7	0.0000
Legume type	2	124.0	0.0000
Time x type	4	9.68	0.0000

- Germination increased time-dependently total protein content (4-14% increase). G and B sprouts showed the highest protein contents.
- Protease activity increased with germination time in lentils although a decrease trend was observed in faba bean at longer germination times. D showed the highest increase in protease activity.
- Trypsin inhibitory activity was generally reduced in legume sprouts. D was an exception to this observation as slightly higher TIA values were found in sprouts. F showed the highest reductions in TIA after germination.
- Peptides < 3 kDa increased with germination in all legume types. G and D showed the highest increase (up to 3 fold vs. control).

Figure 2. Germination-induced proteolysis in gray ZT (G), black (B) and dehulled (D) lentils (a) and faba bean (F) (b) at different time points (96 h, 4D and 114 h, 6D). MK: molecular weight marker.

- A concurrent degradation of the 7S and 11S globulins and accumulation of peptides <20 kDa were observed after germination in all the legumes studied.
- Total levels of some amino acids were increased: Asp in all the sprouts studied; Ser, Pro, Ala, Cys, His and Lys in G; Met and Tyr in B; Pro in D.

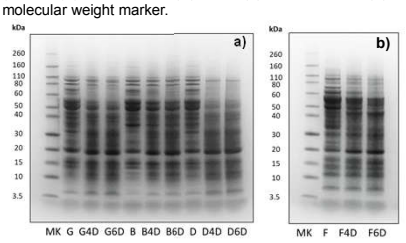
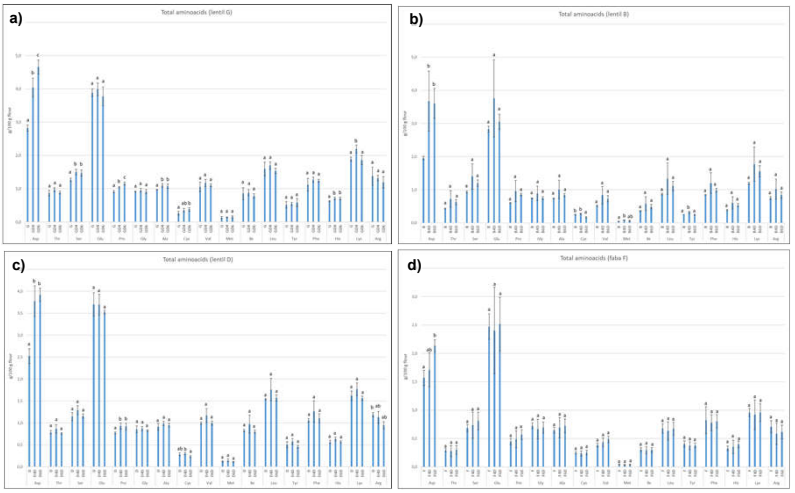


Figure 3. Effect of germination time on total amino acid content of gray ZT (a), black (b) and dehulled (c) lentils and faba bean (d). Results are expressed in g/100 g sample.



CONCLUSION

In general, germination increased protein content, activated proteases that hydrolyzed proteins in small peptides and amino acids while concurrently repressed the activity of trypsin inhibitors that made proteins more digestible. The extent of this changes were dependent on time, legume type and their interaction. These results could be of interest for selection of legumes varieties with higher germination-induced proteolytic rates able to provide plant proteins of better nutritional quality more efficiently.

ACKNOWLEDGEMENTS

This research was funded by University of Saskatcheewan, grant "Lentils for Sustainable and Healthy Proteins".

REFERENCES

(1) Ghumman, A. et al. 2016. *LWT. 65:* 137-144.
(2) Avilés-Gaxiola, S. et al. 2018. *J. Food Sci. 83(1):* 17-29.
(3) Liu, Y. et al. 2020. *Int. J. Biol. Macromol.154:* 706-713.