Title: The Effect of Thermal Processing on the Chemical and Functional Properties of Whole Yellow Pea Flour

Author(s): H. Maskus, L. Bourré, K.Wang, S. Arntfield, L. Malcolmson

Citation: AACC International Annual Meeting, 30 September - 3 October 2012, Hollywood, Florida, U.S.A. Poster 150-P.

Link:
http://www.aaccnet.org/meetings/Documents/2012Abstracts/p12ma150.htm

The Effect of Thermal Processing on the Chemical and Functional Properties of Whole Yellow Pea Flour

H. Maskus [1], L. Bourré [1], K. Wang [2], S. Arntfield [2] and L. Malcolmson [1]
[1] Canadian International Grains Institute (Cigi) 1000-303 Main Street, Winnipeg, MB, Canada R3C 3G7
[2] Department of Food Science, University of Manitoba, Winnipeg, MB, Canada R3T 2N2

Introduction

An excellent way to increase the nutritional content of wheat flour-based foods is through the addition of pulse flours. Although pulses are high in fibre, protein, vitamins and minerals, the seeds also contain bioactive compounds such as trypsin inhibitors, phytic acid and phenolic compounds which have anti-nutritional properties. There is a growing body of literature which shows that some of these bioactive compounds also have protective effects. Thermal processing of seeds prior to milling has been cited as a way to reduce the level of bioactive compounds in the flour but it is not clear what effect thermal processing of the seeds prior to milling has on the chemical and functional properties of the flours.

Objective

To determine the effects of thermal processing (roasting and infrared heating) and processing temperature on the chemical and functional properties of whole yellow pea flour.

Materials and Methods

Canadian whole yellow peas (CDC Meadow var.) were tempered to a moisture content of 14% and thermally processed at three temperatures (80°, 100° and 125°C).

Thermal Processes

- **Infrared Heating:** MR2 Micronizer (Micronizing Company UK, Suffolk, Eng)
- **Roasting:** Moffat Convection Oven (Model ECO-3, DeltaRex Canada Inc. Moffat Food, Toronto ON)

Following thermal processing, peas were milled to flour using a Hosokawa Alpine 100 UPZ pin mill using a feed rate of 5 kg/h and a rotor speed of 10,000 rpm. Control flour was prepared by pin milling untreated yellow peas.

Flour Analyses

- Average Particle Size (APS) - Malvern Scirocco 2000 Mastersizer
- Water Absorption Capacity (WAC) - Beuchat, 1977
- Peak Viscosity (PV) - AACC 76-21.01, Perten Rapid Visco Analyzer
- Starch Damage (SD) - AACC 76-33.01, Chopin SDmatic
- Trypsin Inhibitor Activity (TIA) - AACC 22-40.01
- Total Phenolic Content (TPC) - Folin Ciocalteu method cited by Singleton and Rossi 1965 with modification by Gao et al. 2002
- Phytic Acid (PA) - Latta and Eskin, 1980

Statistical Analysis

- Significant differences ($p<0.05$) among processing temperatures were determined using the Tukey-Kramer test (SAS, JMP version 8).

Results

Infrared Heating - Effect of Processing Temperature on Chemical Properties (Figure 1)

- Flour from peas processed at 80°C had significantly reduced levels of PA compared to the control flour.
- Flour from peas processed at 125°C had significantly reduced levels of TPC compared to flours from peas processed at 80° and 100°C.
- TIA levels were significantly higher in flours from peas processed at 100° and 125°C.

Infrared Heating - Effect of Processing Temperature on Physical & Functional Properties (Figure 2 & Table 1)

- Flour from peas processed at 125°C had significantly lower PV and higher levels of SD compared to other flours.
- The control flour had significantly larger APS than the flours from peas processed at 100°C and 125°C.
- Flours from peas processed at 100°C and 125°C had significantly higher WAC values compared to the control flour and flour from peas processed at 80°C. The flour from peas processed at 125°C had a significantly greater WAC than flour from peas processed at 100°C.

Table 1: WAC (ml water/g flour) of flours from peas processed by two thermal methods using three process temperatures.

Thermal Method	Control	80°C	100°C	125°C
Infrared Heating	1.2c	1.3c	1.5b	2.1a
Roasting	1.2b	1.2b	1.8a	1.7a

(rows with different letters are significantly different ($p<0.05$))

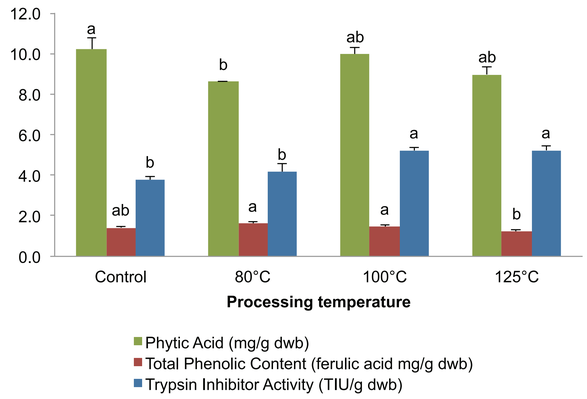

Figure 1: Effect of infrared processing temperature on chemical properties of whole yellow pea flours (bars of the same colour with different letters are significantly different ($p<0.05$))

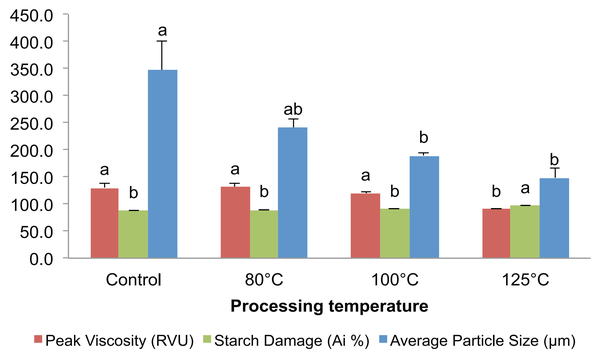

Figure 2: Effect of infrared processing temperature on the physical and functional properties of whole yellow pea flour (bars of the same color with different letters are significantly different ($p<0.05$))

Roasting - Effect of Roasting Temperature on Chemical Properties (Figure 3)

- Flour from peas roasted at 125°C had a significantly lower level of TPC than the other flours.
- TIA levels in peas roasted at 80°C and 100°C were significantly higher than the control flour.

Roasting - Effect of Roasting Temperature on Physical & Functional Properties (Figure 4 & Table 1)

- Flour from peas processed at 125°C had significantly higher PV compared to the control flour.
- SD significantly increased as roasting temperature increased.
- The control flour had a significantly larger APS than the processed flours.
- Flours from peas roasted at 100°C and 125°C had significantly higher WAC values compared to the other flours.

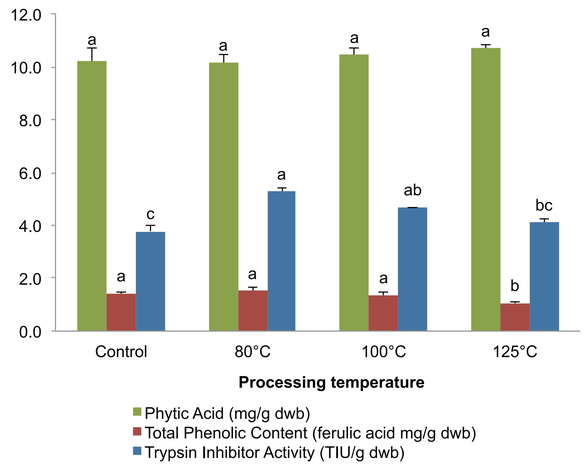

Figure 3: Effect of roasting temperature on chemical properties of whole yellow pea flours (bars of the same colour with different letters are significantly different ($p<0.05$))

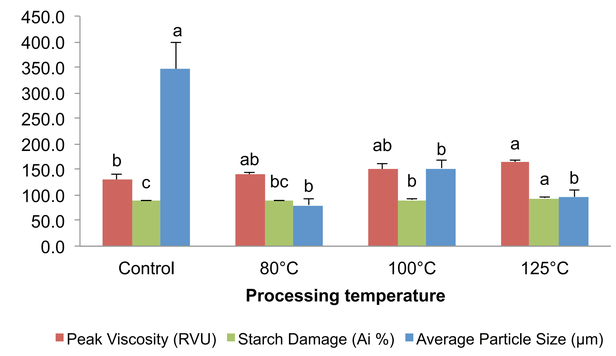

Figure 4: Effect of roasting temperature on the physical and functional properties of whole yellow pea flour (bars of the same colour with different letters are significantly different ($p<0.05$))

Discussion and Conclusions

Reduction in TIA levels in the flour is desirable however no significant reduction in TIA levels was observed. Temperatures greater than 125°C may be required to achieve a reduction in TIA levels; however, functional properties of flours will be affected at these temperatures.

Pea flour infrared processed at 80°C significantly reduced levels of PA and did not significantly alter the functional properties of the flour compared to the control flour. Khattab and Arntfield (2009) reported greater reductions in PA in pulse seeds with microwaving and hydrothermal processing methods such as autoclaving and boiling.

A reduction in the TPC level was observed in the flour from peas roasted at 125°C. This caused a significant change to the functional properties of the flour. The significant effect of processing temperature on flour SD and WAC was also observed by D'Appolonia (1978) in roasted navy bean flours. As expected, flours from peas that had been thermally processed at higher processing temperatures had higher SD values which also resulted in higher WAC values in the flours.

The differences found between roasting and infrared processing are likely due to the heat transfer properties and uniformity of heat transfer associated with each processing method.

The differences observed in the functional properties of the thermally processed flours are expected to change the performance of these flours as food ingredients and warrant further investigation.

References

D'Appolonia, B.L. (1978). Cereal Chem. 55(6):898–907.

Khattab, R.Y. and Arntfield, S.D. (2009). Lebensm. Wiss. u Technol. 42(6): 1113–1118.

Beuchat, L.R. (1977). J. Agri. Food Chem. 25: 258–261.

AACC International. Approved Methods of Analysis, 11th Ed. Method 22-40.01. Approved November 3rd, 1999. AACC International, St. Paul MN.

Singleton, V.L. and Rossi, J.A. (1965). Am. J. Enol. Vitic. 16:144–158.

Gao, L., Wang, S., Oomah, B.D. and Mazza, G. (2002). Wheat quality: Antioxidant activity of millstreams. Pages 219–233. In: Wheat Quality Elucidation. P.Ng and C.W. Wrigley, eds. AACC International: St. Paul MN.

Latta, M. and Eskin, M. (1980). J. Agric. Food Chem. 28:1315–1317.

Acknowledgements

Funding for this project has been provided by the **Canadian Special Crops Association**, **Saskatchewan Pulse Growers**, **Alberta Pulse Growers** and by **Agriculture and Agri-Food Canada** through the Canadian Agricultural Adaptation Program.

The technical assistance provided by the staff at the University of Manitoba and Cigi's Analytical Services is greatly appreciated. Special thanks to Cigi's Communications staff for poster design and layout.

Creating Opportunities for Canada's Field Crops

@CigiWinnipeg Cigi www.cigi.ca