Effect of extrusion on in vitro protein digestibility and available lysine content of direct-expanded chickpea-sorghum snacks

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ABSTRACT
Blending cereals with pulses provides a balanced protein with higher biological value than their amino acid compositions are complementary. Extrusion can improve protein digestibility but may reduce available lysine content. This study investigated the effect of extrusion conditions and blending ratio on in vitro protein digestibility (IVPD), available lysine content, and in vitro protein digestibility corrected amino acid score (PDCAAS) of direct-expanded chickpea-sorghum snacks. Chickpea-sorghum blends (106:0, 50:50, 60:40, 70:30 and 90:10) were extruded at barrel temperatures of 120, 140 and 160°C, feed moisture contents of 18, 16 and 20%, and at the maximal expansion point of 169°C and 15% feed moisture. Extrusion increased the IVPD of all blends (P<0.05). Specifically, a higher extrusion temperature resulted in increased IVPD under all conditions investigated; however, increasing feed moisture content reduced protein digestibility (P<0.05). Inclusion of a greater proportion of chickpea flour in the blend also increased IVPD (P<0.05) and resulted in a greater PDCAAS. Reactive lysine content was reduced by extrusion for all blends (P<0.05), with 100% sorghum having lower lysine content than 100% chickpea or any of the blends. The study illustrated that the chickpea-sorghum blends were superior to chickpea or sorghum alone from a protein quality point of view. The chickpea-sorghum snack with a 70:30 blend ratio and extruded at the maximal expansion point was found to be preferable in terms of protein quality with minimal loss of available lysine. (CFSBF)

MATERIALS AND METHODS

Raw Materials
Kabuli chickpea (500 kg) and sorghum (500 kg) were purchased from Dufenenbaker Spice & Pulse (Elbow, SK, Canada) and Sinner Bros. & Bresnahan Food Inc. (Casselton, North Dakota, USA), respectively.

Protein content
Protein content was determined by combustion (AOAC 996.14-95).

Extrusion Conditions
Barrel temperature at either 120°C, 140°C, 160°C, and feed moisture content at either 16, 18 or 20%. Also extruded at maximal expansion point 169°C and 15% moisture

Amino Acid Composition
Amino acid content of samples were determined by acid hydrolysis. Sulfur amino acids were determined by performic acid oxidized hydrolysis. Tryptophan was determined via alkaline hydrolysis.

In vitro protein digestibility analysis (IVPD)
Samples of the ingredients were incubated at 37°C with chymotrypsin, trypsin and protease. Subsequent pH drop was used to calculate digestibility

Available Lysine Content
• 0.6-3% protein was prepared with SDS and OPA
• Measurement was performed using fluorescence spectrophotometry with Ex: 340 nm Em: 455 nm
• Samples were compared against a standard curve constructed using diluted casein

Calculations
• Amino Acid Score = Amino acid content of the protein source/reference amino acid pattern (mg/g protein).
• Reference values for amino acid score calculation (mg/g protein): T: 34; V: 35; M: 25, I: 28, L: 66, P: 63, H: 19, K: 58, W: 11.
• In Vitro Protein Digestibility-Corrected Amino Acid Score (in vitro PDCAAS) = Lowest uncorrected amino acid ratio X in vitro calculated digestibility (IVPD%).

RESULTS

Effect of Blending
As the percentage sorghum increased in a blend there was a reduction in both amino acid score and in vitro PDCAAS.

The blend ratio with the highest in vitro PDCAAS was 70:30
The maximum in vitro PDCAAS was found in 100% chickpea

Effect of Extrusion Conditions
IVPD increased with increasing barrel temperature and decreased with added moisture.
A higher inclusion rate of chickpea resulted in a higher IVPD across multiple temperatures and moisture.

Available Lysine
• Inclusion of chickpea in the blend increased available lysine
• Extrusion of all blends resulted in a reduction of available lysine

CONCLUSIONS
Extrusion is a valuable processing technique for increasing IVPD and in vitro PDCAAS

Inclusion of chickpea in any sorghum blend will increase the available lysine content, although this will be reduced post-extrusion.

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