Project 2012C001R

Applications of plant proteins from Alberta crops in bakery and meat substitute products

Lead Researcher and Team:

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Background.

Wheat gluten and egg white protein are widely used in many food preparations such as bakery and meat products due to the unique adhesive and cohesive characteristics of the former, and excellent gelling properties of the latter. However, over the last 5 years protein costs for human food, livestock feeds and other non-food industries have been quite volatile, which has created a continually increasing industry demand for new cost-effective protein sources as alternatives to traditional proteins (e.g. wheat gluten and egg white). New proteins from plant resources are especially interesting due to their safety, abundant sources and relatively low cost. Canada is the world's largest producer of canola and third largest producer of barley and oats, which provides an abundant source of vegetable proteins. This project, which was undertaken in collaboration with Kellogg's, was developed in response to the industry's need for more cost effective, plant based proteins that could replace egg white and wheat gluten in bakery and meat products.

Objective:

1. To develop oat and/or canola protein gels that can replace or partially replace egg white protein

2. To scale up the plant protein extraction processing

3. To test the feasibility of using above plant proteins in bakery and meat products

What We Did:

Canola and oat protein gels were prepared by heat treatment of protein concentrates and/or isolates near their denaturation temperature. Oat protein gels were also prepared by cold-gelation method in which the three-dimensional gel networks were formed at room temperature. The impacts of pH, temperature and GDL amount on gel nanostructures (filamentous /particulate/polymer gels), subsequently the gel macroscopic features including texture and water holding capacity were systematically studied.

The protein extraction processes proven at the bench-top scale were scaled up at pilot level in the Food Processing Development Centre at Leduc, Alberta Agriculture and Forestry (AAF) to provide enough samples for food development. Food prototypes such as meat burgers and doughnuts incorporating barley and oat proteins as nutritive and functional ingredients were developed and evaluated.

Key Results:

1. Oat protein gels showed mechanical strength (22.98 kPa) comparable to egg white protein gels and excellent water-holding capacity.

2. Canola protein gels were less strong than those of oat protein, but still comparable to those of soy protein at neutral pH. Stronger canola protein gels were obtained at alkaline pH and high temperature.

3. Oat protein showed good potential to partially replace egg white as a gelling ingredient in meat burger products and the vegan doughnuts with barley proteins replacing egg and milk demonstrated good flavor and taste.

Take-home Message for the Industry:

The information generated through this research may help barley and oat processors to develop new/improved functional plant protein ingredients. The developed novel food products are either with high protein content or targeting specific consumer needs, such as vegetarian/vegan, thus can help food industry better expand their market reach and strengthen their competitive capabilities in the global markets. Such vast potential will contribute significantly to the profitability and sustainability of the Canadian oat and barley industry.

Value to the Industry:

The egg prices increase from US$1.04/dozen in 2014 to $2.21/dozen in 2015. The oat price was CAN$228.89/tonne in 2015. The oat proteins may offer ingredient suppliers a more cost effective ingredient that has similar functionalities to egg white proteins. The use of barley proteins as a potential substitute for wheat gluten, and oat protein gels as a functional replacement for egg white proteins will generate new market opportunities with the food industry for these crops.

Value to Team:

This research has provided training for three PhD students, and one Research Associate in a dynamic academic-industrial collaborative environment.