Product Development from Gluten Free Oat Fractions

Final Report

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SUMMARY

Recently the human food market for oat has been gaining momentum mainly due to the growing public awareness of the health benefits of beta-glucan for reducing blood cholesterol and regulating blood glucose levels. The remaining components such as protein, starch and oil are awaiting research to develop their full value. For example, oats have the highest protein level (12-24%) among cereals with nutritive value nearly equivalent to soy and pea protein. Oat proteins are gaining in popularity among food manufacturers due to its high nutritive value and neutral flavor and taste.

This project is being driven by an emerging industry interest in using fractionated gluten free oat ingredients (protein, starch, fiber) as a source of product innovation. The program has developed a pilot fractionation process for oats that can produce quality ingredient fractions from oats. The combination of this developing fractionation capability and the emerging interest in gluten free oat fractions is creating a product development opportunity, which could gradually increase the utilization of oat ingredients within specific market segments. One of the project's primary goals is to demonstrate how the unique functionalities of oats can be used to improve existing products or develop innovative products that can be commercialized. Specifically two oat fractions from gluten-free oats (Avena Foods, Regina, SK) are focused including a protein fraction containing 70.2% protein, and a starch fraction containing 71.1% starch, 15.5% protein and 1.8% β-glucan.

With the support of the Prairie Oat Growers Association (POGA) and the Alberta Crop Industry Development Fund (ACIDF), the University of Alberta in collaboration with the Northern Alberta Institute of Technology (NAIT) has successfully developed four food prototypes using oat protein and oat starch fractions. These include meat analogue, pasta, doughnut and ice cream. All these food products developed fit into the niche category of being gluten-free and vegan. These good prototypes also represent good models to test protein or starch functionalities such as foaming and emulsifying properties (ice cream, doughnut) and gelling capacity (pasta, meat analogue). Also they reflect industry's interest to replace egg and dairy proteins in food formulations. In some formulations, new foods with a high protein inclusion were developed that are qualify for high protein claims.

The key attributes of each food prototype with different oat ingredient inclusion levels were evaluated such as protein content, moisture retention, texture and nutritive value. The oat starch alone did not give the meat analogue the desired meat-like texture, however, and acceptable meat-like texture was achieved with the addition of konjac and xanthan gum. Oat starch has a gelling capacity which contributed to the product texture by increasing the hardness and chewiness. The formulations can be further improved by increasing the product springiness and cohesiveness. The nutrition facts table shows the meat analogue samples are significantly lower in fat content (~50% reduction) compared to beef patty based on the same calory. In addition, the meat analogue product is high in dietary fiber that bring additional health benefits.

Doughnuts are often perceived as a high-glycemic and high-caloric, thus manufacturers have responded by creating products with more plant based ingredients. In this work, oat proteins have shown potential to be used as an egg-replacer in doughnut recipe due to their emulsifying and foaming characteristics. The final products have good sensory quality and are qualified for a high protein claim. On the other hand, egg is superior to provide product texture and cohesiveness. Interestingly, oat proteins can slow down doughnut hardening during storage at freezing temperature probably due to formation of oat protein gel that also better hold moisture during the freezing-thawing process.

The combination of oat protein and oat starch provides gelling capacity, and acts as an efficient binder in gluten free pasta formulations. The addition of oat and pulse protein ingredients makes the pasta products suitable for high protein claim. Texture analysis suggests that improvements in the product strength and elasticity may be needed in order to increase the overall acceptance.

Imitation ice creams have also attracted interest, both for the purpose of eliminating dairy components that cause allergic or intolerance reactions, and to eliminate dairy fat and cholesterol. This research has demonstrated the feasibility of using oat milk and oat protein as an egg-replacer to make imitation ice cream products. Oat protein served as emulsifier in the formulation, but also formed an entangled network when combined with gum to improve aeration, provide texture and restrict ice crystal growth. The developed all oat frozen-non dairy ice cream have the creamy texture, mouth feel and appearance of an ice cream product. In addition, they are much lower in calories (~60% reduction) and fat content (~90% reduction) compared to the typical dairy ice cream in the market.

Overall, the results obtained from this project are extremely valuable in showcasing the applications of oat fractions in popular consumer food products and promoting an increase of oat fractions for human consumption. Considering the consumers' demand of convenient snack foods that are high in protein and suitable for vegan, the oat protein based doughnuts and imitation ice creams may have potential for commercialization with some improvements in texture.