

## MPSG ANNUAL EXTENSION REPORT

**PROJECT TITLE:** Development of Prairie Pulse-Based Shelf-Stable Vegetarian Chili in Semi-Rigid Containers Using Retort Technology

**PROJECT START DATE:** 1 September 2015

**PROJECT END DATE:** 31 August 2017

**DATE SUBMITTED:** 13 September 2016

### *PART 1: PRINCIPAL RESEARCHER*

#### PRINCIPAL

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### *PART 2: EXECUTIVE SUMMARY*

Canada's food guide encourages Canadians to consume meat alternatives such as beans, lentils and tofu often (Health Canada, 2015). Given the gluten-free nature of pulses, they are an excellent choice for gluten sensitive consumers or even those with celiac disease. Pulse consumption is linked to numerous health benefits (Anderson and Major, 2002). Canada is one of the largest producers of pulses, with pinto beans, black beans, and kidney beans being produced in large quantities. However, the consumption of pulses is relatively low among Canadians compared to Asian consumers. Creating applications such as vegetarian chili may increase the consumption of pulses.

In today's busy world, ready-to-eat foods provide consumers with the convenience of as eating-on the-go, short preparation time, and single serve great tasting healthy foods. Additionally, beans are an inexpensive source of protein to include in the trend.

An initial market survey done on the local market in Manitoba showed that there were very few vegetarian chilis on the retail shelf. Compliments, Blue Menu, and Stagg are the three common vegetarian chilis existing on the market. Sensory evaluation conducted on these products revealed the amount of vegetables used; and, sensory (colour, flavour, and texture) differences among the products. Additional details showed that the most commonly used beans in commercial chili in order of frequency of usage are; kidney beans, pink (chili) beans, and black beans.

Pre treatment trials were investigated to establish the optimal conditions to process the before retorting. Prior to retort processing, a 60 min pre-treatment were deemed acceptable and with good texture and integrity. The colour paled in comparison to the 10 min pre-treatment. Retort over 10 min was deemed unnecessary and potentially detrimental to the bean integrity. FDC has successfully developed a prototype chili product.

### ***PART 3: EXPERIMENT DESCRIPTION & RESULTS***

#### **PHASE 1**

##### **Market Study**

An initial market survey was conducted to establish the availability and types of shelf stable vegetable chili on the market. Samples were purchased and a preliminary sensory evaluation was conducted to understand their taste profiles and bean texture/integrity.

The study conducted on the local market in Manitoba (Portage la Prairie and Winnipeg) showed that there were few vegetarian chilis on the market. Compliments, Blue Menu, and Stagg are the three common vegetarian chilis existing on the market. Sensory evaluation conducted on the chilis showed that the Stagg chili contained a good amount of vegetables compared to its counter parts. The Stagg chili was found to be dark with a high chili flavor and nice aroma. The Compliments vegetarian chili was identified as having a sauce that was glossy, runny, starchy, and a slightly subdued chili flavour. The Blue Menu chili was identified as having an intense tomato taste however, the sauce was glossy and starchy. Few panelists identified that the products lacked a good amount of vegetable content; had lingering heat and the “pork and beans” feel.

The most commonly used beans in commercial chili in order of frequency of usage are; kidney beans, pink (chili) beans, and black beans.

##### **Pre-treatment:**

Pre treatment trials were investigated to establish the optimal conditions to process the pulses/legumes before retorting. Each trial included kidney beans, navy beans, black beans, and soy beans (ratio 1:1:1:0.5). The pulses/legumes were processed in approximately 20L of water in a 40L electric kettle.

- 1) Trial 1: The pulses/legumes were boiled for 2 min followed by a change of water and held at 85°C for 60 min.
- 2) Trial 2: The pulses/legumes were boiled for 60 min at 96-99°C without changing the water or a hold.
- 3) Trial 3: The pulses/legumes were boiled for 60 min at 96-99°C without changing the water (same as trial 2 with small size kidney beans) or hold.

##### **Retort Trials:**

The pre-treated packages containing 120 g of beans (mixed) and 100 g of water were split into three sets. Each set was processed in the retort for 10, 20, or 30 min of cook time (plus 25 minutes ramp and cool down) at a temperature of 121.1°C (250°F).



### **Product Evaluation:**

The retort processed samples were assessed by sensory panellists composed of five FDC staff. The panellist determined the most acceptable combination of the pre-treatment and retort parameters. The results from the assessment were as follows:

The pre-treatment produced similar results, but trial 2 samples were softer and less acceptable when compared to trial 1. Panellists commented that trial 2 samples were acceptable, but were more tacky, pasty, and sticky in the mouth than samples from trial 1. In trial 1, samples pre-treated for the shortest time (15 min) and retort processed for a short cook time (10 min) were preferred by all 5 panellists. The samples had:

- good texture,
- nice mouth feel,
- appealing colour and,
- lacked pastiness or mushiness.

The trial 3 samples were ranked the best overall (compared to trial 1 and 2) because the samples were intact (smaller size chili beans).

Generally, a 60 min pre-treatment and 30 min retort cook time resulted in flavour degradation according to the panellists. As the pre-treatment or retort time increased, the sensory quality decreased as evident in overly soft texture, and dull colour and mushy appearance.

Prior to retort processing, a 60 min pre-treatment were deemed acceptable and with good texture and integrity. Although, the colour of the beans paled more after 60 min in comparison to the 10 min pre-treatment. Also, retort processing over 10 min was deemed unnecessary and potentially detrimental to the integrity of the bean. Samples pre-treated for 30-40 min had acceptable bean texture, flavour, colour, and integrity. Hence, further experiments based on trial #3 were conducted.

### **PHASE 2**

In the first phase of the pre-treatment trials, the pulses and legumes showed acceptable texture/quality following a 30-40 min pre-treatment. However, when the pre-treated pulses/legumes were used in the chili formulation trials that involved the addition of chili ingredients (tomato sauce, vegetables, textured vegetable protein, chili powder, oil, and spices) the quality was adversely affected. The blanched pulses/legumes resulted in a soft product; and unacceptable overall quality after retorting. Hence the pulses/legumes were pre-treated individually for 20-60 min to obtain the desired texture. The drained material was held in the cooler (1°C) for 24-36 hr before use. The chili was formulated and processed using the retort technology.

The chili produced using retort technology is shown in Figure 1 (unopened), and Figure 2 shows the product after transferring from the retort pouch (Appendix). The developed chili had a unique appealing flavour; and texture that is similar to commercial products.

Microbial counts indicated that the product and packaging material did not allow microbial growth as values of  $\leq 10$  cfu/g (colony forming unit per gram) obtained after six weeks signified the absence of microbial activity. Hence, the chili was safe to consume at week 6.



Future work will involve processing to ensure commercial sterility. Attempts will be made to improve the overall quality based on the sensory results. The nutritional profile of the final product will be analysed using Genesis database software to determine appropriate nutrient content/health claims.

#### **PART 4: RELEVANCE TO FARMERS AND FUTURE RESEARCH**

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Pulses and legumes are readily available in larger quantities and are available all year round. Sourcing the raw materials from Manitoba growers to process chili products would facilitate the transfer of the process into commercial operation.

- The development of a ready-to-eat vegetarian chili with ingredients grown in Manitoba indicates that locally grown pulses and legumes are as competitive as the outsourced ones in these applications. Furthermore, it promotes the potential of these ingredients in readily available foods/shelf-stable products.
- Canadian grown pulses and legumes have a reputation for high quality and are often more economical as local ingredients.
- The use of other vegetables such as corn and carrots provide visual and textural contrast and could potentially influence the cost of the products.

#### **PART 5: COMMUNICATION**

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The research has not generated enough information to produce communication materials.

##### **References:**

<http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/choose-choix/meat-viande/index-eng.php> , accessed from January 2016 to May 2016.

Anderson, J.W., and Major, A.W. (2002). Pulses and lipaemia, short- and long-term effect: Potential in the prevention of cardiovascular disease. *British Journal of Nutrition*, 88, Suppl. 3, S263–S271



**APPENDIX**

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**Figure 1: Ready-to-eat vegetarian chili (lot # 210716) in a retort pouch six weeks after processing.**



**Figure 2: Ready-to-eat vegetarian chili (lot # 210716) sampled from retort pouch six weeks after processing.**



**Retort technology:**

Retort processing is an in-container sterilization for low acid (pH greater than 4.6) food products such as pulses, cereal grains, meat, fish, etc. The process kills all commonly occurring microorganisms and bacteria, and prevents spoilage at ambient conditions (shelf stable).

Retort technology was originally developed several years ago by the National Aeronautics and Space Administration to preserve the natural flavour and nutrition in food products. Recently, the technology embraced desirable new packaging formats such as flexible pouches to replace the traditional glass jars and metal cans that were in use for decades. The new operating system also allows for agitation processes to ease cook times and reduce degradation of food quality.

In summary,

- Retorting is a proven and safe technology used to produce shelf stable low acid products.
- Retort is used to process packages such as pouches, metal cans and plastic bowls heated to approximately 118 to 121°C under high pressure.
- The retort uses a recipe-driven cycle to allow for short-time, high-temperature cooking, and controlled efficient cooling to maintaining package integrity and product quality.
- The unopened products remain shelf stable without the need for refrigeration or freezing.

The Food Development Centre uses batch retorting to achieve process flexibility for products. The chili was cooked in special pouches that allow for sterilization. In the process, the partially cooked beans and sauce are placed in pouches and fully cooked in a “retort” to achieve commercial sterility; hence no refrigeration is required until the product is opened. Retortable pouches are extensively used for food ration meals, and for ready-to-eat products.

**Approach/application:**

The research in developing the vegetarian chili using three types of pulses combined with legumes (soybeans) is another new trend, as is the inclusion of vegetables such as carrot, mushrooms and corn kernels. The prototype chili product is formulated as a low fat and low salt containing product. The trend is gaining popularity among consumers, and with the right messaging that pulses are beneficial to our overall health management. This type of processing creates opportunities for pulse consumption.

In addition, an innovative approach on the pre-treatment is being evaluated to obtain whole pulses and legumes (reduce splitting) after processing, as well as improving the nutritional profile of the prototype chili.

**Benefits:**

Beans are an inexpensive source of plant protein for consumers. The consumption of plant based protein products is getting trendy, and there are few vegetarian chilis on the retail shelf compared to cereal based snacks. Furthermore, the slight defective sensory attributes observed in vegetarian products sampled, this project is to explore the opportunities of improving on the defects. Also, very few products currently on the retail shelf incorporate sufficient pulses to the sauce ratio, and use mostly 1 to 2 types of pulses. The prototype chili is aimed to increase the use of more pulse types, and to potentially increase usage by consumers; resulting in a benefit to the growers.

The Food Development Centre does not have the capacity to commercially produce the developed chili product but can work collaboratively with interest groups (farmers, processors, etc) to transfer the information generated from the research/technology through presentations to industry associations.