

***“Extension of Shelf life on Refrigerated Soy Spread and Utilization of Soy in
Non-Dairy Yogurt”***

**Final Report:
*Utilization of Soy in Non-Dairy Yogurt”***

Submitted to:

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Utilization of Soy in Non-dairy Yogurt

Achievements

- Soy yogurt developed from a soy milk extraction of a genetically engineered soybean variety was utilized to develop a soy yogurt beverage prototype that was successfully manufactured at the Food Development Centre (FDC) pilot plant. The process involved the soy milk extraction from whole soybeans and soy press cake; a soy yogurt process development; a soy beverage formulation and process development. The Industry partner, NuEats under the Manitoba Agri-Health Research Network (MAHRN) presented this beverage at Crop Connect, Winnipeg, Manitoba in February 2015 to a sample group of 100 people, where it is well received.
- The beverage quality characteristics, nutrition facts table, ingredient listing and shelf life analysis were conducted to prepare the beverage for commercialization.
- The project resulted in secondary outcomes: the soy milk extraction process developed from genetically engineered soybeans and the processes for reduction of the grassy-beanie flavour in soy milk and a drinkable soy yogurt.
- Review of Health Canada newly released document (March 24, 2015) "Summary of Health Canada's Assessment of a Health Claim about Soy Protein and Cholesterol Lowering" The prescribed wording and prerequisite nutrient levels to meet the conditions of a health claim about the consumption of soy protein and cholesterol lowering on the soy beverage prototype to meet the nutrient claims.

1.0 Introduction

An increased development of soy-based products, including soy yogurts and soy spreads can offer food solutions for the lactose intolerant diets. The lactose intolerant diets are more common in the Asian population. Over the past decade the Asian-American population showed 70% growth in the US market creating a demand for Asian foods and lactose-free foods (Soyfoods, 2012). This in turn, can create a demand for Manitoba soy beans and can further establish a domestic soy processing value-added industry in Manitoba. The project utilized a genetically engineered soy bean variety, a dominant type grown in Manitoba which has not been yet selected for food traits. It is difficult to overcome and avoid the occurrence of the grassy-beanie flavour of soybean in food products. A beanie flavour is an undesirable trait that limits the use and application of the soybean as a food product. Any improvements in flavour and quality identified in the prototypes will create a competitive advantage for Manitoba grown soy over processors who tend to use food grade or non GM soy beans.

A fermentation process researched under MPGA in the project, "Prototype Development of a Soy-saskatoon Smoothie (2013-2014) and the FDC Project 3568" proved successful in reducing and masking the beanie flavour of soy through a lactic acid fermentation process, allowing for the utilization of soy products (defatted soy cake) as a non-dairy alternative. The lactic acid fermentation flavour masking of the beanie and grassy taste of soy milk was also earlier determined by Beasley et al (2002). As the product development intensified it was determined that a soy yogurt and soy beverage could be a more shelf stable market ready product and the challenges of developing this product were undertaken.

The project aimed to investigate if an acceptable, less beanie soy beverage could be created from genetically engineered soy bean variety.

The specific objectives of the project were to:

- Modify and improve the laboratory scale prototype for soy yogurt beverage from genetically engineered soy beans or defatted soy cake, developed in FDC Project 3568 (201-2014) for commercialization.
- Develop processes for manufacturing the soy yogurt beverage and identify pilot plant equipment for producing scaled up batches.
- Develop nutrition fact table (NFT) for the beverage.
- Produce samples for NuEats (MAHRN) for consumer tasting.
- Assess shelf life of the beverage stored under refrigeration.

2.0 Material and Methods

Initial assessment of the project work developed under MPGA “Prototype Development of a Soy-saskatoon Smoothie (2013-2014) and the FDC Project 3568” work was reviewed to understand the challenges that were required to be resolved.

2.1 Formula and Processing Method Development

2.1.1 Soy Milk Extraction

Changes in the soy milk extraction process were required as the defatted soy cake initially used in previous development work was no longer available for this project. A process for soy milk extraction from whole soy bean was developed in this project. During the development several processing methods were investigated to overcome the grassy-beanie flavour. Measurements for water to soy bean ratio, soaking time and water temperature in addition to the most suitable extraction equipment were tested to obtain high yield and good quality soy milk flavour.

2.1.2 Soy Yogurt

The soy yogurt reformulation was based on the restricted availability of ingredients initially used in FDC Project #3658. The low fat soy milk produced from soy cake was replaced by high fat soy milk prepared from whole soy beans. As well, quantitative formulation adjustments were made to the whole soy milk and white grape juice concentrate. The soy yogurt process was adjusted to effectively hydrate and homogenize all ingredients and fat as well as achieve a drinkable yogurt type texture; achieve the pH level 4.4 to 4.6 and a minimum 0.6% lactic acid content, for a distinctive yogurt characteristic. A commercial yogurt culture for vegetal product was used in the inoculation procedure.

2.1.3 Soy Beverage

The original formula for soy berry beverage was adjusted based on the availability of ingredients and alternative ingredient replacement was considered.

1. Saskatoon berry juice (18 °Brix) was replaced with Saskatoon berry syrup (38 °Brix).
2. Sour cherry juice (20°Brix) was replaced with Sour cherry concentrate (68°Brix) or Sour cherry puree (12°Brix)
3. Black currant juice (18°Brix)was replaced with Black currant concentrate (65°Brix)
4. Dairyblend 850 was eliminated as it was directly added to the soy yogurt.
5. Saskatoon berry flavour was increase and a masking agent was added to reduce the beanie notes.
6. Several trials were conducted and the most successful formulations were tested with a small group of sensory panellists. The process to prepare the soy beverage included:
 - Preparation of the soymilk from soy beans
 - Preparation of soy yogurt from the soymilk
 - Preparation of the beverage from the soy yogurt.



The equipment layout for beverage processing is shown in Figure 1. The final soy beverage ingredients were measured out, mixed well, pasteurized, homogenized, filled into glass bottles, cooled, packaged and stored for shelf life testing. A presentation of the soy yogurt beverage was made to NuEats for product acceptance. The formulation accepted by NuEats was produced at the FDC pilot plant facility to a batch size of 50L. Samples of this batch were introduced to about 100 panellists.

Figure 1 Equipment Layout for beverage processing

2.1.4 Quality Assessment

1. The Brix level of the smoothie was measured using a Refractometer (Model# Reichert Mark II plus) and the pH value was measured by a Fisher Scientific pH meter (Accumet®Excel XL50).
2. The total acidity and lactic acid content were measured by titrating with 0.1N sodium hydroxide. The total acidity was titrated until the pH value of 8.4 was achieved and calculated as a percentage of malic acid. The end point for lactic acid was determined by titrating until the first pink color lasted 10 seconds.
3. Sensory evaluation was conducted with 8-10 panelists, qualified as end users of this beverage. Sweetness, tartness, flavour balance, creaminess and overall acceptability were rated using a 4-point hedonic scales.
4. Microbiological testing on shelf life samples were analyzed for Total Aerobic Plate Count, Yeast, Mould and E.Coli. The analytical references are:
MFHPB-33 – Enumeration of Total Aerobic Bacteria in Food Products and Food Ingredients Using 3M™ Petrifilm™ Aerobic Count Plates
MFHPB-32 – Enumeration of Yeast and Mold in Food Products and Food Ingredients Using 3M™ Petrifilm™ Yeast and Mold Count Plates
MFHPB-34 – Enumeration of E.coli/Coliform Count in Food Products and Food Ingredients Using 3M™ Petrifilm™ E-coli/Coliform Count Plates

2.1.5 Nutritional Labelling

Genesis SQL R&D database (ESHA Research, Salem, OR, USA) and certificates of analyses for ingredients were used to generate the Nutrition Facts Tables (NFTs) of the soy beverage.

2.1.6 Shelf life Analysis

The shelf life of production samples is currently ongoing. Samples are stored at refrigeration temperature (1 to 2°C) and tested weekly for pH, colour, sensory analysis and microbiological tests for standard plate count, *Yeast and Mould*, Total Coliforms and *E.Coli*.

3.0 Results

3.1 Soy Yogurt

Two formulations of soy yogurt were acceptable for preparing the beverage as an original flavour and a saskatoon soy yogurt. The original flavour was chosen to move forward to the beverage development as it would allow for a more cost effective beverage.

3.2 Soy Yogurt Beverage



Figure 2: Soy Yogurt Beverage

A final beverage prototype developed (Figure 2) and the sensory evaluation was received from panellists as moderately to very good in overall acceptance. The sensory qualities of the beverage was described by panellists as having an attractive pink color from the berries, creamy texture, somewhat quenching, fruity flavour and only slight to no taste of beanie flavour detected. The beverage displayed a separation of two phases and will require shaking before consuming. The physical characteristics of the prototypes are listed in Table 1.

Table 1 Physical characteristics of the soy yogurt and soy beverage

Soy yogurt base		Soy yogurt		Soy berry beverage	
Total solids %	17.8-18.7	Total solids %	17.4	Total solids %	17.3
°Brix	14- 14.2	°Brix	12.5	°Brix	12.9
pH	5.77-5.85	pH	4.48	pH	4.3

3.3 Nutritional Labelling

The NFT generated by the Genesis SQL R&D database is shown in Figure 3, and the ingredient listing outlined.

Nutrition Facts	
Valeur nutritive	
Per 148 mL / par 148 mL	
Amount Teneur	% Daily Value % valeur quotidienne
Calories / Calories 110	
Fat / Lipides 4.5 g	7 %
Saturated / saturés 0.5 g	3 %
+ Trans / trans 0 g	
Cholesterol / Cholestérol 0 mg	
Sodium / Sodium 10 mg	1 %
Carbohydrate / Glucides 12 g	4 %
Fibre / Fibres 2 g	8 %
Sugars / Sucres 8 g	
Protein / Protéines 7 g	
Vitamin A / Vitamine A	0 %
Vitamin C / Vitamine C	0 %
Calcium / Calcium	4 %
Iron / Fer	8 %

INGREDIENT LISTING

SOYBEANS, WATER, WHITE GRAPES, SASKATOON, RED TART CHERRIES, NATURAL FLAVOUR, PROPYLENE GLYCOL, ETHYL ALCOHOL, CURRANTS, PECTIN, GUAR GUM, BACTERIAL CULTURE

According to the Canadian Guide to Food Labelling and Advertising, the following nutrient content claims can be made for the soy yogurt beverage based on 150 mL serving size and 250 mL reference amount:

- Source of Energy
- Low in Saturated Fatty Acids
- Free of Trans Fatty Acids
- Free of Cholesterol
- Low in Sodium
- Source of Iron

Figure 3: NFT soy beverage

Review of Health Canada Assessment of a Health Claim about Soy Protein and Cholesterol Lowering

On March 24, 2015 Health Canada released the document “Summary of Health Canada’s Assessment of a Health Claim about Soy Protein and Cholesterol Lowering” The prescribed wording and prerequisite nutrient levels to meet the conditions of a health claim about the consumption of soy protein and cholesterol lowering are provided in this document. The document can be found at:

<http://www.hc-sc.gc.ca/fn-an/label-etiquet/claims-reclam/assess-evalu/soy-protein-cholesterol-eng.php>

The nutrition facts table for the soy yogurt beverage (Figure 3) illustrates that that this beverage meets most of the criteria for the soy consumption and the reduction of cholesterol. The current formulation does not contain a minimum of 10% of a mineral or vitamin per reference and serving of stated size nor does it meet the requirements for fortified plant based beverages. In order to meet the prerequisite nutrient levels the current formulation would only require added fortification.

3.4 HACCP Plan

A HACCP Plan #87 for the soy yogurt beverage production at FDC has been developed and will be validated upon completion of the shelf life study.

4.0 Discussion and Conclusions

The research work evaluated a genetically engineered soy bean variety (produced locally in Manitoba) in a food/beverage application for soy yogurt and soy beverage. The processing techniques determined that the reduction of beanie characteristic flavours of soy can result in high quality, great tasting products.

Product development challenges identified the separation of the beverage into two phases after storage. The beverage will require instructions on the label to shake before drinking. Use of functional ingredients such as gums and stabilizers as well as additional processing steps designed to improve the homogenization and filling temperature can also be considered for product improvement. The addition of vitamin and mineral fortification will allow for soy consumption and the reduction of cholesterol claim. The development of these products is at the stage that a small amount of trials are required for the process to be made ready to transfer to turnkey commercialization. These formulations and processes can be transformed into cost effective value added soy yogurts and soy beverages.

5.0 Recommendation

Greater opportunities can be explored for the North American market as the results of the project proved that genetically engineered soybeans typically grown for oil extraction can be processed to mask the soy beanie flavour for food applications such as soy milk, yogurts and beverages. Further food applications can be explored to include frozen soy desserts, kefir, energy bars and bakery products.

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