

FINAL REPORT

Pea Fibre Utilization in Ground Poultry, Beef, and/or Pork Project# 3747

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Executive Summary

The project evaluated the functional effects of pea fibre from yellow peas on ground beef, pork and chicken patties at pea fibre levels (2%, 4% and 6%) required to meet Health Canada “fibre” nutrient claim.

Industry partners of the project were Best Cooking Pulses and Nutri-Pea Limited who provided three different commercial pea fibre ingredients. Beef, pork and chicken patty formulas were developed with three different pea fibre ingredients (Best Pea Fibre, Centara III and Uptake 80) at three different levels of pea fibre (2%, 4% and 6%). The three levels of pea fibre were selected to achieve the minimum levels required for the nutrient content claim of “fibre”.

Based on sensory evaluation results the most successful ground meat patty formulas with acceptability scores of 3 or higher were selected to be scaled up. The selected ground meat patty formulas were: 2% and 4% of pea fibre using Best Pea Fibre or Centara III and 2% pea fibre using Uptake 80. Descriptive sensory and cooking properties evaluations were carried out on the meat patties.

Results suggest that pea fibre can be used in beef and pork patty formulas at levels of 2% and 4% or in chicken patties formulas at 2% without affecting sensory attributes like juiciness, tenderness or adding any off flavour.

Addition of pea fibre to ground beef and pork patties improved the cooking yield of the patties but were inconclusive on moisture loss. However, addition of pea fibre to ground chicken patties did not have any conclusive impact on cooking yield or moisture loss.

Cost comparison between ground beef, pork and chicken patty control formulas and formulas with 2% and 4% of pea fibre showed a cost reduction between 1% and 15% depending on the specific pea fibre ingredient used.

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- To Industry partners Best Cooking Pulses and Nutri-Pea Limited for the pea fibre ingredients.

The information presented in this report is correct to the best of authors' knowledge. World Wide Web sites that have been referred to may or may not contain the information at a later date.

1. Introduction

Health Canada classifies pea fibre as a novel fibre source, allowing the incorporation of pea fibre in meat to make a “fibre” nutrient content claim. However, currently there is little information about how to apply the pea fibre to meat products in order to obtain formulas with acceptable sensory profiles.

Additionally to the health benefit of pea fibre and the ability to make a “fibre” nutrient claim, there are many other potential advantages of utilizing pea fibre as a functional ingredient in meat. Addition of pea fibre to meat patties has been reported to provide good functional properties such as moisture retention and improved cooking yield (Anderson and Berry, 2000). Moreover, current market trends which indicate the interest of consumers for healthy products and price as the main drivers that initiate customers to buy meat and frozen meat products (Euromonitor International, 2014; Neville A, 2014).

The objective of the project was to evaluate the effect of pea fibre manufactured from yellow peas in ground meat patties. The project included developing of beef, pork and chicken patty formulas with pea fibre at levels required to make the meet “fibre” nutrient content claim. The product development of the patties considered the masking of green, bitter and grainy flavours of pea to achieve sensory acceptability. Functional, sensory and economic aspects were compared between developed patty formulas with pea fibre and control patty formulas without pea fibre. Industry partners of the project Best Cooking Pulses and Nutri-Pea Limited, processors of yellow peas into flour, protein, fiber and starch provided the pea fiber ingredients for the project.

2. Objectives

1. To study the application of yellow pea fibre, in ground poultry, beef, and pork products as functional, nutritional and cost benefits in addition to recommending the usage level.
2. To evaluate how the addition of pea fibre impacts sensory properties, cooking yield, color, moisture retention capacity.
3. To develop beef, pork and chicken patty formulas with sensory acceptability

3. Method and Materials

Three different commercial pea fiber ingredients provided by Best Cooking Pulses and Nutri-Pea Limited were selected for this project (Table 1).

3.1 Experimental Design

Patty formulas were developed with three different pea fiber ingredients (Best Pea Fibre, Centara III and Uptake 80) at three different levels of pea fibre (2%, 4% and 6%) which were selected to achieve the minimum levels required to make the nutrient content claim of “fibre”.

Table 1. Pea Fibre Ingredients

Supplier	Name	Fibre content	Fibre source	Process
Best Cooking Pluses	Best Pea Fibre	>91%	Hull	Dry milling
Nutri-Pea limited	Centara III	85%	Hull	Wet milling
Nutri-Pea limited	Uptake 80	35%	Cell Wall	Wet milling

The three pea fibre ingredients used in the project contains different amount of total fibre (Table 1), so it was necessary to formulate the meat patties at a different addition rate for each pea fibre ingredient used in order to achieve the same level of dietary fibre (Table 2).

Table 2. Pea Fibre Ingredient Addition Required to Achieve Dietary Fibre Requirements for Dietary Fibre Claims on Meat Patties

Best Pea Fibre			
Ingredient (%)	2.22	4.44	6.67
Pea Fibre (%)	2.00	4.00	6.00
Centara III			
Ingredient (%)	2.35	4.71	7.06
Pea Fibre (%)	2.00	4.00	6.00
Uptake 90			
Ingredient (%)	5.71	11.43	17.14
Pea Fibre (%)	2.00	4.00	6.00

4. Ground Meat Patties Formulas Development

Several beef, pork and chicken patty formulas with different spice combination and without any binders or extender were developed to mask the pea flavour. A sensory panel group (4-8 panelists) from the FDC staff evaluated the sensory acceptability of the various formulas.

The selected beef, pork and chicken patty formulas included a control formula without pea fibre, and formulas with 2%, 4%, 5% and 6% of pea fibre with each one of the pea fibre ingredients evaluated: Best Pea Fibre, Centara III and Uptake 80. Ground meat patties were

cooked according to the cooking procedure described in section 4.1 and served to a group of panelist to evaluate sensory acceptability of the formulas.

4.1 Cooking Procedure

The meat patties were cooked in a Rational Oven preheated at 163°C according to a procedure described by the American Meat Science Association (AMSA) (1995). The meat patties were cooked to an internal temp of 71°C (160°F) for beef and pork patties and 74°C for chicken patties (recommended degree of doneness by AMSA, 1995).

4.2 Sensory Acceptability Evaluation

A group of eight panelists were selected within the FDC staff. The panelists were asked to evaluate the overall acceptability of the patties, and to comment if they could detect any pea flavor. A sensory ballot was developed to evaluate the overall acceptability of the patties. The ballot scored overall acceptability on a five point scale: Like extremely (5), like very much (4), like moderately (3), like slightly (2), dislike (1).

Based on these sensory evaluation results the most successful ground meat patty formulas with acceptability scores of 3 or higher were selected to be prepared in larger batches.

5. Ground Meat Patties Formulas Scale up

The most preferred sensory acceptability formulations by panellists for ground beef (Table 3), pork (Table 4) and chicken patties (Table 5) control formulas and formulas with 2% and 4% of pea fibre using Best Pea Fiber and Centara III and 2% pea fibre using Uptake 80 were selected and scaled up at the pilot plant to a 20 Kg batch (Figure 1). Ground meat patties manufactured in the pilot plant were packaged and stored frozen for at least 2 days and later evaluated by the trained sensory panel.

Figure 1. Patty Manufacture Scaled Up Process

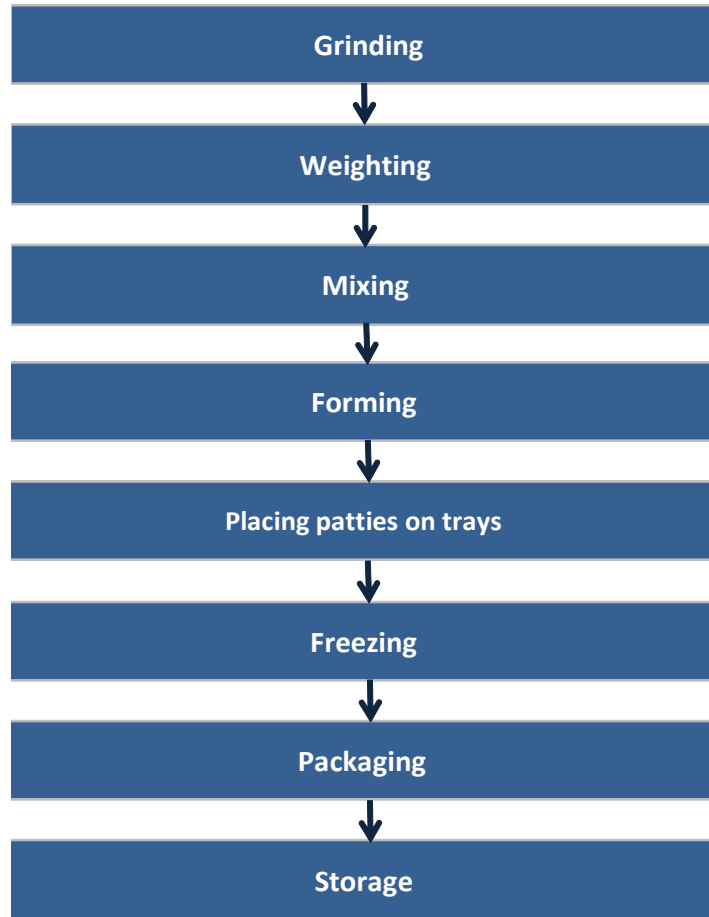


Table 3. Ground Beef Patties Formulas

Ground Beef Patty with Pea Fibre	Control	Best Pea Fibre		Centara III		Uptake 80
	0% Pea Fibre	2% Pea Fibre	4% Pea Fibre	2% Pea Fibre	4% Pea Fibre	2% Pea Fibre
Ingredient	%	%	%	%	%	%
Lean ground beef	85.30	83.08	80.86	82.95	80.59	69.59
Water	12.00	12.00	12.00	12.00	12.00	22.00
Salt	1.20	1.20	1.20	1.20	1.20	1.20
Dried onion	0.85	0.85	0.85	0.85	0.85	0.85
Black pepper	0.40	0.40	0.40	0.40	0.40	0.40
Red pepper	0.25	0.25	0.25	0.25	0.25	0.25
Pea fibre	0.00	2.22	4.44	2.35	4.71	5.71
Total	100.00	100.00	100.00	100.00	100.00	100.00

Table 4. Ground Pork Patties Formulas

Ground Pork Patty with Pea Fibre	Control	Best Pea Fibre		Centara III		Uptake 80
	0% Pea Fibre	2% Pea Fibre	4% Pea Fibre	2% Pea Fibre	4% Pea Fibre	2% Pea Fibre
Ingredient	%	%	%	%	%	%
Lean ground pork	84.75	82.53	80.31	82.40	80.04	69.04
Water	12.00	12.00	12.00	12.00	12.00	22.00
Salt	1.20	1.20	1.20	1.20	1.20	1.20
Dried onion	0.40	0.85	0.85	0.85	0.85	0.85
Ginger	0.85	0.45	0.45	0.45	0.45	0.45
Black pepper	0.45	0.40	0.40	0.40	0.40	0.40
Red pepper	0.10	0.25	0.25	0.25	0.25	0.25
All spice	0.25	0.10	0.10	0.10	0.10	0.10
Pea fibre	0.00	2.22	4.44	2.35	4.71	5.71
Total	100.00	100.00	100.00	100.00	100.00	100.00

Table 5. Ground Chicken Patties Formulas

Ground Chicken Patty with Pea Fibre	Control	Best Pea Fibre		Centara III		Uptake 80
	0% Pea Fibre	2% Pea Fibre	4% Pea Fibre	2% Pea Fibre	4% Pea Fibre	2% Pea Fibre
Ingredient	%	%	%	%	%	%
Lean ground chicken	94.70	92.48	90.26	92.35	89.99	78.99
Water	2.60	2.60	2.60	2.60	2.60	12.60
Salt	1.20	1.20	1.20	1.20	1.20	1.20
Dried onion	0.40	0.85	0.85	0.85	0.85	0.85
Black pepper	0.85	0.40	0.40	0.40	0.40	0.40
Red pepper	0.25	0.25	0.25	0.25	0.25	0.25
Pea fibre	0.00	2.22	4.44	2.35	4.71	5.71
Total	100.00	100.00	100.00	100.00	100.00	100.00

6. Sensory Descriptive and Cooking Properties Evaluation

6.1 Descriptive Sensory Evaluation

A group of eleven trained experienced panelists were selected within the FDC staff. The panelists were provided a training session with the test procedure and the products attributes. A sensory ballot was developed to evaluate the five selected sensory attributes (Appendix A): cooked juiciness (initial and overall), cooked tenderness (initial, overall) and off flavor. Juiciness and tenderness attributes were evaluated on an 8 points scale where 1= extremely dry or tough and 8= extremely juicy or tender. Off flavor intensity was evaluated on 5 points scale where 1=none and 5=extremely intense.

6.2 Cooking Properties

The effect of the addition of pea fibre on the cooking properties of ground meat patties was evaluated by measuring the cooking yield and moisture lost. Change in color was also assessed.

Ground meat patties were cooked according to the cooking procedure described in section 4.1. Patties were removed from the oven and allowed to sit on a cutting tray for 5 minutes prior to commencing the measurements.

6.3 Determination of Cooking Yield and Moisture Loss

Cooking yield and moisture loss were determined using the equations:

$$\text{Cooking Yield} = \frac{\text{Weight of Cooked Patty}}{\text{Weight of Raw Frozen Patty}} \times 100$$

$$\text{Moisture Loss} = \frac{\text{Moisture of Cooked Patty} - \text{Moisture of Raw Frozen Patty}}{\text{Moisture of Raw Frozen patty}} \times 100$$

6.4 Determination of Color Difference

Color was measured using a colorimeter (Mod CR-400, Minolta Camera, Osaka Japan). The colorimeter was standardized using a white tile. Color space coordinates L* (lightness) a* (redness) b* (yellowness) color space were selected. The change in color was determined using the equation:

$$\text{Color Difference}(L, a, b) = \frac{\text{Color of Cooked Patty} - \text{Color of Raw Frozen Patty}}{\text{Color of Raw Frozen patty}} \times 100$$

7. Results and Discussions

Statistical analysis of variance (ANOVA) was carried out using the SPSS Software version 21.0.1 with Advanced Statistics package for Windows (IBM Corporation, Somers, NY). One Way ANOVA with Tukey test using a General Linear Model (GLM) was selected to analyze the descriptive sensory and cooking properties results with pea fiber as the fixed factor and $\alpha < 0.05$ as the level of significance.

7.1 Effect of Pea Fibre on Ground Meat Sensory Attributes

ANOVA analysis showed all sensory attributes evaluated on ground beef patties formulas were similar with no significant difference ($p < 0.05$). Data was analyzed by Tukey test to determine if there was a difference between control beef patties and beef patties with pea fibre. Results showed no significant difference ($p < 0.05$) on all sensory attributes evaluated between control beef patties and beef patties containing pea fibre. Overall results showed that the panelists did not find significant difference in juiciness, tenderness and off-flavor between ground beef patties containing any of the three pea fibre ingredients and the control beef patties without pea fibre.

Descriptive sensory results for pork patties showed results similar to beef patties. ANOVA analysis showed no significant difference ($p > 0.05$) on all sensory attributes evaluated between pork patties with pea fibre and control pork patties without pea fibre. Results analyzed with Tukey test showed no significant difference ($p > 0.05$) on the sensory attributes evaluated between control pork patties and pork patties with pea fibre. Overall results showed panelists did not rate a significant difference ($p > 0.05$) on juiciness, tenderness and off-flavor between pork patties with pea fibre and the control pork patties without pea fibre.

ANOVA analysis on ground chicken patties descriptive sensory results showed significant difference on juiciness (initial and overall) ($p < 0.05$) and tenderness (initial and overall) ($p < 0.05$) between ground chicken patties formulas as a group. Off-flavor attribute showed no significant difference ($p = 0.81$). Analysis of sensory results with Tukey test was carried out to determine which chicken patties with pea fibre presented significant difference compared with control chicken patties. Significant difference was found on initial juiciness between control chicken patties and chicken patties with 4% pea fibre using Best Pea Fibre ($p = 0.02$) and 4% pea fibre using Centara III ($p = 0.03$), which were rated as less juicy (Figure 4). Significant difference was also found on overall juiciness ($p = 0.01$) and tenderness (initial and overall) ($p = 0.01$, $p = 0.02$) between control chicken patties and chicken patties with 4% pea fibre using Centara III, which were rated with less juiciness and tenderness. It is possible that the limited amount of water in the formula could have caused insufficient hydration of the fibre ingredients at levels of 4% fiber, which could have potentially affected juiciness and tenderness of the chicken patties.

Results suggest panelists did not rate a significant difference on juiciness, tenderness and off-flavor between pork patties with pea fibre and the control chicken patties without pea fibre.

Figure 2. Ground Beef Patties Sensory Attributes Rated Means

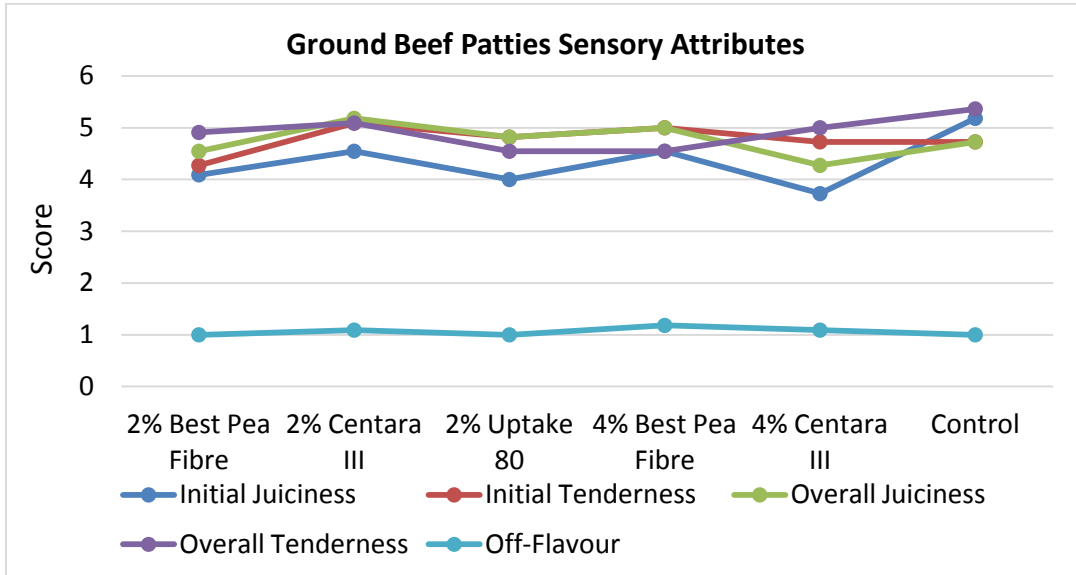


Figure 3. Ground Pork Patties Sensory Attributes Rated Means

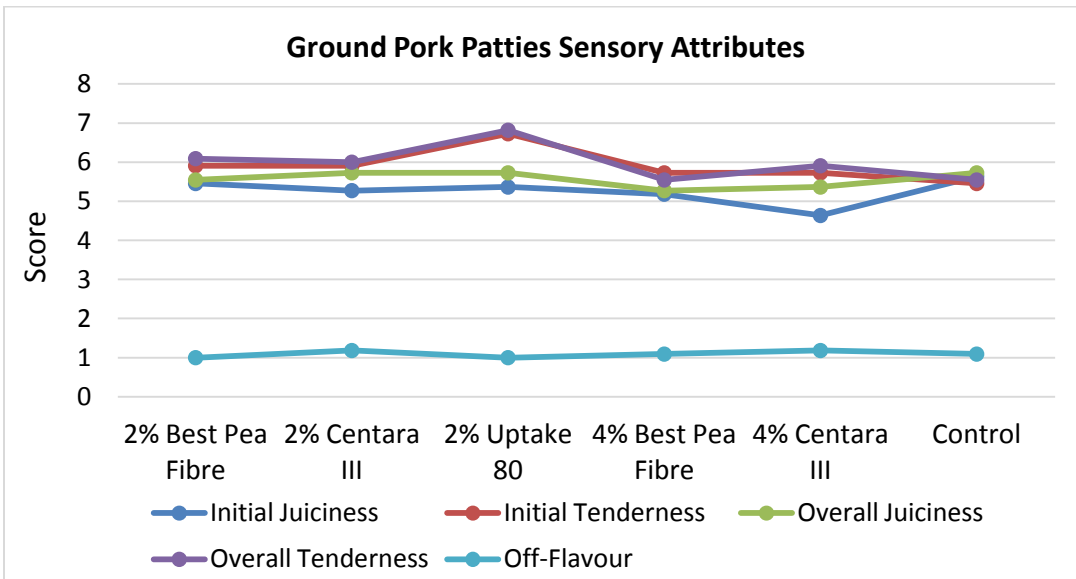
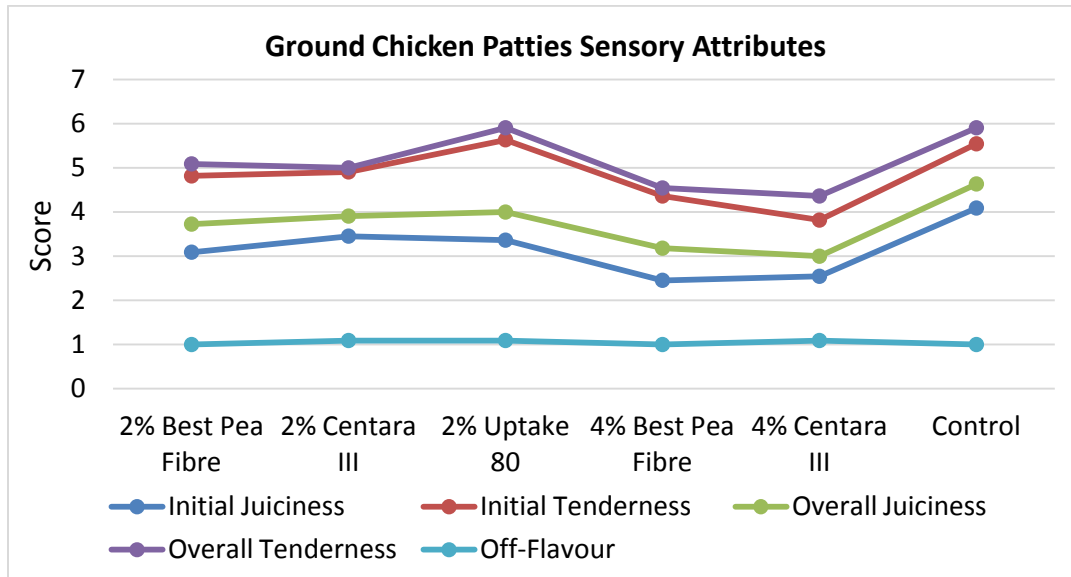


Figure 4. Ground Chicken Patties Sensory Attributes Rated Means



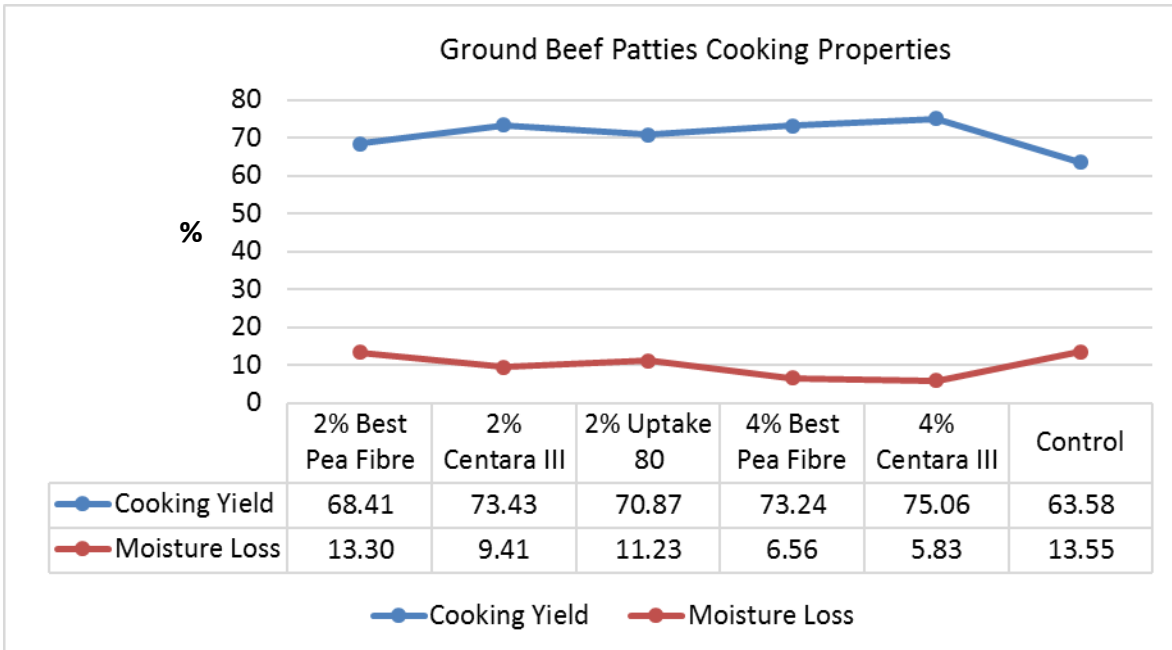
7.2 Effect of Pea Fibre on Ground Meat Patties Cooking Properties.

ANOVA analysis on cooking yield, moisture loss and change in color showed a significant difference between ground beef patties formulas as a group ($p < 0.05$). Results analyzed by Tukey test showed control beef patties had a significant lower cooking yield compared with beef patties with 4 % ($p = 0.00$) pea fibre using Best Pea Fibre, 2% ($p = 0.00$) and 4 % ($p = 0.00$) pea fibre using Centara III and 2% pea fibre using Uptake 80 ($p = 0.00$). Results showed pea fiber at levels of 2% and 4% increase the cooking yield of ground beef patties compared with control beef patties without pea fibre.

Ground beef patties with 4% pea fibre using Centara III showed a significant difference ($p = 0.04$) in lower moisture loss than control formula. However, results were inconclusive on the effect of pea fibre on ground beef patties moisture loss.

Color difference on the coordinates a^* (redness) and b^* (yellowness) did not show significant difference ($p > 0.05$) between any beef patty formulas with pea fibre and the control beef patty formula. However, beef patties with 2% and 4% pea fibre using Best Pea Fiber and 4% pea fibre using Centara III showed significant difference ($p < 0.05$) compared with the control beef patties on the coordinate L^* (lightness). Results suggest the addition of pea fibre affects the lightness component of the beef patties, and this effect may increase as the pea fibre content is increased.

Figure 5. Ground Beef Patties Cooking Properties Means



ANOVA analysis on cooking yield and change in color results showed a significant difference between ground pork patty formulas as a group ($p < 0.05$). However, ANOVA analysis showed no significant difference ($p > 0.05$) on moisture loss between pork patty formulas as a group. Analysis showed pork patties with 2% and 4% pea fibre using Best Pea Fibre, 4% pea fibre using Centara III and 2% pea fibre using Uptake 80 had a significant ($p = 0.00$) higher cooking yield than the control pork patties. Results showed that pea fibre at levels of 2% and 4% increased the cooking yield of ground pork patties compared with the control ground pork patties without pea fibre, with the exception of Centara III pea fibre at a 2% application rate.

Results analyzed by Tukey showed no significant difference ($p > 0.05$) on moisture loss between pork patties with pea fibre and control pork patties.

Significant color difference ($p < 0.05$) on the color coordinate L^* (lightness) was found between pork patties with 2% pea fibre using Centara III and the control patties. Additionally, there was a significant color difference ($p < 0.05$) on the color coordinate a^* (redness) between pork patties with 4% pea fibre using Best Pea Fibre and the control pork patties.

ANOVA analysis on cooking yield, moisture loss and change in color showed a significant ($p < 0.05$) difference between ground chicken patty formulas as a group. Moreover, Tukey test showed that there was no significant difference ($p > 0.05$) on cooking yield and moisture loss between chicken patties with pea fiber and control chicken patties. As explained in section 7.2.3, the smaller amount of water on chicken patties formulas may have affected the pea fibre performance and its effect on cooking yield and moisture loss.

Figure 6. Ground Pork Patties Cooking Properties Means

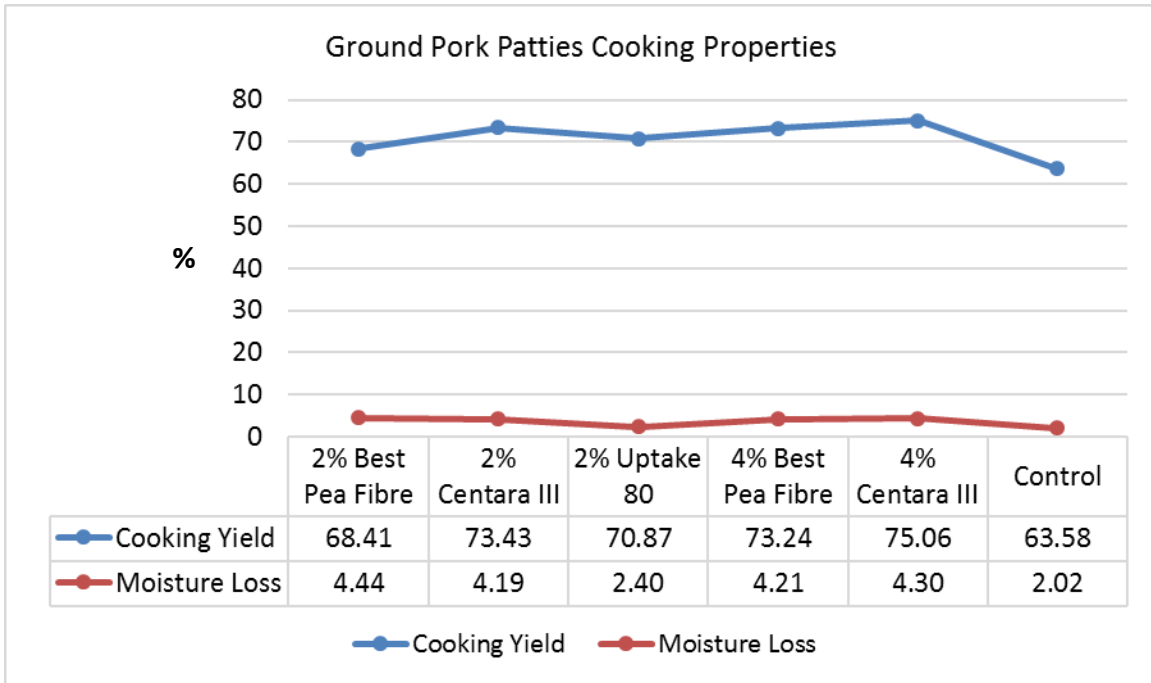
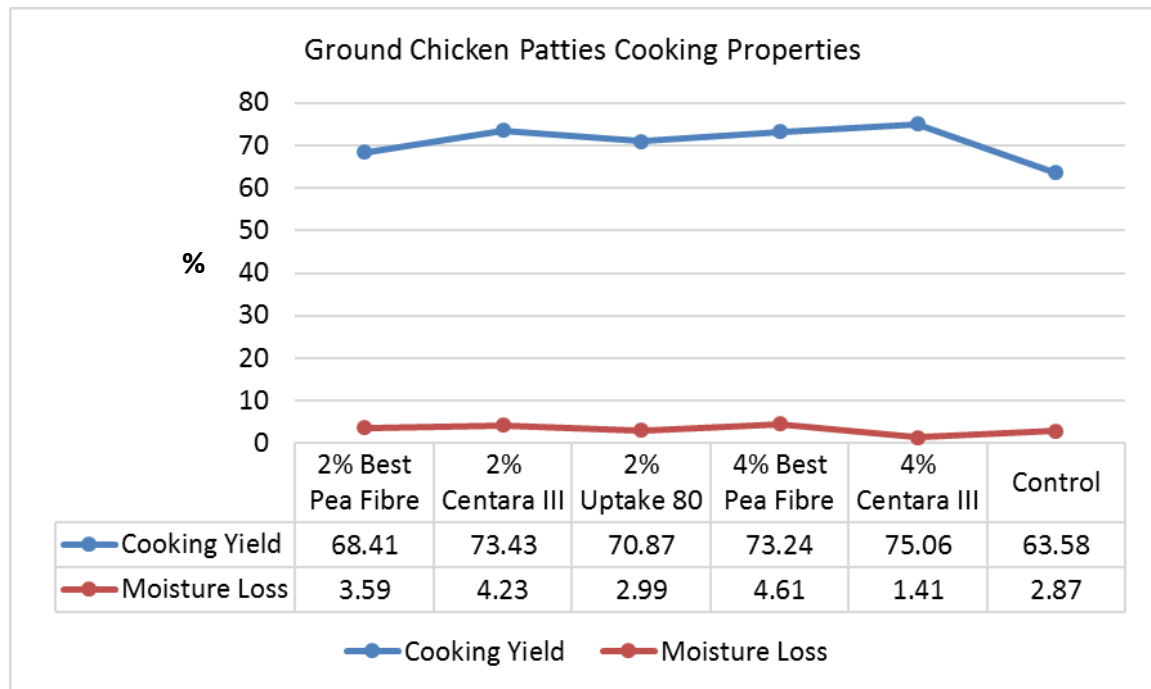


Figure 7. Ground Chicken Patties Cooking Properties Means



Color difference on the coordinate L* (lightness) showed significant difference between chicken patties with 2% and 4% pea fibre using Best Pea Fibre, 4% pea fibre using Centara III and 2% Uptake 80. Additionally, chicken patties with 4% pea fibre using Best Pea Fiber showed significant difference on color coordinates a* (redness) and b*(yellowness) compared with

control chicken patties. Results suggest that the addition of pea fibre predominately affects the lightness color component of the chicken patties. This may increase as the pea fibre content increases.

7.3 Effect of Pea Fibre Addition on Ground Meat Patty Formula Cost

The effect of the addition of pea fibre in meat patties was evaluated using actual cost of ingredients used during the development of the formulas. Table 5 showed percentage of cost reduction when a pea fibre ingredient is added, compared with control formula cost

Table 5. Ground Beef, Pork and Chicken Patties Formula Cost Comparison

Ground Beef Patty	Best Pea Fibre		Centara III		Uptake 80
Ingredient (%)	2.22	2.35	4.71	4.44	5.71
Pea Fibre (%)	2.00	2.00	4.00	4.00	2.00
Cost Reduction vs Control Formula (%)	1.99	1.94	3.89	3.98	15.18
Ground Pork Patty	Best Pea Fibre		Centara III		Uptake 80
Ingredient (%)	2.22	2.35	4.71	4.44	5.71
Pea Fibre (%)	2.00	2.00	4.00	4.00	2.00
Cost Reduction vs Control (%)	1.45	1.41	3.34	3.42	14.50
Ground Chicken Patty	Best Pea Fibre		Centara III		Uptake 80
Ingredient (%)	2.22	2.35	4.71	4.44	5.71
Pea Fibre (%)	2.00	2.00	4.00	4.00	2.00
Cost Reduction vs Control (%)	1.80	1.77	3.53	3.61	13.78

8. Conclusions and Recommendations

This study's results showed that it is possible to develop sensory acceptable lean ground beef and pork meat patties with 2% and 4% pea fibre without detrimental effect on juiciness and tenderness or adding off flavour and moreover, allowing to incorporate a "fibre" nutrient claim. The study also showed that it is possible to develop sensory acceptable ground chicken patties with 2% pea fibre without detrimental effects on juiciness and tenderness or adding off flavour, allowing to incorporate a "fibre" nutrient claim as well. Furthermore, ground beef, pork and chicken patty formulas with pea fibre showed a cost reduction (1% to 15%) compared with control formulas without pea fibre.

8.1 Effect of Pea Fibre on Ground Meat Patties Sensory Attributes

Results suggest pea fibre can be used in beef and pork patties formulas at levels of 2% and 4% without affecting juiciness tenderness or adding any off flavour. Ground beef and pork patties sensory evaluation on five attributes (juiciness, initial and overall, tenderness, initial and overall and off flavour) showed panelist did not rate any significant difference between the six tested formulas (Control without pea fibre, 2% and 4% of pea fibre using Best Pea Fibre and Centara III and 2% of pea fibre using Uptake 80). Additionally pork and beef control patties (without pea fibre) showed no significant difference when compared individually with each beef or pork patties with 2% and 4% of pea fibre using Best Pea Fibre and Centara III and 2% of pea fibre using Uptake 80.

Results suggest pea fibre can be used in chicken patties formulas at levels of 2% without affecting juiciness and tenderness or adding any off flavour. Ground chicken patties were found with significant difference ($p < 0.05$) in juiciness (initial and overall) and tenderness (initial and overall) between the six formulas tested. Individual comparison analysis between control patties and each of the other tested formulas showed control chicken patties had a significant difference on initial juiciness with chicken patties with 4% pea fibre using Best Pea Fiber or Centara III, and also significant difference on overall juiciness and tenderness (initial and overall) compared with chicken patties with 4% pea fibre using Centara III. Results suggested that pea fibre addition at levels of 4% or higher may affect juiciness and tenderness of chicken patties. Perhaps pea fibre performance on chicken was possibly affected by the limited amount of water included in the formula due to processing requirements during the chicken patty forming.

8.2 Effect of Pea Fibre on Ground Meat Patties Cooking Properties.

Ground beef, pork and chicken patties showed significant difference on cooking yield, moisture loss and change in color between the different patty formulas with and without pea fibre addition.

Results suggest the addition of pea fibre to lean ground beef patties improves the cooking yield of the product but there was no conclusive effect on moisture loss. Individual comparison analysis between ground beef control patties results and each other tested formula with pea fibre, showed control beef patties as having a significant lower cooking yield than all other patties with 2% and 4% pea fibre. However, control beef patties showed no significant difference on moisture loss compared with all other tested formulas except for the beef patty formula with 4% pea fiber using Centara III which presented a significant higher moisture loss.

Results suggest that the addition of pea fibre to pork patties improves the cooking yield of the product, however at pea fibre levels of 2% the improvement may dependant on the pea fibre ingredient used. No conclusive effect on moisture loss was found. Individual comparison analysis between ground pork control patties and each of the tested formulas with pea fibre, showed control pork patties having a lower cooking yield than pork patties with 2% and 4% pea fibre using Best Pea Fibre, 4% pea fibre using Centara III and 2% pea fibre using Uptake 80.

Results suggest addition of pea fibre to lean ground chicken patties do not have any conclusive impact on cooking yield and moisture loss. Individual comparative analysis between ground chicken control patties and each of the tested formulas with pea fibre showed no significant difference on cooking yield or moisture loss.

8.3 Comparison of Ground Meat Patties Formula Cost

Cost comparison between ground beef, pork and chicken patties control formulas and formulas with 2% and 4% of pea fibre showed a cost reduction between 1% and 15% depending on which pea fibre ingredient was used.

8.4 Recommendations

Pea fibre on meat allows producers to develop new products to meet the current market trend for healthy products at reasonable prices. Great opportunities for the food industry on the use of pea fibre in meat patties exist based on the results of this study. Incorporating pea fibre in beef and pork patties improves the patties cooking yield and lowers the cost to produce meat patties so providing considerable benefits to the food service sector. The addition of pea fibres at levels of 2% and 4%, allows for a fibre nutrient claim so promoting and upgrading the meat patty.

Chicken patty producers can also benefit from the use of pea fibre at 2%, and the subsequent use of a “fibre” nutrient content claim, in addition to achieving a good sensory profile product. Future studies may help to achieve higher pea fibre usage levels. Further applications for the use of pea fibre in more meat products can also be explored in order to extend the benefits of pea fibre application on various types of value added meat products.

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