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The Effect of *ad libitum* Consumption of Mixed Meals with Added Pureed Navy Beans and Yellow Peas on Satiation, Satiety, and Short-Term Food Intake in Children

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Thesis submitted in partial fulfillment of the requirements for the degree of

Master of Science in Applied Human Nutrition

Halifax, Nova Scotia

TABLE OF CONTENTS

ABBREVIATIONS USED

DEBQ	Dutch Eating Behaviour Questionnaire
FI	Food Intake
NB	Navy Bean(s)
PA-Q	Physical Activity Questionnaire
YP	Yellow Pea(s)

APPENDICES

ABSTRACT

The objective of this study was to investigate the effect of cooked, pureed navy beans (NB) and yellow peas (YP) added to a mixed meal on satiation, subjective appetite, next-meal food intake (FI), 2 hour cumulative FI, and gastrointestinal comfort over two hours in children. Using a randomized single-blinded cross-over design, 28 children (9-14y, 14 boys and 14 girls) attended three sessions and consumed one of three dietary treatments at each session. All treatments contained cooked durum wheat pasta and tomato sauce with cooked and pureed NB or YP providing 43% of energy or additional cooked and pureed pasta (C, pulse-free control). Due to the variability in the *ad libitum* treatment intake, participants were separated into low (<165.67kcal) and high (>165.67kcal) consumption groups based on whether their average treatment intake was above or below the median intake of all treatments. Because the low consumption group does not reflect the effect of treatment, only data from high consumption may explain the effect of added pureed pulses to a mixed meal. The data from this group (n=17, 8 boys, 9 girls, BMI %ile 70.6±6.7) indicates that although both pulse treatments resulted in higher *ad libitum* treatment FI compared to C (P=0.02), there was no effect of treatment on *ad libitum* FI at a test meal 120 min later or cumulative FI (treatment + test meal) over two hours. Analysis of subjective appetite measures indicated lower desire to eat (DTE) scores after YP (P=0.04) and NB (P=0.03) compared to C while NB tended to suppress average appetite (AA) (P=0.08) and prospective food consumption (PFC) (P=0.06) compared to C over two hours. Both pulse treatments resulted in higher dietary fibre intake (YP:12.4±0.9g; NB:15.1±1.4g) compared to C (4.6±0.5g, P<0.0001). Protein intake was also greater after NB (13.1±1.2g, P<0.0001) and YP (12.4±0.9g, P=0.003) compared to C (8.8±1.0g). The intake of the meals with added pulses did not cause any symptoms of gastrointestinal discomfort. Adding pulses to pasta and tomato sauce did not change the pleasantness of the treatments. Cooked, pureed navy beans and yellow peas, when added to a mixed meal, present an effective dietary approach to increase subjective satiety and improve nutrient intake in children.

ACKNOWLEDGEMENTS

Thank you to my supervisor, Dr. Bohdan Luhovyy for allowing me to complete this project and for being a good example of a strong researcher. Thank you to Drs. Qaderi and Glanville for being a part of my committee and providing their invaluable feedback. Thanks to Dr. Norris for taking the abstract concept of critical thinking and bringing me to a higher level of self-awareness. Thanks to Prof. Costey for reminding me that I am not limited in any aspect of my life. Thank you Marianna for making the treatments, I know it was hard work. Thanks to Dr. Bellissimo for introducing me to the exciting world of scientific research. Thank you to the volunteers and fellow graduate students who spent endless hours with me here in Evaristus 365.

Thanks Mom, Dad, Danah, Jet, and Tarzan for being amazing and never being upset when I couldn't answer, "When are you going to be finished?" Thanks for coming around and realizing that my learning journey truly has no end.

Thanks to all of the musicians who wrote the words and melodies, that kept me sane through not only this, but all of my learning experiences. Thanks to all of the teachers who helped develop my love of learning, your work will never be greater than your impact.

Thanks to all of the amazing people I have met along the way. My friends, and now family, from All Saints, Loyola, Planet Kids, McMaster, Nipissing, Mount Saint Vincent, Twin Cities Villa, and travels from down the street to around the world – thank you very much.

Thank you to the Manitoba Pulse Growers Association for funding this important research.

INTRODUCTION

As youth enter adolescence, they tend to make more independent food choices and eat more food away from home. This results in a diet that is higher in sugar and fat, which has contributed to obesity plaguing 26% of Canadian children (Shields, 2006). This could be mitigated through the inclusion of meat alternatives such as pulses in the diet. This is an excellent opportunity for the pulse industry to incorporate them into food products, creating functional foods that reduce excess energy intake by curbing both the emotional and physical desires to eat. Navy beans and yellow peas are excellent candidates as they are low-cost commodities that are produced in high quantities in Canada. Pulses are vehicles for both protein and fibre, ingredients that contribute to the feeling of fullness. The availability of pulses and the lack of acute intervention studies on food intake control in children provide the rationale to further investigate the role of pulses in short-term food intake in youth aged 9 to 14.

In this study, participants were asked to eat either a pulse-free meal (C) or a similar meal with added pureed navy beans or yellow peas until they feel comfortably full. After 2 hours, a second *ad libitum* meal was provided where participants are to eat until they are comfortably full. During this period of time, subjective appetite, FI and physical comfort were measured. It was anticipated that the meals with added pureed navy beans or yellow peas will lead to greater satiety and reduced energy intake compared to a similar pulse-free meal. This research may lead to new dietary guidelines that support product formulations that incorporate pulses into food products that are both functional and palatable. With the development of school policies promoting the health of children, and the pulse industry in Canada having great economic potential, this study serves to provide insight into the roles that pureed navy beans and yellow peas can play in the reduction of short-term food intake when incorporated into mixed meals.

HYPOTHESIS

Mixed meals formulated with pureed pulses, particularly navy beans or yellow peas will reduce subjective appetite, increase satiation, and suppress FI at an *ad libitum* test meal consumed 120 min later in 9-14 year old children compared to a pulse-free control.

OVERALL OBJECTIVE

The overall objective of the study is to determine whether the addition of pureed pulses (navy beans or yellow peas) will result in greater feelings of satiety, resulting in a reduction of energy intake at the next meal.

SPECIFIC OBJECTIVES

1. To measure *ad libitum* food intake of treatments formulated with and without pureed pulses (navy beans, yellow peas, and control).
2. To measure *ad libitum* food intake of a test meal consumed 120 min after treatments (navy beans, yellow peas, and control).
3. To measure subjective appetite over two hour period after consumption of treatments. (navy beans, yellow peas, and control).
4. To measure cumulative food intake over 2 hours, calculated as the sum of treatment and subsequent meal food intakes.
5. To investigate nutrient intake after freely consumed meals with and without added pulses.
6. To measure subjective palatability of treatments formulated with and without pureed pulses (navy beans, yellow peas, and control).

7. To measure physical comfort and gastrointestinal symptoms after the ingestion of the treatments formulated with and without pureed pulses (navy beans, yellow peas, and control).

REVIEW OF RELATED RESEARCH LITERATURE

This is a review of the literature pertaining to the role pulses can have in the regulation of short-term food intake in children and the mitigation of the obesity and related risks. This review also contains an overview of the mechanisms behind food intake as well as the environmental factors that contribute to obesity.

CHILDHOOD OBESITY IN CANADA

Obesity is prevalent in Canadian youth, for between 2009 and 2011, an estimated 19.8% of Canadian children and youth aged 5 to 17 were deemed overweight, and 11.7% were obese based on direct measures (Roberts et al, 2012). The costs of childhood obesity perpetuate present and future health care systems needs for obese children are more likely to have compromised physical and psychosocial well-being, compounded with a greater likelihood of becoming obese adults. Given the nature of the disease, and its impact, there is an urgent need for evidence-based preventative measures.

CAUSES AND CONSEQUENCES OF CHILDHOOD OBESITY

Obesity is the result of the interactions between biological and environmental influences that pose the risk of negative health outcomes. The accumulation of excess body fat and mass is the result of an energy imbalance with more energy being consumed than expended. The aetiology of childhood obesity is dependent on genetics, stress leading to emotional eating, food eaten away from home, time engaged in screen-based activities, and reduced physical activity. Food eaten away from home is an influential factor, being significantly and positively correlated with body fat and having an adverse influence on the quality of the diet and the total amount of energy ingested in youth (Gillis & Bar-Or, 2003).

Body mass index is a valid measure for detecting excess fat mass in children for subcutaneous and total fatness are correlated strongly with body mass index in children (Stunkard et al, 1990). Growth charts developed by the World Health Organization can be used to diagnosis overweight and obesity in children (Dietitians of Canada, 2015). Current recommendations define children who are between the 3rd and 85th percentile for age and gender as normal weight. Children between the 85th and 97th percentile for age and gender are classified to be overweight. Children between the 97th and 100th percentile for age and gender are classified as obese.

Excessive energy intake in children also contributes to obesity. The increased consumption of food is due to a variety of factors including that the energy dense food is relatively inexpensive, and highly palatable. More energy is being eaten due to larger portion sizes, high energy density, and the high concentrations of fats and sugar found in commercially available foods (Ebbeling et al, 2004). The majority of energy needs (61.6%) came from fast food in youth who were both normal weight and overweight (Ebbeling et al, 2004).

Another component of increased consumption is the common practice of snacking with foods that are energy dense. This is evident for more than a quarter of daily energy intake comes from snacks (Piernas & Popkin, 2010). Snacks can contribute to a healthy, balanced diet but the snacks that are being eaten more frequently are convenience foods that are high in sugar, salt, and fat (Piernas & Popkin, 2010). This is happening at an alarming rate such that Canadian children are having snacks displace other foods that contribute to health (Moffat & Galloway, 2008).

The increase in body weight in children is associated with many adverse health effects. Increases in body mass index in youth are associated with an increase in circulating insulin levels. Hyperinsulinemia is associated with many adverse health outcomes including elevated systolic and diastolic blood pressure, plasma blood glucose, plasma triglyceride levels and reduced levels of high-density lipoprotein cholesterol among 9, 13 and 16 year old children (Lambert et al, 2004). In youth ranging from grades 7 to 12, obesity was strongly associated with increased risk for cardiovascular disease (Lambert et al, 2004). Overweight and obese children are also more likely to suffer psychosocial consequences, such as low self-esteem, self-image and self-concept, exacerbating the impact of childhood obesity. The combination of health factors such as increased levels of blood glucose, blood pressure, cholesterol, and body fat around the waist is defined as metabolic syndrome. It was estimated to be prevalent in 11.5% of Canadian youth and is strongly associated with increased adiposity as well as risk factor for type 2 diabetes, heart disease, and stroke (Lambert et al, 2004).

The increased prevalence of obesity is having a direct effect on health expenditures. The direct cost of overweight and obese Canadians was approximately $6.0 billion, which accounted for 4.1% of total health expenditure in 2006. Furthermore, an estimated additional $5.0 billion in indirect costs were also attributable to overweight and obese Canadians. It is evident that obesity is a multifaceted health concern that requires a greater understanding in order to minimize the physical and financial burdens of the disease (Anis et al, 2010).

THE REGULATION OF FOOD INTAKE

Food intake regulation involves the integration and controlled response to stimuli generated as interaction between ingested food and neuroendocrine systems of the body. Hunger is the biological drive to look for food or the sensations that promote food consumption. Satiation refers to the events during the course of eating that lead to the termination of eating, and satiety is the feeling of fullness that persists after a meal has ended and potentially serves to suppress further food intake. Satiation is important in controlling the amount of energy consumed at each eating occasion, while satiety affects the period of time between eating occasions and potentially the amount consumed at the next meal (Gerstein et al, 2004). The stimuli contributing to food intake's impact on satiety and satiation can be divided into four distinct mechanisms: sensory, cognitive, post-ingestive and post-absorptive (Blundell et al, 1994). The factors affecting satiety and satiation can be represented by the satiety cascade, which provides a conceptual framework of how those mechanisms operate in an overlapping manner to influence food intake. Sensory and post absorptive factors serve first to stimulate and then to inhibit food intake. Pre-absorptive and post-absorptive factors are generated post-ingestively to terminate the meal and inhibit postmeal intake. Operating together, and in interaction, the early and late stages of the satiety cascade determine the amount, duration, and frequency of eating. The interaction between stimuli is also a determinant of the duration and strength of the satiety signals and satiation. Satiation can be measured by the amount of food consumed during one meal whereas satiety can be measured by the duration of time between meals (Blundell et al, 1994).

Hormones regulate body weight and energy balance over the long-term. Satiety signals, including those factors that regulate how much energy is consumed at any one meal, interact with adiposity signals (e.g., from insulin and leptin), which are secreted in proportion to fat mass, to determine homeostasis. Satiation signals are dependent not only on the energy content of foods but also on hormones that are released (Polonsky et al, 1988). These hormones are secreted variably in accordance with the macronutrient composition of the food ingested. Known anorexigenic satiation signals include cholecystokinin, the bombesin family, glucagon, glucagon-like peptide-1, amylin, somatostatin, enterstatin and peptide YY among others. The only known satiation signal that exerts an orexigenic effect is ghrelin. It has been hypothesized that functional foods aimed at reducing energy intake and increasing satiety may interfere with these neurohormonal systems through different mechanisms (Woods & D'Alessio, 2008).

Two primary hormones are the pancreatic hormone insulin and the adipose tissue hormone leptin. Both hormones can cross the blood-brain barrier and influence energy homeostasis via interaction with the brain, specifically the arcuate nucleus of the hypothalamus. These hormones interact with satiety signals to control food intake and maintain energy homeostasis. Insulin and leptin regulate food intake and energy balance in the long term. Insulin, which is secreted from the islet beta cells of the pancreas, is stimulated by the ingestion of food. Insulin moves into the central nervous system after a few hours and is responsible for the regulation of body adiposity (Havel, 2001). Insulin functions as a negative feedback signal of recent energy intake and body adiposity, limiting food intake (Havel, 2001). Insulin secretion is induced by GLP-1, which also helps to slow gastric emptying and inhibits movement of food through the gastrointestinal tract. Leptin is a hormone that signals the amount of adipose tissue in the body and mediates long-term energy homeostasis by reducing the desire to eat. Leptin is mediated by the central nervous system in proportion to body adiposity (deGraaf et al, 1992). The anorexigenic effect of leptin is inversely proportional to the levels in the blood for when levels get really high, a resistance is developed.

No known acute studies that have investigated food intake regulation in children by measuring food intake at a test meal following a snack using pulses. Furthermore, the interaction between macronutrients and physiological factors regulating short-term food intake in children has not been explored deeply. Pureed pulses are of interest as they provide all of the macronutrients and evidence suggests that the macronutrient composition of a food (Goran et al, 1995) has a greater impact on regulating appetite and food intake compared to its physical state

(Akhavan et al, 2010). Protein, carbohydrate and fat exert greater sensations of satiety, respectively (Stubbs et al, 2000). All ingested macronutrients can affect the concentration of blood glucose, known to be a key factor in food intake control, through the insulin-dependent and insulin-independent mechanisms. The glucostatic theory of food intake regulation states that there are glucoreceptors located in the central nervous system that can monitor the rate of glucose utilization by the body, proposing that higher levels of glucose in the blood terminates feeding and signals satiety, which subsequently lowers blood glucose levels. When glucose utilization levels are low, a neural pathway is activated leading to a desire to eat and conversely, higher blood glucose levels that will suppress appetite (Mayer, 1952). Since the development of this theory, the difference in blood glucose in arteries and veins, glucose utilization levels in the liver and the activation of glucoreceptive neurons in the periphery or in the brain are all thought to be involved in the glucostatic theory of regulation of food intake (Blundell et al, 1994). Moreover, animal studies have confirmed that the glucostatic theory must account for both peripheral and central glucose sensors (Woods & D'Alessio, 2008).

The protein source, quantity, composition as well as the time until the next meal is important factors to consider when investigating the effect of protein on short-term food intake (Anderson et al, 2004). Over a 3-hour period, young men experienced greater subjective satiety after 50 grams of lean fish compared to an equivalent amount of beef or chicken (Anderson & Moore, 2004). Similarly, 48 grams of whey protein, a fast-acting protein, increased subjective satiety and decreased food intake to a greater extent than an equal amount of casein protein in adults at an *ad libitum* meal 90 min later (Hall et al, 2003). This is done through the secretion of satiety hormones such as cholecystokinin and glucagon-like-peptide 1 as observed in young adults with as little as 20 grams of whey protein (Hall et al, 2003). The thermogenic properties of protein due to protein turnover, or faster gastric emptying rates that occurs along with an increase in plasma amino acid concentrations after eating whey protein may be responsible for this effect (Paddon-Jones et al, 2008).

Quantitative and subjective measures suggest that dietary protein regulates short-term satiety and suppresses food intake more than carbohydrate and fat in adults and has a greater ability to delay hunger (Rolls et al, 1988; Marmonier et al, 2000). When 12 females were given isocaloric preloads of protein, carbohydrate, and fat, subjective hunger and energy intake decreased while satiety increased significantly after the protein preload (Poppitt et al, 1998). Adolescents were provided with breakfasts differing in protein contents (9, 15 or 24 grams) for six days and subjects who ate a breakfast with 24 grams of protein reduced their daily energy intake by 17% compared to those eating a lower protein breakfast only providing 9 grams (Ohlson et al, 1965). The beneficial effect of protein is extended to pulses as they are high in protein and therefore may improve glycemic control and increase subjective satiety.

Comparative studies have shown that fat is less (Cotton et al, 2007) or equally as satiating as carbohydrate (deGraaf et al, 1992). Short-term food intake is reduced following the ingestion of fat. Young men provided with 300 kcal of safflower oil incorporated into treatments significantly reduced their food intake suggesting that there is a higher caloric threshold for fat to be overcome before an reduction in food intake is observed (Woodend & Anderson, 2001). Thus on a per calorie basis, fat exerts the weakest effect on satiety especially when used in preload studies (Blundell et al, 1994). Fat consumption can also reduce short-term food intake through the mediation of gut hormones, mainly cholecystokinin (Matzinger et al, 2000). Similarly, women reported to be slightly hungrier and less satiated following a high-fat preload compared to a high-carbohydrate preload despite the fact that there were no significant differences in food intake at a subsequent test meal (Poppitt et al, 1998). The other role that fat plays is that it increases the energy density of a meal, and meals that are higher in energy density are less satiating in children (McCrory et al, 2006). Children were given snacks of various fat contents, and energy intakes at the subsequent meal were not significantly different, demonstrating that fat is not a driver behind satiation, however children have the ability to compensate for the energy density within the meal (Scalia, 2010).

ASSESSMENT OF SHORT-TERM FOOD INTAKE AND SUBJECTIVE APPETITE

Measuring short-term food intake and subjective appetite assesses the combined influences of hormonal, physiological, and environmental factors on short-term food intake within an eating occasion. Food intake is regulated in both the short and long term by physiological systems mediated by the central nervous system. Satiety and regulatory hormones, acting in shorter term, transmit information in regards to the size and duration of the meal (satiation), as well as the interval to next meal (satiety) (Anderson et al, 2006). Satiety, the inhibition of food intake once an eating occasion has ended, is an important effect of foods for it is has increased in interest among producers and consumers of food. Satiety is measured by calculating the intake of food at an *ad libitum* test meal, and this is generally reported in terms of energy (Anderson et al, 2002). In order to separate foods that increase feelings of fullness, it is imperative that regulations are in place to evaluate which products can make functional claims related to the induction of satiety especially when all foods contribute to the reduction of hunger to varying extents (Health Canada, 2012). Along with satiety, subjective appetite is measured and allows for claims to be supported for, it is difficult to assess compensation for a single food might lead to a reduction in energy intake. Also, satiety claims are to be comparative in nature, which in this project is helping to substantiate that foods containing pureed pulses increase feelings of fullness when compared to a similar product without added pulse purees.

The test meal paradigm is the most accurate way to assess short-term food intake. The test meal paradigm is utilized to assess the ability to detect the caloric content of a treatment and adjust subsequent energy intake at the next meal (Flint et al, 2000). A preload is most usually defined as an eating occasion (smaller than a test meal) that is given at a particular interval, typically 2-4 hours before the presentation of a test meal. This tests individual reception of satiety signals for the response would be changing food or energy intake with respect to the energy content of the treatment (Blundell et al, 2010).

Visual analogue scales are used to measure a range of subjective sensations related to appetite. They are typically composed of 100-mm lines with opposing statements anchored at each end. Subjects are then required to make a mark across the line corresponding to their feelings. This mark is quantified by measuring the distance from the left end of the line to the mark (Hill & Blundell, 1982). A questionnaire was developed using six motivational questions, for example, 'How strong is your desire to eat?' (with very weak/very strong extremes on either side). The visual analogue scales are often used in a pre-load paradigm following the test food as well as at specific time points until the second meal is served (Hill & Blundell, 1982).

Visual analogue scales are tools with high reproducibility. When assessed for reproducibility, the test/retest reliability was high for within day measures but lower for measurements made on different days. Subjective appetite scores are predictive of lunchtime food intake in 9-14 year old boys (Bellissimo et al, 2008). This was evident for food intake strongly correlated with both individual and average appetites in normal-weight boys. This was not observed in obese boys for they were not able to understand and react to the cessation of appetite. When looking at individual components of average appetite (hunger, prospective food consumption, desire to eat, and fullness), prospective food consumption was the stronger predictor of food intake and hunger was the strongest. This could be related to the cognitive factor of eating that time to the next meals or knowledge of when food would become available again (Blundell et al, 2010). Due to the differences in normal weight and obese participants, there is a factor of weight status when assessing the predictive nature of subjective appetite, however it was observed that meal consumption reduces subjective appetite, which demonstrates that children understand the scales, and visual analogue scales can accurately capture their feelings (Bellissimo et al, 2008). On two separate days, 9-14 year old boys significantly differed in their within-person subjective ratings of average appetite when they first arrived at the laboratory after receiving a standardized breakfast (Bellissimo et al, 2008). Although this variation is expected, it is unknown if this is because the visual analogue scales was able to detect a true biological variation or if methodological issues related to using visual analogue scales in children are the reason for the difference between days. The reliability of visual analogue scales is stronger when looking at group data, so taking an average of several scores at a given time point produces greater reliability (Bellissimo et al, 2008) Reproducibility is high when measures are taken by the same participant immediately after each other (Stratton et al, 1998) but not by the same participant on different days (Raben et al, 1994).

The visual analogue scales measure subjective satiety and provides insight into the potential that some foods can have on the reduction of subsequent food intake. This project explores the use of pureed pulses added to commonly eaten foods in the management of short-term food intake in children.

PULSES AND THEIR DIETARY IMPORTANCE

Pulses are commercially available, nutrient-dense foods that contribute to positive health outcomes. A legume is a plant (or a fruit borne by these specific plants) in the botanical family (*Fabaceae*), which includes the edible seeds of pod-bearing plants, namely peas, beans, lentils, and chickpeas (Pulse Canada, 2009). Pulses differ from other legumes in that they are harvested entirely for their dry fruit.

Pulses differ in seed size, colour and nutritional composition. Navy beans belong to common beans (*Phaseolus vulgaris*), also known as white beans or haricot beans, and are traditionally used in baked beans where the beans are cooked and served typically in a tomato-based or maple syrup sauce. Navy beans are small, flat, white beans with a mild flavor and a mealy texture that are often referred to as the 'white pea'. Navy beans have 5.5 – 9.2 grams of fibre per 100 grams of dry matter (Wang & Daun, 2004), which makes grinding of navy beans beneficial for the production of fibres to incorporate into cereal products to improve protein quality.

Yellow peas (*Pisum sativum*) are the split seeds of peas that have split in the cotyledon. The hulls are removed, exposing the round pea inside. The yellow pea has a mild flavour and a soft texture. Both navy beans and yellow peas have many culinary applications including the development of flours to be used in food, extrusion of flours in puffed snacks, and in pulse purees that are added to baked goods as a way to reduce the fat and increase the protein content.

Pulses are consumed worldwide as the Food and Agriculture Organization estimates annual global pulse production at over 60 million metric tons. In 2011, Canada exported 4.7 million tonnes worth $2.7B (Pulse Canada, 2014). Pulses are used all over the world due to their ability to adapt to a wide distribution of climates and their strength in various environment and soil conditions. Historically, cultivation of pulses can be traced back to Latin America and Central Asia where meat sources were rare and this is still true today for in many African countries, pulses contribute to more than 10% of total protein intake per capita (Mywish, 2012).

Pulses are sustainable and productive crops that increases access to foods that improve the diet quality of the world. Pulses also play a role in the ingredient market being a potential source of starches, proteins, and fibres that can be incorporated in a variety of food matrices such as salads, soups or stews (Mollard et al, 2009).

Pulses have many nutritional benefits: they are high in complex and slowly digestible carbohydrates, dietary fibre, protein, folate, iron, phosphorous, magnesium, potassium, calcium and zinc and low in fat, cholesterol and sodium. Pulses contain bioactive phytochemicals (tannins, phenolic acids, flavonoids and phytic acids) and enzyme inhibitors (trypsin and alpha-amylase inhibitors) most of which degrade after cooking. Pulses are gluten free and have a low glycemic index (scoring between 15 and 40 on a 100-point scale) (Araya et al, 2003). Also, pulses are affordable vehicles for nutrients as beans were among the top five classes of foods having the highest micronutrient to price ratio (Drewnowski, 2004). Regular consumption of pulses is linked to improved blood glucose management when incorporated in a low glycemic diet (Jenkins et al, 2012).

Pulses come in many forms including ready-to-eat varieties that can be added to salads, soups, as well as dried beans that are soaked before being eaten. In many cultures, pulses are eaten with another carbohydrate source (such as rice), providing a complete meal. Eating pulses is also supported by governing bodies as Health Canada suggests eating pulses as an alternative to meat to help with reducing saturated fat in the diet. A food guide serving is ¾ cup, which contains approximately 10 grams of fibre, a third of the daily recommendations (Health Canada, 2014).

Pulses can be cooked or drained and then homogenized until the texture is smooth to form a pulse puree. When pureed, the particles are small and can be used in many applications including pulses as a protein source in baked goods and as a base for soups. Pulses are commonly eaten as a side dish with other carbohydrates such as rice which increases the nutrient and energy densities of the meal, but are also being pureed and being used in dips such as hummus.

PULSE CONSUMPTION AND HEALTH OUTCOMES IN CHILDREN

A reported four-fifths of Canadians do not consume any pulses. The rationale for this includes limited awareness of pulses, taste, lengthy cooking time, and negative side effects such as gas or bloating (Liu et al, 2011). Consumption data show that dry bean consumption is low in children and youth are eating pulses in convenience foods, composing of less than 6% of total consumption and are being eaten in foods with added salt and fat (Lucier et al, 2000).

Pulses provide a variety of benefits that improve health and the quality of life of consumers. The consumption of beans by both adults and youth is associated with smaller waist circumferences and lower body weights as assessed by the National Health and Nutrition Examination Survey in the 1999-2002 cohort (Papanikolau & Fulgoni, 2008). Additionally, bean consumption reduces the risk of becoming overweight later in life, especially for bean consumers between the ages of 4 and 12 (Fulgoni et al, 2006). Pulse consumption is correlated to lower body mass indices and increased intakes of fibre and iron. Healthy adults who consumed seven to eight servings of pulses in the diet resulted in significantly more weight loss than their counterparts who did not eat pulses (McCrory et al, 2010). Similar findings were observed when comparing eating ten servings of pulses each week to a calorie-reduced diet over a two-month period. This effect is attributed to the high content of slowly digestible carbohydrates in pulses. These slowly digestible starches also cause a gradual increase in blood sugar levels, which helps to maintain feelings of satiety. The correlation between bean consumption and a reduced risk of having a large waist circumference is important, for it is a risk factor for many chronic ailments such as type 2 diabetes and cardiovascular disease (Papanikolaou & Fulgoni, 2008). The risk of developing obesity is lowered by approximately one-fifth for those who regularly consume beans (Papanikolaou & Fulgoni, 2008).

Eating pulses three times a week can reduce LDL-cholesterol levels significantly with the minimum effective dose being ¾ cup of beans per day? (Bazzano et al, 2011). Pulses can also enrich the diet of vegetarians for pulses have a greater amount of lysine where cereals have greater amounts of methionine and cysteine, so when eaten together, a complete profile of essential amino acids is consumed.

Childhood obesity is a major concern and it has been suggested that including plant-based foods may prevent obesity. Fibre intake in children is less than recommendations and so pulses have been included in the guidelines for school lunches. In children aged 12-19 years, bean consumption has been associated with a significantly lower body weight compared to non-consumers (Fulgoni et al, 2008). Pulses can contribute to improved cognitive function for the consumption of high fibre breakfasts are associated with an improvement in memory and spatial sense tasks in elementary school children (Mahoney et al, 2005). The consumption of 5 cups of pulses per week improves biomarkers of health such as blood pressure and HbA1c to same extent as caloric restriction (Mollard et al, 2012).

The consumption of pulses should be encouraged especially where animal proteins are scarce in order to provide the essential amino acids for growth, enzyme synthesis, and hormone production (Ofuya & Akhidue, 2005). Bean consumption is proportional to lower obesity risk and smaller waist circumferences in children (Fulgoni et al, 2006). It has also been suggested that plant-based foods can help prevent obesity in children (Newby, 2009).

Populations with diets that are richer in pulses have lower body mass indices. Pulse consumption is not the sole cause of body mass index reduction for pulse consumption is one component of healthy weight maintenance (Fulgoni et al, 2006; Greenwood et al, 2000). Beans may contribute to feelings of satiety due to protein and fibre (McCrory et al, 2010). Legume based diets have been linked to a reduction in leptin levels of insulin sensitive and insulin resistant men (Zhang et al, 2011). Participants in a 4-week randomized controlled dietary intervention trial eating cooked navy bean (35 grams of powder/day) made from half a cup of cooked dry beans, added to prepared foods had a substantial decrease in energy consumption compared to those eating foods with added rice bran (Borresen et al, 2012). These studies demonstrate how pulses contribute to health and these positive health outcomes are the result of the functional ingredients found in pulses.

FUNCTIONAL INGREDIENTS OF PULSES

Pulse-derived ingredients including starches, fibre and protein have the potential to reduce glycemic response, and increase the feeling of satiety, contributing to the subsequent reduction of short-term food intake. This effect is dependent on the pulse variety and/or the dose of the ingested ingredient as evidenced by observational and clinical studies using pulses (Wong et al, 2009).

PROTEIN

Pulses are 17-35% protein by dry weight. Meals containing 20 grams of added pea protein significantly reduced food intake 30 min later compared to a meal without pea protein in healthy males (Smith et al, 2012). Blood glucose responses before and after the subsequent meal at two different time points (30 min and 120 min) were also suppressed by pea protein (Smith et al, 2012). Pepsin-derived peptides from *Phaseolus vulgaris* have also been found to stimulate the secretion of cholecystokinin (Sufian et al, 2007).

Proteins bind to starches to form a complex, decelerating starch digestion, promoting a feeling of fullness. Protein-starch complexes have been found in potato starch and legume protein isolates (Takeuchi, 1969). These complexes are associated with increased carbohydrate malabsorption, suggesting that these complexes restricted the accessibility of the starch to digestive enzymes, reducing digestibility and gastric emptying rate. *In vivo* studies have determined that navy beans and yellow peas have the highest protein digestibility that is further improved upon combining with rice or wheat (Pulse Canada, 2011)

The protein found in yellow peas reduces short-term food intake as well as glycemic response to a treatment and a second meal 20 minutes later, confirming that the amino acid plasma profile of pulses exhibits a similar action mechanism to whey protein (Calbet & Maclean, 2002).

CARBOHYDRATES

Pulses contain carbohydrates including starches and fibres that contribute to food intake regulations by attenuating digestion rates and glycemic responses. The amount of navy beans containing 50 g of available carbohydrate reduced blood glucose net area under the curve over 2 hours compared to glucose or white bread. This effect was dependent on preparation, for example, being served in maple syrup versus tomato sauce, which changed the glycemic load of the treatment (Wong et al, 2009). The ingestion of foods with lower glycemic loads result in the postingestive satiating effects of gut hormones being maintained for longer periods of time (Sievenpiper et al, 2009). The low glycemic load of pulses can be attributed to the starches and fibres that make up pulses.

STARCHES

Starch is the predominant component of pulses constituting 22-45% of the pulse by dry weight (Thorne et al, 1983). Starches serve as energy storage and contribute to the gritty texture of pulses. Pulse starches are slowly digestible or resistant to digestion, producing an attenuated postprandial glucose response that helps prolong postprandial satiety (Thomas & Atwell, 1999). The slow digestibility of pulses is attributed to structure, enzyme inhibitors, and the interaction of starches with protein and antinutrients, including phenolic compounds and phytic acid. The typical composition of pulse starch contains 30-40% amylose, a linear polymer containing glucose units with abundant hydrogen bonds, making it prone to retrogradation, and forming a resistant starch (Guillon & Champ, 2002). The starch is resistant for the outer branches of the amylose crosslink with cellulose forming complexes that are not easily hydrolyzed by the enzymes of the digestive system. Pulses contain more amylose than corn or potato starches, which typically contain approximately 25% (Guillon & Champ, 2002). The remaining component is amylopectin, a highly branched polysaccharide of glucose that is easily degraded.

Slowly digestible starches are the fraction converted into glucose within 100 min. After 120 min those that are not degraded are termed resistant (Englyst et al, 1999), demonstrating the validity of 120 min time frame between meals for food intake studies.

FIBRES

Cooked pulses contain approximately 14 grams of fibres per cup that contribute to increased subjective satiety, reduced energy intake, and lowered blood glucose responses and is associated with slower rates of gastric emptying (McCrory et al, 2010). Dietary fibre from remnants of the cell wall is composed of cellulose, hemicelluloseses, other polysaccharides, and lignins (Tiwari et al, 2011). Pulses contain approximately 10-15% of insoluble and 2-9% of soluble fibres found in the hull and cotyledon respectively (Tosh & Yada, 2010). Soluble fibre contains oligosaccharides that are water-soluble that form gels once they are leached from cell walls. This property helps with the experience of satiety due to increased viscosity of food. Increased viscosity of fibrous preloads resulted in a significant reduction of subsequent food intake at the *ad libitum* meal 90 minutes later (Vuksan et al, 2009). Insoluble fibre helps with structural properties of pulses and is found in the seed coat. Fibre regulates satiety signals and blood glucose throughout the course of digestion. When food enters the stomach, fibre's high water-holding capacity adds bulk to the food, increasing gastric distention. Food enters the small intestine, and viscous soluble fibres attenuate gastric emptying. In the small intestine, fibre affects the release of gut hormones, glucagon-like peptide 1 and cholecystokinin, increasing the feeling of satiety. Pea fibres added to meals or introduced enterally both increased subjective fullness in healthy adults (Whelan et al, 2006). Participants reduced energy intake at an *ad libitum* meal by 10% when consuming a high fibre diet (Howarth et al, 2001). Fibre lowered postprandial blood glucose responses to a high carbohydrate meal.

Fibre also decreases small intestinal absorption of minerals and fat. Once food reaches the colon, soluble fibre ferments and positively affects colon health through the production of short chain fatty acids. Those compounds are oxidized and used for energy in preference to glucose, potentially leading to a stable glucose pattern over time. These changes in blood glucose levels are indicative of subsequent eating patterns. The addition of a purified fibre product to whole wheat bread reduced the blood glucose area under the cover in diabetic individuals (Potter et al, 1981). Furthermore, short chain fatty acids derived from the fermentation of fibre may enhance satiety by increasing the expression of proglucagon mRNA, leading to increased levels of glucagon-like peptide 1 [REF].

The carbohydrate fraction of pulses includes raffinose, stachyose, and verbacose, which are oligosaccharides that reduce the digestibility of pulses, leaving the undigested portion to be fermented in the colon, resulting in bloating and gas. However, they also act as prebiotics and change the gut microflora by promoting the growth of beneficial bacteria (Macfarlane & Macfarlane, 2008), and obese individuals extract more energy from the products of fermentation

(Fernandes et al, 2014). The change in gut microflora demonstrates a potential role oligosaccharides may play in energy regulation (Turnbaugh et al, 2006). The low degree of digestibility has been attributed to the non-availability of amylases of starch granules enclosed cell walls to digestive enzymes. Pea fibre enriched bread was found to increase the duration of satiety (Lunde et al, 2011).

Pulses reduced appetite and blood glucose at a given meal as well as at the subsequent meal 4 hours later. This could be attributed to their high fibre content, which can reduce glycemic response. Insoluble fibre added to breakfast cereal reduced blood glucose response 75 minutes after eating in healthy young men (Samra & Anderson, 2007).

Pulses contain protein-based protease and amylase inhibitors that may affect biological response to consuming pulses. Pulses have higher amounts of trypsin inhibitors compared to other plants, but cooking deactivates most of the inhibitors and they do not appear to have an effect on weight reduction (Boye et al, 2010).

PHYTOCHEMICAL COMPOUNDS

Pulses contain a number of phenolic compounds, such as tannins, phenolic acids and flavonoids. These compounds chelate metals such as iron and zinc and inhibit carbohydrate and protein digestive enzymes (Amarowicz et al, 2005). Certain phenolic compounds can interfere with glucose transporters in enterocytes during carbohydrate uptake and precipitate protein during protein digestion (Welsch et al, 1989). Pulses are also one of the primary sources of phytic acid in the diet, an indigestible compound that forms insoluble complexes with iron and zinc (Campos-Vega et al, 2010). Phytic acid decreases starch digestion rate *in vitro* as well as delays postprandial glycemic response in humans when added to bread. Therefore, high level of phenolic compounds and phytic acid may also contribute to the reduced glycemic response and increased satiety following pulse consumption. The impact may be lowered in pureed pulses for common processing procedures such as soaking and cooking may decrease the activity levels of bioactive compounds (Singh & Basu 2012).

PULSES AND FOOD INTAKE REGULATION

Pulses are foods that promote the sensation of satiety within the short-term (2-6 hours), especially as a part of a mixed meal. Meals containing both pulses and rice had higher satiety ratings up to 2 hours after consumption in comparison to meals containing only rice or wheat (Pai et al, 2005). There is contrasting evidence about the role of pulses on satiety. Bean flakes incorporated into potato dishes increased satiety, measured using a 10-point scale, 3 hours later when compared to other isocaloric meals**.** Conversely, the control made with potato was found to be the most satiating 2 hours after eating compared to isocaloric pies made with bean purees (Leathwood & Pollett, 1988). This inconsistency could be reflective of preparation methods for volume was not kept constant and meal volume influences food intake at the next meal (Rolls et al, 2000).

Holt developed the satiety index, which compares the areas under the curve related to appetite post-treatment to that of a white bread control (Holt et al, 1995). It was used to compare a wheat-based treatment to a rice-pulse combination called idli, comprising of milled rice and *Phaseolus muno roxb* that was steamed and fermented. The satiety index was used to confirm that idli was the most satiating using a 7-point scale and a 100-mm visual analogue scale when compared to wheat and rice dishes providing 250 kcal (Pai et al, 2005). This demonstrates the high satiety nature of pulses, and their ability to reduce food intake when eaten in conjunction with high glycemic carbohydrates. Although these findings reflect typical eating patterns of pulses, in order to support the validity of findings involving pulses and their effect on food intake, *ad libitum* meals should be utilized.

The aforementioned studies did not measure food intake and there is limited research on pulses and their impact on food intake but there is evidence of the efficacy of pulses. A diet with incorporated pulses in the form of pea flours (half a cup per day in a single blind crossover study) was associated with a reduction in adiposity around the waist and abdomen in women when compared to products using whole wheat flour without any added pulses (Marinangeli & Jones, 2011). The consumption of pulses contributes to lower intakes of energy. The consumption of beans, 4 times a week, in a randomized control trial resulted in the greatest reduction in weight over 8 weeks compared to other protein-rich diets (Abete et al, 2009).

Subjective appetite of healthy males was measured after eating treatments containing navy beans and yellow peas and it was found that both pulses reduced food intake at the *ad libitum* test meal 120 min later compared to a water control, but not compared to an isocaloric amount of white bread (Wong et al, 2009). Cumulative energy intake was not suppressed when compared to bread, and this could be attributed to the macronutrient distribution provided by pulses (a carbohydrate-protein food matrix) as supposed to bread, which is mainly carbohydrate.

When pulses and white bread are providing the same amount of available carbohydrate, food intake was lower after a meal containing navy beans. Food intake following treatments with navy beans and yellow peas was similar to white bread but lower than water. These results were driven by energy content for isocaloric amounts of pulses and white bread did not result in significantly different food intakes at a meal, 260 min later (Mollard et al, 2011).

The incorporation of one cup of pulses into the daily diet five times a week for eight weeks resulted in lower daily energy intake and improved glycemic control in overweight/obese adults (Mollard et al, 2009). The consumption of 5 cups of navy beans per week for 4 weeks reduced markers of metabolic risks including a reduction in waist circumference in adults and a reduction in total cholesterol in adult males (Luhovyy et al, 2015). Navy beans reduced food intake independent of palatability of the meal for appetite ratings were similar.

Glycemic response to high glycemic beverages of equal volume in young men was inversely proportional to subjective appetite and food intake at an *ad libitum* meal after 60 minutes (Anderson et al, 2002). This demonstrates that preparation method of pulses (cooked, boiled, mashed) affects glycemic response for greater surface area implies greater exposure to digestive enzymes, resulting in greater absorption.

The ingestion of 300 calories of pulses reduced blood glucose faster postingestively for 2 hours than white bread. When a fixed meal was eaten two hours after eating a treatment meal, pulses suppressed blood glucose response right after the meal for the first 15 min after the meal. Pulses incorporated into a mixed meal, representing 44% of energy, lentils and yellow peas lowered subjective appetite area under the curve over 260 min and suppressed food intake at the subsequent meal compared to a meal without any added pulses. This exemplifies how pulses can promote positive health outcomes when eaten with glycemic carbohydrates, adding ecological relevance to any future research in this area (Mollard et al, 2011).

The consumption of meals with added beans made subjects feel fuller and experience a lower desire to eat compared to potato added meals 180 min later. This was in conjunction with lower peak blood glucose responses (Leathwood & Pollett, 1988). There was an identified inverse association between energy density and satiety score. The same satiety scores were associated with the fibre content of treatments. The fibre content may be a strong predictor of satiety as well as food intake. Treatments containing pulses suppressed food intake at a meal 120 minutes later to a greater extent than water, but not as well as white bread, demonstrating the potential pulse consumption could have on food intake suppression. Food intake at a test meal 2 hours later was driven primarily by energy density, which is promising for pulses are not energy dense but high in protein and slowly digestible carbohydrates (Wong et al, 2009).

Food intake is dependent on the variety of pulses for yellow pea treatments led to lower appetite ratings during the 4 hours before a pizza meal. Meals containing yellow peas led to lower energy intake and reduced average appetite scores when compared to a pasta control. These results demonstrate that food intake at the next meal cannot be predicted solely on glycemic index (Mollard et al, 2011).

With all of the factors influencing food intake, and the lack of acute short-term studies done with pulses in children, it is imperative to further investigate the role of pulses in food intake regulation.

CONCLUSION

With many questions to be answered, research should continue analyzing pulses and their impact on food intake and related metabolic outcomes such as glucose control. To observe long-term impacts of pulses on food intake, it is necessarily to understand short-term metabolic effects of pulses. Therefore this type of research in children is warranted.

METHODS

REVIEW OF ETHICAL CONSIDERATIONS

Ethics approval for this study was obtained from the Mount Saint Vincent University Research Ethics Board (UREB File #2012-010) (Appendix). Parental consent and participant assent were obtained at the initial screening session before beginning experimental sessions.

PARTICIPANTS AND EXPERIMENTAL DESIGN

In a within-subject repeated measures randomized crossover design, participants aged 9-14 years old, who were born at normal birth and at full term (37-42 weeks gestational age) were recruited for the study. Thirty-one participants aged 9-14 years old, who were born at normal birth and at full term (37-42 weeks gestational age), were recruited for the study of which twenty-eight participants completed entirely. Two participants dropped out voluntarily, and one only completed one study session before withdrawing. The sample size of 24 participants was based on the power analysis with alpha-level of 0.05 and beta level of 0.8 required to detect the difference of 150 kcal in food intake between the groups based on data from previous experiments.

Participants were primarily recruited through word-of-mouth and the use of posters placed throughout the Halifax Regional Municipality including the MSVU campus.

Participants with allergies or personal aversion to any component of the standard breakfast, treatments, or pizza meals were not included. Those showing evidence of dietary restriction (as per the Dutch Eating Behaviour Questionnaire (DEBQ)) or learning and/or behavioural challenges (are per discussions with parents/guardians) were not asked to participate. Information pertaining to the inclusion criteria was obtained through a screening session held at MSVU where the participant and their parent/guardian confirmed eligibility for the study. This included confirmation that the participant was born at term, at a birth weight between 2.5 and 5.0kg.

Body composition and weight were measured through a Bioelectrical Impedance Analysis (BIA), Tanita Body Composition Analyzer, (Tanita TBF-300A; Tanita Corporation of America, Inc., Arlington Heights, IL). The BIA analyzer calculated fat mass, fat percentage, and body weight (kg). Height was measured using a stadiometer. These were used to calculate body mass index by taking height and diving it by the product of height x height. Center for Disease Control Body Mass Index charts were used to classify weight status where normal weight (NW) is considered to be between 5^{th} and 85^{th} percentile, overweight (OW) is between 85^{th} and 95^{th} percentile, and obese (OB) is above the 95^{th} percentile.

Participants were asked to complete the DEBQ (van Strien et al, 1986), the Physical Activity Questionnaire (PA-Q) (Kowalski et al, 1997), and to rank their preference for the two types of pizza (pepperoni and three-cheese) that were used in the study as a test meal to assess subsequent food intake. The DEBQ assesses factors on eating behaviours. The tool assesses the potential for restrained eating and disinhibition, which is eating in the response of or diffusal of emotion (boredom). The DEBQ has strong internal consistency to identify external and restrained eating behaviours (van Strien et al, 1986). The PA-Q assesses the physical activity of the subjects, the type of physical activity, and the frequency in which the subject is engaged in various activities (Kowalwski et al, 1997). If the subject met all the inclusion criteria, parental consent and participant assent were obtained. The screening included self-reported assessment of puberty known to be the factor that could affect the regulation of food intake (Patel et al, 2010).

This study was conducted in accordance to guidelines set by the University Research Ethics Board at Mount Saint Vincent University. Written consent and assent were obtained from parents/guardians and participants respectively.

TREATMENTS

The treatments were formulated using cooked navy beans, hulled split yellow peas, and durum wheat pasta (Catelli Alphabets, Ronzoni Foods, Montreal, PQ), that were added to a sauce made of strained tomatoes (Bella Tavolla, Loblaws Inc., Toronto, ON) and Club House Parmesan and Herbs (McCormick Canada, London, ON). The added pulses (43% of energy) and pasta were pureed using an immersion blender to ensure similar consistency. The proximate analysis was performed by Maxxam Analytics (Mississauga, ON) to provide composition of treatments seen in Table 1.

Table 1: Composition of Experimental Treatments

	Pasta with tomato sauce (C)	Pasta with tomato sauce and added pureed yellow peas (YP)	Pasta with tomato sauce and added pureed navy beans (NB)
Weight (g)	100.00	100.00	100.00
Protein (g)	2.64	3.93	3.92
Fat (g)	0.20	0.27	0.25
Carbohydrate (g)	12.63	14.74	14.29
Fibre (g)	1.37	3.59	4.52
Energy (kcal)	63.36	77.46	75.39

EXPERIMENTAL PROTOCOL

Before each session, participants fasted for 10-12 hours overnight, after which they consumed a standardized breakfast consisting of 26 g of Honey Nut Cheerios cereal (General Mills, Mississauga, Ontario), 250 ml of skim (fat-free) milk (Baxter's, Saint-Hyacinthe, Quebec) and 236 ml of orange juice (Tropicana, Chicago, Illinois). Participants were able to drink water up to 1 hour prior to the start of the experimental session.

Upon arrival in the lab for each session, the participants were asked if they consumed the entire breakfasts, if any other foods were consumed 12 hours prior to arrival, if they were taking any medication, and the time they went to bed the previous night and woke up the morning of the experimental session**.** The session would be rescheduled upon the identification of atypical eating or sleeping behaviour. Participants were required to fill out a baseline (0 min) Visual Analogue Scale (VAS) to measure motivation to eat (to quantify subjective appetite), thirst, physical comfort, and any sensation of diarrhea, gas, nausea, and stomach pain. VAS consists of a line, 100 mm in length with opposing statements on either side (Blundell et al, 2010). Subjective appetite was measured by asking questions such as:

1. How strong is your desire to eat? ("very weak" to "very strong" anchored on the ends), to measure desire to eat
2. How hungry do you feel? ("not hungry at all" to "as hungry as I've ever felt"), to measure hunger
3. How full do you feel? ("not full at all" to "very full"), to measure fullness and
4. How much food do you think you can eat? ("nothing at all" to "a large amount"), to measure prospective food consumption

Participants were informed to place an 'X' on the line at the location that reflects their current sensation between the two statements. The VAS were scored by measuring the distance, in mm, from the leftmost statement to the intersection of the marked ‘X’. This allowed for the quantification of subjective measures so that they can be measured on a continuum instead of creating discrete categories that may not accurately represent the subjects’ feelings. After completion of baseline VAS, participants were randomly given either a pulse-containing navy beans, yellow peas, or a control snack, which was consumed *ad libitum* for 10 minutes.

The treatments were matched for flavour, energy density, and viscosity; they only differed in the source of pulses. The content of the treatments can be found in Table 1. Preloads were consumed in clear bowls and were given to participants after being warmed in the microwave for 90 seconds and stirred to ensure consistent heating. The formulation of the treatment used pasta that was cooked and mixed with tomato sauce with or without added pulses. Strained tomatoes were used for there was no added starch which impacts glycemic response and subsequently food intake. The pasta was used in the shape of letters (similar to Heinz’s Alphabetti) to create a product in which kids are familiar. The part of the pasta in control and pulses in navy bean and yellow pea treatments were blended to a homogenous puree and therefore it was impossible to identify whether it was a treatment with pulses or pulse-free control.

Following consumption of the treatments along with 500 ml of bottled water, the participants completed two separate VAS to assess the palatability and sweetness of the preload. The palatability VAS included questions assessing the mouthfeel, texture, and hedonic properties of the treatment to ensure that appetite and food intake were not affected by the participant’s level of acceptance of the treatment. In the experiment, subjective appetite, physical comfort, and subjective sensations of gastrointestinal symptoms were measured at 15, 30, 60, 90, 120 (pre-meal) and 150 minutes (post-meal) after consumption of the treatment. During the pre-meal period, participants would play quiet games with researchers who ensured that discussion vied away from food. Upon completion of the VAS, the participants were escorted to a feeding room where they were served an *ad libitum* pizza lunch consisting of McCain Deep 'N Delicious (McCain Foods Canada) pizzas, cheese or pepperoni as decided during screening, prepared as per manufacturer suggestions, for 30 min. A freshly baked tray of pizza was provided to the participants starting at 30 min and every 10 minutes thereafter. The participants were instructed to eat until they were "comfortably full". After a fresh tray was provided, the previous tray was removed. Participants were provided 500 ml of water (Danone Crystal Springs) at the start of the treatment and test meals. If the entire volume of water was consumed during the test meal, it was replaced with an additional bottle.

The pizzas were cooked in the MSVU Research Foods Laboratory, weighed on a digital scale and cut into 4 equal pieces prior to serving placed randomly on the plate. This product provides a lack of crust, which results in a pizza with a more uniform energy content and the elimination of the possibility of participants eating the denser filling and leaving the crust of the pizza. The two varieties of pizza were comparable in caloric and macronutrient content. Food and water intake were measured by weighing the cooked pizza and bottled water before and after the meal without the subjects' knowledge. The manufacturers' nutritional information was used to calculate energy intake in kcal.

Upon completion of the test meal, the participants completed three final VAS to assess subjective appetite, physical comfort, subjective sensations of gastrointestinal symptoms, and palatability of the test meal.

DATA ANALYSIS

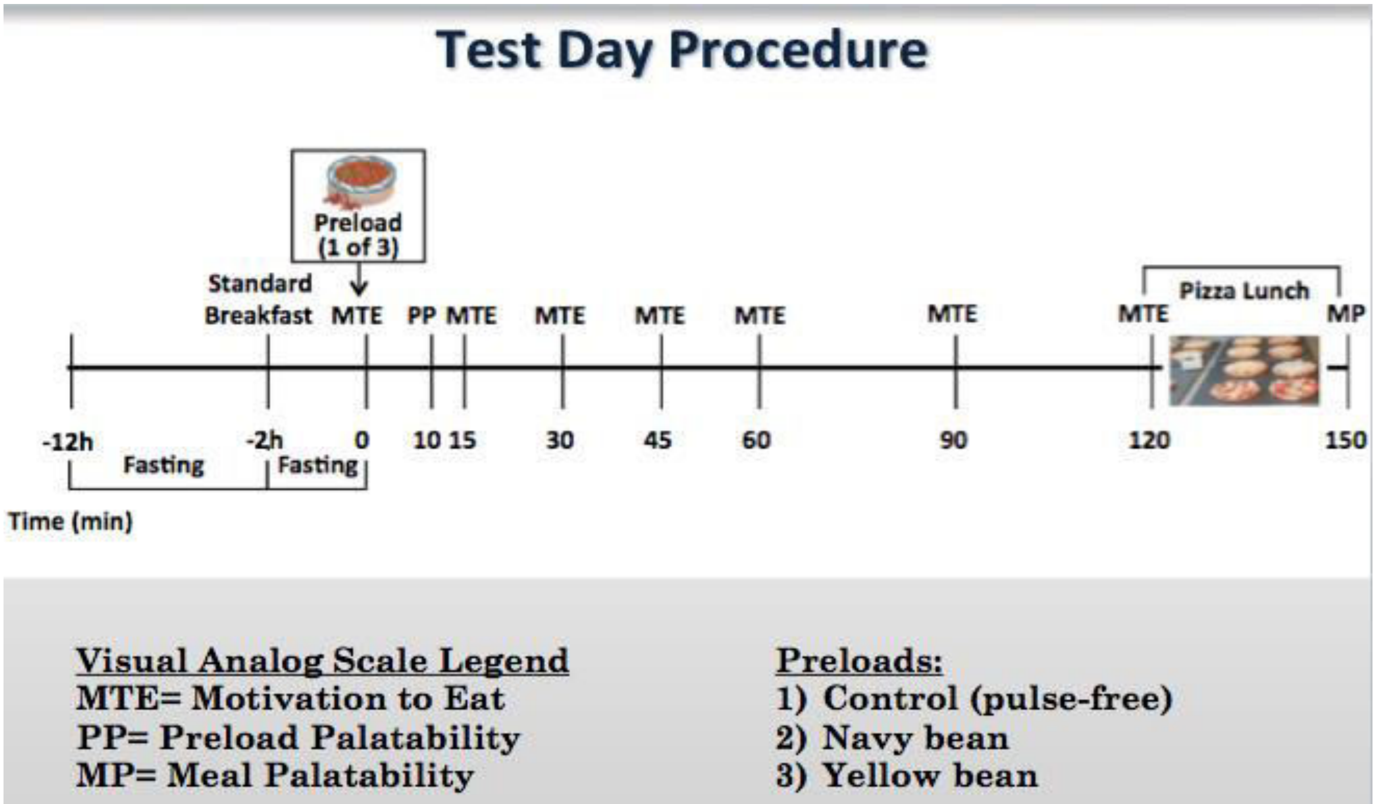
Subjective appetite was assessed using a motivation to eat VAS, which consisted of five questions (Appendix). These scores were used to determine average appetite (AA) score using the following equation: [AA (mm) = [DTE + hunger + (100 – fullness) + PFC)/4] where DTE, and PFC stand for VAS scores related to their subjective desire to eat and prospective food consumption, respectively (Bellissimo et al, 2008).

This VAS provided important additional information concerning the impact of the caloric preload used in the study on satiety. Subjective appetite scores were analyzed to determine if they were predictors of food intake. All statistical analyses were performed using SAS, version 9.3 (Statistical Analysis Systems; SAS Institute Inc, Cary, NC, USA). In the study, treatment and condition effects on food and water intake, cumulative food intake, sweetness and pleasantness were analyzed using a 2-factor mixed model in SAS with treatment as the main factor. The 3-factor mixed model procedure was used to assess the effect of treatment, session, and time on subjective appetite scores, as well as sweetness and palatability of treatment. These scores are all reported as absolute values and subjective appetite scores were recorded as absolute values. All data are reported as mean ± standard error of the mean and results were deemed significant at $P \leq 0.05$.

When statistically significant differences in main effects or interactions were found, one-way repeated measures analysis of variance and post-hoc analysis using Tukey-Kramer's test, adjusted for multiple comparisons were performed to determine between-treatment differences at individual time points. Pearson correlation coefficients were calculated to assess correlations between dependent measures and food intake including the aforementioned subjective appetite scores, treatment and anthropomorphic measurements.

TEST DAY PROCEDURE

Figure 1: Test Day Procedure



RESULTS

Consumption Groups

Twenty-eight participants (14 boys and 14 girls) completed the study. Due to the variability in *ad libitum* treatment intake, and the lack of effect in the lower two quartiles of average treatment intake, the higher two quartiles were used to observe the effect of the treatments on food intake. This was determined using a median split of the average consumption of treatments over the three sessions. Eleven participants were in the lower two quartiles (6.5 to 147.5 kcal) and are called the "low consumption group". The "high consumption group" would be the other seventeen participants whose average treatment intake was greater than the median (169.7 to 384.4 kcal). The anthropometric characteristics of all participants as well as both groups can be found in Table 2.

Table 2: Baseline Characteristics of Participants and High Consumption Group and Low Consumption Group

	All Participants (n=28)	High Consumption Group (n=17)	Low Consumption Group (n=11)
Age (years)	11.8 ± 0.3	11.8 ± 0.4	11.7 ± 0.5
BMI (kg/m^2)	20.2 ± 0.7	21.0 ± 1.0	18.9 ± 0.8
Weight (kg)	47.0 ± 2.6	49.9 ± 3.5	42.7 ± 3.6
Height (m)	1.5 ± 0.0	1.5 ± 0.0	1.5 ± 0.0
BMI Percentile (%)	65.4 ± 5.4	70.6 ± 6.6	57.3 ± 9.1
Fat mass (kg)	10.9 ± 1.4	12.3 ± 1.9	8.6 ± 1.8
Fat free mass (kg)	36.2 ± 1.4	37.5 ± 2.0	34.1 ± 2.0
Average DEBQ	1.5 ± 0.1	1.5 ± 0.3	1.6 ± 0.1

Data are presented as mean ± SEM, n = 28. Abbreviations: BW, body weight BMI, body mass index, FM, fat mass, FFM, fat free mass, TBW, total body weight; FM and FFM were determined using bioelectric impedance. BMI percentiles are recorded as per guidelines developed by the Centre of Disease Control. DEBQ is scored on Dutch Eating Behaviour Questionnaire.

Food intake with Treatments

Ad *libitum* food intake was affected by treatment for all participants (P<0.02) where intake of the treatment with added yellow peas was higher than the control (P=0.01) For the high consumption group there was an effect of treatment on ad *libitum* food intake (kcal) with the treatments (P=0.02) where intake of both treatments with added pureed pulses was higher than that of the control (P<0.05) (Table 3a). There was no effect of participant age or session on ad *libitum* food intake of the treatments. No significant treatment by age or treatment by session interactions on ad *libitum* food intake of the treatments were detected. When food intake is expressed as the mass of the treatments, there was no significant effect of the treatment (Table 3b).

Table 3a: *Ad libitum* Food Intake (kcal) with a Treatment

	All Participants (n=28)	High Consumption Group (n=17)	Low Consumption Group (n=11)
Control	156.1 ± 20.8[a]	211.3 ± 24.0[a]	111.6 ± 28.7
Added Pureed Navy Beans	182.4 ± 22.6[ab]	251.0 ± 23.2[b]	101.2 ± 23.3
Added Pureed Yellow Peas	194.6 ± 22.4[b]	267.6 ± 19.8[b]	105.5 ± 25.2

Mean ± SEM. 1-way ANOVA with Tukey-Kramer post hoc test.
Differences with the superscripts. P<0.05.

Table 3b: *Ad libitum* Food Intake (grams) with a Treatment

	All Participants (n=28)	High Consumption Group (n=17)	Low Consumption Group (n=11)
Control	246.2 ± 6.2	333.3 ± 37.9	111.6 ± 28.7
Added Pureed Navy Beans	241.9 ± 5.6	332.9 ± 30.8	101.2 ± 23.3
Added Pureed Yellow Peas	251.1 ± 5.6	345.3 ± 25.5	105.5 ± 25.2

Mean ± SEM. 1-way ANOVA with Tukey-Kramer post hoc test.

Food Intake with Test Pizza Meal 2 Hours Later

Table 4a: *Ad libitum* Food Intake (kcal) with a Test Pizza Meal at 120 min

	All Participants (n=28)	High Consumption Group (n=17)	Low Consumption Group (n=11)
Control	849.0 ± 60.1	898.9 ± 89.5	771.8 ± 63.8
Added Pureed Navy Beans	835.5 ± 66.7	880.0 ± 88.4	766.8 ± 102.3
Added Pureed Yellow Peas	826.0 ± 61.4	866.7 ± 85.1	763.2 ± 85.6

Mean ± SEM. 1-way ANOVA with Tukey-Kramer post hoc test post-hoc test. Differences with the superscripts. P<0.05.

Table 4b: *Ad libitum* food intake (grams) with a Test Pizza Meal at 120 min

	All Participants (n=28)	High Consumption Group (n=17)	Low Consumption Group (n=11)
Control	389.0 ± 5.2	407.2 ± 39.8	360.7 ± 33.7
Added Pureed Navy Beans	382.1 ± 5.7	395.5 ± 39.1	361.4 ± 49.2
Added Pureed Yellow Peas	377.7 ± 5.2	390.2 ± 38.4	358.4 ± 38.1

Mean ± SEM. 1-way ANOVA with Tukey-Kramer post hoc test post-hoc test. Differences with the superscripts. P<0.05.

Ad *libitum* food intake with the pizza meal 2 hours after treatment for all participants was unaffected by treatment (P=0.8). The relationship was similar in high consumers (P=0.8). There was no effect of participant age or session on *ad libitum* pizza meal intake 2 hours later. Interactions of treatment by age or treatment by session on *ad libitum* intake of the pizza meal were not found to be significant.

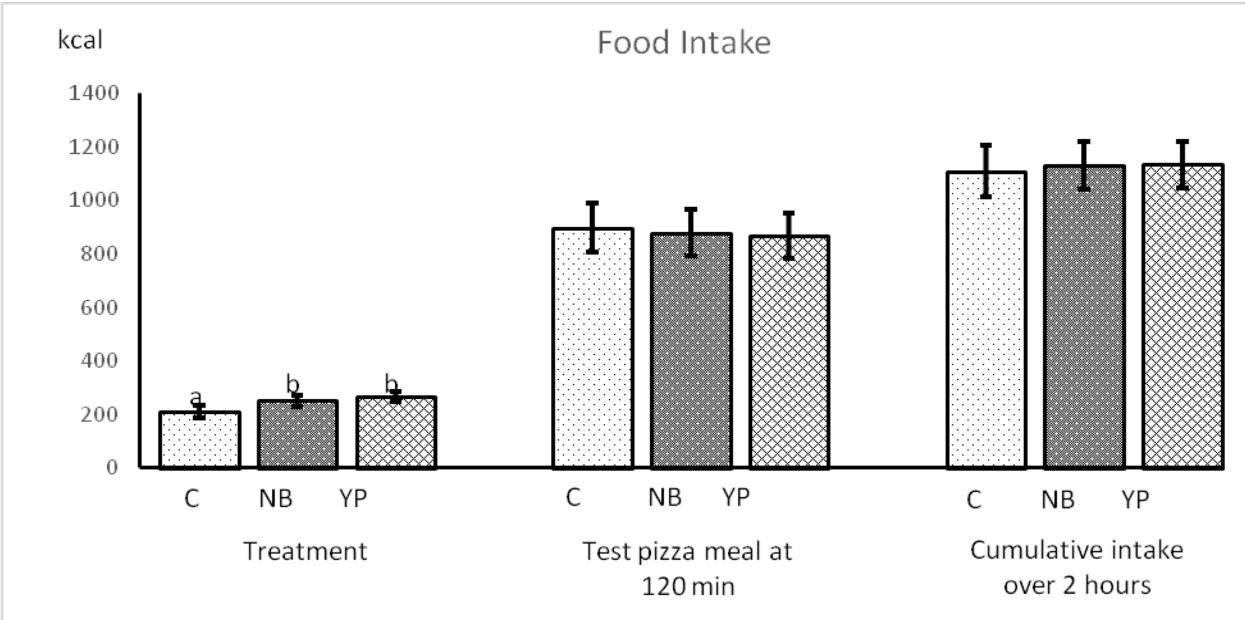
Table 5: Cumulative *Ad libitum* Treatment and Pizza Meal food intake over 2 hours

	All Participants (n=28)	High Consumption Group (n=17)	Low Consumption Group (n=11)
Control	1005.1 ± 62.2	1110.2 ± 97.4	842.6 ± 64.6
Added Pureed Navy Beans	1017.9 ± 72.7	1131.0 ± 90.4	843.1 ± 105.4
Added Pureed Yellow Peas	1020.6 ± 66.9	1134.3 ± 86.9	845.0 ± 83.6

Mean ± SEM, n = 28. Cumulative food intake calculated by adding treatment and pizza meal intake (kcal)

Cumulative food intake was not affected by treatment for all participants (P=0.9), low consumers (P=0.9), or high consumers (P=0.9). There was no effect of participant age or session on cumulative *ad libitum* food intake of the treatments and a pizza meal 2 hours later. There were no significant interactions between the treatment and age or treatment and session on cumulative *ad libitum* food intake.

Figure 2: Treatment, Pizza Meal, and Cumulative Food Intake of High Consumers



Palatability of Treatments and Pizza Meal

Pleasantness of the treatment was not affected by treatment for all participants (P=0.7), low consumers (P=0.27), or high consumers (P=0.66). However, there was a difference between the subjective ratings of pleasantness between low and high consumers (P=0.02) where the high consumers gave higher ratings. Pleasantness was also measured using the Peryam & Kroll Hedonic scale and a difference between the low and high consumers (P=0.02) was observed where high consumers gave higher ratings. Pleasantness of the pizza meal assessed using the hedonic scale was not affected by treatment for all participants (P=0.47). Mouthfeel was higher in the high consumption group compared to low consumers (P=0.02), demonstrating it is a key component in the acceptance of foods. Flavour (P=0.95), sweetness (P=0.65), and subjective pleasantness of the pizza meal 2 hours after eating the treatment (P=0.65) were not affected by treatment for all participants. Younger children liked the pizza less as there was an effect of age on the subjective pleasantness of the pizza (P=0.006). This could be attributed to younger children not having as much exposure as older participants.

Table 6: Palatability of Treatments and Pizza Meal by Consumption Group

Treatments	Low Consumption Group (n=11)						High Consumption Group (n=17)					
	Treatment Pleasantness (mm VAS)	Treatment Pleasantness*	Treatment Mouthfeel**	Treatment Flavour**	Treatment Sweetness (mm VAS)	Pizza Pleasantness (mm)	Treatment Pleasantness (mm VAS)	Treatment Pleasantness*	Treatment Mouthfeel**	Treatment Flavour**	Treatment Sweetness (mm VAS)	Pizza Pleasantness (mm VAS)
Control	30.0 ± 9.4	4.6 ± 0.6	2.7 ± 0.2	2.6 ± 0.2	25.9 ± 7.8	95.1 ± 1.6	60.0 ± 7.8	6.1 ± 0.4	3.1 ± 0.2	3.0 ± 0.2	34.4 ± 5.4	94.6 ± 1.8
Added Pureed Navy Beans	39.8 ± 11.1	4.7 ± 0.7	2.6 ± 0.2	2.8 ± 0.2	25.9 ± 9.2	94.2 ± 1.5	57.6 ± 5.8	6.2 ± 0.3	3.2 ± 0.1	2.9 ± 0.2	38.3 ± 6.2	93.2 ± 1.9
Added Pureed Yellow Peas	37.1 ± 13.0	4.6 ± 0.7	2.7 ± 0.4	2.8 ± 0.3	32.4 ± 11.8	94.1 ± 1.5	62.1 ± 6.0	5.8 ± 0.5	3.4 ± 0.2	2.9 ± 0.1	37.7 ± 5.2	94.5 ± 1.6
Effect of Treatment	0.27	0.84	0.62	0.39	0.56	0.80	0.66	0.08	0.40	0.72	0.30	0.08

Mean ± SEM, n=28. Three-way ANOVA with Tukey-Kramer post-hoc test.
Values with different superscripts are significantly different, P<0.05.
* indicates Peryam & Kroll 9-point hedonic scale
** indicates 5-point pictorial hedonic scale

Significant correlations include the association between treatment food intake and pleasantness measured with the hedonic scale for the control (r =0.65, P=0.03) and navy beans (r =0.72, P=0.01). Mouthfeel is positively associated with treatment food intake after treatments with included navy beans (r=0.66, P=0.02) and yellow peas (r=0.62, P=0.04).

Table 6b: Associations of Treatment and Meal Intake to Treatment and Pizza Palatability in the Low Consumption Group

	Treatment Pleasantness (VAS)	Treatment Pleasantness (Peryam)	Treatment Mouthfeel	Treatment Flavour	Treatment Sweetness (VAS)	Pizza Pleasantness (VAS)
Treatment FI (Control)	0.53 P= 0.09	0.65 P = 0.03	0.57 P= 0.07	0.23 P= 0.50	0.48 P= 0.13	0.48 P= 0.14
Treatment FI (Navy Bean)	0.36 P= 0.28	0.72 P=0.01	0.66 P=0.02	-0.12 P= 0.73	0.27 P= 0.42	-0.36 P= 0.27
Treatment FI (Yellow Pea)	0.48 P= 0.14	0.59 P= 0.06	0.62 P=0.04	-0.05 P= 0.89	0.37 P= 0.26	0.44 P= 0.17
Pizza FI (Control)	-0.45 P= 0.16	-0.57 P= 0.10	-0.48 P= 0.14	0.23 P= 0.50	-0.22 P= 0.51	-0.36 P= 0.27
Pizza FI (Navy Bean)	-0.31 P= 0.36	-0.09 P= 0.79	0.13 P= 0.70	-0.27 P= 0.43	-0.27 P= 0.43	0.05 P= 0.87
Pizza FI (Yellow Pea)	-0.42 P= 0.20	-0.44 P= 0.18	-0.30 P= 0.36	-0.49 P= 0.12	-0.39 P= 0.23	-0.004 P= 0.99

Correlations calculated using Pearson's coefficients.
Values with different subscripts are significantly different, P<0.05.

Table 6c: Associations of Treatment and Meal Intake to Treatment and Pizza Palatability in the High Consumption Group

	Treatment Pleasantness (VAS)	Treatment Pleasantness (Peryam)	Treatment Mouthfeel	Treatment Flavour	Treatment Sweetness (VAS)	Pizza Pleasantness (VAS)
Treatment FI (Control)	0.17 P= 0.52	0.46 P= 0.07	0.32 P= 0.20	0.26 P= 0.31	0.16 P= 0.55	0.31 P= 0.22
Treatment FI (Navy Bean)	0.57 P=0.02	0.64 P=0.006	0.16 P= 0.53	0.47 P=0.05	0.38 P= 0.13	0.32 P= 0.21
Treatment FI (Yellow Pea)	0.12 P= 0.65	0.39 P= 0.12	0.30 P= 0.25	0.10 P= 0.69	0.19 P= 0.46	-0.24 P= 0.36
Pizza FI (Control)	-0.34 P= 0.18	-0.27 P= 0.29	-0.19 P= 0.46	0.01 P= 0.96	-0.40 P= 0.12	-0.06 P= 0.82
Pizza FI (Navy Bean)	-0.24 P= 0.35	-0.25 P= 0.34	-0.24 P= 0.35	0.10 P= 0.69	-0.25 P= 0.34	0.14 P= 0.58
Pizza FI (Yellow Pea)	-0.06 P= 0.83	-0.13 P= 0.62	-0.14 P= 0.60	-0.46 P= 0.06	-0.09 P= 0.72	0.36 P= 0.16

Correlations calculated using Pearson's coefficients.
Values with different subscripts are significantly different, P<0.05.

Significant correlations include the association between treatment food intake with added navy beans and treatment pleasantness measured with both VAS (r=0.57, P=0.02) and hedonic scale (r=0.64, P=0.006). There is also an association between treatment food intake with added navy beans with subjective assessment of flavour (r=0.47, P=0.05).

Figure 3: Treatment and Pizza Meal Pleasantness for All Participants and High Consumption Group

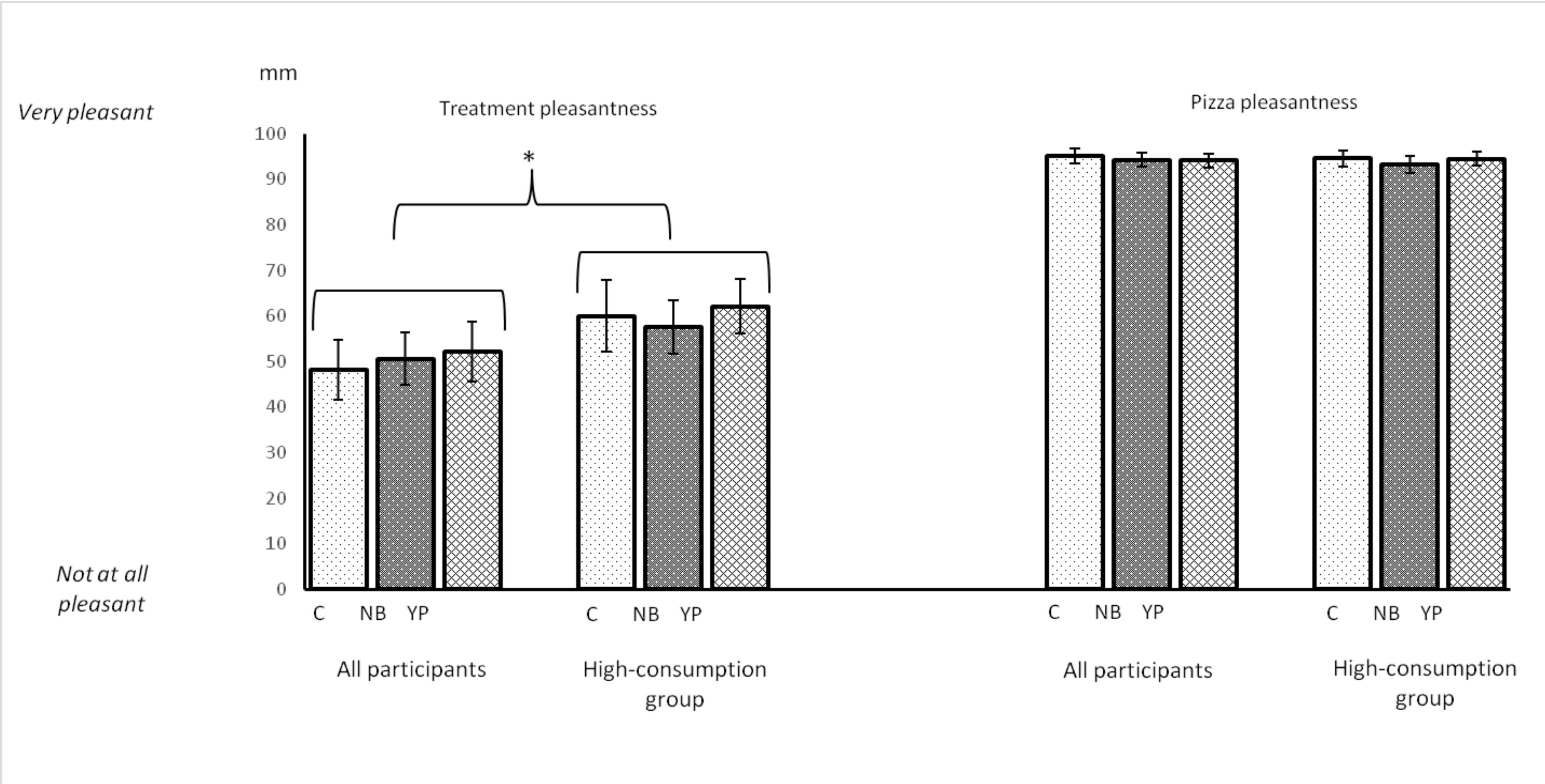
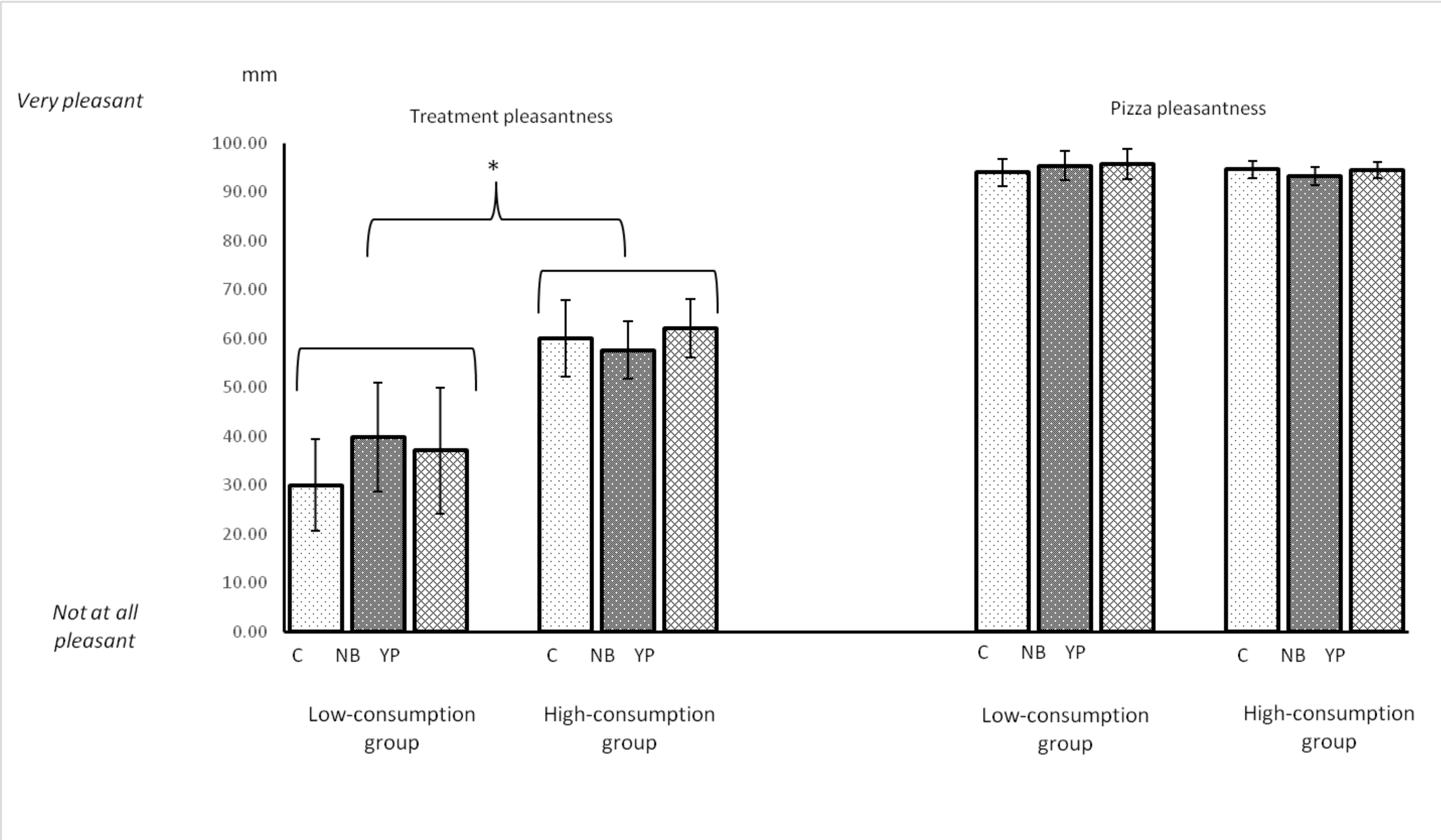


Figure 4: Treatment and Pizza Meal Pleasantness for Low Consumption Group and High Consumption Group



Nutrient Intake

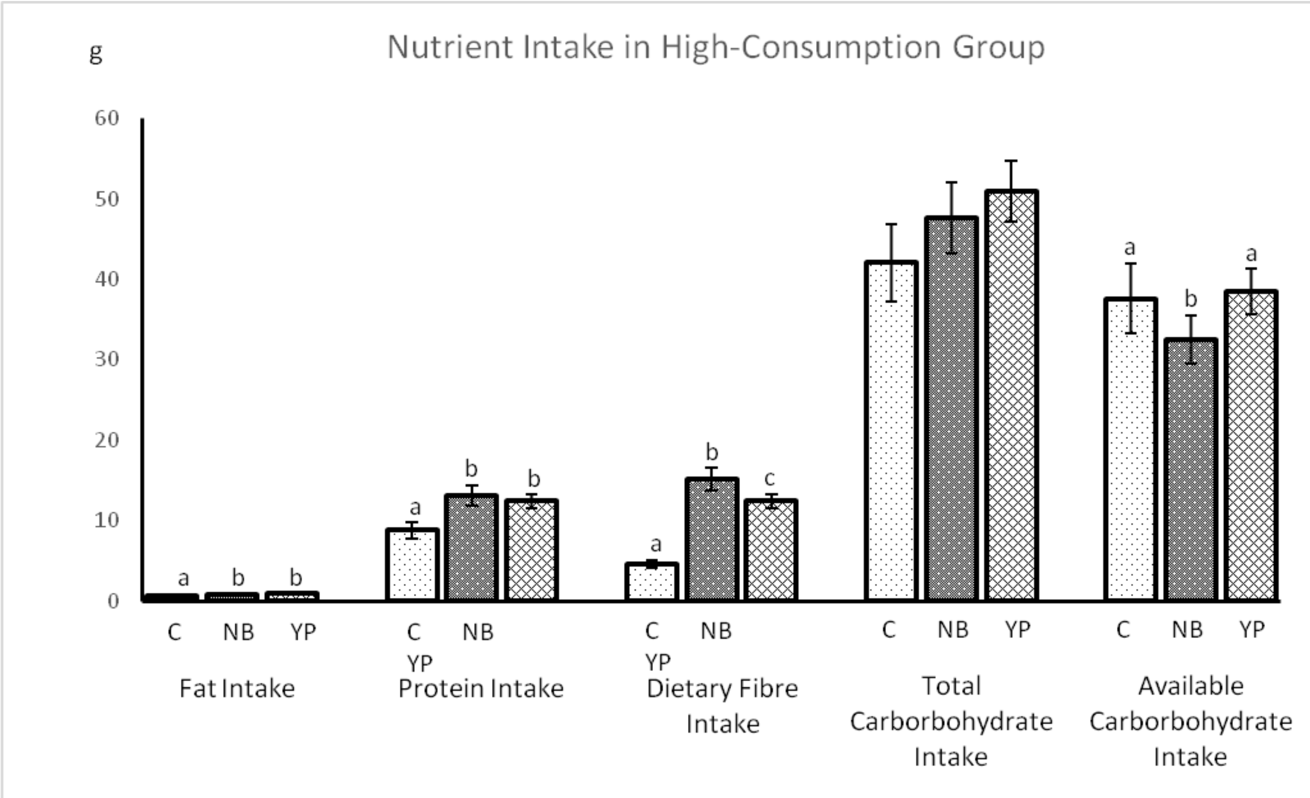
Treatment effects were found on fat intake (P<0.002) as well as fibre and protein intake (P<0.0001). There was no effect of treatment on carbohydrate intake (P=0.14). High consumers had greater nutrient intakes than low consumers (P<0.01). Fibre intake was higher for the treatment with added pureed yellow peas compared to the control (P<0.01). Protein intake was higher with the treatment with added navy beans compared to the control (P=0.0012). In high consumers, there was an effect of treatment on fibre intake (P<0.0001), and protein intake (P<0.0001). Fibre intake was higher with navy beans (P=0.0001) and yellow peas (P=0.0028) compared to control (Table 7).

Table 7: Nutrient Intake from Treatment of All Participants and the High Consumption Group

Treatments	All Participants (n=28)					High Consump	
	Carbohydrate (g)	Available Carbohydrate (g)	Protein (g)	Fat (g)	Fibre (g)	Carbohydrate (g)	Available Carbohydrate (g)
Control	31.1 ± 4.1	27.7 ± 3.7^{ab}	6.5 ± 0.9^{a}	0.5 ± 0.1^{a}	3.4 ± 0.4^{a}	42.1 ± 4.8	37.6 ± 4.3^{ab}
Added Pureed Navy Beans	34.6 ± 4.3	23.6 ± 2.9^{a}	9.5 ± 1.2^{b}	0.6 ± 0.1^{ab}	10.9 ± 1.4^{b}	47.6 ± 4.4	32.5 ± 3.0^{a}
Added Pureed Yellow Peas	37.0 ± 4.3	28.0 ± 3.2^{b}	9.9 ± 1.1^{b}	0.7 ± 0.1^{b}	9.0 ± 1.0^{b}	50.9 ± 3.8	38.5 ± 2.8^{b}
Effect of Treatment	0.15	0.04	<0.0001	0.0018	<0.0001	0.09	0.003

Nutrient intakes are represented as mean ± SEM. Effects measured using three-way repeated measures analysis of variance with Tukey-Kramer post hoc analysis. Significance defined as $P<0.05$ and indicated with different superscripts.

Figure 5: Nutrient Intake in High Consumption Group



Subjective Appetite

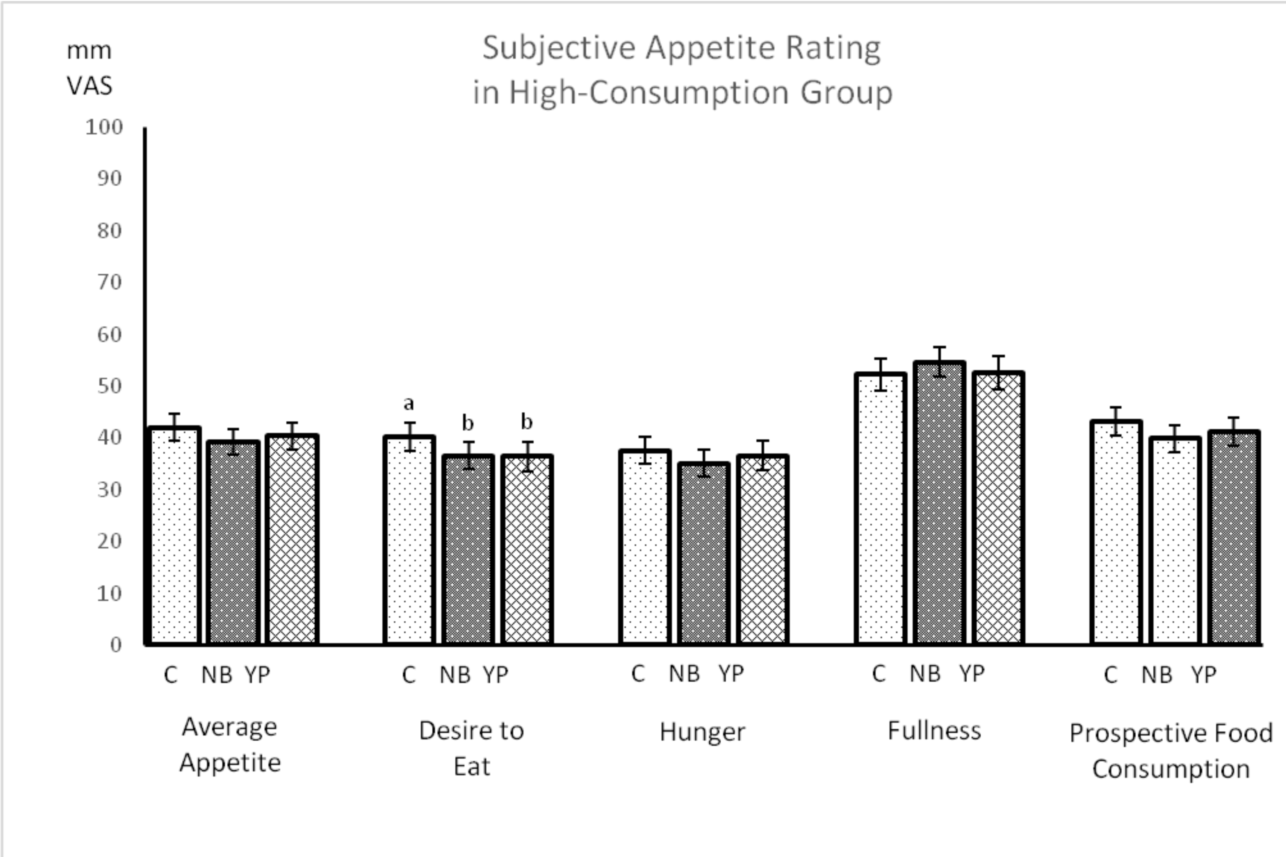
In high-consumption group, there was a trend for a treatment effect on average appetite, the composite measure of subjective appetite (P=0.078). Post-hoc analysis revealed that the treatment with navy beans tended to reduce the average appetite compared to the control (P=0.077). In the high consumption group, there was an effect of treatment on desire to eat (P=0.03). Post-hoc analysis revealed higher desire to eat scores after the control compared to treatment with added yellow peas (P=0.01) as well as the treatment with added navy beans (P=0.03). Treatments exhibited no effect on hunger (P=0.2), but an effect of time (P<0.0001) and session (P<0.0001) was observed. Prospective food consumption was not affected by treatment (P=0.7), but an effect of time (P<0.0001) and session (P<0.04) was observed. There was no effect of treatment on subjective fullness (P=1.0), but an effect of time (P<0.0001) and session (P=0.0004) was observed. All scores contributing to average appetite (except fullness) increased over time and increased across the sessions with randomly assigned treatments. The effect of treatment on subjective appetite over 2 hours can be seen in Table 8.

Table 8: The Effect of Treatment on Subjective Appetite Over 2 Hours

Treatments	All Participants (n=28)					High Consumption Group (n=17)				
	AA (mm)	DTE (mm)	HUN (mm)	FUL (mm)	PFC (mm)	AA (mm)	DTE (mm)	HUN (mm)	FUL (mm)	PFC (mm)
Control	42.7 ± 2.0	39.1 ± 2.1	37.8 ± 2.0	49.2 ± 2.4	42.9 ± 2.1	42.0 ± 2.6	40.2 ± 2.2[a]	37.5 ± 2.6	52.3 ± 1.1	43.2 ± 2.7
Added Pureed Navy Beans	44.5 ± 2.1	42.0 ± 2.2	40.8 ± 2.1	49.5 ± 2.3	44.6 ± 2.2	39.3 ± 2.5	36.6 ± 2.7[b]	35.1 ± 2.6	54.6 ± 2.8	39.9 ± 2.6
Added Pureed Yellow Peas	43.7 ± 2.0	39.5 ± 2.2	40.9 ± 2.1	49.0 ± 2.4	43.5 ± 2.0	40.4 ± 2.6	36.4 ± 2.8[b]	36.6 ± 2.8	52.6 ± 3.2	41.1 ± 2.7
Effect of Treatment	0.6	0.3	0.2	1.0	0.7	0.08	0.03	0.2	0.5	0.07
Effect of Time	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Effect of Session	<0.0001	0.0006	<0.0001	0.0004	0.0001	<0.0001	0.0005	<0.0001	0.0004	0.0001

Mean ± SEM. 3-way repeated measures ANOVA with Tukey-Kramer post hoc test. Statistically significant differences are shown with the superscripts ($P<0.05$).AA: average appetite, DTE: desire to eat, HUN: hunger, FUL: fullness, PFC: prospective full consumption.

Figure 6: Subjective Appetite Ratings in High Consumption Group



In the low consumption group, significant correlations include the inverse association between treatment food intake with added navy beans and subjective desire to eat (r=-0.24, P=0.0005), subjective hunger (r=-0.24, P=0.004), prospective food consumption (r=-0.22, P=0.01), and average appetite (r=-0.20, P=0.02). The inverse association between treatment food intake with added yellow peas and desire to eat (r=-0.27, P=0.001), hunger (r=-0.27, P=0.002), prospective food consumption (r=-0.19, P=0.03), and average appetite (r=-0.18, P=0.04) were significant. The amount of calories eaten in the pizza meal 2 hours after the control treatment was correlated with prospective food consumption (r=0.20, P=0.02) and average appetite (r=0.16, P=0.05).

Table 8b: Associations of Treatment and Meal Intake to Subjective Appetite in the Low Consumption Group

	DTE	HUN	FULL	PFC	AA
Treatment FI (Control)	-0.07 P= 0.45	-0.08 P= 0.36	-0.09 P= 0.29	-0.03 P= 0.71	-0.02 P= 0.84
Treatment FI (Navy Bean)	-0.24 P=0.005	-0.24 P=0.004	0.06 P= 0.49	-0.22 P=0.01	-0.20 P=0.02
Treatment FI (Yellow Pea)	-0.27 P=0.001	-0.27 P=0.002	-0.10 P= 0.27	-0.19 P=0.03	-0.18 P=0.04
Pizza FI (Control)	0.14 P= 0.11	0.13 P= 0.14	-0.16 P= 0.06	0.20 P=0.02	0.16 P=0.05
Pizza FI (Navy Bean)	0.14 P= 0.11	0.08 P= 0.37	-0.12 P= 0.16	0.10 P= 0.26	0.12 P= 0.18
Pizza FI (Yellow Pea)	0.12 P= 0.18	0.10 P= 0.23	-0.12 P= 0.17	0.13 P= 0.15	0.14 P= 0.10

Correlations calculated using Pearson’s coefficients.
Values with different subscripts are significantly different, P<0.05.

Table 8c: Associations of Treatment and Meal Intake to Subjective Appetite in the High Consumption Group

	DTE	HUN	FULL	PFC	AA
Treatment FI (Control)	-0.10 P= 0.36	-0.09 P= 0.43	0.29 P=0.006	-0.10 P= 0.33	-0.16 P= 0.13
Treatment FI (Navy Bean)	-0.05 P= 0.67	0.001 P= 0.99	0.07 P= 0.51	0.02 P= 0.88	-0.03 P= 0.80
Treatment FI (Yellow Pea)	-0.14 P= 0.20	-0.03 P= 0.75	0.03 P= 0.76	-0.08 P= 0.45	-0.09 P= 0.39
Pizza FI (Control)	0.26 P=0.01	0.28 P=0.008	-0.29 P=0.006	0.27 P=0.01	0.30 P=0.005
Pizza FI (Navy Bean)	0.43 P<0.0001	0.44 P<0.0001	-0.27 P=0.01	0.46 P<0.0001	0.42 P<0.0001
Pizza FI (Yellow Pea)	0.002 P= 0.98	-0.06 P= 0.54	-0.08 P= 0.45	0.02 P= 0.85	0.01 P= 0.89

Correlations calculated using Pearson's coefficients.
Values with different subscripts are significantly different, P<0.05.

Food intake with the pizza meal 2 hours after the control and the treatment with added navy beans were positively correlated with desire to eat, hunger, prospective food consumption, and average appetite. In contrary, fullness was inversely associated with pizza meal food intake after the control and the treatment with added navy beans.

Physical Comfort

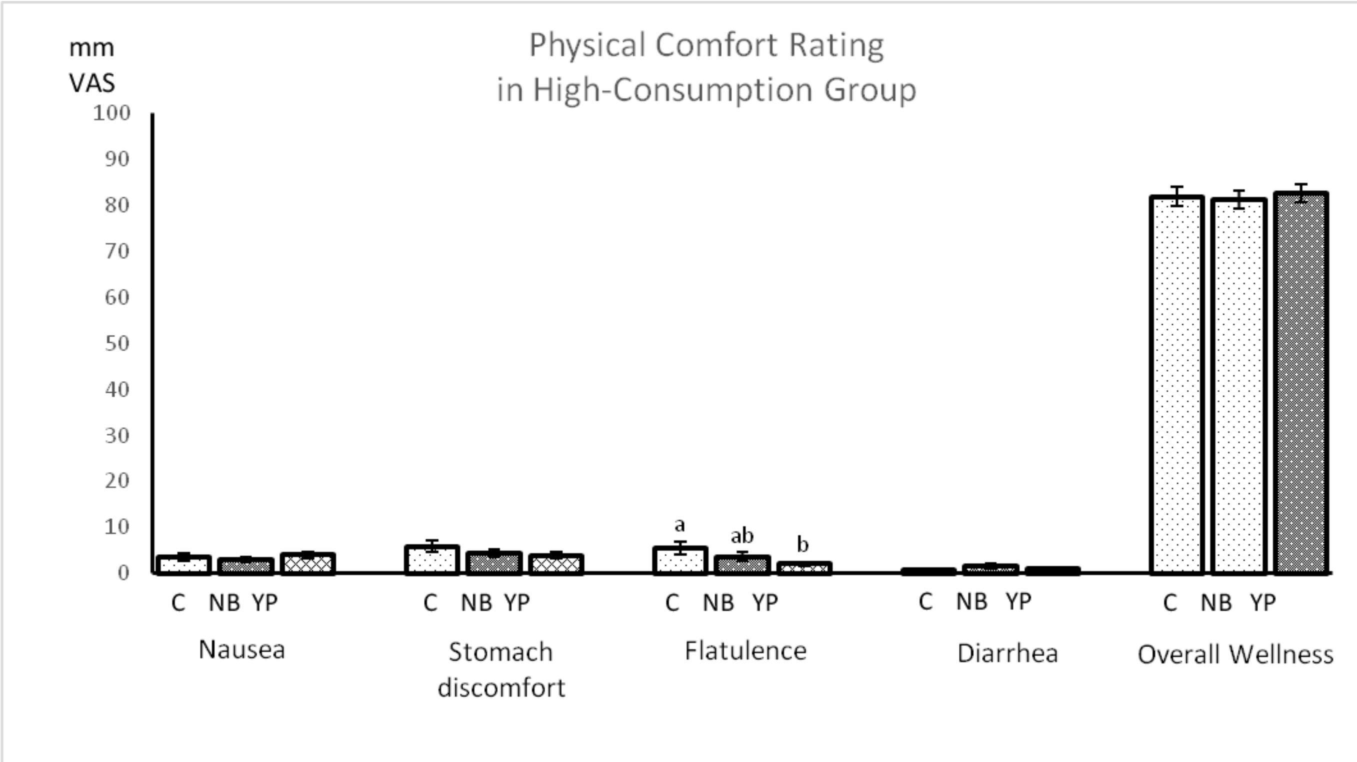
The subjective perception of nausea was affected by treatment (P=0.04), however the absolute difference between treatments is small especially when participants rated their level of nausea between 0 and 5mm on the 100mm visual analogue scale. There was a significant interaction of gas by consumption group where higher consumers rated higher levels of symptoms of gas compared to lower consumers (P=0.03). This interaction is driven by the ratios for the control treatment, which is significantly higher than that of the treatments containing added pulses. The ratings of gas were all lower than 10 on the 100mm visual analogue scale. Perhaps the differences in subjective gas and nausea symptoms influenced wellness scores at different points, resulting in a significant effect of time on wellness (P=0.04). This difference was also seen between consumption groups (P=0.04) where wellness scores were lower in the high consumption group, perhaps due to the significantly higher subjective ratings of gas.

Table 9: The Effect of Treatment on Subjective Assessment of Gastrointestinal Symptoms and Physical Comfort Over 2 Hours

Treatments	All Participants (n=28)					High Consumption Group (n=17)				
	Nausea (mm)	Stomach Discomfort (mm)	Gas (mm)	Diarrhea (mm)	Wellness (mm)	Nausea (mm)	Stomach Discomfort (mm)	Gas (mm)	Diarrhea (mm)	Wellness (mm)
Control	3.1 ± 0.5	4.8 ± 0.8	4.0 ± 0.9	1.0 ± 0.2	86.0 ± 1.6	3.6 ± 0.8	5.9 ± 1.2	5.6 ± 1.4[a]	0.8 ± 0.2	81.9 ± 2.2
Added Pureed Navy Beans	2.9 ± 0.4	4.3 ± 0.6	2.9 ± 0.6	1.5 ± 0.3	86.3 ± 1.4	3.0 ± 0.6	4.4 ± 0.8	3.6 ± 1.0[ab]	1.6 ± 0.5	81.2 ± 2.0
Added Pureed Yellow Peas	4.3 ± 0.6	4.1 ± 0.6	2.4 ± 0.4	1.2 ± 0.2	87.8 ± 1.4	4.1 ± 0.7	3.9 ± 0.7	2.1 ± 0.4[b]	1.1 ± 0.2	82.6 ± 2.0
Effect of Treatment (P-value)	0.04	0.66	0.11	0.09	0.32	0.50	0.22	0.03	0.10	0.78
Effect of Time	P=0.002	P=0.28	P=0.98	P=0.54	P=0.04	P=0.92	P=0.94	P=0.99	P=0.94	P=0.92
Effect of Session	P=0.0001	P=0.37	P=0.43	P=0.50	P=0.23	P=0.48	P=0.55	P=0.42	P=0.62	P=0.74

Subjective gastrointestinal symptom and physical comfort scores are represented as mean ± SEM. Effects measured using three-way repeated measures analysis of variance with Tukey-Kramer post hoc analysis. Correlations calculated using Pearson's coefficients. Values with different subscripts are significantly different, P<0.05.

Figure 7: Physical Comfort Ratings in High Consumption Group



The food intake of treatments was inversely correlated for all subjective gastrointestinal symptoms except for wellness after eating the control treatment (r=0.22, P=0.03). Meal intake was positively correlated to all subjective gastrointestinal symptoms except wellness after the control (r=-0.23, P=0.03), navy bean treatment (r=-0.35, P=0.0007), and yellow pea treatment (r=-0.56, P<0.0001).

Table 9b: Associations of Treatment and Meal Intake to Subjective Gastrointestinal Symptoms in the Low Consumption Group

	Nausea	Stomach Upset	Wellness	Gas	Diarrhea
Treatment FI (Control)	0.05 P= 0.57	0.30 P= 0.0003	-0.17 P=0.05	0.19 P=0.03	0.11 P= 0.24
Treatment FI (Navy Bean)	-0.09 P= 0.28	0.06 P= 0.45	-0.21 P=0.01	0.10 P= 0.26	-0.13 P= 0.12
Treatment FI (Yellow Pea)	-0.24 P=0.001	-0.21 P=0.01	-0.30 P=0.0003	0.02 P= 0.0003	-0.21 P=0.01
Pizza FI (Control)	0.06 P= 0.48	0.35 P<0.0001	0.14 P= 0.11	0.33 P=0.001	0.20 P=0.02
Pizza FI (Navy Bean)	0.24 P=0.004	0.001 P= 0.99	0.14 P= 0.11	-0.11 P= 0.21	-0.04 P= 0.65
Pizza FI (Yellow Pea)	0.02 P= 0.77	0.03 P= 0.69	0.19 P=0.03	-0.06 P= 0.46	0.24 P=0.005

Correlations calculated using Pearson's coefficients.
Values with different subscripts are significantly different, P<0.05.

Table 9c: Associations of Treatment and Meal Intake to Subjective Gastrointestinal Symptoms in the High Consumption Group

	Nausea	Stomach Upset	Wellness	Gas	Diarrhea
Treatment FI (Control)	-0.41 P<0.0001	-0.43 P<0.0001	0.22 P=0.03	-0.34 P=0.01	-0.42 P<0.0001
Treatment FI (Navy Bean)	-0.08 P= 0.46	-0.10 P= 0.35	-0.07 P= 0.53	-0.24 P=0.03	-0.40 P=0.0001
Treatment FI (Yellow Pea)	0.08 P= 0.48	-0.02 P= 0.87	-0.07 P= 0.54	-0.24 P=0.02	-0.35 P=0.0009
Pizza FI (Control)	0.24 P=0.02	0.27 P=0.01	-0.23 P=0.03	0.21 P=0.05	0.40 P=0.0001
Pizza FI (Navy Bean)	0.22 P=0.04	0.33 P=0.002	-0.35 P=0.0007	0.31 P=0.003	0.35 0.0009
Pizza FI (Yellow Pea)	0.29 P=0.006	0.40 P=0.0001	-0.56 P<0.0001	0.49 P<0.0001	0.63 P<0.0001

Correlations calculated using Pearson's coefficients.
Values with different subscripts are significantly different, P<0.05.

DISCUSSION

This study demonstrates the convenience and efficacy of adding cooked pureed pulses to a mixed meal without impacting the palatability. The *ad libitum* intake of mixed meals with added pulses resulted in higher energy intake compared to pulse-free control while intake *per se* expressed in grams was not different. This can be explained by the higher energy density of the meals with added pulses and hence the termination of the intake was triggered by rather the mass of the treatments than their nutrient characteristics. However in a longer term, adding pureed navy beans and yellow peas to a mixed meal with lower energy did not lead to increased short-term food intake over 2 hours, and provided added fibre and protein which resulted in higher intakes of those macronutrients.

Mouthfeel is an oral sensation that is initiated by placing food in the mouth. Once food is in the mouth, olfactory perception occurs using different pathways (Mattes, 2005). This is often a rationale behind the human preference for foods containing fat, contributing to texture-specific satiety. However, pulses are not a great source of fat, and so other influences of mouthfeel need to be considered. Participants who ate more of the treatment gave significantly higher ratings of mouthfeel, demonstrating that mouthfeel is a key indicator of food intake.

Mouthfeel influences the orosensory perception of food, which is often influenced by the extent of mastication (Foster et al, 2011), creating a preference for smoother foods, which could justify increasing the extent of pureeing when making treatments. A learned association may exist between mastication and the perceived healthiness of a food product to the extent that smooth-textured foods led to subsequent preferences for healthier options (Biswas et al, 2014).

Looking at the mouthfeel also provides an opportunity for innovation in pulses within low-fat food matrices. This would require an industrial process to help compensate in terms of flavour and mouthfeel. This experiment provides rationale for focusing on mouthfeel for the participants did not perceive different tastes for treatments with or without added pulses. Identified differences in mouthfeel of the treatments between low and high consumers of treatment supports the homogenization of pulses into familiar food products but perhaps to a different extent to provide a more a palatable consistency.

The addition of pureed yellow peas and navy beans does not change the amount eaten at subsequent meal 2 hours later. However, the addition of pulses results in an increased intake of fibre and protein, nutrients that contributes to satiety via hormonal mechanisms. Also, pulses will help to increase fibre intake, which is low in Canadian children (Storey et al, 2010).

Subjective appetite measures increased in the pre-meal period and decreased after the test meal, confirming the validity of using visual analogue scales as a measurement of subjective appetite in children. There was no difference in food intake between treatments and it was expected these measures of subjective appetite would not correlate with food intake. Subjective measures of gastrointestinal symptoms do not strongly correlate with subjective appetite measures or food intake suggesting that satiating properties of pulses within a mixed meal cannot explain changes in subjective appetite but provides some insight. For example, subjective fullness was not correlated with food intake of the treatments containing added navy beans ($r=0.06$, $P=0.49$) and yellow peas ($r=-0.10$, $P=0.27$) in the low consumption group. This was also observed in the high consumption group with ($r=0.07$, $P=0.53$) and ($r=0.03$, $P=0.76$) for treatments with added navy beans and yellow peas respectively.

Also, the significance of those relationships is weakened by a small sample size. However, pureed pulses reduce subjective appetite in children but the influence on appetite is dependent on pulse type. In high consumers of the treatment, the addition of pureed yellow peas reduced the desire to eat. Pureed navy beans elicited a reduction in the perception of prospective food consumption. This could suggest that a blend of pureed pulses may have compound effects on appetite reduction.

The aim of this study is to study the impact of pulses on food intake in the short term, but in order to do so effectively; an understanding of the factors influencing food preferences is critical (Cooke et al, 2003). The factors discussed include exposure, taste, appearance, societal influence, and most importantly, parental eating behaviours.

With a new food being introduced, there is the role of neophobia, the fear of novel foods, which could impact food intake. However, there were participants who did not eat very much, but still rated the treatments as palatable. Participants in the low consumption group rated the palatability of the treatment significantly lower (P=0.02) than the high consumers due to the perceived mouthfeel from the blended pasta and pulses were not well accepted by participants in the low consumption group. Exposure to new foods plays an important role in the acceptance of new foods. The novelty of the treatments may have discouraged intake, resulting in the two consumption patterns among the participants (Table 2). This is because each week only 20% of Canadians consume pulses (Ipsos Reid, 2010) and children probably exhibit comparable consumption patterns.

Although there was no significant difference in the subjective palatability, one can assume that unfamiliarity with the treatment may have influenced scores. The number of exposures before acceptance of novel foods can be up to 20 times. Eight exposures were required to increase the acceptability of an orange-flavoured drink in 8-to-11-year olds (Liem & de Graaf, 2004) but in a similar age group, the increased willingness to try new foods was observed after twenty exposures (Loewen & Pliner, 1999).

Children develop a preference for sweet and/or salty foods at an early age. Neophobia acts as a justification for rejecting foods in the future. Taste and presentation are important in the introduction of food in order to develop preferences (Abrahamsson et al, 2006). The presentation of a food plays a role where participants may have been overwhelmed being subjected to a large quantity of a new food, which is an imperative component of ad *libitum* studies. The test meal method seems suitable, because the variability of energy intake of an ad *libitum* meal does not seem to depend on the size of the ad *libitum* meal (Gregersen et al, 2008), exacerbating the impact of participants who ate very little of the treatment. This also provided rationale for dividing participants into two groups based on average treatment intake by median split to observe an effect of treatment on food intake (see Results).

Children's preferences for foods that are high in fat are often related to the texture because fat changes flavour as well as texture (for example, creamier cheeses tend to be higher in fat). The fat often elicits a response that impacts consumption for children eat more of the foods they like best. Associative conditioning of learned responses after multiple exposures to energy dense foods, such as the recognition of satiation cues, especially when they are hungry, creates a demand for these foods. The social context also plays a role for the eating environment providing opportunity for modeling eating behaviours. Canadian adults are not eating pulses; so neither their children, or their peers, and this lack of experience influences their food selection. Without that exposure, acceptability of pulses is skewed for average acceptability of a food is positively related to those that have previously tasted the food (Wardle et al, 2001).

Studies using pea soup have confirmed negative attitudes towards pulses in children who were served pulse-based school meals, (Agren & Nilsson, 2007) but have concluded that this was the result of limited exposure. Preconceived notions about food choices are a major factor for food rejection in children. This was seen when participants were asked about eating frog legs and the stereotype that French people eat frogs impacted acceptability (Moura, 2007). This could translate to pulses for they are often used in diets in Mediterranean and Middle Eastern cultures however, exposure to foods from different cultures will help to promote healthier eating habits (Asplind et al, 2000).

With limited consumption in adults, the children in this study would have limited exposure to pulses for parental influences in making dietary changes, including the introduction of new foods, is strong. For example, parents may experience frustration with offering a new food and prematurely conclude that their child does not enjoy the food (Carruth & Skinner, 2000). Food selection is based on taste or consistency (Birch, 1999), which may be hard for pulses have a gritty consistency due to its high fibre content. Preferences are also influenced by the eating experience, which includes visual cues from food. The treatments may have been perceived as 'lumpy', which could have changed children's acceptance of the treatment. However, children introduced to lumpy solids including peas, at a younger age, eat significantly greater amounts and varieties of fruits and vegetables (Couthard et al, 2009).

The availability of food also plays a role in food selection. There are multiple facets including accessibility throughout food networks and immediate availability, which is the readiness or convenience of food products. Comparable pleasantness scores measured by visual analogue scale and hedonic scales show that children are accepting of pulses in a food matrix that is familiar (pasta and tomato sauce) but perhaps needs to be provided in a ready to eat format so that children are more accepting of pulses.

Due to the novel nature of the treatment, some only ate a small amount and the energy content of each treatment was not large enough to create a difference in food intake. When dividing participants into low and high eaters, a treatment effect was found to be closer to significance for all measures of palatability except for mouthfeel (Tables 6b and 6c).

The results of this study do not support the hypothesis that pureed cooked navy beans and yellow peas added to a mixed meal as 43% of a total energy reduce intake at a later meal, which contradicts the growing body of evidence that incorporating pulses into a meal, reduces food intake at the next meal. It needs to be mentioned that pasta meal used as a control in this study was made from durum wheat, the grain product with the highest level of protein. Such “healthy” control could mask the effect of pulses as it could be seen with the regular pasta or other pulse-free control with high glycaemic index. Another plausible cause of the observed lacking effect of pulse treatments on subsequent food intake is their homogenization and resultant higher availability and accessibility of pulse starches to the digestive enzymes. This poses the question whether use of whole pulses could be more effective on food intake suppression compared to pureed ones.

Pulses are value-added ingredients as they provide both protein and fiber and their isolated fractions are known to suppress food intake in the short term (Smith et al, 2012; Samra & Anderson, 2007) using large doses (20 and 33 grams, respectively). However, there is an evidence that fibre and protein, when added together, reduced pre-prandial blood glucose levels to a greater extent than fiber alone (Mollard et al, 2014).

With many food intake studies, there is always the question of whether the time period (120 minutes) is sufficient to observe the benefits of pulses on short-term food intake, but it is used to improve the ecological relevance of the study by matching real-life eating environments and behaviours with the use of treatments that are typically consumed by children.

Similar ratings of palatability between treatments demonstrate that the addition of pulses does not impact the acceptability of a food in children. The addition of pulses did not impact evaluation of hedonic properties of the treatment, amplifying the market potential to improve protein and fibre intake in a way that displaces the current trend of having the majority of energy intake coming from fat and non-fibrous carbohydrates. Also, the ingestion of pulses did not result in symptoms of gastrointestinal discomfort, demonstrating that pulses are well tolerated by children.

FUTURE DIRECTIONS

The results from this study show that mouthfeel is an important indicator in food intake when looking at meals with added pureed pulses. This could be reflected through the use of a fully homogenized treatment meal that resembles a soup to help with the mouthfeel. The participants in this study had to be divided by median split into high and low consumers of treatments to observe an effect, which reduces the significance of a dose-dependent effect of eating treatments with added pulses on the suppression of food intake at a meal 2 hours later. Therefore, in future studies, a fixed amount (250kcal, based on the average intake of participants in this study) would help to better assess the effect of pureed pulses on short-term food intake of youth aged 9-14. The study has demonstrated the satiating effects of added pulses and justifies further investigation into the functional properties of pulses and their relation to food intake regulation. Although participants found the treatments equally palatable, there may have been the influence of neophobia with the treatment and perhaps adding it to another food matrix that is more familiar such as snack foods or baked goods would be more promising. The incorporation of added pureed or whole pulses into familiar foods will increase domestic consumption as well as provide a vehicle for the nutrients of pulses contain while helping Canadians to better regulate their short-term food intake.

CONCLUSION

Cooked, pureed navy beans and yellow peas, when added to a mixed meal, present an effective dietary approach to increase subjective satiety and improve nutrient intake in children. Further research and development of palatable foods with added pulses may increase the consumption of pulses by children and thereby improve their food and eating habits and ultimately reduce the risk of chronic metabolic disorders in adulthood.

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TABLES

FIGURES

Appendix 5
Dutch Eating Habits Questionnaire

1. Subject and test details

ID: ____

Age: ____

Gender: male female

Today's date: ____

2. Your weight, height, etc.

A. Current weight (kg): ________________________

B. Current height (cm): ________________________

C. Has your body weight been constant over the past six months?
yes, my weight did not change much
no, I lost _________ kg
no, I gained ______ kg
no, sometimes I gained weight and sometimes I lost weight

D. Have you ever had an episode of eating an amount of food that others would regard as unusually large?
yes
no

Please do not mark below this line

BMI *(please take the age of the child into account)*: ________________________________

DEBQ scale	**Raw score**	**Number of items**	**Scale score**	**Classification**
Emotional eating		7		
External eating		6		
Restrained eating		7		

Please turn over >>>>>

Instructions **(PLEASE CHECK TO BE SURE THAT YOU TICKED EVERY QUESTION)**
Below you'll find 20 questions about eating. Please read each question carefully and tick the answer that suits you best. Only one answer is allowed.
There are no incorrect answers; it's **your opinion** that counts.

1.	Do you feel like eating whenever you see or smell good food?	No	Sometimes	Yes
2.	If you feel depressed do you get a desire for food?	No	Sometimes	Yes
3.	If you feel lonely do you get a desire for food?	No	Sometimes	Yes
4.	Do you keep an eye on exactly what you eat?	No	Sometimes	Yes
5.	Does walking past a candy store make you feel like eating?	No	Sometimes	Yes
6.	Do you intentionally eat food that helps you lose weight?	No	Sometimes	Yes
7.	Does watching others eat make you feel like eating too?	No	Sometimes	Yes
8.	If you have eaten too much do you eat less than usual the next day?	No	Sometimes	Yes
9.	Does worrying make you feel like eating?	No	Sometimes	Yes
10.	Do you find it difficult to stay away from delicious food?	No	Sometimes	Yes
11.	Do you intentionally eat less to avoid gaining weight?	No	Sometimes	Yes
12.	If things go wrong do you get a desire for food?	No	Sometimes	Yes
13.	Do you feel like eating when you walk past a restaurant or fast food restaurant?	No	Sometimes	Yes
14.	Have you ever tried not to eat in between meals to lose weight?	No	Sometimes	Yes
15.	Do you have a desire to eat when you feel restless?	No	Sometimes	Yes
16.	Have you ever tried to avoid eating after your evening meal to lose weight?	No	Sometimes	Yes
17.	Do you have a desire for food when you are afraid?	No	Sometimes	Yes
18.	Do you ever think that food will be fattening or slimming when you eat?	No	Sometimes	Yes
19.	If you feel sorry do you feel like eating?	No	Sometimes	Yes
20.	If somebody prepares food do you get an appetite?	No	Sometimes	Yes

Appendix 6

The Effect of Edible Beans and Peas on Satiation, Satiety and Food Intake in Children

Recent Food Intake and Activity Questionnaire

Participant's ID: ______________ Session: _______

Date: ______________ Arrived at: _____

Baseline Questionnaire (to be asked by investigator)

1. Have you had the standardized breakfast this morning? YES/NO

2. At what time did you finish the standardized breakfast? ________________

3. Have you had anything to eat or drink for 10 - 12 hours before breakfast? YES/NO

If yes, please describe briefly ____

4. Have you had anything to eat or drink after breakfast before arriving here? YES/NO

If yes, please describe briefly ____

5. Are you taking any medication? YES/NO

If yes, please describe briefly ____

6. What time did you go to bed? ___________

7. What time did you wake up? _____________

To be completed by staff only.
Comments/Notes:

Treatment code: __________

Treatment started at: ___________

Appendix 7

The Effect of Edible Beans and Peas on Satiation, Satiety and Food Intake in Children

Visual Analogue Scale

Motivation to Eat

DATE: ________________ Session ______

Treatment ID ___

ID: ____________________ Time point: 0 min

These questions relate to your "motivation to eat" at this time. Please rate yourself by placing a small "**x**" across the horizontal line at the point which best reflects your present feelings.

1. How strong is your desire to eat?

Very WEAK ____ Very STRONG

2. How hungry do you feel?

Not hungry at all ____ As hungry as I have ever felt

3. How full do you feel?

Not full at all ____ Very full

4. How much food do you think you could eat?

NOTHING at all ____ A LARGE amount

Appendix 8

The Effect of Edible Beans and Peas on Satiation, Satiety and Food Intake in Children

Visual Analogue Scale
Pleasantness (treatment)

DATE: ____________________ Session ________

Treatment ID ____

ID: ________________________ Actual time:____________

This question relates to the palatability of the food you just consumed. Please rate the **pleasantness** of the food by placing a small "**x**" across the horizontal line at the point which best reflects your present feelings.

How pleasant have you found the food?

NOT at all pleasant ____ VERY pleasant

Appendix 8a

The Effect of Edible Beans and Peas on Satiation, Satiety and Food Intake in Children

Peryam & Kroll hedonic scale

DATE: ____________________ Treatment ID ____ Session ________

ID: ________________________ Actual time:____________

Please taste the food sample. How much do you like it? Please circle your answer.

SUPER GOOD

REALLY GOOD

GOOD

JUST A LITTLE GOOD

MAYBE GOOD OR MAYBE BAD

JUST A LITTLE BAD

BAD

REALLY BAD

SUPER BAD

Appendix 8b

The Effect of Edible Beans and Peas on Satiation, Satiety and Food Intake in Children

Hedonic scale: mouthfeel

DATE: ____________________ Session ________

Treatment ID ____

ID: ________________________ Actual time:____________

How the sample feels in your mouth? Please circle your answer.

1	2	3	4	5
				
Really Really Bad	Bad	OK	Nice	Really Really Nice

Appendix 8c

The Effect of Edible Beans and Peas on Satiation, Satiety and Food Intake in Children

Hedonic scale: flavour

DATE: ____________________ Treatment ID ____ Session ________

ID: ________________________ Actual time:____________

Was the flavour intensity of the food sample too weak or too strong? Please circle your answer.

1	2	3	4	5
Much too weak	Too weak	About right	Too strong	Much too strong

Appendix 8d

The Effect of Edible Beans and Peas on Satiation, Satiety and Food Intake in Children

Visual Analogue Scale
Sweetness

DATE: ____________________ Session ________

Treatment ID ____

ID: ________________________ Actual time:____________

This question relates to the palatability of the food you just consumed. Please rate the **sweetness** of the food by placing a small "**x**" across the horizontal line at the point which best reflects your present feelings.

NOT **sweet at all** ____ VERY sweet

Appendix 9
The Effect of Edible Beans and Peas on Satiation, Satiety and Food Intake in Children

Visual Analogue Scale
Pleasantness (pizza)

DATE: ___________________ Session ________

Treatment ID ____

ID: _______________________ Actual time:_______________

This question relates to the palatability of the food you just consumed. Please rate the pleasantness of the food by placing a small "x" across the horizontal line at the point which best reflects your present feelings.

How pleasant have you found the food?

NOT at all pleasant ____ VERY pleasant

Appendix 10

The Effect of Edible Beans and Peas on Satiation, Satiety and Food Intake in Children

Visual Analogue Scale

Physical Comfort

DATE: ________________ Session _______

Treatment ID ___

ID: ____________________ Time point: 150 min

These questions relate to your "stomach" and general feeling at this time. Please rate yourself by placing a small "x" across the horizontal line at the point which best reflects your present feelings.

1. Do you feel nauseous?

NOT at all ____ VERY much

2. Does your stomach hurt?

NOT at all ____ VERY much

3. How well do you feel?

NOT well at all ____ VERY well

4. Do you feel like you have gas?

NOT at all ____ VERY much

5. Do you feel like you have diarrhea?

NOT at all ____ VERY much

Appendix 11

The Effect of Edible Beans and Peas on Satiation, Satiety and Food Intake in Children

Advertisement

Mount Saint Vincent University

ATTN: PARENTS OF CHILDREN
AGED 9-14 YEARS

We are conducting a research study to learn more about beans and peas in child nutrition.

REQUIREMENTS: 9-14 year old boys & girls,
Healthy, have been born at term and not be taking medication

INVOLVES: screening with the information session
and 3 weekend 3 hour sessions.

Children will be asked to eat common foods.
Breakfast and lunch will be provided.

As a reward for taking part:
The child will receive a $10 choice of movie pass or
gift certificate to the bookstore for
each session
Plus $5 per visit or bus tickets for parents for travel reimbursement

Please contact us at: (902)-457-6378 or e-mail us:
Appetite.study@msvu.ca

Appendix 12

Recruitment full-sized and card-sized flyer with general information about our nutritional research with children

MOUNT SAINT VINCENT UNIVERSITY

Department of Applied Human Nutrition

166 Bedford HWY

ATTENTION PARENTS OF 9 TO 14 YEARS OLDS!

We are currently conducting several nutrition studies to better our understanding of how to develop healthy eating habits in children

Studies take place in the morning and cause no pain. It's a great way to meet other kids!

Your child will receive a personalized copy of Canada's Food Guide

Breakfast and lunch provided!

As a reward for taking part, at each session your child will receive a gift card of her/his choice. Parents will also be reimbursed for their travel.

CONTACT US FOR MORE INFORMATION

902 457 6378

Appetite.Study@msvu.ca

Appetite Lab 457-6378
Appetite.Study@msvu.ca

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MOUNT SAINT VINCENT UNIVERSITY

University Research Ethics Board

Certificate of Research Ethics Clearance

Effective Date	June 25, 2014	Expiry Date	June 24, 2015

File #:	**2014-001**
Title of project:	*The Effect of Edible Beans and Peas on Satiation, Satiety and Food Intake in Children*
Researcher(s):	Damion Pollard
Supervisor (if applicable):	Bohdan Luhovyy
Co-Investigators:	n/a
Version :	1

The University Research Ethics Board (UREB) has reviewed the above named research proposal and confirms that it respects the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* and Mount Saint Vincent University's policies, procedures and guidelines regarding the ethics of research involving human participants. This certificate of research ethics clearance is valid for a period of **one year** from the date of issue.

Researchers are reminded of the following requirements:	
Changes to Protocol	Any changes to approved protocol must be reviewed and approved by the UREB **prior** to their implementation. **Form: REB.FORM.002 Info: REB.SOP.113 Policy: REB.POL.003**
Changes to Research Personnel	Any changes to approved persons with access to research data must be reported to the UREB immediately. **Form: REB.FORM.002 Info: REB.SOP.113 Policy: REB.POL.003**
Annual Renewal	Annual renewals are contingent upon an annual report submitted to the UREB **prior** to the expiry date as listed above. You may renew up to four times, at which point the file must be closed and a new application submitted for review. **Form: REB.FORM.003 Info: REB.SOP.116 Policy: REB.POL.003**
Final Report	A final report is due on or before the expiry date. **Form: REB.FORM.004 Info: REB.SOP.116 Policy: REB.POL.003**
Unanticipated Research Event	Researchers must inform the UREB immediately and submit a report to the UREB within seven (7) working days of the event. **Form: REB.FORM.008 Info: REB.SOP.115 Policy: REB.POL.003**
Adverse Research Event	Researchers must inform the UREB immediately and submit a report to the UREB within two (2) working days of the event. **Form: REB.FORM.007 Info: REB.SOP.114 Policy: REB.POL.003**

*For more information: http://www.msvu.ca/en/home/research/researchethics/policies/default.aspx

Dr. Daniel Séguin, Chair
University Research Ethics Board

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PANEL ON
RESEARCH ETHICS

Navigating the ethics of human research

TCPS 2: CORE

Certificate of Completion

This document certifies that

Damion Pollard

has completed the Tri-Council Policy Statement:
Ethical Conduct for Research Involving Humans
Course on Research Ethics (TCPS 2: CORE)

Date of Issue: **4 April, 2014**