Sodium Reduction Challenges and Facilitators in Breads and Processed Poultry Products:

An Industry Perspective

by

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A Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree of

Master of Health Science

in

The Faculty of Health Science
Program

University of Ontario Institute of Technology

June, 2016

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Abstract

Excessive consumption of sodium has been shown to cause high blood pressure (Garriguet, 2007). The breads and processed meat categories were identified as the highest contributors to sodium consumption within the Canadian population. The goal of this research is to identify the challenges associated with reducing sodium in bread and processed poultry products within the food industry in Canada. Results are based on 10 interviews with industry experts as well as a review of relevant industry documents related to industry's sodium reduction policies. Reaching Health Canada's target of 25 percent sodium reduction has been challenging for industry. Reducing sodium is only one of industry's priorities, which also include producing a product that is marketable to the Canadian public in terms of taste, shelf life, and aesthetics. Sodium reduction labeling policies set out by Health Canada have further restricted industries ability to communicate to the public products where sodium reduction has been achieved but fall short of the 25 percent target set by Health Canada. More time is required to drive public desire for sodium reduced products and for the industry to reduce sodium. More research is also required for consumer friendly, cost effective sodium replacement alternatives.

Keywords: Sodium reduction, breads and processed poultry, Canadian food industry, challenges and facilitators, sodium intake.

Acknowledgements

This work could not have been completed without the help and support of many people. First and foremost, I would like to thank my research supervisors, Dr. Brenda Gamble and Dr. Milly Ryan-Harshman, for their support, coaching and guidance. You have been great mentors and challenged me throughout my graduate studies! Thank you both for all your help !

I am also thankful to my supervisory committee members, Dr. JoAnne Arcand and Dr. Mika Nonoyamaon for their invaluable input, support and feedback. Your expertise and knowledge has been very helpful throughout my thesis. I also am grateful to my study participants for giving of their valuable time and insights for my thesis.

My sincere thanks to my family for your loving support and encouragement. Without your patience and understanding it would have been impossible for me to finish this work. I appreciate you being there for me at all times. Thank you for all your support and help!

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CHAPTER ONE

1.0 Introduction

This study identifies the barriers and facilitators associated with reducing sodium in Canadian processed poultry and bread products.

This chapter provides an overview of the issue under consideration and its significance as well as the research questions that guide this study. Chapter two presents the literature on the benefits of dietary sodium reduction and the role of sodium in the production of food products. The current status of sodium reduction within both the Canadian and international processed poultry and bread industries are also presented Chapter 3 documents the methodological approach used in this study to answer the research questions as well as ethical considerations. Chapter 4 presents the results based on the data collected from both the interviews and relevant industry documents. A discussion of the results is presented in Chapter 5. While Chapter 6 highlights the barriers and facilitators for both the processed poultry and bread product industries with recommendations to facilitate the implementation of further sodium reduction.

1.1 Background

The average Canadian consumes 3,400 mg of sodium a day, more than double the adequate intake level of 1,500 mg (Garriguet, 2007). Excessive consumption of sodium has been shown to cause high blood pressure (hypertension). Hypertension is a major risk factor in cardiovascular disease and stroke, which are the second and third leading causes of death in Canada. In Canada, 17.7% (5.3 million) people aged 12 and older reported being diagnosed with high blood pressure (Statistics Canada, 2015). The world's demographic structure is changing dramatically due to population aging,

prolonged life span, and increased prevalence of chronic diseases. High sodium intake puts individuals at greater risk for chronic diseases, such as hypertension, cardiovascular diseases and, stroke. People that are at a high risk for high blood pressure include: African-Americans, older adults (65 and older), overweight individuals, women who are 55 and older, lifestyle factors (poor eating habits, lack of physical activity, too much alcohol and too much stress), and family history (The Kidney Foundation of Canada, 2003). The primary source of sodium in the Canadian diet is salt (sodium chloride) and the majority of sodium found in the typical diet comes from processed food products accounting for about 77% of Canadians' total sodium intake (Garriguet, 2007).

1.2 Significance and Research Questions

In Canada, it has been estimated that if the average sodium intake is decreased by 1840 mg a day, high blood pressure prevalence would decrease by 30% (Joffres, Campbell, Manns, & Tu, 2007). This would result in approximately one million fewer Canadians with high blood pressure and direct annual cost savings of $430 million in the health care system due to fewer physician visits, laboratory tests and prescriptions for associated medications (Joffres et al, 2007). In October 2007, the federal Minister of Health, Tony Clement, announced the creation of the expert Sodium Working Group (SWG). The SWG's mandate was to develop a population-health strategy to reduce sodium in the diets of Canadians (Health Canada, 2012). This strategy included a reduction in sodium to 2300 mg across the population from the current consumption level of 3400 mg by the end of 2016. To help meet the goal of reducing the average daily sodium intake to 2300 mg by 2016, FPT governments have encouraged all stakeholders

to voluntarily include sodium reduction in their guidelines, policies and procedures (Health Canada, 2012).

Despite the knowledge developed around excessive consumption of sodium and sodium reduction targets identified by Health Canada for the industry, slow progress has been made in reducing sodium in products with only 28.7% of products meeting 2016 reduced sodium targets (Arcand, Schermel, & L'Abbe, 2014).

1.3 Research Objectives

This study examines the following research questions, from the perspective of the industry experts working in the processed poultry and breads categories.

1. What are the processing and other technological challenges with reducing sodium within breads or processed poultry?
2. What are the financial and resource challenges with reducing sodium within breads or processed poultry categories?
3. What are the communication challenges and approaches you would recommend when reducing sodium?

The results of this study are based on the views and perspectives of the industry experts interviewed from the processed poultry and breads industry and will be reviewed in the next section.

1.4 Study Context and Participants

The study consisted of ten semi-structured interviews with food industry technical experts. Data saturation was reached with ten participants interviewed. Participants were sent the questions ahead of the interview to allow for preparation of responses. By sending the questions ahead of time, there may have been a risk of having

responses overly prepared and not spontaneous, but it also allowed for participants to reflect and to provide responses based on their experiences which ensured completeness of responses. This also prevented the need to interview the participants again and ensured interviews were completed in the timeframe agreed upon with the researcher.

Participants were asked why they chose one reduction approach over another and implications of that choice. For example, when participants were asked about the sodium reduction approach they selected, they were also asked why they selected the approach they did and what factored into that decision. Participants answered questions about whether or not they believe the 2016 targets for sodium reduction are feasible and achievable based on their expertise and knowledge of what role sodium plays in the production of bread and processed meat categories.

Participants were also asked how they communicated the sodium reduction to their consumers. The communication strategy within a company is important as it identifies actions by a company to help improve nutrition of a product. It is also believed that when consumers are knowledgeable about the health impacts of high sodium, and can identify what high sodium content is on a food label, consumer behavior and product selection will change. The information collected from these interviews will have significant implications for provincial and national education programs and nutrition and ingredient labelling regulations as they provide insight to how the question of sodium reduction is handled by professionals within the food industry.

As well, responses from industry experts will help inform future technology development in the area of sodium reduction, and provide evidence for future sodium reduction strategies. This data will provide meaningful information about the

appropriateness of the targets and the projected likelihood that industry will endorse and support the reductions and respond to government regulations and/or goals.

If a sodium replacement ingredient was used to reduce sodium, industry experts were asked about how the impact of changes to the ingredient listing factored into the decision. Canadian consumers have questioned the "naturalness" of ingredients used in foods, and many sodium replacement ingredients have names that are unfamiliar to the average Canadian, creating a mistrust of the safety and wholesomeness of processed foods. This research will have implications for the food industry and Health Canada as it continues to develop foods that provide lower sodium products for people who also demand foods with ingredients that are considered less processed. It is expected that further education of the Canadian public is required for acceptance of new ingredients regarding their function and safety.

CHAPTER TWO

2.0 Review of the Literature

2.1 Overview of the issue

Sodium is an essential nutrient for health. It is required for blood, sweat, digestive juices and efficient nerve transmission. However, the average Canadian consumes 3,400 mg of sodium a day, more than double the adequate intake level of 1,500mg (Garriguet, 2007). Sodium is commonly used not just for the production of food but also because it is readily available and cost effective and replacements are often ten times more expensive (Desmond, 2006). In Canada, 19% of people aged 20 to 79 years are considered hypertensive and another 20% are classified as pre-hypertensive (Garriguet, 2007). The primary source of sodium in the Canadian diet is salt (sodium chloride) and the majority of sodium found in the typical diet comes from processed food products, which account for about 77% of Canadians' total sodium intake (Garriguet, 2007).

Using the Canadian Community Health Survey, Health Canada identified 18 food categories as the predominant contributors to increased levels of sodium in Canadians' diets.. The breads, quick breads, and bread-like products category was identified as the largest food category contributing 14% to overall sodium consumption within the Canadian population. The second major contributor to dietary sodium intake is the processed meats category, accounting for 9% of overall sodium intake (Health Canada, 2012).

Health Canada's role as part of the sodium reduction initiative is to assist Canadians in reducing their sodium intake from 3400 mg per day to the tolerable upper

level of 2300 mg per day by 2016. This will help create conditions that promote healthier choices for consumers. To achieve these goals, Canada's Sodium Reduction Strategy was developed and published in 2010 by a multi-stakeholder Sodium Working Group that included food industry representatives. The strategy created an awareness and education campaign to inform Canadians on sodium as part of healthy eating, to provide guidance to the food industry to safely lower the amount of sodium in processed foods, and to support research related to sodium reduction in the areas of food science and food technology, health and human physiology, and evaluation and monitoring (Health Canada, 2012).

Health Canada has recommended a voluntary approach to sodium reduction which includes sodium benchmark targets at three different phases to encourage an incremental reduction in the sodium content of foods by 2016. These incremental reductions over time are also designed to help the consumer's palate adjust to the potential flavour differences (Health Canada, 2012). The intended benefits of this reduction strategy were to allow the industry time to reformulate foods, and the consumer to adapt to sodium reductions. Sodium benchmarks for packaged foods were developed in a staged approach to provide the industry with guidance on sodium reduction targets for each food category. These benchmark targets were developed in consultation with the industry as stakeholders within the Sodium Working Group based on the best available evidence. The sodium concentration in each of these product categories are present for a number of different reasons including functional from a processing perspective, food safety and shelf-life, sensory and organoleptic reasons (Health Canada, 2012).

Arcand, Schermel, and L'Abbe, (2014) reported in their Comprehensive Analysis of Sodium Levels in the Canadian Packaged Food Supply, that overall, 51.4% of foods met one of the sodium benchmark levels: 11.5% met Phase 1, 11.1% met Phase 2, and 28.7% met 2016 goal (Phase 3) benchmarks. Food groups with the greatest proportion meeting goal benchmarks were dairy (52.0%) and breakfast cereals (42.2%). Overall, 48.6% of foods did not meet any benchmark level and 25% of all products exceeded maximum levels. Meats (61.2%) and canned vegetables and legumes (29.6%) had the most products exceeding maximum levels. Moreover,, some segments of the market have more progress to make compared to others, who have met the benchmark targets. In addition, this study showed that there was variation in how the benchmark targets were set with some categories being less stringent than others. All sectors need continued focus to reduce the amount of sodium added during food processing.

2.2 Sodium and Importance to Health

Sodium is essential for good health. However, sodium intake is also positively related to blood pressure, which in turn is positively related to the incidence of fatal and nonfatal cardiovascular disease (Sacks, et al., 2001). Hypertension is a major cause of cardiovascular disease and stroke, which are the second and third causes of death in Canada. In Canada, 19% of Canadians aged 20 to 79 years are considered hypertensive and another 20% are classified as pre-hypertensive (Garriguet, 2007). Canadians are also consuming more sodium than they are require compared to the recommended Adequate Intake level of 1500 mg/day and more than the Tolerable Upper level of 2300 mg/day (Institute of Medicine, 2004) and excessive consumption of sodium has been shown to cause high blood pressure (hypertension) (Aburto, et al., 2013). The majority of sodium

found in the typical diet comes from processed food products accounting for about 77% of Canadians' total sodium intake (Garriguet, 2007).

2.3 Overview of Industry Response

The majority of sodium consumption comes from processed foods, it is critical to have industry engagement and perspective on the level of sodium that is used in products and why. Representatives from the food industry have identified that sodium contributes flavour and that consumers have grown to love their signature taste making it difficult to remove sodium from products. Catherine O'Brien, Director of Corporate Affairs at Nestlé Canada Inc. stated "we must balance the push of science against the pull of the market as consumers will simply not compromise on taste therefore; [taste] must be a priority alongside improved health" (Weeks, 2009). Many products positioned as low sodium have been forced off the shelves prematurely in recent years due to poor sales as manufacturers struggled to find workable salt substitutes. Efforts are being made to offer consumers alternatives to sodium but consumers are not willing to compromise on taste (Mintel, 2012).

According to the American Bakers' Association, many bakers are concerned about the return on investment related to sodium reduction, as it costs millions to reformulate their products (Watson, 2012). "It's a lot of work just to take it out," said Mark Andon, vice president of nutrition and food labeling for ConAgra Foods. "We could be innovating in other ways — introducing new products, enhancing the flavors of existing products, offering line extensions. If you're focusing on sodium, you're not doing something else…I don't think it's a stretch to say for anybody that's doing this, especially a company as large as ConAgra, it's tens of millions of dollars."(White, 2014).

Food technology and product type is important when considering sodium reduction. In meat production, salt has an essential function in terms of flavour, texture, and shelf-life. Sodium activates proteins to increase hydration and water-binding (juiciness), increases stability of meat mixtures, and enhances flavour. For example, fat content, sugar, and sodium all interact with each other in the delivery of perceived saltiness in sausages (Desmond, 2006). There are also challenges with removing salt from bread, slight reductions can be achieved but with larger reductions, bread becomes deformed and unpalatable (Belz, Ryan, Arendt, 2012).

2.3.1 Function of sodium in bread. Bread is one of the world's oldest foods and is usually produced by mixing flour, water, yeast, and salt, followed by fermentation and baking. Salt, while present in low amounts, has quite a high impact on the quality characteristics of bread. In general, the functions of salt in bread are summarized as: imparting flavor, controlling yeast growth and fermentation rate, improving product texture, and reducing spoilage (Belz, Ryan, Arendt, 2012). While excess salt use is problematic from a nutritional point of view, it has been shown to positively influence the technological process of every stage of bread production including: (i) mixing, (ii) fermentation, (iii) baking, and (iv) final bread quality characteristics. Two research studies [(Belz, Ryan, & Arendt (2012) & Girgis et al., (2003)], found that a 25% reduction in the sodium content of white bread can be delivered over a short time period, while maintaining consumer acceptance. Braschi, Gill, and Naismith (2009) studied the extent to which sodium chloride in white bread could be reduced and the potassium content raised. They found that a substantial reduction in sodium and an increase in

potassium intake could be achieved by substituting potassium salts for sodium chloride in bread.

Salt is a critical ingredient in bread production, and its reduction can have a significant impact on the production process. This includes an impact on dough handling, as well as final bread quality characteristics, including shelf-life, bread volume, and sensory characteristics, all deviating from the expectations of bakers and consumers (Belz, Ryan, & Arendt, 2012). The intensity of saltiness and the release of sodium ions during chewing was investigated by Pflaum, Konitzer, Hofmann, and Koehler (2013). They found a significantly faster sodium release from a coarse-pored bread compared to a fine-pored bread (constant sample weight) measured in-mouth and in a mastication simulator. Therefore, saltiness was influenced both by the velocity of sodium release and by crumb texture. Gaps in the literature include limits to which a bread product can be reduced in sodium for taste without the addition of other ingredients and the subsequent impacts to the bread manufacturing process, taste and labelling.

2.3.2 Function of sodium in processed poultry. In the meat industry salt is used as a flavour enhancer, is responsible for the desired textural properties of processed meats, and is required for food safety. One of the roles of salt in food safety is to lower the water activity. Water activity is a measure of the amount of water that is available for microbial growth and other chemical reactions (Doyle & Glass, 2010). Like other living organisms, microbes that can cause foodborne illness and need water to survive. Thus, by lowering the water activity, salt inhibits the growth of microbes, such as *Listeria monocytogene*s (Lm). *Listeria monocytogenese* is of particular concern in ready-to-eat processed meat products such as deli meats. Salt also protects against other pathogens

such as *Clostridium botulinum*, *Salmonella* and pathogenic *Escherichia coli* (Doyle & Glass, 2010*).* One of salt's main functions in processed meats is the solubilisation of the functional myofibrillar proteins in meat. This activates the proteins to increase hydration and water-binding capacity, ultimately increasing the binding properties of proteins to improve texture. Increasing the water holding capacity of the meat reduces cook loss, thereby increasing tenderness and juiciness of the meat product (Desmond, 2006). Further product development is required concerning the reduction of salt and the scientific effects that it may have on such technological functions such as water-holding capacity, fat-binding, texture, sensory, stability and shelf life (Man, 2007).

According to the Canadian Meat Council (2016), a gradual reduction in sodium levels is the best strategy to alleviate related costs. One of the most common and economical replacements for sodium (potassium chloride) in processed meat products costs seven times more than sodium chloride and still has flavour and texture functionality difficulties. Salt also acts as a preservative to maintain food safety and therefore, alternative food safety tools need to be explored. The Canadian Meat Council (2016) also identified that the use of post-packaged high pressure treatment equipment or in-package heat treatment, adds to processing costs more than what was achieved by addition of salt alone. In addition, the Canadian Meat Council states that if substitute ingredients cannot be used, another option is to shorten the shelf life of the processed meat products. Another important consideration is the fact that the current production and distribution system in Canada is extremely complex and typically balances manufacturing efficiency gained from long production runs with minimal changeovers at the retail counters, coupled with the time needed to distribute products to a variety of

retail outlets. As a result, shorter shelf-life products will require more frequent product changeovers by retailers, and consumers will need to be educated about the shorter shelf-life of processed meat products.

2.4 Global Action on Dietary Sodium Reduction

The World Health Organization (WHO) recommendations are to decrease sodium intake, where necessary, through public health interventions that include: reducing content in manufactured food, revising food and product labelling, and the establishing food-based dietary guidelines (WHO, 2012). These recommendations are consistent with Health Canada's recommendations to reduce sodium through the food supply, awareness and education, research and monitoring and evaluation. The World Health Organization recommendations do not identify an approach to monitor and evaluate sodium reduction progress within the population. The overall objectives of both the World Health Organization and Health Canada are to reduce sodium intake to reduce blood pressure and risk of cardiovascular disease, stroke and coronary heart disease in adults and children.

The specific World Health Organization recommendations include a reduction to <2 g/day sodium (5 g/day salt) in adults and a reduction in sodium intake to control blood pressure in children. The recommended maximum level of intake of 2 g/day sodium in adults should be adjusted downward based on the energy requirements of children relative to those of adults (WHO, 2012). Health Canada's sodium reduction recommendations are to reduce sodium from the current consumption amount of 3400 mg sodium per day to the recommended upper limit of 2300 mg sodium by the end of 2016 (Health Canada, 2012).

Several countries have already legislated reduced sodium intake; the United Kingdom, Japan (1960–1970), Finland (1975 onwards), and other countries (USA, Chile, Argentina) have sodium reduction strategies underway. Of the countries with a sodium reduction strategy, most have taken voluntary approaches (He & MacGregor, 2009). Each of these countries has approached population sodium reduction in different ways. For example, in the UK, the Consensus Action on Salt and Health (CASH), was developed to help raise the awareness of the importance of salt. In November 2012, there was a formal meeting of member states to conclude the work on the comprehensive global monitoring framework, including indicators, and a set of voluntary global targets for the prevention and control of non-communicable diseases. A successful initiative depends on the heads of states and governments attending the meeting, and endorsing and implementing the commitments to action; long-term success requires inspired and committed national and international leadership (Beaglehole et al., 2011). At this meeting, the UK's salt reduction program was developed to set an initial target of reducing the average population salt intake to 2400 mg sodium from an average intake of 3800 mg sodium by 2010. Targets were established in consultation with the food industry to recognize the technical challenges of reducing the sodium content in certain foods along with a public education campaign (He, 2009). The public education campaign was initiated to help educate the public about the negative health results from over consumption of sodium to help change behaviour. Similarly, since the UK salt reduction program started in 2003/2004, significant progress has been made as demonstrated by the reductions in salt content in many processed foods and a 15% reduction in 24-h urinary sodium over 7 years (He, Brinsden, & MacGregor, 2013).

Canada, Argentina and Chile have all modeled their approaches after Great Britain's salt reduction strategy, with government agencies collaborating with the food industry on voluntary salt reduction targets and timelines and consumer education (Legowskia, 2011). As well, Finland aimed to reduce salt intake in the whole population through collaboration with the food industry to develop reduced-salt food products and raise the general awareness among consumers of the harmful effects of salt on health. The Food Safety Authority of Ireland (FSAI) is another group which focuses on consumer awareness efforts, as well as action by the food industry to lower the salt content of their food products.

The Australian Division of World Action on Salt and Health's (AWASH) goal is to lower salt in food by 25% executed through their main campaign known as "Drop the Salt!" and to increase consumer awareness about the benefits of a low salt diet and promote clear labelling of foods that makes the salt content immediately apparent to the consumers. The Australian Food and Health Dialogue set sodium reduction targets for three food categories (breads, ready-to-eat breakfast cereals, and processed meats) to be achieved by December, 2013. During this time period the mean sodium level of bread products fell from 454 to 415 mg/100 g (9% lower, $p < 0.001$), and the proportion reaching target rose from 42% to 67% ($p < 0.005$). The decline in mean sodium content of bacon/ham/cured meats from 1215 to 1114 mg/100 g (8% lower, $p = 0.001$) was smaller, but associated with a rise in the proportion meeting the target from 28% to 47% (Trevena, Neal, Dunford, & Wu, 2014). The sodium reduction success achieved by these two countries illustrate the progress that can be made in other nations such as Canada despite the technological challenges.

2.5 Canada's Sodium Reduction Approach

Health Canada goals for sodium reduction are to reduce sodium intake of Canadians from 3,400 mg/day/person to an interim goal of 2,300 mg/day/person by 2016 through four areas of focus: the food supply, awareness and education, research, and monitoring and evaluation (Health Canada, 2012). The food industry in Canada needs to ensure, while reformulating products through sodium reduction, that all foods comply with regulations for the production, marketing, and sale of foods in Canada (Health Canada, 2012). There is a need for the industry to also reduce sodium in foods—whether foods are destined for consumers, other food manufacturers, or the restaurant and foodservice sectors – to the lowest level possible while maintaining food safety and consumer acceptance. Because most of the sodium in the Canadian food supply is added during the processing of foods, achieving meaningful decreases in sodium intake will require the cooperation of food industry and food service establishments (Barr, 2010). Additional research is required to improve the state of knowledge in the areas of food science, food technology, human physiology, and evaluation and monitoring methods (Health Canada, 2012). Achieving public health outcomes depends upon the successful implementation of the recommendations made by Health Canada. Increased consumer awareness and education will drive demand for lower sodium food products, while research will enable the development of lower sodium foods that are accepted by consumers. An awareness and education campaign has now been undertaken by Health Canada to help educate Canadians on the amount of sodium they should be consuming and how to choose lower sodium foods through education with the Nutrition Facts table, to reach the reduction goal of 2300 mg per day by 2016 (Health Canada, 2012).

2.6 Education Strategies

Several education methods have been developed to help inform the general population about the nutritional value of their food with the goal that they will choose healthier items more often. The launch of the Nutrition Facts Education campaign was announced to help Canadians make informed food choices. Health Canada and Food and Consumer Products of Canada (FCPC) developed the multi-media Nutrition Facts Education Campaign that focuses on increasing Canadians' understanding of the Nutrition Facts table and, in particular, the percent Daily Value (Health Canada, 2013). Health Canada committed to consult with consumers, especially parents, on ways to improve nutrition information on food labels. These proposed changes aim to regulate serving sizes, making them consistent and realistic, which will make it easier for Canadians to compare similar foods and find information on serving size and calories (Health Canada, 2014). It will include the addition of a footnote at the bottom of the nutrition facts table to explain how to use the percent daily value (% DV). It will improve the labelling of sugars, make the ingredient list and information on allergens easier to find and read and identify colours in the list of ingredients. Finally, it will allow the use of a new health claim: "A healthy diet rich in a variety of vegetables and fruits may help reduce the risk of heart disease." These changes are an example of how Health Canada is working to make nutrition information clearer to consumers. An example of the proposed Nutrition Facts Table changes is listed below.

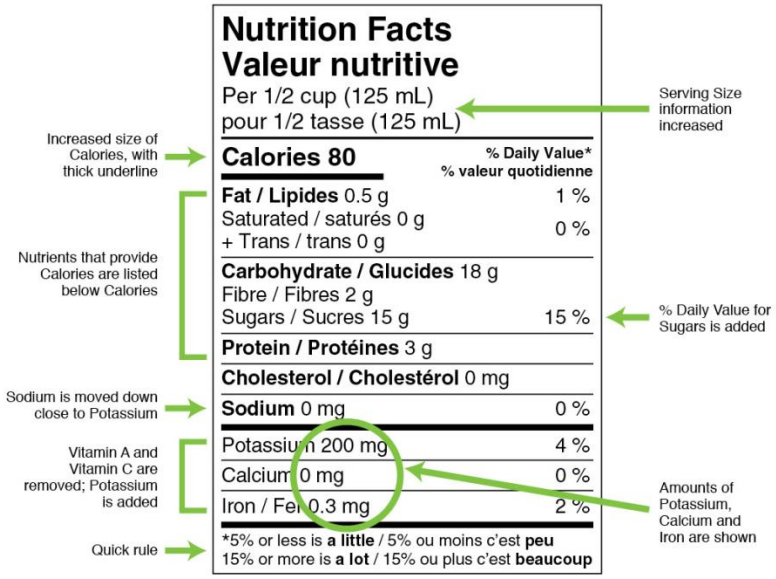

Figure 1: Proposed Changes to the Canadian Nutrition Facts Table. Health Canada, 2015, Retrieved February 5, 2015, from http://healthycanadians.gc.ca/health-system-systeme-sante/consultations/food-label-etiquette-des-aliments/nutrition-facts-valeur-nutritive-eng.php. Reprinted with permission.

The Informed Dining program is a voluntary nutrition information program for restaurants developed by the Province of British Columbia (Healthy Families BC, 2012). Participating restaurants provide their guests with nutrition information for all standard menu items that is easy to access and understand. The government of Ontario has approved mandatory menu labelling. The act would force restaurant chains to post calorie counts on their menus (Bill 45, 2015). The menu-labelling law applies to food premise locations operating under the same name with 20 or more restaurants. Owners and operators of regulated food service premises are required to display the number of calories in each standard food item sold at the premises, as well as any other information required by the regulations.

Likewise, as of December 1, 2015, New York City requires chain restaurants to publish warnings when menu items contain more than the recommended daily limit for sodium, thus taking the lead on regulating the amount of salt in foods. The rule applies to chains with 15 or more locations in New York City, requiring them to display a warning symbol — a salt shaker inside a triangle — if the item has more than 2,300 milligrams of salt (Victor, 2015). According to a study conducted in New Zealand by Maubach, Hoek, & McCreanor, (2009), when participants were provided with a nutrition facts panel with all nutrients (fat, sugar, protein, sodium, calories, cholesterol) those who did use it, primarily focused only on sugar and total fat. Participants did not review other nutrients as they did not understand what these were or why they might be important. Terms such as energy, saturated fat, sodium, and protein were seen as confusing by those who had no framework for interpreting the information provided (Mauback et al., 2009).

Similarly, in a study conducted by Campos, Doxey and Hammond (2011), challenges were identified in terms of consumer understanding and appropriate use of labelling information among children, adolescents and older adults who were obese within Canada. Nutrition labels were perceived as a highly credible source of information with many consumers using nutrition labels to guide their selection of food products. Evidence also showed a consistent link between the use of nutrition labels and healthier diets (Campos, et al., 2011). These studies suggest that alternate labelling formats and education strategies should be explored to help educate and communicate the nutrient content of a food and amounts of each that should be consumed to assist Canadians in making good decisions about their diet.

Another example of an overall nutrition guidance system is the Guiding Star program launched in October 2014 (Loblaws, 2015). The program rates foods based on vitamins, minerals, fibre, whole grains, omega-3 fatty acids, saturated fat, trans fat, added sodium and added sugar [Loblaw Companies Limited]. In 2011, the program was implemented in more than 560 stores from British Columbia to Newfoundland through Loblaws and its affiliated banner stores Atlantic Superstore, Dominion, Fortinos, Provigo, Provigo Le Marche, Real Canadian Superstore, Save Easy, Valu-mart, Your Independent Grocer, and Zehrs (Fischer, et al., 2011).

2.7 Factors Influencing Food Selection

Flavour is a key determinant of food acceptance and consumption. According to the Tracking Nutrition Trends Survey conducted in 2013, 97% of the Canadian study participants say taste is the most important factor when choosing a food. Sodium reduction claims on labels can also have a negative consumer perception on taste (Liem, Miremadi, Zandstra, & Keast, 2012). Emphasizing salt reduction by means of a front-of-pack label can have a negative effect on taste perception and salt use, especially when consumers are able to taste differences between their regular soup and the sodium-reduced soup (Liem, Miremadi, Zandstra, & Keast, 2012). Adams, Maller, & Cardello, (1995) found that perceived saltiness at the same concentration of sodium differed according to the type of food used as a carrier. They discovered that when products are made with few ingredients, the impact of perceived saltiness was increased compared to products that had many ingredients. A key finding was that consumers do not have a consistent liking for high or low salt levels across different foods.

The Canadian Foundation for Dietetic Research (CFDR) and Dietitians of Canada (DC), released the results of the Tracking Nutrition Trends survey results in 2014. The survey involved a detailed analysis of adult Canadians' eating habits and health, knowledge and understanding of nutrition, influences on food choices, awareness and attention to food product labels, and sources of information about food and nutrition. It revealed nearly all Canadians have done something to improve or change their eating and drinking habits over the past year, with most incorporating healthier eating habits into their lifestyle. For example, the top three improvements/changes made by Canadians are: eating more fruits and vegetables (68%), reducing salt/sodium (50%) and reducing sugar (50%) in their diet. It also identified that taste and convenience are the top two influences on food choices (Canadian Foundation for Dietetic Research, 2014).

Roos, Lehto and Ray (2012), found that in general, practical factors dominate the decisions on food selection in grocery stores. They found nutrition labels had little reported influence on food choice through their study of parental family food choice motives and children's food intake in Finland. According to Holsten, Deatrick, Kumanyika, Pinto-Martin, & Compher, (2012), parents affected children's food choices through their presence in the home, time pressure and activity prioritization, incorporation of family members' preferences, food preparation effort and skills, and financial and health concerns. Parents created food options through food purchasing and preparation and indirectly affected children's food choices by setting rules, providing information, and modelling behaviors (Holsten et al., 2012).

In their study with adolescents in St. Paul Minnesota, Neumark-Sztainer, Story, Perry and Casey (1999) found factors influencing food choices included hunger and food

cravings, appeal of food, time considerations of adolescents and parents, convenience and availability of food, parental influence on eating behaviours, mood, body image, habit, cost, media and vegetarian beliefs, and lack of urgency in relation to personal health.

Based on the research, there appears to be a high desire to reduce sodium within the diet but not without compromising taste. In addition, there are many influences purchasing decisions. Nutrition content may not be the primary driver particularly when there is a lack of urgency with regards to personal health and when there is a limited budget or time to prepare food. When a food manufacturer is undertaking sodium reduction they will need to ensure they maintain a desirable taste that consumers love.

2.8 New Ingredient considerations

Sodium substitutes have been identified to assist in the reduction of sodium within the diet and are used in other parts of the world. Rodrigues, Goncalves, Pereira, Carneiro, & Pinheiro, (2014) experimented with salt reduction by using a mixture of salts consisting of sodium chloride (NaCl), potassium chloride (KCl), and monosodium glutamate at different concentrations in cheese. The proportions of salts used did not cause strange or bad tastes but did result in lower intensities of saltiness. Several substitutes for NaCl have been studied, one is KCl due to its similar physical properties. Complete replacement of NaCl by KCl is not recommended because of the bitter taste the latter gives to products, which is generally only somewhat acceptable. High levels of potassium may not be suitable for some people. Those with kidney disease or failure need to avoid foods high in potassium to prevent hyperkalemia (The Kidney Foundation of Canada, 2003). In addition, high potassium levels may interfere with some medications such as angiotensin converting enzyme **(**ACE**)** inhibitors. Monosodium

glutamate, used as a flavour enhancer and bitter masking agent of potassium chloride, achieved positive consumer acceptance results (Desmond, 2006).

Heath Canada (2008) states that monosodium glutamate (MSG) is not a health hazard however some people may have sensitivity to MSG. It is the glutamate part of MSG that can produce symptoms such as: blurred vision, tingling and/or burning sensation, chills and shakes, feeling of pressure on the face, headache, increased heartbeat, nausea and vomiting, pain in the face, back, neck or chest (Health Canada, 2008). Due to the sensitivities experienced by some people, MSG use may not be appropriate for broad application in sodium reduction activities.

When salt is reduced, the roles of preservatives within a product become even more important to maintain shelf-life and microbial safety. According to Mercola (2013), preservatives lengthen the shelf-life of foods, but most are linked to health problems such as cancer and allergic reactions. The ingredients used in a product and declared on a label will become more important with a continued focus on educating the customer on reading and interpreting labels for health decisions.

In summary, salt has many critical functions within food products and removing large amounts of salt will affect sensory properties, shelf-life, and will require product reformulation and expensive product trials. Sodium chloride replacement ingredients will need to deliver on taste, cost, and processing function and have a consumer friendly label to meet all the functions salt delivers. These are all important considerations as taste, cost, texture and other sensory properties may need to change to gain significant sodium reductions within bread and processed poultry products, the focus of the proposed study.

2.9 Current State of Sodium Reduction in Breads and Processed Poultry

As previously mentioned, the Canadian food industry has made some good progress in achieving sodium reduction within the food supply. However, there is still opportunities to reduce sodium even further. According to a recent study analyzing sodium reduction progression within the industry, just over half of foods met the sodium reduction benchmarks set by Health Canada (Arcand, Schermel & L'Abbe, 2014). This highlights the need to continue to focus product development efforts on reducing sodium within the food supply. This study also demonstrates that there are some categories that are able to hit targets easily while others may require adjustment of the sodium targets or further technology development to help industry achieve them. Further dialogue is also required with industry to understand if categories are too broad with many different types of items falling under the same sodium reduction target. For example, white bread, whole grain, bagels and croissants all have the same sodium reduction target but all have very different flavour profiles and processing requirements.

According to The Canadian Food and Beverage Industry: Committed to Healthy Active Living (published in 2006), 62% of companies reported that they had reformulated their products to be healthier, and 25% reformulated products to reduce sodium content. Food and Consumer Products of Canada's members have engaged in the process with Health Canada that is currently taking place to establish sodium reduction targets in line with the Working Group's recommendations. Trevena, Neal, Dunford, and Wu, (2014) found in their analysis of the progression of sodium reduction in Australia,

that significant opportunities to continue to reduce sodium content in breads and processed meat products need to be facilitated by technological innovation and better and more widespread application of existing technology. This is particularly so for processed meats, for which less than half of the products surveyed met the Food and Health Dialogue 2013 targets. They also reported heterogeneity in foods to be a barrier in achieving the same level of reduction and approach within the same product category (Trevena, Neal, Dunford & Wu, 2014). Therefore, food manufacturers providing products for Canada need to find the right solution for their product and customer.

Sodium reduction depends on the type of the product, its composition, the type of processing required and the preparation conditions. These factors determine the type of product that can be modified and the technological limitations of salt reduction (Ruusunen & Puolanne, 2005). There doesn't appear to be a one-size-fits-all solution for all products or product categories when it comes to sodium reduction as each product may have a different recipe to achieve the finished product attributes and food safety and handling requirements.

What is not evident in the literature is the documentation of industry's response to the policy goals identified by Health Canada targeted at sodium reduction in Canada. In particular the documentation of potential barriers and facilitators experienced by both the breads and processed poultry industries for achieving specific thresholds for sodium reduction set by Health Canada.

The goals of this study are to explore the barriers and facilitators associated with sodium reduction in breads and processed poultry products. This was a timely study as we approach Health Canada's voluntary deadline for sodium reduction by the end of

2016; especially since the most recent studies have showed slow movement within the industry and specifically with the breads and processed meat categories. Chapter 3 identifies the goals of the study, data collection methods and data analysis for this research.

CHAPTER THREE

3.0 Methods and Data

This study examines the following research questions, from the perspective of the industry experts working in the processed poultry and bread categories.

1. What are the processing and other technological challenges with reducing sodium within breads or processed poultry?
2. What are the financial and resource challenges with reducing sodium within breads or processed poultry categories?
3. What are the communication challenges and approaches you would recommend when reducing sodium?

To answer these research questions, the views of industry experts were collected through semi-structured telephone interviews. In this particular study the use of telephone interviews were appropriate as it not only allowed increased access to participants located throughout North America, but it also allowed participants to remain on "their own turf", which allowed for more anonymity and privacy and decreased social pressure and increased rapport among the study's participants (Novick, 2008). In addition, it allowed participants to participate while they may have been travelling for work. Although there is the loss of verbal cues, and the potential for distractions from their own environment (also seen in face-to-face interviews) with telephone interviews, the advantages of telephone interviews out-weighed the disadvantages and was determined to be appropriate for this study.

The interviews were conducted to gain insight into the potential barriers to reaching the sodium reduction targets set by Health Canada. This chapter presents the

research design, data collection method, data analysis, and strengths and limitations of this study. A timeline of the data collection and analysis is included in Appendix A.

My role in this research project included a) contacting experts for their participation in the research b) development of research questions and research design; c) completion of research ethics review and obtaining approval; d) development of the questionnaire and interview guide; f) data collection; g) data entry; h) data analysis; and i) thesis writing. I currently work in the food industry which helped facilitate the interviews as industry terms were familiar for translation into themes. Previous knowledge gained through my work experience assisted in gaining trust and easy rapport with the participants. While a potential bias does exist due to my involvement in the food industry, my knowledge of the food industry was instrumental in this particular study to gain access to the participants. In addition, the validity of the responses (and study) is further strengthened through multiple sources corroborating on research findings (e.g., interviews, industry documents, and literature).

3.1 Study Design

This study was conducted using semi-structured interviews with food industry representatives and technical experts using a case study design. Case studies provide rich descriptive information to better understand the phenomenon under study (Yin, 2011). One of the goals of this study was to collect information from food industry experts to better understand the barriers and facilitators associated with reducing sodium in food products. Case study designs are used to illuminate a decision or set of decisions, why they were taken, how they were implemented, and with what results (Yin, 2011). A further goal of this study is to understand the steps industry has taken to reduce sodium in processed poultry and bread products as well as the decisions that were made to reach

sodium reduction targets. An enriched detailed understanding of industry's experience with sodium reduction could potentially assist in the implementation of the sodium reduction targets set by Health Canada. One of the conditions for a case study approach is the researcher has no control over behavioral events as is the situation in this study (Yin, 2011).

One of disadvantages of case studies is that it is a poor method for establishing cause-effect relationships. However, the intention of this study is not to determine cause-effect relationships. One of the limitations of the case study approach is that it often relies heavily on the researcher's subjective interpretations. To help overcome this disadvantage data triangulation was used to facilitate validation of data (Thurmond, 2001). In research, the principle of triangulation pertains to the goal of seeking at least three ways of verifying or corroborating a particular event, description, or fact being reported in a study. Such corroboration serves as another way of strengthening the validity of a study. This is identified as an appropriate methodology and approach by Yin (2011). According to Yin (2011), in such situations, three independent reports are required. All interviews were conducted individually with participants in their own environment. In addition separate documents were used to support and corroborate the findings such as the Canadian Meat Council report.

3.2 Sample Characteristics and Recruitment

Purposive sampling a non-random sampling technique, was used to select the participants to yield the most relevant data. Convenience sampling, snowball sampling, and random sampling were not considered appropriate for this study. Convenience sampling and snowball sampling are likely to produce an unknown degree of

incompleteness because the most readily available sources of data are not likely to be the most informative sources (Yin, 2011). Similarly, convenience samples are likely to produce an unwanted degree of bias. A random sampling technique was not used in this study as the goal was to select industry experts from specific categories who had experience reducing sodium.

Participants were selected based on the technical knowledge they had in reducing sodium within the industries they represented. These informants were selected to identify the specific technological challenges related to their industries and also to identify the challenges and facilitators from an overall organizational and industry perspective. Participants selected all had technical expertise and experience reducing sodium in processed poultry products or bakery products and were aware of the limitations and implications with reducing sodium in their respective industries. They had experience making both small and large reductions from previous trials and were able to speak to any processing or sensory challenges associated with the reduction level. In addition, all the participants had been working for their respective companies in their roles for at least 10 years further supporting their role as an expert. The specific roles the participants had were: Master Bakers, Directors of Product Development, Directors of Research and Development, Quality Assurance Director of North America, Senior Director Innovation and New Technologies, Senior Vice President Supply Chain, and Managing Directors.

Interviewees were also knowledgeable about the ingredients available to support sodium reduction with replacements as well as removal. Participants who provide products to the Canadian retail or food service sectors were selected. Specific industry representatives selected for the study included technical experts in large poultry and

foodservice global and national retail companies for their expertise in the manufacturing and production of processed meats and salt and sodium reduction technologies. Several large foodservice and retail bakeries were also contacted to participate in the study for their perspectives on reducing sodium within baked bread products.

These companies have all undertaken sodium reduction on one or several of their products. In addition, the breadth of products these companies produce are varied but all fall into the proposed Health Canada Category of "bread" products. There are specific and unique ingredient and processing differences between the products they produce; an example is the contrast between bread produced by artisan bakeries and traditional bun or bread products from other bakeries. Artisan style bread products use very simple ingredients with no preservatives and the process of creating the bread is long and fairly complex. Non-artisan buns/bread tend to use faster more efficient production, methods, and preservatives to keep the bread fresher longer and use other additives to ensure consistency in quality of product. All participants were anonymous with general descriptions used to describe all of the companies and the categories of expertise represented by participants in this research.

Not every manufacturing company or organization was contacted as part of this research. By using representatives from several industry experts in both large and small bread and poultry manufacturers, I was able to gather meaningful and reflective information to address the research objectives and questions

3.3 Ethics Considerations

Participants were recruited through professional contacts and referrals in the food industry by an email invitation to participate in the study. Once the participant agreed to

participate, they were sent consent forms and the interview questions prior to the interview. The participants were asked to read the consent form and return to the researcher signed and only after this was done was a date and time set up for the interview.

Participants were informed of their right to withdraw from the interview prior to beginning the interview, any time during the interview, or at the end of the interview. Throughout the interview, participants had the ability to choose to answer or not answer any question. The interviews were confidential as only the principal investigator conducted the interviews and therefore was the only person able to identify the participants. The principal investigator transcribed the audio files from the interviews to an electronic file. Prior to the analysis of the electronic files, the participant had the ability to withdraw from the study. However, after all data has been merged during the analysis, individual data could not be extracted as all identifiers will have been removed.

The researcher informed the participants that they were being recorded during the interview and that all data collected would be kept confidential. The researcher asked the participants to read, sign and return the consent forms and kept a copy on file. The researcher scheduled all telphone interviews for 30 to 60 min once the consent form was returned. The researcher called the participants and asked the interview questions. Interviews were audio taped. If the participant did not want the interview audio-taped, notes were taken during the interview. Only the principal investigator had access to the raw data. There was no information reported that will allow tracing of the participant who was interviewed. Only low risk identifiers (i.e. manager from the food industry) were used. All responses were anonymous, and confidential which may have minimized

the psychological risk. Each participant was interviewed individually to protect the anonymity of potential competitors producing products within the same industry with the same customers. To maintain confidentiality of the participants, codes were assigned for each participant instead of participant names. Respondents may have felt worried or defensive of the progress made in sodium reduction within their company if not much progress has been made. The benefits are to identify the barriers as an area of opportunity for further technology, communication and education strategies to further facilitate sodium reduction within the Canadian Food Supply. The participants were informed that this information will be useful to help inform the policy direction set by Health Canada.

3.4 Data Collection and Tools

Semi structured interviews were used as a guide to get an in depth analysis of sodium reduction challenges from participants who have broad experience reducing sodium in breads and processed chicken. Semi-structured interviews, allowed the participants to expand and elaborate on areas that they felt were important. Moreover, it allowed the researcher to ask for clarifications in order to get further explanations and to generate supplementary questions during the session, which allowed the researcher to get an in-depth understanding of the participants' views and experiences. Interviews were minimum 30 minutes in length and the interview questions guide was reviewed and approved by the researcher's thesis committee members.

All quotes are verbatim with unnecessary repetitions omitted and minor edits made in order to retain the meanings of the quotes. Interviews began with a brief introduction of the researcher and research study and then the researcher continued the interview questions, using the interview guide. During the interview, the researcher was

able to ask for elaborations and further clarifications as necessary. At the end of the interview, the participants were thanked for their participation. One researcher conducted all interviews for consistency. The interviews were audio taped using a digital audio recorder with participants' consent to capture all responses.

Interview questions were designed to address the gaps in research. These questions covered the following topics: sodium reduction procedures, communication strategies, impacts with sodium reduction including cost, resources, shelf-life, sensory properties and food safety implications. Participants were asked about the types of products they have already reduced in sodium, the percent reduction of sodium achieved, and the type of approach they took to reduce sodium (elimination, replacement). If replacement products were used, how did they select the replacement (price, function, proven reduction, ingredient claims)? They were also asked about what barriers they encountered with sodium reduction including whether or not communication of the sodium reduction when done in small amounts, when there are restrictions about label claims, and if there was an incremental reduction over time. Information was gathered from the interviewees on consumer acceptability in the short and long-term based on sales performance.

Consumer perception, cost, and communication strategies were all addressed within the questionnaire. Taste impacts had been previously identified through research and industry feedback and therefore questions about taste of products at various levels of sodium reduction were also asked. In addition, respondents were asked about the testing approach they took to understand if consumers would notice the difference when they

reduced sodium. Participants were asked how the initiative was prioritized, sponsored or endorsed within the company to maintain support.

If a sodium replacement strategy was used, the participants were also asked to identify what ingredients they used to replace sodium, why they chose these ingredients, and what limitations they found. Participants were also asked about the decision criteria they used for making their selections to remove or replace these ingredients. They were asked if they considered consumer perception regarding sodium reduction including taste, response to cost, response to type of ingredients, and any other barriers that influenced the decision making. Finally, all participants were asked what recommendations they would make to others who are undertaking sodium reduction in processed foods.

Questions that were asked during the interview include the following:

1. What sodium reduction strategies (e.g., removal, replacement, other) have you used when reducing sodium in bread/processed poultry products?

2. If a replacement strategy was implemented, what were the replacement ingredients used and how did you make your selection?

3. Did you consider consumer perception of the ingredient statement when making your decision?

4. What communication strategies have you used to communicate the change in sodium (e.g., nutrition facts panel change, other advertising, media? How did you make your selection?

5. What was the impact to taste with the sodium reduction strategy you used? Can you identify other barriers (e.g. Cost, ingredients?) Please explain.

6. What worked well? Please elaborate.

7. What would you do differently next time? Please explain why.

8. Which of these strategies, and approaches would you recommend to others who are undertaking sodium reduction? Please explain.

9. Did you have difficulty assigning resources to identify and support sodium reduction within your company?

10. How did you overcome the barrier(s)?

11. Is there anything more you would like to add?

3.5 Data analysis

The principal investigator transcribed the interview data from the recorder onto scripts. The scripts were then reviewed for quality and content analysis to ensure each interview obtained had detailed responses. Emergent themes and explanations, were noted as scripts were initially read. The data was analyzed in three phases. The first analytic phase, *compiling* data into a formal database, calls for the careful and methodic organizing of the original data. The second phase is *disassembling* the data in the database and coding. The third phase, *reassembling*, is less mechanical and benefits from a researcher's insightfulness in seeing emerging patterns (Yin, 2011). Finally, the data was interpreted by the principal investigator and conclusions drawn. To verify the validity of the results member checking was used asking each participant for clarifications and confirmations to ensure the appropriate theme and response was captured during the interview process (Carlson, 2010). Data saturation was reached throughout the interview process with the 10 participants as consistent responses were seen within each category and across categories and no new information was revealed. According to Fusch & Ness (2015), data saturation is reached when there is enough

information to replicate the study, when the ability to obtain additional new information has been attained (See audit trail in Appendix F).

Themes were identified by key word analysis, category grouping, and searching for cultural and social methods of achieving sodium reduction (Yin, 2011). An example is the theme of ingredient considerations. This concept was expressed in different ways by participants which included "clean" labels, pantry ingredients, or no artificial colours/flavours. Similarly, cost considerations were identified with the identification of cost of salt, the cost of ingredient replacement ingredients, costs of conducting trials, and potential cost increases passed onto customers with reformulated sodium reduced products.

CHAPTER FOUR

4.0 Results

This chapter outlines the responses of ten industry experts providing insight into potential barriers to sodium reduction in breads and processed poultry based on industry experience. The responses from the various categories were compared and contrasted to determine if there were differences or similarities between the recommended approaches each industry took. The following table summarizes the emergent themes across both breads and processed poultry categories. Appendix F provides an audit trail of themes.

Table 4-1: Summary of interview questions and answers

Interview questions **Sample size: 10**	**Breads Category**	**Processed Poultry Category**	**Comments**
What sodium reduction approach did you use to remove sodium from breads or processed poultry?	• All respondents used removal • 30% of participants tried sodium chloride replacement ingredients in tests only	• Used removal for small reductions • All respondents used sodium substitute replacer for larger reductions with mineral salts, other herbs and spices and extracts	• Removal was used for small % reductions then replacement ingredients had to be used to maintain flavour, for processing, shelf-life and food safety reasons.

What were the replacement ingredients used?	• 50% of respondents only used potassium chloride used and other ingredients such as bean flour in tests.	• All respondents used a variety of replacement ingredients such as Potassium chloride ingredients, mushroom extracts, other herbs and spices.	• Replacement ingredients were used when sodium reduction targets, taste, processing function, food safety and shelf-life goals could not be achieved with straight removal.
Did you consider consumer perception of the ingredient statement when making your decision?	• All respondents considered consumer perception of the ingredient statement	• All respondents considered consumer perception of the ingredient statement.	• Simple ingredients were considered across both categories.
What strategies have you used to communicate the change in sodium?	• All respondents only changed the nutrition facts table when the sodium reduction was implemented	• All respondents changed the Nutrition facts table only unless it was part of a larger reformulation and relaunch of the product.	• Both categories didn't communicate sodium reduction changes on front of pack labels or through media.
What was the impact to taste when you reduced sodium?	• All respondents stated that there were no significant difference in taste with small reductions but larger reductions did impact taste.	• All respondents stated that there were no significant difference in taste with small reductions but larger reductions did impact taste.	• Both categories experience differences in taste with large reductions.
What worked well?	• All respondents stated that small reductions in sodium worked well without impacting taste, flavour, shelf-life or functionality.	• All processed poultry respondents were aligned with the following statements: • Small reductions in sodium worked best	

		• Grouping similar products into "families" and using a similar reduction strategy when straight removal didn't achieve the goals.	
What would you do differently next time?	• All participants stated straight removal or develop a new product with a lower sodium percentage from the beginning.	• All respondents stated straight removal or design product with a lower sodium percentage from the beginning. • Use replacement only when sodium reduction goals couldn't be achieved by removal.	
What strategies would you recommend to others?	• All participants recommend removal for small percentage reductions and replacement for larger reductions	• All participants recommend removal for small percentage reductions and replacement for larger reductions	• Use replacement only when sodium reduction targets can't be achieved • Group products into "families" to assist in the reformulation work load.
Did you have difficulty assigning resources to identify and support sodium reduction within your company?	• All participants did not have difficulties assigning resources when supported by leadership.	• All participants did not have difficulties assigning resources when supported by leadership.	When sodium reduction was identified as a priority, resources were assigned accordingly.
Was cost a barrier when reducing sodium in your products?	• All participants did not identify cost as a barrier when removal was used • All participants did identify cost as a barrier when	• All participants did not identify cost as a barrier when removal was used • All participants identified cost as a barrier when	

	replacement was used.	replacement was used	

The following information describes more detailed results from the interviews.

4.1 Ingredient Considerations

In both the breads and processed poultry categories there was strong consideration into replacing sodium with unfamiliar replacement ingredients in the ingredient statement on the product label. All participants noted that they were aiming for simple, short ingredient listings using ingredients with which customers would be familiar. In addition, participants struggled to find an ingredient that worked well to replace salt for its simple familiar ingredient declaration, functional properties, flavour, and cost.

One poultry processer stated:

> "We looked for ingredients that were consumer friendly. The overall goal now is the cleanest label possible. We went away from potassium chloride for years and went back to it as it came back to the functionality."

One baker stated:

> I don't know the answer to a label that says "reduced salt" is going to be more preferable to the consumer vs. something that has 4 or 5 items on it (flour, water, sugar, salt…).

For processed poultry, sodium held a preserving function, unlike in the breads category. Salt removal required shelf-life studies to be undertaken carefully monitoring microbiological growth as part of the assessment process. Replacement ingredients were required when sodium was required for shelf-life, processing or taste. Potassium chloride

substitutions were tested and new formulations were developed in the processed poultry category to aid in sodium reduction. Some bakers experimented with Nutek salt and found success. Nutek salt is made from a patented process using naturally sourced potassium salt (potassium chloride) from North America to replace regular sodium chloride salt. According to the company, it is also designed to deliver the same flavour with a minimal cost impact (Nutek, 2016). According to the bakers, there have been new developments in the area of sodium replacement in the last few years which have proven to be much more successful than earlier versions. A few bakers were familiar with Nutek sodium replacement for bread which uses potassium chloride in addition to a carrier. However, there is still a general apprehension in the bakers interviewed due to addition of new ingredients.

4.2 Taste and flavour considerations

When industry experts from both industry sectors used Nutek salt in trials to replace sodium chloride for flavour, they found that they were able to maintain the same functional and flavour properties of their existing products with one-third less sodium compared to only 10% with straight sodium removal. This technology is available and being used in other parts of the world as well.

One of the processed poultry participants stated "we used internal panels to confirm there was no difference in taste and we grouped the various products into families and used the same approach for each group as they were similar". This helped reduce the administrative load as the same approach could be used for the same type of product. Internal sensory panels helped establish taste thresholds to know how far the sodium reduction could go. As it pertains to taste and flavour impacts, one baker shared:

> The thing about salt it is a flavour enhancer, the buns are no longer sweet, you taste more off flavours in buns, bread particularly we are talking about hamburger buns and so that is why we stopped at 1.8 [%] because commercially we couldn't produce product with less than that and still get functionality of taste.

4.3 Sodium reduction approaches

In the breads category slow incremental removal of sodium was chosen as the best and first choice. The participants used small percentage decreases to reduce sodium in their products as it was the most efficient and cost effective method. All bread manufacturers identified limits to reducing sodium with a straight removal approach. Participants identified the function of salt within bread products was to control the dough and yeast activity, and to contribute to and/or enhance flavour.

A reduction of flavour was the first to be noticed when reducing sodium followed by impacts to dough formation and yeast activity level, which resulted in an impact to the product's texture. One baker stated:

> "we played around with temperature and humidity and used different starters but we found that the white baguette then started to taste like the sour dough baguette".

There was general consensus on sodium reduction limits without replacement within breads. Several bakers identified that it was dependent on the type of bread and how high in sodium the product was initially before there were impacts to dough formation and significant changes to yeast activity.

Based on their experience, the bakers interviewed identified that with a starting point of 2% of salt on a baker's flour basis salt could be reduced to 1.8% or 1.7% without

impacts to taste or processing implications. Several bakers had completed tests using lower salt percentages. One baker stated that when he used a salt percent at 1.5% bakers' flour he lost the appearance of the product, it was a totally different product coming out, nothing stopped the yeast, and the dough was "running wild". Another baker stated:

> "you don't get the same gas retention in the cell structure it has a tendency to break down over time, it tends to dry out over time and becomes crumbly when you just take salt out and don't use replacers and it doesn't perform over the shelf-life probably on the second or third day you see degradation of the cell structure."

The majority of bakers were aware of studies completed using lower percentages of salt, but based on their own trials with their products, they didn't find them successful concerning flavour delivery or dough formation. Many of the bakers interviewed had tried replacement products in trials, but had opted not to use them in their products primarily due to cost and consumer perception of the ingredient listing when compared to salt. Currently, the Health Canada sales weighted average targets for 2016 for sodium reduction in pantry bread is set at 330 mg/100g (Health Canada, 2012), a target which is lower than 1.8% salt within the formulation based on bakers' flour percentage.

In the processed poultry category, sodium reduction by removal was the primary choice by manufacturers to reduce sodium. All participants had reduced sodium via removal and had success with their products. They found limitations to the amount of sodium that could be reduced without impacting a products flavour, shelf-life, yields, and food safety considerations. For products that were high in sodium, participants recommended a slow reduction over time to allow the consumers palate to adjust to the reduction in sodium in the product. Another approach was to group the sodium reduction

with other flavour or texture changes within a product and relaunch the item thereby resetting the consumers' expectation on what the product should taste like. All processed poultry manufacturers interviewed had grouped similar products together and used the same sodium reduction approach for each of the groups. For example, a sodium reduction approach for one type of ground breaded chicken portion would be applied to other ground breaded chicken portions. One poultry processer recommended to others undertaking sodium reduction:

> You have to know their product and what the role of salt is within their products, go into categories is a good approach, go in methodical approach by families with solution and they have to think about shelf-life and cost as well to make sure it fits with their category of product. Salt is a very functional ingredient not just for taste, we use salt for what is needed, everything we add to the product adds cost, we wouldn't add salt just to add salt, so it is not that simple to remove it.

4.4 Barriers to sodium reduction

Reductions of sodium greater than 10% typically were noticeable from a sensory perspective. Based on the participants' experiences, a 10% reduction level, did not affect the yields, shelf-life, or microbiological properties from a food safety perspective. However, these product characteristics were dependent on the original level of sodium present in the product.

Currently, Health Canada has set targets for breaded chicken burger, nuggets and strips at 450 mg of sodium/100 g (Health Canada, 2012). All participants had undertaken sodium reduction to try and achieve this target. All participants stated that it is possible

to achieve this target but not without changes to the sensory profile of their existing products. In addition, in most cases additional flavours and starches were added to maintain a good flavour even though it wasn't the same flavour profile, though generally one that consumers would find equally acceptable. Generally, for poultry products, additional starch or other ingredients were added to prevent yield loss and moisture retention.

Participants in the breads category stated that they struggled to find an acceptable replacement to get below 1.8% or 1.7% sodium content in bakers' flour. Early versions of sodium replacement products containing potassium chloride were tried, but were not found to be a suitable replacement because of cost (salt is one of the cheapest ingredients). Using potassium chloride instead of sodium chloride didn't seem to have the same rheological properties and the flavour delivery was not the same as sodium chloride. All participants felt customers would not like to see potassium chloride in the ingredient listing. One of the bakers had tried an additional bean flour to try and mitigate the flavour difference with reduced salt, but found it cost prohibitive and based on labelling regulations within Canada, it wouldn't meet the standard of identity for bread with the addition of a bean flour. One baker shared his experience with salt replacers below:

> I have worked with some salt replacers that earlier, this was early 2000's, the salt replacers were more chemically derived trying to replace the sodium and they had an off taste and an off flavour so really stayed away from any salt replacer until just recently we have been able to find some salt replacers that worked. You don't get the same gas retention in the cell structure it has a tendency to break

> down over time, it tends to dry out over time and becomes crumbly when you just take salt out.

In the processed poultry category, sodium replacement ingredients such as potassium chloride, addition of other flavours that provided a savoury quality, and addition of starches to assist with yield and moisture retention were employed to lower sodium levels and make reduction feasible. In this particular category, some suppliers had to manage sodium reductions on 80-100 various products which factored into the type of approach that was taken to reduce sodium. Several felt the administrative load and resources required to slowly reduce sodium over time on this many products created an onerous situation and an inefficient use of resources. They preferred completing one reformulation and set of tests for acceptability instead of many sodium reductions and tests required with a step down approach. One poultry processor stated:

> There were new formulations because the formula now was different and there was an administrative load that was associated with that and quite frankly there was the likelihood of having to develop new package labelling because your nutrition facts panel may have changed and that given the number of SKUs that we had, that would add up to a quite frankly an onerous administrative load.

Potassium chloride replacement products tried by the participants were 10-100 times more expensive than salt making them typically cost-prohibitive. Additional ingredients were used to help adjust the flavour with the removal of salt which included mushroom extracts, herbs, spices and seasonings, and soya to help deliver the savoury

flavour typically found in meat products. Cost was identified as a barrier by one of the bakers:

> It was upwards of 20 to 30 to 40% more (cost) to use replacers, they're very expensive. When you are looking at it on a per piece perspective it doesn't make that much of a difference but the cost of the ingredient is significant compared to salt.

Participants within both categories based their selection of sodium replacements on achieving food safety and microbiological targets, taste, cost and functional properties for the product they were manufacturing. Food safety was a primary consideration within the processed poultry category. One of the poultry processors stated "The preeminent consideration was food safety, so we would not go to any place with regards to the sodium chloride content if we felt it would compromise food safety."

Overall taste was most important in the bread category. Cost was also a significant factor for both breads and processed poultry categories when it came to using a replacement product. All participants felt that consumers were not willing to pay more for the sodium-reduced product than what they had previously.

4.5 Communication strategies with sodium reduction

Communication about sodium reduction within products was limited for a number of reasons. In the breads category, no participants were able to make any front of pack or other sodium reduction claims because the sodium reductions were small (less than 25%). According to Health Canada, in order for a food to carry a lower in sodium, or reduced sodium claim, the food must be processed, formulated, reformulated or otherwise modified so that it contains at least 25% less sodium (Health Canada, 2012).

They also felt that making sodium reduction claims would indicate to the customer that the product tastes different in a negative way, and they didn't want to impact sales of the product. They chose only to change the sodium value on the nutrition facts panel instead of advertising the sodium reduction.

Participants felt they were not able to use the available "25% reduced sodium" claim allowed by Health Canada for a number of reasons. The first reason was that in order to meet the 2016 Health Canada targets for bread, such a significant reduction of 25% wasn't required. Reductions percentages were typically around 10%. Another reason why the participants reported they didn't reduce the breads by 25% in sodium was that the sodium would be too low and would impact taste, texture, and manufacturing of the product. If they used a sodium replacement ingredient to reduce sodium by 25% or more they would see an increase in cost and the addition of unfamiliar terms/ingredients on the ingredient listing when they were striving for very simple ingredient listings. Some manufacturers felt that there was only a very small percent of bread customers who would purchase a 25% reduced sodium bread. Participants felt these consumers were concerned about their health and well-being where the majority wanted to pay the same price and were concerned about taste.

In the processed poultry category, there were no sodium reduction claims that were used when the participants reduced sodium among the subjects in the study. They changed the sodium values on the nutrition facts panel only. Similar to the breads category, they felt that putting such a claim on the package would provide a negative taste impression for the product and they were concerned about maintaining sales. In products where sodium reduction was part of a reformulation of the entire product, the

suppliers interviewed were not able to use a comparative claim such as "25% less sodium per serving than our regular chicken strips" as they discontinued the original product. This made it difficult to communicate to the public the work manufacturers were doing in the areas of sodium reduction. Overall participants felt that taste was a big factor that they were not willing to compromise on, there were labeling restrictions with regards to allowable claims available and the negative consumer impression of sodium reduction claims on products impacted their ability to reduce sodium. One poultry processor stated:

> With sodium reduction we didn't really advertise it because there is a perception with consumer side that if we reduce the sodium, it won't taste as good so that is not something that we advertised but for sure we did change the nutrition panel, we changed our information on all the pack. We didn't go at large and say we did reduce the sodium because we didn't want to impact the sales of our products.

Communication strategies for public and scientific audiences were addressed separately. Companies communicated to scientific audiences by providing input into industry and association reports such as the Canadian Meat Council, Baking Association of Canada, and Food and Consumer Products of Canada. There were also some company specific reports and company websites where sodium reduction and other sustainability initiatives were published.

The communication strategy taken by all participants for the general public was to simply provide the lower sodium values on the Nutrition Facts Table on the packaged product once they had reduced sodium instead of any further front of pack claims or media. This type of "silent" approach seemed to be effective at achieving the sodium reduction targets without alerting to the customer that there was a change and potentially

impacting sales. One of the negative impacts of the silent approach was that consumers were not made aware of the work that companies were doing or had done to improve the nutritional profile of the products over time.

4.6 Sodium reduction recommendations

When participants were asked what approach they would recommend to others undertaking sodium reduction, both participants from the bread and processed poultry industries recommended a slow reduction over time. From their experience in both industries this was found to be the most efficient and successful approach when only small reductions were required. Several respondents also reinforced the importance of identifying and recording the sensory properties of the food item that was currently being produced to be able to identify thresholds of when the taste or texture was changing with a change within the formulation. Participants recommended going slowly and methodically, ensuring that all appropriate testing was completed before launching the new product. Shelf-life testing, sensory testing, and food safety testing were all identified as being critical. In the case of new food development where there isn't an existing product in the market to try and match, the suggestion was to not introduce sodium higher than the Health Canada 2016 targets. A baker with extensive sodium reduction experience stated:

> I think the main thing is to make sure you really understand your flavour profile and what your current attributes of your food are so you don't miss something along the way so you have to be really calibrated to your sensory tastes and texture and make sure that as you move through it and I would recommend that you move through it slowly with small steps as far as reduction and then small

steps as you replace with something else just to make sure you don't. The last thing you want to do is to not know what you are sending out so make sure you go with smaller steps, make sure that the shelf-life validations are completed, and make sure shelf-life and sensory profile is where you want it to be. I know there has been some other companies out there that have sacrificed flavour and some functionality to get to that magical number.

If a producer has many products to reduce in sodium, participants suggested that the product developer group the products into similar categories and use the same sodium reduction approach on each. For example, the strategy used to reduce sodium in one type breaded chicken portion could be applied to multiple breaded chicken portions or chicken strips. This strategy would help simplify the sodium reduction process and also would build on the success of an existing product. When there was a large sodium reduction required for a product to get closer to the Health Canada targets, and when no further sodium could be removed without impacting the quality attributes of the product, sodium replacement products were suggested.

CHAPTER FIVE

5.0 Discussion

The goal of this research is to identify the challenges and facilitators associated with reducing sodium in bread and processed poultry products within the food industry in Canada. This study examines the following research questions, from the perspective of the industry experts working in the processed poultry and breads categories.

1. What are the processing and other technological challenges with reducing sodium within breads or processed poultry?
2. What are the financial and resource challenges with reducing sodium within breads or processed poultry categories?
3. What are the communication challenges and approaches you would recommend when reducing sodium?

In this study there were a number of challenges identified by the food manufacturers in reducing sodium in bread and processed poultry products. These barriers included addition of unfamiliar ingredients, additional cost, taste impacts, manufacturing challenges, communication challenges, and lack of, or constrained resources for product development. In addition to barriers competing priorities were noted. These competing priorities include: developing new products, meeting government and regulatory requirements, and also meeting sales targets, and making a profit. All of these priorities require resources (human resources, time, and funding). Setting agreed upon sodium reduction targets and goals was necessary when undertaking sodium reduction within a corporation. Having a desirable taste was identified as a key driver of purchase intent, and therefore taste was a prime consideration in taking on a

sodium reduction project. Health Canada goals to reduce sodium by 25% to improve the prevalence of high blood pressure gave little consideration to taste when significant reductions were required or industry goals of sales and profit.

To achieve Health Canada's goals of achieving sodium reduction, industry has collaborated to share expertise within specific product categories. Examples of this include information and document sharing through industry organizations such as the Food and Consumer Products of Canada who have published technical documents identifying barriers with reducing sodium. Food and Consumer Products of Canada employs over 300,000 Canadians across the country making it the largest employer in the Canadian manufacturing sector (Food and Consumer Products of Canada, 2016). Other examples of knowledge sharing within industry include technical information sharing through the Canadian Meat Council, and the Baking Association of Canada in addition to Restaurants Canada.

Through technical information sharing, industry has identified several ways to improve efficiency and minimize resources. One of the strategies identified by industry was to group products into categories or families and use the same sodium reduction approach on each. Another strategy to assist with sodium reduction was to identify and work with strong ingredient supplier partners. Many corporations are global brands where further information sharing through internal global company colleagues also provide product development ideas and sodium reduction support.

Health Canada's sodium reduction targets were developed through the work of the Sodium Working Group (Health Canada, 2012). The working group was comprised of government agencies, the scientific community, the health professional community,

health-focused non-governmental organizations, the food manufacturing industry, the restaurant and food service industry, and consumer-advocacy groups. These targets were developed using the UK Food Standards agency as a reference and based on the latest available research at the time (Health Canada, 2012). These targets have been further identified by industry as being too restrictive in some areas due to their functional role (e.g., dough development and crumb structure) and flavour role. In addition, the cost of replacing sodium was identified as a barrier on a low priced item when sodium needed to be replaced for taste or functionality as consumers are not willing to pay more for a reduced sodium item. There is also is cost associated with a slow reduction approach as nutrition facts tables and ingredient declarations would need to be continually changed to reflect the most recent nutrition information with each sodium reduction.

5.1 Bread Products Barriers and Facilitators

Many of the challenges and barriers in implementing the sodium reduction policy were identified through the interviews are further supported by the literature. For example, in the breads category challenges identified by participants included controlling the dough and yeast activity, and addressing lack of flavour. Similarly Charlton, MacGregor, Vorster, Naomi, Levitt & Steyn, (2007) stated the functions of salt in bread are summarized as: imparting flavor, control of yeast growth and fermentation rate, improvement of product texture and reduction of spoilage, particularly mold spoilage. Another finding through interviews and also supported through the literature is the substitution of sodium chloride for potassium chloride within the bread formulation. Braschi, Gill, and Naismith (2009), found that a substantial reduction in sodium and an increase in potassium intake could be achieved by substituting potassium salts for sodium

chloride in bread. Some bakers interviewed also found that versions of potassium chloride based replacement products were also a good substitution for sodium chloride as it pertains to flavour and function within the bread. It was identified through interviews and from the literature that it is possible to reduce sodium in bread products by straight removal as well. All of the bakers interviewed did not add potassium chloride in any of the final formulations because they had already reduced sodium levels by an average of 10% and due to the perception of artificial sounding ingredients and cost. Some bakers did have experience in reducing sodium in larger percentages with baked products in other countries by including sodium replacement ingredients that included potassium chloride. This finding suggests that lower levels of sodium are possible but not without changing the cost, or the ingredient listing. Charlton, MacGregor, Vorster, Naomi, Levitt & Steyn (2007) also found success reducing sodium at higher percentage levels (32.3%) by replacing sodium chloride with potassium chloride, magnesium and calcium, without adversely affecting palatability or product quality in brown bread. However, the challenge was to for the food industry to make this bread cost competitive to the target population.

The bakers interviewed found a level of 10% reduction or going from 2% salt based on flour to 1.8% salt based on flour weight was close to the limit of reduction achievable without impacts to flavour and function. In contrast, Belz, Ryan, Arendt, (2012) and Girgis et al., (2003), found that a 25% of reduction in the sodium content of white bread can be delivered over a short time period, while maintaining consumer acceptance. They found the production of bread reduced in salt is feasible, but the sensory characteristics of bread have to be adjusted to meet the consumer's expectations.

As it pertains to communicating sodium reduction in breads, the participants did not make any front of pack claims or other advertising claims because they were concerned about the consumer impression as it relates to taste. This thinking was the same across both categories (breads and processed poultry). Literature also exists to support this impression. Liem, Miremadi, Zandstra and Keast (2012) found that emphasizing salt reduction by means of a front-of-pack label can have a negative effect on taste perception and salt use. They investigated front of pack labels on taste perception and use of table salt for soups. Participants were asked to rate their expected salt intensity and liking before and after tasting. After tasting, participants rated their perceived salt intensity and liking. Reduced-salt labels generated a negative taste expectation and actual taste experience in terms of liking ($P < 0.05$) and perceived saltiness ($P < 0.05$). Perceived saltiness of sodium-reduced soups decreased more ($P < 0.05$), and consumers added more salt ($P < 0.05$), when soups carried the reduced-salt label.

5.2 Processed Poultry Barriers and Facilitators

Similar to the bread category there were challenges found with reducing sodium in meat products. The participants found there were limitations to the amount of sodium that could be reduced without impacting a products flavour, shelf-life, yields, and food safety considerations. Reductions of sodium greater than 10% typically were noticeable from a sensory perspective however yields, shelf-life or microbiological properties were not impacted based on the participants' experience. Desmond (2006) identified cost as one of the biggest barriers to sodium reduction in meat products but was followed by taste and ingredient declaration challenges with using replacement products. Ruusunen,

& Puolanne (2004) found in most countries and in most cases, sodium content of meat products can be lowered markedly as the threshold for perceived saltiness and overall acceptability of the low-salt products decrease. They also found that lean meat content reduced perceived saltiness. What also needs to be considered is the current content of salt in consumers' normal diets.

New findings in the processed poultry category included the strong desire to not include any sodium reduction alternatives as they contributed additional ingredients, negative taste impacts and cost. The level of sodium reduction achievable within processed poultry products also varied depending on the original content of sodium within the product and other flavours that could contribute flavour for equal consumer liking. Contrary to the approach of slowly reducing sodium, many processed poultry manufacturers opted to change the formulation all at once to prevent constant requirement for resources, time, and packaging associated with slow removal in sodium reduction.

5.3 Significant findings

Novel findings identified through the interviews included the identification of distinct thresholds for when taste and functional differences with the removal of sodium took place in breads and processed poultry. Additional new findings identified through the interviews were the differences found in sodium reduction taste perception comparing white bread to whole wheat bread. Artisan bakers also identified barriers with sodium removal as artisan breads have very short, simple ingredient listings and salt contributed an important functional role. In contrast, pantry breads may contain dough conditioners or emulsifiers added within the bread formulation to help maintain structure and texture

when salt was removed. As the sodium removal in breads was typically 10%, the current claim of 25% less sodium was never available for use in the breads category.

Communication of sodium reduction was challenging on two fronts. All bakers interviewed stated that they were unable to utilize the available comparative "25% reduced" claims for sodium reduction as the sodium reductions were smaller. Two of the processed poultry participants interviewed also didn't use the 25% reduction claim because they opted to reformulate and therefore the original product no longer existed. According to Mintel (2012), products with low/no/reduced sodium claims have seen some decline over the past years. Globally, launches of foods with low/no/reduced sodium claims declined 5% over the 2010/2011 period, appearing on just 2% of total food launches in 2011. All bakers interviewed stated only a very small population were looking for a sodium reduced product and sodium reduced products did not sell compared to their existing products.

All participants across both categories felt that using such a claim would not be beneficial to sell the product. In contrast, according to Wong, 2015 found that sodium claims have the potential to facilitate lower sodium food choices. Data from the study showed that consumers were attracted to and considered sodium claims useful and influential in their intended purchasing decisions.

One of the limitations of this study is that it was conducted with a small set of participants and not all responses from all types of products and manufacturers were reported. However, based on the findings and similar themes identified in the literature, the results are informative. It is believed that these results can be shared broadly with food manufacturers from the breads and processed poultry categories to assist with

sodium reduction as themes discovered were supported through industry documents and within the literature. In addition, themes identified through this research can be shared with Health Canada and industry groups to assist with further policy development and implementation as similar information has been identified as well through industry reports. The results are also considered helpful and informative for both small and large organizations with the same goals of producing great tasting products consumers love while meeting regulatory requirements related to sodium reduction. Specifically, the development of great tasting, low cost, simple ingredient products are all consumer trends in the industry.

All participants across both categories stated that resources were required to support product reformulation and quality testing. Participants have already conducted sodium reduction activities within their products. If further sodium reduction is required within their products, they would need to direct resources to support that activity instead of focusing on other business priorities. The continued development of sodium replacement solutions are required at less expensive prices that deliver the same customer experience. Customers are not willing to pay more for a sodium reduced product that might not taste as good as the original according to the participants.

Within Canada, sodium reduction by the industry is well underway with many food manufacturers having already reduced sodium in their products either over time or by complete reformulation and relaunch of a similar type of product (Canadian Meat Council, 2016). These changes will help reduce the saltiness appeal or flavour intensity experienced by consumers. There continue to be challenges with addressing consumer impressions related to replacement or masking products on ingredient labels and cost of

sodium replacement ingredients compared to salt. For the industry to reduce sodium even further, consumer education on the benefits of potassium introduction and reduction in cost of other mineral replacements for sodium chloride are required. As taste is the primary driver of food purchases, taste appeal is critical as the industry continues on the sodium reduction journey. A change in the food supply needs to happen across all food categories, gradually over time to allow consumer to adapt. This gradual approach will assist with readjusting the saltiness expectations, and less expensive sodium replacement ingredients can be used at smaller quantities to achieve the same shelf-life and sensory properties.

CHAPTER SIX

6.0 Conclusion

This study identifies approaches from participants to reduce sodium in breads and processed poultry products. It also identifies barriers to sodium reduction in each of these product categories. This study illustrates that sodium reduction is underway within the food industry with many food manufacturers making progress despite the barriers to taste, function, cost, communication strategies, and resource restraints.

New insights provided through the interviews not previously identified in the research include thresholds for sodium reduction without impacts to taste and processing, the identification of consumer perception barriers with existing sodium replacement ingredients in the market, and communication barriers. In the artisan bread category, there were more concerns with reducing sodium due to the artisan manufacturing methods and the desire to have very simple ingredient listings. In the processed poultry category, the interviews provided recommendations into how to maximize use of resources by applying similar reduction approaches across multiple products. The communication barriers identified through the interviews further highlighted the need to develop more informative ways to communicate sodium reduction to the public without impacting taste perception.

This study also identified that a straight 25% sodium removal approach is highly problematic from a processing perspective in both the breads and processed poultry categories. A 25% removal of sodium impacts a breads texture and flavour. The bread crumb structure becomes more crumbly and there is a significant reduction in flavour. In processed poultry products, moisture retention, and flavour changes are noticeable with a

25% removal of sodium. As a result of these impacts, manufacturers have had to search for sodium replacement ingredients to achieve a 25% reduction and maintain a desirable product.

The most successful and recommended approach for small reductions was to reduce slowly over time across both categories of breads and processed poultry. This had the least impact on taste and cost which were identified as the primary drivers of food purchase. In addition, it had the least impact on processing and shelf-life impacts of sodium reduction.

New insights provided through this study can help further inform policy development as they identified the need for more time required for the food industry to complete the sodium reduction. The study identified the need for further development of approved claims with sodium reduced products with lower than 25% reduction. It also identified the need for a continued focus on public education on the hazards of consuming too much sodium to drive the need for sodium reduced products from industry. In addition, this study identified the need for further development of sodium replacement ingredients including potassium chloride to maintain the taste and function that table salt currently provides. These replacement ingredients are necessary to maintain the same texture and flavour and maintain the same function of salt within manufacturing with more than a 10% reduction.

More time is required for the food industry in Canada to meet Health Canada's targets for sodium reduction. Time is required for the development of further research and technology in sodium replacement ingredients, time is required to continue to develop public demand for sodium reduced products, and time is also required to develop

new ways for industry to communicate their sodium reduction achievements without impacting taste perception. In addition, more time is required for the food industry to reformulate products with equally desirable consumer acceptability with simple, natural ingredients. As many countries around the world have had many years to reach their sodium reduction goals with success, Canada also needs more time to achieve the goals set by Health Canada.

Appendices

Appendix A: Timeline of Data Collection and Data Analysis Process

ACTIVITY	2015/2016					
	May 2015	June – Sept 2015	Sept-Oct 2015	Nov-Dec 2015	Dec – Feb 2016	March – April 2016
Obtain Research Ethics Board (REB) Application						
Obtain Research Ethics Board (REB) Approval						
Recruitment of Participants (via email)						
Interviews completed						
Transcribing & Data Analysis						
Thesis Writing Begins						

Appendix B: UOIT Ethics Approval Letter

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

RESEARCH ETHICS BOARD
OFFICE OF RESEARCH SERVICES

Date:	September 29, 2015
To:	Brenda Carr, Brenda Gamble and Milly Ryan-Harshman, Co-Supervisors
From:	Shirley Van Nuland, Chair, Research Ethics Board
REB File #:	14-142
Decision:	Approved
Current Expiry:	September 29, 2016

Notwithstanding this approval, you are required to obtain/submit, to UOIT's Research Ethics Board, any relevant approvals/permissions required, prior to commencement of this project.

The University of Ontario Institute of Technology Research Ethics Board (REB) has reviewed and approved the research proposal cited above. This application has been reviewed to ensure compliance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans 2014 and the UOIT Research Ethics Policy and Procedures.

You are required to adhere to the protocol as last reviewed and approved by the REB. Always quote your REB file number on all future correspondence.

Continuing Review Requirements:

- **Renewal Request Form:** All approved projects are subject to an **annual** renewal process. Projects must be renewed or closed by the expiry date indicated above ("Current Expiry"). **Projects not renewed within 30 days of the expiry date will be automatically suspended by the REB; projects not renewed within 60 days of the expiry date will be automatically closed by the REB.** Once your file has been formally closed, a new submission will be required to open a new file.
- **Change Request Form:** any changes or modifications (e.g. adding a Co-PI or change in method) must be approved by the REB through the completion of a change request form before implemented.
- **Adverse or Unexpected Events Form:** events must be reported to the REB within 72 hours after the event occurred with an indication of how these events affect (in the view of the Principal Investigator) the safety of the participants and the continuation of the protocol (i.e. un-anticipated or un-mitigated physical, social or psychological harm to a participant).
- **Research Project Completion Form:** must be completed when the research study has completed.

Forms can be found at http://research.uoit.ca/faculty/policies-procedures-forms.php.

We wish you success with your study.

Chair, Research Ethics Board
Dr. Shirley Van Nuland
shirley.vannuland@uoit.ca

Ethics and Compliance Officer
compliance@uoit.ca

University of Ontario Institute of Technology
2000 Simcoe Street North, Oshawa, ON, L1H 7K4
Telephone: (905) 721-8668 ext. 3693

Appendix C: Consent Form

Research Consent Form

Title of Research Project:
Sodium Reduction in Breads and Processed meat products: An Industry Perspective

Investigator:

Principal Investigator:
- Brenda Carr (PI), Master's Student, Faculty of Health Sciences, UOIT

Co-supervisors
- Brenda Gamble, Ph.D., Associate Professor, Faculty of Health Sciences, UOIT
- Milly Ryan-Harshman, Ph.D., Faculty of Health Science, UOIT

Purpose of the Research:
Objective: The goal of this research is to identify the barriers associated with sodium reduction through semi-structured interviews.

Description of the Research:
Interviews will be focused on the barriers associated with reducing sodium in bread and processed poultry products within the food industry in Canada. These products were identified as top contributors to sodium consumption within the diet making them important categories to focus on. The information gathered from the interviews from industry experts will help inform and guide efforts in the food industry to continue to reduce sodium in products.

Interviews
To identify the barriers associated with sodium reduction, interviews will be conducted with key representatives in the food industry from both large and small companies.

You are being asked to participate in one interview conducted with the principal investigator. The investigator will be asking you to share your views about sodium reduction barriers to aid in future sodium reduction. The interview will take between 30-60 minutes and will be led by the principal investigator. The researcher will contact you to set up the day and the time of the interview according to your preference. You will receive a copy of the interview questions prior to the interview to allow respondents to prepare. The interview will be audio-taped and transcribed. If you prefer not to be audio taped the researcher will take detailed notes of the discussion. Only the principal investigator will be able to identify you.

Once the interview has been completed the audio-tape and any written information from the audio-tape will be kept in a locked, safe place and your name will not be marked on either the tape or any paper material. The transcribing and de-identification of materials will occur within 5 business days of the interview. You will not be identified in any reports or publications. Participants will not be able to withdrawal from the study once the data has been transcribed and de- identified. The audio-tape/detailed notes will be erased at the end of the study. The transcribed electronic files will be destroyed after five years by erasing the electronic files.

Potential Harms:
There are no known harms that we are aware of that are associated with participation in this study but there may be harms that we do not know about.

Potential Discomforts or Inconvenience:
Sometimes people involved in interviews like these feel stress and anxiety about questions asked. Respondents can choose not to answer any question and withdraw from the interview at any time. Participation is voluntary.

Potential Benefit to Individual Subjects:
Individuals will be able to identify bariers to help inform policy direction set by Health Canada.

Potential Benefit to Society:
The benefits are to identify the barriers as an area of opportunity for further technology strategies, communication strategies and education strategies to further facilitate sodium reduction within the Canadian Food Supply. This information will be useful to help inform the policy direction set by Health Canada.

Confidentiality:
Your privacy will be respected. No information about who you are will be given to anyone or be published without your permission, unless required by law. For example, the law could make us give information about you if a child has been abused, if you have an illness that could spread to others, if you or someone else talks about suicide (killing themselves), or if the court orders us to give them the study papers.

All information related to the specific project data obtained during this study will be kept strictly confidential. Only the PI will have access to the raw data. References to aggregate information only will be used when discussing and reviewing this project. **Data will be kept in a password-protected computer and will be available only to the principal investigator. After a five-year period all data will be deleted.**

Participation:
Participation in this study is voluntary. By participating in this study you are not waiving your legal rights. You are free to withdraw from the study at any time during the study period. Any information already provided by you prior to withdrawing will not be used in the study and will be permanently destroyed.

New information received while the study is being conducted may affect your decision to take part in this study. If this happens, the principal investigator will tell you about this new information. And the principal investigator will ask you again if you still want to be in the study.

Conflict of Interest:
The Principal Investigator, Carr, Co-Supervisors, Gamble, Ryan-Harshman, have no conflict of interest to declare.

Consent:
"By signing this form, I agree that:
1) You have explained this study to me. You have answered all my questions.
2) You have explained the possible harms and benefits (if any) of this study.
3) I understand that I have the right not to take part in the study and the right to stop at any time.

4) I am free now, and in the future, to ask questions about the study.
5) I understand that no information about who I am will be given to anyone or be published without first asking my permission.
6) I have read and understood pages 1 to 4 of this consent form. I agree, or consent, to take part in this study.

_____ _____

Printed Name of Subject Subject's signature & date

If you have any questions about this study, please call:

Brenda Carr
Master's Student
University of Ontario Institute of Technology
E-mail: Brenda.carr@uoit.ca
Phone: 416-566-2976
REB File #

If you have any questions or concerns regarding your rights as a research participant, or have concerns about this study please contact:

The Ethics and Compliance Officer, Sascha Tuuha
University of Ontario Institute of Technology
E-mail: compliance@uoit.ca
Phone: 905-721-8668 ext. 3693

Appendix D: Letter of Invitation

Sodium Reduction in the Food Industry

Invitation to Participate in a Research Study

You are invited to participate in a research initiative on sodium reduction in the Food Industry that is being conducted by Brenda Carr, a Master's student from the Faculty of Health Sciences (UOIT). This study has received ethics approval from UOIT (14-142) September, 2015.

Industry manufacturing experts and representatives of bread and poultry manufacturers will be invited to participate in this study.

All participation in the interview will be entirely voluntary. Participants may decide to withdraw from the interview at any time. There will be no consequences for not answering any question or from withdrawal from the study.

Participants will be invited to participate in the interview for approximately 30-60 minutes. Interviews will be focused on the barriers associated with reducing sodium in bread and processed poultry products within the food industry in Canada. The interview will be audio-taped and transcribed. If you prefer not to be audio taped the researcher will take detailed notes of the discussion. Only the principal investigator will be able to identify you.

All information obtained during this study will be kept strictly confidential. Only the principal investigator will have access to the raw data. There will be no information reported that will allow tracing of the participant who was interviewed.
Data will be kept in a password-protected computer and will be available only to the principal investigator. After a five-year period all data will be deleted.

Please consider the information in this letter of invitation before you consent to participate. If there is anything you do not understand, or you have any questions, please contact

Brenda Carr
Master's student Faculty of Health Science
University of Ontario Institute of Technology
E-mail: Brenda.carr@uoit.ca
Phone: 416-566-2976
REB File #*14-142*

Appendix E: Interview Guide Questions

Interview Questions- Sodium Reduction

1. What sodium reduction strategies (e.g., removal, replacement, other) have you used when reducing sodium in bread/processed poultry products?
2. If a replacement strategy, what were the replacement ingredients used?
3. How did you make your selection?
4. Did you consider consumer perception of the ingredient statement when making your decision?
5. What communication strategies have you used to communicate the change in sodium (e.g., nutrition facts panel change, other advertising, media? How did you make your selection?
6. What was the impact to taste with the sodium reduction strategy you used? Can you identify other barriers (eg. Cost, ingredients?) Please explain.
7. What worked well? Please elaborate.
8. What sodium reduction approaches would you recommend to others who are undertaking sodium reduction? What were the barriers, if any, that you encountered?

I'll be analyzing the information you and others gave me and creating a draft report in one month. I'll be happy to send you a copy to review at that time, if you are interested.

Thank you for your time.

Appendix F: Audit Trail of Themes Identified for Sodium Reduction in Breads and Processed Poultry Products.

Audit trail of themes Identified for Sodium Reduction in Breads and Processed Poultry Products and sample/selected quotes for each theme*

Theme	**Quotes from participants**
Strategies used when reducing sodium in bread products	It was through reduction rather than replacement. Early on we tried to replace sodium with potassium chloride but it gave us a bitter flavour so it wouldn't functionally work as well several years ago but what we did try to do was more or less how much salt we can take out. You may lose flavour or lose functionality. We used reduction to 1.8% and most of our formulas now we are at 1.8 on a flour basis on a baker's flour basis. Getting much below that, you start to see a degradation in functionality, the doughs become weaker, harder to manage, especially hamburger buns, heavy breads you may be able to go a little lower because you are not required to have the same volume as you typically would in white bread. The primary strategy has been a step down in usage level of sodium chloride. And I will say that has been the most effective strategy. We have also looked at replacement ingredients including potassium chloride. In my experience I have never really gone below about 1.75%. I have seen it as low as 1.5% and there are studies that show that as well. In the products I have worked with in wholesale bun/bread products we have not been able to get below 1.75% and that is where some whole sale bakeries today have landed at 1.8% or 1.75%. I have seen it as high as 2.5% in some whole grain and whole wheat products. It is added at the higher level because it in effort to mask that comes from the tannins from the bitterness. Our process has typically been a gradual reduction. Based on testing a 15% or less reduction does not create a noticeable difference in taste. We have made those changes allowed them to be in the market for a period of time and then continued the reduction as requested by our customers. Reducing sodium has worked. The best way to do it is to go down by 5%, gradually go down 5%, 10% so you create a consumer palate. If you change it right away people will notice the change you will shock them but if you gradually get them used to it 5%, 10% and 15% less then eventually people will adapt. When I did tests at 1.5% I lost the appearance of the product, totally different product coming out, nothing stopped the yeast, and the dough was running wild. We played

	around with temperature and humidity and used different starters but we found that the white baguette then started to taste like the sour dough baguette. Totally changed the product. Primarily removal from 2% to 1.8%. The reason we landed there was that we did several different tests going all the way down to 1.4% and as you took the salt out you saw the bread degrade because salt has a functionality with gluten to maintain cell structure so. And then I have worked with some salt replacers that earlier in this was early 2000's, the salt replacers were more chemically derived trying to replace the sodium and even the functionality had an off taste and an off flavour so really stayed away from any salt replacer until just recently we have been able to find some salt replacers that worked. you don't get the same gas retention in the cell structure it has a tendency to break down over time, it tends to dry out over time and becomes crumbly when you just take salt out and don't use replacers and it doesn't perform over the shelf-life probably on the second or third day you see degradation of the cell structure. We had the strategy that we actually reduced sodium gradually so the consumer wouldn't know the difference and we also had the strategy that we replaced the sodium to maintain the performance. When I say performance there are two things in bread. One is about the dough development, to control the yeast activity and the other one is flavour. The majority of the time we reduced the sodium, the first one to be noticed is the flavour and of course the performance part at the production level. You start to see a difference with more than 10% reduction with salt. For performance basically when you go below 1.7% in a bakers dosage in a bread application, you start to see differences We reduced sodium by primarily reducing the salt level in products The easiest way is if you remove salt, salt has been cheaper than any other ingredient, it used as a carrier and a filler. Amount of salt was driven by cost and flavour delivery as it can deliver flavour at a cheap price. Health concerns were never worried about. We don't have a defined level for removal it has been driven by sensory impact. From a

	processing perspective there is various level but it depends on the product and what can be achieved by blending longer to make up the difference. It is all about having good taste. Taste is number 1. We used both replacement of sodium and reduction. We reduced to a level that didn't have any impact on shelf-life or or texture. We used internal panels to confirm there was no difference in taste. We grouped the various products into families and used the same approach for each group as they were similar. This helped as we had 80-100 products we reduced sodium Removal and very little replacement
What ingredients did you use when you replaced sodium?	**Quotes from Participants**
	We used Saltwise including Trehalose and a combination of sodium chloride and potassium chloride and other flavours to help the flavour be better. Trehalose is a type of natural sugar. We used some potassium chloride but we didn't want to introduce potassium chloride into products because the perception of potassium chloride isn't that great but we did use a bit depending on the product. We had to add some other functional ingredients as well to functional ingredients at some places where we didn't want to effect the yield like some starches, some ingredients that are more functional, soya or other protein that we did. And we also used some flavours, to make sure that our taste was still there, natural flavours or we used a mushroom extract that we found as well that would enhance the flavour because it has kind of a umami, msg mimicking taste, so it would help the taste. When we did use replacements we used potassium chloride and in some cases masking agents. There hasn't been an adequate replacement ingredient around you know sodium chloride is a rather unique ingredient ah in terms of cost and efficacy, potassium chloride contributes some of the same functions but it also contributes a bitter after taste which can be negative from a sensory view point. One of the reasons we stuck with potassium chloride was that it was efficacious and of all the alternatives that was available it was the only one that was in striking distance of sodium chloride. A number of companies have put together ingredients that are supposed to help with the reduction of sodium chloride and I remember

	when I first looked at them, in many cases, the ingredients were 10X more expensive, 20X more expensive and 100X more expensive and to be used in a 1X1 ratio and so that was untenable from an economic view point Really until we started to use Nutek earlier this year we haven't been able to find a suitable replacement that would allow us to go below 1.8% sodium potassium chloride without using one or the other or both. The other thing you start to lose is flavour. We were able to reduce it by about 1/3rd in the formula, they claim and are confident that they can take 50% of it out, the sampling and testing that we did here, we were able to get 33% out We have also looked at replacement ingredients including potassium chloride, and a combination ingredient that included autolyzed yeast, natural flavours and ammonium chloride and it contributed salty flavour notes to the baked goods and bread and bun products is what we primarily tested it in. To date we haven't been replacing, we have simply been gradually removing and we have not gotten to a place with any of our development that has required a replacement to maintain the functional aspects of sodium in the bread. We have done some tests with Potassium Chloride and bean flours. We want to create simple natural ingredients. We don't want to add a bunch of different ingredients which may be worse than salt itself. You have to be careful about what you are putting in the product as it may be something that nobody had heard of. Soda Lo from Tate and Lyle, Nutek, Potassium chloride Potassium chloride and some artificial flavours for the flavour side. For the performance side there is a combination of enzymes basically it is one enzyme that helps with that that is called Xylanase and that enzyme can help develop the dough faster with what the salt is also going to give. There were three products we tried as replacers, calcium acid pyrophosphate, low sodium sea salt and potassium chloride. None of those three really gave us the result in terms of the flavour functionality.
How did you make your selection?	**Quotes from Participants**

	Selection was based on taste, cost and functional properties. We asked our network for solutions We used natural flavours to assist with the flavour removal with the Umami flavour, some starches, soya and other proteins to assist with the yield. We asked our existing suppliers and new suppliers to also provide us with solutions The preeminent consideration was food safety, so we would not go to any place with regards to the sodium chloride content if we felt it would compromise food safety so that was preeminent and then of course you know the sensory aspects and of course the third one in the case of private label products, would be whatever the particular customer desired and even discussions with customers we absolutely said in those instances where we felt where they wished to go it was a food safety compromise we absolutely said "no" we will not do it. The thing about salt it is a flavour enhancer, the buns are no longer sweet, you taste more off flavours in buns, bread particularly we are talking about hamburger buns and so that is why we stopped at 1.8 because commercially we couldn't produce product with less than that and still get functionality. The Nutek product which is a combination of potassium chloride and some other patent technologies was the first real substitute in baked goods were we were able to actually lower the sodium chloride to a level where we could say reduced salt. It brings up some other issues because it doesn't really clean the label because salt is just salt and now we have to put potassium chloride on the label so we don't know what the consumer might react to that but we do know that we reduced sodium. Potassium Chloride didn't have the same rheological properties, and it was found that it didn't have the same flavour properties, it left a more metallic and I guess more metallic off flavour than sodium chloride did. The most effective methodology that I have seen is a simple reduction in salt using a step down process to evaluate ah again the rheological properties in the dough and the finished quality aspects of lower salt from a flavour and texture stand point in a finished product. If you were reducing sodium in bread and you were at a 1.8 and you took it down to 1.7 or 1.6 and consumer started saying "wow did you do something to your product" they would take it back up to 1.8 to ensure that they

	felt that was the lowest they could go. Some companies did do panels but it was also driven by the consumer perception and consumer complaints When you do a reduction you lose the quality of the bread so we needed something to help the functionality piece and you also lose some flavour so with potassium chloride you are able to maintain the flavour and functionality. Whereas if you just pulled the salt out you would be fighting quality issues on an ongoing basis. Went with reduction as none of the replacements worked as well with the same clean label, cost or functionality.
Did you consider consumer perception of the ingredient statement when making your decision	**Quotes from Participants**
	Yes definitely and looked for ingredients that were consumer friendly. The overall goal now is the cleanest label possible. We went away from potassium chloride for years and went back to it as it came back to the functionality. Yes, we didn't want to add ingredients that were not suitable for the consumer, we wanted to have natural ingredients. We avoided hydrolyzed yeast extract, hydrolyzed vegetable protein, things like that because of the perception of the term hydrolyzed Yes definitely and looked for cleanest labels possible. The question as we posed it earlier, is the whole consumer perception in clean label, not talking about driving sales vs. motivation, I don't know the answer to a label that says "reduced salt" is going to be more preferable to the consumer vs. something that has 5 items on it (flour, water, sugar, salt) vs. if there is a preference to the consumer with a label that says reduced salt than one that has more items on it wheat starch, enzymes, potassium chloride. Tried Potassium chloride but I don't believe customers like it on the label. Definitely that plays a role that is why we had two options one that is cleaner label than the other, the customer would read the label and see something different there because there are some

	different strategies for reduction sodium content. Some people would mention and make claims about it and some people don't. Some people might think okay something is different or less good. So the lower the impact on the label the lower the impact on the product change as well. You are replacing salt with other ingredients that people might not know what it is especially if it is potassium chloride, they might not understand what that is doing in their bread application. Bread has a very clean ingredient dec. which plays an important role in it. Everyone is moving towards cleaner labels, to add sodium acid pyrophosphate to a label is not very enticing to a consumer is what we are finding, that was another reason that we didn't go down that road.
What communication strategies have you used to communicate the change in sodium (e.g., nutrition facts panel change, other advertising, media?	**Quotes from Participants**
	We don't advertise, any changes we made were silent and reflected on the nutrition facts panel in food service but for some retail customers we have made some packaging claims. When we grouped the sodium reduction with other ingredient changes we would advertise those. With sodium reduction we didn't really advertise it because there is a perception with the consumer side that if we reduce the sodium, it won't taste as good so that is not something that we advertised but for sure we did change the nutrition panel, we changed our information on all the pack. We didn't go at large and say we did reduce the sodium because we didn't want to impact the sales of our products. We did identify our sodium reduction through industry competitions but not to the consumer directly. When we removed salt, sodium chloride still appeared on the label but it might be in a lower position on the ingredient statement. In the few occasions that we did use potassium chloride the masking agents I think was labeled as flavour so in no case do I think we tread on any concerns from a consumer perception standpoint. There were only a few instances where the magnitude of reduction would allow us to make a front panel statement. So In most cases I would say the especially if we were dealing with a new product that we didn't have that product in the market place so it wasn't a

	reduction there was no basis that we could say x% reduction because the product didn't exist in the market. Through the Canadian Meat Council , there was a document that was put together and a number of companies made contributions in terms of educating, providing labels and front panel and back panel of particular products so that we did illustrate to the regulatory bodies that as an industry we were making progress I do not recall with any of the companies I worked with that there were any lower salt or lower sodium claims made unless that was the goal of the product and those products, there used to be some diet breads that were produced, that were smaller loaves of bread, they cut down the sugar, they cut down the salt and they just didn't last very well. From a flavour stand point they weren't very good We have not actively communicated changes in sodium. We have made gradual changes in our products and updated the nutritional facts panel accordingly but we have not drawn attention to the change None- Only changed the nutrition facts panel We never really advertised anything that we have done internally. It has been more about clean label for us and getting more natural rather than sodium reduction. We did update the nutrition facts tables. We changed the nutrition facts panel only. No other marketing.
What was the impact to taste with the sodium reduction strategy you used? Can you identify other barriers (e.g. Cost, ingredients?)	**Quotes from Participants**
	Some replacement ingredients worked very well. It was a Cadillac system and were very expensive and therefore cost was a barrier as customers were not willing to pay the extra cost. People are expecting the same great tasting product and it can vary slightly. We used other flavours/herbs to also season the product. For sure there was a reduction in the saltiness of the product, but the consumer taste has changed. Like when we were

	comparing the old product to the new proposed product people preferred the new product. They found the old product tasted too salty. We couldn't affect the yield so we wouldn't affect the cost of our product as we needed to stay cost competitive so that was one thing that we added some functional ingredients to make sure and that to say that we were working to make sure there was not a cost increase. So yes it was a challenge at some point to make sure we kept because salt has moisture retention so yes we did have some challenges there to keep the same price. We wanted to have a cleaner label as well so there were challenges with taste and performance as well. As you lower sodium chloride you lose listeria protection and as you well know, the listeria monocytogenes If one uses the 2016 guidelines as targets that, I believe you can make products that are satisfactory from a sensory view point. Now if you have an existing product in the market place and you reduce the sodium level, to hit the 2016, I think consumers would notice a difference. As you go out to do focus groups and if you ask people if they are interested in reducing sodium, everybody would probably say yes but then there was always a caveat, I want it to taste the same as my product always did. As we went more than that with the version of Nutek that we tested, this goes back maybe 6 months we lost functionality. They weren't inedible but they weren't the same. Functionally we still got a bun but it wasn't an exact match to the control. My concern over Nutek would be abundance of supply and availability of it in large quantities. Cost wise, salt is pretty cheap, I'm guessing you would have minimally a cost increase as you are trading your least expensive ingredient for something that is more expensive. It may not be significant in the cost of loaf of bread but next to water, salt is the cheapest thing you can put it. But probably you are going to impact cost. Source of supply, salt has an abundance of supply and you don't have to worry about it and then cost would be the barrier, as you take salt out, you lose power of the dough for overmixing/under mixing, hot temperatures, colder temperatures, your bandwidth narrows so exceptions that might occur will be more damaging than at a higher salt level. As you reduce salt, your proofing is quicker, less inhibited yeast activity. Salt come in many forms, we take calcium propionate there is salt in there as well and when we go to a more natural mold inhibitor, so as we reduce salt level our yeast activity goes up, we have faster fermentation and faster

	fermentation it can cause further issues down the road if it is not controlled With the gradual reduction there were no discernible differences in taste. We noticed differences in taste if the decrease was greater than 15%. There were no negative cost implications to employing this strategy. The natural starters will help a lot to enable some of the taste profile but again you can't go all the way down to 1.6. If you stayed at 1.8 it is a reasonable level to achieve the quality of the product and not change the taste too much and give the same product. Again anything beyond that I don't think is a good idea. Yeah it was upwards of 20 to 30 to 40% more (cost) to use replacers, they're very expensive. When you are looking at it on a per piece perspective it doesn't make that much of a difference but the cost of the ingredient is significant compared to salt. Reducing, flavour is bland at a certain level and functionality with gluten so that would be the only two I would say. Using replacers that would be another ingredient that we have to carry and then the cost would be the other barrier but from an actual flavour and functionality there are a few that work quite well. So with replacement you need to either to increase the price of the product or your decrease your margins. The majority of the case we try and pass the price increase along. So that is why communication is an important part because you need to have a benefit to the consumer as well and sometimes the benefit is there and the consumer understands that okay I have lower sodium product with the same flavour profile and I am interested to pay that because I am concerned about my health and what I eat but for other consumers they would say okay I don't have a sodium problem or a health related problem with salt and I want to pay the same for my day to day bread so you might lose some customers with the price increase. Another issue with salt replacers is that they are very cost prohibitive. Customers always want a lot but they are not willing to pay for it. If you can't market the reason for the change it makes it cost prohibitive
What worked well? Please elaborate	**Quotes from participants**

	Removal of salt over time and replacement with potassium chloride. Challenges were to maintain cost, taste and clean label. It was a mix of everything. It was a reduction for most of the product and some replacement for others and new ingredients for others, so it was a mix depending on the families of product. In our particular case my view that each time one did it via stealth it meant to say that they were now from an administrative view point there were new formulations because the formula now was different and there was an administrative load that was associated with that and quite frankly there was the likelihood of having to develop new package labelling because your nutrition facts panel may have changed and that given the number of SKU's that we had, that would add up to a quite frankly an onerous administrative load so in many cases we just went straight to the 2016 guidelines and didn't do the 5%, 5% and 5% that some people have done. Go straight to the 2016 and it works best when you don't have an existing product that people are going to make comparisons against. In essence you are establishing the sensory guidelines at day one. Our first approach would be to reduce salt to maintain the same function and flavour, then if we need to go further, it would be how natural how clean are the replacers and what other implications come with those because we don't know. In classic white bread or even whole wheat bread or yeast raised, something where you are trying to get volume out of your gluten structure requires a certain amount of sodium chloride in order for that process to work and so you can't take 25% of the salt out and have it look like the control. Primary strategy has been a step down in usage level of sodium chloride. And I will say that has been the most effective strategy. Gradually reducing sodium has allowed for fairly easy adoption. The product still tastes great and performs well. Reducing to 1.8% anything beyond that there were processing issues.

	Gradual salt reduction to a point, then use of sodium replacements to get to larger percentages of reduction. What worked well was to just reduce, no communication. Reducing sodium to a point.
Which of these strategies, and approaches would you recommend to others who are undertaking sodium reduction	**Quotes from Participants**
	The best thing that has worked well is just to remove salt and then also potassium chloride and a reduction over time as well to allow the pallet to adjust. They have to know their product and what the role of salt is within their products, go into categories is a good approach, go in methodical approach by families with solution and they have to think about shelf-life and cost as well to make sure it fits with their category of product. Salt is a very functional ingredient not just for taste, we use salt for what is needed everything we add to the product adds cost, we wouldn't add salt just to add salt, so it is not that simple to remove it for example in cheese and breads and things it is a big challenge. Flavour is obviously one component but food safety is a very, very, very large component. So if anybody out there is in the perishable products business, and perishable products where you can have risks associated with Lm, salmonella or E.coli I would say to them, tread very carefully. If you don't know why you have so much salt in there in the first place I would start taking it out to when it made a difference to me, if I was in the consumer business and it was my own brand I would make sure I was happy with it. If it isn't significant enough, I would engage Nutek people to see what you can do to take it down further. I would also engage consumer research to engage and understand if potassium chloride has an impact on the label. I would definitely recommend a step down approach, and looking at what is the end goal. Obviously it is going to be lower the sodium content, the other thing I would recommend is that they look at the other ingredients that may contain

	sodium within their formula, what else is contributing to the overall sodium content in those products. Having done a lot of work with chemically leavened products I know that you ought to take a look at the sodium that is present in the baking powders that you are using so rather than just looking at added salt, what are the other ingredients that you are putting in that have salt in them that are potentially that contributing to the overall sodium content of that product. Gradually reducing sodium I think the main thing is to make sure you really understand your flavour profile and what your current attributes of your food are so you don't miss something along the way so you have to be really calibrated to your sensory tastes and texture and make sure that as you move through it and I would recommend that you move through it slowly with small steps as far as reduction and then small steps as you replace with something else just to make sure you don't. The last thing you want to do is to not know what you are sending out so make sure you go with smaller steps, make sure that the shelf-life validations are completed, make sure shelf-life and sensory profile is where you want it to be. I know there has been some other companies out there that have sacrificed flavour and some functionality to get to that magical, whatever it is 50% reduction but I don't know what that did to their sales but I wouldn't buy it. Understand the content they would like to achieve, what is the target level, what the level they have at the moment, if the reduction would be greater than 10% then we would talk about replacers. The lean bread is easier to achieve as the salt content on those is already lower but if you go for a multigrain or wholegrain bread, you normally have a higher content of salt which is for the flavour profile to enhance especially if you use whole grain flours or grains and seeds you have a larger content of sodium on those ones it is more of a challenge to get a nice flavour profile by achieving the guidelines for the sodium content. Really start simple, see how far you can go with just reducing salt without adversely affecting the flavour profile and also the yeast leavening system.

Appendix G: Triangulation Chart of Themes Identified for Sodium Reduction in Breads and Processed Poultry Products.

Audit trail of themes Identified for Sodium Reduction in Breads and Processed Poultry Products and sample/selected quotes for each theme*

Theme	**Quotes from participants**	**Documents**
Strategies used when reducing sodium in bread products	It was through reduction rather than replacement. Early on we tried to replace sodium with potassium chloride but it gave us a bitter flavour so it wouldn't functionally work as well several years ago but what we did try to do was more or less how much salt we can take out. You may lose flavour or lose functionality. We used reduction to 1.8% and most of our formulas now we are at 1.8 on a flour basis on a baker's flour basis. Getting much below that, you start to see a degradation in functionality, the doughs become weaker, harder to manage, especially hamburger buns, heavy breads you may be able to go a little lower because you are not required to have the same volume as you typically would in white bread. The primary strategy has been a step down in usage level of sodium chloride. And I will say that has been the most effective strategy. We have also looked at replacement ingredients including potassium chloride. In my experience I have never really gone below about 1.75%. I have seen it as low as 1.5% and there are studies that show that as well. In the products I have worked with in wholesale bun/bread products we have not been able to get below 1.75% and that is where some whole sale bakeries today have landed at 1.8% or 1.75%. I have seen it as high as 2.5% in some whole grain and whole wheat products. It is	**Canadian Meat Council Fact Sheet on Sodium in processed meat products** Gradual reduction in sodium levels is the best strategy to alleviate related costs **Baking Association of Canada Sodium Reduction Successes and Challenges** Most members have been reducing the sodium content gradually and without replacers in order to maintain a clean label.

	added at the higher level because it in effort to mask that comes from the tannins from the bitterness. Our process has typically been a gradual reduction. Based on testing a 15% or less reduction does not create a noticeable difference in taste. We have made those changes allowed them to be in the market for a period of time and then continued the reduction as requested by our customers. Reducing sodium has worked. The best way to do it is to go down by 5%, gradually go down 5%, 10% so you create a consumer palate. If you change it right away people will notice the change you will shock them but if you gradually get them used to it 5%, 10% and 15% less then eventually people will adapt. When I did tests at 1.5% I lost the appearance of the product, totally different product coming out, nothing stopped the yeast, and the dough was running wild. We played around with temperature and humidity and used different starters but we found that the white baguette then started to taste like the sour dough baguette. Totally changed the product. Primarily removal from 2% to 1.8%. The reason we landed there was that we did several different tests going all the way down to 1.4% and as you took the salt out you saw the bread degrade because salt has a functionality with gluten to maintain cell structure so. And then I have worked with some salt replacers that earlier in this was early 2000's, the salt replacers were more chemically derived trying to	

	replace the sodium and even the functionality had an off taste and an off flavour so really stayed away from any salt replacer until just recently we have been able to find some salt replacers that worked. you don't get the same gas retention in the cell structure it has a tendency to break down over time, it tends to dry out over time and becomes crumbly when you just take salt out and don't use replacers and it doesn't perform over the shelf-life probably on the second or third day you see degradation of the cell structure. We had the strategy that we actually reduced sodium gradually so the consumer wouldn't know the difference and we also had the strategy that we replaced the sodium to maintain the performance. When I say performance there are two things in bread. One is about the dough development, to control the yeast activity and the other one is flavour. The majority of the time we reduced the sodium, the first one to be noticed is the flavour and of course the performance part at the production level. You start to see a difference with more than 10% reduction with salt. For performance basically when you go below 1.7% in a bakers dosage in a bread application, you start to see differences We reduced sodium by primarily reducing the salt level in products The easiest way is if you remove salt, salt has been cheaper than any other ingredient, it used as a carrier and a filler. Amount of salt was driven by	

	cost and flavour delivery as it can deliver flavour at a cheap price. Health concerns were never worried about. We don't have a defined level for removal it has been driven by sensory impact. From a processing perspective there is various level but it depends on the product and what can be achieved by blending longer to make up the difference. It is all about having good taste. Taste is number 1. We used both replacement of sodium and reduction. We reduced to a level that didn't have any impact on shelf-life or or texture. We used internal panels to confirm there was no difference in taste. We grouped the various products into families and used the same approach for each group as they were similar. This helped as we had 80-100 products we reduced sodium Removal and very little replacement	
What ingredients did you use when you replaced sodium?	**Quotes from Participants**	**Documents**
	We used Saltwise including Trehalose and a combination of sodium chloride and potassium chloride and other flavours to help the flavour be better. Trehalose is a type of natural sugar. We used some potassium chloride but we didn't want to introduce potassium chloride into products because the perception of potassium chloride isn't that great but we did use a bit depending on the product. We had to add some other functional ingredients as well to functional ingredients at some places where we didn't want to effect the yield like some starches,	**Canadian Meat Council Fact Sheet on Sodium in processed meat products** Gradual reduction in sodium levels is the best strategy to alleviate related costs. One of the most common and economical replacements for sodium in processed meat products costs seven times more than sodium chloride and still has flavour and texture functionality difficulties.

	some ingredients that are more functional, soya or other protein that we did. And we also used some flavours, to make sure that our taste was still there, natural flavours or we used a mushroom extract that we found as well that would enhance the flavour because it has kind of a umami, msg mimicking taste, so it would help the taste. When we did use replacements we used potassium chloride and in some cases masking agents. There hasn't been an adequate replacement ingredient around you know sodium chloride is a rather unique ingredient ah in terms of cost and efficacy, potassium chloride contributes some of the same functions but it also contributes a bitter after taste which can be negative from a sensory view point. One of the reasons we stuck with potassium chloride was that it was efficacious and of all the alternatives that was available it was the only one that was in striking distance of sodium chloride. A number of companies have put together ingredients that are supposed to help with the reduction of sodium chloride and I remember when I first looked at them, in many cases, the ingredients were 10X more expensive, 20X more expensive and 100X more expensive and to be used in a 1X1 ratio and so that was untenable from an economic view point Really until we started to use Nutek earlier this year we haven't been able to find a suitable replacement that would allow us to go below 1.8% sodium potassium chloride without using one or the other or both. The other thing you start to lose is flavour.	**Baking Association of Canada Sodium Reduction Successes and Challenges** Most members have been reducing the sodium content gradually and without replacers in order to maintain a clean label

	We were able to reduce it by about 1/3rd in the formula, they claim and are confident that they can take 50% of it out, the sampling and testing that we did here, we were able to get 33% out We have also looked at replacement ingredients including potassium chloride, and a combination ingredient that included autolyzed yeast, natural flavours and ammonium chloride and it contributed salty flavour notes to the baked goods and bread and bun products is what we primarily tested it in. To date we haven't been replacing, we have simply been gradually removing and we have not gotten to a place with any of our development that has required a replacement to maintain the functional aspects of sodium in the bread. We have done some tests with Potassium Chloride and bean flours. We want to create simple natural ingredients. We don't want to add a bunch of different ingredients which may be worse than salt itself. You have to be careful about what you are putting in the product as it may be something that nobody had heard of. Soda Lo from Tate and Lyle, Nutek, Potassium chloride Potassium chloride and some artificial flavours for the flavour side. For the performance side there is a combination of enzymes basically it is one enzyme that helps with that that is called Xylanase and that enzyme can help develop the dough faster with what the salt is also going to give.	

	There were three products we tried as replacers, calcium acid pyrophosphate, low sodium sea salt and potassium chloride. None of those three really gave us the result in terms of the flavour functionality.	
How did you make your selection?	**Quotes from Participants**	**Documents**
	Selection was based on taste, cost and functional properties. We asked our network for solutions We used natural flavours to assist with the flavour removal with the Umami flavour, some starches, soya and other proteins to assist with the yield. We asked our existing suppliers and new suppliers to also provide us with solutions The preeminent consideration was food safety, so we would not go to any place with regards to the sodium chloride content if we felt it would compromise food safety so that was preeminent and then of course you know the sensory aspects and of course the third one in the case of private label products, would be whatever the particular customer desired and even discussions with customers we absolutely said in those instances where we felt where they wished to go it was a food safety compromise we absolutely said "no" we will not do it. The thing about salt it is a flavour enhancer, the buns are no longer sweet, you taste more off flavours in buns, bread particularly we are talking about hamburger buns and so that is why we stopped at 1.8 because commercially we couldn't produce	**Baking Association of Canada Sodium Reduction Successes and Challenges** A challenge in reducing sodium is that one solution does not fit the diverse offerings of styles of baked products. Sodium reduction strategies need to address all the possible sources of sodium. The first step may be in the reduction of sodium chloride which can be done by identifying a minimum level of sodium chloride that has acceptable flavour and functionality. Once a salt level is established, other sources of sodium can be systematically reduced based on correlating the importance of a specific attribute as it relates to the specific sodium ingredient.

	product with less than that and still get functionality. The Nutek product which is a combination of potassium chloride and some other patent technologies was the first real substitute in baked goods were we were able to actually lower the sodium chloride to a level where we could say reduced salt. It brings up some other issues because it doesn't really clean the label because salt is just salt and now we have to put potassium chloride on the label so we don't know what the consumer might react to that but we do know that we reduced sodium. Potassium Chloride didn't have the same rheological properties, and it was found that it didn't have the same flavour properties, it left a more metallic and I guess more metallic off flavour than sodium chloride did. The most effective methodology that I have seen is a simple reduction in salt using a step down process to evaluate ah again the rheological properties in the dough and the finished quality aspects of lower salt from a flavour and texture stand point in a finished product. If you were reducing sodium in bread and you were at a 1.8 and you took it down to 1.7 or 1.6 and consumer started saying "wow did you do something to your product" they would take it back up to 1.8 to ensure that they felt that was the lowest they could go. Some companies did do panels but it was also driven by the consumer perception and consumer complaints When you do a reduction you lose the quality of the bread so we needed something to help the functionality piece and you also lose some flavour	

	so with potassium chloride you are able to maintain the flavour and functionality. Whereas if you just pulled the salt out you would be fighting quality issues on an ongoing basis. Went with reduction as none of the replacements worked as well with the same clean label, cost or functionality.	
Did you consider consumer perception of the ingredient statement when making your decision	**Quotes from Participants**	
	Yes definitely and looked for ingredients that were consumer friendly. The overall goal now is the cleanest label possible. We went away from potassium chloride for years and went back to it as it came back to the functionality. Yes, we didn't want to add ingredients that were not suitable for the consumer, we wanted to have natural ingredients. We avoided hydrolyzed yeast extract, hydrolyzed vegetable protein, things like that because of the perception of the term hydrolyzed Yes definitely and looked for cleanest labels possible. The question as we posed it earlier, is the whole consumer perception in clean label, not talking about driving sales vs. motivation, I don't know the answer to a label that says "reduced salt" is going to be more preferable to the consumer vs. something that has 5 items on it (flour, water, sugar, salt) vs. if there is a preference to the	

	consumer with a label that says reduced salt than one that has more items on it wheat starch, enzymes, potassium chloride. Tried Potassium chloride but I don't believe customers like it on the label. Definitely that plays a role that is why we had two options one that is cleaner label than the other, the customer would read the label and see something different there because there are some different strategies for reduction sodium content. Some people would mention and make claims about it and some people don't. Some people might think okay something is different or less good. So the lower the impact on the label the lower the impact on the product change as well. You are replacing salt with other ingredients that people might not know what it is especially if it is potassium chloride, they might not understand what that is doing in their bread application. Bread has a very clean ingredient dec. which plays an important role in it. Everyone is moving towards cleaner labels, to add sodium acid pyrophosphate to a label is not very enticing to a consumer is what we are finding, that was another reason that we didn't go down that road.	
What communication strategies have you used to communicate the change in sodium (e.g., nutrition facts panel change, other	**Quotes from Participants**	**Documents**

advertising, media?		
	We don't advertise, any changes we made were silent and reflected on the nutrition facts panel in food service but for some retail customers we have made some packaging claims. When we grouped the sodium reduction with other ingredient changes we would advertise those. With sodium reduction we didn't really advertise it because there is a perception with the consumer side that if we reduce the sodium, it won't taste as good so that is not something that we advertised but for sure we did change the nutrition panel, we changed our information on all the pack. We didn't go at large and say we did reduce the sodium because we didn't want to impact the sales of our products. We did identify our sodium reduction through industry competitions but not to the consumer directly. When we removed salt, sodium chloride still appeared on the label but it might be in a lower position on the ingredient statement. In the few occasions that we did use potassium chloride the masking agents I think was labeled as flavour so in no case do I think we tread on any concerns from a consumer perception standpoint. There were only a few instances where the magnitude of reduction would allow us to make a front panel statement. So in most cases I would say the especially if we were dealing with a new product that we didn't have that product in the market place so it wasn't a reduction there was no basis that we could say x% reduction because the product didn't exist in the	**MINTEL** Despite increased awareness about the risks of too much sodium in consumers' diets and pledges from governments around the world to reduce salt levels in food, products with low/no/reduced sodium claims have seen some decline over the past years Many food brands are already introducing step-by-step salt reduction programs that gradually reduce the salt content of their products – a strategy often called "stealth health", as the incremental removal of sodium can be carried out over a period of time to help the consumer to become accustomed to the changed flavour profile, without the need to flag that up prominently on-pack and thus deter consumers who may perceive "less taste".

	market. Through the Canadian Meat Council, there was a document that was put together and a number of companies made contributions in terms of educating, providing labels and front panel and back panel of particular products so that we did illustrate to the regulatory bodies that as an industry we were making progress I do not recall with any of the companies I worked with that there were any lower salt or lower sodium claims made unless that was the goal of the product and those products, there used to be some diet breads that were produced, that were smaller loaves of bread, they cut down the sugar, they cut down the salt and they just didn't last very well. From a flavour stand point they weren't very good We have not actively communicated changes in sodium. We have made gradual changes in our products and updated the nutritional facts panel accordingly but we have not drawn attention to the change None- Only changed the nutrition facts panel We never really advertised anything that we have done internally. It has been more about clean label for us and getting more natural rather than sodium reduction. We did update the nutrition facts tables. We changed the nutrition facts panel only. No other marketing.	
What was the impact to taste with the	**Quotes from Participants**	**Documents**

sodium reduction strategy you used? Can you identify other barriers (e.g. Cost, ingredients?)		
	Some replacement ingredients worked very well. It was a Cadillac system and were very expensive and therefore cost was a barrier as customers were not willing to pay the extra cost. People are expecting the same great tasting product and it can vary slightly. We used other flavours/herbs to also season the product. For sure there was a reduction in the saltiness of the product, but the consumer taste has changed. Like when we were comparing the old product to the new proposed product people preferred the new product. They found the old product tasted too salty. We couldn't affect the yield so we wouldn't affect the cost of our product as we needed to stay cost competitive so that was one thing that we added some functional ingredients to make sure and that to say that we were working to make sure there was not a cost increase. So yes it was a challenge at some point to make sure we kept because salt has moisture retention so yes we did have some challenges there to keep the same price. We wanted to have a cleaner label as well so there were challenges with taste and performance as well. As you lower sodium chloride you lose listeria protection and as you well know, the listeria monocytogenes If one uses the 2016 guidelines as targets	**Canadian Meat Council Fact Sheet on Sodium in processed meat products** Salt is an essential ingredient in the processing of many foods. In the case of meat products, it is used as flavouring, a preservative and an antibacterial agent; it also has many positive effects on the texture and structure of foods. Salt, or sodium chloride, is a well known anti-microbial and is therefore a contributor worldwide to both food safety and product shelf-life. Processed meat products with reduced levels of sodium have been available to Canadian consumers for over 20 years. More research is needed to determine the appropriate formulations and other alternatives that will deliver safe products and at the same time will be acceptable to consumers. As sodium salts are replaced by other ingredients, taste and

	that, I believe you can make products that are satisfactory from a sensory view point. Now if you have an existing product in the market place and you reduce the sodium level, to hit the 2016, I think consumers would notice a difference. As you go out to do focus groups and if you ask people if they are interested in reducing sodium, everybody would probably say yes but then there was always a caveat, I want it to taste the same as my product always did. As we went more than that with the version of Nutek that we tested, this goes back maybe 6 months we lost functionality. They weren't inedible but they weren't the same. Functionally we still got a bun but it wasn't an exact match to the control. My concern over Nutek would be abundance of supply and availability of it in large quantities. Cost wise, salt is pretty cheap, I'm guessing you would have minimally a cost increase as you are trading your least expensive ingredient for something that is more expensive. It may not be significant in the cost of loaf of bread but next to water, salt is the cheapest thing you can put it. But probably you are going to impact cost. Source of supply, salt has an abundance of supply and you don't have to worry about it and then cost would be the barrier, as you take salt out, you lose power of the dough for overmixing/under mixing, hot temperatures, colder temperatures, your bandwidth narrows so exceptions that might occur will be more damaging than at a higher salt level. As you reduce salt, your proofing is quicker, less inhibited yeast activity. Salt come in many forms, we take calcium propionate there is salt in	texture of processed meat products will change **Baking Association of Canada Sodium Reduction Successes and Challenges** Two concerns identified by members include the crumble quality of the bread and the shortened lifespan of the product resulting in earlier development of mould. Another issue is consumer acceptance; demonstrated by the introduction of new products with a low sodium that did not result in expected sales and were subsequently removed from the market. Most members have been reducing the sodium content gradually and without replacers in order to maintain a clean label.

	there as well and when we go to a more natural mold inhibitor, so as we reduce salt level our yeast activity goes up, we have faster fermentation and faster fermentation it can cause further issues down the road if it is not controlled With the gradual reduction there were no discernible differences in taste. We noticed differences in taste if the decrease was greater than 15%. There were no negative cost implications to employing this strategy. The natural starters will help a lot to enable some of the taste profile but again you can't go all the way down to 1.6. If you stayed at 1.8 it is a reasonable level to achieve the quality of the product and not change the taste too much and give the same product. Again anything beyond that I don't think is a good idea. Yeah it was upwards of 20 to 30 to 40% more (cost) to use replacers, they're very expensive. When you are looking at it on a per piece perspective it doesn't make that much of a difference but the cost of the ingredient is significant compared to salt. Reducing, flavour is bland at a certain level and functionality with gluten so that would be the only two I would say. Using replacers that would be another ingredient that we have to carry and then the cost would be the other barrier but from an actual flavour and functionality there are a few that work quite well. So with replacement you need to either to increase the price of the product or your decrease your margins. The majority of the case we	

	try and pass the price increase along. So that is why communication is an important part because you need to have a benefit to the consumer as well and sometimes the benefit is there and the consumer understands that okay I have lower sodium product with the same flavour profile and I am interested to pay that because I am concerned about my health and what I eat but for other consumers they would say okay I don't have a sodium problem or a health related problem with salt and I want to pay the same for my day to day bread so you might lose some customers with the price increase. Another issue with salt replacers is that they are very cost prohibitive. Customers always want a lot but they are not willing to pay for it. If you can't market the reason for the change it makes it cost prohibitive	
What worked well? Please elaborate	**Quotes from participants**	**Documents**
	Removal of salt over time and replacement with potassium chloride. Challenges were to maintain cost, taste and clean label. It was a mix of everything. It was a reduction for most of the product and some replacement for others and new ingredients for others, so it was a mix depending on the families of product. In our particular case my view that each time one did it via stealth it meant to say that they were now from an administrative view point there were new formulations because the formula now was different and there was an administrative load that was associated with that and quite frankly	**Canadian Meat Council Fact Sheet on Sodium in processed meat products** Gradual reduction in sodium levels is the best strategy to alleviate related costs. One of the most common and economical replacements for sodium in processed meat products costs seven times more than sodium chloride and still has flavour and texture functionality difficulties. Other food safety tools to the use of

	there was the likelihood of having to develop new package labelling because your nutrition facts panel may have changed and that given the number of SKU's that we had, that would add up to a quite frankly an onerous administrative load so in many cases we just went straight to the 2016 guidelines and didn't do the 5%, 5% and 5% that some people have done. Go straight to the 2016 and it works best when you don't have an existing product that people are going to make comparisons against. In essence you are establishing the sensory guidelines at day one. Our first approach would be to reduce salt to maintain the same function and flavour, then if we need to go further, it would be how natural how clean are the replacers and what other implications come with those because we don't know. In classic white bread or even whole wheat bread or yeast raised, something where you are trying to get volume out of your gluten structure requires a certain amount of sodium chloride in order for that process to work and so you can't take 25% of the salt out and have it look like the control. Primary strategy has been a step down in usage level of sodium chloride. And I will say that has been the most effective strategy. Gradually reducing sodium has allowed for fairly easy adoption. The product still tastes great and performs well. Reducing to 1.8% anything beyond that there were processing issues.	salt, such as post-packaged high pressure treatment equipment or in-package heat treatment, add to processing costs

	Gradual salt reduction to a point, then use of sodium replacements to get to larger percentages of reduction. What worked well was to just reduce, no communication. Reducing sodium to a point.	
Which of these strategies, and approaches would you recommend to others who are undertaking sodium reduction	**Quotes from Participants**	**Documents**
	The best thing that has worked well is just to remove salt and then also potassium chloride and a reduction over time as well to allow the pallet to adjust. They have to know their product and what the role of salt is within their products, go into categories is a good approach, go in methodical approach by families with solution and they have to think about shelf-life and cost as well to make sure it fits with their category of product. Salt is a very functional ingredient not just for taste, we use salt for what is needed everything we add to the product adds cost, we wouldn't add salt just to add salt, so it is not that simple to remove it for example in cheese and breads and things it is a big challenge. Flavour is obviously one component but food safety is a very, very, very large component. So if anybody out there is in the perishable products business, and perishable products where you can have risks associated	**Baking Association of Canada Sodium Reduction Successes and Challenges** Sodium reduction strategies need to address all the possible sources of sodium. The first step may be in the reduction of sodium chloride which can be done by identifying a minimum level of sodium chloride that has acceptable flavour and functionality. Once a salt level is established, other sources of sodium can be systematically reduced based on correlating the importance of a specific attribute as it relates to the specific sodium ingredient. The extent to which some products are able to reduce the sodium content in order to meet Health Canada's

	with Lm, salmonella or E.coli I would say to them, tread very carefully. If you don't know why you have so much salt in there in the first place I would start taking it out to when it made a difference to me, if I was in the consumer business and it was my own brand I would make sure I was happy with it. If it isn't significant enough, I would engage Nutek people to see what you can do to take it down further. I would also engage consumer research to engage and understand if potassium chloride has an impact on the label. I would definitely recommend a step down approach, and looking at what is the end goal. Obviously it is going to be lower the sodium content, the other thing I would recommend is that they look at the other ingredients that may contain sodium within their formula, what else is contributing to the overall sodium content in those products. Having done a lot of work with chemically leavened products I know that you ought to take a look at the sodium that is present in the baking powders that you are using so rather than just looking at added salt, what are the other ingredients that you are putting in that have salt in them that are potentially that contributing to the overall sodium content of that product. Gradually reducing sodium I think the main thing is to make sure you really understand your flavour profile and what your current attributes of your food are so you don't miss something along the way so you have to be really calibrated to your sensory tastes and texture and	guidance benchmark levels is unknown and requires further discussion.

	make sure that as you move through it and I would recommend that you move through it slowly with small steps as far as reduction and then small steps as you replace with something else just to make sure you don't. The last thing you want to do is to not know what you are sending out so make sure you go with smaller steps, make sure that the shelf-life validations are completed, make sure shelf-life and sensory profile is where you want it to be. I know there has been some other companies out there that have sacrificed flavour and some functionality to get to that magical, whatever it is 50% reduction but I don't know what that did to their sales but I wouldn't buy it. Understand the content they would like to achieve, what is the target level, what the level they have at the moment, if the reduction would be greater than 10% then we would talk about replacers. The lean bread is easier to achieve as the salt content on those is already lower but if you go for a multigrain or wholegrain bread, you normally have a higher content of salt which is for the flavour profile to enhance especially if you use whole grain flours or grains and seeds you have a larger content of sodium on those ones it is more of a challenge to get a nice flavour profile by achieving the guidelines for the sodium content. Really start simple, see how far you can go with just reducing salt without adversely affecting the flavour profile and also the yeast leavening system.	

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