Cookbooks as cultural indicators: An examination of protein consumption trends in North America

by

Makayla Mosher

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Abstract

The production of animal-derived products from cattle, pigs, poultry, and fish has negative impacts on the environment. These negative effects such as climate change and eutrophication are being driven by consumer demand. As population increases, demand for animal protein increases. Demand, however, is increasing in excess of population growth. It is important to understand why animal protein consumption is increasing in excess of population growth in order to predict and, if possible, limit negative impacts on the environment. This study seeks to document whether there has been a change in what North American society considers a "typical" portion of animal protein over the past 100 years. Cookbooks were used to collect information on what authors and readers of these books understood as an acceptable serving size of protein in the year the book was published or printed. Documenting the trend demonstrated that portion sizes in the recipes examined have, in fact, been decreasing. This suggests that increased protein consumption may be caused by factors such as increasing meal frequency rather than portion size. Further studies should be done to examine the frequency of meals being eaten containing animal protein as this is likely contributing to the increase.

Chapter 1: Problem Definition

INTRODUCTION

Human activities have had large impacts on the environment at local to global scales. Biodiversity loss, food insecurity, climate change, and ecosystem degradation are among the results of human consumption. Human food provisioning in particular is a major driver of these effects. Processes, both direct and indirect, involving the production, transport and consumption of food products have had negative effects on the environment (FAO, 2013). As a growing population, humans have created a global food system that has increasing annual outputs. Demand for food outputs is growing faster than human population is growing:

> Food production has outpaced population, chiefly as a result of the development and use of improved plant varieties, major increases in the use of nitrogen, potassium and phosphorus fertilizers, a doubling of the irrigated area, more effective control of insects and diseases, improved strains of livestock and poultry, and wider use of nutritionally balanced feeds. (Gilland, 2002, p.47-48)

More food is grown every year to meet the needs of earth's population, therefore, it is important to consider the environmental cost of the food that is produced.

The impacts of the global food system become more complex when we consider nutrition. Protein, for example, is highly important for promoting and maintaining adequate health in all ages of people. There are populations on earth today that have low protein consumption per capita, which results in malnutrition (FAO, 2013). The amount of protein needed to sustain an individual, or their biological need, varies based on their age, weight, gender, lifestyle and climate they live in. On average, "The intake of 0.75 g of protein/kg body weight estimated as the safe level for adults…" (FAO Agriculture and Consumer Protection, 1985). An estimated 2 billion people on earth suffer from micronutrient deficiencies. Nutrients they lack include protein, fat, and carbohydrates (FAO, 2013). Annual consumption of protein globally per capita, however, is increasing. It is increasing in excess of global population growth estimates, and is expected to double from 2000 levels by 2050 (Pelletier & Tyedmers, 2010). This would suggest that a large fraction of humanity currently consumes protein in excess of their biological need.

Overconsumption of protein in the Global North can be studied as a cultural phenomenon. Overconsumption is a trend apparent in affluent societies as, “A diet containing a relatively high proportion of animal products is preferred by almost all who can afford it” (Gilland, 2002, p.48). The act of food preparation and consumption are symbolic and they represent the food culture of the region or nation (Mintz, 1996). These acts are recorded in recipes and cookbooks, which can be studied to understand the traditions and eating habits of different regions over time. (Billing & Sherman, 1998). The cultural perception of an adequate amount of protein could, therefore, be recorded in a recipe. How this perception changes over time can affect nutrition, consumption and environmental impacts of the food industry.

Within food provisioning, nutritional components of food products are not driving the environmental impacts equally. For example, production of soy bean protein is less environmentally impactful than the equivalent production of animal protein when considering the release of greenhouse gases (GHGs) into the environment:

> The range of impacts associated with achieving United States Department of Agriculture (USDA) recommendations for kilogram per capita/year protein consumption levels when derived in entirety from either meat/eggs and dairy (livestock scenario), or from soybeans (soy protein scenario), for global populations in 2050, spans almost two orders of magnitude. (Pelletier & Tyedmers, 2010, p.18372)

Allison et al. suggest an increase in mean surface temperature of the earth over 2 °C dangerous (Pelletier & Tyedmers, 2010). Meeting the livestock protein demands projected by the Food and Agriculture Organization (FAO) for 2050 will emit enough GHGs to encourage an increase of more than 2°C. This demand could be satisfied with legume-based protein production, such as soybeans. Soybean protein production would emit amounts of GHGs that could be sustainable within this temperature barrier (Pelletier & Tyedmers, 2010). The cost of meeting protein demand through animal production (livestock) is evidently more impactful. Even given this understanding, demand for animal protein moving forward far exceeds the demand for plant protein (Pelletier & Tyedmers, 2010). Animal protein is resource intensive and also in high demand.

Given the significant impacts of the FAO's projection on the environment, it is important to better understand the cultural trend that is leading the global food system towards increased livestock production. Human population growth combined with current consumption habits surrounding animal protein is evidently unsustainable as global nutrition needs are not being met and yet animal protein output is increasing (FAO, 2013). An increase in per capita demand for animal protein in an affluent society is, therefore, the topic of research for this study.

PURPOSE

The purpose of this study is to assess whether there has been a cultural shift towards eating larger portion sizes of animal protein in North America over the last century. Through the examination of cookbooks, data has been collected on the changing amount of grams of animal protein in individual serving sizes over the last century. Previous studies have looked at increased consumption of food goods in North America. A study done by Swartz and Byrd-Bredbenner demonstrated the change in young adults understanding of portion size changed significantly in just two decades (Swartz & Byrd-Brenner, 2006). Using cookbooks to understand increasing consumption trends was a useful strategy in Wansink and Payne's study, where they concluded, "Calorie density and serving sizes in recipes from *The Joy of Cooking* have increased since 1936” (Wansink & Payne, 2009, p.291). Studies such as this analyze the impact these habits have on human health. This study provides insight into the changing cultural trends, by focusing on a particularly environmentally impactful nutrient: protein. Ultimately, this study explores the possibility that culture perceptions of acceptable protein portion sizes could be fueling the increased demand for animal protein in North America.

RESEARCH QUESTION

Is there a cultural trend apparent in the last century in North America of increasing animal-derived protein portion sizes?

Chapter 2: Literature Review

The following is a review of the literature pertaining to protein consumption. After collecting the literature, it was clear there were several lenses under which this phenomenon may be viewed. This review is, therefore, broken up into four sections that cover the different scales and scopes of the problems surrounding protein consumption.

GLOBAL FOOD CONSUMPTION

The amount of food being consumed each year on global basis is increasing. The development of the agricultural industry and global trade has supported population growth since its induction from humanity's hunter gatherer societies. Subsequently, this population growth has fueled the need for more food to support the population in terms of nutrition and demand (Helms, 2004). Technology has allowed the global food industry to increase its outputs through the use of technology such as pesticides, genetically modified crops and fertilizers. Events such as the Green Revolution have spread these technologies globally. These trends have resulted in the increased manufacturing of food products at a rate which is faster than the human population is growing (Gilland, 2002). Despite this, much of the global population suffers from malnourishment and food insecurity (Gani & Prasad, 2007).

Alleviating malnutrition involves understanding all components of the global food system, including consumption trends. Changes in nutrition are fueled by consumption trends in the global food system: "New modes of transportation, leisure, employment and work within the home cause people to lead more sedentary lifestyle and to demand more convenient foods" (FAO, 2013, p.x). Current research on increasing portion sizes widely discusses the implications for human nutrition. A study of portion size increase undertaken in Britain concluded that increased protein consumption is apparent between 1999 and 2009 (See Figure 1). Along with the increased sizes of meals in general since 1988, this study hypothesizes increased consumption trends that could be affecting obesity in Britain (Benson, 2009). Studying increased portion sizes is common through the lens of nutrition (Young & Nestle, 2003; Smiciklas-Wright et al., 2003; Swartz & Byrd-Bredbenner, 2006).

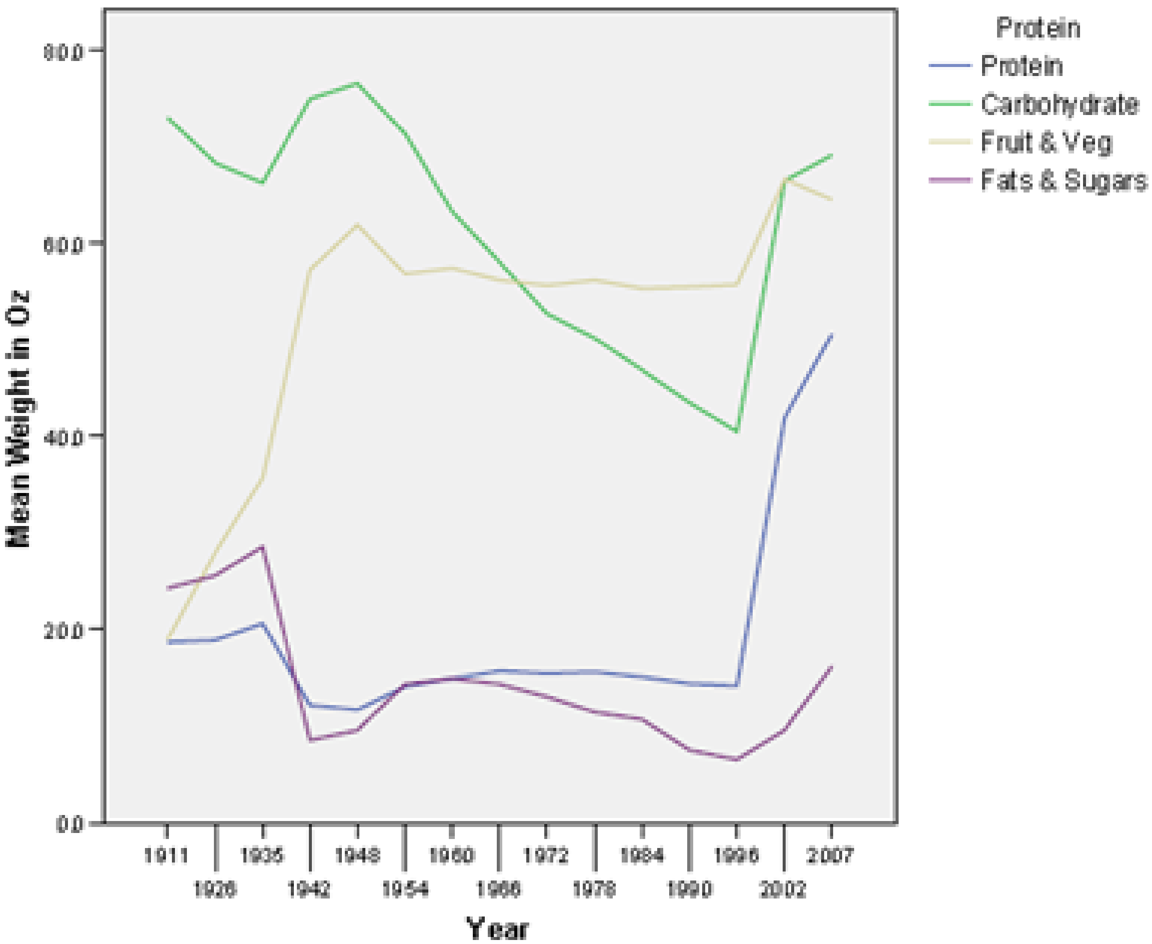


Figure 1: Changes in mean portion size consumed per person, per week, in Britain over the period 1911-2009, for four major food groups (from Benson, 2009, p.13).

Fishery industries globally have shown trends of increased production. Technologies that have assisted in the growth of these industries includes genetically modified species, catch techniques that allow for more fish to be caught using less time and energy, and the establishment of farmed fish (Kennelly & Broadhurst, 2002). Fish is an important source of animal protein in areas such as the Pacific island countries and territories as they have limited access to land that can be devoted to livestock agriculture. Population growth has also affected the demand for this protein source, as it is an important economic nutritional resource (Bell et al., 2008). More than a third of global fishery catches go into world trade, where it is disproportionately consumed by different counties. The availability of this protein is already declining, as decreased fish stocks have been recognized globally (Kent, 1997). Understanding consumption trends of this protein source is significant as certain communities are nutritionally and economically dependent on this limited resource.

The FAO has outlined four dimensions of food security based on the 1996 World Food Summit's definition: "Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2008, p.1). These four dimensions are physical availability of food, economic and physical access to food, food utilization, and stability of the previous three dimensions over time (FAO, 2008). The World Bank understands the creation of food insecurities as acute misfortune, such as environmental events, war, or chronic misfortune created by a systematic inability to acquire food (Gani & Prasad, 2007). Food insecurity is created in these situations as animal products are traded to where there is a demand. This encourages economic growth. Consumption trends are, therefore, important to understand in order to achieve equal access to such a resource (Gilland, 2002).

Dietary patterns have shaped the nature of the food industry as, "Animal products provide 27% of food calories in the developed countries and 13% in the developing countries (Gilland, 2002, p.48). A large portion of the cereal production sector is used to feed livestock for the growth of animal products. Energy is lost when nutrients are consumed moving up a food chain. The full amount of available energy contained grain is, therefore, not captured when feed is consumed by livestock (Horrigan et al., 2002). This is a problem in the meat industry as:

> Cattle are the most inefficient in their energy conversion, requiring 7 kg of grain to produce 1 kg of beef (compared to 4:1 for pork and 2:1 for chicken)…Despite this inefficiency, livestock diets have become higher in grains and lower in grasses. (Horrigan et al, 2002, p.445)

Animal protein requires more energy to produce than plant based proteins (Horrigan et al., 2002). It is important to understand if this energy intensive resource is being consumed more frequently and/or in larger quantities in order to understand the driving factors behind increased demand.

Food security is influenced by protein consumption trends. This has broad implications in animal product availability and nutrition in communities globally. A study done on low income countries demonstrated: "…a positive correlation between food availability, per capita energy and protein supply and human development" (Gani & Prasad, 2007, p.316-317). Projections of animal product projected out to 2050 suggest a substantial increase in demand, and meeting these demands will be stressful on the environment as well as food provisioning industries (Pelletier & Tyedmers, 2010). It is, therefore, important to understand the influences on the global food system to promote food security and human development.

A large body of literature discusses nutritional drivers related to protein and how they are affecting the global food system. An adequate amount of protein is defined differently by different nations, groups and experts: "The World Health Organization (WHO) recommends that daily protein intake for good nutrition should be ~0.7 g of protein per kg body weight per day, derived from a variety of sources to prevent micro nutrient deficiencies" (Bell et al., 2009, p.65).

The FAO has recognized that the prevalence of micronutrient deficiencies, such as protein, has declined since 1990, but still rests at approximately 15% globally (FAO, 2013). Research on animal protein and nutrition identifies the importance of being able to access it. In communities in the Global South, for example: “The high protein content of animal foods makes them especially suitable for children, and children will not receive an adequate supply unless it is also available to the adult population” (Gilland, 2002, p.49). Under consumption and over consumption of protein are prevalent trends in different parts of the world (Singh et al., 2003). Consumption trends can, therefore, be understood as geographically different. It is useful to study both extremes in consumption patterns to understand the existing trends in changing protein portion sizes.

While literature discussing protein consumption and nutrition is extensive, there are still areas that need exploration. Studies examined were incredibly specific as scopes were narrowed by scale, age demographic, gender, and time period. A comprehensive understanding of this trend across all of these demographics over a larger period of time is not well understood. The FAO recognizes this gap in the knowledge around nutrition, as: “Further research is needed on nutrition education and behavior change…” (FAO, 2013, p.12). One such educational tool could be recipes and cookbooks.

COOKBOOKS: INDICATORS OF PORTION SIZES

Consumption trends have been studied culturally a number of different ways. Patterns of meat consumption in Australia was studied by Tapsell through examining cuisine. It was determined that nutrition trends and meat consumption were influenced by cuisine (Tapsell, 2007). A study done by Tandon et al., examines the restaurant menu’s role in influencing over consumption. The study concluded that menus have a significant influence on consumption trends (Tandon et al., 2010). Examinations of seafood menus over a long period of time have also been used to describe important trends. 376 menus analyzed from Hawaii document shifts in the fishing industry between 1928 and 1974. The authors of this article recognize the usefulness of tools such as menus to explain these trends where data are not available (Houtan et al., n.d.).

Cookbooks have not been used extensively as a tool to understand cultural consumption trends. A notable exception, however, is a study undertaken by Wansink and Payne in 2009 documenting changes in portion sizes in the cookbook series The Joy of Cooking. Seven edition of the book were examined, released between 1936 and 2006. Only reoccurring recipes were analyzed, and it was concluded that portion sizes were increasing (Wansink & Payne, 2009). Cookbooks are evidently a useful tool in examining consumption over long periods of time, although, "The calories and portion sizes of classic recipes may reflect prevailing tastes and norms" but not exact consumption amounts of meal frequencies (Wansink & Payne, 2009, p.291).

Cookbooks have been studied to understand the cultural consumption habits of a culture or region. Billing and Sherman looked at 93 cookbooks from 36 different countries to understand what kinds of spices were prevalent in different recipes and cuisines (Billing & Sherman, 1998). A similar study, conducted by Sherman and Hash, examined 107 cookbooks examined to understand how prevalent spices are in vegetarian dishes in different countries (Sherman & Hash, 2001). Neither study assess protein consumption over time, however, the studies demonstrate how cookbooks are useful for studying consumption trends. Gaps in the literature surrounding protein consumption could be assessed using this research method.

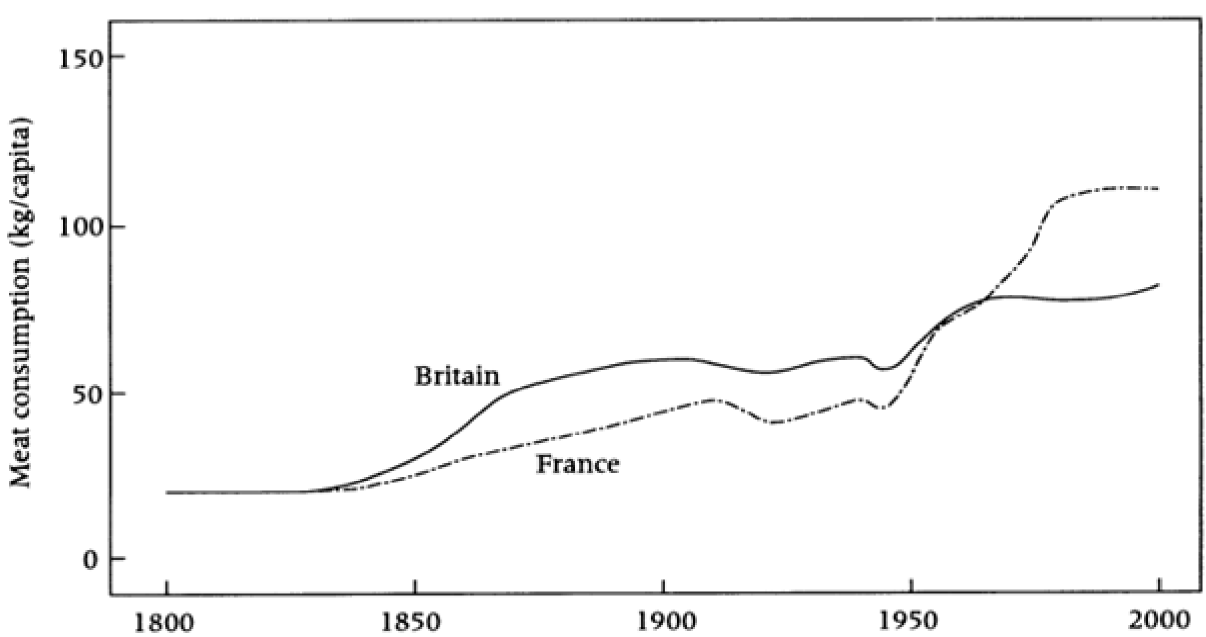
NORTH AMERICAN FOOD PATTERNS

Causes of increased protein consumption can be understood as a cultural trend. Diets are unique to different cultures, and vary between them. Given this understanding and the previous assessment of protein production's environmental impact, different cultures can have different impacts on the environment through their diets (Boer et al., 2006, p.267). Food consumption trends in France and America have been studied, for example. The observable differences between the two are listed in Table 1. Each criteria in this figure generate different observations in each nation's food culture (Rozin, 2005). Other differences could arise from these habits such as what type of proteins and quantities they commonly eat. This is significant because "On average, 6 kg plant protein is required to yield 1 kg meat protein" (Boer et al., 2006, p.267). Between plant and animal protein, meat is a more significant product to study as it is in higher demand with a larger impact. It is also nutritionally significant as Singh et al. completed a study in which it was found adults in North America and Europe that consume less meat have a lower mortality risk and a higher life expectancy (Singh et al., 2003). Over consumption of meat products are evidentially not promoting equal nutrition standards globally.

Table 1: Summary of French and American eating habit differences (Rozin, 2005, p.S111).

Food, eating, and physical activity
Portion size
Eating time
Eating sociality/conversation
Degree of snacking and snacking opportunities
Freshness and taste (vs shelf life) as priorities
Pleasure vs worry orientation to food
Actual foods consumed (eg, wine)
Variety of foods consumed
Walk or bicycle vs car orientation
Overall outlook on/orientation to life
Moderation vs excess/abundance ideology
Focus on quality vs quantity
Joy/pleasure vs comfort

Historically, meat consumption has cultural significance. In the mid-19th century a dietary shift in Europe towards larger meat consumption is apparent. Fueled by increased grain yields that were declining in economic value as human food products, these changes started first in Western Europe and spread east as feed for livestock became more available. Livestock production continued to increase at the end of World War II as global grain production devoted to livestock feed was 10% in, 20 %. By 1950, however, 20% of grains were destined for livestock and by the 1990s the fraction had increased to 40%. British consumption specifically doubled in the 19th century and then doubled again between 1925 and 1975. Similar trends were apparent in China, Japan and the Americas, with the United States historically consuming the most animal protein. Figure 2 is a collection of graphs, representing the discussed animal production trends (Smil, 2002).



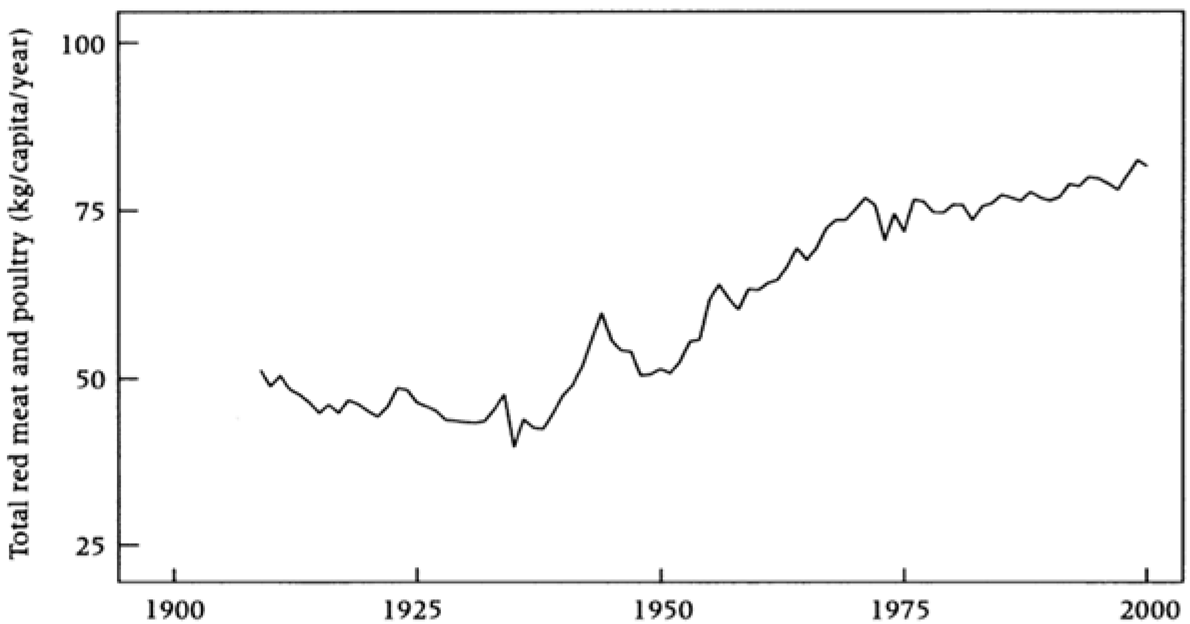


Figure 2: Above: Average annual meat consumption in France and Britain 1800-2000, Below: Average annual United States per capita consumption of red meat and poultry 1909-2000 (from Smil, 2002, p.610-611).

Consumption of food products has increased in North America. In a study done by Smiciklas-Wright et al., portion sizes have increased significantly between 1989 and 1996. 107 foods were assessed, and the increased portion sizes of different foods correlated with market availability and obesity trends (Smiciklas-Wright et al., 2003). In a study done by Swartz et al., American youth's understanding of portion sizes was examined. University students at one university were observed over the course of three meals in one day in 2006. 14 different meals were offered, and their serving quantities of each were unlimited. The results were compared to a similar study done in 1984, and a significant increase in the conceptual understanding of a portion size was found (Swartz et al., 2006). Factors such as food cost and availability influence consumption trends, and there is a need to study them over a long period of time to understand how they are changing (Young & Nestle, 2003).

IMPLICATIONS FOR THE ENVIRONMENT

Protein consumption trends have impacted the physical environment in which humans live: "The diversity of environmental impacts due to food production is probably larger than any other human activity" (González et al., 2011, p.562). Creating the grains to feed livestock can involve deforestation, the use of fertilizers and pesticides that affect surrounding ecosystems, and GHG emissions caused by harvesting and production processes. In 2000, 32% of global GHG emissions were caused by the agricultural food industry (González et al., 2011). Estimates also suggest that 18% of global GHG emissions are due to livestock production specifically (Mitloehner, 2010; González et al., 2011).

Table 2 demonstrates the amounts of GHG emissions associated with different types of meat based on life cycle assessment research. Emissions can vary significantly, however, depending on the technology used, and the size and location of the livestock farm (González et al., 2011). These emissions are major contributors to anthropogenic climate change. Studies have demonstrated significantly lower emissions related to generating plant protein (González et al., 2011; Carlsson-Kanyama & González, 2009). Given the different impacts from two protein sources, it is important to understand the extent of trends that have led humanity to increased animal protein consumption.

Table 2: Protein content in selected foods, energy use, GHG emissions, and the protein delivery efficiency of these foods in terms of energy use and GHG emissions (from González et al., 2011, p.566).

		Protein content of food[a] (g protein/kg)	Energy use[b] (MJ/kg)	GHG emissions[b] (kg CO_2 eq./kg)	Protein delivery efficiency energy (g protein/ MJ)	Protein delivery efficiency GHG (g protein/kg CO_2 eq.)
Meats	Beef	206	47	29	4.4	7.1
	Mutton and lamb	193	46	26	4.2	7.6
	Pork	206	28	8.2	7.3	25
	Chicken	188	27	4.7	7.0	39
	Fish	207	40	3.1	5.1	67

More land is needed annually to meet the demands of the global food industry. Land is a limited resource; therefore, efficient use of land is necessary to accommodate the expansion of the livestock industry. Increased energy inputs to provide fuels to run machinery and products are used to maximize land productivity. This is explained simply in Figure 3 within the context of climate change. This flow chart displays the effect consumer demand has on climate change, land use, and environmental inputs (Harvey & Pilgrim, 2011). Land for livestock production varies based on the type of farming used. In industrial agriculture, however, immense amounts of land are required for livestock feed production and livestock production (Harvey & Pilgrim, 2011). The overconsumption of meat, therefore, affects land use and land availability for other industries.

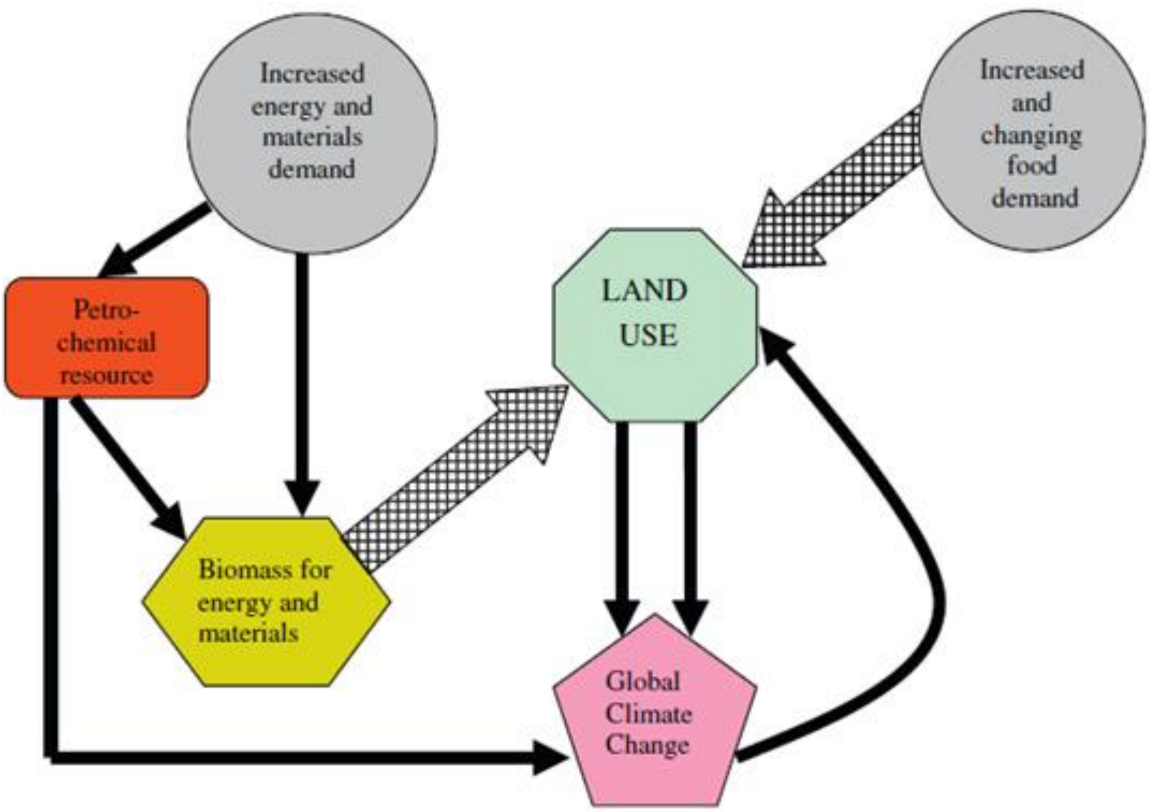


Figure 3: Interactions and feedbacks due to land use for the livestock industry (from Harvey & Pilgrim, 2011, p.S41).

Climate change is impactful on the natural environment: "On current trajectories, it is estimated that anthropogenic climate change may increase global mean temperatures by 3°C by 2100. Given that a rise of 2°C above preindustrial levels may result in 'dangerous climate change,' with serious negative impacts to ecosystems and human welfare…"(Pelletier & Tyedmers, 2010, p.18371). Based on projections by the FAO for protein demands by earth's 2050 population, the livestock industry will release GHG emissions that will assist in raising the global temperatures above 2°C. Protein consumption is increasing at a disproportionate rate to human population growth which is, in turn, causing significant environmental impacts (Pelletier & Tyedmers, 2010).

Other impacts associated with the livestock industry include eutrophication from fertilizer run off. The Baltic Sea and its surrounding rivers are influenced by this process along with many other water bodies globally (Hägg et al., 2009). Eutrophication is caused when an excess of nutrients such as nitrogen or phosphorus enters an aquatic ecosystem (Smith et al., 1999). Organisms in these ecosystems flourish from the input of these nutrients, causing rapid population increases. These organisms, such as phytoplankton, can then create anoxic conditions in these environments from consuming the majority of available oxygen in the water (Smith et al., 1999). Environments can subsequently become uninhabitable to species that would otherwise live there. A study of eutrophication in the Baltic Sea suggested that 63% of nitrogen emissions driving the process came from cattle production. Eutrophication impacts large and small marine environments globally (Hägg et al., 2009).

The advancement of technology to mass produce protein has increased global output. Technology has also made industries more impactful on the environment in different ways. This is especially apparent in industrial fishing practices, as fish capturing techniques have increasing numbers of by-catches associated with them. In recent decades quantities of fish extracted from oceans globally has increased, however, fish stocks are evidently decreasing. New technologies that have allowed for effective extraction of this now limited resource have played a large role in their decline. Accompanied by ineffective regulations at national and international levels, this protein source is depleting (Kennelly & Broadhurst, 2002).

Fish farming has environmental impacts that are similar to livestock production. Different techniques exist in which fish are breed and fed for sale as meat, fish meal, and fish oil. A life cycle assessment of four salmon farming techniques demonstrates environmental impacts associated with land based and water based farming techniques. The four techniques assessed were: conventional marine net-pen system; a marine floating bag system; a land-based saltwater flow through system; and a land-based freshwater recirculating system (Ayer & Tyedmers, 2008). Environmental performance was assessed based on criteria such as necessary feed inputs, energy demand, global warming potential and eutrophication potential. Water-based systems such as marine net-pen system had higher chances of eutrophication and land based systems were much higher in energy demand and global warming potential. Fish protein, therefore, has impacts associated with its production that are detrimental to the industry (Ayer & Tyedmers, 2008).

There is plenty of evidence suggesting current consumption of animal protein is unsustainable when considering the health of natural environments. This trend will only be exacerbated with projected population growth estimates and animal protein demand projections moving into the future. It is, therefore, important to address and understand the current trends that suggest protein is being over consumed in certain areas of the world in order to mitigate the predicted effects of the industry.

Methods

SCOPE

This study examines animal protein consumption trends in North America. Cookbooks have been used to understand portion sizes in a single serving of animal protein. Cookbooks that initially qualified for data collection needed to have been published in North America and included a main meal recipe that featured wither chicken, beef, fish or pork as a primary ingredient. Fish was excluded from the study early on due to time constraints as well as lack of specificity in cookbook descriptions. Recipes that were considered also needed to include descriptor of the cut of meat and intended serving size of each recipe. This usually existed within the recipe or in the book preface or introduction. Sources have been collected as far back as 1907 with an emphasis on examining a similar amount of cookbooks per decade to assist in even data distribution.

LITERATURE REVIEW

A literature view was conducted to understand the potential drivers behind increased animal protein consumption and the environmental impacts associated with this trend. In order to find secondary literature for this review, different search terms were used to find sources. A log of search terms was kept in order to record the use of different terms. This was useful when completing later searches as time was not wasted repeating searches. Platforms used to complete this search were Google Scholar and Dalhousie Libraries. Journals that were found while searching these terms include *Marine Policy*, *The Ecological Society of America*, and *Food Policy*. Sources were also collected from attending lectures related to protein consumption and food culture. These sources were consulted to contextualize the environmental, nutritional and social issues surrounding increased animal protein consumption. The literature, therefore, justifies the significance of this sustainability thesis paper.

SOURCE COLLECTION

Several methods were used to collect cookbooks for this study. A structured online literature search of publically available documents was conducted to find cookbooks that were within the scope of this study. Another search log was kept to track the terms used. Finding sources online was difficult, and many searches did not yield results. The useful search terms and the corresponding websites appear in Table 3.

Table 3: Cookbook search terms and useful websites found during online searches

Search Date	Search Platform	Word(s)	Useful website found
Nov-13	Google	Cookbook, 1900	http://vintagecookbooks.healthyeatingandlifestyle.org
Nov-13	Google	Cookbook, old	http://chowhound.chow.com/topics/800296
Mar-14	Google	Cookbook, Halifax, libraries	http://discover.halifaxpubliclibraries.ca/
Mar-14	Google Books	Cookery, 1940	http://books.google.ca/

Sources were also collected through contacting people using social media, email, and word of mouth. A document was created and sent out via email and over Facebook to friends and family members during the first week of December asking for copies of, or actual cookbooks. A copy of this letter can be seen in Appendix A. This message was sent out before the winter holidays anticipating that sources would be brought back or emailed in by January. The topic of this thesis was modified after the letter was sent, as the study was limited to beef, pork, and poultry. Fish was excluded due to a number of difficulties with recipes involving fish such as lack of serving sizes, few descriptions of quantities needed in recipes, and few descriptions of species of fish required. These problems were especially prevalent in older recipes, making it difficult to collect useful data. A search for physical copies of cookbooks was conducted through the Dalhousie Killam Library last, after the search criteria was focused.

DATA EXTRACTION AND ANALYSIS

A spreadsheet in Microsoft Excel was used to organize data collected from recipes. One spreadsheet was created for each type of meat: chicken, pork and beef. Certain information about each dish was recorded for organization and data analysis purposes. In order to ensure data was collected from a wide variety of sources, only the first ten usable recipes for each type of meat were used. This practice began after the analysis of several books when it became clear how many applicable recipes some books contained, and how time consuming it would be to use them all. The first ten recipes for each type of meat were chosen out of the "Mains" section of each book with only one type of meat in them. Mains were distinguished as the recipes listed in a chapter titled "Mains" or "Meats", or based on the description at the beginning of the book as some books contained nothing but mains.

Basic information was first recorded on the cookbook and recipe being examined in the spreadsheet: title, author, publication year, publication location, name of recipe, recipe page number, target audience, and cut of meat. The target audience was a subjective description created after reading the preface or introduction to the cookbook. Next, the mass of the portion meat required in the recipe was inputted in its given units. Some recipes had ranges for this value, therefore, the mean of the minimum and maximum weights described was calculated. The intended serving size of the recipe was noted as described in the cookbook. These values also occasionally had ranges and, once again, the mean was calculated for use in data analysis.

The ultimate purpose of collecting this information was to be able to calculate the grams of animal meat-derived protein per serving size. This required not only knowing the number of servings and mass of meat called for in the recipe, but also knowledge of the cut of meat, as some cuts contain bone, and the typical protein content of the edible portion of the cut of meat.

The nature of digestible protein in meat changes as it is cooked depending on the type of meat, duration of cooking and style of cooking. In order to simplify analysis, I did not attempt to calculate the amount of protein that could be absorbed by the average person after cooking. The wet weight of the meat was, therefore, calculated by converting the given mean mass of the cut as described in the recipe to metric units (grams). The wet weight was then divided by the mean intended serving size of the dish. This calculation gave the intended wet weight of meat per person.

The wet weight of the given amount of meat per individual serving next needed to be converted into grams of protein. The United States Department of Agriculture's (USDA) nutrient database was used as the source of information regarding the grams of protein present in each cut of meat. Initially, it was assumed that there would not be a significant difference between the amounts of protein in different cuts of meat derived from a given species. For example, it was initially assumed that flank steak and ground beef would have the same approximate amount of protein per 100 grams as they are both from a cow. A test was conducted to test this by choosing 10 random cuts from each type of meat: chicken, beef, and pork. The database describes each cut with a description and a five digit numeric code. It provides the grams of protein per 100 grams of the specified cut and from this, the mass percentage of each cut that is protein could be estimated. These values were inputted into a Microsoft Excel spreadsheet and the mean and standard deviation was calculated for each type of meat. This spreadsheet can be seen in Appendix B.

This test demonstrated that there was a significant difference in protein values between different cuts of meat as the standard deviations were large. It was, therefore, important to use specific values for each cut of meat as described in the recipe. This required further research into each recipe examined; cuts with and without bones needed to be distinguished. Observations from using the database indicated a significant difference between cuts with and without bones, therefore, recipes were revisited to see if they noted whether bones were included or not in the cut. For recipes that did not include a description of whether the cut included bone or not, or recipes that could no longer be accessed, a Google search was conducted and recipes or images of the same dish were used to infer whether a cut of meat likely included bone. A column was added to each of the original three spreadsheets to record the findings of this research.

Relating the description of each cut in a recipe to descriptions in the USDA database was difficult as the database is very specific with respect to cut description but recipes were not as precise. For most cuts, a variety of values from the database could have applied. Another spreadsheet was created in Microsoft Excel with a master list of all the cuts described in my recipe data. The five digit code and protein value of every USDA cut description that might apply to the cut described in each recipe was recorded and the average of each protein value was taken. These averages can be seen for beef, chicken, and pork in Appendices C, D, and E respectively. The amount of protein per cut was then entered into the original three spreadsheets for each type of meat in order to relate the values with the amount of meat intended per person. The protein values were first divided by 100 so they could represent a percentage. The resulting value for each cut was then multiplied by the intended wet weight per person. This gave the amount of protein intended for a serving size in each recipe. The grams of protein per person for each recipe was then inputted into graphs and charts for visual and statistical analysis. Regression analysis was completed in Microsoft Excel and was interpreted to discover whether certain findings of the study were significant or not.

Results

SOUCRE COLLECTION

During the study period, 35 cookbooks were examined and 423 useful recipes were found. Of these recipes, the majority were ones containing only beef (Figure 4). Chicken recipes were the second most numerous and pork was third. Most of the cookbooks were collected through an online search (Table 4). Only one less source was collected through contributions from those contacted by the message sent out over email and Facebook. The fewest sources were collected from the Dalhousie Library.

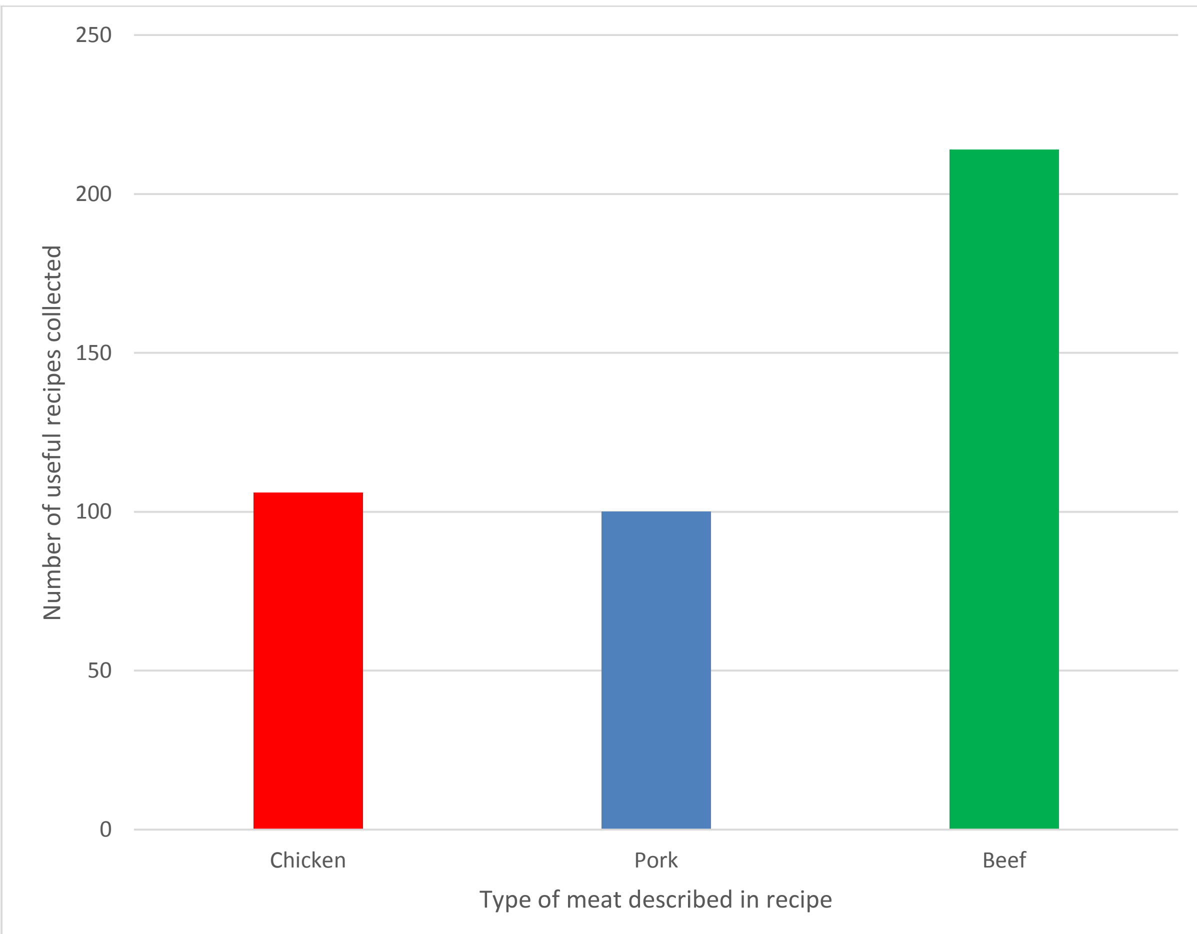


Figure 4: Total recipes collected for each type of meat

Table 4: Number of useful cookbooks found and used from the three different methods used.

Source of Cookbook	Through Email/Facebook message and word of mouth	Online Search	Dalhousie Killam Library
Number of Sources Obtained	15	16	4

An attempt was made to collect a similar amount of sources published or printed in each decade between 1900 and 2014. The actual distribution of sources collected appears in Figure 5. The fewest sources were collected from the years between 1931 and 1950 as well as 1961 and 1970. The distribution of where sources were published or printed geographically within North America was also recorded (Table 5). Data was collected on the target audience for each cookbook used in this study. Five subjective categories were made to categorize the audience description of each book. Most books were designed to be used by anyone cooking for a family. Ethnic cuisine and budgeting families were also large categories (Figure 6). There were few sources collected for fine dining recipes.

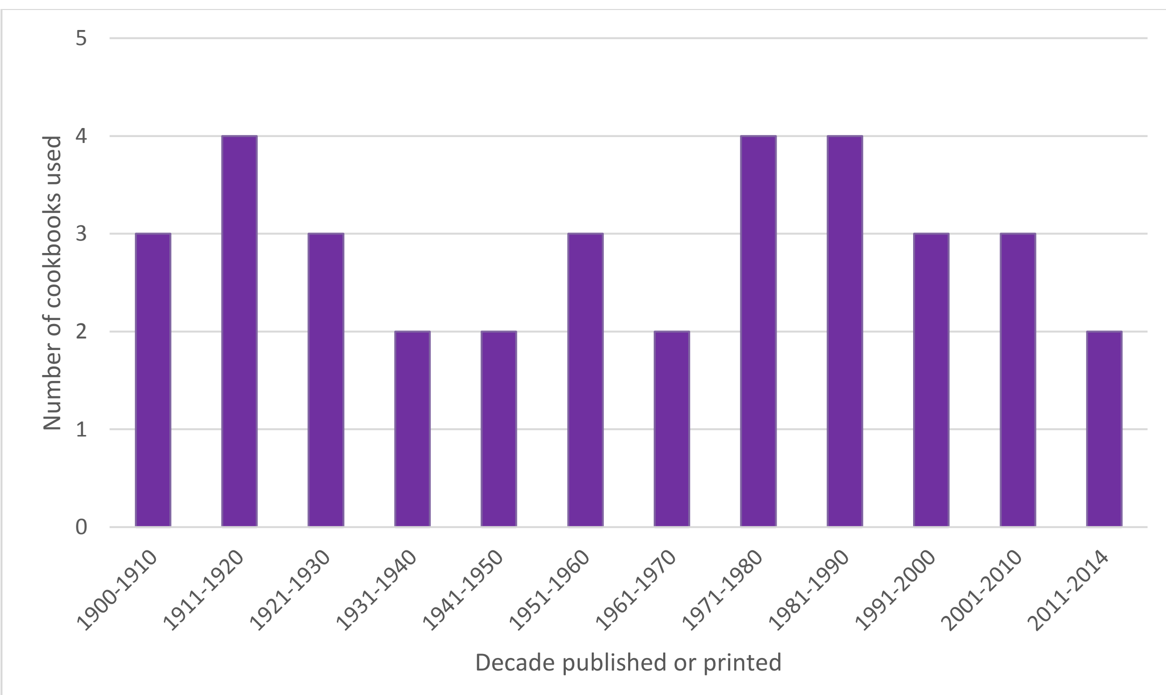


Figure 5: Number of sources used that were published or printed in the correlating decade.

Table 5: Publishing or printing locations of all 35 cookbooks used in this study.

Location Published or Printed	**Number of Cookbooks**
United States of America (USA)	1
New York	11
New York, New York	2
Smithtown, New York	1
California	1
Los Angles, California	1
San Anselmo, California	1
Chicago	3
Hutchington, Kansas	1
Avon, Massachusetts	2
Des Moines, Iowa	1
Columbus, Ohio	1
Milwaukee	1
Milwaukee, Wisconsin	1
Canada	1
Hampton, New Brunswick	1
Toronto, Ontario	2
Saskatoon, Saskatchewan	1
Nova Scotia, Canada	1
Steinbach, Manitoba	1

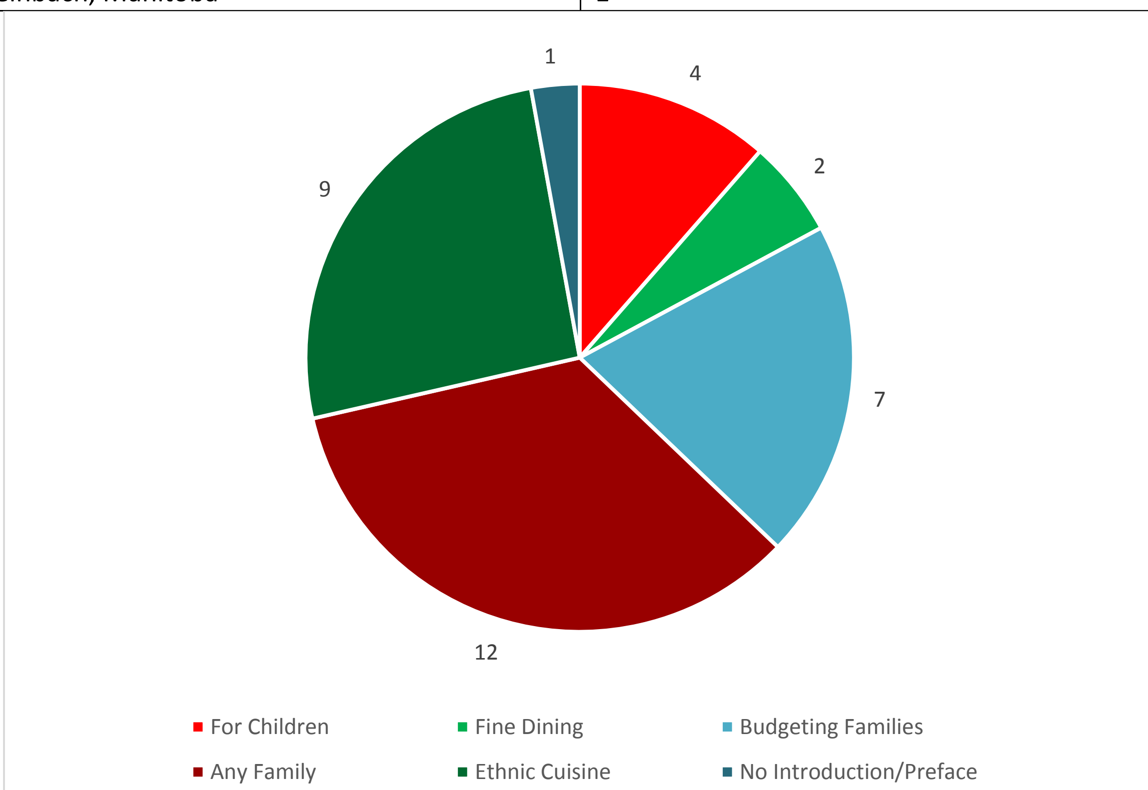


Figure 6: Intended audiences for cookbooks

MAJOR COMSUMPTION TRENDS

Across all of the recipes analyzed over the period from 1907 to 2012, North Americans consumed the most protein per serving size in meals with chicken when compared to pork and beef (Figure 7).

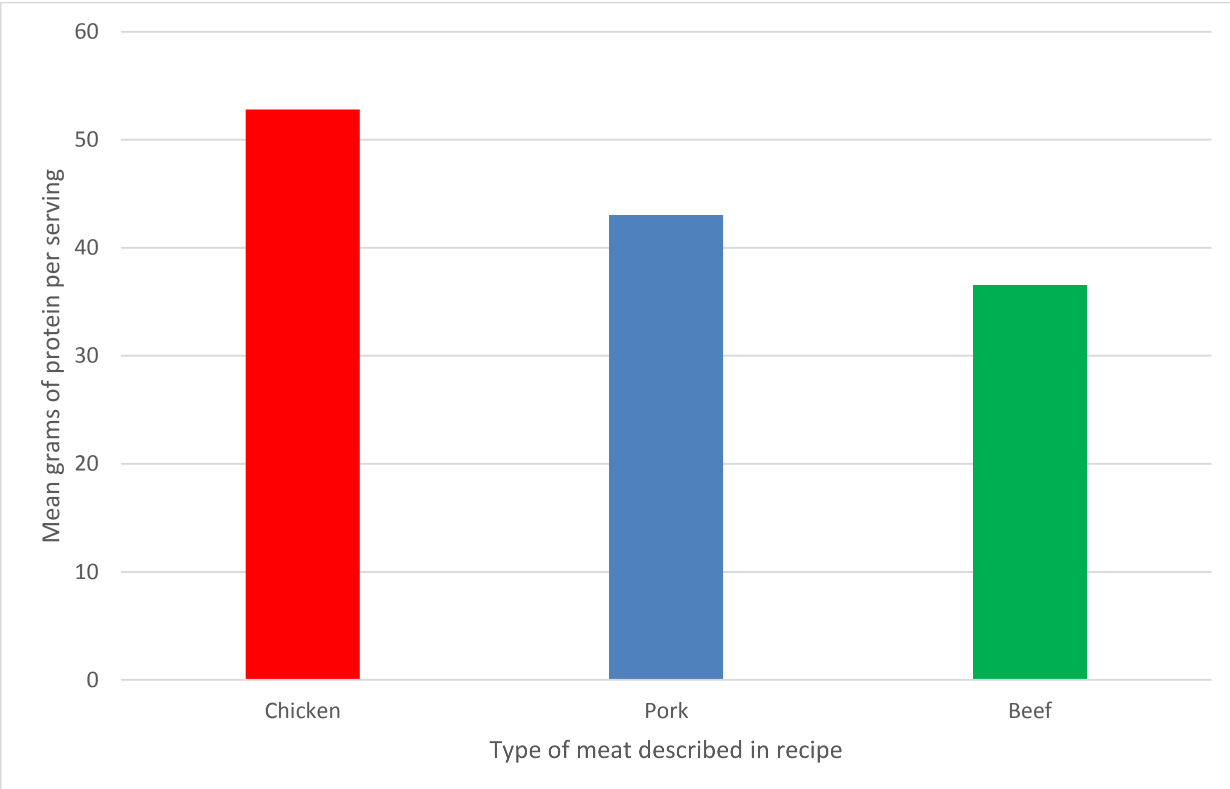


Figure 7: Mean grams of protein per serving size for all recipes examined between 1907 and 2012

Figure 8 represents all the collected data on protein per individual serving size correlated to the publishing or printing time of the book. A trendline was inserted using Microsoft Excel that demonstrates a negative slope. To find out if this slope was significant, a regression analysis was done in Excel. The analysis indicated that the slope of the line was -0.147883191. This is the average amount of protein decreasing annually from serving sizes indicated in cookbooks for beef, chicken, and pork in North America. In order to understand whether this slope was

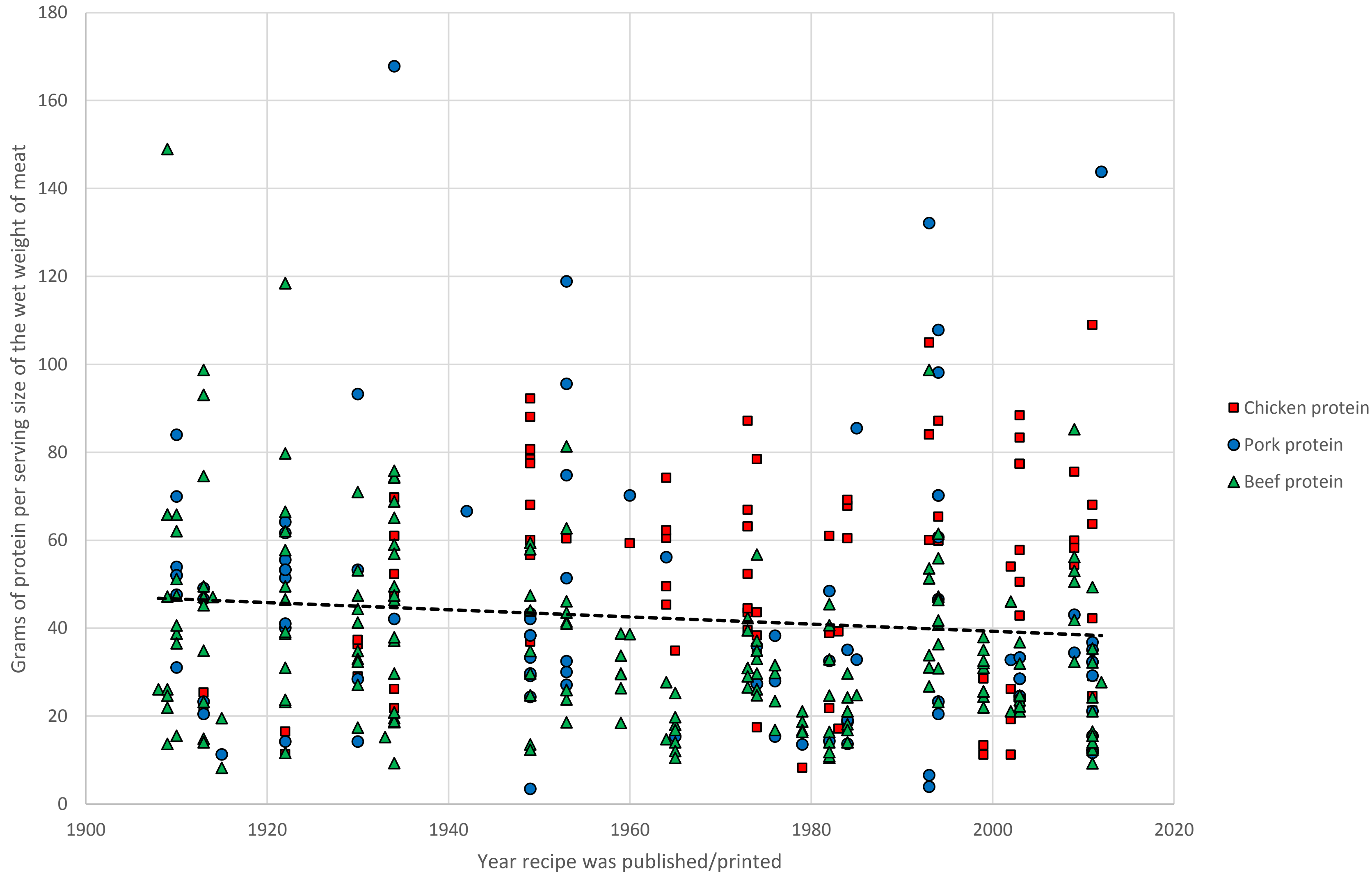


Figure 8: Changes in serving size of protein as described in North American cookbooks over time.

decreasing significantly, a null hypothesis and an alternative hypothesis were formed. The prediction made at the outset of this study was that there would be an increasing trend when protein values per serving size were graphed over time. The null hypothesis, therefore, becomes that there is no trend. In other words, it hypothesizes the slope will be zero. The alternative hypothesis is then that the slope will not be zero. The p-value in this analysis was 0.021854595. If this value is under 0.05, it indicates that within a 95% confidence interval the null hypothesis should be rejected. The alternative hypothesis should then be accepted. Based on this analysis, it appears that the decline in animal derived protein per serving in North American recipes over the last ~100 years is statistically significant (De Veaux et al., 2005). Using this slope, projections can be made into the future. Figure 14 is the same trendline from Figure 14 projected 50 years forward.

MINOR CONSUMPTION TRENDS

The regression analysis that was done for Figure 8 was repeated for three other data sets. Chicken, pork, and beef protein values were graphed independently of one another. The data and corresponding trendlines can be seen in Figures 9, 10, and 11 respectively. The regression analysis for chicken recipes (Figure 9) demonstrated a slope of 0.032292782 and a p-value of 0.686188564. This large p-value means that, within a 95% confidence interval, there is not a significant trend. Regression analysis undertaken for pork recipes (Figure 10) indicates a slope of -0.140363967 and a p-value of 0.10847893. This is also not a significant trend as the p-value is larger than 0.05. Finally, the regression analysis done on beef recipes (Figure 11) yeilded a slope of -0.189925961 and a p-value of 1.4231E-05. The trendline for beef is, therefore, significant.

Figure 9: Intended chicken protein per serving based on raw meat weight in recipes

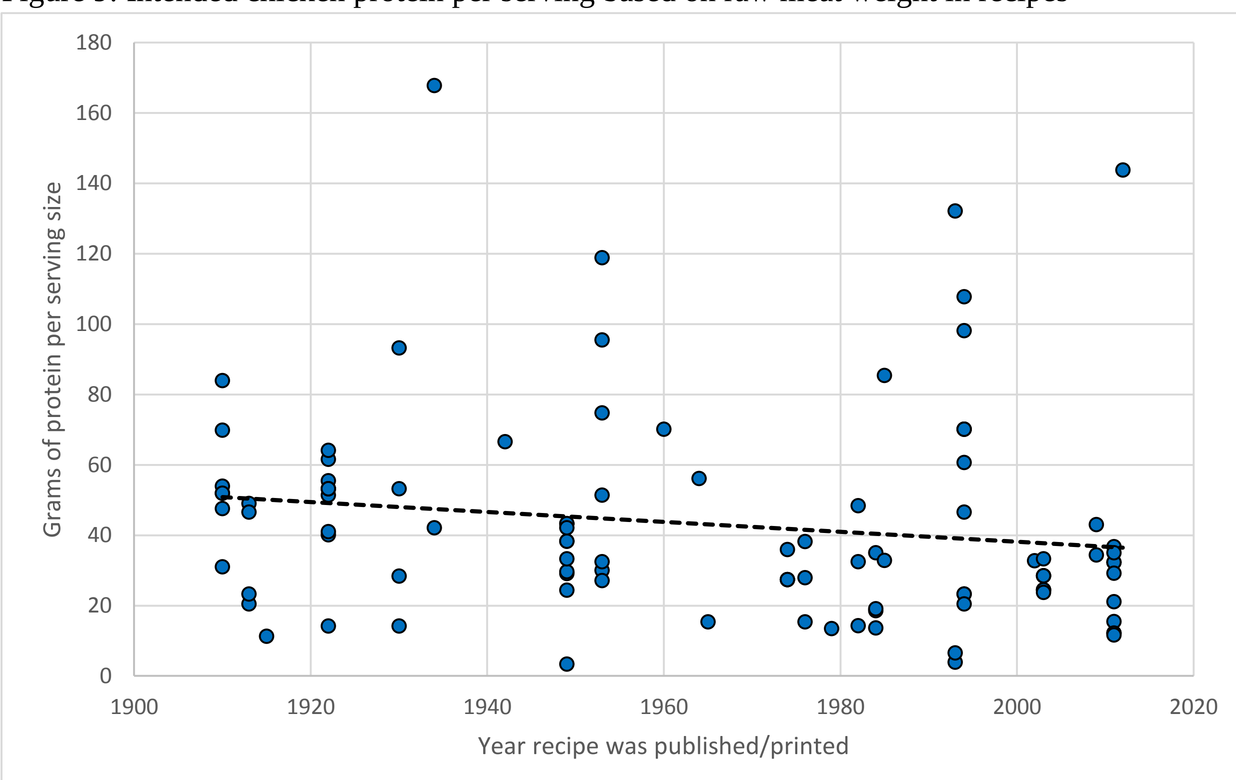


Figure 10: Intended pork protein per serving based on raw meat weight in recipes.

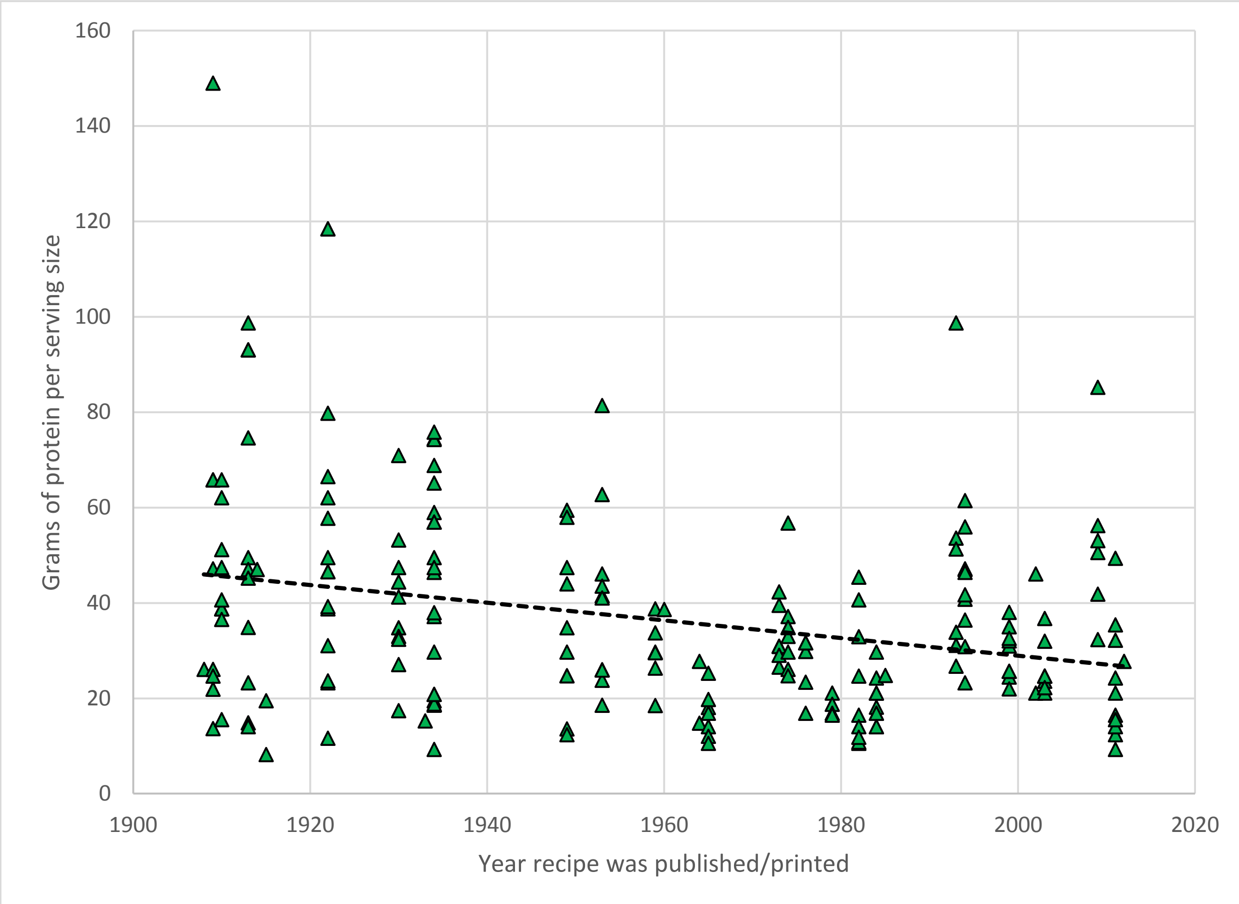


Figure 11: Intended beef protein per serving based on raw meat weight in recipes

Discussion

LIMITATIONS

Limitations exist in the methods discussed for data collection and analysis. First, cookbooks as a study tool are limited as they do give information on the frequency meals are eaten. They are useful representations of cultural perceptions of an ideal or adequate animal protein portion size; however, they do not describe actual consumption patterns. There are few comparable studies with which to evaluate the methods used, therefore, the usefulness of techniques could not be extensively evaluated prior to the study. Second, cookbooks are pieces of literature that describe meals to a specific audience. Depending on the audience and time frame in which the book was written, the significance of the meal described could be intended as simply an average meal or an extravagant dish. This perception is important as it could create outliers in the data points, however, as the frequency of meals being eaten is not being analyzed in the study, these recipes are still useful to examine perceptions of portion sizes.

The time frame in which this study was completed and published was approximately eight months. This was a limited time to collect and analyze data. A larger collection of sources, both within the time frame analyzed and over a longer time horizon, may highlight different trends if this study were replicated. Assumptions have also been made in collecting and analyzing information. It is assumed that the micronutrients ingested by animals do not significantly influence the quantity of protein in the animals' muscle. It is also assumed that changes in animals' typical food sources do not affect this; for example grass fed and corn fed livestock have comparable levels of protein in their muscle. Conversions to grams of protein were kept consistent by using the same source to calculate grams of protein in each cut: the

USDA database. Using these values, however, does not perfectly reflect the reality of how much protein each dish may contain.

Estimating the average grams of protein per serving for various cuts of meat was a somewhat subjective process. The values that were collected were based on a search using four terms: the state of the meat (raw), the name of the cut (flank steak, breast, etc.), an indication of whether it was bone-in or boneless, and the type of meat (beef, chicken, or pork). An example of a search that would have been typed into the search engine would be, "raw, beef, boneless, loin steak". The searches often generated multiple responses that varied based on the amount of fat on the cut. The vaguer the description in the recipe, the larger the number of cut specific values were used to estimate an average. For example, the simple term "Beef" was used in many recipes. Half of these recipes indicated that it needed to be lean. In creating the averages for these two cuts, all the beef values in the database were averaged for "raw, beef, boneless" and then for "raw, beef, boneless, lean only". If it was not noted in the recipe whether a meat need to be lean for all other values, an average of the lean and fatty versions of the cut was taken.

Beef cut descriptions in both the USDA database and the recipe data was extremely diverse. In order to relate them a reference page was needed. Recipes do not always use the same terms for meat cut from a certain part of an animal as the database does. Also, the words used to describe different parts of meat were different in American, Dutch and British recipes. Figure 18 was used as a reference to relate the recipe and database descriptions for recipes containing beef. These average may have been more accurate overall if an expert had been consulted in the selection of every applicable value for each cut. A butcher or food historian, for example, could be accessed for future studies of a similar nature. Consulting these experts may create different values and may affect the trends discovered.

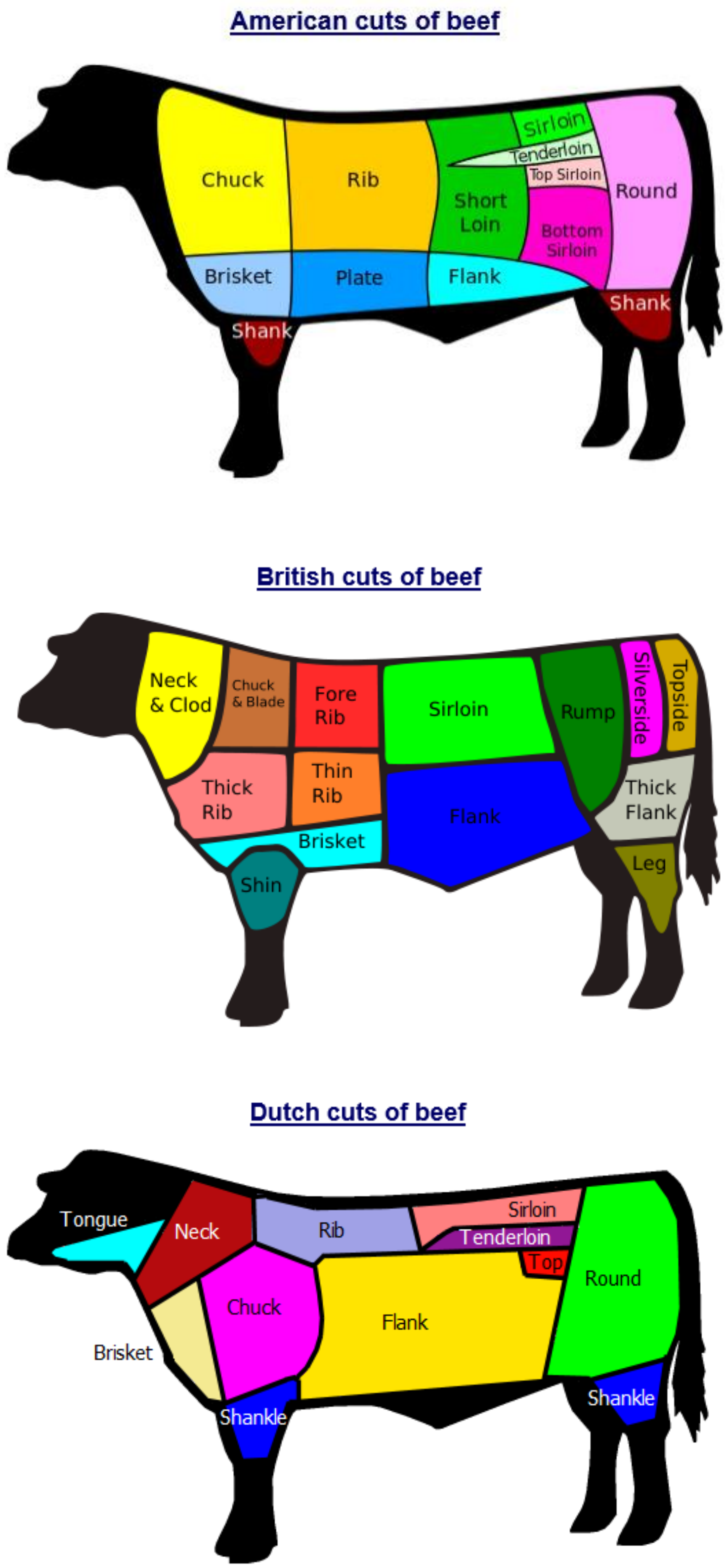


Figure 18: Typical cuts of beef used in American, British and Dutch cuisine (Regents of the University of Minnesota, 2014)

FINDINGS

The different methods used to collect sources have strengths and weaknesses. The majority of sources were collected online because searches for these sources could be completed anywhere there is a computer available. They were also easier to screen for useful recipes as using a search function quickly made it clear if recipes in the book contained serving sizes or meat weights. Most of the recipes examined were excluded from the study because they did not have a description of serving size either in the recipe itself or in the preface or introduction of the cookbook. The overall prevalence of useful recipes containing beef in this study was due both to their commonness and also due to the fact that, in observation, they had both serving sizes and quantities attached to them more often than recipes calling for other meats (Figure 4).

Words that were searched to look for serving sizes in online documents were: people, person, serve, serving, or family. Although the most sources were found using this method, only about one in every ten books examined was usable (Figure 5). Screening books that were contributed from the letter sent out online had a much higher success rate in terms of usability. This is due to the parameters participants were given in the letter that was sent out to obtain these sources (See Appendix A). They effectively did the screening process in most cases and made sure the recipes were usable in this study. This was, therefore, a more efficient method to collect sources. Collecting sources from the library was the most time consuming as screening had to be done manually and it required physically being at the library to do data collection.

Attempting to have an even distribution of sources over time was important to try and establish an accurate trendline that reflected consumption patterns over the last century. Searches were catered towards decades where earlier collection efforts had yielded fewer sources. Despite this, several decades still had only two sources. Finding cookbooks from the decades between

1931 to 1940 as well as 1941 to 1950 may have been harder as fewer cookbooks may have been published during the Great Depression and then again during World War II (Friedman & Schwartz, 1963). These events could have affected the publishing industry and, therefore, limited sources available. The other decade with few sources, 1961-1970, followed the economic recession in the USA of 1960 (Friedman & Schwartz, 1963). Most of the sources obtained for this study were from the USA, demonstrating how they were more easily available through the search methods used (Table 5). The economic and political history of this country, therefore, may have restricted source availability. There was no attempt made to find sources that were evenly distributed geographically in terms of publication location. This is because the publication location does not necessarily correlate to where the books were sold or owned.

Cookbooks were not selected based on the intended audience for the book. This was done in order to observe consumption trends across all genres. Many more books that correlated to budgeting families were used than those describing fine dining (Figure 6). This could be evidence of economic hardships in the last 100 years in North America, or a cultural preference towards cheaper meals. It was interesting that the intended audience for most of the books were families, however, second was those looking to cook ethnic cuisine. These were books with specific descriptions of cultural cuisine such as German, Indian, or Maritime. This is significant as it described something about North American food culture. Just as the formation of Canada and the USA has its roots in other nations through colonialism, these countries still borrow cultural markers such as cuisine from other cultures. The trends observed in this study may have been significantly different if data was collected for a specific audience or genre of cookbook.

Using an average of all recipes collected within each meat category, Figure 6 makes it clear that meals with chicken have the highest amount of protein per serving size. Pork was second followed by beef, which is interesting as beef was the most prevalent meat described out of the three in recipes overall (Figure 4). This indicates that it may have been eaten more commonly, but not in as large protein portion sizes. When the protein values were graphed against their respective publishing or printing dates, a significant downward slope became apparent. Figure 8 shows this slope and every data point on which it is based. This trend is contrary to the hypothesis made at the outset of the study. Given the clear macro-economic increases in protein consumption for a number of western countries over the last century as indicated in the literature review, it was predicted that protein portion sizes would increase over time. This hypothesis must be rejected, however, as they are evidently decreasing. The declining trendline also suggests that other factors are driving the increased consumption that cannot be examined from cookbooks. Two factors immediately come to mind, either the frequency that meals containing meat are being eaten is increasing or the serving sizes indicated in recipes are not reflective of actual consumption practices in homes.

Projecting the trendline seen in Figure 8 forward creates a contrast between projections made in the literature review. Using analysis from the FAO, Pelletier and Tyedmers predicted a doubling of demand for animal protein by 2050 (Pelletier & Tyedmers, 2010). In the last one hundred years, Smil et al. also documented an increase in aggregate protein consumption in the USA (See Figure 2). Despite this, the amount of protein intended for a serving size is decreasing and may continue to decrease. The contrasting patterns suggest that increased animal protein consumption may be less about our cultural expectations around individual meals, and more a function of increased access to meat and, consequently, a collective increased frequency that meat-based meals are eaten. It also raises concerns for nutrition, as it may be useful to study at what point recipes are predicted to become not nutritionally balanced in terms of protein content, or if they have done so already.

Figures 9 and 10 show that there is no trend within chicken and pork serving size changes respectively. Figure 11, however, does have a significantly decreasing slope for beef protein per serving size since 1907. This may be the result of having more data for recipes containing beef, as shown in Figure 4, or it might mean that beef is an ideal indicator out of the three to examine changes in protein portion size. The slope of Figure 11, -0.189925961, is similar to but steeper than the slope of the combined protein values in Figure 8 at -0.147883191. Beef may be an important meat to include in future studies of animal protein consumption.

CONCLUSION AND RECOMMENDATIONS FOR FURTHER RESEARCH

Consumption of animal protein is increasing in excess of population growth (Pelletier & Tyedmers, 2010). This has negative effects on the natural environment that, in turn, harm humans. Looking at the changes in animal protein portion sizes as described in cookbooks is one lens under which this problem can be understood. This study found that the cultural perception of an acceptable amount of animal protein in a meal is likely not driving the increasing aggregate demand for animal protein. The fact that there was a significant overall downward trend in protein consumption per serving size indicates a cultural change towards eating less animal protein in a single meal. This can be understood as positive evidence a cultural solution to the increased consumption problem exists. If this trend is changing, it is likely possible to change other trends that might be affecting increased consumption such as meal frequency.

Future studies would benefit from looking at a larger quantity of sources over a longer time period. If a similar study was done, more data could be collected if the researcher found a way to calculate grams of protein per serving size without needing a description of serving sizes in the recipes or prefaces of a cookbook. A wider variety of protein sources should also be analyzed and would ideally include fish, venison, and turkey. Including these sources would allow researchers to collect more data and look further back in time. Studying cookbooks by their specific genres may also give insight into what types of cuisines are more environmentally impactful through their animal protein content. Such research could then inform dietary choices. Understanding the patterns underlying consumption trends is a first step towards effecting change. Studying these trends might lead to solutions that can ultimately reduce the negative externalities of the food provisioning industry such as GHG emissions and eutrophication.

Acknowledgements

Many of the cookbooks used as sources for this paper were contributions of generous individuals. I would like to thank them for taking the time to help me with my research: Peter Tyedmers, Catherine Alexander, Joyce Bunn, Derrick Alexander, Maureen Alexander, Jess Lynds, Jean Lynds, Susan Tirone, Baliegh McWade, Susan Brown, Tami Mosher, Edward Mosher, Laura Bartlett, Terry Smith, Bronwen Smith Cooke and Adelle Meagher. I would also like to mention the extra support given to me throughout the various stages of this project in terms of editing and encouragement. The quality of this paper would be drastically different without the help of Tami Mosher, Edward Mosher, Jess Lynds, Susan Tirone, Tetjana Ross, Steven Mannell, Derrick Alexander and Laura Bartlett.

Finally, this paper could not have been possible without the support and guidance of my advisor Peter Tyedmers. He was the perfect mentor to help me through this challenging process, and he has taught me new skills that I know will prove invaluable in the future. Thank you for putting up with me and my unending questions.

Appendices

APPENDIX A

Hello friends and strangers,

My name in Makayla Mosher and I am a student in the Environment, Sustainability and Society honors program at Dalhousie University. I am currently collecting data for my thesis project and I could use your help!

My thesis looks at changes in protein consumption overtime in North America. I will be doing this by looking at recipes in cookbooks that contain beef, pork, poultry or fish.

Contemporary sources are easy to find. My challenge, however, is tracking down much older cookbooks. My goal is to also find recipes as far back as the 1800s, and so I am sending this message in the hopes that, over the holidays, you might look through your personal or family collections and send me some recipes. Older and recent recipes are both welcome, although I anticipate more difficulty locating older published books.

If you are unwilling to loan me an original book, I would love to accept scanned copies of any recipes sent to mk477927@dal.ca, or photocopies which I can arrange to pick up. I am happy to cover the costs of any photocopying fees associated with your help.

Some things that need to be included in these scanned recipes are:

1) Name of book
2) Author
3) Date published
4) Publisher
5) Location published (Must be in North America)
6) Name of recipe (Must be a dish containing beef, pork, poultry or fish)
7) Serving size of the recipe

Should any of these be difficult to locate or if you are unsure if a cookbook qualifies, send/bring it to me anyway and I will be the judge. I am interested in accepting as many or as few recipes that you are willing to send from any number of different publications.

Your personal information will be in no way associated with the study and submissions will be kept entirely anonymous. Should you have any questions, do not hesitate to email me.

Thank you for your time,

Makayla Mosher

APPENDIX B

	USDA Description	NDB No.	Grams of Protein per 100 grams		
Pork	Pork, fresh, loin, country-style ribs, separable lean only, raw	10207	20.76		
	Pork, fresh, loin, tenderloin, separable, lean only, raw	10060	20.95		
	Pork, fresh, shoulder, (Boston butt), Blade (steaks), seperable lean and fat, raw	10080	17.42		
	Pork, fresh, loin, top loin (roasts), boneless, separable lean and fat, raw	10224	21.34		
	Pork, fresh, loin, top loin (chops), boneless, separable lean and fat, raw	10032	21.55		
	Pork, fresh, ground, raw	10219	21.19		
	Ham, Minced	7030	16.28		
	Pork, pickled pork hocks	10898	19.11		
	Pork, fresh, loin, center rib (chops or roasts), boneless, separable lean and fat, raw	10194	19.9	Mean	Standard Deviation
	Pork, fresh, enhanced, shoulder, (Boston butt), blade (steaks) separable lean and fat, raw	10953	17.19	19.569	1.955893942
Beef	beef, chuck for stew, separble lean and fat, select raw	23094	21.9		
	beef, ground, 85% lean meat/15% fat, raw	23567	18.59		
	beef, tenderloin, steak, separable lean and fat, trimmed to 1/8" fat, all grades	13917	18.16		
	beef, round, outside round, bottom round steak, steak, separable lean and fat, trimmed to 0'	23063	21.59		
	beef, flank, steak, separable lean and fat, trimmed to 0" fat, all grades, raw	13970	21.22		
	beef, chuck eye roast, boneless, America's Beef Roast, separable lean and fat, trimmed to 0"	13972	20.61		
	beef, cured, corned beef, brisket, raw	13346	14.68		
	beef, chuck eye Country-Style ribs, boneless, separable lean and fat, choice, raw	23138	18.87		
	beef, brisket, flat half, boneless separable lean only, trimmed ro 0" fat, all grades raw	13595	21.47	Mean	Standard Deviation
	beef, chuck, under blade center steak, boneless, Denver Cut, separable lean only, trimmed t	13356	19.42	19.651	2.216876932
Chicken	chicken, ground, raw	5332	17.44		
	chicken, roasting, giblets, raw	5115	18.14		
	chicken, stewing, meat only, raw	5125	21.26		
	chicken, broilers or fryers, giblets, raw	5020	17.88		
	chicken, broilers or fryers, back, meat only, raw	5053	19.56		
	chicken, broilers or fryers, wing, meat only, raw	5105	21.97		
	chicken, broilers or fryers, breast, meat and skin, raw	5057	20.85		
	chicken, broilers or fryers, dark meat, drumstick, meat only, raw	5071	19.41		
	chicken, broiler or fryers, breast, skinless, boneless, meat only, raw	5062	22.5	Mean	Standard Deviation
	chicken, brilers or fryers, leg, meat only, raw	5080	19.16	19.817	1.759450988

APPENDIX C

Beef	
Type of cut	
stewing beef boneless	21.76333333
flank steak	21.39666667
ground beef	18.586
round steak bone in	21.83166667
corned beef	20.89
beef chuck boneless	20.45941176
blade roast bone-in	17.17
tenderloin boneless	21.67571429
tenderloin bone in	20.615
boneless brisket	20.92166667
top loin boneless	22.308125
sirloin steak boneless	20.80428571
sirloin steak bone in	21.195
boneless round steak	23.00666667
rib bone in	16.4425
short rib bone in	16.725
back rib bone in	17.69833333
Bone in beef chuck	19.93210526
liver	20.36
veal liver	19.93
veal boneless	19.35
boned veal shoulder	19.55166667
veal shank bone in	19.745
foreknuckle of veal	cannot calculate
beef boneless	20.5153012
lean beef ground	21.41
lean beef boneless	21.50616279
veal cubed for stew	20.27
beef steak boneless	20.74426087
pot roast bone in	21.89428571
tripe (stomach)	12.07
loin steak boneless	21.16111111
boneless beef from leg	21.75
corned beef brisket	14.68
lean shoulder boneless	21.02
porterhouse steak bone in	21.43333333
boneless beef skirt	19.61916667

APPENDIX D

Chicken
Type of cut
liver
16.92
whole chicken
19.216
canned chicken
23.804
broiler or fryer whole
19.995
breast boneless skinless
21.41
chicken legs bone-in
15.1
dark boneless
18.717
stewing chicken whole
19.405
breast and legs
18.61
bone-in chicken thigh
17.815
skinned whole chicken
20.99333333
legs, thigh, breast
16.855
roasting chicken
20.33
ground chicken
17.44

APPENDIX E

Pork
Type of cut
Ground Pork
16.88
Shoulder Pork boneless
20.085
spareribs bone-in
15.47
Ham bone-in
20.55333333
pork loin roast boneless
21.365
Pork blade/ chops boneless
20.802
Boneless pork
18.08365854
Bone-in pork
20.38178571
Pork Hock
19.11
Pork loin boneless
21.82333333
Leg of pork bone in
20.25333333
Lean Pork
20.99083333
Pork Chops bone in
21.13
ham boneless
18.76833333
Suckling pig
19.01623188
pork tenderloin boneless
20.5375
salt pork boneless
pork shoulder whole
18.365
leg of pork boneless
22.26
Boneless pork chops
21.598
pork loin chop bone in
20.96
pork shoulder steak bone in
17.9075
pork loin center cut bone in
21.1925
pork butt lean bonless
18.73
bacon
12.62
sausage
14.914

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