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Trans-Border Reformulation: US and Canadian Experiences with *trans* Fat

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Abstract

Food managers are engaged in altering the nutritional quality of diets. They do so directly through product innovation strategies (food manufacturers) and the selection of products available in stores (grocers and restaurants) and indirectly through distribution and promotion strategies and prices. Decisions to alter products, menus, assortments and marketing strategies are drivers of supply, which interact with consumer demand to impact the nutritional quality of food available, purchased and eventually consumed. The sequence of managerial decisions leading to product-level marketing mixes is explored.

This case-study provides a comparison of monitored industry self-regulation of *trans* fat (Canada primarily) and more autonomous firm strategy (US primarily) on the nutrient quality of new cookies launched between 2006-12. Cookies were selected for this case-study given that they are commonly consumed and have traditionally contained *trans* fat. Differences between food labeling policies in the US and Canada are then compared to explore the merits of a conceptual model.

Keywords: food reformulation, adoption, assimilation, public health

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Introduction

Product innovation and reformulation has the potential to improve diet quality, provided that consumers purchase and consume adjusted products. Reformulation and launch of novel products with better quality lipid ingredients serves as a simple test of managerial response to food policy. Do managers respond to changes in labeling policy? This case study explores two nuances of the role of managers in shaping food demand, diet and health - adapting to the local environment and the role of voluntary initiatives. We conducted a comparative study of the responses of managers in the US and Canada to similar policy approaches. The main difference between the approaches taken by the two countries was the Canadian government's threat of additional legislation if managers did not comply with voluntary *trans* fat limits in food by 2009. However, many cookies are available for sale on both sides of the border. Thus, certain managerial decisions may impact the availability of *trans* fat in both nations. We explore if there were different food innovation responses in the US and Canada.

To impact public health through food innovation at least five sequential steps in managerial decision making play a role (see Figure 1). 1) Managers need to be aware of external/internal, demand/supply or policy drivers of change (diffusion); 2) when, and how will new ingredients be used (adoption); 3) how much will processing and product characteristics be changed (assimilation); 4) will these changes be consistent (adherence); and finally, 5) what balance of marketing strategies will distribute, communicate and value these product changes? Merging traditional industrial organization (Structure-Conduct-Performance) and population health (belief-behavior-cues to action) frameworks into the theory of diffusion of innovation (Rogers, 2003) we present a conceptual model of a path towards the impact of these managerial decisions on food demand, diet and health. This model is presented within the context of a particular public health-food innovation dynamic and comparative study – *trans* fat in the US and Canada (Schleifer 2011, 2012 and 2013).

Background

The World Health Organization (WHO) has acknowledged the role that the private sector can play in limiting the levels of saturated and *trans* fat in processed food products, through product reformulation (WHO 2004). These innovations need to be part of broader efforts to improve the quality of the food supply, inform and educate consumers in order to reduce the risk of diet-related chronic disease (WHO 2004).

Artificial *trans* fat is produced through the process of hydrogenation resulting in a stable fat that can withstand repeated heating at high temperatures while providing an extended shelf life. Although it was previously favored by the food industry because of these properties, its consumption has been associated with an increased risk of cardiovascular disease (Teegala et al. 2009, Mozaffarian et al. 2009). In response to these public health consequences various efforts to remove *trans* fats from the global food supply have been attempted. Unlike any other food component artificial *trans* fats serve no beneficial nutrition purpose and their consumption should be reduced as much as possible (Uauy et al. 2009). In order to maximize health gains from removing *trans fat*, the WHO recommends replacing it with unsaturated fats (WHO 2004 and 2013). Indeed, the US Food and Drug Administration (FDA) has recently proposed a policy which would categorize partially-hydrogenated vegetable oils (PHVOs) as unsafe, requiring pre-market approval for their continued use (FDA 2013). Food processing firms can (and in the future may have to) help improve diet quality by reducing the use of certain fats while controlling the level of other nutrients. This paper tracks managerial responses to the inclusion/standardization of *trans* fat information on food labels in the US and Canada.

The US and Canada chose subtly different strategies to promote the reduction of artificial *trans* fat in processed foods. Both included *trans* fats on Nutrition Facts panels around the same time (December 2005/January 2006 for Canada/US respectively). The US selected a threshold of 0.5g/serving above which products could not claim on the front of the pack to be *trans* fat free. Canada selected a more restrictive threshold of 0.2g/serving in addition to the more binding constraint of less than 2g/serving for the sum of *trans* and saturated fat[1]. In addition, Health Canada adopted the recommendations of the *Trans Fat Task Force* setting two public health goals to be met by 2009 (Health Canada, 2006):

1. Limit the *trans* fat content of vegetable oils and soft, spreadable margarines to 2% of the total fat content, and
2. Limit the *trans* fat content for all other foods to 5% of the total fat content, including ingredients sold to restaurants.

Although the Canadian Government had threatened legislation if the food industry didn't meet the recommendations by 2009, neither nation chose to ban *trans* fats in processed foods unlike other countries worldwide (Downs et al. 2013). The US and Canada opted for a collaborative, industry partnership and communication approach. Similar efforts, such as the provision of front of pack nutrition marketing messages (Van Camp et al. 2012b) have met with mixed success. Further, the recent move by the FDA suggests that the US will now take a stronger regulatory approach (FDA 2013).

This voluntary environment provided opportunities for managerial responses at various stages of the food supply chain. This can be characterized by the speed, nature, and completeness of product and process innovation and the set of marketing strategies selected by food firms operating in each nation, retailers and food manufacturers' alike.

The FDA adopted this policy in 2003 in response to a petition from the Centre for Science in the Public Interest and to published studies linking *trans* fat intakes with increased cholesterol levels in blood (FDA 2003). The FDA adopted labeling policies in 2003 and Health Canada in 2004 in order to provide consumers with additional standardized product information needed to make healthier food choices. As both countries adopted regulation a few years prior to it being implemented, companies likely started reviewing *trans* fat in their products prior to the deadline for compliance. In 2001-02, 42% of cookies sold in the US used PHVOs as their main oil ingredient and by 2005-06 this had already dropped to 15% (Unnevehr and Jagmanaite 2008). Heath Canada (2006) suggested cookies were "easy" (for firms) to find an alternative for *trans* fat, while cautioning that consumers might be led into choices with a higher saturated fat content.

[1] Serving size for cookies is 30g in the US and 30-40g in Canada.

Our study builds on Rahkovsky et al. (2012) and Van Camp et al. (2012a) for the US and Ratnayate et al. (2009) and Health Canada (2006) for Canada which document initial reductions in *trans* fat content of processed foods prior to 2006.

There were likely three main market incentives which led to the reduction of *trans* fat in food over the period 2003-12: mandatory disclosure of *trans* fat information on food labels; product liability and lawsuits; and the banning of products by countries, states and cities (Unnevehr and Jagmanaite 2008). The media attention garnered by the labeling regulation and by *trans* fat bans in Denmark and New York City (which happened prior to 2006) likely contributed to increased consumer demand for low *trans* fat products, fueled by enhanced knowledge and awareness of *trans* fat (Eckel et al. 2009).

What do we know about Food Innovation?

Traditional studies of food innovation build from the ***diffusion*** literature (Rogers 2003) where an internal or external driver for change (or policy environment) raises the awareness of an issue, process or product attribute. Responding to this, managers and consumers are placed along the continuum of early adopter-mainstream-laggard. Such an approach can accommodate the joint supply and demand aspects of ***adoption*** so may be useful in this discussion where firms supply products in part due to consumer interest and also to increase awareness and demand. As a next step, Sporleder et al. (2008) and Shanahan et al. (2008) provide a basis to consider the combined processes of adoption and ***assimilation*** of food innovations using the context of the US National Organic Program. In this study both are prompted by a trigger, here the policy requirements of *trans* fat labeling. Think of the adoption decision as the selection of key inputs and food processing steps by the firm targeting *trans* fat (and saturated fat in Canada). Assimilation then considers the "spread" (or contagion) over the various products within a firms' portfolio as managers become aware of, recognize and then accept the benefits of the innovation.

An industrial organization Structure-Conduct-Performance model (e.g., Marion 1976; Porter 1987) might consider this a change in basic conditions, prompting a new pattern of conduct (innovation) and performance (change in diet quality) with feedback loops perhaps altering the structure of the (sub) sector. For example, a successful new cookie with low *trans* fat might garner consumer attention, sales and profit and then be mimicked by other brands. Cooper and Zmud (1990) add a focus on the use of the innovation within firms (and by extension consumers). The 6-step implementation process (initiation, adoption, adaptation, acceptance, routinization, and infusion) is more concisely packaged by Lewin (1951) as unfreezing, changing and refreezing. This might suggest that once change has been accepted (adoption), and once the next managerial decision of how much to implement this change (assimilation) is made that ***adherence*** through routinization (Cooper and Zmud 19990) or refreezing (Lewin 1951) will suggest the resultant level of compliance. This may not be the case if a new trigger or impetus for innovation (consumer demand, external competition or a new internal managerial decision) or novel feedback loop becomes important for a particular firm (e.g., adaptation highlights food processing concerns, ingredient sourcing, etc.). Again, firms may be placed at various stages along the early adopter-mainstream-laggard spectrum. As discussed by Henson and Heasman (1998) more research is needed to understand such compliance (policy) or more generally adherence (voluntary) decisions of food firms.

Finally, from the perspective of managerial decision making, a ***marketing*** strategy is then designed to distribute, promote and value the innovation. Integrating an understanding of the population drivers of adoption of health behaviors (e.g., Cohen et al. 2000), prices, advertisements and locations (convenience) all interact with product strategies to encourage the selection (purchase) and use (consumption) of innovative foods.[2] However, it is important to note that the conceptual model is part of a broader process of change that remains under studied. A schematic of this sequence of managerial decisions is presented in Figure 1. This conceptual framework will be applied to the findings of the case-study.

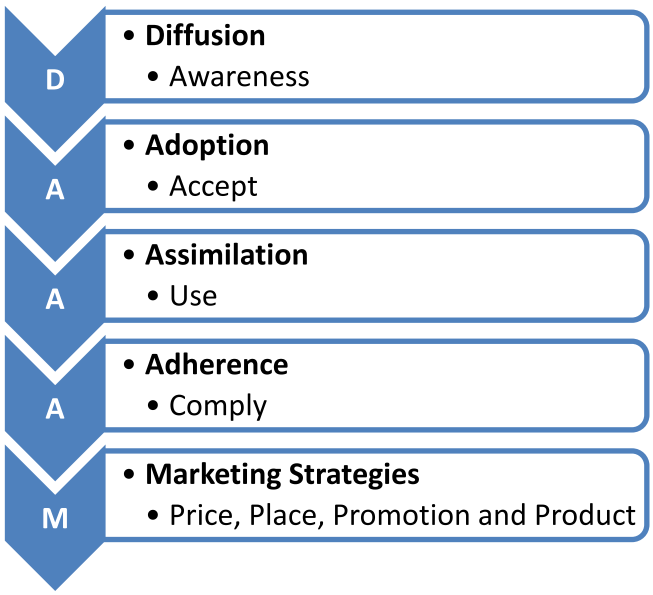

Figure 1. Conceptual Model: DAAAM A Process of Change

Objective

The overall objective of this study was to determine whether the different approaches to reduce *trans* fat in cookies implemented in the US and Canada altered the degree and speed of diffusion, adoption, assimilation, adherence and marketing of food innovations by firms. To do this we examined: 1) the nutrition composition and type of oil used, 2) the presence of front of pack nutrition claims, and 3) cookie prices.

Methods

The Mintel/GNPD (Global New Products Database) data were used to examine new cookies (all types of sweet biscuits/cookies) launched in the US and Canada between 2006 and 2012. GNPD documents a rich array of new product information and is used for competitor tracking between

[2] An extension of this framework might consider lessons from the TAM – Technology Acceptance Model (Davis et al., 1989) which relies upon the perceptions and realizations of usefulness and ease of use. The perceptions of all stakeholders; firms, consumers and policy makers would need to be incorporated.

rival companies. New product launches sold in supermarkets, drug stores, natural food stores/health shops, gas stations, convenience stores and independent outlets are included in the database. The data are compiled by looking at food label information and not through food composition analysis. Key nutrient levels for each product were compared over time, and across each country.

We selected cookies as the food category of interest in this study given that they are frequently consumed, have traditionally used *trans* fat rich PHVOs as their major lipid ingredient and progress towards *trans* fat removal in this category has been slower than other food categories (Downs et al. 2013; Unnevehr and Jagmanaite 2008). Moreover, the food industry has indicated that there may be challenges in finding a replacement lipid in bakery products given the organoleptic properties demanded by consumers (Eckel et al. 2007).

In order to compare nutrient contents across cookies with different serving sizes, we used a standardized 100g serving. Although the average suggested serving size is approximately 30 grams, consumers often exceed recommended serving sizes. The main type of oil used was identified by examining the ingredients list of individual cookie products. Given that ingredients are listed in the order of largest to smallest contribution to the cookie, we identified the first oil/fat type listed on the label as the primary oil ingredient. In many cases several types of oils are listed. However, our analyses focused on the main oil ingredient. In order to identify the proportion of oil types used, we divided the total number of cookies with each primary oil by the number of cookies per country and year.

All statistical analyses were performed using SPSS (version 19). T-tests and one-way ANOVAs were used to assess differences among groups using continuous variables and chi-squared tests were used to assess differences of categorical variables. Non-parametric tests (Mann-Whitney U-test and Kruskal Wallis test) were used to assess differences among groups of abnormally distributed variables. A p-value of <0.05 was considered statistically significant.

Results

Our data set include a total of 2,701 new cookies launched in the US and 965 in Canada over the period 2006-12. Numbers of cookie innovations are reasonably consistent over time with the exception of a recessionary dip in 2008 and 2009 in the US.

Overall, 12.2% of cookies contained *trans* fat in the US as compared to 29.6% in Canada ($p<.001$) which is surprising to see if one believes these markets to have similar diffusion-adoption-assimilation drivers. Figure 2 depicts the proportion of cookies with and without *trans* fat. The proportion of cookies without *trans* fat significantly increased over time in both countries ($p<.01$). In both countries there was a decrease in the proportion of cookies containing *trans* fat in 2009 as compared to earlier years. More specifically, in 2008 12% of US cookies contained *trans* fat as compared to 9% in 2009. In Canada, 35% of cookies in 2008 contained *trans* fat as compared to 28% in 2009. It is therefore impossible to attribute the decline in Canada to the deadline for compliance with self-regulation. Further, there is mixed evidence for Canada after this date, with little improvement in the proportion of cookies reporting any *trans* fat content (and for 2012 a reversal) perhaps indicating a step back in adherence.

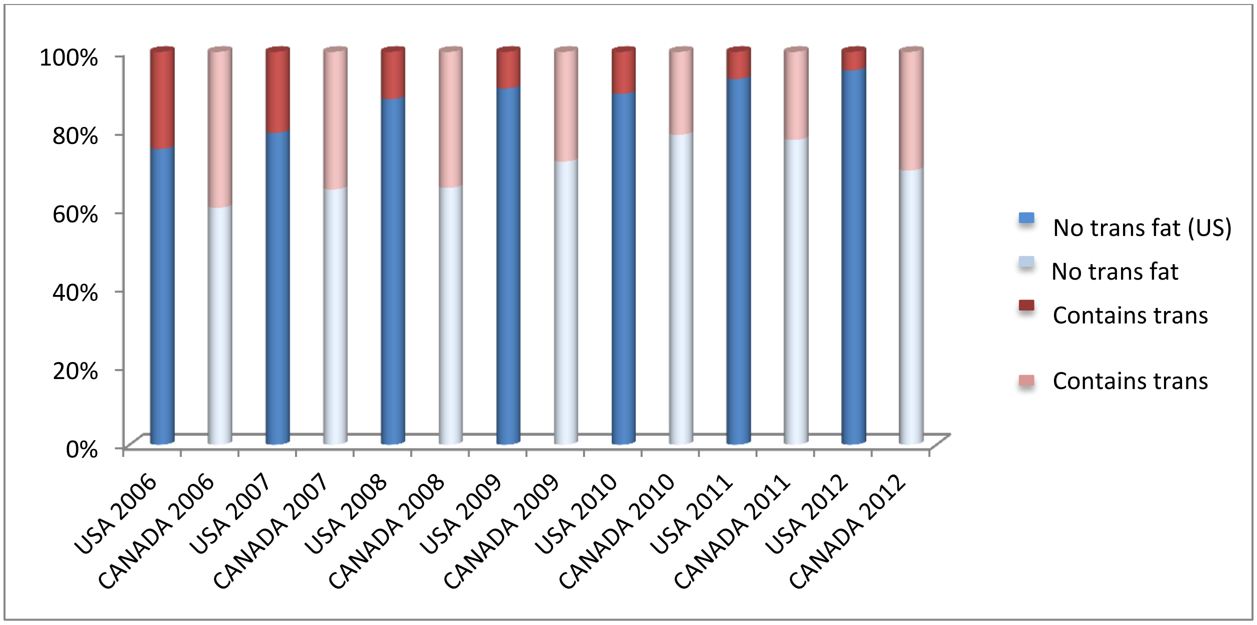

Figure 2. The proportion of products containing *trans* fat in the US and Canada from 2006 to 2012.

Although there were differences in the proportion of cookies that contained *trans* fat between the two countries the actual quantity of *trans* fat did not differ (p=.347). Table 1 (see Appendix) depicts the composition of cookies over time. There were no significant differences in key nutrients in Canadian and US cookies with the exception of 2009 where Canadian cookies had significantly more saturated fat (9.0 ± 5.6 vs 10.7 ± 6.5; p=0.015) and energy (p=0.023) than US cookies. However, sodium levels were significantly higher in the US (308.0 ± 142.4 vs 255.6 ± 145.5; p=0.002). In the US, saturated fat was higher in 2012 as compared to 2006 and 2007 and *trans* fat levels decreased over the same time period. In Canada, with the exception of reductions in *trans* fat over time, there were no differences in the composition of cookies from 2006 to 2012.

Products Containing trans Fat

The cookies that contained *trans* fat differed from those that did not contain *trans* fat in both countries. More specifically, the cookies without *trans* fat were significantly lower in energy, lower in fat and higher in protein and fiber in the US and Canada. Overall, 19% of US and 24% of Canadian cookies had front of pack product positioning claims related to *trans*, saturated or total fat. Of those cookies, 98.3% contained no *trans* fat. The relationship between saturated fat and *trans* fat was different between the two countries, though not apparently due to the joint saturated plus *trans* fat requirements of Canada. In the US, saturated fat content was significantly higher in the cookies that did not contain *trans* fat but in Canada saturated fat levels were significantly lower because those products with *trans* fat had markedly higher saturated fat contents (11.5g/100g Canada vs. 7.9 g/100g US, a significant difference). We interpret this to be partial support for the role of assimilation. Firms select nutrition quality among their product portfolios in distinct ways across the two nations.

Private Labels

Overall, there was no difference in the proportion of branded or private label cookies (12% vs 12.6%) containing *trans* fat in the US. However, in Canada 26% of branded products contained *trans* fat as compared to 45.6% of private label cookies ($p<0.01$). Retailers differ across nations, food processors less so. This therefore may be interpreted as partial support of the role of adoption decisions across types of firms in each country if one believes those contract manufacturing firms producing private label cookies in the US are not similarly producing for Canadian grocery chains.

Price

Price was significantly related to the presence of *trans* fat in cookies. Median price per 100 grams was $US 0.75 (interquartile range: $US 0.46, $US 1.48) in US cookies containing *trans* fat as compared to $ US 1.36 (interquartile range: $US 0.82, $US 2.66) in cookies without *trans* fat ($p<.001$). In Canada, the same relationship was found where cookies that did not contain *trans* fat were more expensive (Median: $US 1.79; interquartile range: $US 1.02, $US 3.51) than those containing *trans* fat (Median: $US 1.43; interquartile range: $US 0.87, $US 2.58; $p=.001$). Following the recommendations of two reviewers we referenced two producer price indices (US Bureau of Labor Statistics, 2003-13) to consider cost-based drivers of these price changes. Both the cookie and cracker manufacturing and fats and oils refining and blending series exhibited significant increases over the 2007-9 period for the former and 2007-8 period for the latter. This period coincided with general food inflation at the consumer level - firms altering marketing mixes (both product and price). Yet this general trend doesn't suggest why we see changes in the various types of fats/oils used (see below).

Product Launch Type

There were no significant differences in the energy or macronutrient content among the different types of product launches. However, cookies that were being launched with new packaging had significantly less sodium than new products and new variety/range extensions in the US ($p<.001$) and Canada ($p=.016$). Cookie re-launches were the least likely to contain *trans* fat (6.3%) as compared to other launch types (new product (17%), new variety/range (19%), new packaging (14%), new formulation (10%); $p<0.05$). This result is perplexing, while diffusion may play a role as cookies pass through a life cycle (launch-re-launch/reformulation) it isn't clear why re-launched products should be the "best." Indeed, more novel products appeared to have higher *trans* fat content.

Type of Oil Used

Overall, 71% of US and 70% of Canadian cookies contained more than one oil ingredient. Figures 3 and 4 depict the different types of oils used as the main fat ingredient in cookies launched between 2006 to 2012 in the US and Canada, respectively. In the US, the main fat ingredient was PHVOs in 2006 but by 2012 it was palm oil. In Canada, vegetable oils were the main fat ingredient used in both 2006 and 2012. Overall, in both countries the use of PHVOs decreased over time and by 2012 only 8.3% of cookies in the US and 1.3% in Canada used

PHVOs as the main oil ingredient. However, many of the shortenings - most of which were made up of hydrogenated fat in combination with another type of oil - included smaller quantities of PHVOs. In the US 31% included PHVOs as compared to only 5.4% in Canada. Of the cookies that did not report *trans* fat quantities on the label, 11.7% in the US still contained PHVOs or shortening containing PHVOs as the main oil ingredient. In Canada, only 2.7% of cookies that did not report *trans* fat on the label included PHVOs as the main oil ingredient. Cookies launched in the US provided information in the ingredients list on use of interesterification and high-oleic oils (Flickinger 2004). In 2012, 6% of cookies used interesterification and 6.8% used high-oleic oils.

Vegetable oils were blends of a variety of oils usually including a soft oil (mono or polyunsaturated) and a hard oil (palm, palm kernel or coconut). In the US, the most frequent combination was soybean and palm and in Canada it was canola and palm. Many of the cookies provided a list of oils that they may use. For example, "canola or soy and palm and palm kernel" or "sunflower or safflower", etc. In some cases, the ingredients list would provide up to six possible oils that may be used including PHVOs. Overall, 12% of US and 6% of Canadian products gave multiple possibilities for the oil used. Again, the provision of such marketing information (product and promotion strategies) is an important final step in the conceptual model.

Implications and Limitations

Managers often call for flexibility in meeting standards or new rules and regulations. Other stakeholders question the effectiveness of self-regulation and advocate for mandatory regulation. In the US this has led for continued calls for further attention to the role of *trans* fat in the diet as characterized by FDA's recent proposed policy change to classify PHVOs as unsafe (FDA, 2013). Within the food environment, manufacturers and retailers can be encouraged to change the nutritional quality of products available (whether through choice editing of the assortment or through product innovation) and to play a role in information dissemination and education. How do managers decide strategy? This case study provides a comparison of two sets of responses to self-regulation primed by mandatory inclusion of *trans* fat on food labels.

Although *trans* fat levels were already decreasing between 2001 and 2006 in the US and Canada, we found a further reduction of nearly 50% coinciding with the implementation of the labeling regulation. The types of replacement oils used in the different product formulations were variable (i.e., high in saturated fat versus high in unsaturated fats). The way managers respond to different policies in terms of product reformulation has potential health implications. We found some benefit to considering the multi-step managerial decision making process (DAAAM) but clearly more work is needed if this model is to have any predictive merit.

Given the resources required to reformulate products, it may be an opportunity not only to remove *trans* fat but also address other key nutrients as well. This would further complicate the already dense diffusion-adoption-assimilation-adherence-marketing process to overlay multiple dimensions of nutrition quality. But towards this goal, we found that cookies that did not contain *trans* fat in both countries were also less energy dense and had less fat than those that did contain *trans* fat. Moreover, the Canadian cookies that did not contain *trans* fat also had lower saturated fat levels. These differences are important from a public health nutrition perspective, particularly for individuals who consume cookies frequently. Incremental increases in energy and fat have the potential to lead to weight gain over time and increase the risk of diet-related disease. These differences are therefore encouraging from a public health perspective but would need to be extended into a consumption data set to determine if the supply of more nutritious products is related to better quality diets. There has been some concern that industry would simply replace *trans* fat with saturated fats, which may only have a nominal impact on health. However, this case-study demonstrates that product reformulation was done in a way that resulted in relatively healthier cookies, though not uniformly. Although the reformulated products were 'healthier', it is important to note that cookies are an energy-dense, nutrient poor, ultra-processed food product and consumption should therefore be limited.

It is important to acknowledge the importance of price in both consumer decision-making and the decision-making of managers. We found that products that contained *trans* fat were cheaper than their non-*trans* fat containing counterparts. This relationship has also been found in other studies (Albers et al. 2008; Ricciuto and Tarasuk 2005). It is likely that this price differential could be attributed to alternative oil ingredients being more expensive than PHVOs as highlighted by producer price index data. This points to the need for complementary policies and approaches to reducing *trans* fat in food products and promoting the consumption of healthier oils, given that price conscious consumers may be more likely to buy lower priced products that contain *trans* fat. Interestingly, we found that nearly double the proportion of private label cookies contained *trans* fat as compared to branded cookies in Canada. It is likely that these cookies cater to price conscious consumers providing additional support for policies that go beyond nutrition labeling (e.g., *trans* fat bans) to reduce *trans* fat levels in processed food.

In addition to price, the way products are positioned can influence consumer-purchasing patterns. A substantial proportion of cookies in both Canada and US contained front of pack nutrition claims related to fat. Managers use front of pack nutrition claims as a marketing tool to promote sales (Nestle and Ludwig 2010; Van Camp et al. 2013b). They also often highlight multiple attributes and can provide a "health halo" which reduces the probability consumers explore traditional side of pack (Nutrition Facts) information for more detail. Applying our DAAAM approach to food innovation, it appears clear that various diffusion-adoption-assimilation-adherence decisions can be supported by a range of marketing strategies, including the price, product and promotion. Further firm and brand-level analysis would be useful to determine if front of pack nutrition marketing claims such as these are associated with higher quality products or not.

The conceptual model is part of a broader process of change that remains under studied. We don't consider the motivation for starting the food innovation process by policy makers for example through industry outreach and education to promote awareness. Neither do we extend the model to consider the ***impact*** of these changes in supply on nutrient intake, diet quality and wellness (which may need to accommodate lifestyle changes such as exercise, smoking, etc.). A fully integrated approach would also include feedback loops encouraging subsequent policy changes, managerial decisions and consumer reactions. The empirical case provides a perspective over time in one product category focusing (mostly) on one food component – fat.

In addition to the aforementioned limitations related to the conceptual model, there are also limitations in the data used to conduct these analyses. Although the Mintel data provides us with an understanding of the nutrient quality of new products launched, it does not provide information on market share. Moreover, we do not have information on consumption patterns, thereby limiting the analyses to the foods that are available for consumers to purchase rather than those actually purchased and consumed. Nevertheless, these findings still provide important information which have the potential to inform the policy making process. One of the implications of these study findings for policy makers is that mandatory nutrition labeling can influence the quality of food available in the market, as it becomes an impetus for product reformulation. In this context such a role was likely aided by increased consumer awareness for low *trans* products and subsequent changes in demand. The labeling regulation in both countries was likely the impetus of these changes but this study does not evaluate the direct impact of the policy on new product launches. However, the distinct implementation approaches used in the US and Canada appeared to have some role on the DAAAM food innovation process.

It is important to acknowledge that diet and wellness isn't simply a discussion of one product, one attribute or one eating occasion! Product reformulation of processed foods is only one component of a multipronged approach to improving the quality of the food supply leading to improved diets and reduced risk of non-communicable disease. Nutrition labeling of packaged foods should be complemented with broader initiatives aimed at improving access to affordable healthy foods. The national diets of the US and Canada include contributions from manufacturers and food service companies alike, so innovations from a range of food firms need to be considered when determining how to improve diet quality.

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Appendix

Table 1. Energy and nutrient composition of cookies in the US and Canada from 2006 to 2012

Energy and Nutrients	2006 (n=409)	2007 (n=438)	2008 (n=340)	2009 (n=265)	2010 (n=423)	2011 (n=416)	2012 (n=410)	p-value
				US (n=2,701)				
Energy (kcal/100g)	463 ± 78	463± 77	461± 61	452 ± 69	469 ± 104	459 ± 66	470 ± 57	.058
Fat (g/100g)	20.4 ± 7.7	19.6 ± 8.7	20.1 ± 7.8	19.9 ± 7.0	20.1 ± 7.6	19.6 ± 7.6	20.5 ± 7.4	.636
Saturated fat (g/100g)	8.4 ± 5.6[a]	8.4 ± 6.1[a]	8.7 ± 5.5	9.0 ± 5.6	9.2 ± 5.8	9.3 ± 6.9	9.9 ± 5.9[b]	.012*
Trans fat (g/100g)[§]	1.2 ± 2.5	1.1 ± 2.5	0.6 ± 1.9	0.3 ± 1.3	0.5 ± 1.5	0.3 ± 1.1	0.2 ± 0.9	.000*
Carbohydrate (g/100g)	65.8± 12.0	68.1 ± 13.1[a]	66.5± 9.1	65.2 ± 9.3[b]	66.2± 10.8	66.5 ± 10.1	66.8 ± 8.8	.049*
Protein (g/100g)	5.8 ± 5.0	5.7± 2.4	5.8 ± 2.6	5.8 ± 2.7	5.7± 2.5	5.6 ± 2.3	5.6± 2.7	.873
Fibre (g/100g)[§]	2.9 ± 4.8	2.4 ± 2.4	3.1 ± 3.6	3.3 ± 4.1	3.0 ± 5.0	2.7 ± 3.2	2.6 ± 2.9	.504
Sodium (mg/100g)	298± 154	317± 160	321± 150	308 ± 142	287± 158	287± 143	288 ± 198	.015*

Energy and Nutrients	2006 (n=141)	2007 (n=150)	2008 (n=102)	2009 (n=118)	2010 (n=124)	2011 (n=167)	2012 (n=163)	p-value
				CANADA (n=965)				
Energy (kcal/100g)	460 ± 62	468± 60	462 ± 56	470 ± 64	478 ± 62	477± 106	468 ± 67	.363
Fat (g/100g)	19.1 ± 7.0	21.2± 6.6	20.2± 6.4	21.5± 7.8	21.2 ± 7.3	21.3 ± 7.4	20.7± 7.4	.110
Saturated fat (g/100g)	8.6 ± 5.8	9.5 ± 6.3	9.5 ± 5.7	10.7 ± 6.5	9.7 ± 5.6	9.7 ± 6.1	10.0± 6.2	.247
Trans fat (g/100g)[§]	1.1 ± 1.9	0.8 ± 2.1	0.5 ± 1.2	0.5 ± 2.3	0.2 ± 1.1	0.2± 0.9	0.3 ± 1.5	.000*
Carbohydrate (g/100g)	66.4 ± 10.7	66.0 ± 11.0	63.3 ± 10.7	63.8 ± 10.7	65.7± 7.6	65.1 ± 12.5	64.5± 9.7	.261
Protein (g/100g)	6.0 ± 2.9	6.5 ± 3.3	6.3 ± 2.2	5.7± 2.1	6.3 ± 3.1	6.6 ± 3.3	6.1 ± 2.2	.148
Fibre (g/100g) [§]	3.2± 5.4	2.7± 2.3	3.1± 2.6	2.6 ± 2.7	3.4 ± 3.2	2.6 ± 2.4	2.6± 2.7	.279
Sodium (mg/100g)	280± 156	258 ± 155	276± 181	256± 146	250± 152	276 ± 159	265± 143	.687

[§]Kruskal Wallis test used for abnormally distributed data
*Statistically significant a p<.05

Table 2. The energy and nutrient composition of cookies containing *trans* fat as compared to those without trans fat in the US and Canada

Energy and Nutrients	No *trans* fat (n=1928)	Contains *trans* fat (n=268)	p-value	No *trans* fat (n=601)	Contains *trans* fat (n=255)	p-value
		US			**CANADA**	
Energy (kcal/100g)	462 ± 68	471 ±79	.042*	461 ± 79	485 ±47	.000*
Fat (g/100g)	20.0 ±7.7	20.9 ±7.4	.063	19.9 ± 7.4	22.7 ±6.0	.000*
Saturated fat (g/100g)	9.2 ± 6.0	7.9 ±5.6	.000*	8.8 ± 6.2	11.5 ± 5.3	.000*
Carbohydrate (g/100g)	66.6 ± 10.5	66.4 ± 10.5	.765	65.4 ±11.2	65.0 ±6.8	.554
Protein (g/100g)	5.8 ±3.1	5.3 ±2.2	.025*	6.4 ± 2.8	5.8 ±2.4	.001*
Fibre (g/100g) §	2.9 ± 3.8	1.9 ±1.9	.002*	3.1 ±3.6	2.2 ± 1.9	.000*
Sodium (mg/100g)	299 ±161	318 ±145	.074	270 ± 163	259 ± 129	.283

§ Mann-Whitney U test used for abnormally distributed data
*Statistically significant a p<.05

