# Overview of
# Pizzas
## available in Canada
## 2017-2022

FOOD QUALITY
**OBSERVATORY**

UNIVERSITÉ
LAVAL

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# Key findings <span>1</span>

This report monitors pizzas offered and sold in Canada between 2017 and 2022. It makes a number of observations about the evolution in nutritional composition of pizzas, based on content and packaging information. Analyses were also carried out according to pizza status (new, identical, modified or withdrawn), again in comparison with the initial 2017 portrait. Here is a summary of the main results:

- A sample of 204 pizzas was counted (vs. 155 in 2017), representing 81% of the market (vs. 80% in 2017). This represents an increase of 49 products (i.e., 32% of the offer), and a 37% increase of sales.
- The type of pizzas offering the greatest **variety** (number of different products) are vegetable and deli meat type (n=60/204; 29%). As in 2017, the best-selling pizzas are deli meat-based, with 39% of sales in the category.
  - Pizzas with a thin crust are still the most present on the market (n=91/204; 45%), but have seen a reduction in sales since 2017 from 49% to 34% (-15 pp). Traditional-crust pizzas are now the most popular (39% of sales).
  - Basic pizzas (with no specific characteristics) continue to offer the greatest variety (n=163/204; 80%), up +7 pp. With an increase in sales of +9 pp, they now account for 95% of all category sales. Conversely, the variety of authentic-looking pizzas fell by -9 pp, as did their sales.
- As regards pizza **status** in 2022, there are 5 identical products, 61 modified products and 138 new products. Since 2017, 89 products have been withdrawn from the market.
  - Vegetable and deli meat pizzas offer the highest proportion of new products (n=40/60; 67%), followed by deli meat pizzas (n=35/56; 63%).
  - The largest proportion of modified products are deli meat pizzas (n=19/56; 34%), followed by vegetable and deli meat pizzas (n=17/60; 28%).
- Analysis of the **nutritional composition** of pizza types shows that the 2022 **offering** is statistically similar to that of 2017. In terms of **purchases**, pizzas in 2022 contain more energy (+20.9 kcal; +4.5%) and fat (+1.7 g; +9.2%) per serving, but less fibre (-0.4 g; -12.5%) and sodium (-49.6 mg; -4.7%) than in 2017. The only significant difference, by pizza type, comes from vegetable pizzas purchased, which are now lower in sodium (-86.9 mg; -10.3%) than in 2017.
- As regards the **30% Daily Value** (DV) threshold, a minority of pizzas meet this threshold for saturated fat (28% of the offering representing 20% of sales) and sodium (4% of the offering representing 1% of sales). Therefore, virtually all pizzas should reduce their sodium content, and around three-quarters should reduce their saturated fat content. Therefore, unless their nutritional composition changes, most pizzas will be required to display the

symbol on the front of their packaging stating that they contain an excess of saturated fat and sodium.

- o Compared with 2017, the only more pronounced variation is that observed with **fibres**, for which the percentage of pizzas meeting the 15% DV threshold fell by 45% for offering and 36% for purchases. Thus, even more pizzas do not contain enough fibre.
- o As for the voluntary **sodium** reduction target, the majority of pizzas (86% of the offering representing 88% of sales) still exceed this target, whereas it had been 85% of pizzas (96% of sales) in 2017. Vegetable pizzas have seen the biggest increase in target-compliant products since 2022 (+65%).
- In order to track the evolution regarding pizzas, nutritional composition analyses were carried out in relation to product status.
- o The **new pizzas** on market in 2022 are higher in saturated fat and protein, yet lower in sugar than the other pizzas (identical, modified or withdrawn).
- o As for **modified pizzas**, they contain less saturated fat and protein, but more sugar than the others. The nutrient of interest most often modified is sodium (93% of modified pizzas). Sodium content was reduced in 49% of modified products (average of -97 mg per portion), while it increased in 44% of cases (average of +44 mg).
- The nutritional composition of pizzas may vary according to the **information on the packaging**. Purchased pizzas with thin **crusts** now contain more energy, fat and sugars, but less fibre than they did in 2017. As for traditional-crust pizzas, they have reduced sodium levels compared to 2017.
- Focusing on the **top sellers**, pizzas in quintiles 4 and 5 (the top sellers) had the highest sodium content and the lowest fibre content. Compared to 2017, saturated fat levels have risen more in the lowest-selling pizzas. As for sodium, reductions were more marked in the best-seller quintiles.

## In summary

Despite a major renewal of products offered on the market, changes in the nutritional composition of the pizza offering in recent years have been minor. They still contain too much saturated fat and sodium, and too little fibre. The pizzas purchased by consumers were higher in fat and lower in fibre and sodium than they were in 2017. This improvement in sodium levels may be due to a reduction in this nutrient in traditional-crust pizzas. Since these represent a high percentage of sales, this has an impact on all products sold. Unless changes are made to their nutritional composition, the majority of pizzas will end up displaying the front-of-package nutrition symbol indicating that they are high in saturated fat and sodium. In light of these findings, and considering that pizzas are consumed widely, efforts are still required to improve the nutritional quality of pizzas offered in Canada.

# Context and issues

# 2

The mission of the Food Quality Observatory (hereinafter referred to as the Observatory) is to monitor the evolution of the food supply in order to generate new knowledge and contribute to the collective effort for improving its quality and accessibility. The aim of the studies carried out by the Observatory is to analyze the nutritional composition of certain food categories, and to follow their evolution over time.

The purpose of this report is to monitor the pizzas offered and sold in Canada five years after the initial portrait[1] conducted in 2017 for this food category. This report shows the changes in the biofood industry's product offering, as well as changes in consumer purchasing behaviour.

This first section reviews the main findings of the initial portrait of the pizza category. It also outlines the changes observed in public policy and in the food context since the initial portrait. Finally, an update of the scientific and grey literature published over the last five years is provided, together with studies that have also tracked the nutritional composition of pizzas over time.

## 2.1 Review of the initial portrait

The Observatory, in partnership with Health Canada, drew up an initial portrait of the pizza category with a total of 155 different products identified in Canadian food markets in 2017[1]. The pizzas offered were mainly deli meat pizzas (31% of the supply), followed by vegetable and deli meat pizzas (23%). Deli meat pizzas and vegetable and deli meat pizzas alone accounted for 61% of the category's sales volume. On the other hand, thin-crust pizzas had a greater variety in terms of offering (42% of the offering), while traditional-crust pizzas had a greater proportion of sales (49% of the market). In terms of nutritional composition, the deli meat pizzas had higher energy, fat and sodium levels than the other pizzas. Vegetable pizzas were lower in carbohydrates, protein and sodium than the other pizza types. Overall, more than two-thirds (71%) of all pizzas exceeded the 30% Daily Value (DV) threshold for saturated fat. As for sodium, 94% of all pizzas exceeded the 30% DV threshold for this nutrient, and 85% exceeded Health Canada's voluntary sodium reduction target. It would therefore be appropriate to follow up on the evolution regarding pizzas - particularly deli meat pizzas - to see if any nutritional improvements have been made since the first portrait was produced.

## 2.2 Changes in public policy and in the food context

Since 2016, various regulations and public health initiatives have been introduced. At the provincial level, the *Politique gouvernementale de prévention en santé*[2] (Government health prevention policy) was rolled out in 2016. Through objective 3.2, this policy aims to improve the nutritional quality of food in Québec[2]. As a result, players in the biofood sector have been encouraged to produce, offer and promote healthier foods. Then in 2018 the *Politique bioalimentaire* (Biofood policy) was launched[3]. This policy aimed at improving the nutritional value of processed foods in Québec, encourages industries to reformulate their products or develop new products that are more beneficial from a nutritional point of view. This policy is being implemented in conjunction with financial levers to support industries in this approach. Moreover, the *Amélioration alimentaire Québec* (AAQ) initiative was created in 2021 to support food processing companies that wish to develop foods of good nutritional quality or improve the nutritional value of existing foods[4].

At the national level, thanks to Health Canada's Healthy Eating Strategy, Canada's Food Guide, released in 2019, highlighted the benefits of whole grains and plant-based foods. In addition, it proposed limiting highly processed foods rich in sodium, sugars and saturated fats[5]. At the same time, consultations concerning the addition of the front-of-package (FOP) nutrition symbol for food products with high levels of saturated fats, sugars and sodium may have motivated the biofood industry to reduce their content of these nutrients of interest[6]. Similarly, voluntary sodium reduction targets for processed foods were first introduced in 2012[7] and have been updated for the period 2020-2025[8]. The aim of these targets is to encourage the food processing sector to reduce sodium levels in their products, in order to reach these targets by 2025. In addition, regulatory changes to reference amounts, nutrition claims, the presentation of the Nutrition Facts table and the list of ingredients were introduced and should be implemented no later than December 2022[9]. Once again, this may encourage manufacturers to reformulate their products or develop new ones with a more beneficial nutritional composition from the outset.

Finally, the COVID-19 pandemic has reinvented the way food is sourced. More and more Québecers are doing their grocery shopping online, which can have an impact on their purchasing behaviour. According to a 2020 Canadian internet usage survey, there was a 77% increase in online purchases compared to 2018[10]. One in five Canadians also reported shopping online for groceries more often than before the pandemic, and 13% of Canadians did so online for the first time during the pandemic. Just over one in six Canadians have also used the internet to purchase physical goods through subscriptions – 7% have received boxed lunches on a regular basis, and 5% have received groceries. All these changes may have influenced the pizzas offered and purchased in Canada between 2017 and 2022.

## 2.3   Purchasing and consumption

In Québec, the frozen pizza and submarine sandwich sector accounted for nearly $174 million in sales in 2020, up 16.1% on 2019. Frozen pizza snacks or bites accounted for nearly $24 million in sales in 2020 (up 18.1% on 2019), while refrigerated pizzas accounted for nearly $22 million in sales (up 185.2% on 2019). Also in Québec, ready-to-eat meals, including pizzas, ranked 4th among the most purchased ultra-processed foods in 2019[11]. Pizza therefore has a special place in the diet of Québecers. Pizza is also one of the most frequently consumed fast foods, particularly among young people[12]. In fact, pizza was the best-selling food in Canadian elementary school socio-financing campaigns[13].

## 2.4 Health impact and nutritional intake

Fast food is typically high in energy, saturated fat, sugars and sodium[14]. Excessive consumption of these nutrients has been repeatedly associated with an increased risk of chronic disease[15]. More specifically, researchers have observed that pizza consumption is associated with an increased risk of being overweight or obese[16].

In 2015-2016, the *Institut national de santé publique du Québec* (INSPQ) noted that small-format pizzas and frozen sandwiches were the 7th largest sodium-contributor category purchased by Québecers, providing 3.3% of total sodium from the grocery basket[17]. For reference purposes, breads were the food category contributing the most sodium, followed by deli meat. Across Canada, a report published in 2017 showed that mixed meals – such as pizza, lasagna or prepared salads – represented the second highest source of dietary sodium[18]. The first source was bakery products such as breads. During the same years in the United States, pizza was the second-largest source of sodium, accounting for 5.4% of total sodium intake[19]. According to a National Health and Examination Survey (NHANES) study conducted in 2011-2014, pizza was the second-largest source of saturated fat in the diets of young people aged 6 to 11, contributing 9% of intake[20] and the leading source of saturated fat for 12-18 year-olds, with 9.1% of intake. In addition, pizza was the number one source of sodium for children aged 6 to 18. These results were generally explained by the presence of cheese on the pizzas, although the presence of deli meats could also contribute, since it was the 3rd highest contributor of sodium. Furthermore, pizza was the third-largest source of energy in the diet of Americans aged 10-19 (6.6%)[21]. In a study of eight Latin American countries, researchers found that pizza was the third highest source of saturated fat, accounting for 10.3% of total intake[22].

Pizza is therefore a major source of sodium and saturated fat in people's diets.

## 2.5 Nutritional composition

A few studies have looked more specifically at the nutritional value of pizzas.

### In Canada

In Canada in 2017, pizzas, pizza snacks and frozen sandwiches contained an average of 533mg of sodium per 100g serving[8]. In this regard, Health Canada has set the voluntary sodium reduction target for 2025 at 400mg (weighted average for the category) and the maximum level at 580 mg per 100g (for an individual product within the category). Targets are set according to the food matrix, and therefore vary from one food category to another.

> **In Canada in 2017, pizzas, pizza snacks and frozen sandwiches contained an average of 533 mg of sodium per 100 g serving.**

### International

According to nutritional profiling analyses carried out on 3,449 pizzas from 62 countries, researchers observed that in order to rank among the top 50% of pizzas, they had to contain less than 5g of saturated fat, less than 600mg of sodium and more than 8.7g of protein per 100g[23]. To rank among the top 15%, pizzas had to contain less than 4g of saturated fat, less than 520mg of sodium and more than 9.8g of protein.

In Australia, the nutritional composition of private label pizzas was analyzed by a research group. They observed that the pizzas had an average nutritional profiling score (according to the star system) of 2.9 out of 5[24]. According to these researchers, the criteria for calculating the star system score should be reviewed, since this score is not strict enough and allows ultra-processed foods to obtain a "healthy" score, i.e., a score higher than 2.5 out of 5.

Researchers in Spain looked at gluten-free pizzas and found that they contained significantly less protein than those with gluten (3.9g vs. 9.3g)[25]. This may be explained by the use of ingredients that are naturally high in carbohydrates and low in protein to replace wheat (e.g., cornstarch, corn flour and rice flour).

## 2.6 Marketing

Empirically, foods with low nutritional value are routinely promoted in advertising. In fact, fast food advertising, where pizza is often at the forefront, was the most prevalent at 40.6% of food ads aimed at Canadian teens in 2016. More specifically, pizzas accounted for 2.8% of TV food ads aimed at Canadian teens in 2011, whereas the proportion had dropped to 1.7% in 2016[26]. Other researchers observed that frozen pizza was the fourth most frequently advertised food in New York subway stations[27].

## 2.7 Importance of packaging information

Several studies have identified front-of-pack nutrition labelling as a promising strategy for improving the nutritional quality of consumer choices and encouraging the biofood industry to offer products with higher nutritional value.

First, researchers set out to assess the impact of five types of front-of-pack information on the ability to rank pizzas in order of nutritional quality. This study was carried out in 15 countries[28,29-33]. The five types of information evaluated were: the guidelines daily amounts[*], the traffic-light system[†], the warning symbol[‡], the Nutri-Score[§] and the Health Star Rating system[**]. In all countries, the ability to rank pizzas in order of nutritional quality was improved with the Nutri-Score compared to other systems.

Other researchers observed that, among the Health Star Rating system, traffic lights or guidelines daily amounts displays on pizza packaging, the star rating system was the best at helping consumers choose the "healthiest" option[34], reduced the pizza portion size that consumers deemed appropriate to eat,[35] and increased the likelihood that consumers would choose a more nutritious pizza over a less nutritious one[36].

A Danish study assessed the impact of sodium claims on the purchase of sodium-reduced frozen pizzas[37]. Two types of frozen pizza were therefore labelled "Meets Danish Food Administration sodium targets" or "Meets Danish Food Administration sodium targets, same great taste". After eight weeks, the researchers observed that demand for these products had not increased. One-on-one interviews with consumers also revealed that they were more focused on elements other than sodium when making food choices at the grocery store (e.g., choosing whole grains, reducing fat or sugar intake).

One study showed that processed foods such as pizza featuring an organic logo were perceived as tastier and higher in calories than their conventional counterparts[38].

## 2.8 Product reformulation

Reformulating pizzas to reduce their sodium and saturated fat content, or to increase their protein and micronutrient content, is an important public health strategy that does not require major behavioural changes on the part of consumers. The following paragraphs therefore present various attempts that have been undertaken to improve the nutritional composition of pizzas.

Researchers have evaluated the use of salt water to replace salt in the manufacture of pizza crusts[39]. This saline water reduced the sodium content of the crust by 50%. Although crusts produced with saline water were perceived as less salty, this difference did not result in a significant decrease in overall product appreciation.

Other researchers have observed that the use of acid whey from yogurt in pizza crusts led to an increase in their protein, calcium and potassium content, while reducing their sodium and

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[*] Guidelines daily amounts indicate what percentage of daily intake corresponds to the content of a given nutrient.
[†] The traffic light system indicates whether a given nutrient is low (green), medium (yellow) or high (red).
[‡] The warning symbol is displayed if the product is high in saturated fats, sugars and/or sodium.
[§] The Nutri-Score assesses the nutritional quality of a product on a scale from E to A.
[**] The Health Star Rating system assesses a product's nutritional quality on a scale of 0.5 to 5 stars.

sugar content[40]. Acid whey is a by-product of the dairy industry, and its use in pizza crusts would avoid the release of this compound into the environment. Acid whey also extends the life of crusts, reducing the need for additives.

Researchers wanted to assess the nutritional composition and acceptability of gluten-free pizzas produced with banana co-product flour (e.g., peels, stems)[41]. The results showed that banana co-product flour was high in fibre and minerals, and low in energy. Generally speaking, pizzas made with this flour were however not particularly popular with consumers.

Partial replacement of wheat flour by soy dough and wheat fibre resulted in higher fibre and protein content, as well as lower saturated fat and energy content in pizzas[42]. While the dough's elasticity level was the same as for regular dough, the moisture level was increased due to the water-binding capacity of soy proteins. According to consumers, texture was rated as similar between the two types of pizzas, but appearance, aroma and taste were diminished in pizzas enriched with soy dough and wheat fibre.

According to another study, adding 5%, 10%, 15% or 20% tuna meal (i.e., bones, skin, dried and ground muscle) to pizza dough increased the protein and polyunsaturated fat content of pizzas[43]. This result was achieved without affecting aroma, flavour, overall impression or purchase intent.

Finally, researchers wanted to assess the impact of substituting 5%, 7.5% or 10% wheat flour with dried carp powder or chickpea flour[44]. The addition of dried carp powder increased the protein and zinc content of the pizzas, while chickpea flour increased the iron and zinc content. Substituting 7.5% dried carp powder or chickpea flour was considered the best option for maintaining all the pizzas' sensory characteristics.

## 2.9 Environmental impact

French researchers set out to measure the environmental impact of 80 different pizzas through a life-cycle analysis[45]. Ingredients, pizza production, packaging, transport, distribution and type of consumption at home were all taken into account in calculating the score. The score varied widely from one pizza to another, ranging from 0.22kg CO2eq to 0.88kg CO2eq per 140 g portion. Note that the higher the score, the greater the environmental impact. On average, the pizzas had a score of 0.44kg CO2eq per serving.

Similarly, other researchers have estimated that the carbon footprint of vegetable pizzas varies between 0.18 and 0.45kg CO2eq per 140g portion, and between 0.56 and 0.73kg CO2eq per portion for meat pizzas[46]. These differences between pizzas can be explained by differences in toppings, crust ingredients and the availability of environmental information on ingredients. Currently, pizza consumption in the USA generates a carbon footprint of between 0.072 and 0.098kg CO2eq per person per day, which corresponds to 0.38 to 0.52kg CO2eq per 140g pizza serving.

## 2.10 Evolution in the category

There have been few studies examining the evolution of the nutritional composition of pizzas over time. These few studies are of particular interest in the context of this report, which documents the evolution in pizza in Canada between 2017 and 2022.

First, in France, the French food Observatory (OQALI) monitored the pizza sector between 2010 and 2015[47]. In 2015, 63% of pizzas were new products, 36% were modified products and only 1% were identical compared to 2010. Nearly a third of these products have been withdrawn from the market since 2010. Overall, saturated fat levels remained stable between the two portraits, but some pizzas present during the two years of the study had nevertheless significantly reduced their levels (4% drop in cheese pizzas and a 9% drop in vegetable pizzas). As for salt, a downward trend was observed between 2010 and 2015 across the whole range of pizzas on offer. In fact, a 15% reduction in salt content was noted for deli meat pizzas, 13% for meat pizzas, 7% for vegetable pizzas and 6% for seafood pizzas. The drop was explained both by the presence of new, lower-salt products and by the reformulation of products already on the market in both years.

In the UK, analysis of the nutritional composition of pizzas via supermarket websites revealed that, over a six-month period, 10.8% of the 903 pizzas identified had changed their nutritional composition[48]. Furthermore, around 30% of the pizzas offered were discontinued or new on the market.

In Australia, researchers measured evolution in sales of unhealthy foods and beverages over a five-year period[49]. They observed that between 2012 and 2017, sales of frozen pizzas increased by 6%.

In Brazil, between 2008-2009 and 2017-2018, the contribution of out-of-home pizza consumption to total pizza consumption fell from 42.5% to 24.7%[50]. So pizza, whether homemade or commercial, seems to be consumed more and more at home. Even so, pizza was one of the foods eaten most outside the home during both study periods.

## 2.11 Rationale and relevance of the Observatory's work

Since the initial portrait of pizzas conducted in 2017, there has been a growth in purchases as well as the release of new studies as previously described both in Canada and internationally on the contribution of pizzas to nutrients to limit demonstrate the ever-present interest in analyzing this food category. However, few studies have monitored the nutritional composition of pizzas and their sales over time. In such a context, the Observatory's work is relevant to characterize the evolution of the food supply of this food category in Canada. This type of follow-up will provide long-term support for actions intended for improving the nutritional quality of the Canadian food supply.

# Objectives 3

The objectives of this pizza follow-up study are as follows:

1. Identify differences in the types of pizzas available in Canada, their packaging information and sales between 2017 and 2022;

2. Compare the nutritional composition, selling price and nutrient contribution of different types of pizza offered and sold in Canada between 2017 and 2022, also according to their status (new, identical, modified or withdrawn from the market);

3. Verify:
   a) how packaging information relates to the content of certain nutrients of interest, and to the selling price of pizzas;
   b) to what extent these associations differ between 2017 and 2022.

# Methodology 4

## 4.1   Nutritional composition data

To meet the research objectives, a web-based data collection was carried out across Canada. This collection took place during the months of April and May 2022. To this end, sales volume data from NielsenIQ[51] were used to develop a sampling plan for the products to be collected, and to obtain a representative sample of pizzas sold in Canada. Pizzas from companies accounting for the majority of pizza sales in Canada (around 80 to 85%) were identified, and the websites of these companies and grocery stores were visited.

The pizzas included in this study were only frozen pizzas available in packaging with a Nutrition Facts Table (NFT). The following pizzas were also included: pocket pizzas, pizza bites/snacks and frozen calzones. A total of 204 products were listed.

All the information found on the main faces of the product packaging was entered into an Excel file in double encoder. The data entered includes the brand name, product name, Universal Product Code (UPC), NFT, list of ingredients and claims. More specifically, the nutritional composition variables used in this study are: energy (kcal), fat (g), saturated fat (g), carbohydrates (g), total sugars (g), fibre (g), protein (g) and sodium (mg). The regular price per pack was also documented by averaging the prices observed on the various websites, and the selling price per portion was then calculated. However, for the reference year (2017), only prices actually paid by consumers were available. These prices come from the NielsenIQ database. As prices calculated using this method were available for both years, these were used for comparisons with 2017. The 200 g serving size is the reference quantity used by Health Canada.

## 4.2 Product classifications and definitions

The pizzas listed were grouped according to the classifications presented in Table 1. These classifications are identical to those used in the initial portrait and were inspired by the scientific and grey literature[47].

## Table 1. Classification of products by type and packaging information

| Classifications[a] | | Definitions |
|---|---|---|
| Type [b] | Cheese only | Pizza containing only cheese or imitation cheese. |
| | Vegetable | Pizza with vegetables and/or fruit only. Includes olives, onions and jalapeños. |
| | Deli meat | Pizza with deli meat only. Includes bacon and sausage as well as plant-based equivalents. |
| | Vegetable and deli meat | Pizza made with vegetables and/or fruit **and** deli meat or their plant-based equivalents. |
| | Vegetable and meat | Pizza with vegetables and/or fruit **and** meat, poultry, fish, seafood or their plant-based equivalents. Excludes deli meats. |
| | Meat and deli meat | Pizza with meat, poultry, fish or seafood **and** deli meat. Includes plant-based equivalents. |
| | Vegetable, meat and deli meat | Pizza with vegetables and/or fruit, meat, poultry, fish or seafood **and** deli meat. Includes plant-based equivalents. |
| | Without cheese | Pizza without cheese (e.g., tomato sauce or vegetable pizza). |
| Origin | Animal | Pizza containing at least one animal-source ingredient. |
| | Plant-based | Pizza containing only plant-based ingredients. |
| Crust | Traditional | Pizza with a traditional, classic and/or thick crust. The bottom of the crust may be thin if the rim is thick. |
| | Traditional stuffed | Pizza with a traditional crust, but stuffed (regardless of the type of stuffing). |
| | Thin | Pizza with a thin, light crust. |
| | Calzone | Where the dough completely folds around the pizza (pizza pocket style). Can be traditional, thin, fried, flaky or baked. |
| Sauce[c] | Tomato | Pizza topped with tomato, bolognese, pesto or vegetable sauce. Includes vegetable and garlic purées. |
| | Rosé | Pizza topped with a rosé sauce (a mixture of tomato sauce and white sauce). |
| | White | Pizza topped with cream, béchamel, cheese or tzatziki sauce. |
| | Other | Pizza topped with a sauce other than those mentioned above (barbecue, garlic butter, etc.). |
| Target customer | Children | Pizza intended for children, i.e., with packaging that displays or mentions:<br> - that it is a product for children;<br> - a character / image / film / program intended for children;<br> - an activity or promotion intended for children;<br> - a fun or fantastical theme;<br> - use for kids' lunch boxes or at school;<br> - a fun shape or a catchy name for children. |
| | General population | No specific target customer. |
| Specific characteristic | Organic | When most of the ingredients are organic, or when it is clearly stated on the packaging that the pizza is organic. |
| | Natural-looking | When a term on the packaging designates a less-processed product, less preservatives, natural/nature or a derived term. Excludes all terms referring to the origin of ingredients and natural aromas or flavours. |
| | Authentic-looking | When a term on the packaging or in the product name explicitly designates authentic, rustic, old-fashioned, *vintage*, wood-fired, stone-fired, traditional, true (where this is synonymous with authentic), artisan/craftsman, old-fashioned, hand-kneaded or a derivative term. Excludes all terms referring to the origin of ingredients. |
| | Basic | All pizzas not classified as organic, natural or authentic. |

[a]*Only the photo of the main face of the packaging has been used to classify the pizzas.*
[b]*The sauce has been excluded and cheese has been included.*
[c]*If the sauce was not visible and not specified on the packaging, the ingredient list was consulted to determine the type of sauce.*

The first classification was based on the **type** of pizza, i.e., the topping on each one. Figure 1 shows a pictorial representation of the eight types of pizza.
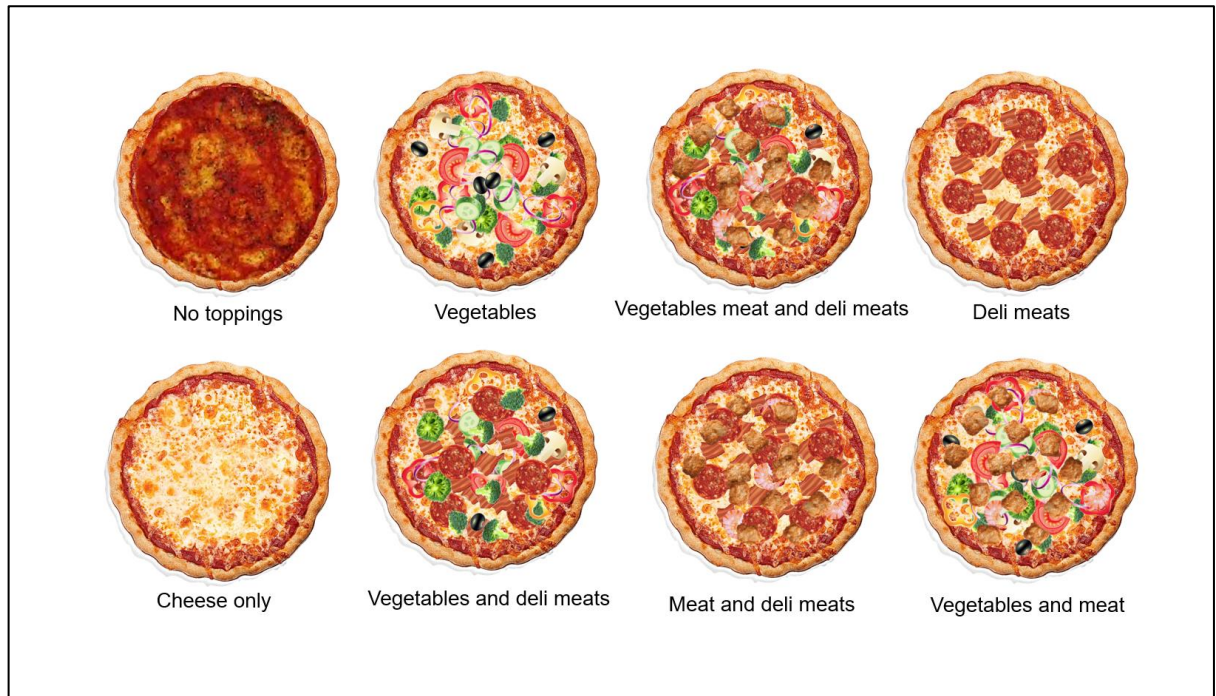
**Figure 1. Overview of pizza types according to content**

Each product has also been classified according to certain information contained on the packaging. As shown in Table 1, a classification has been made according to **origin**, **crust**, **sauce**, **target customer** and **specific characteristic**. This classification process was carried out using a double coder system, and a third party was consulted in the event of discrepancies, with a view to reaching a consensus.

Although the classifications are the same as in the initial 2017 portrait, some classifications have been adjusted. In fact, the "meat" content classification has been removed, since no product was identified in 2022 with only meat as a topping. However, the "vegetable, meat and deli meat" content has been added to accurately represent the offering in place in 2022. In fact, this type of content was present in 2017, but only on two pizzas, which was an insufficient number for analysis. Therefore those pizzas were then grouped with another classification for analysis. With the aim of best representing today's market, classifications based on origin and main crust ingredient have also been added. As for the target customer, no products intended for the health-conscious were identified in 2022. This classification has therefore been withdrawn.

In addition to these classifications, pizzas were also separated according to their status compared to 2017, i.e., whether they were new products, identical products, modified products or products withdrawn from the market.

**Table 2. Product status compared to 2017**

| Status | Definitions |
|---|---|
| **New product** | Product not related to any product in the 2017 collection and with a UPC found only in the 2022 study. |
| **Identical product** | A product that can have a different UPC between the two collection years as long as the following information is identical: product name, ingredient list, nutrition facts table, claims and packaging. |
| **Modified product** | Product on the market in 2017 and 2022 (with or without the same UPC), but with changes in packaging (e.g., images, logos, claims) and/or nutritional composition. |
| **Withdrawn product** | Product present only in the initial 2017 portrait. |

With regard to modified products, certain changes are permitted by the regulations without necessarily having to change the UPC[52]. In this respect, changes in the ingredient list (addition, removal or substitution of an ingredient) seem to be the most frequent. They are often accompanied by packaging modifications. Thus, for the purposes of this study, the reason(s) why a product ended up with "modified" status (with or without a change in UPC) was also taken into account. Overall, a modified product could be deemed such due to one or more of the following reasons:

- ⌡ addition(s), removal(s) or change(s) to the Nutrition Facts Table;
- ⌡ addition(s), removal(s) or change(s) in the list of ingredients;
- ⌡ addition(s), removal(s) or change(s) to health or nutritional claims or logos (e.g., source of fibre or low in saturated fat);
- ⌡ addition(s), removal(s) or change(s) to any other packaging information (e.g., made with Canadian wheat or preservative-free);
- ⌡ addition(s), removal(s) or change(s) in the general appearance of the packaging (e.g., image, photo).

It should also be noted that in the event of a change in the list of ingredients, the product was then analyzed more closely to check whether the change detected was a real one. In fact, in many cases, it was a modification made mostly to comply with Health Canada's new labelling regulations[53] (e.g., grouping of sugar-based ingredients, but with a recipe identical to 2017 because the absolute amounts of nutrients were identical in the NFT). Within the modified products, regardless of the reason for the modification, it was possible to distinguish those that had genuinely changed their composition from those that had merely complied with a new regulation. In other words, if the NFT was modified to comply with regulations, but the nutritional content remained unchanged, the product was not considered to have a modified NFT .

## 4.3 Food purchasing data

A second database was used as part of this project to cross-reference data on food purchases with data on their nutritional composition. More specifically, sales data for pizzas sold in

Canada are provided by NielsenIQ[54]. Most of the information in this database comes from the scanning of products purchased at the checkout, representing purchases made in the supermarkets of Canada's major food chains (e.g., Loblaws, Sobeys, Metro, Walmart [national brands only]). However, part of the information comes from a projection based on purchase data from a *Homescan* consumer panel (i.e., 12,000 households across Canada, statistically representative of the population) and supplements the information for non-participating retailers, which is the case for the warehouse club network (e.g., Costco) and dollar stores (e.g., Dollarama), among others. Finally, since small chains (e.g., Marché Richelieu) are unable to provide sales information for all their stores, an audit was carried out to estimate the market they represent as accurately as possible. Convenience stores and service stations are not covered by the database, but represent only 3% of the total market. It should also be noted that this database covers a 52-week period ending on January 29, 2022. The variables available by product are sales in Canadian dollars, sales in kilograms and unit sales (number of pizza boxes).

## 4.4 Cross-referencing with nutritional data

Data on purchases were combined with data on the nutritional composition of pizzas. More concretely, the matching was done first by UPC, then by product name for products for which the UPCs did not match (e.g., different formats). Since the collection of nutritional composition data was based on the list of purchase data provided by NielsenIQ, there is 100% coverage between the two types of data in this study. Sales of products with more than one format available have been grouped together for analysis purposes. It should be noted that the analyses were carried out taking inflation into account. Prices shown in the tables are for 2022, but comparisons have been made by adjusting 2017 prices for inflation (constant dollars).

## 4.5 Statistical analysis

To provide a general description of the offering and purchase of pizzas in Canada, as well as their trend, frequency tables are presented. The market shares of each pizza classification in 2022 are detailed both in terms of number of products and sales volume (kg). The change in market share is expressed as a difference in percentage points (pp) compared with 2017 (objective 1). For its part, the trend in variety[††] is expressed in terms of the number of products that differ from the reference year (2017), then the differences in distribution are presented in pp.

Each type of pizza from 2022 is first compared to the other types on the basis of its nutritional composition and price. Next, the evolution of this information between 2017 and 2022 is evaluated in relative percentage and in units for each type of pizza. Figures illustrating average

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[††] Variety represents the number of different products found on the market in a given year. A product is not considered different if the only change is the sales format. In the event that several formats exist on the market, sales of each format are added together.

levels for the four nutrients of interest (saturated fat, sodium, protein and fibre) are presented in the appendix. These figures are produced to facilitate comparisons of both raw and adjusted data for sales in 2017 and 2022. Other figures illustrate the evolution between 2017 and 2022 of the proportion of products offered and sales meeting the 30% thresholds for saturated fat, protein[‡‡] and sodium, and the 15% DV threshold for fibre. These figures show quickly whether the thresholds for the four nutrients of interest are more or less respected, for each type of pizza. Descriptive analyses detailing nutritional composition and price according to pizza status are also presented (objective 2).

The nutritional composition and selling price of each 2022 pizza classification are first compared with the reference classification, for each packaging information classification. Next, nutritional and price change between 2017 and 2022 is assessed in relative percentage and unit terms for each pizza classification. Finally, nutritional composition and selling price by status (new, identical, modified or withdrawn) were compared by combining all pizzas and sales data from the 2017 and 2022 collections.

The tests used are the Kruskal-Wallis test when the data are not weighted for sales, and rank regressions when weighted, since the residuals of the parametric models do not follow the normal distribution. For all statistical tests, the significance level (alpha=0.05) was corrected using the Bonferroni correction method to take account of multiple comparisons.

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‡‡ Since proteins have no DV, the calculation was based on the Dietary Reference Intakes (i.e., 0.8g per kg body weight per day, which represents the Recommended Dietary Allowance). An average weight of around 75kg for a Canadian adult was used, based on CCHS 2004 data. Thus, the daily value was estimated at 60g and the 30% threshold was set at 18g.

# 5 Results

## 5.1 Variety of pizzas (objective 1)

Table 3 shows the number of different products (variety), in descending order, and their sales for each classification, as well as the evolution compared to 2017. Variety is presented in terms of the number of products and the percentage that this number represents of the entire offering for a given year. Evolution in variety is expressed as the number of products that differ from the reference year (2017), then in percentage points (pp). Percentage points represent the percentage difference in market share represented by the same classification between 2017 and 2022.

**Table 3. Evolution of pizza variety and sales by their type and packaging information**

| Classifications | | Variety 2017 (n(%)) | Variety 2022 (n(%)) | Variety evolution (n(pp[a])) | Sales 2017 (%) | Sales 2022 (%) | Sales evolution (pp) |
|---|---|---|---|---|---|---|---|
| **Type** | Deli meat | 48 (31) | 56 (27) | +8 (-4) | 35 | 39 | +4 |
| | Vegetable and deli meat | 35 (23) | 60 (29) | +25 (+6) | 26 | 26 | 0 |
| | Vegetable | 25 (16) | 34 (17) | +9 (0) | 13 | 10 | -3 |
| | Vegetable and meat | 15 (10) | 8 (4) | -7 (-6) | 6 | 3 | -3 |
| | Meat and deli meat | 4 (3) | 7 (3) | +3 (+1) | 6 | 5 | -2 |
| | Cheese only | 20 (13) | 36 (18) | +16 (+4) | 11 | 16 | +4 |
| | Meat | 3 (2) | 0 (0) | -3 (-2) | 1 | 0 | 0 |
| | Vegetable, meat and deli meat | 2 (1) | 2 (1) | 0 (0) | 1 | 1 | 0 |
| | Without cheese | 3 (2) | 1 (0) | -2 (-1) | 0 | 0 | 0 |
| **Origin** | 100% plant-based[b] | 3 (2) | 12 (5) | +9 (+4) | 0 | 1 | 0 |
| | Animal[c] | 152 (98) | 192 (94) | +40 (-4) | 100 | 99 | 0 |
| **Crust** | Thin | 65 (42) | 91 (45) | +26 (+3) | 49 | 34 | -15 |
| | Traditional | 60 (39) | 83 (41) | +23 (+1) | 40 | 39 | -2 |
| | Calzone | 30 (19) | 19 (9) | -11 (-10) | 12 | 19 | +6 |
| | Traditional stuffed | 0 (0) | 11 (5) | +11 (+5) | 0 | 8 | +8 |
| **Sauce** | Tomato | 137 (88) | 189 (93) | +52 (+4) | 93 | 92 | 0 |
| | Rosé | 8 (5) | 3 (1) | -5 (-4) | 4 | 4 | 0 |
| | White | 7 (5) | 7 (3) | 0 (-1) | 2 | 0 | -2 |
| | Other | 3 (2) | 5 (2) | +2 (+1) | 1 | 3 | +2 |
| **Target customer** | General population | 132 (85) | 170 (83) | +38 (-1) | 84 | 72 | -12 |
| | Children | 21 (14) | 34 (17) | +13 (+3) | 16 | 28 | +11 |
| | Health | 2 (1) | 0 (0) | -2 (-1) | 0 | 0 | 0 |
| **Specific characteristic** | Basic | 113 (73) | 163 (80) | +50 (+7) | 86 | 95 | +9 |
| | Authentic-looking | 42 (27) | 37 (18) | -5 (-9) | 14 | 5 | -9 |
| | Organic | 0 (0) | 3 (1) | +3 (+1) | 0 | 0 | 0 |
| | Natural-looking | 0 (0) | 1 (0) | +1 (0) | 0 | 0 | 0 |
| **Total** | | 155 | 204 | + 49 | | | |

[a]pp: percentage points.
[b]Only pizzas containing entirely plant-based ingredients (e.g., with imitation cheese) were considered "100% plant-based".
[c]Vegetarian pizzas (without meat, poultry or fish) were considered of "animal" origin if they contained cheese.

A total of 204 products (representing 81% of the market) were identified for 2022, compared with 155 products (representing 80% of the market) in 2017. This represents an increase of 49 products, or 32%. This growth contributed – at least in part – to a 37% increase in sales. In 2022, the most common **type of pizza** on the market contain vegetables and deli meat. These pizzas also saw a 6 pp increase in terms of variety, but this was not reflected in their sales (0 pp change compared to 2017). As in 2017, the best-selling pizzas are deli meat-based, with 39% of sales in the category, up 4 pp.

As for **origin**, as in 2017, the vast majority of pizzas are of animal origin, both in terms of variety and sales. However, a slight increase of 4 pp was observed in plant-based pizzas in 2022, but they are nevertheless still under-represented.

In terms of **crust**, thin-crust pizzas still have the greatest variety in terms of offering, but have declined in terms of sales with a 15 pp reduction since 2017. Traditional-crust pizzas are now the best-selling, despite a slight decrease of 2 pp. Stuffed crusts saw the biggest increase in terms of both variety (+5 pp) and sales (+8 pp).

Tomato-based **sauces** are still the most popular and best-selling sauces on the market. Already dominant in 2017, they nevertheless experienced a +4 pp increase in variety without affecting their sales.

Pizzas whose **target customer** was the general population once again make up the largest proportion of products offered. However, they have seen a slight decline in variety (-1 pp), leading to a 12 pp reduction in sales in 2022. For their part, pizzas intended for children saw their variety increase by 3 pp as did their sales volume, with an 11 pp rise compared to 2017.

In terms of **specific characteristic**, basic pizzas (with no specific characteristic) are still the most represented on the market and increased by 7 pp in variety and 9 pp in sales compared to 2017. Conversely, the variety of authentic-looking pizzas fell by 9 pp, as did their sales.

Figure 2 below shows the percentage of products that are identical, modified, new or withdrawn compared with 2017.
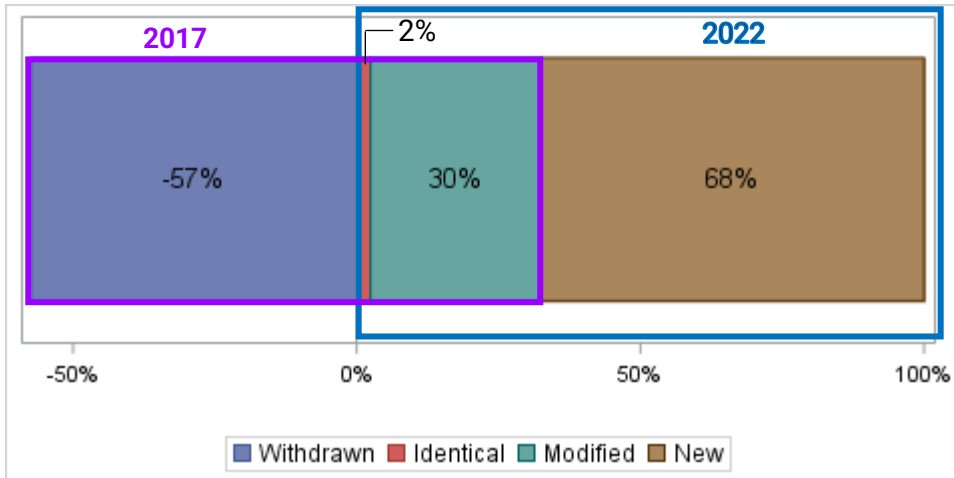
**Figure 2. Status of all pizzas collected in 2022 compared with 2017**

Overall for 2022, there are 5 identical products (representing 5% of sales), 61 modified products (representing 61% of sales), 138 new products (representing 36% of sales) and 89 products withdrawn since 2017 (then representing 24% of sales). Of the modified products, 95% (n=58/61) had a change in NFT nutrient amounts, 100% (n=61/61) in the ingredient list, 20% (n=12/61) in the packaging, 20% had different nutrition and health information, while 34% had other information. The number of reasons for having a modified status is shown in the appendix (table 9).

More specifically, the following figure shows the breakdown of product status by pizza type. In this respect, the product percentages in each of the statuses are calculated as follows: the same denominator is used to calculate the percentage of identical, modified and new products. This denominator is the number of products found on the market by type of content, for the year under review. For the calculation of withdrawn products, the denominator used is the number of products of the same type found on the market in the reference year.
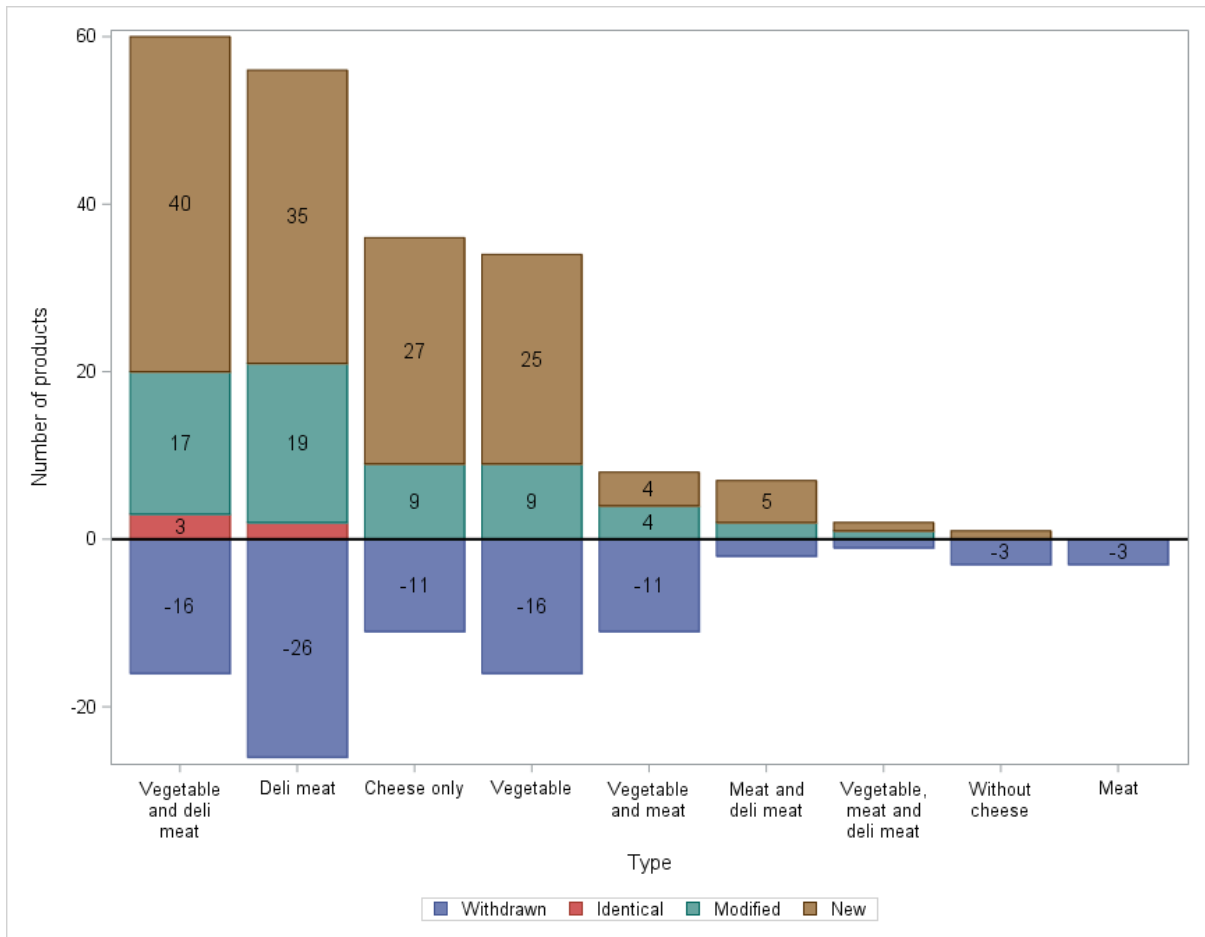
**Figure 3. Breakdown of pizza status by type in 2022 compared with 2017**

Figure 3 shows that the highest proportion of new products is found in pizzas with vegetables and deli meat (n=40/60; 67%), followed by pizzas with deli meat (n=35/56; 63%). The opposite is true for modified pizzas, where pizzas with deli meat are the most numerous type (n=19/56; 34%), followed by vegetable and deli meat (n=17/60; 28%). These two types of pizzas are equally divided between identical products, with 3 products (60% of identical products) for pizzas with vegetables and deli meat, and 2 products (40% of identical products) for pizzas with deli meat. The products withdrawn were mainly deli meat pizzas (n=26/89; 29% of all products withdrawn). Finally, meat-only pizzas were all withdrawn in 2022 (n=3/3; 100%).

Similar analyses were carried out on the crust. The following figure illustrates these results.
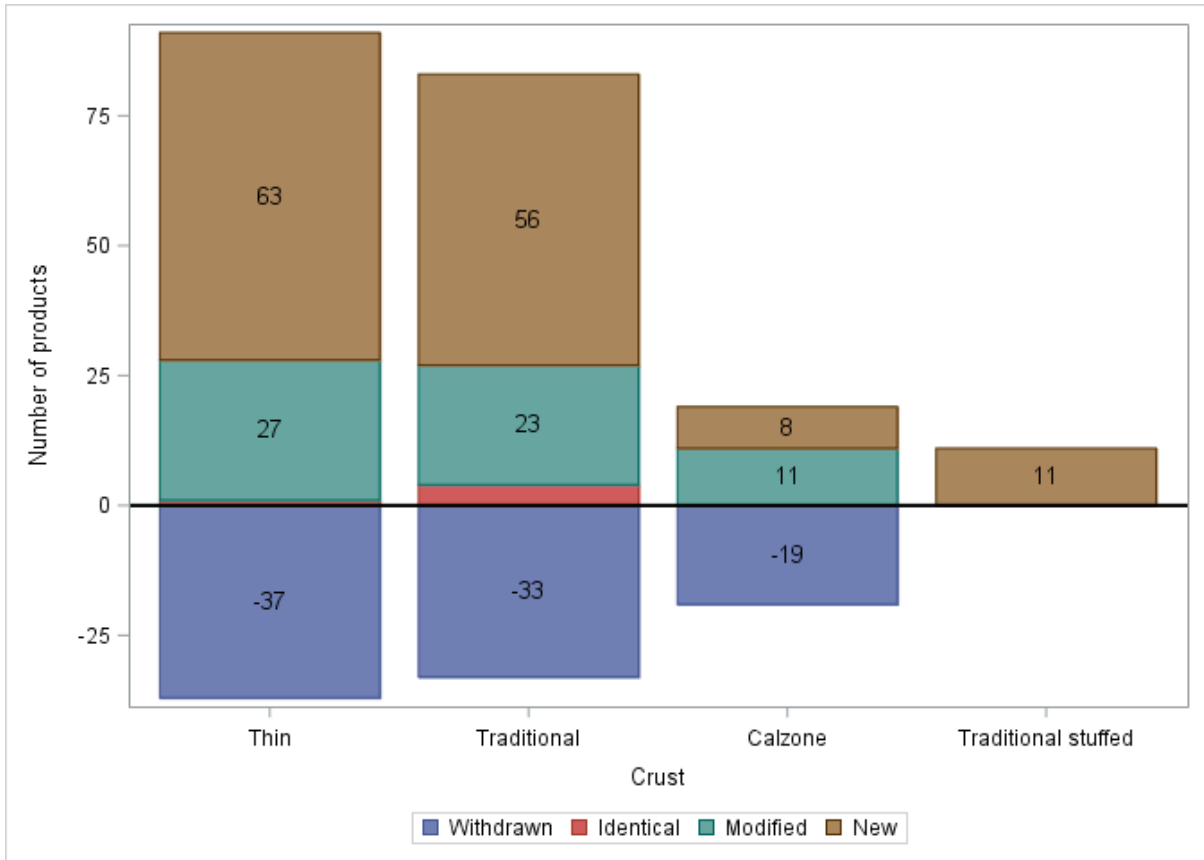
**Figure 4. Breakdown of pizza status by crust in 2022 compared with 2017**

Figure 4 shows that the majority of new products are found in thin-crust (n=63/91; 69%) and traditional-crust (n=56/83; 67%) pizzas. Traditional stuffed-crust pizzas were not present on the market in 2017, while a total of 11 new products are now available in 2022. Among the calzones, more than half the products were modified (n=11/19; 58%). As for the identical products, almost all of them are traditional-crust pizzas (n=4/5; 80% of identical products). Finally, most of the products withdrawn were also thin-crust (n=37/89; 42% of all products withdrawn).

## 5.2 Nutritional composition and selling price (objective 2)

Table 4 shows the nutritional composition and selling price per 200 g serving for all pizzas available on the market in 2022, as well as the percentage change compared with pizzas available in 2017. Change in absolute values is also shown.

**Table 4. Nutritional composition and selling price of pizzas offered and sold in 2022 (n=204) per 200g serving and percentage change from 2017 (n=155)**

| | Energy (kcal) | | Lipids (g) | | Saturated fats (g) | | Carbohydrates (g) | | Fibre (g) | | Sugars (g) | | Protein (g) | | Sodium (mg) | | Price list ($) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases |
| All pizzas - 2022 | 475±52 | 488±51 | 19.1±5.2 | 20.5±5.1 | 7.3±2.3 | 7.4±2.0 | 57±9 | 56±7 | 3.3±1.2 | 2.9±0.7 | 6.0±2.3 | 6.5±2.1 | 19.0±4.5 | 19.2±3.7 | 983±199 | 1017±186 | 2.39±1.14 | 1.80±0.52 |
| Change (unit) vs 2017 | 6.0±5.5 | 20.9±5.4 | 0.6±0.6 | 1.7±0.6 | 0.3±0.3 | 0.1±0.2 | 1.0±0.9 | 1.4±0.7 | -0.3±0.1 | -0.4±0.1 | -0.6±0.3 | -0.1±0.3 | -0.9±0.4 | -0.7±0.4 | -11.3±21.6 | -49.6±19.1 | 0.42±0.09 | -0.05±0.06 |
| Change (%) vs 2017 | 1.3±1.2 | 4.5±1.1 | 3.4±3.1 | 9.2±3.0 | 4.2±3.6 | 1.1±3.2 | 1.7±1.6 | 2.5±1.3 | -7.4±3.8 | -12.5±3.3 | -8.6±4.4 | -1.5±4.1 | -4.3±2.2 | -3.3±1.9 | -1.1±2.2 | -4.7±1.8 | 21.4±4.8 | -2.6±3.2 |

Mean ± standard deviation.
Offering=Nutritional composition of pizzas offered on the market (n=204) / Purchases=Nutritional composition of pizzas sold (average weighted according to the number of portions sold) (n=204).
Orange boxes mean that the value is significantly higher than in 2017, while blue boxes mean that the value is significantly lower than in 2017.
The threshold used is 0.0694% (p<0.000694) which corresponds to the Bonferroni correction (5% / 72).

First of all, when it comes to the pizza **offering** in 2022, we can see that it is statistically similar to that of 2017. However, in terms of **purchases**, pizzas now contain more energy (+20.9 kcal; +4.5%) and fat (+1.7 g; +9.2%), but less fibre (-0.4 g; -12.5%) and sodium (-

**Pizzas bought in 2022 are higher in energy and fat, but lower in fibre and sodium than those in 2017.**

49.6 mg; -4.7%) compared to 2017. As for the sales price, it remained similar, given that the analyses were carried out in constant dollars. These results are also illustrated below, in figure 5, for the nutrients of interest for both offering and purchase. Note that asterisks in these figures indicate significant values.



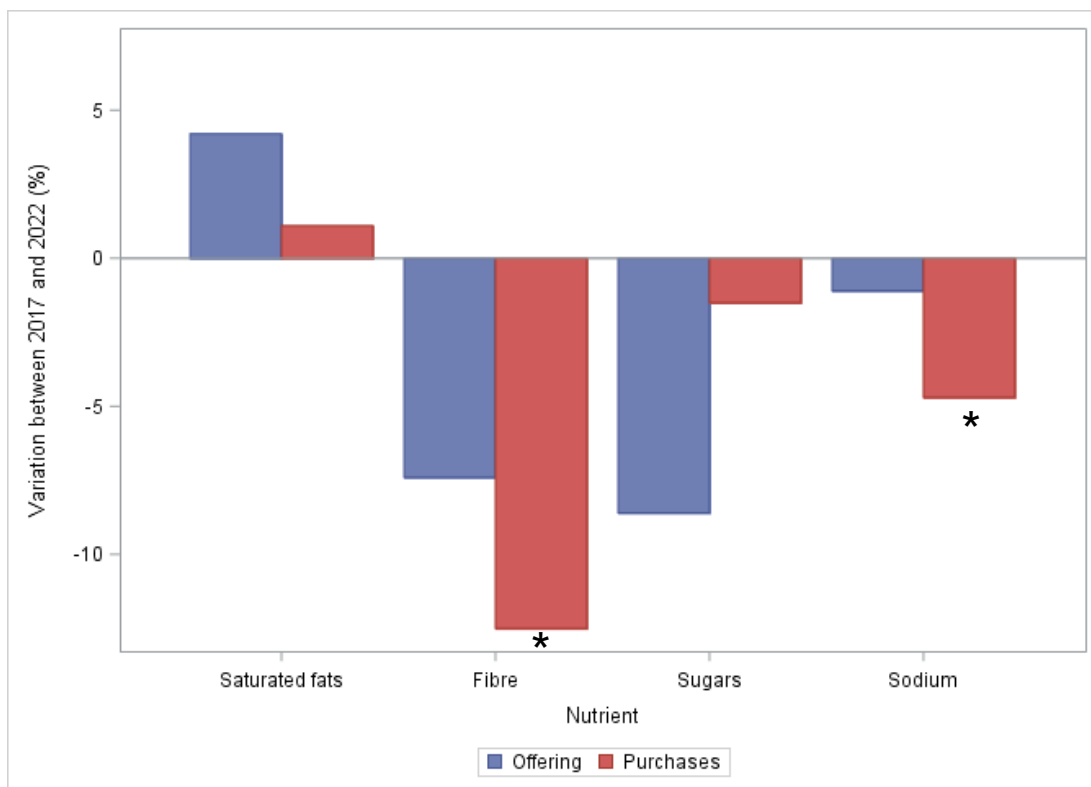**Figure 5. Percentage change in nutrients of interest for the offering and purchase of all pizzas between 2017 and 2022**

These same analyses were repeated for each type of pizza, to check evolution over time more specifically. The following table shows the nutritional composition of pizzas in 2022 compared with 2017. These changes are presented in percentages, while changes in units are shown in the appendix (table 10).

## Table 5. Nutritional composition and selling price of 2022 pizzas(n=204) by type, per 200g serving and change from 2017 (n=155)

| Content type | Quantity | Energy (kcal) Offering | Energy (kcal) Purchases | Lipids (g) Offering | Lipids (g) Purchases | Saturated fats (g) Offering | Saturated fats (g) Purchases | Fibre (g) Offering | Fibre (g) Purchases | Sugars (g) Offering | Sugars (g) Purchases | Protein (g) Offering | Protein (g) Purchases | Sodium (mg) Offering | Sodium (mg) Purchases | Price list ($) Offering | Price list ($) Purchases |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetable and deli meat§ (n=60 / 26%) | Content | 460±48 | 461±39** | 18.3±4.9 | 18,4±4,3** | 7.0±1.8 | 7.3±1.6 | 3.2±1.1 | 3.0±0.6 | 5.8±2.1 | 6.5±2.0 | 18.9±3.7 | 19.2±2.9 | 975±151 | 1002±127 | 2.14±0.84 | 1.70±0.49 |
| | % §§ | 1.5±2.0 | 3.2±1.8 | 9.0±5.3 | 8.5±5.1 | 5.3±5.6 | 6.4±5.0 | -14.0±7.0 | -13.9±6.0 | -4.6±8.0 | 6.3±7.4 | -6.6±3.7 | -3.7±2.9 | -5.2±2.8 | -5.7±2.0 | 14.9±8.0 | -2.5±6.6 |
| Deli meat (n=56 / 39%) | Content | 493±44* | 500±43 | 20.5±4.5 | 21.3±4.6 | 7.6±2.3 | 7.3±2.1 | 3.1±1.0 | 2.8±0.7 | 5.7±2.4 | 6.3±1.9 | 19.9±3.8 | 19.4±4.1 | 1097±184* | 1105±172* | 2.17±0.91 | 1.75±0.45 |
| | % | 0.0±1.6 | 3.1±1.7 | -0.2±4.4 | 6.2±4.9 | -1.4±6.2 | -6.8±5.7 | -10.6±6.3 | -16.6±5.8 | -14.3±7.9 | -6.2±7.6 | -3.2±3.5 | -5.4±3.5 | 0.2±3.5 | -5.5±2.8 | 16.2±8.0 | -4.1±5.4 |
| Cheese only (n=36 / 16%) | Content | 498±58 | 524±60* | 20.2±6.6 | 22.7±6.3 | 8.5±2.6 | 8.3±2.3 | 3.0±1.1 | 2.7±0.7 | 6.1±2.4 | 6.5±2.2 | 20.2±5.0 | 19.5±3.9 | 983±232 | 979±165 | 2.69±1.37 | 1.93±0.59 |
| | % | 1.7±4.1 | 5.4±4.0 | 6.1±11.3 | 12.0±10.6 | 14.4±10.8 | -2.6±10.5 | -18.7±9.8 | -27.3±9.4 | -10.9±11.2 | -20.3±11.1 | -1.3±5.7 | -6.0±4.6 | -6.0±5.5 | -10.1±4.1 | 46.6±13.5 | 10.2±7.0 |
| Vegetables (n=34 / 10%) | Content | 452±43 | 466±43 | 17.3±4.3 | 21.0±4.6 | 6.4±1.8 | 6.7±1.5 | 4.0±1.6* | 3.5±0.9* | 6.4±1.9 | 5.8±1.4 | 15,6±5,5** | 16,3±3,5** | 815±133** | 755±87** | 3.03±1.39 | 2.15±0.62 |
| | % | 0.9±3.0 | 3.2±2.6 | -7.6±7.4 | 3.1±6.3 | -5.7±7.1 | -2.6±6.1 | 5.7±9.7 | 3.4±8.3 | 7.1±9.8 | 12.6±7.6 | -13.6±6.7 | -1.0±5.3 | 6.5±5.5 | -10.3±3.0 | 23.9±10.9 | -9.6±5.9 |
| Vegetable and meat (n=8 / 3%) | Content | 425±35 | 430±30 | 14.5±4.3 | 15.5±3.8 | 5.9±2.6 | 6.0±2.0 | 3.0±1.0 | 2.9±0.8 | 7.5±3.2 | 7.2±2.3 | 20.3±1.8 | 20.1±2.0 | 846±82 | 827±91 | 2.02±0.70 | 1.86±0.52 |
| | % | -2.1±3.8 | 2.8±3.4 | -2.0±12.9 | 8.6±12.1 | -8.6±17.5 | -2.0±15.0 | -5.1±17.2 | -2.3±13.5 | -5.3±20.5 | 10.3±16.4 | -0.6±5.0 | 2.5±4.6 | -6.2±5.2 | -6.7±4.3 | -1.1±13.7 | -3.1±12.5 |
| Meat and deli meat (n=7 / 5%) | Content | 511±38 | 494±34 | 21.5±5.3 | 19.8±4.1 | 8.2±2.2 | 8.0±1.5 | 2.9±0.6 | 2.9±0.5 | 6.7±3.4 | 7.6±3.0 | 21.7±1.3 | 21.6±1.0 | 1114±214 | 1114±185 | 1.77±0.41 | 1.57±0.33 |
| | % | 7.7±3.2 | 6.0±2.9 | 18.1±11.6 | 14.7±9.1 | 20.2±12.6 | 24.6±9.0 | -6.9±23.4 | 22.3±28.8 | 14.1±23.0 | 14.2±17.7 | 4.7±6.7 | -2.7±3.3 | 1.3±9.4 | -1.1±6.5 | 28.0±12.9 | 10.6±9.7 |
| Vegetable, meat and deli meat (n=2 / 1%) | Content | 467±32 | 488±9 | 18.9±1.6 | 19.9±0.4 | 7.0±1.5 | 7.9±0.4 | 3.0±0.0 | 3.0±0.0 | 6.7±3.2 | 8.8±0.9 | 23.4±0.5 | 23.0±0.1 | 1022±209 | 1157±60 | 2.04±0.91 | 1.46±0.26 |
| | % | 0.5±7.7 | 2.0±3.8 | 0.6±12.7 | 0.4±6.7 | -11.8±14.2 | 3.0±5.2 | 17.6±17.8 | 8.7±10.0 | 15.6±48.4 | 32.8±18.1 | -1.4±5.7 | -0.1±3.5 | -5.2±14.7 | 4.7±5.0 | 6.2±39.3 | -15.7±17.7 |
| No cheese (n=1 / 0%) | Content | 513±0 | 513±0 | 17.7±0.0 | 17.7±0.0 | 2.7±0.0 | 2.7±0.0 | 5.3±0.0 | 5.3±0.0 | 10.6±0.0 | 10.6±0.0 | 12.4±0.0 | 12.4±0.0 | 956±0 | 956±0 | 5.94±0.00 | 5.94±0.00 |
| | % | 4.6±0.0 | -1.6±0.0 | 8.6±0.0 | 16.1±0.0 | 134.4±0.0 | 145.5±0.0 | 81.1±0.0 | 128.2±0.0 | 41.5±0.0 | 28.5±0.0 | -7.6±0.0 | -14.7±0.0 | -9.5±0.0 | -15.1±0.0 | 228.5±0.0 | 291.6±0.0 |

*Mean ± standard deviation.*
*Offering=Nutritional composition of pizzas offered on the market (n=204) Purchases=Nutritional composition of pizzas sold (average weighted according to the number of portions sold) (n=204).*
*Content: Boxes with * mean that the value is significantly higher than other pizza contents, while boxes with ** mean that the value is significantly lower than other pizza contents,*
*Change: Orange boxes indicate that the value is significantly higher than pizzas of the same content in 2017, while blue boxes mean that the value is significantly lower than pizzas of the same content in 2017.*
*The threshold used is 0.069% (p<0.00069) which corresponds to the Bonferroni correction (5%/72).*
*§n represents the variety of products offered and the percentages indicate the percentage of sales volume. The volume of sales, rather than the number of products, determines the effectiveness of the tests carried out for purchases.*
*§§% = change in % (2022 vs 2017).*

Table 5 shows that, compared with 2017, vegetable pizzas on the market in 2022 have lower sodium levels (-10.3%). There are no other significant changes compared with 2017 based on pizza content. Note that, as in 2017, vegetable pizzas contained less sodium than other pizzas, while deli meat pizzas contained more.

## 5.2.1 Comparison with daily value thresholds

Beyond the absolute nutritional value presented per portion, it is also possible to illustrate this same nutritional composition by comparing it with the Daily Value (DV) percentage. The 5% DV threshold is generally used to represent a low quantity of a given nutrient for a reference quantity, whereas the 15% threshold represents a high quantity[§§]. In addition, for pre-packaged main dishes such as pizzas, the 30% DV threshold will be used by Health Canada to assign a nutrition symbol on the FOP to identify products high in saturated fat, sugars and/or sodium[55,56]. The following figures illustrate the change in the percentage of products meeting the 30% DV threshold for saturated fat (Figure 6) and sodium (Figure 7), per 200 g serving, according to pizza type. As a complement, fibre and protein are also of interest in this food category. However, as sugar is not a nutrient of interest for pizzas, results in this respect are not presented in relation to the 30% DV threshold. Figure 8 shows the change in the percentage of products meeting the 15% DV threshold for fibre. The 15% threshold is used here because it corresponds to the "good source of fibre" claim, which is the same regardless of the type of food. Finally, Figure 9 illustrates the change in the percentage of products meeting the threshold of 18 g of protein per serving, i.e., approximately 30% of the daily intake for this nutrient[***]. In fact, in the case of fibre and protein, meeting the threshold means being above it (15% of DV for fibre and 30% for protein), whereas for other nutrients (saturated fat and sodium), it means being below the threshold of 30% of DV. In these figures, the blue stripes represent offering and the red stripes represent purchases. Note that asterisks in these figures indicate significant values. The figures in the appendix (figures 12 to 15) show changes in the nutrient content of offering and purchases in 2017 compared with 2022.

Figure 6 shows changes in the proportion of pizza types meeting the 30% DV threshold for **saturated fat** (<6 g per 200 g serving), for both offering and purchases.

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[§§] A note about the percentage of DV can be found at the bottom of the NFT displayed on pre-packaged products.
[***] The daily protein requirement for an average 75kg person is 60g, or 0.8g of protein per kg of body weight.

**Figure 6. Trend (2017-2022) in the percentage of offering and purchases of products meeting the 30% DV threshold for saturated fat, per 200 g serving**

Overall, both the average pizzas offered and purchased are above the 30% DV threshold for saturated fat. In fact, 28% of the pizzas on offer and 20% of those purchased met this threshold in 2022. Compared to 2017, this represents a slight decrease in the number of products meeting this threshold (-3% for offering and -4% for purchases). While no variation is significant, the main change observed is within the vegetable pizza or vegetable, meat and deli pizza offerings, which have seen an increase (+27% and +50%, respectively) in products meeting the 30% DV threshold for saturated fat since 2017. Conversely, purchases of pizzas containing vegetables and deli meat, cheese-only and vegetables and meat saw a decline in products meeting this threshold in 2022 compared to 2017 (-10%, -11% and -13%, respectively).

The following figure (Figure 7) shows the change in pizzas meeting the 30% DV threshold for **sodium** (<700 mg per 200 g serving) in 2022 as compared with 2017.
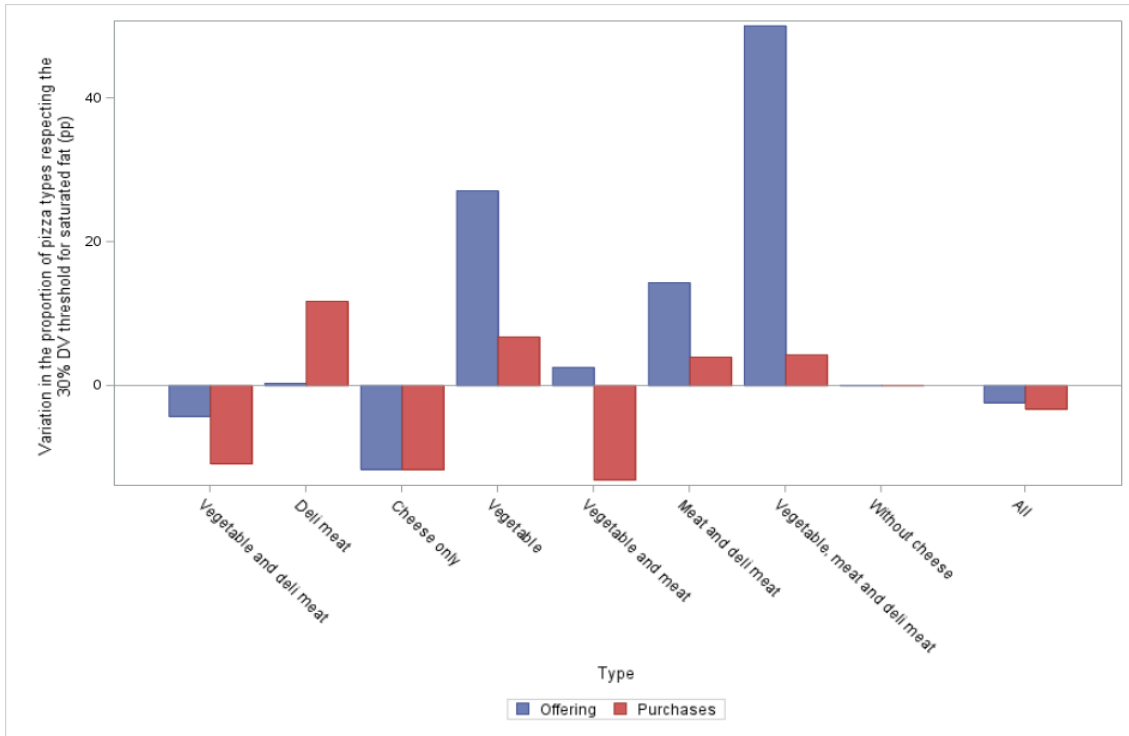
**Figure 7. Trend (2017-2022) in the percentage of offering and purchases of products meeting the 30% sodium DV threshold, per 200 g serving**

It is worth noting that the majority of pizzas far exceed 30% of the DV for sodium, for both offering and purchase (average 983mg and 1017mg, respectively [see Table 4]). Despite a decrease in average sodium levels since 2017, a smaller percentage of products now meet the 30% DV threshold for both offering (-5%) and purchase (-3%). More specifically, pizzas made with vegetables and deli meat showed the greatest improvement in 2022, with a +5% increase in the number of products now meeting this threshold. Vegetable pizzas, on the other hand, saw a significant drop (-17%) in the number of products offered that met the threshold. However, this was not reflected in purchases, as vegetable pizzas saw a +2% increase in products meeting the 30% DV threshold for sodium.

With regard to the voluntary sodium reduction target (see figure 13 in the appendix) of 400mg per 100g serving of pizzas, 86% of pizzas (representing 88% of sales) still exceed this target, up from 85% (for 96% of sales) in 2017. In other words, despite a slight drop in target-compliant offerings (-1%), overall pizza purchases were compliant with the targets than in 2017 (+8%). More specifically, the vegetable pizzas purchased and vegetable and meat pizzas purchased saw a significant increase in target-compliant products since 2022 (+65% and +36%, respectively).

Figure 8 shows a decrease in the number of products (-24% for offering and -28% for purchase) meeting the 15% DV threshold for **fibre** (>4g per 200g serving) compared to 2017.
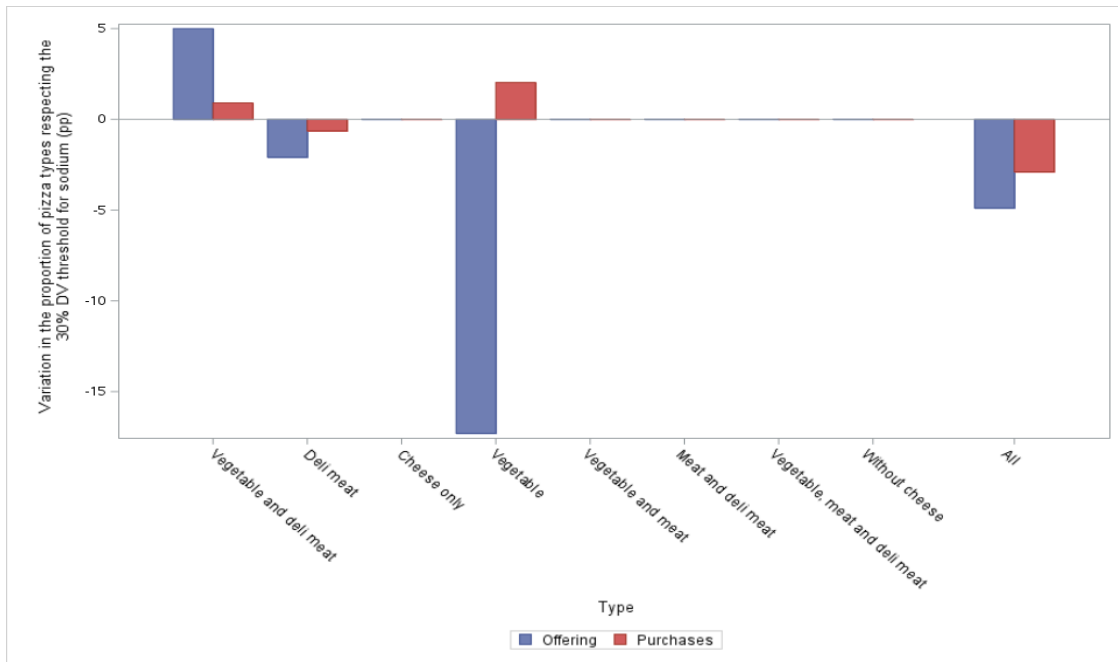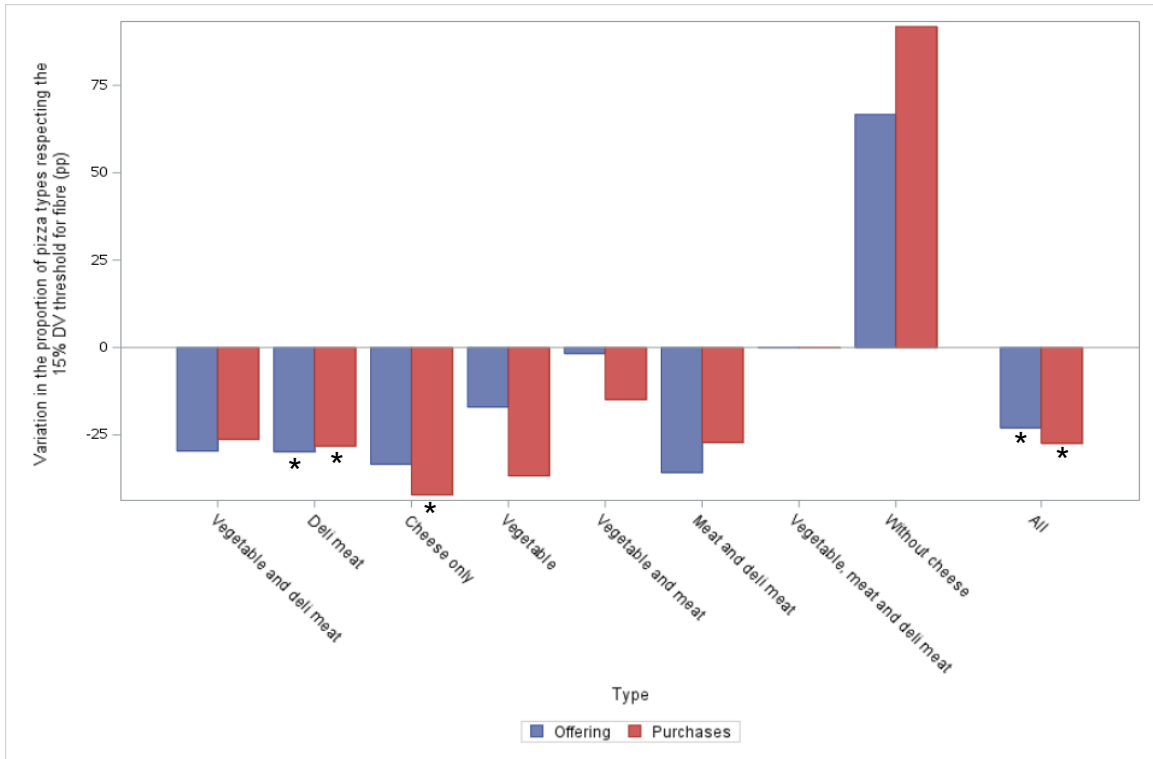
**Figure 8. Trend (2017-2022) in the percentage of offering and purchases of products meeting the 15% DV fibre threshold, per 200 g serving**

All in all, 21% of pizzas on offer (representing 8% of sales) exceed the 4g fibre threshold in 2022. This is a significant reduction compared to 2017 (45% of the offering representing 36% of sales). Pizzas containing deli meat saw a significant drop in both offering and purchase (-30% and -28%, respectively) in products meeting the 15% DV threshold for fibre. The same applies to purchases of cheese-only pizzas (-43%).

Figure 9 illustrates the change in pizza offering and purchases in 2022 compared to 2017 with regard to the 30% of daily intake threshold for **protein** (>18g per 200g serving).
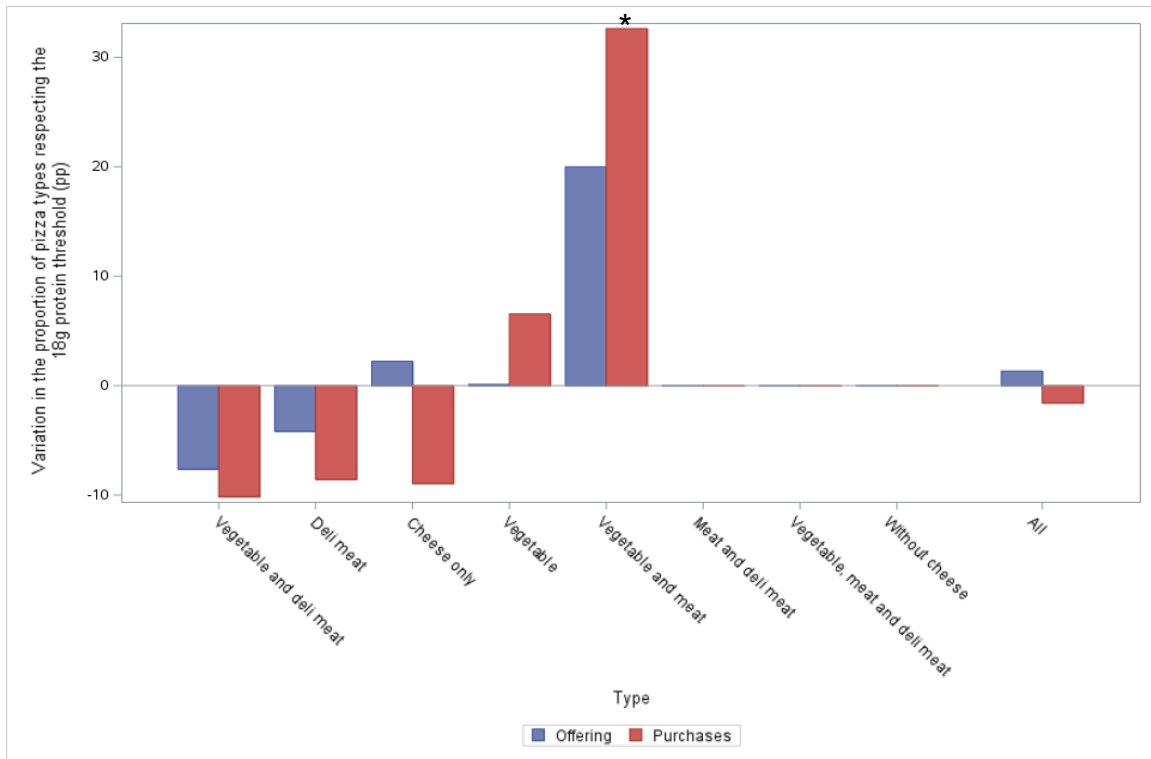
**Figure 9. Trend (2017-2022) in the percentage of products on offer and purchased that meet the 18g protein threshold per 200g serving**

In 2022, 69% of pizzas (representing 70% of sales) were already above the threshold of 18g of protein per 200g serving. These figures are very similar to those observed in 2017, with a slight 2% increase in offering and a slight 3% drop in purchases. However, greater variations were noted for pizzas containing vegetables and meats, with an increase in products meeting this threshold both in terms of offering (+20%) and purchases (+33%). However, this change is significant only for purchases. Conversely, a lower proportion of pizzas made with vegetables and deli meat (-7% for offering and -10% for purchases) and those made with deli meat (-4% for offering and -9% for purchases) meet this threshold in 2022 compared to 2017.

As mentioned at the outset, results relating to the 30% DV threshold for sugars (i.e., 30g per serving) are not presented in this section. In fact, no pizza contains more than 15g of sugars per serving. Therefore sugars are not an issue when it comes to pizzas.

Another way of interpreting these results is to estimate which pizzas would end up with the **symbol on the front of their packaging** signifying that these products are high in saturated fat, sugars and/or sodium. For pre-packaged main meals such as pizza, the 30% DV threshold will be used by Health Canada for the assignation of this symbol. So, if there were no change in the nutritional composition of currently available pizzas, almost all of them would be required to display the symbol for at least one nutrient. In fact, 99% of pizzas offered (representing 100% of sales) would display the symbol for sodium, while

76% would have the symbol for saturated fat (representing 82% of sales). Note that no pizza would display this symbol for sugars. In short, only two pizzas would display no symbol (1% of offering and 0% of purchases), 46 would have the symbol for one nutrient (23% of offering and 18% of purchases) and 156 would have the symbol for two nutrients (76% of offering and 82% of purchases).

## 5.2.2 Comparison by status

In addition to the results concerning the types of pizza according to content, the comparison with the reference year (2017) can also be made by analyzing products according to their status. The following table shows the nutritional composition of new products (2022), identical products (2017 and 2022), modified products (2022) and withdrawn products (2017). Each status is compared with the others. For example, new pizzas are compared with identical, modified and withdrawn pizzas. Note that identical pizzas account for 2% of the offering (representing 3% of sales), modified pizzas account for 30% of the offering (representing 61% of sales), new pizzas account for 68% of the offering (representing 36% of sales) and withdrawn pizzas accounted - in 2017 - for 57% of the offering (representing 24% of sales).

**Table 6. Nutritional composition and selling price of pizzas offered and sold by status, per 200g serving**

| | Energy (kcal) | | Lipids (g) | | Saturated fats (g) | | Fibre (g) | | Sugars (g) | | Protein (g) | | Sodium (mg) | | Price list ($) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases |
| **Status** | | | | | | | | | | | | | | | | |
| New (n=138/30%)* | 479±53 | 492±53 | 19.5±5.3 | 20.8±5.0 | 7.6±2.5 | 8.4±2.3 | 3.4±1.3 | 3.0±0.9 | 5.7±2.5 | 6.0±2.6 | 19.0±5.0 | 20.8±3.5 | 979±181 | 1007±163 | 2.73±1.23 | 2.09±0.66 |
| Identical (n=5/3%) | 451±45 | 456±41 | 17.2±3.5 | 17.1±2.9 | 6.5±1.5 | 6.4±1.2 | 3.0±0.7 | 3.0±0.6 | 4.6±1.7 | 4.6±1.7 | 19.4±4.1 | 19.4±3.5 | 1228±326 | 1300±293 | 1.66±0.31 | 1.62±0.30 |
| Modified (n=61/52%) | 468±47 | 488±49 | 18.2±5.0 | 20.5±5.2 | 6.7±1.7 | 6.9±1.6 | 3.0±0.7 | 2.9±0.7 | 6.9±1.9 | 6.8±1.5 | 18.9±3.3 | 18.3±3.6 | 973±215 | 1007±181 | 1.69±0.32 | 1.64±0.34 |
| Withdrawn (n=89/15%) | 477±57 | 495±66 | 19.0±6.0 | 21.1±7.3 | 7.4±2.8 | 8.8±3.7 | 3.5±1.3 | 3.2±1.2 | 6.8±3.2 | 7.8±3.8 | 20.3±3.8 | 20.2±3.2 | 977±191 | 1054±180 | 2.01±0.53 | 1.90±0.47 |

*Mean ± standard deviation.*
*Offering=Nutritional composition of pizzas available on the market (n=293).*
*Purchases=Nutritional composition of pizzas sold (average weighted according to number of portions sold) (n=293).*
*Orange boxes mean that the value is significantly higher than pizzas of other statuses, while blue boxes mean that the value is significantly lower than pizzas of other statuses. The threshold used is 0.139% (p<0.00139) which corresponds to the Bonferroni correction (5%/36).*
*\* n represents the variety of products offered, and the percentages indicate the percentage of sales volume. The volume of sales, rather than the number of products, determines the effectiveness of the tests carried out for purchases.*

Table 6 shows that new pizzas (especially those purchased) are higher in saturated fat and protein, yet lower in sugar than other pizzas. Furthermore, they sell at a higher price in constant dollars. When it comes to the modified pizzas purchased, they contain less saturated fat and protein, but more sugar than the others. Plus, they are sold at a lower price than other pizzas. Note that new and modified pizzas are mostly above the voluntary sodium reduction target for both offering (88% and 82%, respectively) and purchases (90% and 87%, respectively) (data not shown). Finally, identical products and the products withdrawn from the market are not statistically different from the other ones. However, it can be seen that identical pizzas appear to be different in terms of their higher sodium content. However, this difference does not appear significant due to the low number of products (n=5).

For pizzas that have been modified, the change in nutrients of interest is shown in Figure 10. This figure illustrates the evolution of a given nutrient and its average change.
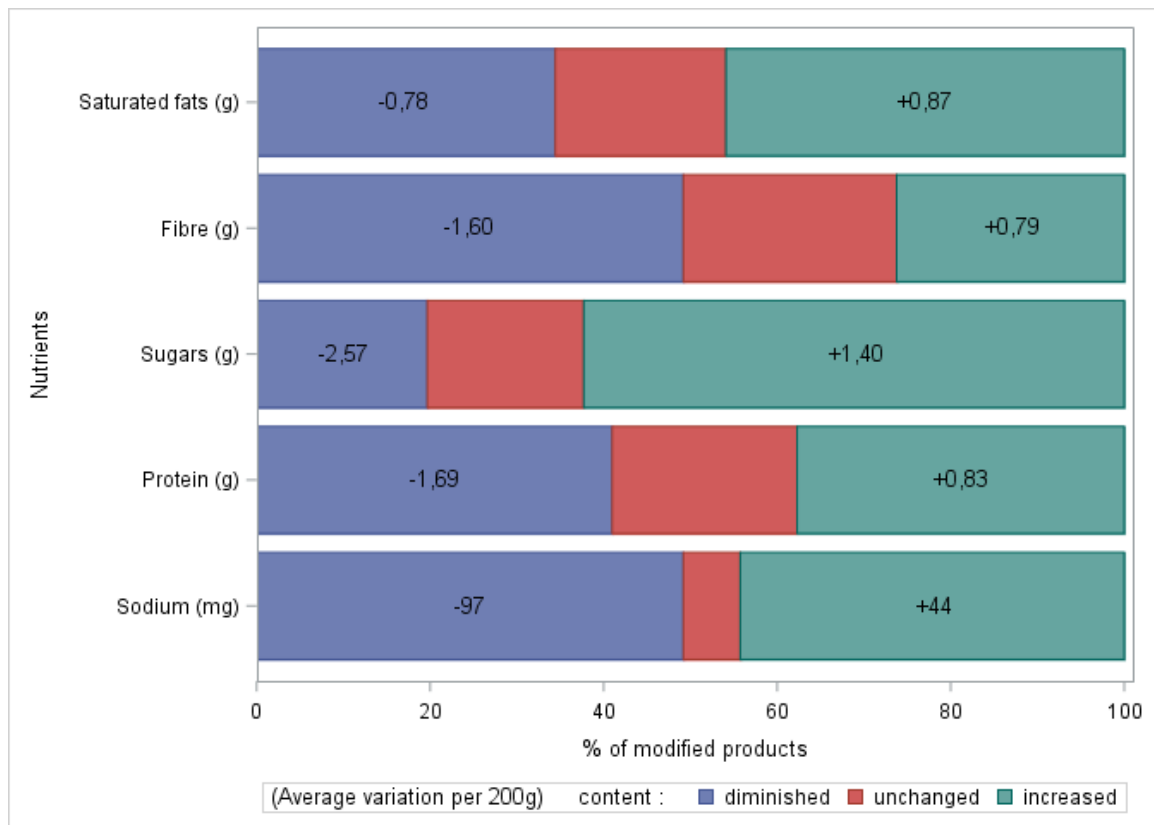


**Figure 10. Change in nutrients of interest in modified pizzas between 2017 and 2022 (n=61), per 200g serving**

Figure 10 shows that 34% of modified pizzas reduced their saturated fat content by an average of -0.78g per 200g serving. However, a greater percentage of modified pizzas showed an increase in saturated fat content (46%), but this increase averaged +0.87g per serving. As for changes in fibre, a greater percentage of modified pizzas decreased their

content of this nutrient (49%), and this decrease (-1.60g) was greater than the increase (+0.79g) observed in 26% of modified products. As for changes in sugars, it can be noted that a greater proportion (62%) of modified pizzas increased their sugar content (+1.40g), but this was less significant than the decrease noted in pizzas with a lower content (-2.57g). On the protein side, 41% of modified pizzas reduced their protein content. Although this percentage was similar to that of pizzas with increased protein content (38%), the amount of the reduction was greater (-1.69g vs. +0.83g). Finally, 93% of modified pizzas changed their sodium content, making this the most frequently reworked nutrient. In more detail, 49% of these pizzas reduced their content of this nutrient by an average of 97mg. The proportion of pizzas with increased sodium content is 44%, but the average increase is only 44mg.

Figure 11 below visually illustrates the changes relative to the voluntary sodium reduction target. More specifically, it shows in red those products that do not meet the target, and in green those that do.
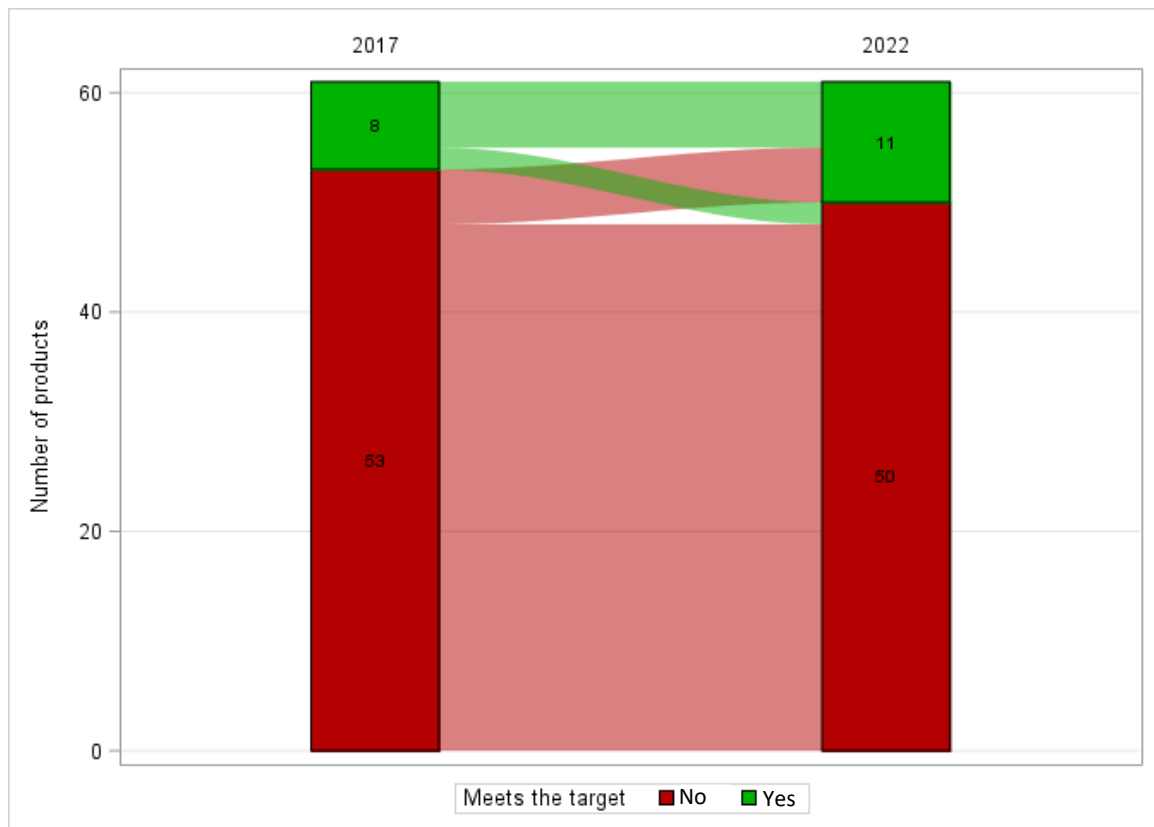


**Figure 11. Change in sodium target compliance for pizzas modified between 2017 and 2022**

Figure 11 shows that more pizzas in 2022 (n=11) met the target than in 2017 (n=8). The lines that change colour represent the same pizza that failed to meet the target in 2017 and now meet it in 2022 (and vice-versa). Since the line from red to green is wider than

the line from green to red, it means that more pizzas have been reformulated to fall below the sodium reduction target than vice versa.

## 5.3 Nutritional composition and selling price according to packaging information (objective 3)

In addition to the type and content of the pizzas, the tracking can also be performed based on the information on the packaging. The following table shows the nutritional composition and selling price per 200g serving, based on classifications relating to origin, crust, sauce, target customer and specific characteristic. Once again, data for the year 2022 are presented and compared with the reference year (2017) in terms of percentage change. Changes in units are shown in the appendix (table 11). Note that in some boxes a dash (-) appears. This means that no pizza of this classification existed in 2017. Therefore no comparison with the current year was possible.

# Table 7. Nutritional composition and price per serving of pizzas offered and sold in 2022 (n=204) according to packaging information per 200g serving and change versus 2017 (n=155)

| | Quantity | Energy (kcal) | | Lipids (g) | | Saturated fats (g) | | Fibre (g) | | Sugars (g) | | Protein (g) | | Sodium (mg) | | Price ($) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases |
| **Origin** | | | | | | | | | | | | | | | | | |
| Animal‡ | Content | 475±50 | 488±51 | 19.1±5.2 | 20.5±5.1 | 7.4±2.3 | 7.4±2.0 | 3.1±1.0 | 2.9±0.7 | 6.0±2.4 | 6.5±2.1 | 19.7±3.7 | 19.3±3.6 | 984±202 | 1017±187 | 2.25±0.9 | 1.78±0.49 |
| (n=192 / 99%)§ | Change % | 1.3±1.2 | 4.6±1.2 | 3.5±3.2 | 9.2±3.1 | 3.5±3.5 | 0.7±3.2 | -12.4±3.6 | -13.2±3.4 | -8.4±4.5 | -1.3±4.2 | -1.5±2.0 | -3.1±1.9 | -0.9±2.2 | -4.6±1.8 | 15.1±4.5 | -3.6±3.2 |
| 100% plant-based | Content | 481±77 | 468±69 | 18.3±4.4 | 17.0±3.9 | 6.2±2.0 | 6.0±1.6 | 5.9±1.0* | 5.9±0.8 | 6.1±1.7 | 5.4±1.2 | 8,1±2,7** | 8.3±2.4 | 963±125 | 931±111 | 4.66±0.8 | 4.25±0.72 |
| (n=12 / 1%) | Change % | -1.9±6.3 | -10.3±4.6 | 12.1±9.6 | 11.4±8.1 | 446.8±52.7 | 452.5±43.5 | 101.9±21.3 | 152.2±16.3 | - | -35.1±6.5 | -39.8±8.5 | -42.6±5.8 | -8.8±8.2 | -17.3±4.5 | 157.8±19 | 179.8±16.8 |
| **Crust** | | | | | | | | | | | | | | | | | |
| Thin‡ | Content | 472±48 | 482±47 | 19.5±5.0 | 21.4±4.3 | 8.0±2.7 | 8.4±2.2 | 3.4±1.2 | 3.0±0.7 | 6.3±2.1 | 6.3±1.8 | 18.4±5.3 | 19.1±3.1 | 956±199 | 941±186 | 2.77±1.3 | 2.06±0.57 |
| (n=91 / 34%) | Change % | 3.1±2.0 | 5.6±1.8 | 6.6±5.1 | 14.1±4.6 | 6.8±5.1 | 8.7±4.0 | -12.1±5.0 | -16.5±4.2 | 4.5±7.0 | 22.0±5.5 | -12.1±3.4 | -1.7±2.7 | 6.0±3.6 | -5.6±2.8 | 19.0±6.7 | -4.9±4.7 |
| Traditional | Content | 470±57 | 470±49 | 17.4±5.3 | 17,1±4,3** | 6.8±1.6 | 7,2±1,3** | 3.3±1.1 | 3.0±0.7 | 5.6±2.5 | 6.6±2.3 | 19.9±3.6 | 20.4±2.7 | 986±200 | 1042±194 | 2.21±0.9 | 1.68±0.48 |
| (n=83 / 39%) | Change % | 0.5±1.8 | 0.8±1.7 | 2.0±4.8 | -4.7±4.5 | 3.2±5.9 | -0.8±5.4 | 0.0±6.1 | 1.3±4.8 | -11.4±6.7 | -2.2±6.0 | -2.0±2.7 | -3.6±1.9 | -12.2±2.8 | -8.2±2.6 | 29.9±6.7 | 3.7±4.3 |
| Calzone | Content | 505±49 | 538±36* | 22.4±4.3 | 25.2±3.9* | 5,4±1,1** | 5,4±1,0** | 3.3±1.1 | 2.8±0.9 | 7.1±2.1 | 6.9±1.1* | 15.9±3.1 | 15,0±3,1** | 1007±175 | 1052±130 | 1.79±0.6 | 1.55±0.36 |
| (n=19 / 19%) | Change % | 1.9±2.6 | 6.7±1.9 | 4.7±5.9 | 12.7±4.8 | -22.0±7.3 | -17.0±7.4 | -1.5±12.0 | -29.9±10.6 | -16.3±9.1 | -34.0±5.8 | -4.9±5.4 | -4.9±5.4 | 7.1±5.1 | 4.4±4.1 | -7.9±9.5 | -12.2±6.8 |
| Traditional stuffed | Content | 485±25 | 480±24 | 22.2±1.5 | 21.9±1.2 | 9.1±0.9 | 9.3±0.8 | 2,3±0,4** | 2.4±0.4** | 5.6±2.8 | 5.3±2.9 | 23.0±2.1 | 24.1±1.5* | 1149±146 | 1138±133* | 1.76±0.2 | 1.84±0.27 |
| (n=11 / 8%) | Change % | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Sauce** | | | | | | | | | | | | | | | | | |
| Tomato‡ | Content | 473±49 | 486±47 | 19.0±5.1 | 20.4±4.9 | 7.2±2.2 | 7.3±1.9 | 3.3±1.2 | 2.9±0.8 | 5.9±2.2 | 6.4±1.9 | 19.0±4.5 | 19.2±3.7 | 991±198 | 1027±180 | 2.38±1.1 | 1.77±0.53 |
| (n=189 / 92%) | Change % | 1.0±1.1 | 4.0±1.1 | 3.8±3.1 | 9.1±3.1 | 5.0±3.8 | 0.2±3.4 | -8.3±3.9 | -14.3±3.5 | -6.7±4.3 | -1.0±4.2 | -4.7±2.3 | -4.1±1.9 | -1.9±2.3 | -4.9±1.8 | 24.6±5.2 | -1.9±3.4 |
| White | Content | 483±38 | 480±27 | 20.0±3.5 | 19.5±2.5 | 9.5±2.2 | 9.4±1.8 | 2.7±1.0 | 2.7±0.9 | 5.6±1.7 | 5.4±1.1 | 20.2±4.6 | 21.2±4.6 | 871±133 | 826±161 | 2.98±0.9 | 2.60±0.88 |
| (n=7 / 0%) | Change % | 2.4±4.4 | 1.8±3.4 | 3.7±9.5 | -1.6±7.4 | -1.4±12.0 | -1.9±9.3 | 30.6±23.5 | 38.1±21.0 | - | -30.4±17.6 | -1.6±12.4 | 5.5±11.4 | 0.2±9.3 | -9.2±8.4 | 33.4±16. | 13.8±14.8 |
| Other | Content | 526±111 | 558±82 | 19.3±10.8 | 23.1±7.3 | 6.6±2.7 | 8.3±1.5 | 3.3±1.0 | 2.9±0.7 | 9.1±5.4 | 6.8±5.1 | 19.4±6.2 | 22.6±3.6 | 992±273 | 1095±237 | 2.38±1.0 | 2.07±0.38 |
| (n=5 / 3%) | Change % | -6.9±21.0 | -10.5±15.7 | -18.7±56.1 | -26.2±32.9 | - | -13.8±17.7 | -0.5±29.6 | -3.9±25.9 | - | -34.6±42.2 | -7.3±19.5 | 6.1±15.5 | 9.8±20.4 | 12.3±16.4 | 12.1±23. | -1.6±11.3 |
| Rosé | Content | 480±74 | 491±63 | 20.1±7.3 | 21.0±6.3 | 9.0±2.9 | 9.5±2.5 | 3.2±0.4 | 3.1±0.3 | 8.1±2.6 | 7.9±2.2 | 16.7±3.6 | 17.2±3.0 | 766±65 | 766±51** | 2.03±0.1 | 2.06±0.16 |
| (n=3 / 4%) | Change % | 8.9±10.0 | 14.6±8.5 | 13.1±25.4 | 21.8±21.6 | 32.1±25.6 | 33.7±20.5 | -17.5±17.7 | 13.8±16.1 | -4.1±25.1 | 5.2±19.9 | -6.9±13.4 | 7.4±12.7 | -12.2±7.9 | -12.0±4.4 | -16.2±5.1 | -15.3±4.3 |
| **Target customer** | | | | | | | | | | | | | | | | | |
| General population‡ | Content | 471±50 | 476±43 | 18.8±5.1 | 19.8±4.4 | 7.3±2.2 | 7.7±1.8 | 3.3±1.2 | 3.0±0.8 | 6.0±2.4 | 6.4±2.2 | 19.3±4.6 | 20.3±3.2 | 980±199 | 1012±196 | 2.51±1.2 | 1.89±0.55 |
| (n=170 / 72%) | Change % | 1.1±1.2 | 3.0±1.1 | 3.9±3.2 | 7.1±3.1 | 1.9±3.8 | 1.3±3.4 | -4.4±4.2 | -5.2±3.6 | -6.5±4.8 | 2.6±4.5 | -3.9±2.3 | 1.7±1.7 | -0.2±2.4 | -4.2±2.0 | 22.8±5.2 | -1.3±3.5 |
| Child | Content | 495±58 | 521±55* | 20.2±5.6 | 22.4±6.2 | 7.3±2.6 | 6,8±2,3** | 3.0±0.9 | 2.7±0.7 | 6.4±2.2 | 6.7±1.7 | 17.4±3.7 | 16,4±3,6** | 998±198 | 1028±160 | 1.81±0.4 | 1.56±0.33 |
| (n=34 / 28%) | Change % | -1.2±3.7 | 4.6±3.0 | -3.9±8.8 | 9.2±8.1 | 15.1±9.2 | 8.9±8.1 | -20.6±9.7 | -36.0±7.6 | - | -19.9±9.3 | -6.2±6.6 | -15.7±6.3 | -9.9±4.8 | -8.3±3.5 | 12.0±6.7 | 2.6±6.0 |
| **Specific characteristic** | | | | | | | | | | | | | | | | | |
| Basic‡ | Content | 484±50 | 491±50 | 20.0±4.8 | 20.8±5.0 | 7.6±2.2 | 7.5±2.0 | 3.1±1.0 | 2.9±0.7 | 5.9±2.2 | 6.5±2.0 | 18.9±4.3 | 19.2±3.7 | 1002±185 | 1023±184 | 2.28±1.0 | 1.78±0.49 |
| (n=163 / 95%) | Change % | 2.5±1.4 | 5.0±1.3 | 4.9±3.5 | 10.3±3.5 | 5.8±4.0 | 1.2±3.7 | -8.5±4.0 | -13.6±3.7 | -14.8±4.8 | -5.3±4.6 | -2.2±2.5 | -2.9±2.2 | -1.6±2.3 | -4.3±2.0 | 21.0±5.2 | -0.9±3.6 |
| Authentic-looking | Content | 435±40* | 438±36 | 14,4±3,3** | 14,8±3,1** | 6.2±1.8 | 6.1±1.7 | 3.7±1.4 | 3.5±1.2 | 6.4±2.8 | 6.5±2.8 | 19.5±4.4 | 20.2±3.4 | 882±177 | 882±175 | 2.61±1.2 | 2.12±0.81 |
| (n=37 / 5%) | Change % | -5.4±2.1 | -6.1±1.9 | -13.4±5.0 | -20.0±4.2 | -7.0±7.2 | -12.4±6.3 | -2.5±8.9 | 6.8±9.5 | 11.3±10. | 30.6±10.6 | -9.0±4.2 | -2.3±3.3 | -5.3±4.8 | -15.8±3.8 | 18.2±9.8 | -3.7±6.8 |
| Organic | Content | 478±31 | 478±26 | 25.4±11.8 | 22.9±8.2 | 7.8±6.5 | 6.6±4.6 | 3.6±1.6 | 3.8±1.2 | 8.8±3.4 | 8.1±2.9 | 23.1±14. | 20.3±9.8 | 1255±572 | 1125±401 | 5.71±0.2 | 5.71±0.17 |
| (n=3 / 0%) | Change % | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Natural-looking | Content | 412±0 | 412±0 | 13.9±0.0 | 13.9±0.0 | 6.1±0.0 | 6.1±0.0 | 7.3±0.0 | 7.3±0.0 | 6.7±0.0 | 6.7±0.0 | 13.3±0.0 | 13.3±0.0 | 927±0 | 927±0 | 3.73±0.0 | 3.73±0.00 |
| (n=1 / 0%) | Change % | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

*Mean ± standard deviation. ‡= Reference classification.*
*Offering=Nutritional composition of pizzas available on the market (n=204). Purchases=Nutritional composition of pizzas sold (average weighted according to number of portions sold) (n=204).*
*Content: Boxes marked * indicate that the value is significantly higher than the reference category, while boxes marked ** indicate that the value is significantly lower than the reference category.*
*Change: Orange boxes indicate that the value is significantly higher than pizzas from the same group in 2017, and blue boxes indicate that the value is significantly lower than pizzas from the same group in 2017.*
*The threshold used is 0.069% (p<0.00069) which corresponds to the Bonferroni correction (5%/72).*
*§n represents the variety of products offered and the percentages indicate the percentage of sales volume. The volume of sales, rather than the number of products, determines the effectiveness of the tests carried out for purchases.*

Table 7 shows that pizzas purchased in 2022 that are of animal **origin** are higher in energy and fat and lower in fibre than in 2017. For their part, 100% plant-based pizzas now provide more fibre, but less sugar and protein than in 2017. As regards **crust**, it can be seen that the thin-crust pizzas purchased now contain more energy, fat and sugars, but less fibre than they did in 2017. Traditional-crust pizzas (both offered and purchased) have lower sodium levels than their 2017 counterparts. In terms of **sauces**, the only significant difference compared with 2017 is in purchases of tomato sauce-based pizzas, where the corresponding fibre content fell significantly in 2022. Among **target customers**, a reduction in fibre content was observed in pizzas purchased for children in 2022 compared with 2017. Finally, concerning **specific characteristics**, the basic pizzas (without any specific characteristics) purchased are now higher in energy and fat, but lower in fibre than in 2017. As for the authentic-looking pizzas purchased, they are now lower in fat and sodium compared to 2017.

> **>>** Compared to 2017, thin-crust pizzas purchased are now higher in energy, fat and sugars while lower in fibre.

## 5.4 Comparison between top sellers

In view of the wide variations from one type of pizza to another, and according to offering and purchases, the same analyses have been repeated, separating all pizzas by sales quintile (see tables 12 to 15 in the appendix). This shows that pizzas in quintiles 4 and 5 (top sellers; n=82, comprising n=5 identical, n=45 modified and n=32 new) are those with the highest sodium levels. Furthermore, the top-selling quintile offers pizzas that are lower in fibre than the other quintiles. In terms of variation compared to 2017, saturated fat levels increased more in the lowest-selling pizzas. On the other hand, protein levels fell more sharply in the lowest-selling pizzas. As for sodium, reductions were more marked in the best-seller quintiles.

In addition to total annual sales, the results can be interpreted by considering the **50 best-selling pizzas** (kg per year) for both 2022 and the reference year (2017). In this respect, Table 8 lists the types of pizza that contribute most to the nutrients of interest, in relation to their sales volume, and the evolution noted between 2017 and 2022. First, it can be seen that the 50 best-selling pizzas in 2022 represent 25% of products on offer (n=50/204), but account for 72% of total sales in kg. It should be noted, however, that these percentages are lower than in 2017. In fact, if we compare the top 50 of these two years, it is possible to see a decline in all

**The 50 best-selling pizzas in 2022 represent 25% of products offered, but contribute 72% of sales.**

percentages in 2022. However, the 2017 top 50 represented a larger market share, with 32% of products on offer and 78% of sales in kg.

**Table 8. Contribution and evolution (2017-2022) of the 50 best-selling pizzas by type**

| Type of pizza | Frequency (units) | | % of sales ($) | | % of sales (kg) | | % saturated fat intake* | | % fibre intake | | % sugar intake | | % protein intake | | % sodium intake | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2017 | 2022 | 2017 | 2022 | 2017 | 2022 | 2017 | 2022 | 2017 | 2022 | 2017 | 2022 | 2017 | 2022 | 2017 | 2022 |
| Deli meat | 19 | 18 | 32.1 | 29.3 | 30.1 | 31.3 | 32.8 | 31.3 | 30.8 | 29.4 | 31 | 30.8 | 31 | 31.3 | 33.2 | 34.0 |
| Vegetable and deli meat | 13 | 13 | 19.4 | 13.4 | 20 | 15.7 | 18.4 | 15.8 | 20.1 | 15.7 | 19.5 | 17.1 | 20 | 16.4 | 20 | 15.8 |
| Cheese only | 7 | 9 | 8.8 | 12.1 | 8.8 | 11.7 | 10.3 | 13.6 | 9.7 | 10.9 | 11.7 | 12.0 | 9.2 | 11.8 | 9.5 | 11.2 |
| Vegetable | 5 | 4 | 11.5 | 7.2 | 8.5 | 6.3 | 7.9 | 5.8 | 7.6 | 7.5 | 6.4 | 5.4 | 6.6 | 5.1 | 6.7 | 4.5 |
| Meat and deli meat | 3 | 3 | 5.5 | 3.1 | 6.6 | 3.9 | 6 | 4.1 | 4.9 | 3.8 | 6.9 | 5.2 | 7.4 | 4.4 | 6.9 | 4.4 |
| Vegetable and meat | 3 | 2 | 4.2 | 1.7 | 3.9 | 1.8 | 2.9 | 1.3 | 3.5 | 1.7 | 3.6 | 2.0 | 3.9 | 1.8 | 3.2 | 1.4 |
| Vegetable, meat and deli meat | 0 | 1 | 0 | 0.6 | 0 | 0.8 | 0 | 0.9 | 0 | 0.8 | 0 | 1.1 | 0 | 1.0 | 0 | 0.9 |
| **Total** | **50** | **50** | 81.5 | 67.3 | 77.8 | 71.5 | 78.2 | 72.8 | 76.6 | 69.8 | 79.1 | 73.6 | 78.1 | 71.7 | 79.5 | 72.3 |

*The intake percentages represent the contribution of one type of pizza for a given nutrient out of the total offering of 204 pizzas listed.*

More specifically, it can also be seen that pizzas containing deli meat (n=18) are the ones most often found in the top 50 best sellers and are also the ones sold in the greatest quantities, both in 2017 and 2022. In fact, as in 2017, deli meat pizzas in the top 50 best sellers contribute the most to nutrient intake, and particularly sodium intake. Among the top 50, cheese-only pizzas saw the biggest increase in sales between 2017 and 2022. This is reflected in their increased contribution to the intake of all nutrients, particularly saturated fats. Note that when pizza status is analyzed, few new pizzas make it into the top 50 (data not shown).

# 6 Discussion

The monitoring of frozen pizzas available in Canada has led to a number of observations concerning the evolution in this food category. Firstly, analyses were carried out on a sample of 204 products (vs. 155 in 2017), representing 81% of the market (vs. 80% in 2017). Consequently, this sample can be considered representative of the pizza offering in Canadian grocery stores.

At the outset, it is important to contextualize the particular situation in which this food category was tracked. Indeed, the COVID-19 pandemic may have affected not only consumer purchasing behaviour, but also the selling prices of various products. At the same time, supply problems linked to the pandemic may also have created a scarcity phenomenon, influencing the price of certain ingredients. At this stage, it remains difficult to determine whether, and to what extent, a rise in prices can be explained by inflation and/or the pandemic. Even so, this context provides an important perspective that should not be overlooked in the analysis of this tracking.

A first series of analyses were focused on the evolution of product **variety** (objective 1) and revealed that the type of pizza most offered on the market now contains vegetables and deli meat, whereas in 2017 it was deli meat only. Vegetable and deli meat-based pizzas have also seen a 6 pp increase in product variety, with no impact on sales.

> **Deli meat-based pizzas are still the best-selling (+4 pp), even if they are now offered less (-4 pp) than in 2017.**

Furthermore, deli meat pizzas are still – as in 2017 – the best-selling pizzas, with 39% of sales, up 4 pp. In terms of origin, despite a 4 pp rise in variety, pizzas of plant origin remain relatively uncommon and low-selling. This may come as a surprise given the rise of vegetarian and vegan products[57]. However, no studies specifically on pizzas have been listed in the literature concerning origin. Although thin-crust pizzas are still the most widely offered, they have seen a drop in sales of around 15 pp since 2017. Conversely, stuffed-crust pizzas saw an increase in both variety (+5 pp) and sales (+8 pp). Indeed, the latter had not been listed on the market in 2017. As far as sauces are concerned, pizzas made with tomato sauce are still the most popular on the market, as well as the best-selling. As for target customer, pizzas intended for the general population are once again the most popular, despite a slight reduction in variety (-1 pp) and a significant drop in sales in 2022 (-12 pp). For their part, pizzas aimed at children saw their variety increase (+3 pp), as did their sales (+11 pp). Finally, as regards specific characteristics, pizzas classified as basic

(i.e., with no specific characteristic) increased by 7 pp in variety and 9 pp in sales compared to 2017. In contrast, the variety of authentic-looking pizzas fell by 9 pp, as did their sales. Fisher's exact tests indicate that among all classifications, the only one that shows a significantly different distribution between 2017 and 2022 is crust, due to the appearance of stuffed-crust pizzas in the sample. It should be noted that for all these classifications, the results could not be compared, as no studies of this kind were found in the literature.

In the current context of monitoring what is on offer, pizzas were grouped according to their **status**, i.e., whether they were new, identical, modified or withdrawn from the market compared to 2017. While only 5 pizzas remained identical, 89 were withdrawn from the market, 61 were modified and 138 were new. The pizzas that were withdrawn were more often deli meat-based, while the new pizzas were mainly vegetable and deli meat. As far as modified pizzas were concerned, these were mainly pizzas with deli meat or with vegetables and deli meat. In 100% of modified pizzas, a change was made in the list of ingredients other than those due to the 2016 labelling regulations. In France, OQALI conducted similar analyses and observed a lower proportion of new pizzas (63%), but a higher proportion of modified pizzas (36%) between 2010 and 2015[47]. Furthermore, similar to what was observed in the present study, only 1% of pizzas remained identical in France during this period. In the United Kingdom, an analysis showed that almost 11% of pizzas had undergone a change in their nutritional composition[48]. It should be noted, however, that the two measurements under study were only six months apart. Therefore it is not surprising that the percentage of modified products in the present study is higher, given that the time elapsed between the two measurements is five years.

The **nutritional composition** analysis was carried out on a 200g serving. The offering of frozen pizzas in 2022 is statistically similar to that of 2017. However, when purchases are considered, it can be seen that pizzas in 2022 provide more energy (+20.9 kcal; +4.5%) and fat (+1.7 g; +9.2%), but less fibre (-0.4 g; -12.5%) and sodium (-49.6 mg; -4.7%) than in 2017. There are a few possible explanations for these results. Firstly, thin-crust pizzas are widely consumed and have seen a significant increase in their energy, fat and sugar content, as well as a significant reduction in their fibre content. In addition, children's pizzas also seen a significant drop in fibre content, while still seeing a significant increase in sales compared to 2017. Thus, the change in fibre content can be partially explained by the nutritional composition of pizzas intended for children. As for the decrease in sodium levels in pizzas in 2022 compared to those in 2017, it could be linked to pizzas with traditional and/or authentic-looking crusts, which have also seen a significant reduction in sodium. Otherwise, in a medium such as pizza crust, salt has no technological role to play. That is, it is added essentially for the sake of taste. By comparison, these results diverge from those noted by Health Canada[7]

> **Pizzas purchased in 2022 are higher in energy (+4.5%) and fat (+9.2%), while lower in fibre (-12.5%) and sodium (-4.7%) than in 2017.**

which observed a reduction of 57mg of sodium per 100g (or 114mg for the 200g serving used in this study) in pizzas purchased between 2010 and 2017. It is possible that most sodium reduction efforts took place between 2012 and 2016, the first period covered by Health Canada's voluntary sodium reduction targets (i.e., before the Observatory's initial portrait). Also, the time elapsed between the two measures taken by Health Canada (seven years vs. five years for the present results) may have played a role. By way of comparison, OQALI also tracked the offering of pizzas between 2010 and 2015[47]. At that time, they noted a downward trend in salt concentrations across the entire pizza offering. In fact, a 15% drop in salt content was noted for deli meat pizzas, 13% for meat pizzas, 7% for vegetable pizzas and 6% for seafood pizzas. The drop was explained both by the presence of new, lower-salt products and by the reformulation of products already on the market in both years. In the present study, only vegetable pizzas saw a significant reduction (-10%) in their sodium content between 2017 and 2022. It should be noted that these changes are not associated with the changes observed according to product status. So, contrary to what was observed in France, changes in sodium levels cannot be explained by the nutritional composition of the new products.

Changes in nutritional composition were also analysed according to the **30% DV thresholds** for saturated fat, protein[†††] and sodium, and the 15% threshold for fibre. Overall, a minority of pizzas meet the thresholds for saturated fat (28% of offerings representing 20% of sales), sodium (4% of offerings representing 1% of sales) and fibre (21% of offerings representing 8% of sales). This means that most pizzas contain too much saturated fat and sodium while having too little fibre. As for protein, 69% of pizzas (representing 70% of sales) exceed the desirable threshold of 18g per portion. Most of these percentages remained stable compared with 2017. The only more marked change was in the case of fibre, where the percentage of pizzas meeting the 15% DV threshold fell by 45% in terms of offering and 36% in terms of purchases. This means that in 2022, the number of pizzas that do not contain sufficient fibre is even higher than in 2017. With regard to the voluntary sodium reduction target, the majority of pizzas (86% of the offering representing 88% of sales) still exceed this target. Once again, there was little change, as 85% of pizzas (for 96% of sales) exceeded this target in 2017. However, it will be interesting to monitor this data over the next few years to see how this percentage evolves.

> **Unless their nutritional composition changes, most pizzas will be required to display a symbol on the front of their packaging stating that they contain an excess of saturated fat and sodium.**

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[†††] As a reminder, since proteins have no DV, the calculation was based on the Dietary Reference Intakes (i.e., 0.8g per kg body weight per day, which represents the Recommended Dietary Allowance). An average weight of around 75kg for a Canadian adult was used, based on CCHS 2004 data. Thus, the daily value was estimated at 60g and the 30% threshold was set at 18g.

> The nutrient most often modified is sodium. In fact, 49% of modified pizzas reduced their sodium content, whereas 44% increased it. However, the amount of the reduction was greater than the amount of the increase in sodium.

The change in nutritional composition can also be assessed according to the pizza **status** (new, identical, modified or withdrawn) in comparison with the reference year, i.e., 2017. First of all, the new pizzas purchased contain more saturated fat and protein, while containing less sugar than other pizzas (identical, modified or withdrawn). In the case of modified pizzas, the nutrient that changed most often was sodium, with 93% of these modified pizzas having changed their sodium content. Of these, 49% have reduced their sodium content, while 44% have increased it. However, the amount of the reduction was greater than the amount of the increase (-97mg vs +44mg per 200g serving, respectively). It should be noted that the only other study to compare products by status is the one done by OQALI. However, no nutritional analysis of these statuses has been carried out.

Analysis of packaging information shows that the animal-**origin** pizzas purchased are now higher in energy and fat, and lower in fibre than in 2017. For their part, 100% plant-based pizzas now provide more fibre, but less sugar and protein than in 2017. These changes are significant despite the low number of products (n=12 in 2022 and n=3 in 2017). This widens the gap between animal and plant-based pizzas when it comes to fibre and protein. In fact, plant-based pizzas are even higher in fibre and even lower in protein (compared to animal-origin pizzas) than they were in 2017. Despite the new Canadian food guide's emphasis on plant-based proteins[5], it would seem that 100% plant-based pizzas have instead emphasized the presence of vegetables, resulting in consistent nutritional compositions. In terms of **crust**, thin-crust pizzas purchased in 2022 are now higher in energy, fat and sugars and lower in fibre than they were in 2017, while traditional-crust pizzas are now lower in sodium. In fact, while the nutritional composition of traditional-crust pizzas has improved, that of thin-crust pizzas has deteriorated. It should be noted that in the initial portrait, it was mentioned that "*traditional-crust pizzas would benefit from a reduction in sodium content*". Therefore it is encouraging to see that pizzas with this type of crust really have in fact improved. A similar phenomenon was observed for the **specific characteristic**. Indeed, the basic pizzas purchased now contain more energy and fat but less fibre than they did in 2017, while authentic-looking pizzas purchased are now lower in fat and sodium. With regard to the other packaging information identified in this study (i.e., sauce and target customer), few differences were identified in comparison with the

reference year. It should be noted that no other study seems to have examined the issue from these different angles.

Looking more specifically at the evolution of the **top sellers**, additional analyses have been undertaken. It was then observed that the 50 best-selling pizzas in 2022 represent 25% of products offered, but contribute 72% of sales in kg. Even so, these 50 pizzas of 2022 provide fewer quantities of all nutrients than the top 50 of 2017. However, the 2017 top 50 represented a larger market share, with 32% of products on offer and 78% of sales in kg. When pizzas are analyzed on the basis of sales quintiles, it emerges that pizzas in the top-selling quintiles are those that have improved their sodium content the most since 2017.

To improve the nutritional composition of pizzas, several **reformulations** could be considered. Firstly, reducing the amount of deli meats or cheese and replacing some or all of the deli meats with meat (e.g., chicken, beef strips) would improve the nutritional composition of pizzas, especially those containing deli meats. Given their high sales volumes, minor improvements could have a major impact on the health of the population. In fact, both deli meats and cheese are typically high in sodium and saturated fats. Another option would be to add vegetables or replace certain toppings (e.g., deli meat) with vegetables. At present, it is not possible to quantify the vegetables on a pizza. Despite this methodological limitation, we can assume that more vegetables would have a positive impact on the nutritional value of pizzas by increasing their fibre content. Consequently, keeping the same portion would – by default – reduce the levels of less beneficial nutrients such as saturated fat and sodium. As for the crust, as mentioned in section 2.8, the use of salt water instead of salt would reduce sodium levels by 50% without affecting the overall enjoyment of the product[39]. A change that could also be made to the crust is the integration of a proportion of whole-wheat flour, which would increase the fibre content of the pizzas. Finally, the greater use of nutrient profiling in the current literature, compared to 2017, suggests that considering multiple nutrients simultaneously would be an interesting way to reformulate products rather than targeting a single nutrient, sometimes to the detriment of another. However, no studies have been carried out to compare trends of the pizzas on offer. It will therefore be interesting to validate one or more nutritional profiling tools in such a context, and to track the literature in this area over the next few years.

# Conclusion and perspectives 7

The monitoring of the pizza category offered and sold in Canada has led to a number of findings and perspectives on efforts to improve the nutritional profile of processed foods. In addition, this analysis allowed to identify areas for significant improvement, which remain relatively unchanged from 2017.

First of all, despite a major renewal of products on the market, changes in the nutritional composition of the food offering over the last few years have been minor. Initiatives undertaken as part of the federal government's Healthy Eating Strategy (e.g., the new Canada's Food Guide, changes to nutrition labelling), as well as actions initiated at the provincial level through the *Politique bioalimentaire* and the *Politique gouvernementale de prévention en santé*, do not yet appear to have led to a marked improvement in the offering of frozen pizzas. Unless their nutritional composition changes, most pizzas will have to display – by 2026 – Health Canada's front-of-package nutrition symbol stating that they contain an excess of saturated fat and sodium. In fact, a minority of pizzas meet the established thresholds for saturated fat (28% of the offering, representing 20% of sales) and sodium (4% of the offering, representing 1% of sales). Therefore, virtually all pizzas should reduce their sodium content, and around three-quarters should reduce their saturated fat content. To this end, incentives and alternatives could be offered to food industries to encourage them to act accordingly. For example, product innovation solutions or customized professional coaching could be offered to support them in this process.

As deli meat pizzas are still the top sellers, they remain the type of pizzas where improvements would be most relevant from a public health point of view. Having undergone no significant change in their nutritional composition since 2017, they still stand out from the rest for their highly excessive sodium levels. In fact, compared to 2017, more deli meat pizzas are above the 30% DV for sodium. Given that most new pizzas are made with either deli meats or with vegetables and deli meats, one possible solution would be to ensure that new pizzas sold in this category contain lower levels of sodium.

Another finding was that while traditional-crust pizzas saw their nutritional composition improve slightly through a significant reduction in sodium, thin-crust pizzas saw precisely the opposite. In fact, thin-crust pizzas in 2022 contain more energy, fat and sugar, as well

as being lower in fibre than in 2017. Given that these are still the most popular products on the market, reformulation efforts should be undertaken to improve the nutritional composition of thin-crust pizzas.

Although changes in the overall pizza offering since 2017 have led to improvements in the nutritional quality of some products, most of pizzas on the market would have a nutritional symbol on the front of the packaging indicating high sodium and/or saturated fat content. The biofood industry should therefore make greater efforts to offer pizzas of higher nutritional quality.

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# Appendices

**Table 9. Number of reasons for modified product status**

| Number of reasons | Number of products (%) |
|:---:|:---:|
| 1 | 3 (5%) |
| 2 | 30 (49%) |
| 3 | 13 (21%) |
| 4 | 13 (21%) |
| 5 | 2 (3%) |

## Table 10. Change in units of pizzas offered and sold by content, per 200g serving

| Content type | | Energy (kcal) Offering | Energy (kcal) Purchases | Lipids (g) Offering | Lipids (g) Purchases | Saturated fats (g) Offering | Saturated fats (g) Purchases | Carbohydrates (g) Offering | Carbohydrates (g) Purchases | Fibre (g) Offering | Fibre (g) Purchases | Sugars (g) Offering | Sugars (g) Purchases | Protein (g) Offering | Protein (g) Purchases | Sodium (mg) Offering | Sodium (mg) Purchases | Price list ($) Offering | Price list ($) Purchases |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vegetable and deli meat§ (n=60 / 26%) | Unit change | 6.9±9.2 | 14.1±8.1 | 1.5±0.9 | 1.4±0.9 | 0.4±0.4 | 0.4±0.3 | -0.1±1.5 | 0.1±1.2 | -0.5±0.3 | -0.5±0.2 | -0.3±0.5 | 0.4±0.5 | -1.3±0.8 | -0.7±0.6 | -53.3±28.4 | -60.4±21.4 | 0.28±0.15 | -0.04±0.11 |
| Deli meat (n=56 / 39%) | Unit change | -0.1±7.8 | 14.9±8.3 | 0.0±0.9 | 1.2±1.0 | -0.1±0.5 | -0.5±0.5 | -1.1±1.6 | 1.2±1.3 | -0.4±0.2 | -0.6±0.2 | -1.0±0.5 | -0.4±0.5 | -0.7±0.7 | -1.1±0.7 | 1.8±38.6 | -64.0±33.3 | 0.30±0.15 | -0.08±0.10 |
| Cheese only (n=36 / 16%) | Unit change | 8.1±20.1 | 26.8±19.8 | 1.2±2.2 | 2.4±2.2 | 1.1±0.8 | -0.2±0.9 | 1.8±2.2 | 0.5±1.7 | -0.7±0.4 | -1.0±0.3 | -0.7±0.8 | -1.7±0.9 | -0.3±1.2 | -1.2±1.0 | -62.3±57.0 | -109.9±44.9 | 0.86±0.25 | 0.18±0.12 |
| Vegetable (n=34 / 10%) | Unit change | 4.0±13.2 | 14.3±11.6 | -1.4±1.4 | 0.6±1.3 | -0.4±0.5 | -0.2±0.4 | 7.2±1.8 | 2.9±1.3 | 0.2±0.4 | 0.1±0.3 | 0.4±0.6 | 0.7±0.4 | -2.5±1.2 | -0.2±0.9 | 50.0±41.8 | -86.9±25.4 | 0.58±0.27 | -0.23±0.14 |
| Vegetable and meat (n=8 / 3%) | Unit change | -9.2±16.3 | 11.6±14.3 | -0.3±1.9 | 1.2±1.7 | -0.6±1.1 | -0.1±0.9 | -1.1±4.0 | -0.4±2.5 | -0.2±0.6 | -0.1±0.4 | -0.4±1.6 | 0.7±1.1 | -0.1±1.0 | 0.5±0.9 | -56.4±47.2 | -59.0±37.9 | -0.02±0.28 | -0.06±0.24 |
| Meat and deli meat (n=7 / 5%) | Unit change | 36.6±15.2 | 27.8±13.7 | 3.3±2.1 | 2.5±1.6 | 1.4±0.9 | 1.6±0.6 | 3.0±2.4 | 3.6±1.7 | -0.2±0.7 | 0.5±0.7 | 0.8±1.4 | 0.9±1.2 | 1.0±1.4 | -0.6±0.7 | 14.8±103.3 | -11.9±73.3 | 0.39±0.18 | 0.15±0.14 |
| Vegetable, meat and deli meat (n=2 / 1%) | Unit change | 2.2±35.7 | 9.4±18.1 | 0.1±2.4 | 0.1±1.3 | -0.9±1.1 | 0.2±0.4 | 1.2±8.5 | 3.1±4.3 | 0.4±0.5 | 0.2±0.3 | 0.9±2.8 | 2.2±1.2 | -0.3±1.4 | 0.0±0.8 | -55.5±158.5 | 51.6±54.8 | 0.12±0.76 | -0.27±0.31 |
| Without cheese (n=1 / 0%) | Unit change | 22.6±0.0 | -8.4±0.0 | 1.4±0.0 | 2.5±0.0 | 1.5±0.0 | 1.6±0.0 | 0.9±0.0 | -4.7±0.0 | 2.4±0.0 | 3.0±0.0 | 3.1±0.0 | 2.4±0.0 | -1.0±0.0 | -2.1±0.0 | -100.6±0.0 | -170.4±0.0 | 4.13±0.00 | 4.42±0.00 |

Mean ± standard deviation.
Offering=Nutritional composition of pizzas available on the market (n=204).
Purchases=Nutritional composition of pizzas sold (average weighted according to number of portions sold) (n=204).
Change: Orange boxes indicate that the value is significantly higher than pizzas of the same content in 2017, while blue boxes mean that the value is significantly lower than pizzas of the same content in 2017.
The threshold used is 0.069% (p<0.00069) which corresponds to the Bonferroni correction (5%/72).
§n represents the variety of products offered and the percentages indicate the percentage of sales volume. The volume of sales, rather than the number of products, determines the effectiveness of the tests carried out for purchases.

# Table 11. Change in units of pizzas offered and sold according to packaging information, per 200g serving

| | Energy (kcal) | | Lipids (g) | | Saturated fats (g) | | Carbohydrates (g) | | Fibre (g) | | Sugars (g) | | Protein (g) | | Sodium (mg) | | Price list ($) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases | Offering | Purchases |
| **Origin** | | | | | | | | | | | | | | | | | | |
| Animal‡ (n=192 / 99%)§ | 6.0±5.6 | 21.4±5.5 | 0.6±0.6 | 1.7±0.6 | 0.2±0.2 | 0.1±0.2 | 0.5±0.8 | 1.5±0.7 | -0.4±0.1 | -0.4±0.1 | -0.6±0.3 | -0.1±0.3 | -0.3±0.4 | -0.6±0.4 | -8.8±22.3 | -48.7±19.5 | 0.30±0.09 | -0.07±0.06 |
| 100% plant-based (n=12 / 1%) | -9.5±30.8 | -53.9±24.0 | 2.0±1.6 | 1.7±1.2 | 5.1±0.6 | 4.9±0.5 | -2.5±5.4 | -9.3±3.7 | 3.0±0.6 | 3.5±0.4 | -1.4±0.9 | -2.9±0.5 | -5.3±1.1 | -6.2±0.8 | -92.8±86.5 | -194.6±50.6 | 2.85±0.36 | 2.73±0.25 |
| **Crust** | | | | | | | | | | | | | | | | | | |
| Thin‡ (n=91 / 34%) | 14.0±9.1 | 25.4±8.3 | 1.2±0.9 | 2.6±0.9 | 0.5±0.4 | 0.7±0.3 | 4.2±1.4 | 0.7±0.9 | -0.5±0.2 | -0.6±0.2 | 0.3±0.4 | 1.1±0.3 | -2.5±0.7 | -0.3±0.5 | 54.2±32.3 | -56.1±28.1 | 0.44±0.16 | -0.11±0.10 |
| Traditional (n=83 / | 2.3±8.4 | 3.6±8.1 | 0.3±0.8 | -0.8±0.8 | 0.2±0.4 | -0.1±0.4 | 0.2±1.2 | 3.0±0.9 | 0.0±0.2 | 0.0±0.1 | -0.7±0.4 | -0.1±0.4 | -0.4±0.5 | -0.8±0.4 | -136.4±31.5 | -93.6±29.2 | 0.51±0.11 | 0.06±0.07 |
| Calzone (n=19 / 19%) | 9.4±12.7 | 33.7±9.4 | 1.0±1.3 | 2.8±1.1 | -1.5±0.5 | -1.1±0.5 | -2.0±2.8 | -0.8±1.7 | 0.0±0.4 | -1.2±0.4 | -1.4±0.8 | -3.6±0.6 | -0.8±0.9 | -0.8±0.9 | 67.0±48.2 | 44.3±41.6 | -0.15±0.18 | -0.22±0.12 |
| Traditional stuffed (n=11 / 8%) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Sauce** | | | | | | | | | | | | | | | | | | |
| Tomato‡ (n=189 / 92%) | 4.9±5.4 | 18.5±5.2 | 0.7±0.6 | 1.7±0.6 | 0.3±0.3 | 0.0±0.2 | 0.7±0.9 | 1.1±0.7 | -0.3±0.1 | -0.5±0.1 | -0.4±0.3 | -0.1±0.3 | -0.9±0.4 | -0.8±0.4 | -19.4±22.8 | -52.9±19.5 | 0.47±0.10 | -0.03±0.06 |
| White (n=7 / 0%) | 11.3±20.7 | 8.5±15.9 | 0.7±1.8 | -0.3±1.5 | -0.1±1.2 | -0.2±0.9 | 1.9±2.8 | 2.8±2.6 | 0.6±0.5 | 0.8±0.4 | -1.3±1.5 | -2.4±1.4 | -0.3±2.5 | 1.1±2.3 | 1.9±80.7 | -83.5±76.4 | 0.75±0.36 | 0.32±0.34 |
| Other (n=5 / 3%) | -39.1±118.5 | -65.7±98.1 | -4.4±13.3 | -8.2±10.3 | -1.1±2.8 | -1.3±1.7 | 0.4±4.8 | -1.5±4.0 | 0.0±1.0 | -0.1±0.8 | -2.9±4.7 | -3.6±4.4 | -1.5±4.1 | 1.3±3.3 | 88.5±184.4 | 119.8±159. | 0.26±0.51 | -0.03±0.24 |
| Rosé (n=3 / 4%) | 39.3±43.9 | 62.6±36.5 | 2.3±4.5 | 3.8±3.7 | 2.2±1.8 | 2.4±1.5 | 3.4±4.4 | 4.5±3.5 | -0.7±0.7 | 0.4±0.4 | -0.3±2.1 | 0.4±1.5 | -1.2±2.4 | 1.2±2.0 | -106.1±68.6 | - | -0.39±0.12 | -0.37±0.11 |
| **Target** | | | | | | | | | | | | | | | | | | |
| General population‡ (n=170 / 72%) | 5.3±5.4 | 14.1±5.2 | 0.7±0.6 | 1.3±0.6 | 0.1±0.3 | 0.1±0.3 | 1.3±0.9 | 0.2±0.7 | -0.2±0.1 | -0.2±0.1 | -0.4±0.3 | 0.2±0.3 | -0.8±0.5 | 0.3±0.3 | -2.3±23.1 | -44.3±21.5 | 0.47±0.11 | -0.03±0.07 |
| Children (n=34 / 28%) | -6.0±18.7 | 22.9±15.2 | -0.8±1.9 | 1.9±1.7 | 1.0±0.6 | 0.6±0.5 | -2.0±2.4 | 1.7±2.0 | -0.8±0.4 | -1.5±0.3 | -1.5±0.8 | -1.7±0.8 | -1.2±1.2 | -3.1±1.2 | -110.0±53.0 | -93.6±39.1 | 0.19±0.11 | 0.04±0.09 |
| **Specific characteristic** | | | | | | | | | | | | | | | | | | |
| Base‡ (n=163 / 95%) | 12.0±6.4 | 23.2±6.2 | 0.9±0.7 | 1.9±0.7 | 0.4±0.3 | 0.1±0.3 | 0.4±1.0 | 1.3±0.8 | -0.3±0.1 | -0.5±0.1 | -1.0±0.3 | -0.4±0.3 | -0.4±0.5 | -0.6±0.4 | -16.3±23.6 | -46.3±21.7 | 0.40±0.10 | -0.02±0.06 |
| Authentic-looking (n=37 / 5%) | -24.9±9.6 | -28.3±8.9 | -2.2±0.8 | -3.7±0.8 | -0.5±0.5 | -0.9±0.4 | 1.9±1.8 | 2.4±1.6 | -0.1±0.3 | 0.2±0.3 | 0.6±0.6 | 1.5±0.5 | -1.9±0.9 | -0.5±0.7 | -49.6±44.4 | -165.7±39.9 | 0.40±0.22 | -0.08±0.15 |
| Organic (n=3 / 0%) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Natural-looking (n=1 / 0%) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Mean ± standard deviation. ‡ †reference category.

Offering=Nutritional composition of pizzas available on the market (n=204). Purchases=Nutritional composition of pizzas sold (average weighted according to number of portions sold) (n=204).

Change: Orange boxes indicate that the value is significantly higher than pizzas of the same group in 2017, while blue boxes mean that the value is significantly lower than pizzas of the same group in 2017.

The threshold used is 0.069% (p<0.00069) which corresponds to the Bonferroni correction (5%/72).

§n represents the variety of products offered and the percentages indicate the percentage of sales volume. The volume of sales, rather than the number of products, determines the effectiveness of the tests carried out for purchases.

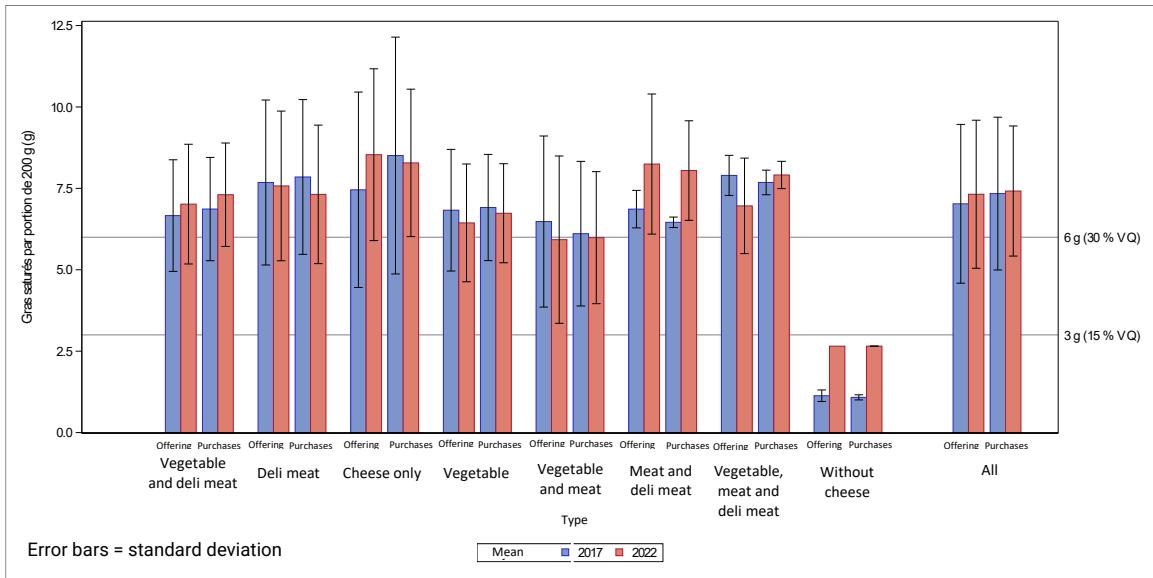- = no pizzas in this group in 2017, meaning no comparison is possible.

**Figure 12. Saturated fat content of pizza types in 2017 and 2022, per 200g serving**
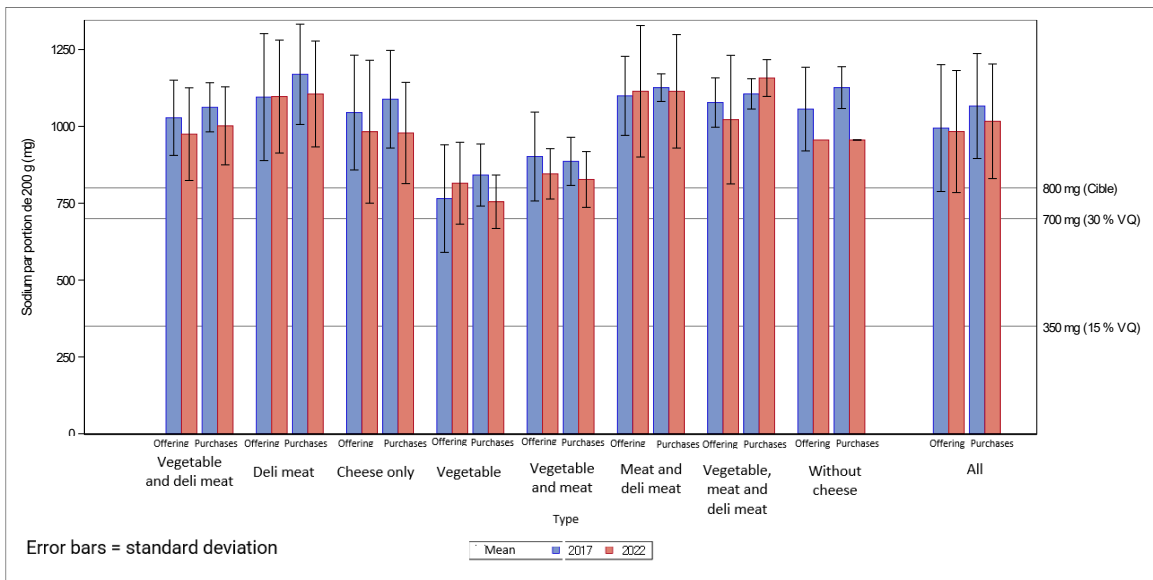


**Figure 13. Sodium content of pizza types in 2017 and 2022, per 200g serving**
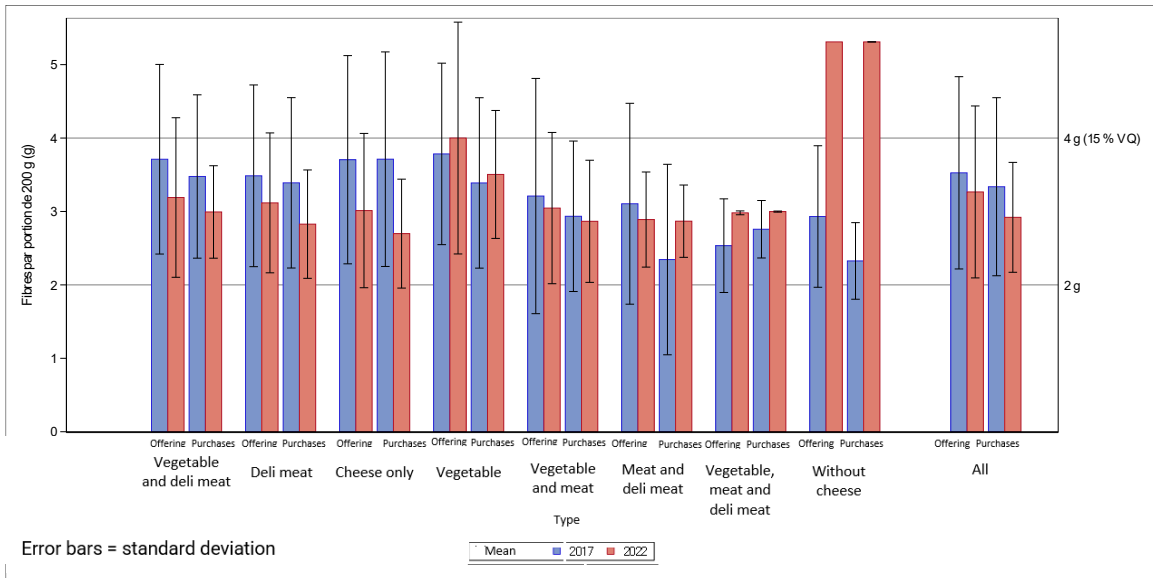
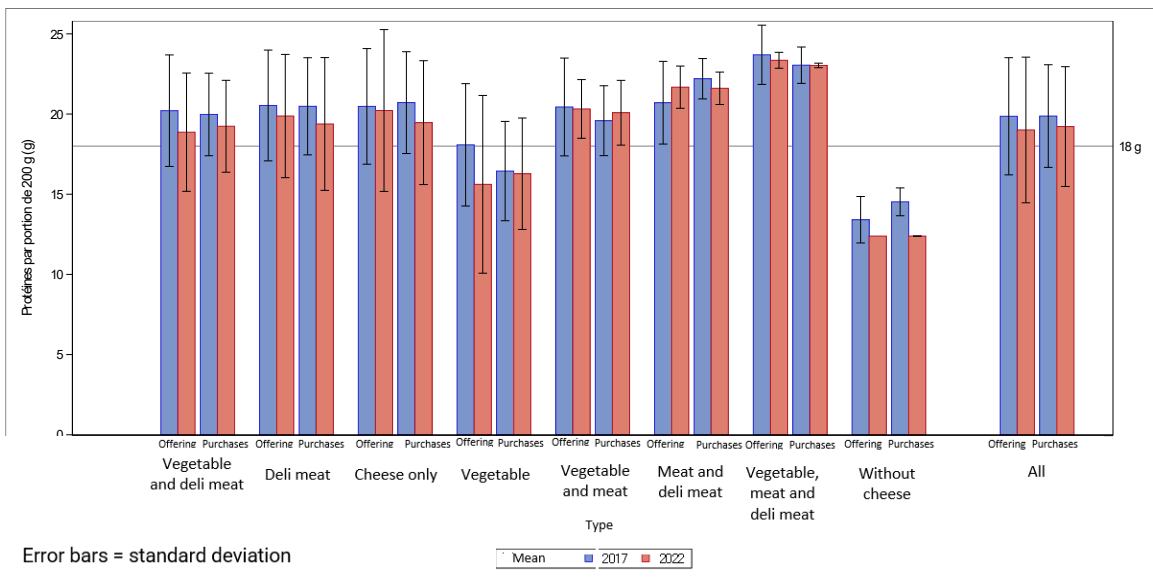**Figure 14. Fibre content of pizza types in 2017 and 2022, per 200g serving**



**Figure 15. Protein content of pizza types in 2017 and 2022, per 200g serving**

## Table 12. Average saturated fat content by year and sales quintile

| Quintiles* | Offering | | | Purchases | | |
|---|---|---|---|---|---|---|
| | 2017 | 2022 | Change | 2017 | 2022 | Change |
| 1 | 6.5 | 7.4 | +0.9 | 6.8 | 7.1 | +0.3 |
| 2 | 6.5 | 7.2 | +0.7 | 6.4 | 7.1 | +0.6 |
| 3 | 7.4 | 6.8 | -0.6 | 7.4 | 6.9 | -0.5 |
| 4 | 7.2 | 7.5 | +0.2 | 7.2 | 7.6 | +0.4 |
| 5 | 7.5 | 7.8 | +0.3 | 7.5 | 7.5 | 0.0 |

*Quintile 5: top sellers
**Offering: unweighted data for sales / Purchases: weighted data for sales.

## Table 13. Average sodium content by year and sales quintile

| Quintiles* | Offering | | | Purchases | | |
|---|---|---|---|---|---|---|
| | 2017 | 2022 | Change | 2017 | 2022 | Change |
| 1 | 988.6 | 1001.2 | +12.6 | 991.6 | 991.8 | +0.3 |
| 2 | 836.5 | 922.2 | +85.6 | 849.5 | 917.1 | +67.6 |
| 3 | 1010.4 | 926.0 | -84.4 | 1020.4 | 930.5 | -89.9 |
| 4 | 1098.7 | 1046.6 | -52.1 | 1101.7 | 1037.6 | -64.1 |
| 5 | 1066.9 | 1020.6 | -46.4 | 1078.4 | 1026.4 | -52.0 |

*Quintile 5: top sellers
**Offering: unweighted data for sales / Purchases: weighted data for sales.

## Table 14. Average fibre content by year and sales quintile

| Quintiles* | Offering | | | Purchases | | |
|---|---|---|---|---|---|---|
| | 2017 | 2022 | Change | 2017 | 2022 | Change |
| 1 | 3.9 | 3.9 | 0.0 | 4.0 | 3.7 | -0.3 |
| 2 | 3.6 | 3.5 | -0.1 | 3.6 | 3.5 | -0.1 |
| 3 | 3.2 | 3.2 | -0.1 | 3.2 | 3.2 | -0.1 |
| 4 | 3.6 | 2.8 | -0.8 | 3.6 | 2.8 | -0.8 |
| 5 | 3.2 | 2.9 | -0.2 | 3.2 | 2.9 | -0.3 |

*Quintile 5: top sellers
**Offering: unweighted data for sales / Purchases: weighted data for sales.

## Table 15. Average protein content by year and sales quintile

| Quintiles* | Offering | | | Purchases | | |
|---|---|---|---|---|---|---|
| | 2017 | 2022 | Change | 2017 | 2022 | Change |
| 1 | 20.8 | 17.3 | -3.5 | 21.6 | 18.4 | -3.2 |
| 2 | 20.9 | 18.6 | -2.3 | 20.7 | 18.5 | -2.2 |
| 3 | 18.2 | 20.0 | +1.7 | 18.2 | 20.1 | +1.9 |
| 4 | 19.3 | 19.3 | 0.0 | 19.3 | 19.5 | +0.2 |
| 5 | 20.0 | 19.7 | -0.3 | 20.2 | 19.1 | -1.2 |

*Quintile 5: top sellers
**Offering: unweighted data for sales / Purchases: weighted data for sales.