Trends in Prices of Fresh vs. Ultra-Processed foods: Analyses of Seattle-King County Prices from 2004-16.

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ABSTRACT:

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Introduction: The availability of safe, affordable, nutrient-rich food for purchase is a key component of food equity. However, foods higher in nutrients and lower in energy tend to be associated with higher per- calorie costs. By contrast, foods with lower nutrient content and higher energy density generally cost less. Many of the lower cost foods are processed rather than fresh. This study explored the temporal profile of food prices in Seattle King county (2004-2016) by food group and by level of processing.

Methods: Food prices were obtained for 379 food and beverage items from a Food Frequency Questionnaire (FFQ) provided by the Fred Hutchinson Cancer Research Center. Price data for King County were collected in 2-year cycles over 13-year period (2004-2016). In 2016 data were collected for 3 different counties in Washington State (2016). Prices data were used to generate prices per 100 g and per 100 kcal, edible portion of food. Analyses were conducted to determine whether fresh foods increased in price more than did processed and ultra-processed foods. The cross-sectional county comparisons followed the same criteria, using prices from a single cycle (2016). Prices and availability data were collected in July and August in King, Pierce, and Yakima counties in Washington State. Some items were re-collected for clarification in November. The prices were collected from the following supermarkets in King County: Safeway Inc., Quality Food Centers (QFC), and Albertsons, Pierce County: Safeway Inc., and Fred Meyer's, and Yakima County: Safeway Inc. and Fred Meyer's. Item cost was defined by Shelf Price, Unit Price, and Price per pound or Price per pint. The independent variables were 7 food group categorizations, and 4 food processing categories. The dependent variables were $/100 grams and $/100 Kcal of food. Statistical analyses and descriptive statistics through STATA were used to compare the 2014 and 2016 prices and the 13-year time trends by food group and food processing classifications.

Results: The price of the market basket of foods increased from 2004 to 2016. The food group category Fish/Poultry/Seafood was consistently the highest priced group out of the 7 total. The food processing category Fresh was consistently the most expensive classification for $/100 grams and $/100 Kcal. Foods with a higher energy density, more processed, were less expensive than food with lower energy density, less processed.

Discussion: Fresher, less energy dense foods are important for healthy diets. Many studies have shown price to be a significant factor in consumers purchasing habits, and an intervention to encourage or discourage the consumption of certain foods and beverage items. The trends in food prices for both food group and food processing classifications are important for understanding future changes for policy, education, and the prevention of chronic disease.

Introduction:

The consumption of foods from various food groups is important for healthy and diverse diets. Cost of diet is often cited as a barrier to eating healthier and more diverse dietary patterns, especially in lower socioeconomic status (SES) households, whose percentage of overall disposable income spent on food is much greater than that in higher SES.[1,2] Diverse diets are defined in terms of a diversity of nutrients, not just diversity in the food items consumed. A more diverse diet results in positive health outcomes and lower all-cause mortality compared to that of less diverse dietary patterns.[2]

However, healthier diets tend to cost more. [3,4,5,15,17] Energy-dense, nutrient poor foods tend to be cheaper than low-energy dense, nutrient-rich foods. [3,4] Consuming low cost energy dense diets has been linked with a higher risk of diabetes mellitus type II, heart disease, and obesity.[5] Another study examined how changes in prices affect purchasing decisions. Increase in price of unhealthy food items was associated with reduction in the amount purchased and consumed. By contrast, when healthy food options were reduced in price, there was an increase in the purchase and consumption of those food items.[6]

According to USDA surveys, low-income households spend their food budgets on more energy-dense foods, more likely to contain added sugars and fat.[4,7] Given that malnutrition is defined as either a deficiency in calories or a deficiency in vitamins and minerals, or both, reliance on low cost empty calories could result in undernutrition.[8]

In order to supply an adequate amount of both calories and nutrient density the food environment is measured on a scale of food security, which the USDA divides in four categories: 1) High food security 2) Marginal Food Security 3) Low Food Security and 4) Very Low Food Security[9]. Food security is defined as enough food to live healthy and active.[8] However, in 2012

on average, 61% of total food energy purchased in America was in the form of highly processed foods and beverages.[10]

The level of processing is likely to affect the per calorie cost of foods and beverages. Most products sold are processed in some way, but the intensity and type of processing that occurs may be important predictors of overall nutritional value.[11] The level of processing ranges from slightly altering the item by drying or freezing while barely altering nutrient composition to completely altering the nutrition and composition of the item to affect taste, color, or to disguise unwanted qualities of the original item.[12] Further issues arise during food structure manipulation, or food-processing[13]. When nutrient interactions and food structure are altered, the primary characteristics of these items begin to affect a number of issues related to satiety, satisfaction, and overall nutrient availability.[13] Food processing occurs for a number of reasons including food safety, longevity, convenience, palatability, and nutrient enrichment. However, the links between food prices by the level of processing have not been fully studied yet.

Research suggests that diet plays a role in prevention of chronic disease with nutrition as an avenue of intervention and control.[14] Recommendations for improving diet quality include increasing consumption of fresh fruit and vegetables, whole grains, lean meats and decreasing intakes of added fats, sugars, and refined grains.[15] One study showed that higher levels of food processing were associated with a higher amount of saturated fats, sugar, and sodium content when compared to less processed or unprocessed foods.[16]

There is a need to better understand the various level of processing within each food group and the impact of food processing on diet quality. The present analyses examined price trends in Seattle-King county from 2004-2016. These analyses were based on $/100 grams of edible portion and $/100 kcal. Previous studies using the same data set have looked at the pricing of food and

beverage items from many aspects including price per serving, price per 100 grams edible portion, price per 1000 kcal per edible portion.[17] These studies showed the cost of high energy, low nutrient density foods were more robust and tended to increase in price less than did low energy, high nutrient density foods.[17]

Methods:

Prices for 384 food and beverage items were collected over 7-cycles (every 2y) from 2004-2016 for Seattle-King county in Washington State. During the most recent cycle, prices were collected in Pierce and Yakima counties following the exact same methods for Seattle-King county, but will not be analyzed here. Graduate students and faculty at the University of Washington were involved in collecting food price data for years 2004-16.

Market Basket

Market baskets include food and beverage items in a purchasable form. Market baskets are used by a number of researchers and organizations to measure price and availability changes [3,16]. The food and beverage items for this market basket were determined by a Food Frequency Questionnaire (FFQ) provided by the Fred Hutchinson Cancer Research Center, who used it for population studies on diets and health (G-SEL version). In this paper, only 379 food and beverage items were used in the analysis due to insufficient data on 5 items. None of the food or beverage items in this market basket are categorized as a supplement or medicinal.

Prices, 2004-2016

Food and beverage prices were collected seven times over 13 years. Each collection period was between April to July. Safeway, one of the most commonly used supermarket in each county, was used to collect price data. If data was not available at Safeway secondary and tertiary stores were used to collect data and were explicitly shown in the price data. King county involved Safeway, QFC, and Albertsons, Pierce county: Safeway, Fred Meyers, and Albertsons, and Yakima county: Safeway, Walmart, and Fiesta Foods. Price data collection included the items name, description, shelf price, and quantity. Other prices were collected from fast food restaurants and Mutual Fish, a local Seattle fish market. The items collected from Mutual Fish were also

collected in Safeway for a cross-county comparison of price and availability. Price data was collected during in-store visits, online food retail website for Safeway, and telephone. All discounts were removed from the price data in order to show the true price of foods and beverages, regardless or promotions or specials.

The lowest-priced item of average (medium) purchasable size constituted the selection of food and beverage items for collection. Items for each cycle were chosen via item description and size in the current cycle. If the item is unavailable a substitute item was chosen that most closely matches the product description and size. If an item was discontinued by the supermarket, an alternative was selected to replace it using the aforementioned criteria of size and description at the lowest available price. If the item was unavailable due to being out of stock and could not be found elsewhere, the price from the previous cycle was used to limit the effects on trends.

After prices were collected for each item in each county, the items were adjusted based on price data and calculations of edible portion (yield) to calculate price per 100 grams per edible portion and a secondary analysis of price per 100 Kcal per edible portion. Yield was calculated to show amount of a food or beverage item consumed after losses or gains in overall food weight occurring during preparation. Yield values were selected from the USDA Handbook 102.[9]

Food Groups

The 379 food and beverage items collected were stratified into 7 food groups based on the USDA MyPyramid. These groups included: Dairy, Meat/Poultry/Seafood, Beans/Nuts/Seeds, Grains, Fruit & Fruit Juice, Vegetables, and Fat/Non-Grain Sweets.[10]

Food Processing

Each of the 379 food items from the FFQ market basket were grouped into four food processing categories, using the recently proposed classification.[12] These groups included: Fresh,

Ultra-processed, Processed, and Processed Culinary Ingredients. Fresh foods were defined as fresh, dry, or frozen food items will little to no processing, such as fruits, vegetables, and a number of meats. Ultra-processed foods were food and beverage items formulated by multiple ingredients not within the processed culinary ingredients classification. These products have changes in chemical composition, structure, flavor, color, other sensorial qualities, or were altered to cover up unwanted qualities of the original product. Processed foods were items manufactured with the addition of culinary ingredients to unprocessed or minimally processed items, such as canned food, simple breads, and cheeses. Lastly, processed culinary ingredients were basic ingredients used in culinary endeavors, such as table salt, sugars, oils, and fats.[12]

This was the first ever attempt to develop a food processing classification for the FHCRC FFQ foods.

Statistical Analysis:

A series of analyses were conducted to study trends in food prices over 13 years overall, and by food group and food processing classifications. The primary dependent variables of interest were: $/100g EP, and $/100Kcal EP. The three independent variables of interest were: overall market basket, by food group classification, and by 4 levels of food processing classification. Comparing 2014 and 2016 prices for continued trend analysis required log transformation of price per 100 grams of edible portion due to right skewed data. The correlation coefficient (r^2) was calculated and recorded. Once food price data were collected and cleaned, the data were stratified into food groups, food processing, cross-tab of food groups and food processing. All 379 foods items were stratified into each of these groups for each analysis. The mean cost of each item for all years for each stratification was used to analyze trends and to compare across food group and processing classifications.

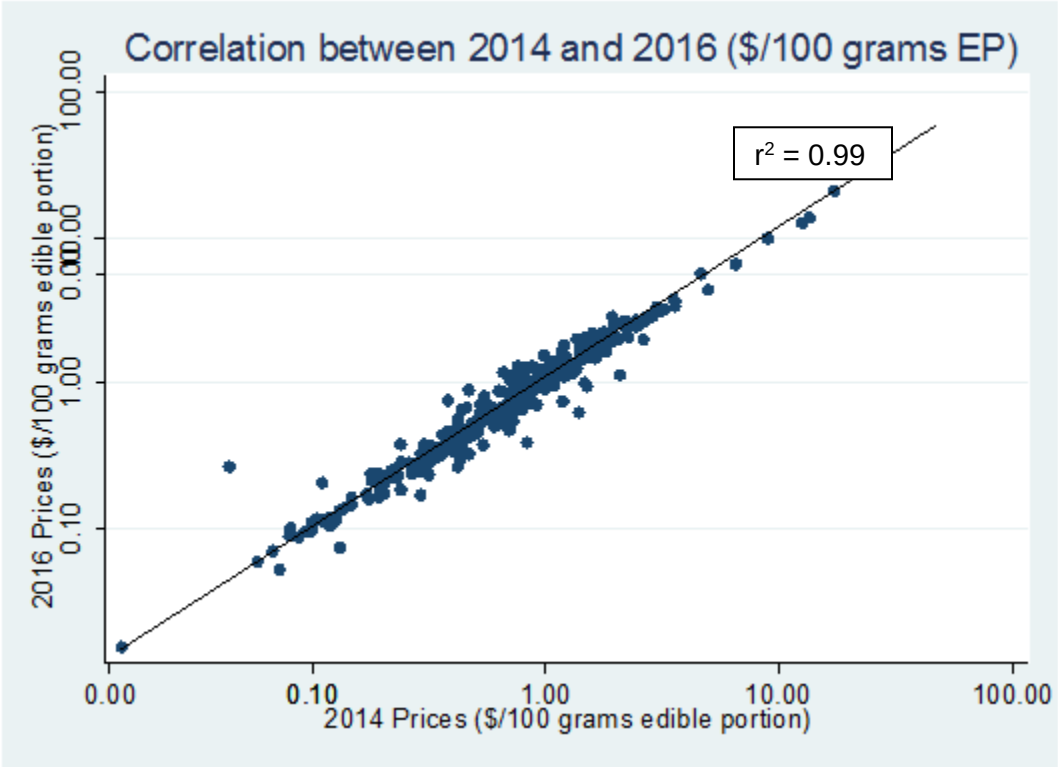
P-values were collected by utilizing t-test to compare each year individually to the current data collection cycle as well as testing individual food groups and food processing classifications against other groups via STATA14. Results were shown to be statistically significant if the p-value were ($p<0.05$). The analyses were used with $/100g EP and $/100kcal EP. These analyses took place with STATA14 statistical software for Windows 10 and with Microsoft Excel (2016).

Results:

Correlation between 2016 and 2014 prices

Figure 1 shows a strong correlation ($r^{2=}0.99$) between the 2014 and 2016 food and beverage item prices per 100 grams of edible portion (EP). This high correlation indicates the methods were followed reliably over the most recent cycle. Percent price change by food group and food processing classification for both ($/100g EP) and ($/100Kcal EP) can be found in tables 11-14.

Figure 1. Relationship between 2014 and 2016 mean price per 100 grams of edible portion. Overall correlation coefficient was 0.99.



Distribution of market basket by food group and food processing classifications

Table 1 shows the distribution of FFQ market basket by each food group. Grains made up the largest proportion of the overall market basket (26.9%) followed by Meat/Poultry/Seafood (21.1%). The smallest proportions by food group was found in Beans/Nuts/Seeds (5.3%) and Dairy (7.3%).

Table 1. Proportion of FFQ market basket by food groups.

Food Group*	**Number of items**	**%**
Dairy	**28**	**7.3%**
Meat/Poultry/Seafood	**80**	**21.1%**
Beans/Nuts/Seeds	**20**	**5.3%**
Grains	**102**	**26.9%**
Fruit & Fruit Juice	**42**	**11.1%**
Vegetables	**63**	**16.6%**
Fat/non-grain sweets	**44**	**11.6%**
Total	**379**	

*Foods ordered to match the USDA ARS [16].

Table 2 summarizes the distribution of the FFQ market basket by novel food processing classification, adapted from a 2015 study on food processing.[12] The greatest proportion of the market basket was under the Ultra-processed classification (58.6%) followed by the Fresh classification (34.3%). The smallest proportion by food processing was in the Culinary Ingredients classification (2.4%).

Table 2. Proportion of FFQ market basket by food processing classification.[12]

Processing Classification*	**Number of items**	**%**
Fresh	130	34.3**%**
Ultra-processed	222	58.6**%**
Processed	18	4.7**%**
Culinary Ingredients	9	2.4**%**
Total	379	

Table 3 shows the food processing categories and types of foods that can be found in each classification. The Fresh category consisted of fresh or partially altered foods, such as frozen or dried food items. The Ultra-processed category includes items that have undergone drastic chemical changes or include a number of additives for preservation or taste/color/structural manipulation. Processed foods included those that were fresh or minimally processed with the addition of culinary ingredients. These items were categorized from previous literature on food processing.[12]

Table 3. Food processing categories and examples of food for each classification.	
Food Processing Groups*	**Examples**
Fresh (unprocessed or minimally processed foods)	Meat Fruit (including freshly squeezed juice) Milk and Plain Yogurt Vegetables Eggs Legumes Fish and seafood Nuts/Seeds (unsalted) Non-presweetened, non-whitened Coffee and Tea
Ultra-Processed	Breads Cakes Frozen Meals Pizza Sauces Sweet Snacks Fruit Drinks Ice Cream French Fries Instant Soup Soft Drinks Breakfast Cereals
Processed	Cheese Ham Other salted, smoked, or canned meat/fish Vegetable and other plant foods preserved in brine Salted or Sugared Nuts Beer Wine
Processed Culinary Ingredients	Table Sugar Plant Oils Animal Fats Starches Coconut and milk cream

	Unsweetened baking chocolate Gelatin powder Vinegar Baking powder

*Complete list of 379 market basket item classifications can be found in Appendix 1.

Examine food prices for year 2016

The average cost of the market basket item in the year 2016 was $1.18 with a range of $0.02/100g EP to $20.81/100g EP, the mean was $1.2 with SD 2.0, the median was $0.7/100g EP. The distribution of the cost variable was positively skewed (Figure 2) due to outliers in seafood items. Figure 3 presents the same distribution after excluding those outliers.

Figure 2 shows price data is right skewed with few outliers being out of the normal distribution of prices. These outliers are attributed to Seafood items. A range limited version ($/100 g EP < $5.00) of the distribution can be found in figure 3.

Figure 2. Frequency distribution of FFQ Market Basket items by food price variable ($/100g EP), 2016.

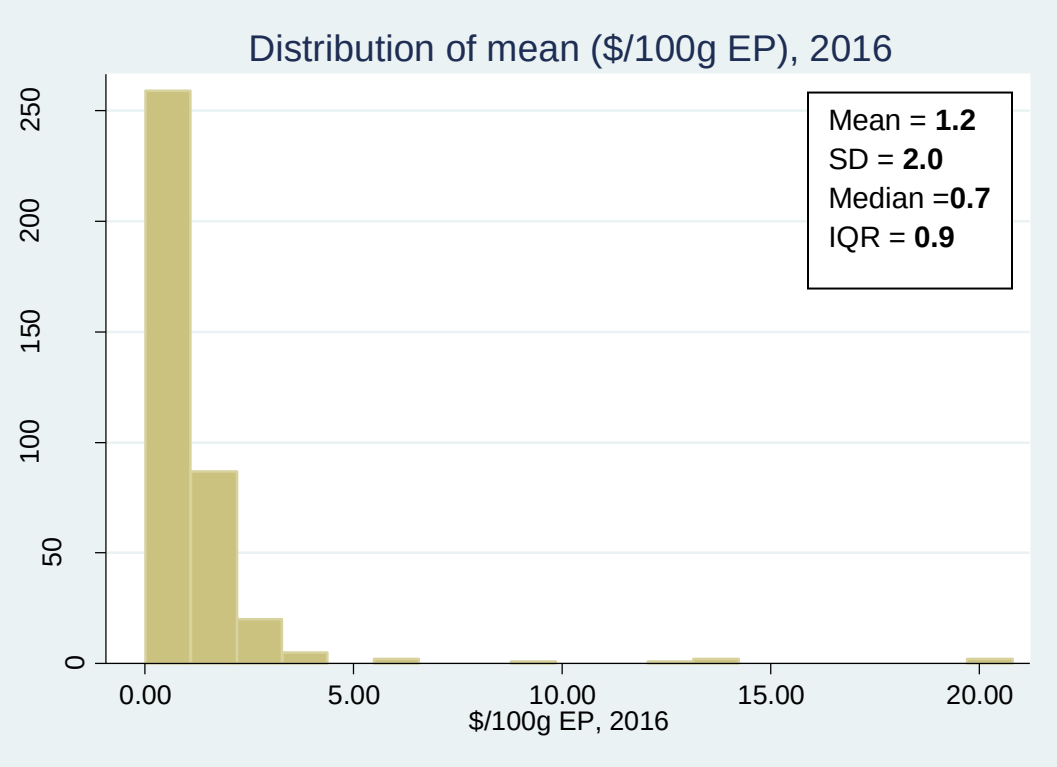


Figure 3 shows the data distribution more closely in the less than $5.00 region. The median price and IQR are similar in both figure 2 and 3, but the Mean and Standard Deviation vary due to the outliers in figure 2. The range limited version allows us to see a more detailed example of the distribution frequencies. The Mean is $0.93/100g EP, Standard Deviation $0.76/100g EP, Median $0.72/100g EP and the IQR is $0.91, when outliers greater than $5.00/100g EP are excluded.

Figure 3. Frequency distribution of FFQ Market Basket items by food price variable ($/100g EP), 2016, under the value of ($5.00/100g EP).

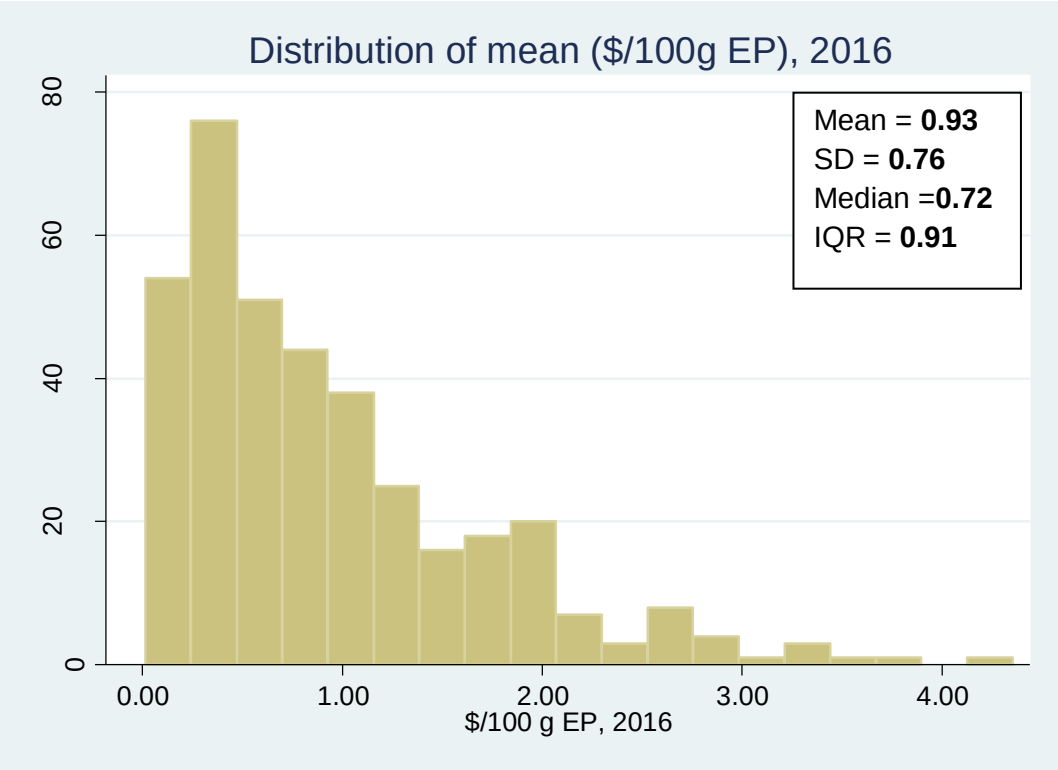


Figure 4 shows the highest priced outliers for price per 100 gram edible portion across all food group classifications are seafood items. The Mean, Median, and IQR for Meat/Poultry/Seafood are higher than any other food group. All groups have outliers, but the greatest outliers are in the Seafood classification for Meat/Poultry/Seafood. The Mean for Meat/Poultry/Seafood is $2.72/100g EP, Median is $1.76/100g EP, Standard Deviation is $3.90/100g EP and IQR is $1.38/100g EP. The range of this food group is from $0.30/100g EP to $20.81/100g EP. A closer examination, excluding outliers greater than $6.00 in the figure, but still a part of the calculations, can be found in figure 6. Due to overcrowding a number of item names were omitted from the boxplot and can be found in the legend.

Figure 4. Boxplot with outliers for mean ($/100g EP) 2016, by food group category.

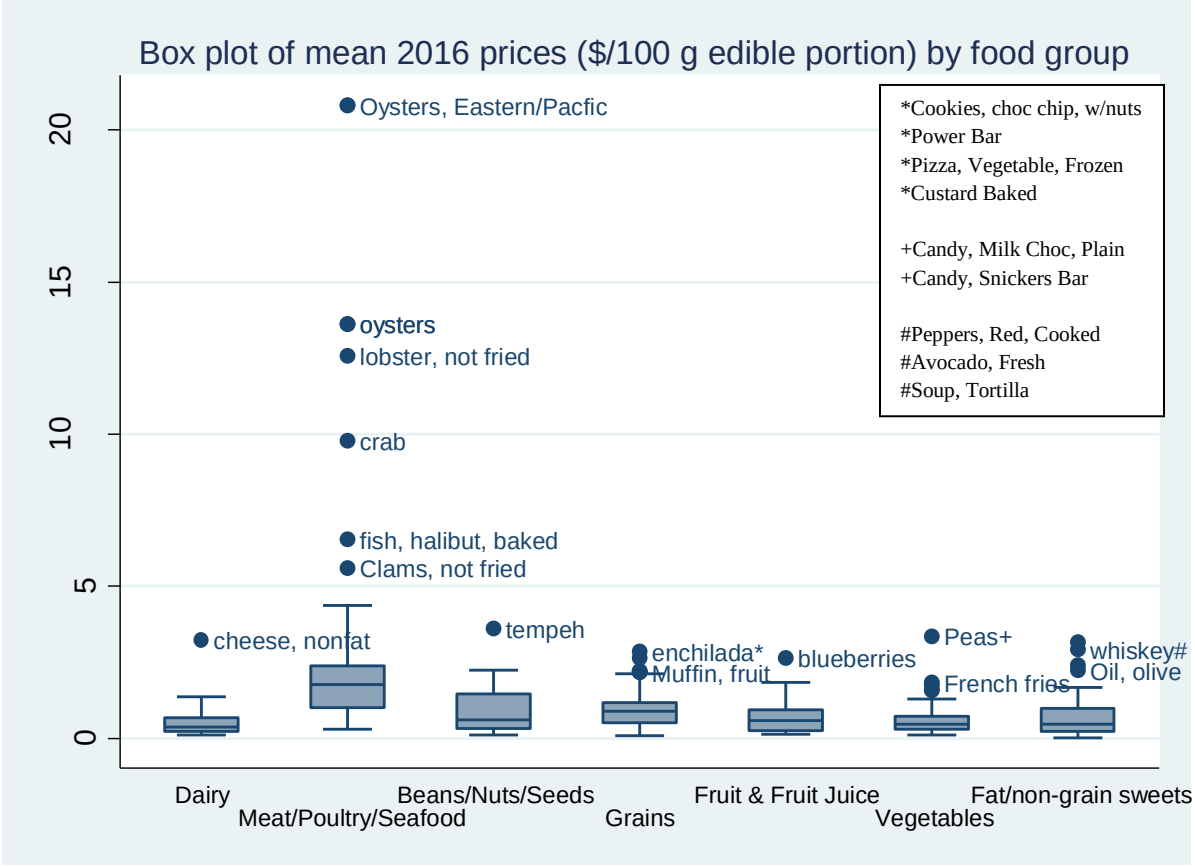


Figure 5 shows the most expensive outliers for price per 100 kcal across all food group classifications were the Seafood items from the food group Meat/Poultry/Seafood. All groups contained outliers, but the greatest outliers were in the Seafood classification for Meat/Poultry/Seafood. The Mean for Meat/Poultry/Seafood is $2.16/100kcal EP, Median is $0.86/100kcal EP, Standard Deviation is $4.38/100kcal EP and IQR is $0.95/100kcal EP. The range is from $0.14/100kcal EP to $30.60/100kcal EP. A closer examination, excluding outliers greater than $6.00 in the figure, but still a part of the calculations, can be found in figure 7. Due to overcrowding a number of item names were omitted from the boxplot and can be found in the legend.

Figure 5. Boxplot with outliers for mean ($/100kcal EP) 2016, by food group categories.

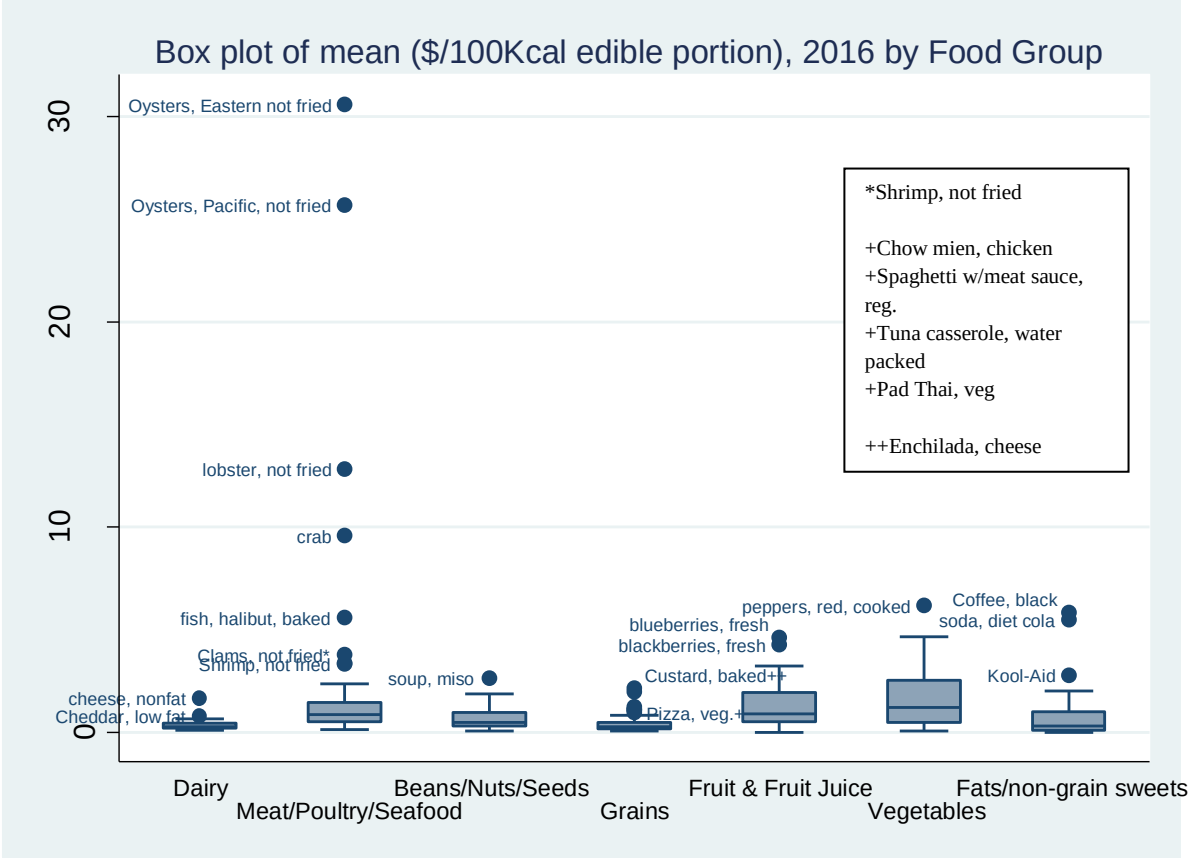


Figure 6 shows a range restricted ($/100 grams edible portion less than 6) for food group classifications, with outliers still a part of the calculations. This shows the median price for Meat/Poultry/Seafood ($1.76/100g EP) is higher than other food groups. In this figure we see that many of the IQRs for food groups cross over with the exception of Meat/Poultry/Seafood compared to Dairy and Vegetables, showing a larger difference in mean, median, and range. Due to overcrowding a number of item names were omitted from the figure and put into a legend.

Figure 6. Boxplot excluding major outliers in figure, but contained in calculations, for mean ($/100g EP) 2016, by food group classification.

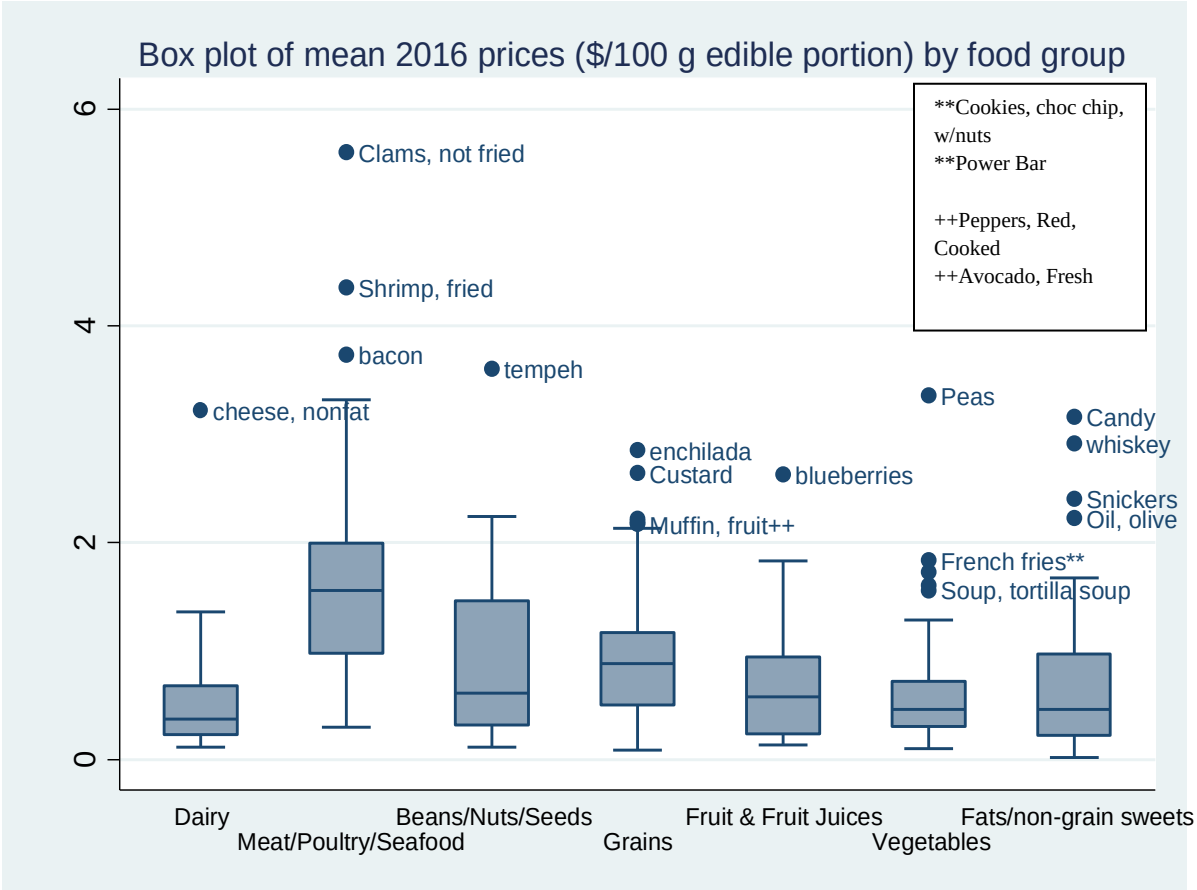


Figure 7 shows a range restricted ($/100 kcal edible portion less than 5) for food group classifications. The median price per 100kcal EP for Meat/Poultry/Seafood ($2.16/100kcal EP), Fruit & Fruit Juice ($1.30/100kcal EP), and Vegetables ($1.54/100kcal EP) are the highest. In this figure we see that many of the IQRs for food groups cross over with the exception of Dairy and Grains compared to Meat/Poultry/Seafood, Fruit & Fruit Juice, and Vegetables, showing a larger difference in mean, median, and range. Due to overcrowding a number of item names were omitted from the figure and put into a legend.

Figure 7. Boxplot excluding major outliers for mean ($/100Kcal EP) 2016, by food group classification.

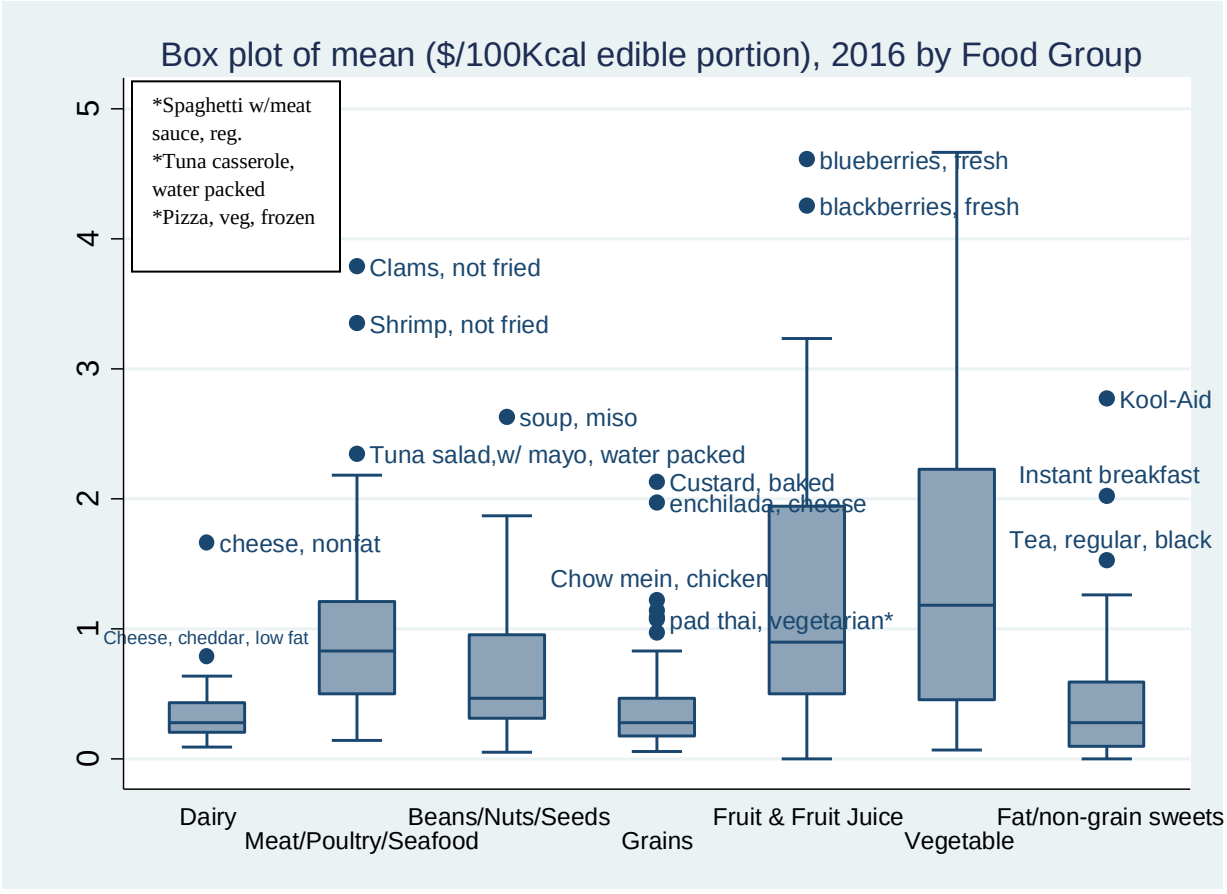


Figure 8 shows the highest priced outliers for price per 100 grams edible portion across all food processing classifications Seafood items from the Fresh food prcoessing classification. The Mean ($1.73/100g EP), Median ($0.79/100g EP), Standard Deviation ($3.26/100g EP) and IQR ($1.42/100g EP) for Fresh foods are higher than any other food group. However, the Median of Fresh and Ultra-processed are similar at ($0.79/100g EP) and ($0.74/100g EP) respectively. All groups have outliers, but the greatest outliers are in the Seafood classification for Fresh foods. The range for Fresh foods is from $0.02/100g EP to $20.80/100g EP. A more descriptive form of figure 8 for items less than $6.00/100g EP can be found in figure 10. Due to overcrowding a number of item names were omitted from the boxplot and can be found in the legend.

Figure 8. Boxplot with outliers for mean ($/100g EP) 2016, by food processing category.

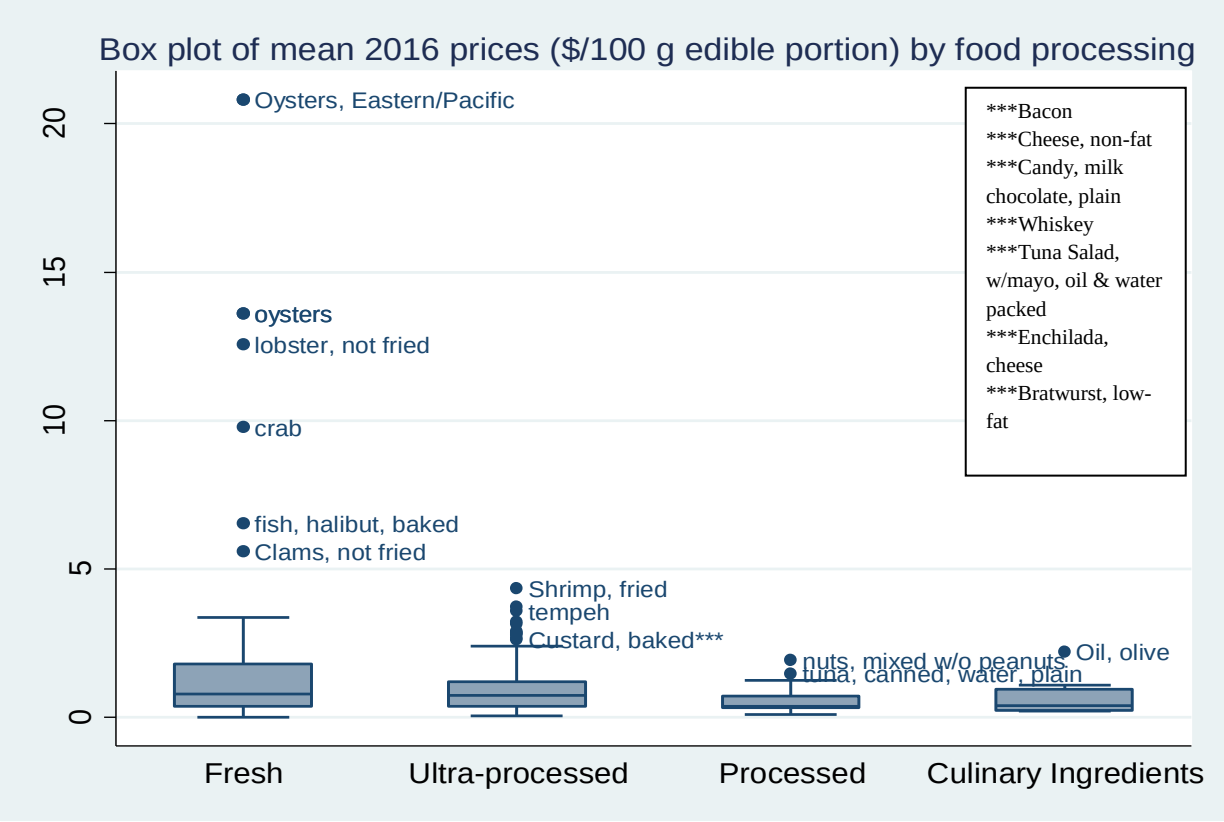


Figure 9 shows the highest priced outliers for $/100kcal EP across all food processing classifications, these outliers are mainly Seafood items. Only Fresh and Ultra-processed food processing classifications contained outliers, with the greatest being Seafood items from the Fresh category. The Mean for Fresh foods is $2.15/100kcal EP, Median is $1.03/100kcal EP, Standard Deviation is $3.96/100kcal EP and IQR is $1.67/100kcal EP. The range is from $0.00/100kcal EP to $30.60/100kcal EP. A closer examination, excluding outliers greater than $5.00 in the figure, but still a part of the calculations, can be found in figure 11. Due to overcrowding a number of item names were omitted from the boxplot and can be found in the legend.

Figure 9. Boxplot with outliers for mean ($/100Kcal EP) 2016, by food processing classification.

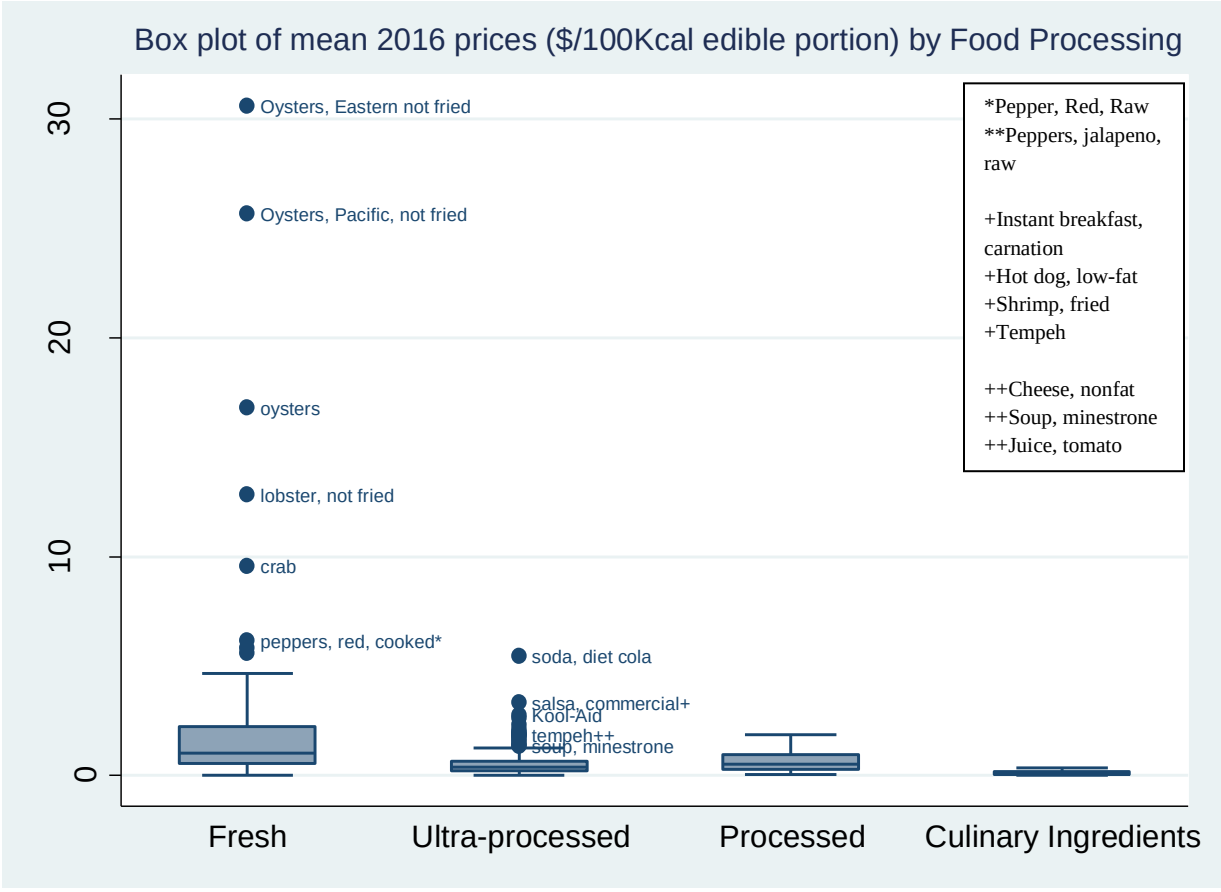


Figure 10 shows a range restricted ($/100g EP < $6.00) for food processing classifications, with outliers contained in the calculations. As in figure 8, Fresh and Ultra-processed foods have similar Median prices, but the Mean ($1.73/100g EP), Stadard Deviation ($3.26/100g EP), and IQR ($1.42/100g EP) for Fresh food items are greater for Fresh food items. All categories IQRs overlap, however, the Processed and Culinary Ingredients food classifications have much lower Median prices ($0.37/100g EP) and ($0.39/100g EP) respectively, with a smaller spread of prices within the IQR, compared to Fresh and Ultra-processed. Due to overcrowding a number of item names were omitted from the boxplot and can be found in the legend.

Figure 10. Boxplot with a range restriction to exclude major outliers for mean ($/100g EP) 2016, by food processing classification.

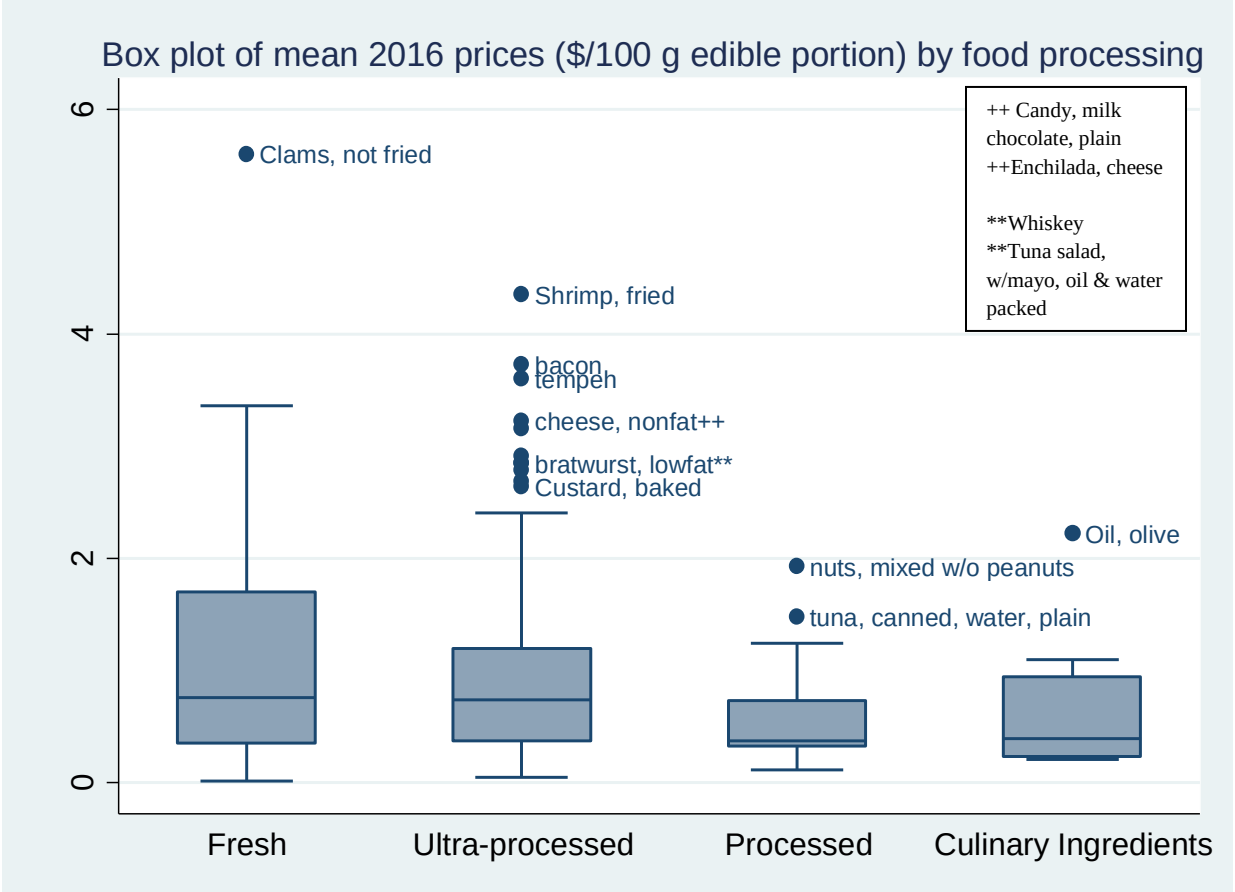


Figure 11 shows a range restricted boxplot ($/100 Kcal edible portion less than 5), with outliers still contained in the calculations. As in figure 9, only the Fresh and Ultra-processed food classfications have outliers. However, compared to other measurements, the Processed food classification has a larger IQR ($0.70/100kcal EP) and Median ($0.53/100kcal EP) compared to the Ultra-processed ($0.44/100kcal EP) and ($0.38/kcal EP), repectively. This shows that although Ultra-processed food items have a greater range, the majority of the items within the classification are cheaper than in the Proceesed category. Due to overcrowding a number of item names were omitted from the boxplot and can be found in the legend.

Figure 11. Boxplot with a range restriction to exclude major outliers for mean ($/100Kcal EP) 2016, by food processing classification.

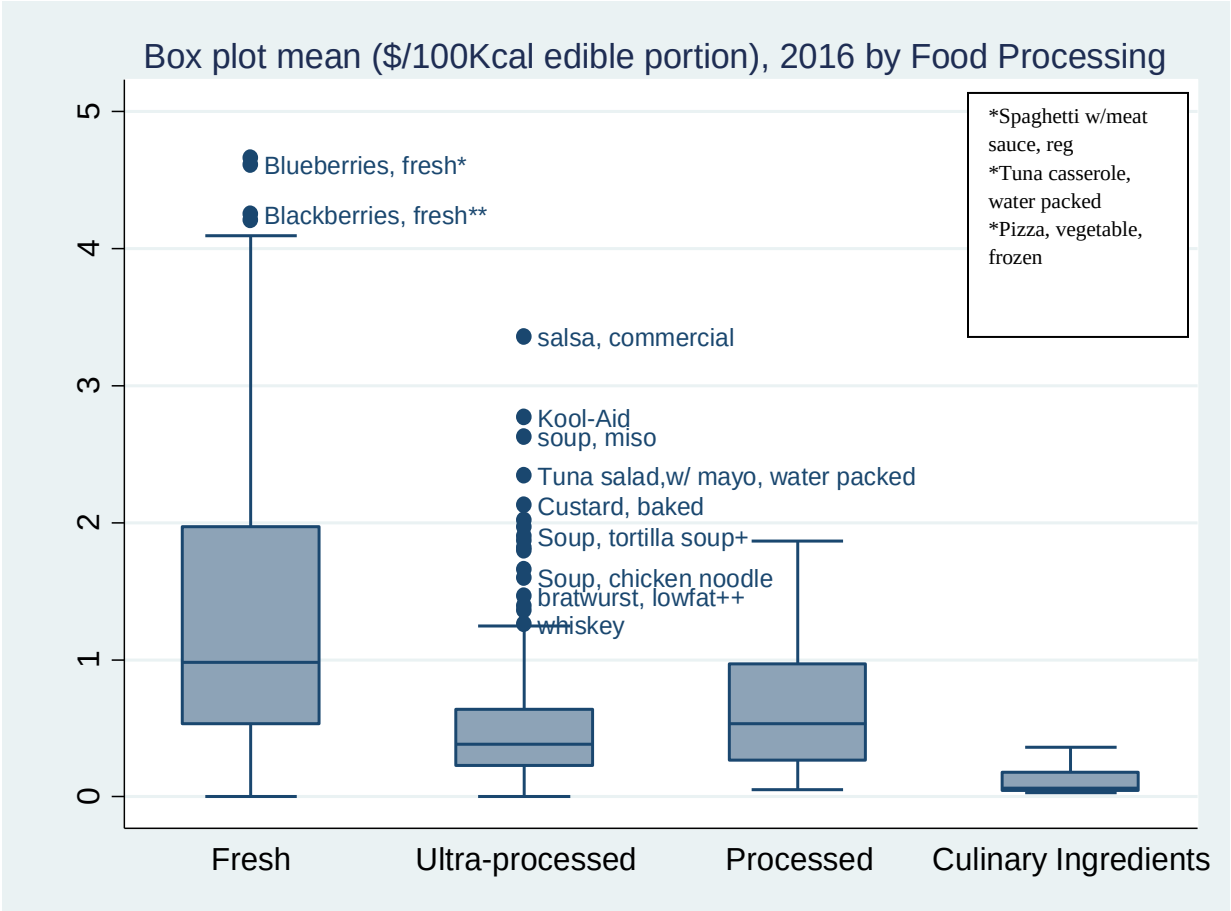


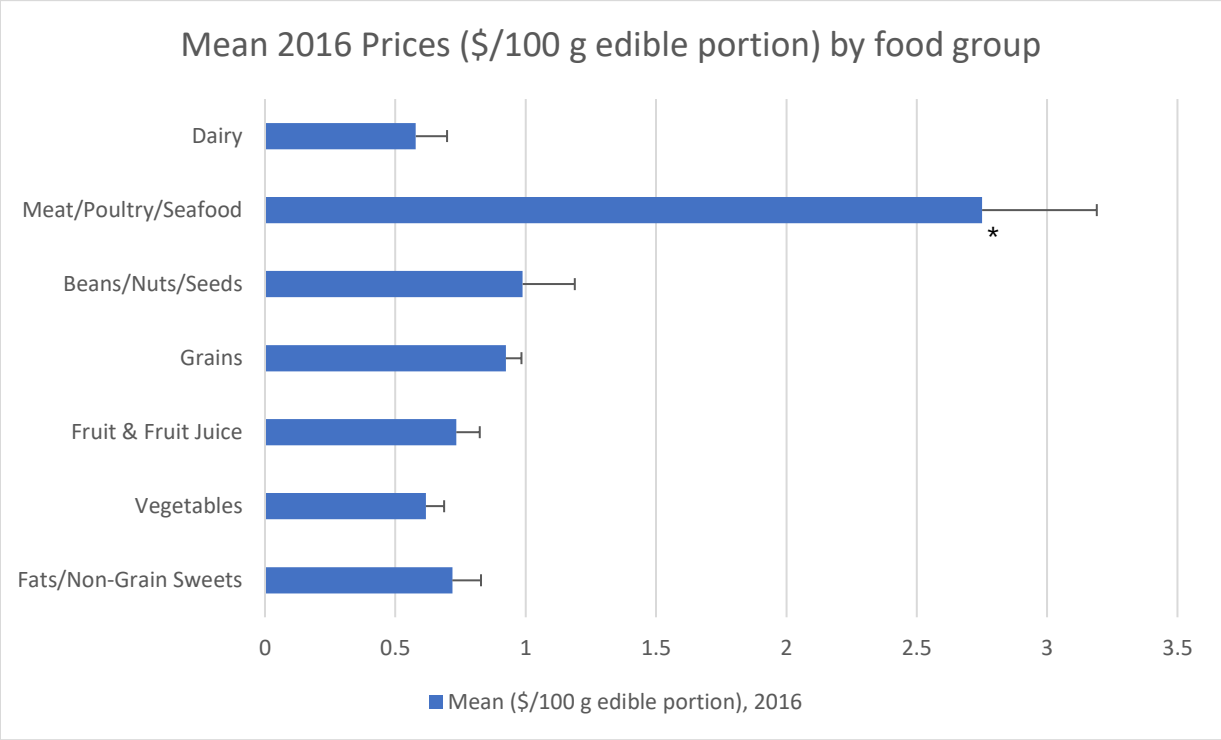
Table 4 shows that the Meat/Poultry/Seafood food group classification has the highest Median price by over double compared to any other food group and total of all items. Furthermore, the IQR for this group is also the largest. No other food group classification 95% CI overlaps with the Meat/Poultry/Seafood classification, showing a larger difference in price when comparing across all food group classifications as well as when compared to the total of all items.

Table 4: Distribution of standard statistics for 2016 price data ($/100g EP) by food groups

	# of items	Mean (SD)	95% CI	Median (IQR)
All Items	**379**	**1.18 (2.03)**	**[0.98, 1.39]**	**0.73 (0.97)**
Dairy	28	0.58 (0.63)	[0.34, 0.82]	0.37 (0.45)
Meat/Poultry/Seafood	80	2.72 (3.9)	[1.85, 3.59]	1.76 (1.38)
Beans/Nuts/Seeds	20	0.99 (0.92)	[0.56, 1.42]	0.61 (1.15)
Grains	102	0.92 (0.59)	[0.81, 1.04]	0.89 (0.67)
Fruit & Fruit Juice	42	0.73 (0.60)	[0.51, 0.89]	0.46 (0.71)
Vegetables	63	0.62 (0.53)	[0.48, 0.75]	0.46 (0.42)
Fats/non-grain sweets	44	0.72 (0.75)	[0.49, 0.95]	0.46 (0.76)

Figure 8 shows mean prices ($/100 grams edible portion). Each food group shows Standard Error. Similar to the boxplot in figures 4 and 6, Meat/Poultry/Seafood (n=80) is the most expensive Mean price ($2.72/100g EP) by category compared to all other food groups. This is statistically significant given the p-value ($p<0.05$). As we saw in figure 4, the price is elevated by the Seafood items. Overall the Dairy food group classification (n=28) has the lowest Mean ($0.58/100g EP) with Vegetables being similar ($0.62/100g EP).

Figure 8. Mean prices ($/100g EP) 2016, by food group classifications.



*p<0.05 greater than all other categories

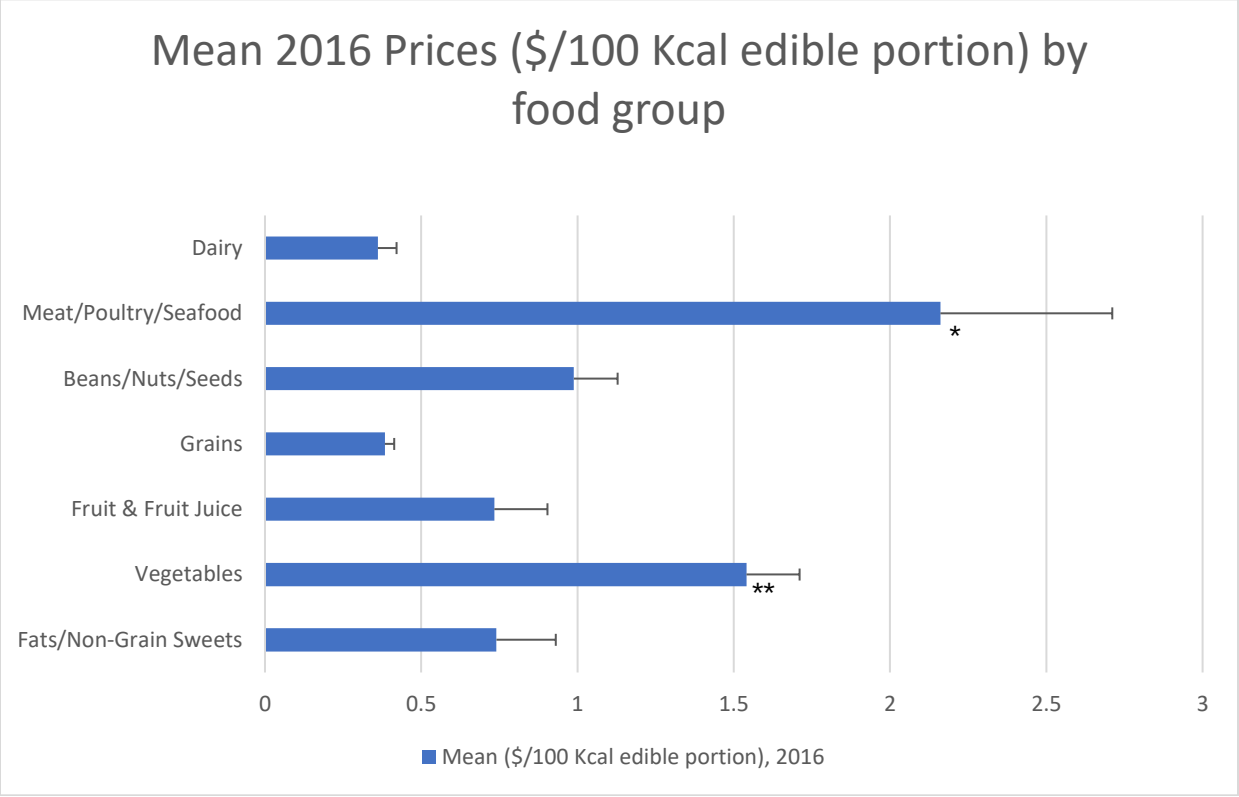
Table 5 shows the distribution of standard statistics for 2016 price data by food group by ($/100 Kcal edible portion). The Meat/Poultry/Seafood food group classification is the most expensive group ($2.16/100kcal EP). However, compared to ($/100g EP) the ($/100kcal EP) the Median price for Fruit & Fruit Juice and Vegetables ($0.90/100kcal EP) and ($1.20/kcal EP), respectively, is much greater and more similar to the Meat/Poultry/Seafood ($0.86/100kcal EP) category. The Vegetable food group classification has the largest IQR (2.10) compared to all other groups, including the Median of all food items.

Table 5: Distribution of 2016 price data ($/100Kcal EP) by food groups

	# of items	Mean (SD)	95% CI	Median (IQR)
All Items	**379**	**1.11 (2.03)**	**[0.86, 1.36]**	**0.50 (0.82)**
Dairy	28	0.36 (0.31)	[0.24, 0.48]	0.28 (0.63)
Meat/Poultry/Seafood	80	2.16 (4.91)	[1.07, 3.25]	0.86 (0.95)
Beans/Nuts/Seeds	20	0.68 (0.64)	[0.39, 0.98]	0.46 (0.64)
Grains	102	0.38 (0.34)	[0.32, 0.45]	0.28 (0.29)
Fruit & Fruit Juice	42	1.30 (1.10)	[0.96, 1.64]	0.90 (1.44)
Vegetables	63	1.54 (1.36)	[1.20, 1.88]	1.20 (2.10)
Fats/non-grain sweets	44	0.74 (1.23)	[0.37, 1.12]	0.29 (0.90)

Figure 9 shows mean prices ($/100kcal EP). Each food group shows Standard Error. Similar to the boxplot in figures 5 and 7, Meat/Poultry/Seafood ($2.16/100kcal EP) is the most expensive category compared to all other food groups by ($/100 Kcal). This is statistically significant for all groups excluding Vegetables with a p-value ($p<0.05$). Vegetables are significantly different from other groups ($p<0.05$), excluding Beans/Nuts/Seeds and Meat/Poultry/Seafood. Price for Beans/Nuts/Seeds and Vegetables are higher when stratifying by ($/kcal) versus ($/grams). Overall the Dairy food group classification has the lowest Mean ($0.36/100g EP) with Grains being similar ($0.38/100g EP).

Figure 9. Mean price ($/100 Kcal EP) 2016, by food group classification.



*p<0.05 greater than Dairy, Beans/Nuts/Seeds, Grains, Fruit & Fruit Juice, Fats/non-grain sweets
**p<0.05 greater than Dairy, Grains, Fruit & Fruit Juice, Fats/non-grain sweets

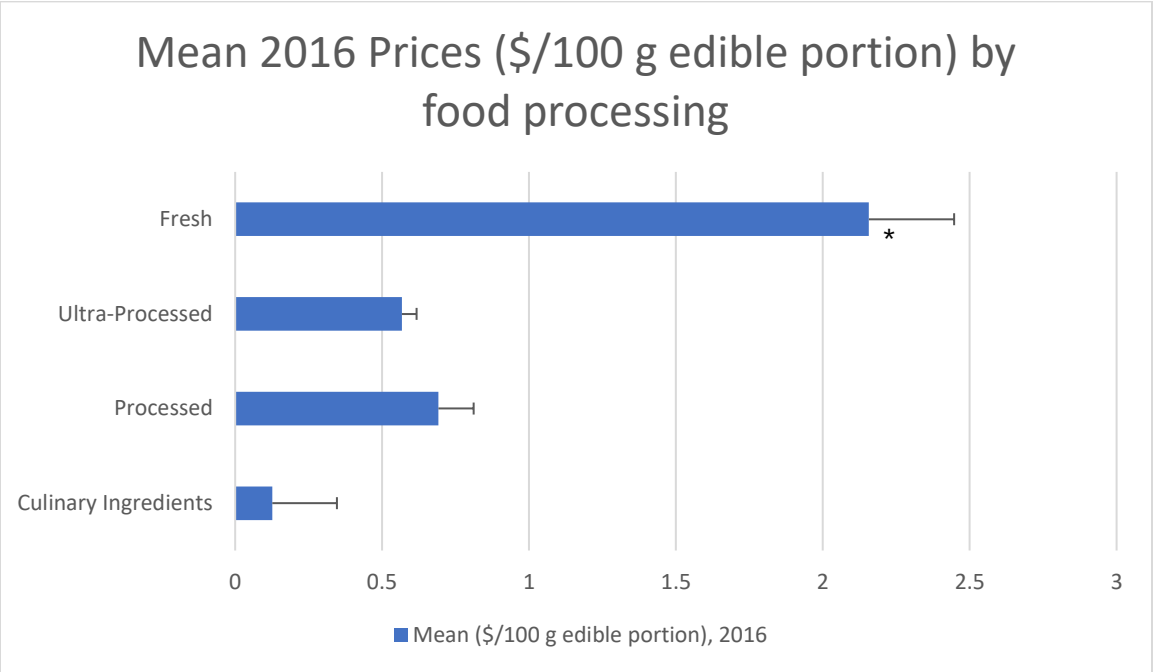
Table 6 shows the distribution of standard statistics for 2016 price data by food processing classification in ($/100g edible portion). The Meat/Poultry/Seafood food group classification is the most expensive group ($2.16/100kcal EP). However, compared to ($/100g EP) the ($/100kcal EP) the Median price for Fruit & Fruit Juice and Vegetables ($0.90/100kcal EP) and ($1.20/kcal EP), respectively, is much greater and more similar to the Meat/Poultry/Seafood ($0.86/100kcal EP) category. The Vegetable food group classification has the largest IQR (2.10) compared to all other groups, including the Median of all food items.

Table 6: Distribution of standard statistics for 2016 price data ($/100Kcal EP) by food processing

	# of items	Mean (SD)	95% CI	Median (IQR)
All Items	**379**	**1.11 (2.49)**	**[0.86, 1.36]**	**0.50 (0.82)**
Fresh	130	2.16 (3.96)	[1.47, 2.84]	1.04 (1.68)
Ultra-processed	222	0.57 (0.61)	[0.49, 0.65]	0.38 (0.44)
Processed	18	0.69 (0.53)	[0.43, 0.96]	0.53 (0.70)
Culinary Ingredients	9	0.13 (0.12)	[0.04, 0.22]	0.06 (0.13)

Figure 10 shows food processing classifications with Standard Error. Similar to the boxplot in figures 5 and 7, the Fresh food processing category is the most expensive category compared to all other food groups, this is a statistically significant difference with a p-value of ($p<0.05$).

Figure 10. Mean price ($/100g EP) 2016, by food processing classification.



*p<0.05 greater than Ultra-processed, Processed, Culinary Ingredients

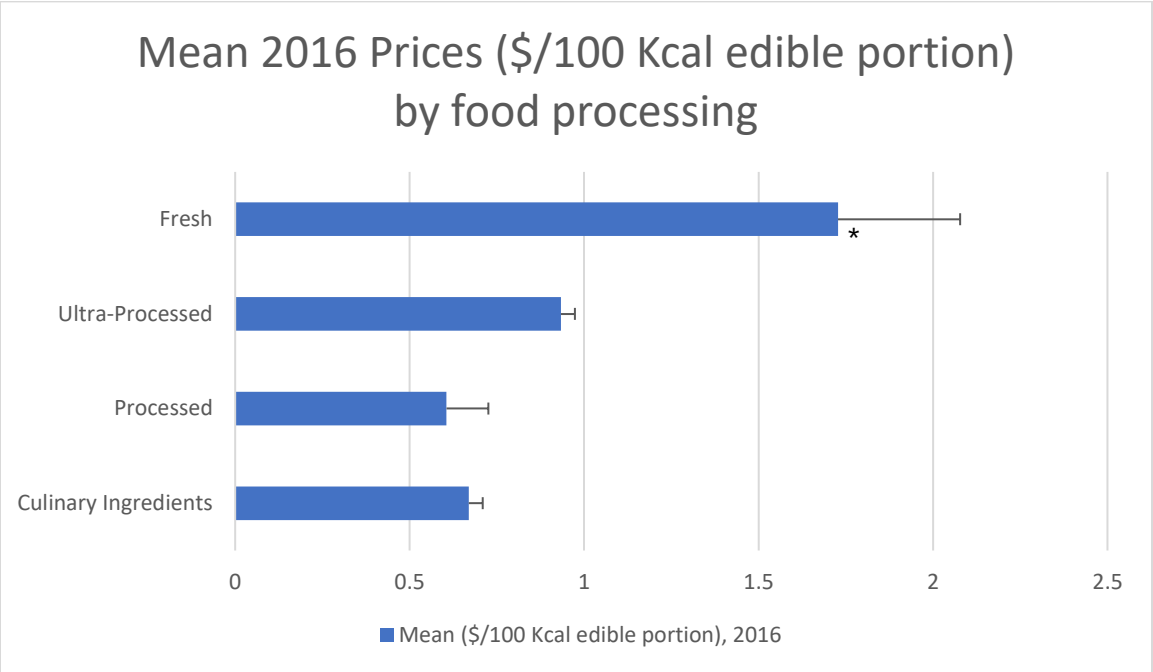
Table 7 shows the distribution of standard statistics for the 2016 price data by $/100kcal EP. The mean price for the Fresh items ($1.73/kcal EP) is significantly ($p<0.05$) greater than the other categories. The Median, as shown in figure 10 and 11, are similar between the processing groups Fresh and Ultra-processed, but the IQR for the Fresh classification is much larger than that of the Ultra-processed.

Table 7: Distribution of standard statistics for 2016 price data ($/100 Kcal edible portion) by food processing

	# of items	Mean (SD)	95% CI	Median (IQR)
All Items	**379**	**1.18 (2.03)**	**[0.98, 1.39]**	**0.73 (0.97)**
Fresh	130	1.73 (3.26)	[1.16, 2.29]	0.79 (1.42)
Ultra-processed	222	0.93 (0.75)	[0.83, 1.03]	0.74 (0.82)
Processed	18	0.61 (0.50)	[0.36, 0.85]	0.37 (0.40)
Culinary Ingredients	9	0.67 (6.67)	[0.16, 1.18]	0.39 (0.71)

Figure 11 shows the mean price distribution ($/100kcal EP) for food processing classifications. Standard Error bars are shown with each category. Similar to figure 10, the Fresh food group classification is significantly ($p<0.05$) greater than the other classifications.

Figure 11. Mean price ($/100 Kcal EP) 2016, by food processing classification.



*p<0.05 greater than Ultra-processed, Processed, Culinary Ingredients

Table 8 shows descriptive statistics for Mean 2016 prices by both ($/100g EP) and ($/100kcal EP) for food group classifications. For both variables, the Meat/Poultry/Seafood classification is the most expensive. However, table 8 shows the increase between ($/100g EP) to ($/100kcal EP) of Fruit & Fruit Juice and Vegetables as well as the decrease in price of Grains comparing the two variables.

Table 8. Descriptive statistics for Mean prices for 2016 food groups by ($/100g EP) and ($/100kcal EP)

Group	**$/100 grams edible portion**				**$/100 Kcal edible portion**			
	Sample Size	Mean	Standard Error	95% CI	Sample Size	Mean	Standard Error	95% CI
All Items	**379**	**1.18**	**0.10**	**[0.98, 1.39]**	**379**	**1.11**	**0.13**	**[0.86, 1.36]**
Dairy	28	0.58	0.12	[0.34, 0.82]	28	0.36	0.06	[0.24, 0.48]
Meat/ Poultry/ Seafood	80	2.72	0.44	[1.85, 3.59]	80	2.16	0.55	[1.07, 3.25]
Beans/ Nuts/ Seeds	20	0.99	0.20	[0.56, 1.42]	20	0.68	0.14	[0.39, 0.98]
Grains	102	0.92	0.06	[0.81, 1.04]	102	0.38	0.03	[0.32, 0.45]
Fruit & Fruit Juice	42	0.73	0.09	[0.51, 0.89]	42	1.30	0.17	[0.96, 1.64]
Vegetables	63	0.62	0.07	[0.48, 0.75]	63	1.54	0.17	[1.20, 1.88]
Fats/non-grain sweets	44	0.72	0.11	[0.49, 0.95]	44	0.13	0.19	[0.37, 1.12]

Table 9 shows descriptive statistics for Mean 2016 prices by both ($/100g EP) and ($/100kcal EP) for food processing classifications. For both variables, the Fresh food classification is the most expensive. The 95% CI for the Fresh food classification is higher than the other food processing classifications further validating a higher mean price. Furthermore, the price decreases for the Ultra-processed food classification when comparing the two variables ($/100g EP) and ($/100kcal EP), whereas, increases for the Fresh food classification between the two variables.

Table 9. Descriptive statistics for Mean prices for 2016 food processing classifications by ($/100g EP) and ($/100kcal EP)

Processing	**$/100 grams edible portion**				**$/100 Kcal edible portion**			
	Sample Size	Mean	Standard Error	95% CI	Sample Size	Mean	Standard Error	95% CI
All Items	**379**	**1.18**	**0.10**	**[0.98, 1.39]**	**379**	**1.11**	**0.13**	**[0.86, 1.36]**
Fresh	130	1.73	0.29	[1.16, 2.29]	130	2.16	0.35	[1.47, 2.84]
Ultra-Processed	222	0.93	0.05	[0.83, 1.03]	222	0.57	0.04	[0.49, 0.65]
Processed	18	0.61	0.12	[0.36, 0.85]	18	0.69	0.12	[0.43, 0.96]
Culinary Ingredients	9	0.67	0.22	[0.16, 1.18]	9	0.13	0.04	[0.04, 0.22]

Stratification and distribution by food groups and food processing for 2016

Table 10 shows that the most frequent (n>20) food group items in each level of processing are: Fresh Meat/Poultry/Seafood, Fruit & Fruit Juice, and Vegetables and Ultra-Processed Meat/Poultry/Seafood, Grains, and Fats/non-grain sweets. This shows the distribution of the FFQ market basket in terms of double-stratification of food groups and food processing classifications.

Table 10. Distribution of food group items based on food processing classification.

Food Processing Classifications	**Food Group Classification**								
		Dairy	**Meat/ Poultry/ Seafood**	**Beans/ Nuts/ Seeds**	**Grains**	**Fruit & Fruit Juice**	**Vegetables**	**Fat/non grain sweets**	**Total items**
	Fresh	6	50	0	5	27	40	2	**130**
	Ultra-Processed	20	28	17	97	10	16	34	**222**
	Processed	1	2	3	0	5	7	0	**18**
	Culinary Ingredients	1	0	0	0	0	0	8	**9**
	Total	**28**	**80**	**20**	**102**	**42**	**63**	**44**	**379**

Table 11 shows the distribution of Mean prices for the items double-stratified in table 10. The most expensive by Mean price ($/100g EP) for each food group by food processing classification as Fresh: Meat/Poultry/Seafood, Fruit & Fruit Juice, Ultra-Processed: Dairy, Grains, Vegetables, and Fats/non-grain sweets, and Processed: Beans/Nuts/Seeds. Although the majority of the highest priced items fall under the Ultra-processed classification, the total mean price ($/100g EP) is smaller for Ultra-processed compared to the Fresh food classification.

Table 11. Distribution of mean price ($/100g EP) of food group items based on food processing classification.

Food Processing Classifications	**Food Group Classification**								
		Dairy	**Meat/ Poultry/ Seafood**	**Beans/ Nuts/ Seeds**	**Grains**	**Fruit & Fruit Juice**	**Vegetables**	**Fat/non grain sweets**	**Total Mean**
	Fresh	0.26	3.42	0	0.16	0.95	0.64	0.04	**1.73**
	Ultra-Processed	0.71	1.56	0.98	0.96	0.27	0.67	0.76	**0.93**
	Processed	0.35	1.36	1.01	0	0.47	0.35	0	**0.61**
	Culinary Ingredients	0.23	0	0	0	0	0	0.72	**0.67**
	Total Mean	**0.58**	**2.72**	**0.99**	**0.92**	**0.73**	**0.62**	**0.72**	**1.18**

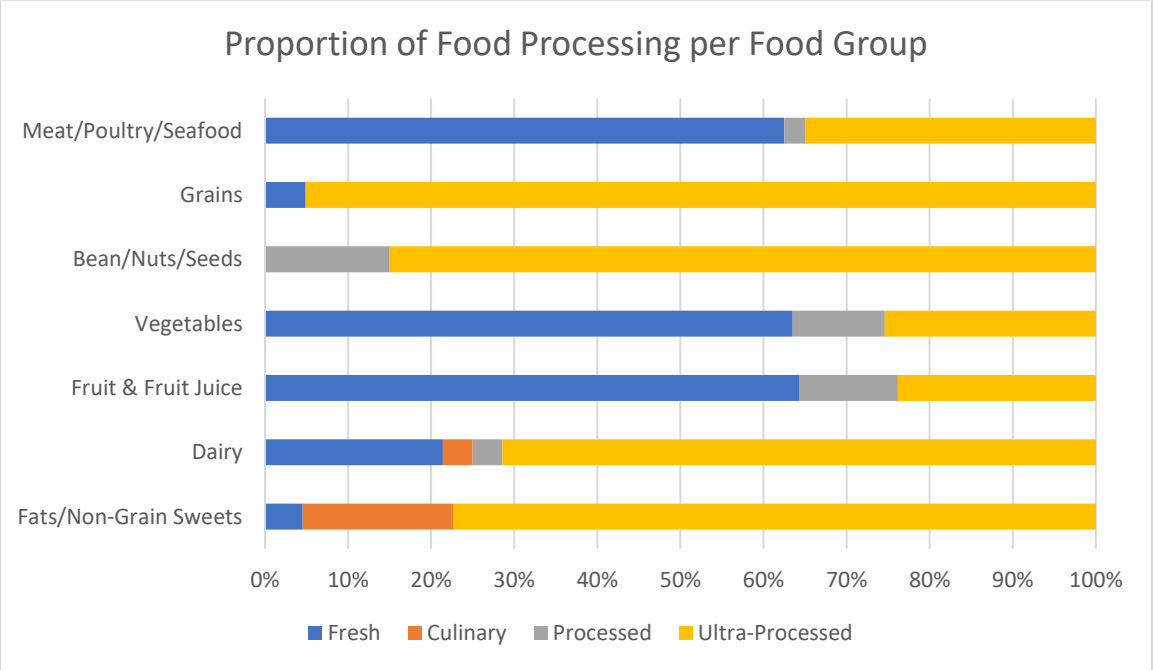
Table 12 shows the distribution of Mean prices for the items double-stratified in table 10. The most expensive by Mean price ($/100kcal EP) for each food group by food processing classification as Fresh: Meat/Poultry/Seafood, Fruit & Fruit Juice, Vegetables, and Fats/non-grain sweets, Ultra-Processed: Dairy, Beans/Nuts/Seeds, and Grains. Similar to table 11, the total mean price ($/100kcal EP) is smaller for Ultra-processed compared to the Fresh food classification.

Table 12. Distribution of mean price ($/100kcal EP) of food group items based on food processing classification.

Food Processing Classifications	**Food Group Classification**								
		Dairy	**Meat/ Poultry/ Seafood**	**Beans/ Nuts/ Seeds**	**Grains**	**Fruit & Fruit Juice**	**Vegetables**	**Fat/non grain sweets**	**Total Mean**
	Fresh	0.34	2.96	0	0.10	1.65	1.95	3.68	**2.16**
	Ultra-Processed	0.38	0.82	0.77	0.40	0.57	0.85	0.71	**0.57**
	Processed	0.18	0.95	0.18	0	0.86	0.79	0	**0.69**
	Culinary Ingredients	0.18	0	0	0	0	0	0.12	**0.13**
	Total Mean	**0.36**	**2.16**	**0.68**	**0.38**	**1.30**	**1.54**	**0.74**	**1.11**

Figure 12 shows the majority of Grains, Beans/Nuts/Seeds, Dairy, and Fats/non-grain sweets are Ultra-processed items. Meat/Poultry/Seafood, Vegetables, and Fruit & Fruit juice are majority Fresh items, highlighted in table 10. This shows a graphical representation of the total mean averages of food group classifications from table 11. Food group classifications with a higher proportion of Fresh food processing tend to be more expensive than those with a higher proportion of Ultra-processed foods. The exception to this is for the Vegetable food group classification where the price is relatively similar for both Fresh and Ultra-processed ($0.64/100g EP) and ($0.67/100g EP), respectively. Furthermore, for the Beans/Nuts/Seeds classification, the proportion of Processed food items has a higher mean ($/100g EP) than the Ultra-processed.

Figure 12. Proportion by percentage of food processing included in each food group for 2016.



Time trend analysis of food price trends (2004-2016)

Table 13 shows the comparison of relative and absolute price changes by percent change and actual price change from 2004 to 2016. The mean price for each food group was used to calculate the numbers. From 2004 to 2016 there was a relative (%) change of 27.3% for the mean total price of all food groups based on ($/100 grams) and 37.0% change for all food groups for ($/100 Kcal). The actual mean price difference between 2004 and 2016 was $1.56 for ($/100 grams edible portion) and $1.85 for ($/100 Kcal). Meat/Poultry/Seafood saw the largest increase in actual price. Vegetables showed a much higher increase in actual price when looking at ($/100Kcal).

The largest change in relative price was for Beans/Nuts/Seeds with a 45.6% increase for ($/100g) and a 61.9% increase for ($/100 Kcal). However, the actual price change was not the largest out of the food groups. The smallest actual change in price occurred in the Dairy group with a change of $0.04 for ($/100g) and $0.05 for ($/100Kcal).

Table 13. Relative and absolute price changes by (%) and ($) from 2004-2016 by food group classification.

		All Items	Dairy	Meat/ Poultry/ Seafood	Beans/ Nuts/ Seeds	Grains	Fruit & Fruit Juice	Vegetables	Fats/ Non-Grain Sweet
Relative Change in Price (%)	$/100 Grams	27.3	9.4	25.3	45.6	24.3	14.0	36.3	46.9
	$/100 Kcal	37.0	12.5	44.9	61.9	18.8	8.4	50	51
Actual Change in Price ($)	$/100 Grams	1.56	0.05	0.55	0.31	0.18	0.09	0.17	0.33
	$/100 Kcal	1.85	0.04	0.66	0.25	0.06	0.11	0.48	0.24

Table 14 shows the comparison of relative and actual price changes by percent change and actual price change from 2004-2016. The mean price for each food processing classification was used to calculate the numbers. From 2004 to 2016 there was a relative (%) change of 39.7% for ($/100g) and 36.0% for ($/100Kcal). The actual mean price difference between 2004 and 2016 was $1.12 for ($/100g) and $0.95 for ($/100Kcal). The Fresh food category had the highest actual ($) change from 2004 to 2016 with a change of $0.50 for ($/100g) and $0.63 for ($/100Kcal). The largest relative (%) change was for Culinary Ingredients for both grams and kcals with a respective 59.5% and 44.4% change. The actual ($) difference by ($/100Kcal) for the Fresh category was much larger than any other category of processing.

Table 14. Relative and absolute price changes by (%) and ($) from 2004-2016 by food processing classification.

		All Items	Fresh	Ultra-Processed	Processed	Culinary Ingredients
Relative Change in Price (%)	$/100 Grams	39.7	40.7	31.0	32.6	59.5
	$/100 Kcal	36.0	40.1	35.7	23.2	44.4
Actual Change in Price ($)	$/100 Grams	1.12	0.50	0.22	0.15	0.25
	$/100 Kcal	0.95	0.63	0.15	0.13	0.04

Figure 13 shows Meat/Poultry/Seafood are consistently the highest priced item by food group classification across all 7 cycles based on price per 100g edible portion. Meat/Seafood/Poultry have the largest actual ($) change out of the food group classifications. This group has been steadily increasing over the 7 data collection cycles. A figure excluding Meat/Seafood/Poultry can be found in figure 14 to see how trends of the other food group classifications have changed over time.

Figure 13. Time trends from 2004-2016 for mean prices of each food group ($/100g EP).

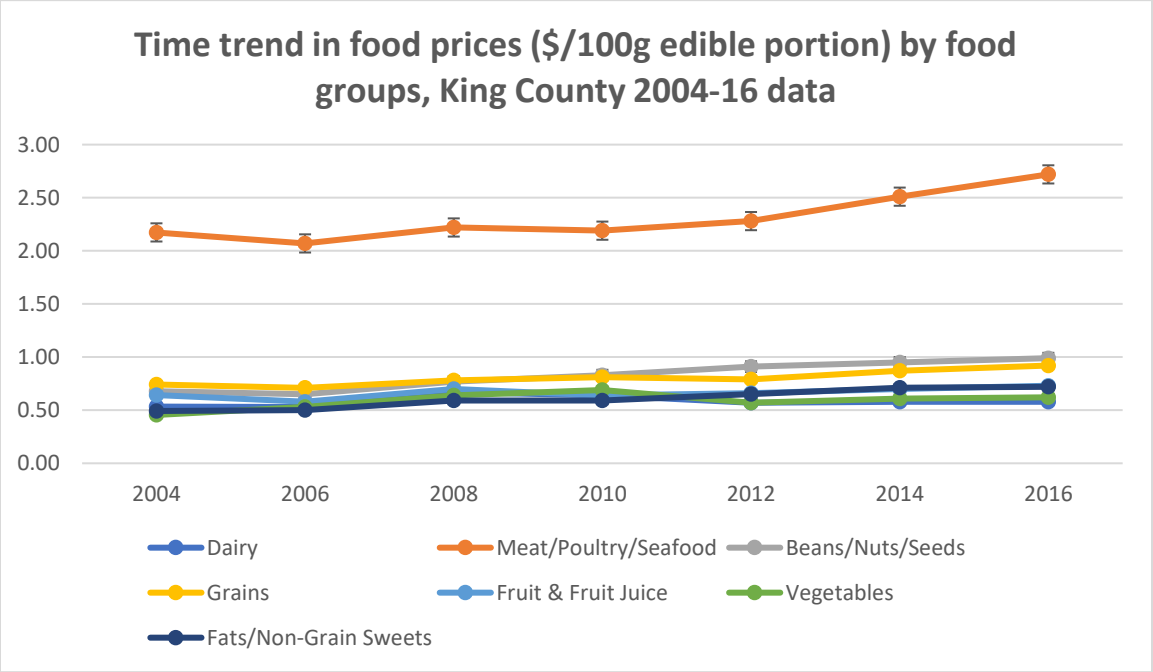


Figure 14 shows time trends for food groups from figure 11 excluding Meat/Poultry/Seafood. Beans/Nuts/Seeds, Grains, and Fats/non-grain sweets have seen a relative increase in price per 100g edible portion compared to Dairy, Fruit & Fruit Juice, and Vegetables which stayed relatively similar, although with spikes a spike in 2008 for Fruit & Fruit Juice and Dairy, and a spike in 2010 for Vegetables.

Figure 14. Time trends from 2004-2016 for mean prices of each food group ($/100g EP), without the Meat/Poultry/Seafood.

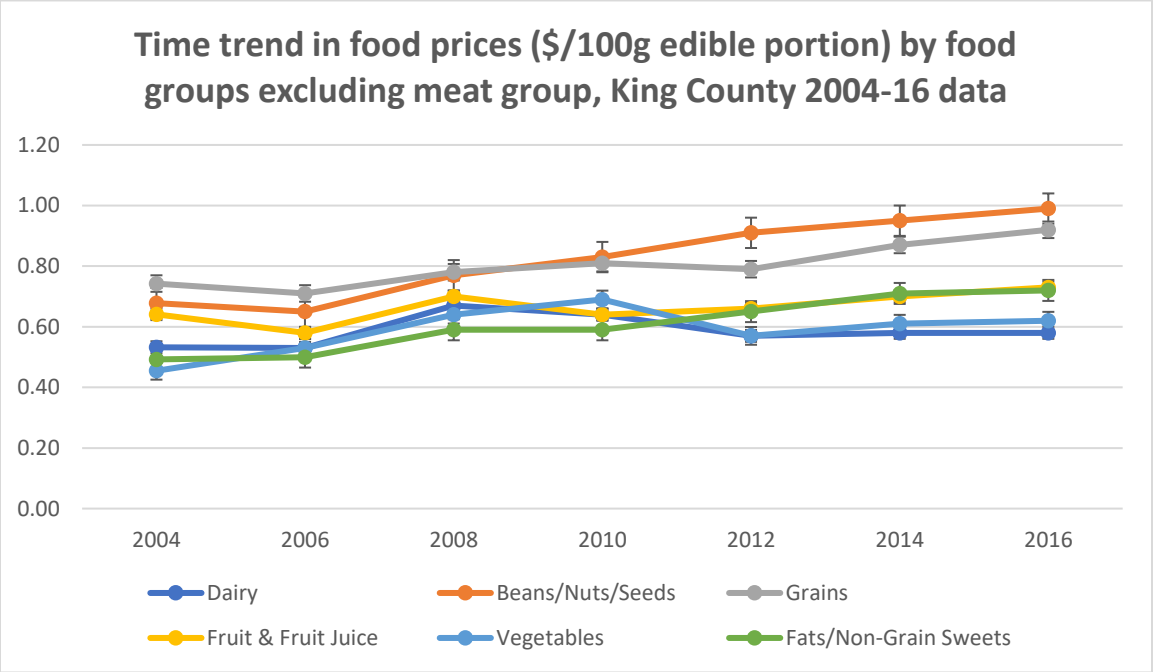


Figure 15 shows an increase in Meat/Poultry/Seafood and Vegetables compared to all other categories which have remained relatively stagnant for price per 100 kcal edible portion. Meat/Poultry/Seafood, Vegetables, and Fruit & Fruit Juice, all of which are majority Fresh items, are the most expensive over all cycles. There was a spike for Vegetable price data in 2010, which was also shown in figure 14.

Figure 15. Time trends from 2004-2016 for mean prices of each food group ($/100kcal EP).

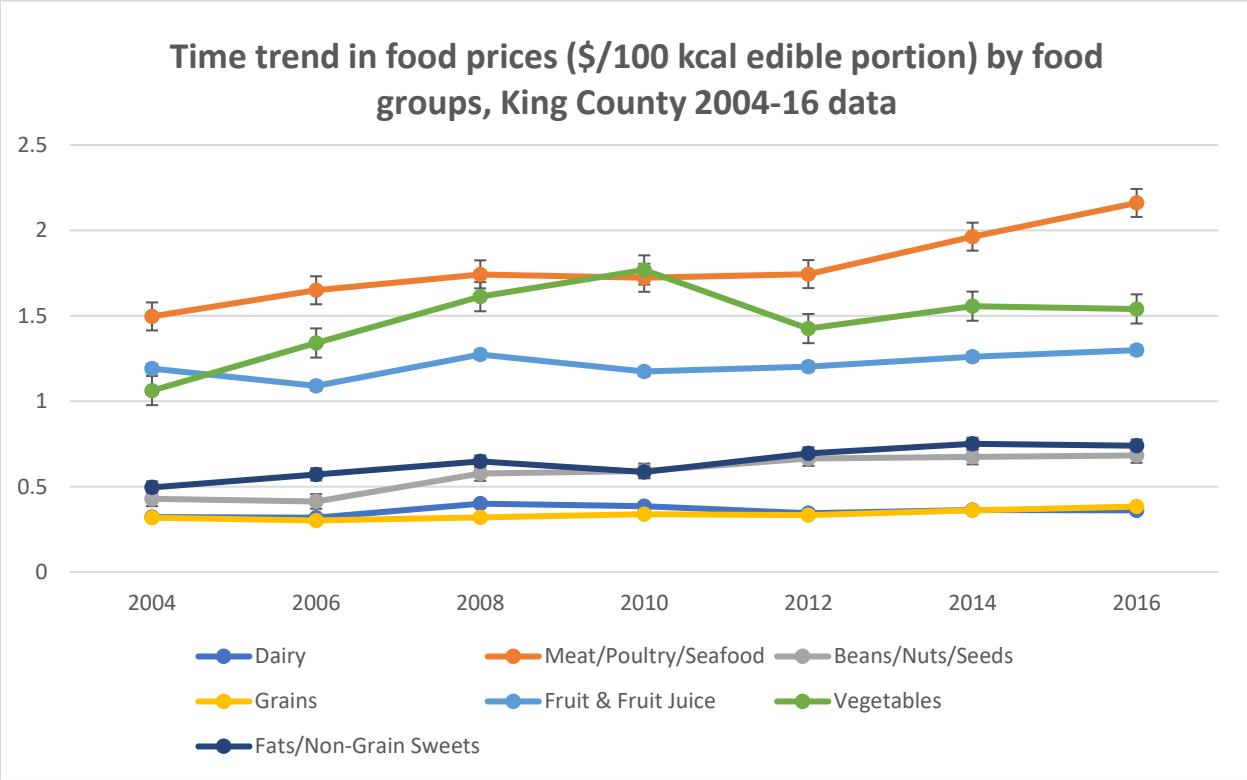


Figure 16 shows that foods in the Fresh processing category are consistently the most expensive over all 7 cycles based on price per 100g edible portion. All foods based on food processing classifications have been steadily increasing over the 7 data collection cycles, but Fresh food items have the largest change in pricing when compared to the others. The two largest increasing in Fresh food items were from 2004-2008 and from 2012- 2016. These two time frames are where the majority of price changes for Fresh and Ultra-processed, but for Processed and Culinary Ingredients it was a continuous trend.

Figure 16. Time trends from 2004-2016 for mean prices of each food processing classification ($/100g EP).

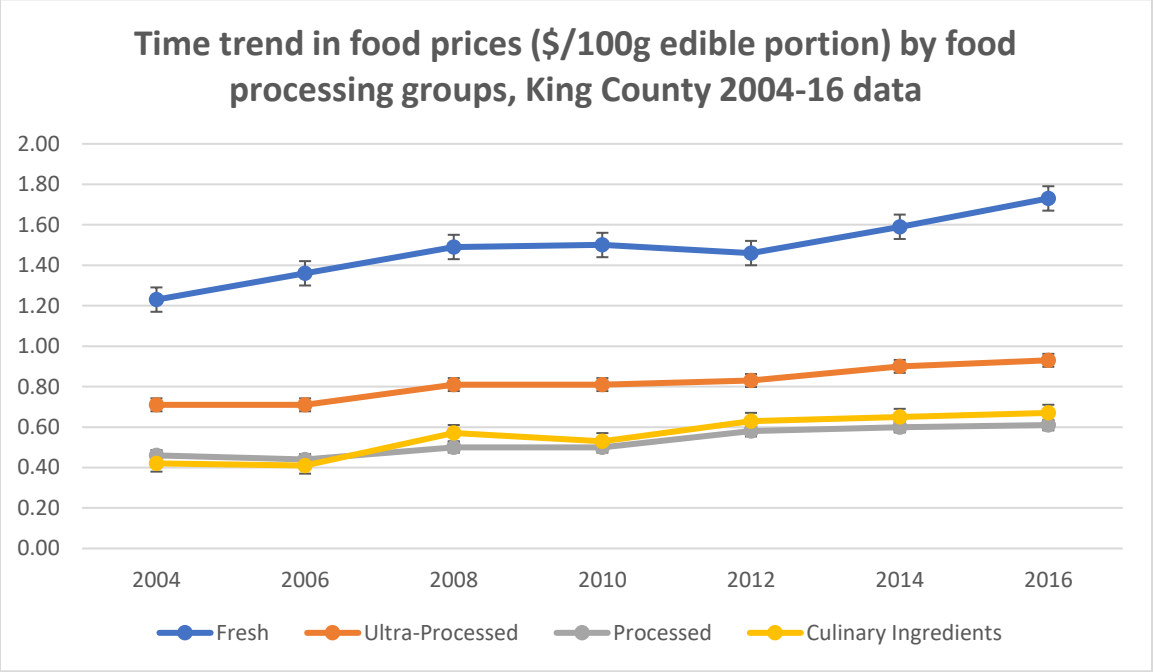


Figure 17 Shows that foods in the Fresh processing category are consistently the most expensive over all 7 cycles based on price per 100 kcals edible portion. Similar to figure 16, the largest increases in Mean food prices for the Fresh food classification can be seen from 2004-2008 and from 2012-2016. There was very little change in the Processed and Ultra-processed food processing classifications over the 7 data collection cycles, and almost no change for the Culinary Ingredients based on ($/100kcal EP).

Figure 17. Time trends from 2004-2016 for mean prices of each food processing classification ($/100Kcal EP).

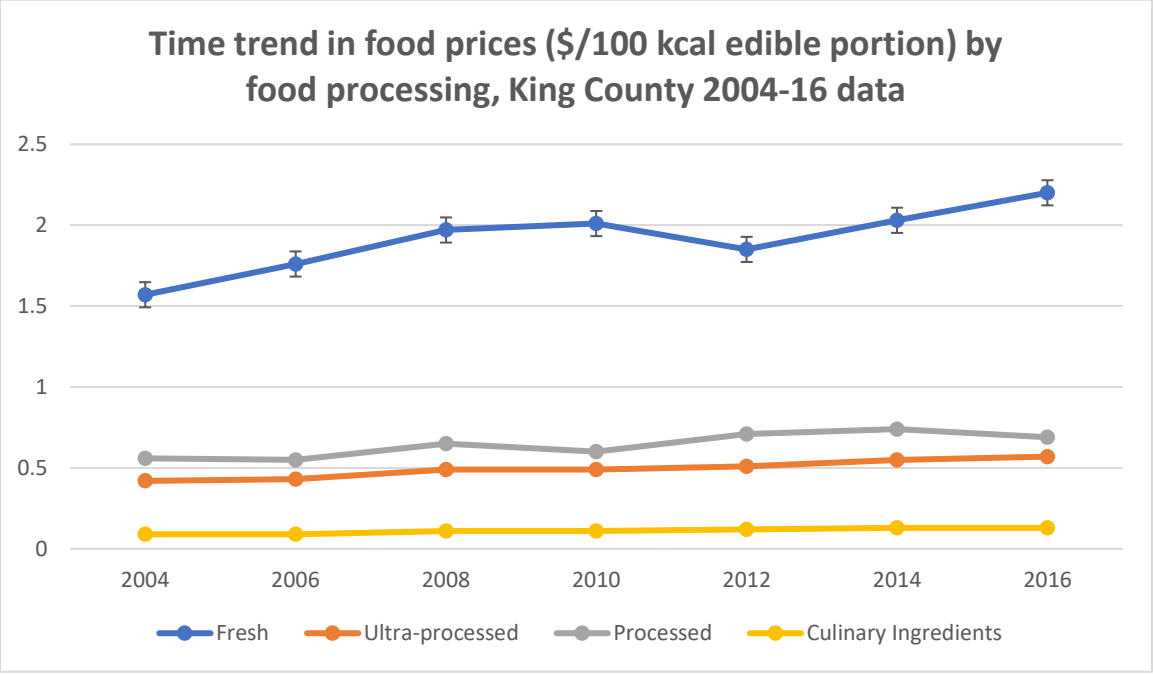
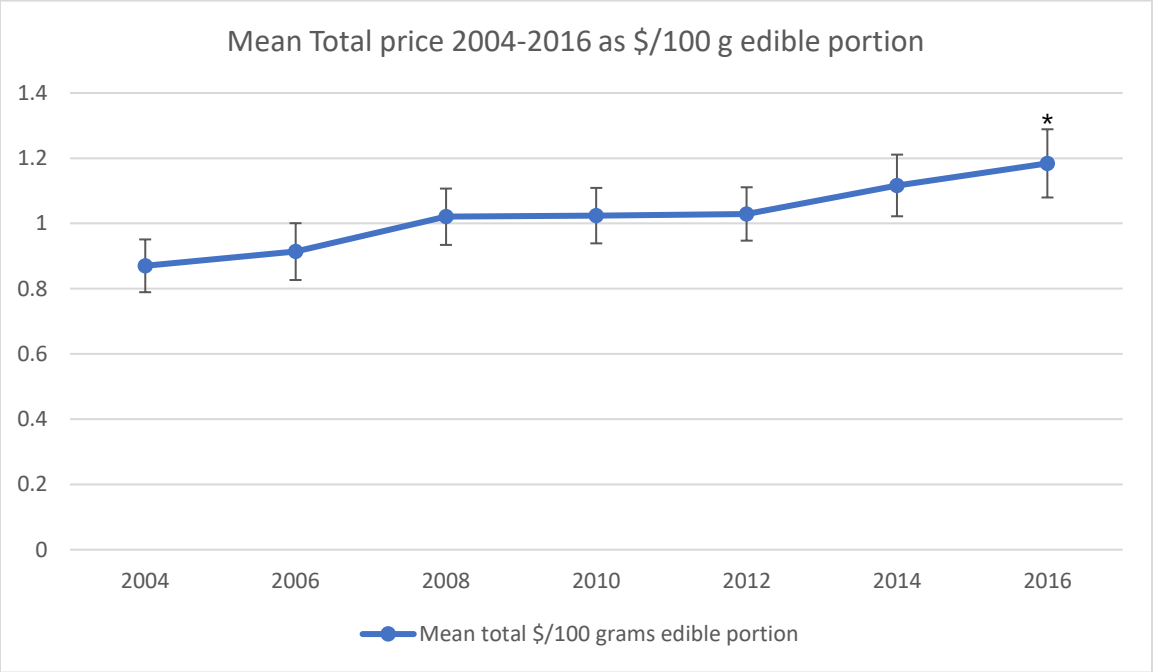


Figure 18 shows that prices by price per 100g edible portion, on average, have increased each collection cycle. The most recent collection cycle (2016) was statistically the most expensive ($p<0.05$). Mean price trends have continued to increase over the 7 data collection cycles with the largest changes in prices being from 2004-2008 and from 2012-2016. This is the same trend in figures 14-17 with the most expensive items.

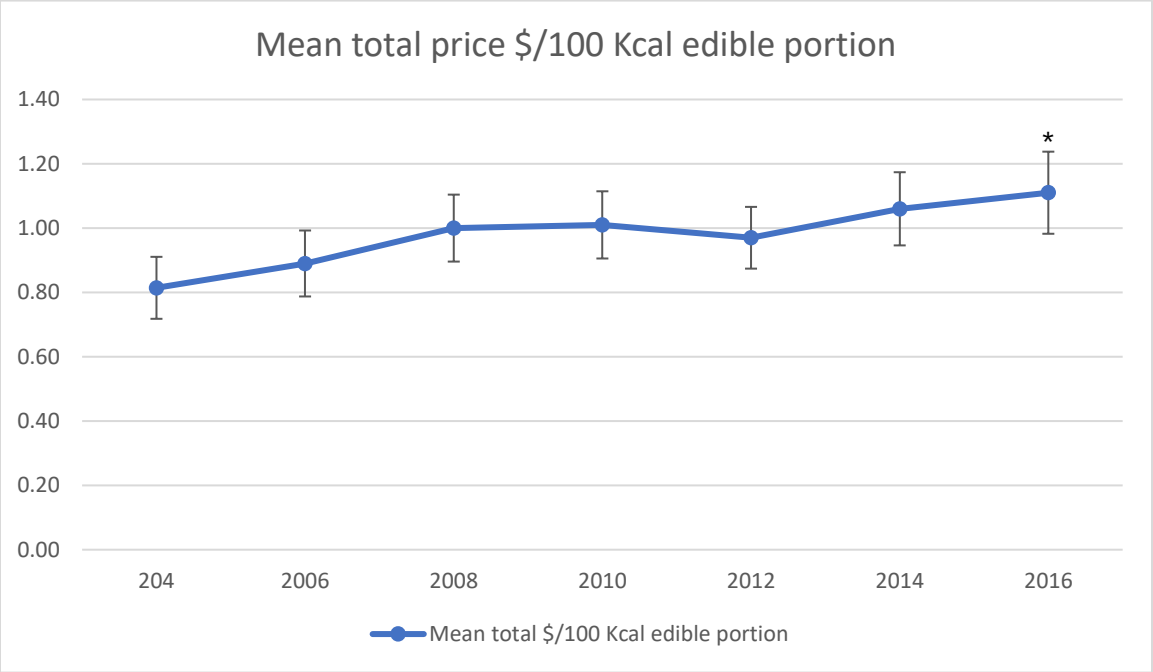
Figure 18. Average time trends from 2004-2016 by $/100 grams edible portion



*p<0.5 greater than 2004-2014

Figure 19 shows that prices by price per 100kcal edible portion, on average, have increased each collection cycle, except for 2012 where there was a slight decrease. The most recent collection cycle (2016) was statistically ($p<0.05$) the most expensive. The Mean price trends for figure 19 follow the same trends as those from figure 18 even when using a (4/100kcal EP) as the dependent variable instead of ($/100g EP).

Figure 19. Average time trends from 2004-2016 by $/100 Kcal edible portion



*p<0.05 greater than 2004-2014

Percent change in Mean prices 2014-2016

Table 15 shows that the highest percent increase by price per 100g edible portion of all food groups was in the Dairy food group classification. Although Dairy had the highest percent change from 2014-2016, it was a much lower priced item, therefore, it is less robust to overall change by percentage than an item such as Meat/Poultry/Seafood, which was consistently the highest priced food group classification.

Table 15. Time trend 2014-2016 for food groups classification by (%) change ($/100g EP).	
Dairy	**+9.4%**
Meat/Poultry/Seafood	**+8.4%**
Beans/Nuts/Seeds	**+4.2%**
Grains	**+5.75%**
Fruit & Fruit Juice	**+4.3%**
Vegetables	**+1.64%**
Fats/non-grain sweets	**+1.41%**

Table 16 show the highest percent change by price per 100kcal edible portion of all food groups was in the Beans/Nuts/Seed classification for 2014-2016. There was a percent decrease in both the Vegetables and the Fats/non-grain sweets food group classifications. However, the 10% increase in Meat/Poultry/Seafood, similar to that of table 15, changes the actual ($) more so than the 15% change for the Bean/Nuts/Seeds due to the Mean price data for each group.

Table 16. Time trend 2014-2016 for food groups classification by (%) change ($/100kcal EP).	
Dairy	**+0%**
Meat/Poultry/Seafood	**+10%**
Beans/Nuts/Seeds	**+15%**
Grains	**+5.6%**
Fruit & Fruit Juice	**+2.4%**
Vegetables	**-1.3%**
Fats/non-grain sweets	**-1.3%**

Table 17 shows the highest percent change in price per 100g edible portion by food processing classifications was in the Fresh processing classification for 2014-2016. The Fresh food classification was not only statistically ($p<0.05$) the highest priced group, it also increased by the highest percent change by ($/100g EP) from 2014-2016. This shows that it is not only the most expensive, but it is becoming more expensive at a higher rate than the other food processing classifications.

Table 17. Time trend 2014-2016 for food processing classification by (%) change ($/100g EP).	
Fresh	**+8.8%**
Ultra-Processed	**+3.3%**
Processed	**+1.7%**
Culinary Ingredients	**+3.1%**

Table 18 shows the highest percent change in price per 100kcal edible portion by food processing classification was in the Fresh processing classification for the years 2014-2016. There was a decrease in the Processed classification. Similar to table 17, Fresh food items have consistently been the highest cost by food processing classification and have been increasing at the highest rate.

Table 18. Time trend 2014-2016 for food processing classification by (%) change ($/100kcal EP).	
Fresh	**+17%**
Ultra-Processed	**+3.6%**
Processed	**-7.2%**
Culinary Ingredients	**+0%**

Percent change in Mean prices 2004-2016

Table 19 shows that the highest percent increase by price per 100g edible portion for 2004-2016 of all food groups was in the Fats/non-grain sweets (46.9%) and Beans/Nuts/Seeds (45.6%) food group classifications. However, these items are consistently cheaper than the Meat/Poultry/Seafood food group classification, making them less robust for percent change. Dairy (9.4%) changed the least over all 7 data collection cycles. In figure 17 we see that Dairy has maintained low price data over the collection cycles with more robust pricing.

Table 19. Time trend 2004-2016 for food groups classification by (%) change ($/100g EP).	
Dairy	**+9.4%**
Meat/Poultry/Seafood	**+25.3%**
Beans/Nuts/Seeds	**+45.6%**
Grains	**+24.3%**
Fruit & Fruit Juice	**+14.0%**
Vegetables	**+36.3%**
Fats/non-grain sweets	**+46.9%**

Table 20 show the highest percent change by price per 100 Kcal edible portion of all food groups was in the Beans/Nuts/Seed (61.9%) classification. Fruit & Fruit Juice (8.4%) changed the least during the 7 data collection cycles. Dairy and Grains, mostly made up of Ultra-processed food items maintained a relatively low percent change, while Fats/non-grain sweets, also with a high number of Ultra-processed food items changed by a large percentage. Furthermore, the other food group classifications with majority Fresh food items increased at much higher rates.

Table 20. Time trend 2004-2016 for food groups classification by (%) change ($/100kcal EP).	
Dairy	**+12.5%**
Meat/Poultry/Seafood	**+44.9%**
Beans/Nuts/Seeds	**+61.9%**
Grains	**+18.8%**
Fruit & Fruit Juice	**+8.4%**

Vegetables	**+50.0%**
Fats/non-grain sweets	**+51%**

Table 21 shows the highest percent change in price per 100g edible portion by food processing classifications was in Culinary Ingredients (59.5%) processing classification. However, the price data for Culinary Ingredients if relatively low compared to the other classifications. The Fresh food items (40.7%) increased with at the second highest percent change from 2004-2016. Given they are consistently the highest priced items over the 7 data collection cycles, they are increasing at a higher rate by actual ($) change. Furthermore, the Ultra-processed food items (31.0%) have increased the least amount over 13 years.

Table 21. Time trend 2004-2016 for food processing classification by (%) change ($/100g EP).	
Fresh	**+40.7%**
Ultra-Processed	**+31.0%**
Processed	**+32.6%**
Culinary Ingredients	**+59.5%**

Table 22 shows that the highest percent change in price per 100 Kcal edible portion by food processing classification was in the Culinary Ingredients (44.0%) classification. Similar to table 21, the Fresh food items (40.1%) increased by the second largest percentage. Further insinuating that Fresh food items are getting more expensive at higher actual ($) change out of the four food processing classifications. Unlike table 21, Ultra-processed food items (35.7%) are not the lowest percent change out of food items by ($/100kcal EP).

Table 22. Time trend 2004-2016 for food processing classification by (%) change ($/100Kcal EP).	
Fresh	**+40.1%**
Ultra-Processed	**+35.7%**
Processed	**+23.0%**
Culinary Ingredients	**+44.0%**

Discussion:

Food prices have risen from 2004-2016. There were spikes between 2004-2008 and again between 2012-2016. Food prices rose the most for fresh foods (as opposed to processed) and for the Meat/Poultry/Seafood food group. Pieces increased the least for processed and ultra-processed foods and for the grains food group. These price trends support the argument that more fresh, typically healthier, food items continue to become more expensive compared to energy dense, less healthy food items.

Further analysis should be done to see how much of an impact the Seafood category has on the overall prices of the Meat/Poultry/Seafood classification, either by taking it out completely, or making it its own group. Although we would expect the outcomes to be similar to what they are now, it would be a less drastic difference for both the food processing classification Fresh and the food group classification Meat/Poultry/Seafood.

Although price per 100 grams and price per 100 kcal edible portion do not represent typical servings or purchasing habits, these measures are important for looking at the overall cost of food in the context of literature and application. Price per 100 grams edible portion is a measurement used in a number of previous studies surrounding food cost, price per serving, and price per 100 kcal. Given nutritional labels and dietary recommendations of 2000 calories a day diet pattern, using price per 100 grams edible portion allows for an easy adjustment to see how much a diet, in regards to energy density, is affected by a variety of foods. Further assessment of these factors could be used in conjunction with price per serving to further help the general population understand how much their diets are costing them.

With the continued trend of healthier, less energy dense, foods becoming more expensive at a higher actual price change compared to less healthy, more energy dense foods, the measurements used in this paper allow for the opening up of a dialogue on how to address the

increasing costs of healthy diets. These measurements can further be used in education to both professionals and the general public to help them understand the cost burden of their dietary patterns.

The strengths of the study include the longevity (13 years) of data collection, the number of market basket items (n=379), and the diversity of food items included in the market basket. With the number and variety of items it allows for a wider span of coverage on types of dietary patterns to fit the general population more easily. This study compared the trends of food prices in two ways, food groups and food processing levels. These trends were analyzed by ($/100 grams edible portion) and ($/100 Kcal edible portion).

The combination of food groups and food processing classifications allowed us to see where specifically prices were changing in respect to healthier or less healthy food items, instead of only using the normal food group classification, which did not take into account how healthy the items are in each category. The final strength of this study includes the data collection for this cycle taking place in 3 counties, King, Pierce, and Yakima, which increases the application of the study to a wider geographic region.

There were limitations to basing a study on a FFQ-driven market basket. First, many FFQ items may be purchased by a number of people in the population where the data collection took place, for example, the amount of seafood items covered in the market basket. Furthermore, even there is a variety of items in the market basket, there is no indication of frequency of purchase of these items. Therefore, the actual market basket of a consumer may be drastically different each time they go to the grocery store. Furthermore, using these classification systems do not take into account quality or consumer brand purchases/loyalty. Therefore, the pricing of each individual

item, taken at the lowest price for the average sized item, may not be applicable to those who prefer a more expensive version of that food item.

Another limitation was in the study design. In a cross-sectional study, we were unable to draw causal inferences as to the impact of diet costs on health. Although a wider geographical region was used in the data collection, Peirce and Yakima county data were not analyzed for this paper. Furthermore, given price data was collected between April-August each year, these prices may not be applicable to the market basket cost outside of those months, since seasonality places a role in both availability and price, even in large supermarkets. Lastly, these prices are not reflective of any rewards or coupon systems. Therefore, Safeway member cards, which are free to anyone who signs up for them, could affect overall food prices and purchasing habits of the customers. These rewards systems may further play a role in the types of diets Safeway consumers intake.

Intervention practices that will help improve diet quality and purchasing habits of consumers should be address on a variety of levels. On the store level, they could incentivize consumers to purchase more nutrient rich, less energy dense, fresher food items by tailoring their rewards or coupon systems towards those styles of foods. Furthermore, state and federal governments could reevaluate their subsidy system to include Vegetables and Fruit & Fruit Juice to a higher degree while simultaneously reducing the number of subsidies that are award for cash crops that end up in Ultra-processed food items such as corn and soybeans [18].

Promotion of a fresher diet that is less shelf stable could cause problems with food waste, but may also help offset the carbon footprint generated by the production and shipping of food items. Incentivizing a more local food system to acquire less processed food items would not only

help with overall health issues, but potentially help in decreasing carbon emissions and any negative health outcomes associated with pollution.

Further data collection and analyses for this project should consider continuing with stratifying the food items by both food group as well as by level of food processing. Given the novelty of these food processing classifications (2015), there should be continued research and standardization for classifying the foods into the correct level of classification. After applying the food processing classification to this data set, it seems pertinent to alter the market basket in a way the balances out the numbers of items in each group to get a better understanding of price fluctuations. This would allow for an even more accurate indication of how health outcomes and food price data are correlated.

Results of this study as well as previous studies on this project trend towards healthier diets costing more than less healthy diets. An overall goal in these analyses is to look at possible interventions to address non-communicable chronic disease such as diabetes and obesity. In order to provide more accurate levels of intervention, we need to develop an environment that bolsters the consumption of food items with lower energy density and higher nutrient content to reduce the risk of developing chronic disease [15,7]

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Adam Drewnowski, PhD, Committee Chair

Anju Aggarwal, PhD, Committee Member

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Appendix 1. Food and beverage items assigned to food group and food processing classifications

Foods and Beverages	Food Group	Food Processing
Margarine, diet	Fats/non-grain sweets	Ultra-processed
Margarine, stick	Fats/non-grain sweets	Ultra-processed
Margarine, tub	Fats/non-grain sweets	Processed Culinary Ingredients
Butter	Fats/non-grain sweets	Processed Culinary Ingredients
Lard	Fats/non-grain sweets	Processed Culinary Ingredients
Oil, olive	Fats/non-grain sweets	Processed Culinary Ingredients
Oil, canola	Fats/non-grain sweets	Processed Culinary Ingredients
Oil, soybean/cottonseed	Fats/non-grain sweets	Processed Culinary Ingredients
Sour cream	Dairy	Processed
Apples, fresh, with skin	Fruit & Fruit Juices	Fresh
Pear, fresh	Fruit & Fruit Juices	Fresh
Pears, canned	Fruit & Fruit Juices	Processed
Banana, fresh	Fruit & Fruit Juices	Fresh
Peaches, canned	Fruit & Fruit Juices	Ultra-processed
Peaches, fresh	Fruit & Fruit Juices	Fresh
Nectarine, fresh	Fruit & Fruit Juices	Fresh
Plums, fresh	Fruit & Fruit Juices	Fresh
Apricots, fresh	Fruit & Fruit Juices	Fresh
Apricots, canned	Fruit & Fruit Juices	Ultra-processed
Apricots, dried	Fruit & Fruit Juices	Fresh
Prunes, dried	Fruit & Fruit Juices	Fresh
Raisins	Fruit & Fruit Juices	Fresh
Tangerines, fresh	Fruit & Fruit Juices	Fresh
Cantaloupe	Fruit & Fruit Juices	Fresh
Watermelon	Fruit & Fruit Juices	Fresh
Strawberries, fresh	Fruit & Fruit Juices	Fresh
Kiwi, fresh	Fruit & Fruit Juices	Fresh
Fruit cocktail	Fruit & Fruit Juices	Processed
Blueberries, frozen	Fruit & Fruit Juices	Fresh
Applesauce	Fruit & Fruit Juices	Processed
Grapes	Fruit & Fruit Juices	Fresh
Pineapple, canned	Fruit & Fruit Juices	Processed
Orange jucie	Fruit & Fruit Juices	Ultra-processed
Grapefruit juice	Fruit & Fruit Juices	Ultra-processed
Kool-Aid	Fats/non-grain sweets	Ultra-processed

Hi-C	Fats/non-grain sweets	Ultra-processed
Grape juice	Fruit & Fruit Juices	Ultra-processed
Apple juice	Fruit & Fruit Juices	Ultra-processed
Mango, fresh	Fruit & Fruit Juices	Fresh
blueberries, fresh	Fruit & Fruit Juices	Fresh
blackberries, fresh	Fruit & Fruit Juices	Fresh
raspberries, fresh	Fruit & Fruit Juices	Fresh
pineapple, fresh	Fruit & Fruit Juices	Fresh
cherries, fresh	Fruit & Fruit Juices	Fresh
strawberries, frozen	Fruit & Fruit Juices	Fresh
Frutopia drink	Fats/non-grain sweets	Ultra-processed
Oranges, fresh	Fruit & Fruit Juices	Fresh
Grapefruit, fresh	Fruit & Fruit Juices	Fresh
String beans, canned	Vegetables	Processed
Green beans, fresh, cooked	Vegetables	Fresh
Peas, canned	Vegetables	Processed
Peas, fresh, cooked	Vegetables	Fresh
Beans, kidney, cooked	Vegetables	Processed
Beans, lima, dry	Vegetables	Fresh
Beans, pinto, cooked	Vegetables	Processed
Corn, canned	Vegetables	Processed
Corn, fresh, cooked	Vegetables	Fresh
Tomatoes, raw	Vegetables	Fresh
Green pepper, raw	Vegetables	Fresh
Peppers, red, raw	Vegetables	Fresh
Broccoli, cooked	Vegetables	Fresh
Spinach, cooked, from frozen	Vegetables	Fresh
Collard greens, cooked	Vegetables	Fresh
Carrots, raw	Vegetables	Fresh
Carrots, cooked	Vegetables	Fresh
Summer squash, cooked	Vegetables	Fresh
Winter squash	Vegetables	Fresh
Cauliflower, cooked	Vegetables	Fresh
Cabbage, cooked	Vegetables	Fresh
Sauerkraut	Vegetables	Processed
Brussel sprouts, cooked	Vegetables	Fresh
Onions, cooked	Vegetables	Fresh
Onions, green, raw	Vegetables	Fresh
Salad dressing, Italian	Fats/non-grain sweets	Ultra-processed

French fries, fast food	Vegetables	Ultra-processed
Hashbrowns	Vegetables	Ultra-processed
Sweet potatoes, canned	Vegetables	Ultra-processed
Sweet potatoes, baked	Vegetables	Fresh
Potato, baked, w/ skin	Vegetables	Fresh
Potato, boiled, w/o skin	Vegetables	Fresh
Potato, mashed w/ milk and fat	Vegetables	Ultra-processed
Salad, potato w/ mayo	Vegetables	Ultra-processed
Salad, macaroni w/ mayo	Grains	Ultra-processed
Rice, white	Grains	Fresh
Rice, brown	Grains	Fresh
Pasta, cooked	Grains	Fresh
Dressing, salad, low calorie French	Fats/non-grain sweets	Ultra-processed
Dressing, salad, fat free Italian	Fats/non-grain sweets	Ultra-processed
spinach, fresh	Vegetables	Fresh
lettuce, iceberg, fresh	Vegetables	Fresh
lettuce, romaine, fresh	Vegetables	Fresh
green peppers, cooked	Vegetables	Fresh
peppers, jalapeno, raw	Vegetables	Fresh
peppers, red, cooked	Vegetables	Fresh
broccoli, raw	Vegetables	Fresh
hominy	Vegetables	Processed
squash, zucchini	Vegetables	Fresh
greens, mustard	Vegetables	Fresh
onions, white, raw	Vegetables	Fresh
garlic, cooked	Vegetables	Fresh
avocado, fresh	Vegetables	Fresh
guacamole	Vegetables	Ultra-processed
potatoes, fried	Vegetables	Fresh
potatoes, mashed, dehydrated	Vegetables	Fresh
beans, baked	Beans/Nuts/Seeds	Ultra-processed
chili, meatless	Beans/Nuts/Seeds	Ultra-processed
coleslaw, with mayo dress	Vegetables	Ultra-processed
juice, tomato	Fruit & Fruit Juices	Ultra-processed
juice, v-8	Fruit & Fruit Juices	Processed
ranch salad dressing, reg	Fats/non-grain sweets	Ultra-processed
cauliflower, raw	Vegetables	Fresh
cabbage, raw	Vegetables	Fresh
string beans, frozen,ckd	Vegetables	Fresh

pumpkin, cnd	Vegetables	Ultra-processed
refried beans, cnd, reg	Beans/Nuts/Seeds	Ultra-processed
refried beans, cnd, fat free	Beans/Nuts/Seeds	Ultra-processed
refried beans, recipe	Beans/Nuts/Seeds	Processed
V-8 Splash	Fats/non-grain sweets	Ultra-processed
Beef, ground, regular	Meat/Poultry/Seafood	Fresh
beef, chuck, arm, braised	Meat/Poultry/Seafood	Fresh
beef, sirloin, wedge bone, broiled	Meat/Poultry/Seafood	Fresh
pork, whole loin, roasted	Meat/Poultry/Seafood	Fresh
Pork, ham, boneless, roasted, w/ fat	Meat/Poultry/Seafood	Ultra-processed
chili, canned with meat and beans	Meat/Poultry/Seafood	Ultra-processed
chili, homemade, beef and beans	Meat/Poultry/Seafood	Fresh
Liver, beef	Meat/Poultry/Seafood	Fresh
Liver, chicken	Meat/Poultry/Seafood	Fresh
Organ meats, other	Meat/Poultry/Seafood	Fresh
chicken, breast, fried w skin	Meat/Poultry/Seafood	Fresh
chicken, breast, rstd w skin	Meat/Poultry/Seafood	Fresh
chicken, breast, rstd w/o skin	Meat/Poultry/Seafood	Fresh
chicken, thigh, rstd w/o skin	Meat/Poultry/Seafood	Fresh
Sauce, white	Grains	Ultra-processed
Shrimp, fried	Meat/Poultry/Seafood	Ultra-processed
Clams, fried	Meat/Poultry/Seafood	Fresh
Shrimp, not fried	Meat/Poultry/Seafood	Fresh
crab	Meat/Poultry/Seafood	Fresh
oysters	Meat/Poultry/Seafood	Fresh
tuna, canned, oil, plain	Meat/Poultry/Seafood	Processed
Tuna salad w/ mayo, oil packed	Meat/Poultry/Seafood	Ultra-processed
tuna, canned, water, plain	Meat/Poultry/Seafood	Processed
Tuna salad,w/ mayo, water packed	Meat/Poultry/Seafood	Ultra-processed
Tuna casserole, water packed	Grains	Ultra-processed
sole, baked	Meat/Poultry/Seafood	Fresh
salmon, baked	Meat/Poultry/Seafood	Fresh
Bluefish	Meat/Poultry/Seafood	Fresh
Macaroni and cheese	Grains	Ultra-processed
lasagna, homemade w meat sauce	Grains	Ultra-processed
Spaghetti with meat sauce, reg	Grains	Ultra-processed
Spaghetti sauce without meat	Grains	Ultra-processed
Tamales with meat	Meat/Poultry/Seafood	Ultra-processed
Chilaquiles	Meat/Poultry/Seafood	Ultra-processed

Quesadilla	Grains	Ultra-processed
Quesadilla with fat	Grains	Ultra-processed
enchilada, chicken	Grains	Ultra-processed
Tostada, bean and cheese	Grains	Ultra-processed
luncheon meat, ham	Meat/Poultry/Seafood	Ultra-processed
Bologna	Meat/Poultry/Seafood	Ultra-processed
Salami, cooked	Meat/Poultry/Seafood	Ultra-processed
Hotdog, regular	Meat/Poultry/Seafood	Ultra-processed
bratwurst, reg	Meat/Poultry/Seafood	Ultra-processed
Beef, ground, lean	Meat/Poultry/Seafood	Fresh
Beef, ground, extra lean	Meat/Poultry/Seafood	Fresh
Turkey, ground	Meat/Poultry/Seafood	Fresh
Beef, chuck, trimmed	Meat/Poultry/Seafood	Fresh
Beef, sirloin, trimmed	Meat/Poultry/Seafood	Fresh
Pork, whole loin, trimmed	Meat/Poultry/Seafood	Fresh
Ham, boneless, trimmed	Meat/Poultry/Seafood	Ultra-processed
Soup, tomato	Vegetables	Ultra-processed
Soup, cream of potato	Vegetables	Ultra-processed
Soup, clam chowder	Grains	Ultra-processed
Soup, bean with bacon	Beans/Nuts/Seeds	Ultra-processed
Soup, green pea	Vegetables	Ultra-processed
soup, lentil	Beans/Nuts/Seeds	Ultra-processed
Soup, vegetarian-vegetable	Vegetables	Ultra-processed
Soup, tortilla soup	Vegetables	Ultra-processed
Soup, tripe	Meat/Poultry/Seafood	Ultra-processed
Soup, chicken noodle	Meat/Poultry/Seafood	Ultra-processed
hot dog, lowfat	Meat/Poultry/Seafood	Ultra-processed
bratwurst, lowfat	Meat/Poultry/Seafood	Ultra-processed
luncheon meat, turkey	Meat/Poultry/Seafood	Ultra-processed
bologna, low fat	Meat/Poultry/Seafood	Ultra-processed
spam, cooked	Meat/Poultry/Seafood	Ultra-processed
lamb, roasted	Meat/Poultry/Seafood	Fresh
meatloaf, ckd with reg grd beef	Meat/Poultry/Seafood	Ultra-processed
chicken, thigh, fried w skin	Meat/Poultry/Seafood	Fresh
chicken nuggets	Meat/Poultry/Seafood	Ultra-processed
turkey, white and dark meat	Meat/Poultry/Seafood	Ultra-processed
oysters	Meat/Poultry/Seafood	Fresh
Clams, fried	Meat/Poultry/Seafood	Fresh
lobster, not fried	Meat/Poultry/Seafood	Fresh

snapper, baked	Meat/Poultry/Seafood	Fresh
cod, baked	Meat/Poultry/Seafood	Fresh
mackerel, baked	Meat/Poultry/Seafood	Fresh
tofu, reg, firm	Beans/Nuts/Seeds	Ultra-processed
tofu, lowfat	Beans/Nuts/Seeds	Ultra-processed
tempeh	Beans/Nuts/Seeds	Ultra-processed
soy burgers	Beans/Nuts/Seeds	Ultra-processed
tofu hotdog	Beans/Nuts/Seeds	Ultra-processed
cheese, tofu	Beans/Nuts/Seeds	Ultra-processed
lamb, curried	Meat/Poultry/Seafood	Fresh
chicken, pot pie	Meat/Poultry/Seafood	Ultra-processed
casserole, beef, mixed, with gravy	Meat/Poultry/Seafood	Ultra-processed
chicken, thigh, rstd w skin	Meat/Poultry/Seafood	Fresh
casserole, chicken, mixed, creme sauce	Grains	Ultra-processed
fish fillets, cod, fried	Meat/Poultry/Seafood	Fresh
fish fillet, commercial pre-breaded	Meat/Poultry/Seafood	Ultra-processed
pasta, alfredo sauce	Grains	Ultra-processed
pasta, with oil and parmesan	Grains	Ultra-processed
macaroni and cheese, boxed	Grains	Ultra-processed
rice, fried, pork	Grains	Ultra-processed
Chow mein, chicken	Grains	Ultra-processed
pad thai, vegetarian	Grains	Ultra-processed
pizza, meat, frozen	Grains	Ultra-processed
pizza, vegetable, frozen	Grains	Ultra-processed
burrito, bean, cheese	Grains	Ultra-processed
taco, beef, cheese	Grains	Ultra-processed
soup, minestrone	Vegetables	Ultra-processed
soup, cheese	Dairy	Ultra-processed
soup, black bean	Beans/Nuts/Seeds	Ultra-processed
soup, miso	Beans/Nuts/Seeds	Ultra-processed
soup, ramen	Grains	Ultra-processed
fish, halibut, baked	Meat/Poultry/Seafood	Fresh
stew, beef, homemade	Meat/Poultry/Seafood	Fresh
turkey, white and dark, w/o skin	Meat/Poultry/Seafood	Fresh
lamb, roasted, trimmed	Meat/Poultry/Seafood	Fresh
lasagna, frozen	Grains	Ultra-processed
pizza, meat, fast food	Grains	Ultra-processed
pizza, vegetarian, fast food	Grains	Ultra-processed

enchilada, cheese	Grains	Ultra-processed
meatloaf, ckd with lean grd beef	Meat/Poultry/Seafood	Fresh
meatloaf, ckd with x-lean grd beef	Meat/Poultry/Seafood	Fresh
chicken, breast, grilled NFA w/o skin	Meat/Poultry/Seafood	Fresh
chicken, thigh, grilled NFA w/o skin	Meat/Poultry/Seafood	Fresh
chicken, breast, grilled w skin	Meat/Poultry/Seafood	Fresh
chicken, thigh, grilled w skin	Meat/Poultry/Seafood	Fresh
Oysters, Pacific, fried	Meat/Poultry/Seafood	Fresh
Oysters, Pacific, not fried	Meat/Poultry/Seafood	Fresh
Oysters, Eastern fried	Meat/Poultry/Seafood	Fresh
Oysters, Eastern not fried	Meat/Poultry/Seafood	Fresh
granola, reg	Grains	Ultra-processed
Oatmeal	Grains	Fresh
Grits, unknown, after cooking	Grains	Ultra-processed
pancake, plain, mix	Grains	Ultra-processed
waffle, homemade	Grains	Ultra-processed
Eggs, fried	Meat/Poultry/Seafood	Fresh
Eggs, boiled	Meat/Poultry/Seafood	Fresh
bacon	Meat/Poultry/Seafood	Ultra-processed
sausage, breakfast	Meat/Poultry/Seafood	Ultra-processed
Cereal, All Bran	Grains	Ultra-processed
Cereal, 40% bran	Grains	Ultra-processed
Cereal, Raisin Bran	Grains	Ultra-processed
Cereal, Cheerios	Grains	Ultra-processed
Shredded Wheat	Grains	Ultra-processed
Cereal, Total	Grains	Ultra-processed
Cereal, Product Fresh9	Grains	Ultra-processed
Cereal, Cornflakes	Grains	Ultra-processed
cream of wheat, made w/water	Grains	Ultra-processed
oatmeal, flavored, pre-packaged, made w/water	Grains	Ultra-processed
french toast, plain	Grains	Ultra-processed
waffle, frozen	Grains	Ultra-processed
eggs, scrambled	Meat/Poultry/Seafood	Fresh
Muffin, fruit	Grains	Ultra-processed
biscuit, plain	Grains	Ultra-processed
Bread, white	Grains	Ultra-processed
Bread, whole wheat	Grains	Ultra-processed
Cornbread, homemade	Grains	Fresh

Cornbread, made from mix	Grains	Ultra-processed
Chips, potato	Grains	Ultra-processed
Chips, tortilla	Grains	Ultra-processed
Saltines	Grains	Ultra-processed
Popcorn, in oil	Grains	Ultra-processed
Peanuts, dry roasted	Beans/Nuts/Seeds	Ultra-processed
Peanut butter, smooth	Beans/Nuts/Seeds	Ultra-processed
mayo, real, reg	Fats/non-grain sweets	Ultra-processed
mayo, real, lowfat	Fats/non-grain sweets	Ultra-processed
mayo, real, nonfat	Fats/non-grain sweets	Ultra-processed
Popcorn, air-popped, no fat	Grains	Ultra-processed
scone, plain	Grains	Ultra-processed
croissant, plain	Grains	Ultra-processed
bagel, plain, white	Grains	Ultra-processed
bagel, plain, wheat	Grains	Ultra-processed
english muffin, plain, white	Grains	Ultra-processed
granola bar	Grains	Ultra-processed
cereal bar	Grains	Ultra-processed
power bar	Grains	Ultra-processed
tortilla chips, nonfat, WOW	Grains	Ultra-processed
pretzels	Grains	Ultra-processed
popcorn, microwave, LF	Grains	Ultra-processed
chips, potato, LF	Grains	Ultra-processed
popcorn, reg, microwave, buttered	Grains	Ultra-processed
snacks, cheese puffs	Grains	Ultra-processed
crackers, ritz	Grains	Ultra-processed
crackers, wheat thins	Grains	Ultra-processed
seeds, sunflower	Beans/Nuts/Seeds	Processed
nuts, mixed w/o peanuts	Beans/Nuts/Seeds	Processed
sauce cheese	Dairy	Ultra-processed
gravy, turkey, made w/drippings	Grains	Ultra-processed
gravy, beef, made w/drippings	Grains	Ultra-processed
ketchup, reg	Vegetables	Ultra-processed
salsa, commercial	Vegetables	Ultra-processed
salsa, homemade	Vegetables	Fresh
Clif bar	Grains	Ultra-processed
chips, corn	Grains	Ultra-processed
tortilla chips, lowfat, baked	Grains	Ultra-processed
chips, potato, nonfat, WOW	Grains	Ultra-processed

crackers, Ritz, reduced fat	Grains	Ultra-processed
crackers, Snackwells's, fat free	Grains	Ultra-processed
granola bar, lowfat	Grains	Ultra-processed
Tortilla, corn, plain	Grains	Ultra-processed
Tortilla, flour, white	Grains	Ultra-processed
Cottage cheese, 2% fat	Dairy	Ultra-processed
Cottage cheese, 4% fat	Dairy	Ultra-processed
cheese, nonfat	Dairy	Ultra-processed
cheese, mozzarella	Dairy	Ultra-processed
Cheese, cheddar, reduced fat	Dairy	Ultra-processed
Cheese, cheddar	Dairy	Ultra-processed
Cheese, American, processed slices	Dairy	Ultra-processed
Yogurt, nonfat, fruit	Dairy	Ultra-processed
Yogurt, lowfat, plain	Dairy	Fresh
Milk, whole	Dairy	Fresh
Milk, 2%	Dairy	Fresh
Milk, Fresh%	Dairy	Fresh
Milk, skim	Dairy	Fresh
Cream	Dairy	Fresh
Cream, half and half	Dairy	Processed Culinary Ingredients
Cream, nondairy, liquid	Fats/non-grain sweets	Ultra-processed
Milk, soy, canned	Beans/Nuts/Seeds	Ultra-processed
cheese, ricotta, whole	Dairy	Ultra-processed
cream cheese	Dairy	Ultra-processed
Custard, baked	Grains	Ultra-processed
doughnut, raised	Grains	Ultra-processed
Cake, chocolate, frosted (20 oz)	Grains	Ultra-processed
cookies, oatmeal raisin	Grains	Ultra-processed
cookies, chocolate chip w/o nuts	Grains	Ultra-processed
ice cream, Neapolitan	Dairy	Ultra-processed
Pie, apple, double crust (552g tot weight)	Grains	Ultra-processed
Pie, cherry, double crust(564 g tot weight)	Grains	Ultra-processed
Pie, chocolate cream (9Fresh2 g)	Grains	Ultra-processed
Candy, milk chocolate, plain	Fats/non-grain sweets	Ultra-processed
Jelly, jam	Fats/non-grain sweets	Ultra-processed
Honey	Fats/non-grain sweets	Processed Culinary Ingredients
cookies, figbars	Grains	Ultra-processed

gingersnap cookies	Grains	Ultra-processed
cookies, vanilla wafers	Grains	Ultra-processed
Cookies, graham cracker	Grains	Ultra-processed
Cake, angel food, unfrosted	Grains	Ultra-processed
doughnut, cake	Grains	Ultra-processed
pudding, choc, from a box with 2% milk	Fats/non-grain sweets	Ultra-processed
sherbet	Dairy	Ultra-processed
cake, white, not frosted	Grains	Ultra-processed
cookies, choc chip, w/nuts	Grains	Ultra-processed
candy, snickers bar	Fats/non-grain sweets	Ultra-processed
candy, toffee	Fats/non-grain sweets	Ultra-processed
candy, lifesavers	Fats/non-grain sweets	Ultra-processed
icecream, choc, NF	Dairy	Ultra-processed
ice cream, vanilla, Lf	Dairy	Ultra-processed
frozen yogurt, NF, choc	Dairy	Ultra-processed
frozen yogurt, LF, vanilla	Dairy	Ultra-processed
shake, hard ice cream	Dairy	Ultra-processed
shake, softserve	Dairy	Ultra-processed
licorice	Fats/non-grain sweets	Ultra-processed
jelly beans	Fats/non-grain sweets	Ultra-processed
Soft drink, Cola	Fats/non-grain sweets	Ultra-processed
Soft drink, non-cola	Fats/non-grain sweets	Ultra-processed
beer, regular	Fats/non-grain sweets	Ultra-processed
wine, red	Fats/non-grain sweets	Ultra-processed
wine, white	Fats/non-grain sweets	Ultra-processed
whiskey	Fats/non-grain sweets	Ultra-processed
Coffee, black	Fats/non-grain sweets	Fresh
Tea, regular, black	Fats/non-grain sweets	Fresh
Sugar, white	Fats/non-grain sweets	Processed Culinary Ingredients
hot chocolate	Fats/non-grain sweets	Ultra-processed
slim-fast, liquid	Fats/non-grain sweets	Ultra-processed
ensure, liquid, cnd	Fats/non-grain sweets	Ultra-processed
instant breakfast, Carnation	Fats/non-grain sweets	Ultra-processed
soda, diet cola	Fats/non-grain sweets	Ultra-processed
soda, non-cola, diet	Fats/non-grain sweets	Ultra-processed
beve, water (water as a beverage)	Fruit & Fruit Juices	Fresh
Vitamin E-fortified juice	Fruit & Fruit Juices	Ultra-processed
Vitamin C-fortified juice	Fruit & Fruit Juices	Ultra-processed

Calcium-fortified juice	Fruit & Fruit Juices	Ultra-processed

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