Eighty-five Percent of Menu Items from the Six Highest Selling Fast-food Restaurants in the United States are Ultra-processed

Anthony J. Basile[1,2]; Nereus K. Noshirwani[1]; Karen L. Sweazea[1,3]

[1]School of Life Sciences, Arizona State University, Tempe, AZ, USA

[2]Department of Human Ecology, State University of New York at Oneonta, NY, USA

[3]College of Health Solutions, Arizona State University, Phoenix, AZ, USA

Corresponding Author: Karen L. Sweazea; LSE 421 427 E. Tyler Mall, Tempe Arizona, USA 85287-4501, United States; karen.sweazea@asu.edu

Shortened Title: Ultra-processed Food & FF Restaurants

Abstract:

Objective: While fast-food is typically considered highly processed, an analysis to demonstrate this has yet to be conducted. Therefore, the objective of this research was to examine the menu items and ingredients from six fast-food restaurant menus using the NOVA Classification.

Design: Cross-sectional study.

Setting: Data were collected from the top six highest selling United States restaurants, per each food category, identified using the Quick Service and Fast Casual Restaurants (QSR) 2020 Report.

Participants: A total of 740 menu items were identified and classified according to their degree of processing based on ingredient lists using the NOVA Classification: Minimally Processed (MPF), Culinary Processed Ingredient (CPF), Processed (PRF), or Ultra-processed (UPF). In addition, individual ingredients that appeared on at least three menus were classified into NOVA groups, and the 20 most common ingredients were identified based on frequency of appearance in ingredient lists.

Results: Across all menus, 85% (Range: 70-94%) of items were UPFs with only 11% (Range: 6-25%) being MPF (p<0.001). Additionally, 46% of the ingredients that appeared on at least three menus were ultra-processed ingredients. Three ultra-processed ingredients appeared on all six menus: natural flavors, xanthan gum, and citric acid.

Conclusions: These findings show that the vast majority of menu items from major fast-food restaurants are UPFs and there are few options for MPFs. Fast-food companies should consider reformulation or the addition of MPF to the menu to increase healthful food options for their patrons.

Keywords: Ultra-processed foods, Fast-food, restaurant, quick-service, food processing

Introduction:

The nutritional environment plays a key role in determining eating behavior and overall health [1]. Fast-food (FF) restaurants are abundant in industrialized countries as nearly a third of United States (US) adults consume FF on a daily basis [2]. FF and full-service restaurants account for roughly 20% of daily calories in the US [3] while FF customers tend to underestimate how many calories they have consumed [4]. Over a recent thirty-year span, FF restaurants have increased the variety of their menus along with the portion size, calories served, and sodium content [5]. Greater access to FF and FF consumption have been observed as associated factors in childhood [6,7] and adult [8] obesity, and an increase in the density of FF restaurants is associated with an increase in body mass index [9]. Overall, FF restaurants supply a major source of calories in the nutritional environment, and thus are implicated in the current US obesity epidemic [10].

Over half of the calories in the US diet come from ultra-processed foods (UPFs; [11]) and consumption of UPFs is correlated with an increased risk of various mental disorders, cardiometabolic disease and mortality outcomes [12]. Per the NOVA Classification, UPFs are defined as foods that include the fractioning of whole foods into substances, chemical modifications of these substances, assembly of unmodified and modified food substances, frequent use of cosmetic additives and sophisticated packaging [13]. The presence of a single ultra-processed ingredient warrants the UPF designation, and thus, it is likely that many foods in FF restaurants will be ultra-processed; however, this has not been demonstrated via a menu analysis using the NOVA Classification.

Eating outside of the house is associated with increased consumption of UPFs [14], and among people eating at FF restaurants, it has been observed that 88% of their calories were from UPFs [15], which suggests that FF restaurants serve UPFs. Of note, the availability of energy-dense [16] and highly palatable [17] UPFs in the nutritional environment has been associated with obesity [18,19] and clinical trials using UPFs as the independent variable have shown increased weight gain with a fully UPF diet over two-week period [20]. Therefore, both FF restaurants and UPFs are implicated as contributing to the current US obesity epidemic by supplying energy-dense calories into the nutritional environment.

To determine the level of food processing of FF restaurant menus, the NOVA Classification [13] was used to evaluate menus from six different FF restaurants. These restaurants were those that had the highest sales within their respective restaurant category as reported by Quick Service Restaurants Magazine 2020 Top 50 Report: (Sandwich, Pizza, Burger, Snacks, Global, and Chicken). There were three research questions: 1) What percentage of FF menu items are ultra-processed, and 2) what are the most common ingredients found in FF menus and what type of food processing group would the ingredient belong to? It was hypothesized that the majority of the menu items would be UPFs and that some of the most common ingredients would belong to UPFs.

Methods:

Data Collection

The top six highest grossing FF restaurants, for each restaurant category were identified from QSR Magazine 2020 Top 50 Chart (www.qsrmagazine.com/content/qsr50-2020-top-50-chart; See Supplemental Table 1). Nutritional information was gathered from each restaurant's website (Burger: McDonald's, Chicken: Chik-Fil-A, Global: Taco Bell, Pizza: Dominos, Sandwich: Subway, and Snack: Starbucks; See Supplemental Table 2). Nutritional information was presented as either purchasable menu items, individual ingredients found within food, or both (See Supplemental Table 2), so the term 'menu items' is used to capture each of these. When ingredient information was not available for a brand-named item, the company's website was reviewed (e.g., Starbucks sold "KIND® Salted Caramel & Dark Chocolate Nut Bar" and the ingredient information was collected from www.kindsnacks.com). Alcoholic beverages, items from a specific version of restaurants (e.g., Cantina menu for Taco Bell) and carry-home items (e.g., the 'at home items' from Starbucks) were not included in the analysis. In total, 872 menu items were collected across restaurants, and after removing duplicate items and items without ingredient information available (See Supplemental Table 2), the remaining 748 items were then included in the analysis.

Analysis of Menu Items

To answer the research questions, the proportion of menu items for each NOVA group was determined with a mean calculated for all restaurants. Based on ingredient information, menu items were coded into the four NOVA Classification groups: minimally processed (MPF), culinary processed (CPF), processed (PRF), and UPF [11]. Coding was performed independently to agreement by NKN and AJB. Coders initially agreed on 93% of all menu items (Chicken: 93%, Pizza: 85%, Burger: 96%, Snack: 92%, Sandwich: 93%, and Global: 100%). Data were presented in a 100% stacked column using Microsoft Excel (Redmond, WA, USA). SPSS was used to conduct non-parametric single chi-square tests to determine if there was a difference in the proportion of menu items in the processing groups for each menu and for all menu items (SPSS 29; IBM; Armonk, NY, USA).

Ingredient Analysis

Using Monkeylearn.com, word/phrase frequency clouds were created to visualize the top 50 words/phrases within and across menu items, where the larger the word/phrase appears, the more frequently it appeared in the ingredient list. From there, the top ingredients in each menu (words/phrases identified from monkeylearn.com) were ranked (i.e., the most and least common appearing ingredient were ranked from 1 to 50, respectively). Ingredient lists were then merged and the number of times an ingredient was listed was identified and the mean rank and SD were calculated. Ingredients that appeared in half or more of the food menus were presented and functional classes were identified from Codex General Standard for Food Additives (GSFA) from the Food and Agriculture Organization of the United Nation and World Health Organization [21]. Ingredients were then coded independently and to agreement by NKN and AJB (77% initial agreement) into five groups: MPF, CPF, PRF, UPF, and NTR (vitamins, minerals, and water).

Results:

Food Processing Percentage

Figure 1 shows the percentage of menu items for each NOVA Classification group for each restaurant menu and all menus. The majority of menu items in each restaurant (range: 70-94%), and across restaurants (85%), were ultra-processed (p<0.001 for all menus and for all menu items across menus). In addition, MPF comprised only 11% of items on average across menus.

Ingredient Analysis

Figure 2 depicts the top 50 ingredients across the six chosen restaurants, where the larger the word appears the more frequently it appears in the menus. Thirty-nine ingredients appeared in half or more of the menus (Table 1). Salt and sugar, both CPF, were the two highest-ranked ingredients. Only three UPF ingredients appeared in all six menus: natural flavor, citric acid, and xanthan gum (listed in descending mean rank). Of the 39 ingredients, 15% were CPF, 18% were NTR, 21% were MPF, 46% were UPF, with zero PRF ingredients. Fifteen of the ingredients were listed in the Codex General Standard for Food Additives and most (80%) were UPF ingredients. The top three common UPF functional classes were emulsifier (n=8 appearances), thickener (n=6), and sequestrant and stabilizer (n=5).

Discussion:

This was the first study to explore the level of food processing among menus for several popular FF restaurants in the United States using the NOVA Classification. The results show that, on average, FF restaurant menu items are highly processed with 85% of menu items being ultra-processed foods and only 11% of menu items consisting of minimally processed foods. Thus, there are very few non-UPF options available at these six FF restaurants. Given the role of the food environment in health, FF restaurants may be contributing to the rise in obesity in the United States by providing predominantly energy-dense, ultra-processed foods to their customers. In addition, across ingredients that appeared in three or more of the menus, 46% were

considered ultra-processed, with the most common functional classes being emulsifier, thickener, and sequestrant and stabilizer. The three most frequently appearing ultra-processed ingredients in the FF restaurant menu items were natural flavors, citric acid, and xanthan gum.

Considering that nearly a third of US adults consume FF on a daily basis [2], and the association between FF restaurant proximity, FF consumption, and UPF consumption with obesity [6–10,18,19], these results are of concern for public health. This prevalence of UPFs across these six FF restaurants is higher than what has been observed in grocery stores, where the majority of items are also UPF [16]. Together, between the abundance of UPFs at grocery stores and FF restaurants, consumers may need to go out of their way to seek non-UPFs. Future research examining the prevalence of UPF in non-FF restaurants is warranted to better describe additional sources of food within the US nutritional environment. Public health efforts to decrease consumption of UPFs and increase consumption of MPFs, at every level of the nutritional environment, are warranted to combat the obesity epidemic.

Natural flavors were the most common UPF ingredient, which appeared in every FF restaurant that was analyzed. According to the US Food and Drug Administration (FDA), natural flavors are anything (e.g., essential oil, extract, protein) collected from foods (e.g., spice, fruit, vegetables, herbs, etc.) whose function is flavoring, rather than nutritional [22]. While there is debate whether natural flavors are "natural" [23], the presence of them within a food item warrants the classification of an UPF. The next two most popular UPF ingredients were citric acid and xanthan gum. Citric acid (an organic acid) is currently the single largest chemical obtained from chemical biosynthesis and its popularity as a food additive is due to its chemical nature (multiple functions within food) [24]. In an analysis of ingredients used in culinary preparations from institutional food services (e.g., private cafeterias and universities), 8.4-12.6% of ingredients were UPFs, and were mainly used in protein dishes and desserts [25]. This further demonstrates the invasiveness of ultra-processed ingredients used in food preparation.

A critique of the NOVA classification is the inclusion of specific ingredients as a method to identify UPFs because, while citric acid is a food additive, citric acid is also found naturally in foods [26]. Xanthan gum is a naturally occurring microbial exopolysaccharide and it is considered

safe by the FDA but is not digestible by humans [27]. Emulsifiers form a uniform texture consistency and are abundant in UPFs. This, there is concern about the impact of emulsifiers on the pathogenesis of certain diseases [28]. While natural flavors, citric acid, and xanthan gum are all ambiguous in their effects on human health, collectively, these three ingredients make UPFs shelf stable and more flavorful, which may increase palatability and promote increased consumption.

This analysis has some strengths and limitations. Firstly, the sample size was limited to six restaurants; however, these six represented the highest grossing restaurant for each restaurant category and thus represented the most frequented FF restaurants. In addition, selecting one from each of the restaurant-types allowed for a broad menu analysis capturing the variety of FF options available within the US. However, because we only chose one restaurant per food category, our findings cannot be applied to other FF restaurants. Another limitation is that some menu items were removed from analysis because the restaurants or internet did not provide ingredient information, thus the menu and ingredient analyses were produced with only available data. While the NOVA classification is one of the most common food processing classifications, the definition of ultra-processed foods has changed considerably over time [29], thus, as new food processing definitions and categorizations are developed, the results of this study may differ.

This study illustrates the invasive nature of ultra-processed foods in the US nutritional environment. The high intake UPFs in the US could also be due to the low availability of healthful, nutrient-dense, minimally processed food choices among some of the highest-grossing FF restaurants in the United States. Therefore, to improve the nutritional quality of their menu items, FF companies should consider reformulation or the addition of MPF to the menu to increase healthful food options.

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Table 1: Ingredients Appearing in Three or More of Analyzed Fast-food Restaurant Menus

Ingredient	Menu Count	Mean Rank and SD	NOVA Group	Functional Class
Salt	6	1.17 ± 0.41	CPF	n/a
Sugar	6	3.17 ± 1.60	CPF	n/a
Natural Flavor	6	4.33 ± 1.03	UPF	n/a
Citric Acid	6	9.17 ± 3.87	UPF	Acidity Regulator, Antioxidant, Color Retention Agent, Sequestrant
Soybean Oil	6	10.50 ± 8.73	CPF	n/a
Xanthan Gum	6	25.17 ± 11.20	UPF	Emulsifier, foaming agent, stabilizer, thickener
Water	5	2.40 ± 0.55	NTR	n/a
Wheat Flour	5	9.20 ± 6.14	MPF	n/a
Folic Acid	5	16.20 ± 9.47	NTR	n/a
Potassium Sorbate	5	16.20 ± 7.19	UPF	Preservative
Soy Lecithin	5	17.80 ± 5.89	UPF	Antioxidant, emulsifier
Cheese Culture	5	21.60 ± 10.06	UPF	n/a
Thiamine Mononitrate	5	23.40 ± 6.88	NTR	n/a
Spice	4	5.75 ± 2.06	MPF	n/a
Riboflavin	4	13.00 ± 2.45	NTR	Color
Niacin	4	14.00 ± 2.45	NTR	n/a
Sodium Phosphate	4	18.25 ± 9.22	UPF	Acidity regulator, emulsifier, emulsifying salt, humectant, raising agent, sequestrant, stabilizer, thickener.
Canola Oil	4	22.00 ± 5.48	CPF	n/a
Modified Corn Starch	4	25.00 ± 8.45	UPF	Emulsifier, thickener*
Reduced Iron	4	25.75 ± 7.41	NTR	Color (Listed as Iron oxides)
Sodium Benzoate	4	27.75 ± 8.96	UPF	Preservative
Malted Barley Flour	4	29.25 ± 9.91	MPF	n/a
Modified Food Starch	4	29.25 ± 17.76	UPF	Emulsifier, thickener*

Sodium Acid Pyrophosphate	4	36.75 ± 12.89	UPF	n/a
Calcium Disodium Edta	4	44.25 ± 3.20	UPF	Color retention agent, preservative, sequestrant
Enzyme	3	6.67 ± 2.52	UPF	n/a
Dextrose	3	11.33 ± 2.08	UPF	Emulsifier, stabilizer, thickener (listed as Dextrins, roasted starch)
Garlic Powder	3	17.67 ±3.06	MPF	n/a
Onion Powder	3	19.67 ± 8.08	MPF	n/a
Pasteurized Milk	3	20.67 ± 11.02	MPF	n/a
Lactic Acid	3	21.00 ± 12.29	UPF	Acidity regulator, emulsifier, sequestrant, stabilizer
Distilled Vinegar	3	21.67 ± 3.51	CPF	n/a
Yeast Extract	3	22.00 ± 16.64	UPF	n/a
Corn Syrup	3	22.67 ± 16.50	UPF	n/a
Nonfat Milk	3	23.33 ± 14.47	MPF	n/a
Guar Gum	3	28.33 ± 10.21	UPF	Emulsifier, stabilizer, thickener
Enriched Wheat Flour	3	32.33 ± 12.01	MPF	n/a
Ascorbic Acid	3	32.67 ± 9.61	NTR	acidity regulator, antioxidant, flour treatment agent, sequestrant
Sunflower Oil	3	36.33 ± 8.14	CPF	n/a

Note: Data developed from the top 50 appearing words/phrases in each menu; Functional class determined via the Codex General Standard for Food Additives (GSFA) from the Food and Agriculture Organization of the United Nation and World Health Organization; MPF: minimally processed; CPF: culinary processed; PRF: processed; UPF: ultra-processed foods; NTR: nutrient and water.
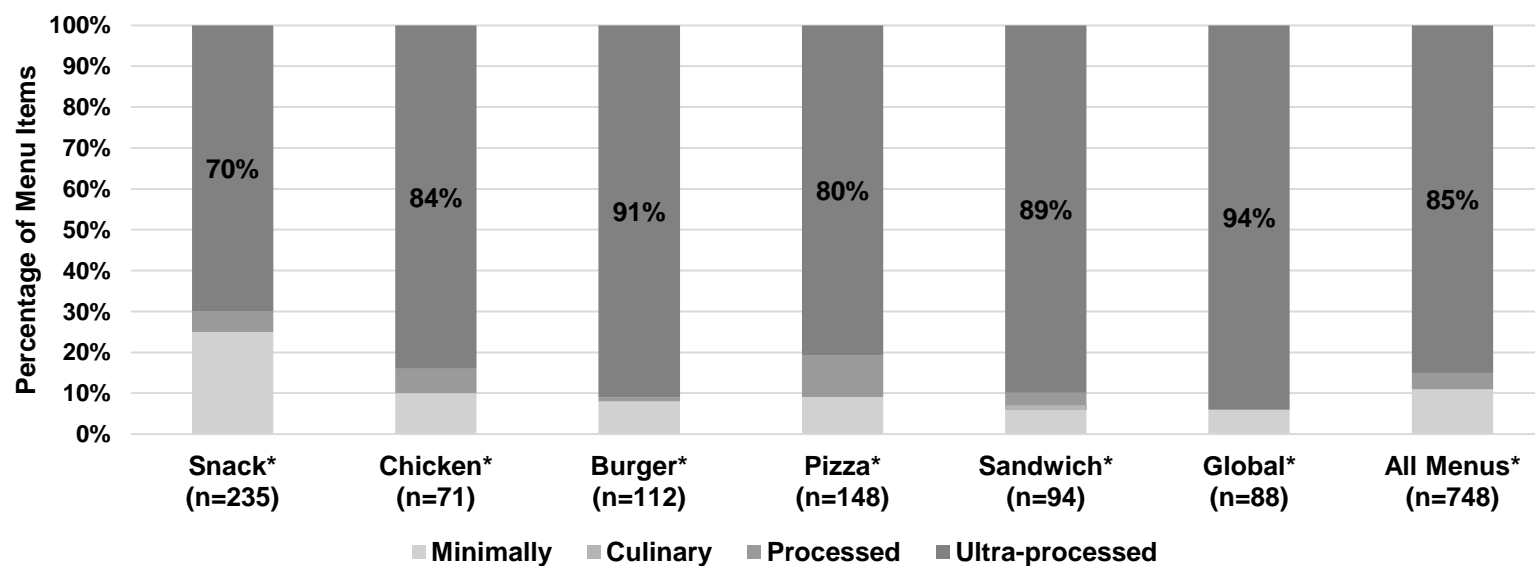
Figure 1: Proportion of Menu Items from Each Food Processing Group for Six Fast-food Restaurant Menus. Note: *p<0.001 for all; Single Sample Chi-square Test.

Figure 2: Ingredient Word Cloud from Six Fast-food Restaurant Menu Items. Note: Word/phrase frequency cloud produced from the top 50 words from all menu items.