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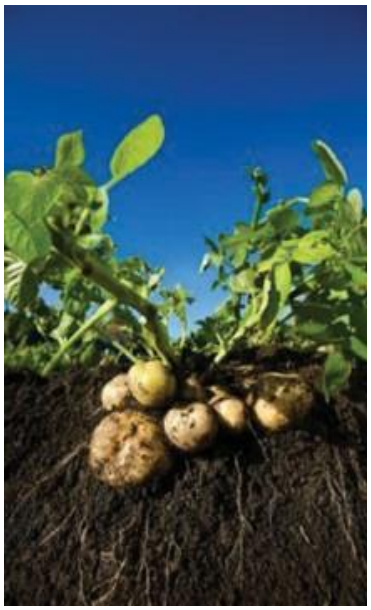
Potato Product Innovation

Fats and Dietary Guidance

White potatoes in all forms, including frozen French fried potatoes (oven heated or deep fried), provide important nutrients, such as potassium, dietary fiber, and vitamin C, and are now prepared with healthier oils. When eaten in moderation, French fried potatoes can be part of a healthy, well-balanced diet. Technological advances continue to improve the nutrition profile of white potatoes in all forms, ensuring this already-nutritious and popular vegetable is aligned with dietary guidance.



White potatoes are the fourth most important food crop in the world and the leading vegetable crop in both the United States and Canada.

Background

Potatoes (*Solanum tuberosum*) are the fourth most important food crop in the world and the leading vegetable crop in both the United States and Canada (1,2). Given the popularity of potatoes, it is worth exploring how this vegetable fits within dietary guidance for total fat, saturated fat, and *trans* fat.

In the United States, 26% of potatoes are grown for sale as fresh whole potatoes, and one-third of potatoes are grown for frozen French fried potatoes, either oven heated or deep fried (3). This paper examines dietary consumption patterns and marketplace changes to provide a current assessment of frozen white potatoes, including both oven heated and deep fried. More specifically, French fried potatoes' contribution to calories, total fat, *trans* fat, and saturated fat intake are evaluated in terms of overall food intake and dietary guidance.

As currently consumed, white potatoes are not substantial sources of saturated or *trans* fat, and emerging evidence suggests they contribute only a small percent of energy intake while contributing critical nutrients (4-6).

Balancing Calories, Fat, and Nutrition: Potatoes in the Context of Overall Diet

Diseases and conditions of overnutrition seem to grab headlines, yet underconsumption of key nutrients is also a continuing concern for the United States and Canada. Thus, public dietary guidance in both countries accounts for dietary excesses as well as deficiencies by encouraging eating patterns that:

- Meet nutrient needs;
- Achieve and sustain healthy weight; and
- Reduce risk for chronic diseases, such as heart disease, type 2 diabetes, cancer, and osteoporosis (6,7).

While staying within calorie needs, individuals are advised to increase vegetable and fruit intake and choose foods that provide more potassium, dietary fiber, calcium, and vitamin D, which are nutrients of concern in American diets. These foods include vegetables, fruits, whole grains, and milk and milk products (6).

"Consume less than 10 percent of calories from saturated fatty acids."

"Keep *trans* fatty acid consumption as low as possible."

– 2010 DGA

Dietary Guidance and Fat

Dietary fat is one of three macronutrients (the others being protein and carbohydrate) that provide energy. In addition to providing calories, fat is a source of essential fatty acids and aids in absorbing fat-soluble vitamins (A, D, E, and K). While some dietary fat is critical to human health, fat is of concern because it is a concentrated source of energy that can contribute to excess calories, and certain types of fat can increase risk for certain diseases.

Specific to cardiovascular disease, the *2010 Dietary Guidelines for Americans* (*2010 DGA*) note that the types of fatty acids consumed are more important than is the total amount of fat in the diet (6). Individuals are advised to:

- "Consume less than 10 percent of calories from saturated fatty acids by replacing them with monounsaturated and polyunsaturated fatty acids.
- Keep *trans* fatty acid consumption as low as possible, especially by limiting foods that contain synthetic sources of *trans* fatty acids, such as partially hydrogenated oils, and by limiting other solid fats.
- Reduce the intake of calories from solid fats…" (6).

In its 2005 report *Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients)*, the Institute of Medicine (IOM) did not set maximum intake levels for saturated or *trans* fats, but recommended consuming as little as of these nutrients as possible while still consuming a diet adequate in important essential nutrients (8). Specific to saturated fats, the IOM concluded, "It is neither possible nor advisable to achieve 0 percent of energy from saturated fatty acids in typical whole-food diets. This is because all fat and oil sources are mixtures of fatty acids, and consuming 0 percent of energy would require extraordinary changes in patterns of dietary intake. Such extraordinary adjustments may introduce undesirable effects (e.g., inadequate intakes of protein and certain micronutrients) and unknown and unquantifiable health risks" (8).

Concerning *trans* fats, the IOM report states, "Because *trans* fatty acids are unavoidable in ordinary, nonvegan diets, consuming 0 percent of energy would require significant changes in patterns of dietary intake. As with saturated fatty acids, such adjustments may introduce undesirable effects (e.g., elimination of commercially prepared foods, dairy products, and meats that contain *trans* fatty acids may result in inadequate intakes of protein and certain micronutrients) and unknown and unquantifiable health risks. Nevertheless, it is recommended that *trans* fatty acid consumption be as low as possible while consuming a nutritionally adequate diet" (8).

Neither the IOM nor the *2010 DGA* set an upper limit for *trans* fat intake. Instead, they advise minimizing consumption of *trans* fats, but not at the expense of nutrient adequacy. However, the American Heart Association (AHA) recommends limiting *trans* fat intake to less than 1% of total daily calories (9). Applying AHA guidance for *trans* fat intake to the federal government's 2000 kcal/day reference point for total calories would limit *trans* fat intake to less than 20 kcal/day (less than 2 g/day).

In 2006, the *Trans* Fat Task Force formed by Health Canada and the Heart and Stroke Foundation of Canada released a joint report with quantifiable recommendations to reduce *trans* fat in the food supply through the following voluntary industry actions:

- Limiting total *trans* fat content of vegetable oils and soft, spreadable margarines to 2% of total fat content; and
- Limiting total *trans* fat content of all other foods to 5% of total fat content, including ingredients sold to restaurants (10).

Food Technology, Nutrition, and the Current Marketplace

Food technology continues to improve the nutritional profile of French fried potatoes. In recent years, *trans* and saturated fats have decreased in packaged foods as well as in food service settings, including restaurants and schools (6,11,12). Researchers are also exploring ways to transfer health-promoting micronutrients from frying oils to French fried potatoes (13).

Marketplace Changes Reduce *Trans* and Saturated Fats

Reductions in *trans* and saturated fats have been achieved by modifying cooking methods and reformulating products. Food technology methods to reduce the levels of *trans* fatty acids in food ingredients and in frying oils include modification of hydrogenation to reduce *trans* fatty acid content of partially hydrogenated fats, production of oil seeds with modified fatty acid composition, use of tropical oils, and interesterification of mixed fats (14).

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Concerns that voluntary or mandatory reductions in *trans* fats from partially hydrogenated oils would lead to increases in the saturated fat content of U.S. foods are, almost without exclusion, not borne out by the data. In fact, for the most part, the opposite has occurred. As supported by several studies along with corroborating evidence from industry surveys, *trans* fat reduction is typically concurrent with a decrease in saturated fat for a given food. (11,12,15,16).

The Grocery Manufacturers Association (GMA) conducts an annual Health and Wellness Survey. Fifty-seven companies, which account for approximately half of U.S. food and beverage sales, have provided data for the GMA survey since 2002. The 2010 data collected and analyzed by Georgetown Economic Services for the GMA survey showed that food and beverage companies collectively have eliminated or reduced *trans* fats in more than 10,000 product choices and saturated fat in more than 6,600 product choices (16).

A U.S. Department of Agriculture (USDA) Economic Research Service (ERS) report examining trends in *trans* fat content of new food products introduced between 2005 and 2010 showed a significant decline in amounts of *trans* fats. The five food categories with the highest *trans* fat content showed a 73% decline, while other food categories showed a 50% decline (12). The same analysis showed that new products without *trans* fats generally contained less saturated fat, sodium, and calories.

The USDA/ERS research is consistent with the findings of another study that explored changes in levels of *trans* fat and saturated fat in major brand-name U.S. supermarket and restaurant foods that were reformulated to reduce *trans* fatty acid content from 1993 through 2006 (first evaluation) and 2008 through 2009 (second evaluation). In a comparison over time of 83 reformulated products (58 supermarket foods and 25 restaurant foods), *trans* fat content was reduced to less than 0.5 g/serving in 95% of the supermarket products and 80% of the restaurant products, with mean absolute reductions of 1.8 g/serving (84 percentage points) and 3.3 g/serving (92 percentage points), respectively. In most restaurant and supermarket foods, there was a reduction in the total combined level of *trans* fat and saturated fat (11).

While most marketplace studies show corresponding reductions for saturated fat when *trans* fat is reduced, the data are inconsistent for snack foods (such as cookies and chips). U.S. snack foods (including cookies and chips) historically have contributed substantial amounts of commercially-produced *trans* fat (17). A recent study of label information for more than 5,000 chip and cookie products introduced for sale between 2001 (prior to *trans* fat labelling) and 2009 (after *trans* fat labelling) showed that *trans* fat reduction in cookie products led to significantly higher levels of saturated fat and significantly higher ratios of saturated fat to total fat. However, use of partially hydrogenated vegetable oil has declined in chip products without a corresponding increase in total fat or saturated fat content (18).

For packaged foods available in grocery stores, the FDA reported that some food categories have been reformulated to remove partially hydrogenated fats completely, including frozen potato products and frozen seafood.

Trans and Saturated Fat Greatly Reduced in French Fried Potatoes

Studies of French fried potatoes show consistent declines in the presence of both *trans* fats and saturated fats. Frozen potato fries no longer contain partially hydrogenated vegetable oils, food service frying oils have been reformulated to reduce *trans* and saturated fats, and deep-fat fryers are no longer used in most schools (11,15,19,20). French fried potatoes, including both oven heated and deep fried, are not among the top five sources of *trans* fat or among the top 10 sources of saturated fat (6,12).

Specific to packaged foods available in grocery stores, the U.S. Food and Drug Administration (FDA) reported that some food categories have been reformulated to remove partially hydrogenated fats completely, including frozen potato products and frozen seafood (19). Several studies have also shown saturated and *trans* fat reductions for French fried potatoes served in quick service restaurants (QSR) due to product reformulations, including frying oils.

Using data from the University of Minnesota Nutrition Coordinating Center Food and Nutrient Database, researchers analyzed the fatty acid composition of French fried potatoes available at six leading fast food restaurants between 1996 and 2008. Major changes in the fatty acid composition of French fried potatoes were observed at four of the six restaurant chains examined, with the most marked changes occurring between 2004 and 2008. At the four chains where major changes occurred, the saturated and *trans* fatty acid compositions of French fried potatoes decreased while the polyunsaturated and/or monounsaturated fatty acid compositions increased. The researchers concluded, “Results suggest that fast food restaurants are making major changes in the frying oils they use” (15).

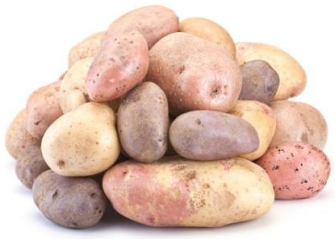
Researchers at the USDA Nutrient Data Laboratory assessed the fatty acid profiles of three top-selling fast food chain menu items—boneless fried chicken pieces, French fried potatoes, and hash browns—between 2001 and 2005 and again in 2008. Lab analyses for total fat and fatty acid composition showed a noticeable reduction of total, *trans*, and saturated fats in fast food menu items in three of the four restaurant chains sampled (21).

More recently, FDA researchers conducted laboratory analyses to assess the *trans* and saturated fat contents of menu item samples from 17 fast food restaurants belonging to major U.S. chains and operating in Prince George's County, Maryland (22). For French fried potatoes, five of the seven samples contained 0.2 g or less of *trans* fat and less than 3.5 g of saturated fat per serving, with a range of 0.1-3.1 g/serving for *trans* fat and 1.84-5.85 g/serving for saturated fat.

In addition to improvements in the fat profile of French fried potatoes, the potential exists to increase health-promoting microconstituents, such as vitamins, minerals, and phytochemicals.

These studies show a consistent pattern of reduced saturated and *trans* fats in French fried potatoes served in most QSR.

Beyond improvements in the fat profile of French fried potatoes, the potential exists to increase health-promoting microconstituents, such as vitamins, minerals, and phytochemicals. In addition to the nutrients naturally occurring in white potatoes (e.g., potassium, dietary fiber, and vitamin C), tocopherols, carotenoids, phytosterols, polyphenols, and other health-promoting microconstituents have all been shown to be present in substantial amounts in French fried potatoes as a result of transference from frying oils (13). Oil type, oil quality, and frying procedures all affect these substances. French fried potatoes are a popular food, so improving their nutrition profile could potentially make significant incremental contributions of important health-promoting microconstituents.



Calorie and Fat Intake in the U.S. and Canada: How Do Potatoes Fit?

White potatoes' contribution to intake of calories, total fat, *trans* fat, and saturated fat in terms of overall food intake appears to be relatively low, although continuing research is needed to ensure accuracy as the marketplace and consumption patterns shift over time.

Analyzing National Health and Nutrition Examination Survey (NHANES) data, the Centers for Disease Control and Prevention (CDC) concluded that energy, total fat, and saturated fat intake among Americans remained relatively stable between 1999 and 2008 (23). In 2007-2008, mean daily energy intake was 2504 kcal for men and 1771 kcal for women. Mean daily total fat intake was 33.6% of kcal for men and 33.5% of kcal for women, and mean daily saturated fat intake was 11.0% of kcal for men and 11.1% of kcal for women.

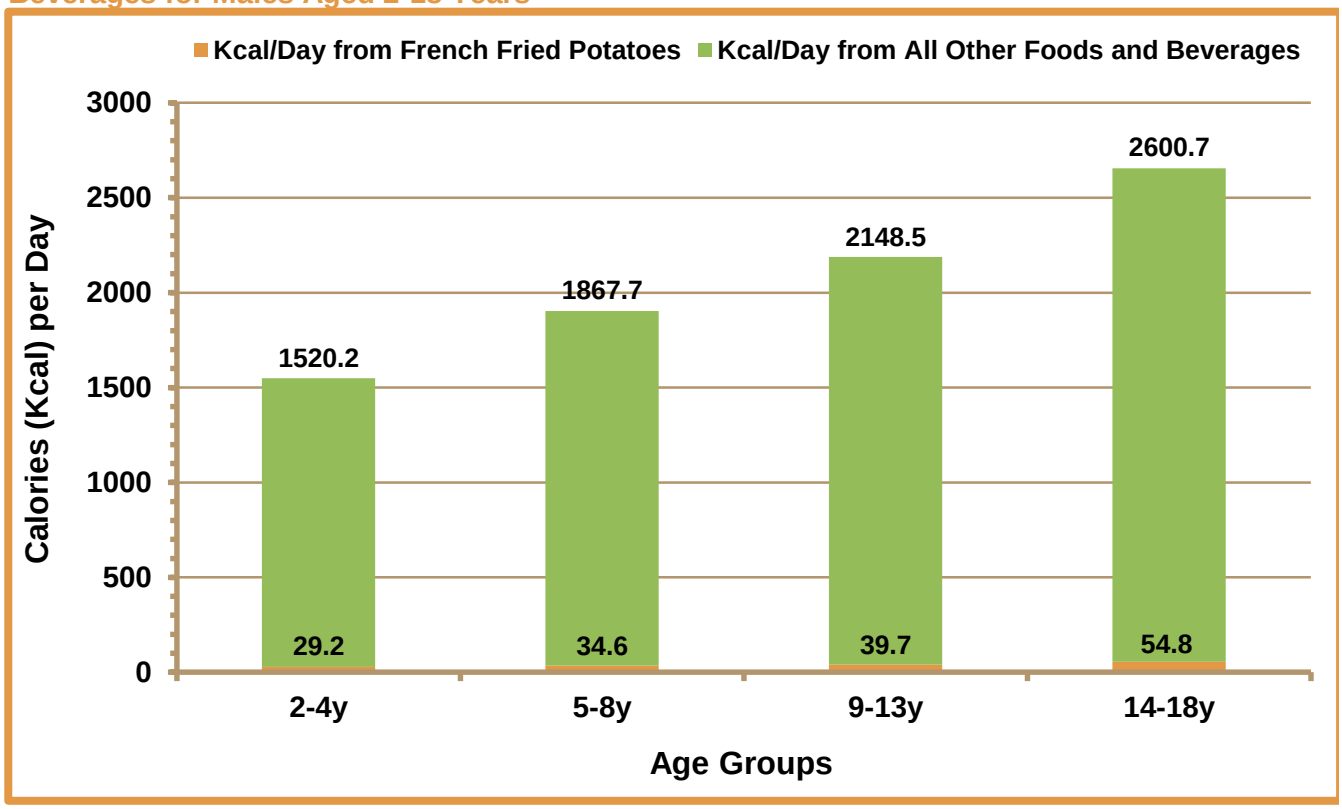
NHANES data suggest that white potatoes contribute a very small portion of total calories consumed by children and teens aged 2-18 years.

Calorie Contributions of French Fried Potatoes

An analysis of 2005-2006 and 2007-2008 NHANES data suggests that intake from white potatoes (baked, boiled, roasted, stewed, stuffed, mashed, with sauce, French fried, hash browned, home fried, potato skins, and potato salad) is relatively low and declining among adults (19+ years) (4). Among all adults, 50% did not consume any white potatoes on the day of the NHANES survey, and the 90th percentile of white potato consumption was 103 g, which is less than one medium skin-on baked white potato (148 g). French fried potato intake also declined with age. Mean calories from French fried potatoes declined from 78.5 and 39.4 kcal/day among men and women aged 19-30 years to 9.7 and 4.6 kcal/day among men and women aged 71+ years. Seventy-five percent of all adults did not consume any French fried potatoes on the day of the NHANES survey.

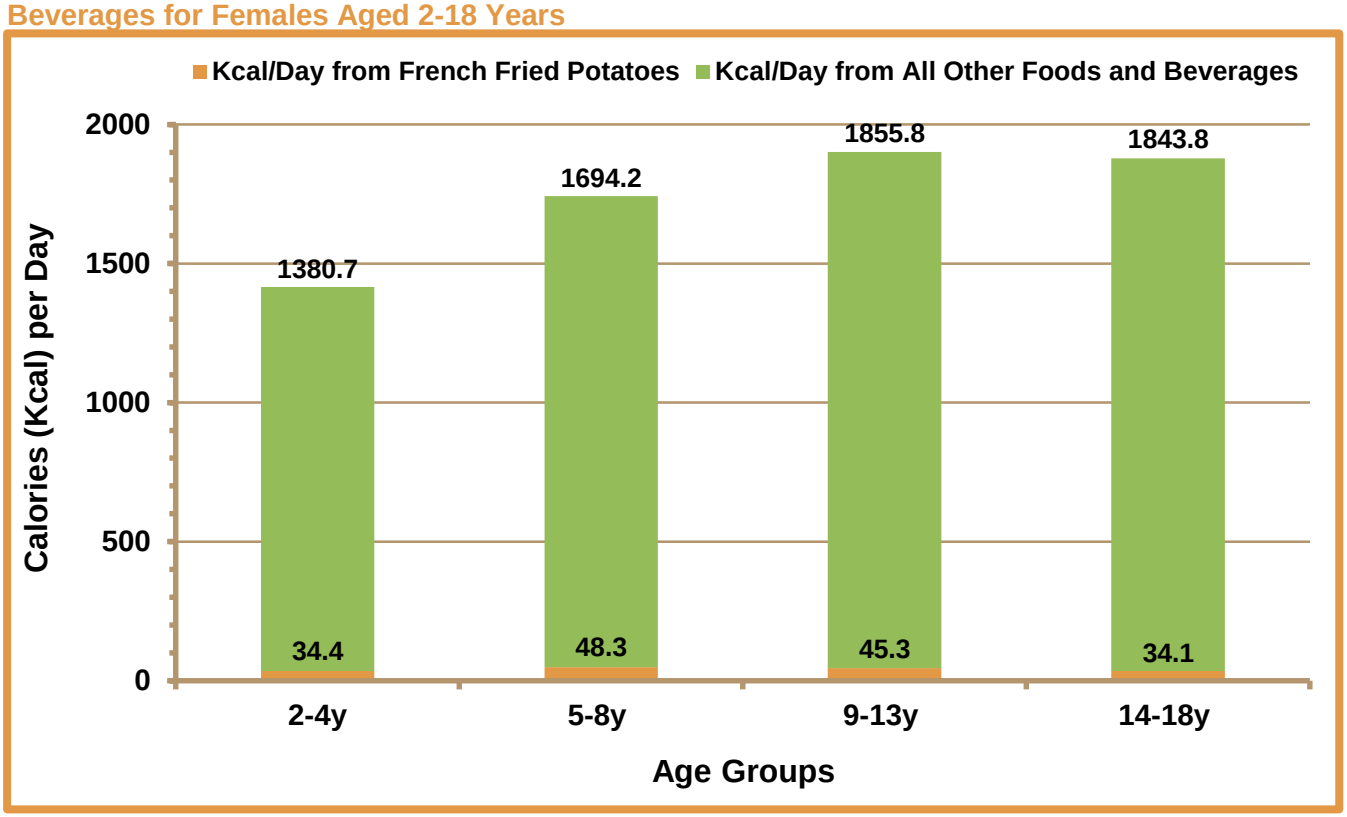
Using the same NHANES data set and potato preparation categories, the researchers also found that white potatoes contribute a very small portion of total calories consumed by children and teens aged 2-18 years (5). Among males, mean calories from white potatoes increased from 45 kcal/day in early childhood (2-4 years) to 79.5 kcal/day among teens (14-18 years). A similar pattern of white potato consumption was observed for females. Mean calories from white potatoes increased from 46.4 kcal/day for females aged 2-4 years to 61.5 kcal/day for females aged 14-18 years. Males aged 2-4, 5-8, 9-13, and 14-18 years consumed a mean of 29.2, 34.6, 39.7, and 54.8 kcal/day from French fried potatoes, respectively (Figure 1).

Figure 1. Mean Calories per Day from French Fried Potatoes and All Other Foods and Beverages for Males Aged 2-18 Years



Females aged 2-4, 5-8, 9-13, and 14-18 years consumed a mean of 34.4, 48.3, 45.3, and 34.1 kcal/day from French fried potatoes, respectively (Figure 2).

Figure 2. Mean Calories per Day from French Fried Potatoes and All Other Foods and Beverages for Females Aged 2-18 Years

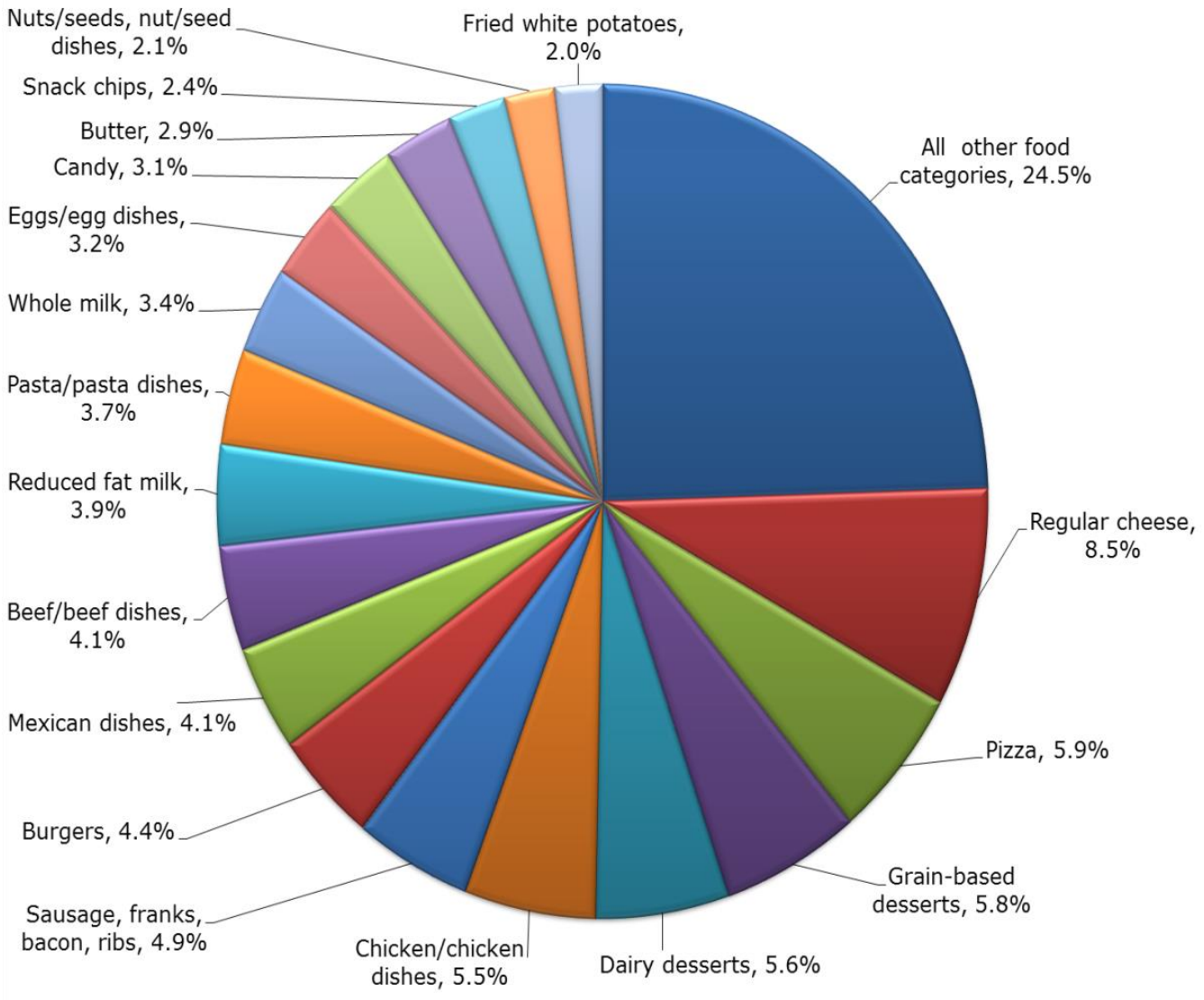


Fried white potatoes contribute only 2.0% of saturated fat intake and are not among the top 10 contributors of saturated fat in the American diet.

Saturated Fat Contribution of French Fried Potatoes

At 11% of total calories, saturated fat intake is above the limit of 10% of total recommended in the *2010 DGA*. In the United States, the top five contributors of saturated fat are regular cheese (8.5%), pizza (5.9%), grain-based desserts (5.8%), dairy desserts (5.6%), and chicken/chicken dishes (5.5%) (6). Fried white potatoes contribute only 2.0% of saturated fat intake and are not among the top 10 contributors of saturated fat in the American diet (Figure 3).

Figure 3. Dietary Sources of Saturated Fat for U.S. Population (2+ Years) from NHANES 2005-2006†



† 2010 Dietary Guidelines for Americans, pg. 26

One 2.5-oz serving (70g or about 10 strips) of oven-heated French fried potatoes provides 10% DV for potassium (330mg) and 6% DV for dietary fiber (1.6g) and only provides 116 kcal, 6% DV for total fat (3.6g), and 4% DV for saturated fat (0.8g).

As currently consumed, white potatoes are not a substantial source of saturated fat in the American diet, and emerging evidence suggests that white potatoes in all forms contribute only a small portion of energy to total calories (4-6). White potatoes in all forms also provide important nutrients. A medium skin-on baked white potato (148 g)—the Nutrition Labeling and Education Act (NLEA) serving size for this vegetable—is naturally low in saturated fat and is an excellent source of potassium [23% of the Daily Value (23% DV)], vitamin C (24% DV), and vitamin B_6 (23% DV) and a good source of dietary fiber (13% DV) and magnesium (10% DV) based on a 2000 kcal/day diet (24-26). One 2.5-oz serving (70 g or about 10 strips) of oven-heated French fried potatoes—the NLEA serving size for this potato product—provides 10% DV for potassium (330 mg) and 6% DV for dietary fiber (1.6 g) and only provides 116 kcal, 6% DV for total fat (3.6 g), and 4% DV for saturated fat (0.8 g) based on a 2000 kcal/day diet (24-26). Even if oven-heated French fried potato intake were to double, the calorie and saturated fat contributions from this potato product would still be relatively low. However, the intake of potassium and dietary fiber, which have been identified by the IOM and the *2010 DGA* as two of the four nutrients of concern, would increase substantially.

Trans Fat Intake Declining

Mean estimated *trans* fat intake ranged from 1.0-2.5% of mean daily energy intake for Americans and Canadians during the 1990s (8). An FDA analysis of the Continuing Survey of Food Intakes by Individuals (CSFII) 1994-1996 identified the major sources of *trans* fat intake as margarine (16.6% or 0.42% of total calories); cake and related products (23.8% or 0.61% of total calories); cookies and crackers (9.8% or 0.25% of total calories); fried potatoes (8.3% or 0.21% of total calories); chips and snacks (4.8% or 0.12% of total calories); and household shortening (4.3% or 0.11% of total calories). Intake of naturally-occurring *trans* fats associated with consumption of animal products represented 20.6% of *trans* fat intake (9,17).

Since the 1990s, partially hydrogenated fats have substantially declined in the food supply. Canada was the first country in the world to introduce mandatory labeling of *trans* fat (27). After implementing mandatory labeling of *trans* fat in 2005, Health Canada reported that mean *trans* fat consumption dropped from mid-1990s levels of 8.4 g/day to 3.4 g/day by 2008 (28). In the United States, levels of commercially-produced *trans* fats have decreased dramatically in the food supply since requiring the inclusion of *trans* fat on the Nutrition Facts label in 2006 (6,11). From 2000 to 2009, blood levels of *trans* fatty acids in white adults in the U.S. population decreased by 58% according to the CDC, which credits marketplace changes for the decrease (29).

Potatoes in the School Setting

White potatoes in the school setting are not a substantial source of calories, saturated fat, or *trans* fat among school children. A survey of school foodservice directors showed that 9 out of 10 potatoes served in schools are baked, boiled, mashed, or otherwise prepared without a fryer (20), and only 11% of school kitchens even have deep-fat fryers. According to the most recent publicly-available NHANES data, school-aged children, on average, consume less than 1% of their daily calories from white potatoes at school, including French fried potatoes (5).

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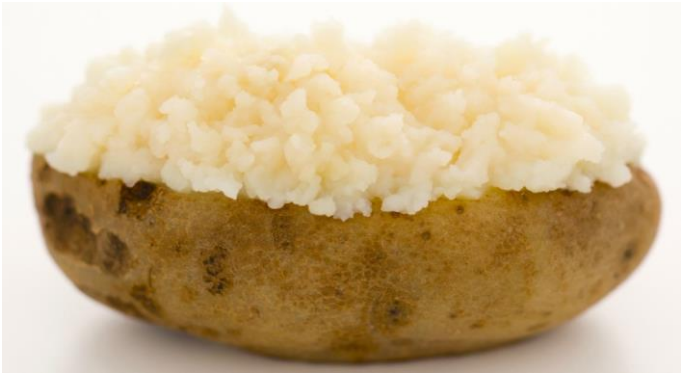
Depending on the age of the child, the revised nutrition standards in the National School Lunch and School Breakfast Programs require school meals to provide the potential energy of 900-1450 kcal/school day. Therefore, the low calorie contribution of white potatoes in school cafeteria settings (less than 9.0-14.5% of kcal/school day) is noteworthy (30). The nutritional and caloric contribution of school meals continues to grow increasingly important as more U.S. children, particularly those from low-income families, participate in the National School Lunch and School Breakfast Programs (31).

Federal regulations in the United States and provincial policy in Canada also include requirements to reduce and/or eliminate *trans* fat in foods served in the school setting. As recommended by the 2006 Canadian *Trans* Fat Task Force, the Province of Ontario limits *trans* fat in foods and beverages sold in schools, as well as in food ingredients used in school meal preparation, to less than 2% of total fat for cooking oils and soft margarines and to less than 5% of total fat for all other foods and beverages (32). In the United States, the revised nutrition standards in the National School Lunch and School Breakfast Programs that were finalized in January 2012 require "that food products and ingredients used to prepare school meals contain zero grams of added *trans* fat per serving (less than 0.5 g per serving as defined by FDA) according to the nutrition labeling or manufacturer's specifications" (30).

Conclusion

White potatoes in all forms, including frozen French fried potatoes (oven heated or deep fried), contribute important nutrients—potassium, dietary fiber, magnesium, vitamin C, and vitamin B_6—to the diets of Americans and Canadians. Emerging evidence also suggests that white potatoes in all forms contribute relatively small amounts of calories, saturated fat, and *trans* fat to the overall diet.

Studies are still being conducted, but existing research reveals a significant reduction of *trans* fat levels in French fried potatoes without a corresponding increase in saturated fat levels. Innovations in food technology are continually improving nutrient profiles of all forms of the white potato to ensure that this already nutritious and popular vegetable continues to align with dietary guidance.



The predominant type of unsaturated fatty acids that occur naturally are *cis* fatty acids. Most *trans* fatty acids are commercially-produced via a process called hydrogenation.

Fat Primer

Dietary fat consists primarily of triglycerides (98%) and smaller amounts of phospholipids and sterols. Triglycerides include one glycerol molecule esterified with three fatty acid molecules (8). These fatty acid molecules are categorized as saturated, monounsaturated, or polyunsaturated and describe the degree to which the carbon-carbon links in the fatty acid chain are bonded with hydrogen. Triglycerides typically contain a mixture of the three types of fatty acids.

Saturated Fats

Saturated fatty acids are composed of carbon-carbon links that are fully bonded (i.e., saturated) with hydrogen and are commonly found in foods from animal sources, such as cheese and butter. According to the *2010 DGA*, "A strong body of evidence indicates that higher intake of most dietary saturated fatty acids is associated with higher levels of blood total cholesterol and low-density lipoprotein (LDL) cholesterol, both of which are risk factors for cardiovascular disease" (6).

Trans Fats

Trans fatty acids are a type of unsaturated fatty acid. Small amounts of *trans* fatty acids occur naturally in foods from ruminant animals (e.g., beef and dairy products), while most *trans* fatty acids are commercially-produced via a process called hydrogenation. *Trans* fatty acids are structurally different from *cis* fatty acids, which are the predominant type of unsaturated fatty acids that occur naturally in foods from plants. "*Trans*" and "*cis*" refer to the position of the hydrogen atoms at the site of a carbon double bond. Hydrogen atoms on opposite sides of a carbon double bond are in the "*trans*" position, while hydrogen atoms on the same side of a carbon double bond are in the "*cis*" position.

The hydrogenation of unsaturated fatty acids to form *trans* fatty acids was widely used in food processing due to the increased stability of *trans* fatty acids versus unsaturated fatty acids. This increased stability made many foods, including frying oils, less susceptible to spoilage. At one point, substituting intake of saturated fats with commercially-produced *trans* fats (e.g., using margarine instead of butter) was also thought to be a means of lowering risk of cardiovascular disease (9).

However, increased *trans* fatty acid intake has since been shown to raise serum levels of low-density lipoprotein (LDL) cholesterol, and a preponderance of data suggests that hydrogenated fatty acid intake lowers serum levels of high-density lipoprotein (HDL) cholesterol relative to saturated fatty acid intake. High levels of LDL cholesterol along with low levels of HDL cholesterol have been implicated in an increased risk of cardiovascular disease (6,8).

Solid Fats

The term "solid fats" is sometimes used to refer to saturated and *trans* fats since most fats with a high percentage of these fatty acids are solid at room temperature (6). However, scientific data specific to the term "solid fats" are lacking.

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OUR MISSION STATEMENT

The Alliance for Potato Research and Education (APRE) is 100% dedicated to expanding and translating scientific research into evidence-based policy and education initiatives that recognize the role of all forms of the potato—a nutritious vegetable—in promoting health for all age groups.

OUR PHILOSOPHY

APRE is committed to informing the conversation that white potatoes in all forms are affordable, nutrient-dense vegetables; provide critical nutrients; and are an important part of USDA's *MyPlate*. Two of the nutrients provided by white potatoes—potassium and dietary fiber—have been identified by the Institute of Medicine's Food and Nutrition Board and the 2010 Dietary Guidelines Advisory Committee as nutrients that are underconsumed by both children and adults.

OUR ORGANIZATION

APRE is a not-for-profit organization funded by the potato industry, including potato growers and potato food manufacturers. APRE's research program is guided by APRE's Scientific Advisory Council (SAC) and Economics Advisory Council (EAC), both of which include a blue ribbon panel of experts from prominent universities in the United States and Canada. APRE does not lobby or further any political or partisan interest.

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