



Review on Public Health Aspects of Processed Foods

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ABSTRACT

Historically, food processing has been almost entirely concerned with increasing palatability and shelf life while also ensuring food safety. Nowadays, there is a growing need to examine both their health potential and their environmental footprint at the same time. Any food that has been altered during the preparation process to make it more convenient, shelf-stable, or palatable is considered a processed food. However, little consideration has been devoted to the public health consequences of processed food and more detailed studies on the public aspect of processed food have not been conducted. Therefore, the primary goal of this paper was to provide an overview of the public health implications of processed foods. Processed foods are easier to eat and cook, and they help to compensate for nutritional deficiencies in raw foods. Processed foods, on the other hand, raise concerns about negative health outcomes because they contain a variety of high-saturated-fat, sugar, cholesterol and sodium food additives and sauces. The nutritional content of food may be degraded during processing, and the additives used in processing may pose a public health risk. The risks associated with processed food are primarily determined by the degree to which the food has been altered. Non-communicable diseases are the most common public health impact of processed foods. Examples of Non-communicable diseases include hypertension, atherosclerosis, obesity, weight gain, stroke, depression, type 2 diabetes, and cancer. The public health risk of processed food can be mitigated by food processing technologies that modify and change the hazardous ingredients of processed food, as well as reduce the consumption of additives in processed food. To recapitulate, public health's role in processed food includes screening for common hazardous additives and avoiding Non-communicable disease risk factors raised by processed food consumption. Additional research is needed to reduce the impact and dangers of processed foods, as the updated and subsequent studies failed to screen for hidden chemicals in processed foods.

Keywords: Additives; Processing foods; Processed foods; Processed foods; Public health

Abbreviations: CRC: Colorectal Cancer; CVD: Cardiovascular Diseases; HCA: Heterocyclic amines; HDL: High Density Lipoproteins; HNE: Hydroxynonenal; LDL: Low Density Lipoproteins; MDA: Malondialdehyde; NCD: Noncommunicable Diseases; NOC: N-nitroso Compounds; PAMP: Pathogen Associated Molecular Patterns; RTE: Ready to Eat; SPB: Sulfide-Producing Bacteria; UPF: Ultra-Processed Foods

INTRODUCTION

Throughout human history, technology and food processing have had a significant impact on the nutritional makeup of food. Food processing has traditionally focused almost entirely on boosting palatability and shelf life while also guaranteeing food

safety. However, there is a rising need to examine both their health potential and their environmental footprint at the same time nowadays. Food processing is the transformation of raw food or food ingredients into finished food products for consumption [1]. The quantities and bioavailability of nutrients found in food are affected by food preparation. As a result, this

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has a significant impact on consumer perceptions of a food product's healthfulness, as well as its calorie content. Under certain circumstances, food processing procedures employed in industry and home cooking can have negative health repercussions. High level Pathogen Associated Molecular Patterns (PAMPs), for example, are toxins excreted by *Enterobacteriaceae* and *Pseudomonas* that might occur during kitchen procedures or be commercially applied to minimally processed and refrigerated foods. PAMPs or their derivatives may engage innate Toll-like receptors during processing, resulting in significant immunological reactions linked to inflammation, type 2 diabetes, atherosclerosis, and elevated cardiometabolic risk factors [2].

Food processing is described as any process that changes the status of food from its original state, such as drying, freezing, grinding, canning and adding flavorings and preservatives. Food classifications will be more useful in measuring and monitoring dietary patterns once food processing is routinely incorporated into them. Food categorization systems that emphasize industrial food processing and describe and distinguish relevant distinct forms of processing would aid in the prevention and control of overweight, obesity and related chronic noncommunicable diseases, as well as malnutrition [3].

Food processing can be defined as the physical, biological, and chemical processes that take place after foods have been separated from their original condition and before they are swallowed or used to prepare dishes and meals. Dietary habits have long been linked to the development of noncommunicable diseases. Processed foods have a negative impact on health due to their altered nutritional status [4].

Processed food is any food that has been altered during preparation to make it more convenient, shelf-stable, or palatable. Some foods have been processed more thoroughly than others. On the other hand, a package of macaroni and cheese or a microwaveable supper, on the other hand, is regarded as excessively processed because it has been chemically altered with artificial flavors, additives, and other components. Sugar, fat, and empty calories are commonly found in heavily processed foods [5]. Obesity, high blood pressure, higher cholesterol, cancer and depression have all been related to eating a lot of these foods, which can lead to non-communicable diseases like heart disease or early death. Processed and ultra-processed foods are detrimental to public health, especially the cardiovascular and digestive systems. However, its public health ramifications have gotten little attention and further studies haven't been conducted on the public aspect of processed food. Therefore, the main objective of this manuscript is to overview the public health aspects of processed foods [6].

LITERATURE REVIEW

Definition of processed foods

The NOVA system, which divides foods into four classes based on their degree of processing, is increasingly being used in public health nutrition research. The first category includes items that are unprocessed or slightly processed. The second

group consists of processed culinary ingredients such as oils, butter, sugar, lard and salt. Processed foods, on the other hand, are made by combining meals from the first category with salt, oil, sugar or other elements from the second group. The fourth and last group is Ultra-Processed Foods (UPFs), which includes soft beverages, confectionary, sweet biscuits, ice cream, and savory snacks and is also summarized in Figure 1 [7].

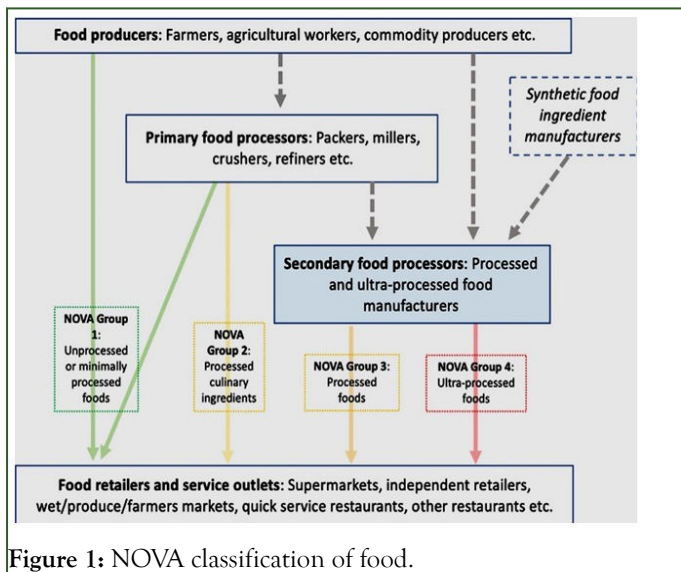
Food processing was created to address the issue of long-term storage and transportation. Processing has recently focused on palatability and the production of indulgent products. Food palatability has always been a priority for food manufacturers. If a preserved food is unpalatable, it will not be consumed and thus will not provide nutrients to consumers.

The high palatability of all foods, including PF and UPF, presents a significant challenge not only to the food industry. Good cooks and chefs hope that their food is highly palatable and as a result, they are constantly on the lookout for new ingredients that add new sensations to various food products [8].

Processed foods are agricultural, animal, marine, or forest products that have been modified using physical, chemical or biological procedures to make them edible, preserve their nutrients and provide storage quality for longer periods of time. Processed foods are convenient to eat and cook, as well as supplement nutritional inadequacies in raw foods. Processed foods, on the other hand, raise concerns about bad health outcomes because they contain a variety of high-saturated-fat, sugar, cholesterol and sodium food additives and sauces [9].

Highly processed foods and beverages are those that have been processed or cooked in a way that adds too much sodium, sugar or saturated fat to the diet. Sugary drinks, chocolate and candies, ice cream and frozen desserts, fat foods (burgers), frozen spaghetti and pizzas, bakery items (muffins, toast, and cakes) and processed meats are examples of highly processed foods. Highly processed goods, such as those from bakeries and catering shops, that require little or no domestic preparation other than heating and cooking (for example, bread, breakfast cereals, cheese, commercial sauces, canned foods including jams, commercial cakes, biscuits, and sauces).

There are two types of moderately processed foods: Dried fruits, raw, vacuum-packed or under controlled atmosphere foods (for example, salads), frozen basic foods, extra virgin olive oil, fruits and vegetables canned in water/brine or in their own juice are among the industrial and commercial foods that require relatively little processing and can be consumed without further cooking [10]. Second, foods prepared or cooked at home from raw or moderately processed items, such as vegetables, meat and fish, cooked from fresh raw materials or vacuum-packed, deep-frozen, canned in water/brine or in their own juice (Figure 1).



Food additive in processed foods

In most diets, a number of naturally occurring nutrients can be found at modest levels. Increases the levels of one or more nutrients in regularly consumed foods, either through enrichment (replacing nutrients lost during processing) or fortification (adding nutrients in higher quantities than naturally present in the product), resulting in increased intakes [11]. The bulk of grain products, as well as a variety of other meals, are fortified. For example, bread is fortified with thiamin, niacin, riboflavin, and iron; most RTE cereals are enhanced with iron and B vitamins, including folate; and most milk is fortified with vitamin D. Although chemical food additives and preservatives are generally thought to be safe, a number of them have negative and potentially life-threatening side effects. When nitrates are consumed, they are converted to nitrites, which can react with hemoglobin to form met-hemoglobin, which can cause loss of consciousness and death, especially in infants. Artificial food colorings such as tartrazine, allura red, ponceau and benzoate preservatives have a negative impact on infant behavior; these additives are blamed for infant hyperactivity [12].

Some artificial additives found in wine, beer, and dried fruits, such as sodium bisulfite, sodium meta-bisulfite, and potassium bisulfite, have been linked to asthma attacks, and sodium nitrate and sodium nitrite have been identified as carcinogenic to humans. Not only the aforementioned food additives, but also the useful additives that cause noncommunicable diseases such as extra sugar, fat, removal of fiber content, salt and other colors can be listed as follows [13].

Added sugar

Sugar is widely available and comes in a number of forms in the food supply. Sweet snacks and desserts, on the other hand, aren't the only sources of sugar. Added sugar can be found in sauces, salad dressings, breads, and a range of other products. Despite the fact that the body can handle sugar, excessive amounts have been linked to weight gain and chronic diseases such as type 2 diabetes. Refined carbohydrates are wheat or

other grains that have been stripped or bleached and are commonly found in highly processed foods [14].

A lack of fiber: Fiber is an important ingredient that is often lacking in processed diets. During the processing process, important nutrients and fiber that are present in the unprocessed, natural form are eliminated. Cereals and breads for breakfast are a great illustration of this. Processed foods are generally lacking in fiber, which may be detrimental to one's health. The Body Mass Indexes (BMIs) of those who consume adequate fiber are lower than those who consume very little fiber. A low-fiber diet has been linked to an increase in colon cancer, hemorrhoids, and other digestive issues [15].

Trans fat: The type of fat in processed meals, as well as the amount of fat, is a source of worry. Trans fat, in particular, has been demonstrated to be harmful to one's health, including raising the risk of heart disease. While there is an ongoing attempt to eradicate trans-fat from the food supply, it is still present. Trans fat are commonly found in chips, fried meals, pastries and are sometimes known as "(partially) hydrogenated oil" or "hydrogenation" [16].

Added salt: Salt is commonly utilized in the food supply to improve flavor and extend shelf life. Sodium can be dangerous, especially if you're trying to control your blood pressure, often known as hypertension. Uncontrolled hypertension can harm the heart and arteries over time, increasing the risk of heart attack, congestive heart failure and stroke [17].

DISCUSSION

Public health impact of processed food

Nutrients and their metabolites act as direct moderators of protein function, powerful signaling agents, as well as inducers and repressors of gene expression, in addition to being building blocks of cellular structures and fuel sources. The nutritional content of food may be degraded during processing and the additives used in processing may pose a public health risk. The nutritional value of processed foods is a public health concern and the ingredients of processed foods are confined to lowering hazard action [18]. Processed food's risks derive mostly from the degree of alteration that food has undergone. Weight gain, overweight and obesity and hence obesity-related malignancies, have been linked to added sugar, saturated fat, energy-dense diets, sugar-sweetened drinks, and fast foods. Processed meats have been recognized as a strong contributor to colorectal cancer. Meat comes in a variety of colors and textures, including white and red meat. Red and processed meats, on the other hand, are often stigmatized because of potential health risks.

Noncommunicable Diseases (NCDs) are recognized as worldwide health hazards and burdens in underdeveloped countries. NCDs such as cardiovascular disease, cancer, and type 2 diabetes are linked to dietary patterns. Obesity, hypertension, and atherosclerosis are all increased by eating too much dietary energy, salt, and animal fat, whereas eating enough vegetables and fruits reduces these risks. NCDs' current prevalence has disastrous health consequences and poses a severe danger to global health systems [19]. A better understanding of the

potential risk factors is required to reduce the number of deaths caused by NCDs. Unhealthy diets have long been recognized as a primary factor in the development of NCDs. With the rising prevalence of NCDs, the share of processed foods has steadily increased. Food processing has changed dramatically in the last half-century as a result of the industrialization and globalization of food systems [20].

Obesity and type 2 diabetes

Because processed foods contain so many chemicals that contribute to obesity, diet directly causes increased calorie intake and, as a result, weight gain. Obesity is caused by an excess of calorie-dense foods, which is usually accompanied by insufficient physical exercise. Carbohydrates and fats are the primary sources of calories in foods. Obesity and type 2 diabetes have been related to eating and drinking a lot of foods and drinks with added sugars. People who eat junk food may gain weight due to its low nutritional properties and potential to induce overeating. Excess body fat and weight are key risk factors for type 2 diabetes. Fructose is absorbed by the liver without being regulated, which can lead to a buildup of liver lipids and a reduction in insulin sensitivity. Insulin sensitivity influences how well cells consume glucose and remove it from the bloodstream. When this occurs, blood sugar levels might remain high for long periods of time, potentially leading to type 2 diabetes.

Vascular diseases and hypertension

Processed and ultra-processed foods induce a significant increase in LDL cholesterol in the body, which leads to blood vessel thickening and hypertension. Added sugar, salt and fat are all found in high amounts in heavily processed foods. These components improve the taste of food, but too much of them can cause serious health problems such as heart disease and high blood pressure. Besides particular infectious disorders, diarrhea, lower respiratory infections, and other infectious diseases combined, CVD was the second most prevalent cause of mortality. Cardiovascular Diseases (CVD) are becoming a bigger part of the global illness burden, with CVD epidemics spreading across many parts of the world that are going through a rapid health transformation.

A poor-quality diet high in salt and low in seafood and omega-3 fatty acids has been associated with CVD illness. Low-fat dairy products with high calcium content are suggested to help lower blood pressure. Processed foods heavy in fat, on the other hand, have been demonstrated to raise HDL and LDL cholesterol levels. Small, compact LDL particles are more atherogenic than their larger counterparts due to their poorer affinity for the LDL-receptor and higher susceptibility to oxidation. In most foods, salt has functional, sensory, and safety functions. Processed meals, on the other hand, may provide too much salt to consumers, thus increasing the risk of hypertension and cardiovascular disease.

Cancer: Processed meat has a high salt and saturated fat content. An increased risk of colon cancer has been related to consuming too much processed meat. In developed countries,

colorectal cancer is the second leading cause of cancer related mortality. Processed meat consumption is one of the most common health concerns when it comes to cancer. The colon's complex microbiota, as well as its high exposure to environmental chemicals, has piqued researchers' interest in figuring out how Colorectal Cancer (CRC), microbiota, and nutrition interact. Heterocyclic amines, N-nitroso Compounds (NOCs), heme, and protein, all contained in red and processed beef, may be carcinogenic to humans. Consumption of red and processed meat has been linked to an elevated risk of Colorectal Cancer (CRC), which may be due to carcinogens such as Heterocyclic Amines (HCA) generated during the cooking and preservation processes.

In the human colon, microorganisms that have played a role in colorectal carcinogenesis are ubiquitous. The consumption of red or processed meat is associated with the many types of bacteria linked to colorectal cancer. *Fusobacterium nucleatum*, *streptococcus bovis*, *E. coli*, and *Bacteroides fragilis* levels are higher in patients with adenoma or adenocarcinoma than in healthy people. The bacteria can attach to colon cells, change tumor suppressor gene suppression, oncogene activation, genotoxicity and have active angiogenesis downstream targets. The role of these microbes in the conjugation of N-nitroso compounds heterocyclic amines, and heme with meat components, and also mentioned in Figure 2.

The association between microbial makeup and colorectal cancer progression varies. Heme promotes carcinogenesis by causing epithelial damage and decreasing cell death by downregulating pentraxin. As a result, the microbiota mediates compensatory hyperproliferation. Heme causes lipid peroxidation, which results in the formation of carcinogenic aldehydes such as Malondialdehyde (MDA) and 4-Hydroxynonenal (4-HNE). Heme also causes microbial dysbiosis and increases the number of Sulfide-Producing Bacteria (SPB), which destroys the mucosa and exposes the epithelium to carcinogens. Finally, heme increases the synthesis of N-nitroso compounds in the body (Figure 2a).

NOCs can also be detected in nitrate-containing foods. The activity of nitro reductase, which transforms nitrates to NOC, a carcinogen, is increased by the microbiota (Figure 2b). Heterocyclic Amines (HCAs) are formed when amino acids in meat are heated to high temperatures. From HCA, mutagenic intermediates can be released by-glucuronidase bacteria (Figure 2c). Undigested proteins, such as hydrogen sulfide, ammonia, secondary bile acids and phenolic compounds, appear to enhance the risk of CRC. Secondary bile acids promote dysbiosis by increasing the formation of gallicin, a bactericidin (Figure 2d).

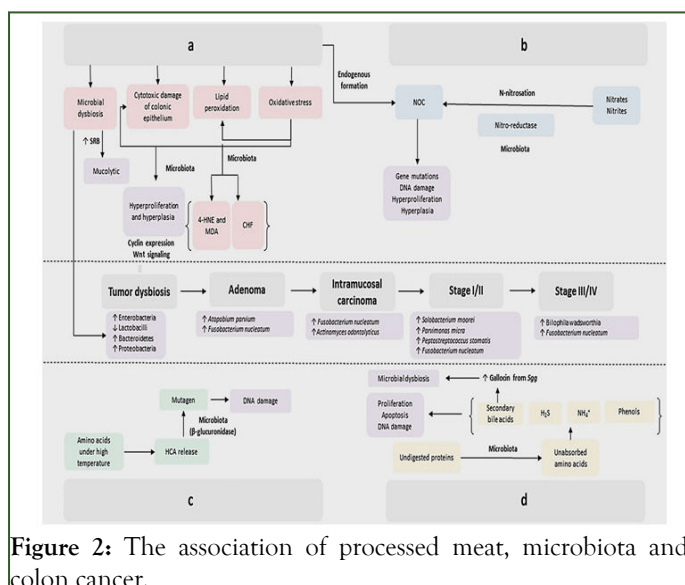


Figure 2: The association of processed meat, microbiota and colon cancer.

An approach to reducing the risks of processed foods

Food processing technologies hold a good prospect for improving consumer health and well-being. The most popular approaches to reducing noncommunicable diseases caused by overconsumption of processed foods involve reducing additives and changing the ingredients of processed foods. Modified starches that resist digestive action can help to minimize sugar or starch digestion. Blood glucose levels are more evenly distributed, resulting in enhanced glycemic responses and longer satiety, lowering the risk of diabetes and cancer.

Using creative ways, it is possible to reduce the quantity of fat absorbed while keeping the dish palatable and delightful to eat. For example, dynamic radiant frying, which uses a high-heat flux to offer the appearance, taste, and texture of fried food without the use of additional oil, may be able to make fried potatoes without the use of oil. Innovative technologies and replacements are being used to reduce the amount of salt in foods. For instance, changing the structure of salt during the drying process allows for a higher salt taste with less salt. Food packaging is being improved with nanotechnology methods to prevent oxygen and light penetration, boost strength and durability, inactivate germs, and improve product tracking. Sensors and sensing devices on packages could be used to ensure freshness or alert consumers to spoilage using this technology. Edible films, or nanolaminates, are being developed using natural materials derived from polysaccharides and proteins (fruit puree, soy protein, egg albumin, starch, algae or whey protein) and infused with antimicrobial chemicals.

CONCLUSION

Aspects of public health contribute to evaluate the nutritional value of processed foods, as well as public concerns about additives in processed foods. The role of public health is to address the most common hazardous chemicals in processed food, and it gives the way to reduce the risk of such additives in processed food. Processed foods are convenient to eat, cook and

supplement nutritional inadequacies in raw foods. However, processed foods have a great risk to public health, which is concerned about bad health outcomes because they contain a variety of highly saturated fats, sugars, cholesterol and sodium additives. Overconsumption of nutrients may cause noncommunicable diseases, including cardiovascular diseases, cancer, type 2 diabetes, obesity, hypertension, renal failure, stroke and depression. The influence of processed meat on public health has not been thoroughly investigated by food technologists and researchers.

RECOMMENDATIONS

There is a lack of understanding of the public health consequences of processed food in underdeveloped nations, as well as a failure to screen additives and chemicals in packaged processed food. Significant study is being undertaken in poor nations, particularly Ethiopia, on the health effects of over consumption of hazard foods and processed foods, which contributes to non-communicable diseases that cause untimely death. Food processing technology on the other hand, has the potential to improve consumer health and well-being by reducing toxins and altering processed food ingredients. Noncommunicable diseases, such as cardiovascular disease and cancer, will continue to exist until technology improves. Therefore, further research should be conducted on the impacts of processed foods and also all consumers should be aware of and understand the impact of processed foods on public health.

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