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Review Article

A review on nutritional susceptibility of processed foods

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Abstract

Dietary formulation and processing technologies serve as a vital tool for maintaining food quality and give millions worldwide access to wholesome, inexpensive, sustainable, and aesthetically pleasing foods. However, any level of food processing can also have detrimental effects on health due to the heat destruction of vitamins, the production of carcinogens such as acrylamide, or excessive consumption of fat, sugar, and salt. The composition and formulation of foods are the focus of research on ultra-processed foods. Furthermore, many contemporary food formulations have a higher energy density and less nutritional quality. Notwithstanding the possible adverse health consequences, food processing and formulation offer a chance to use the most recent advancements in technology and ingredient innovation to enhance the food supply by producing foods that reduce the likelihood of overindulging.

Keywords: Processed food, Nutrition, Obesity, Health, Sustainability

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1. Introduction

The operations involved in transforming raw materials from various sources, including vegetable and animal sources, into a finished product fit for human consumption are called food processing.[1] In the past, food processing methods, including heating, curing, and smoking, were created with an emphasis on the long-term preservation and transportation of food. However, processed foods are now safer due to the efficient decrease in dangerous germs and spoilage that is made possible by processing methods like pasteurization and other heat treatment technologies. Strategies to improve the production of decadent items and their palatability have also been included in later developments in food processing.[2] It is unavoidable for people of all ages to include it in their diets because of its great accessibility, variety, and availability.

Over the past few decades, food processing has undergone significant and quick change. It is frequently linked to possible detrimental effects on food's nutritional value, which in turn affects dietary habits and the rise in non-communicable illnesses. Food processing, however, should not be viewed as a nutritional issue for people. Instead, it contributed significantly to the advancement of civilizations and humanity by increasing the variety and safety of food. Additionally, extending the shelf life of foods or just making them palatable is crucial.

The Nova cataloguing (Portuguese nova classificação, or new classification) categorizes comestible substances based on food processing. The approach has been employed in nutrition and public health exploration, policy, and advice worldwide as a tool for understanding the health consequences of colourful food particulars. The classification methods like NOVA suggest that food processing activities have an impact on food-related health consequences. Rather, the existing knowledge on nutrients that have historically been the focus of public health concerns (such as fat, sugar, and salt) appears to have a stronger influence on health outcomes. To reformulate and enhance the food supply, experts are concentrating their efforts on these nutrients. Food fortification is a historical illustration of this idea, giving billions of people worldwide inexpensive access to nutrients that they may not otherwise be able to obtain. Any attempt to fortify or reformulate a meal or beverage, however, can only make it more processed and harmful, according to NOVA. The degree and intent of food

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processing, which includes physical, biological, and chemical procedures employed after foods are extracted from their natural state and before consumption or preparation as dishes and meals, are considered by the NOVA food categorization. NOVA comprises four food groups[4]:

1. minimally processed and unprocessed foods;
2. processed culinary ingredients;
3. processed foods; and
4. Ultra-processed foods, which are formulations that contain little to no intact group-1 foods and are primarily or exclusively made from ingredients and ingredients from group-1 foods.

These efforts include the addition of pre- and probiotic cultures to improve gut health, the reduction of sugar using non-nutritive sweeteners, the removal of fat from dairy products, the development of alternatives to breast milk to support infant growth, the addition of food fortification to increase micronutrient content, and technological advancements that support efforts to make food production more sustainable. To decrease nutrients that are sensitive to public health and increase the nutritional density and sustainability of the food supply, producers and consumers are faced with the choice of either completely avoiding processed foods or embracing reformulation and processing.

2. Discussion

In factories, food service, and homes, food processing is crucial because it improves food's digestibility, nutritional bioavailability, palatability, and shelf life while also making it safe. Economies of scale, which lower food costs, use food by-products, lower production energy, and use food additives and packaging technologies to further extend shelf-life, are additional benefits of industrial food processing. This leads to less food waste and more sustainable food production. The affordability, convenience, and acceptability of sustainable plant-based alternatives to animal-based diets may all be improved with the use of food processing technology and formulation. The substantial environmental effect of such a worldwide transition should be considered when recommending that all processed foods be avoided. In any attempt to lessen the environmental impact of food preparation, the food industry will be crucial due to its size. In the future, food processing, formulation, and technological innovation will be required for the creation of new foods and food categories that can assist consumers in switching to more sustainable food sources.

Processed foods are becoming more and more popular among consumers, mostly due to their affordability, accessibility, taste, and practicality.[5,6] Food processing has advanced quickly in recent decades due to the industrialization and globalization of food systems, resulting in a vast array of foods that are processed in various ways and, most importantly, have varying health effects. Because processed foods are known to contain large amounts of fat, sugar, and salt, excessive intake of them is frequently linked to the early onset of non-communicable illnesses. It is commonly known that processed foods contain sugar, saturated fat, salt, and trans fatty acids. Overconsumption of these nutrients is thought to be the primary cause of an elevated risk for the emergence of some of the most significant global public health issues, including cancer, obesity, type 2 diabetes, and heart disease. Our regular diet is significantly impacted by food processing. Food ingredients are subjected to a wide range of treatments, including fermentation, high pressure, heating, cooling, drying, mechanical treatment, and acid and alkaline treatments. The impact of dietary components on health can be greatly impacted by these processes, which can also have a substantial impact on their composition, structures (chemical and multiple-scale structures), and interactions.[7,8] From harvest to the finished food products, either processed, unprocessed, or ultra-processed, that we eat, food processing may be included at every stage.

It has been noted that novel chemicals with potential health benefits or drawbacks can be created during food preparation. For instance, heat treatments can result in substantial changes to the food items' chemical makeup, which might impact their digestibility, bioavailability, and palatability.[9] Depending on how food is prepared and processed, it is possible to create both toxic (such as acrylamide, HMF, and heterocyclic amines) and healthy (like AGE inhibitors and antioxidant melanoidins) substances.[10] The health value of citrus products can be increased by modifying nutrients and bioactive compounds in ways that affect their effects on nutritional status and health. For example, polymethoxyflavones (PMFs) in citrus fruits can be changed during drying to hydroxylated PMFs with stronger bioactivities than the parent compounds, such as antioxidative, anti-inflammatory, and anti-cancer effects.[11] Clarifying how various food processing methods affect food ingredients and how that affects their health functions is therefore very important.

Moreover, foodborne illnesses brought on by bacteria, chemicals, allergies, and physical pollutants continue to pose a global public health concern since new dangers are always being discovered while others are being managed.[12] Food processing procedures are used to restrict microbial growth or inactivate microorganisms in food items to reduce the danger of microorganisms or foodborne pathogens.[13] Throughout human history, methods based on physical or natural antimicrobials have been used to control these microbes to provide safer foods.[14]

A variety of chemical toxicants, including some naturally occurring poisons like lectins and cyanogenic glycosides, may also become inactive because of food processing. Others, including metals and mycotoxins, can be partially removed when grains are polished. However, several methods of thermally processing food, such as

roasting, baking, frying, and grilling, can produce carcinogenic compounds like furan, acrylamide, and polycyclic aromatic hydrocarbons. Furthermore, it is acknowledged that processed meals contain ingredients like pesticides and chemicals that are purposefully used in food manufacturing.[15] Proteins' capacity to induce allergy sensitization may also be impacted by food preparation. For instance, hydrolysis and fermentation may be able to lessen allergenicity to the point that symptoms are not triggered.[16]

Ultra-processed foods are hazardous for a variety of reasons. They eliminate the need for plates and silverware and are often portable, handy, and easy to eat anywhere—in front of a computer or television, at work, while walking, or while driving. They are often offered for sale as beverages, snacks, or meals that are ready to consume or reheat. Freshly made meals based on natural or minimally processed foods are thus replaced by them. According to some research, the amount of food offered at fast-food restaurants has grown dramatically in the last several decades,[17] and there is a clear correlation between larger portions and weight gain and total calorie consumption.[18,19] Aggressive and complex marketing further exacerbates the collection of these unfavourable external traits of ultra-processed meals. Social standards are altered, particularly for the most susceptible customers, including children.[20] Unsupported health claims are a common component of these items' marketing campaigns. Advertising swiftly spreads in developing nations with poor and moderate incomes.[21]

Furthermore, ultra-processed meals raise the risk of illness for several tenable biological causes. One is the detrimental effect that ultra-processed food intake has on diet quality.[22] Other aspects of ultra-processed meals are detrimental to health, even while studies that control for intake of total fat, sugar, and salt[23] still reveal links to illnesses and diseases. Accordingly, there is evidence that eating a lot of ultra-processed food causes one to consume more food additives[25] and less water.[24] The gut flora is harmed by some chemicals, including artificial sweeteners, emulsifiers, and colourings.[26] Additionally, when additives are mixed with fat, salt, and sugar, they produce dishes that are extremely appetizing and may be overindulged.[27]

In addition to that, the entire food structure is harmed or destroyed by ultra-processing. This harms food absorption, bio accessibility, and gut microbiota inflammation. Moreover, it eliminates food's phytochemicals.[28] Plastic compounds, including phytates and bisphenols, are found in ultra-processed food packaging.[29] According to a study, bisphenol A increases oxidative stress and insulin resistance. Additionally, extrusion and extreme heat processing can produce acrylamide and acrolein, which have been connected to insulin resistance and oxidative stress.[30] Thermic impact, decreased satiety, and higher glycaemic response[31] are further plausible explanations for why ultra-processed meals raise the risk of several illnesses and diseases as well as early mortality.

In the Indian context, the rules for fortified processed foods, such as fruit juices, bakery goods, and cereal items, have been announced by the Food Safety and Standards Authority of India (FSSAI).[32] The Food Safety and Standards (Fortification of Foods) First Amendment Regulations, 2020, provide these guidelines. However, foods that are heavy in fat, salt, and sugar have been exempted from these requirements by the FSSAI. According to these laws, fortified processed foods refers to processed foods that have undergone fortification by their requirements, meaning that they have been changed from their original condition using industrial processing procedures. By the Food Safety and Standards (Food Product Standards and Food Additives) Regulation of 2011, the same may have used fortified staples as raw materials and/or fortified with approved micronutrients and additives.

According to the regulation, "Fortified Processed Foods" can be made from fortified food items, such as cereals and/or milk, and they must supply 15–30% of the Indian adult RDA of micronutrients based on an average intake of 600 kcal from processed foods, or roughly one-third of an adult's daily energy needs. However, foods that include high levels of fat, sugar, or salt (HFSS) will not be included in the category of fortified processed foods. Foods classified as HFSS must be defined by the Food Safety and Standards (Labelling and Display) Regulations of 2020.

Additionally, any producer who fortifies a processed product must make sure that the micronutrient content of the fortified food falls within the range that the food regulator has established. Furthermore, according to the law, multigrain Atta can also be fortified with vitamins and minerals at the same amounts as "Fortified Atta," as long as it includes more than 50% wheat flour.

The FSSAI has established guidelines for fortified processed foods under "Schedule-III" of these rules, which sets restrictions for fortified fruit juices, bread goods, and cereal items. When fortified, cereal items such as breakfast cereals, pasta, and noodles must have iron, folic acid, and vitamin B12 in addition to vitamins B1, B2, B3, and B6. Bread, biscuits, rusks, and buns are examples of bakery goods. When fortified, they must have additional iron, folic acid, and vitamin B12 at the amounts specified by these standards. By the recommended limitations, the bakery goods can also be fortified with zinc and vitamins B1, B2, B3, and B6. According to the regulation, fruit juices can be supplemented with vitamin C (mg): (ascorbic acid) at a rate of 6–12 mg per 100ml.

3. Conclusion

Future health and global economic prosperity are seriously threatened by the present obesity pandemic and other non-

communicable illnesses linked to the population's eating habits. As people live longer yet have more comorbidities (diabetes, cardiovascular illnesses, respiratory diseases, obesity, and oncological diseases), there is currently a new paradigm addressing the population's health and quality of life. Due to lower production, higher absenteeism, and higher healthcare expenses, these illnesses have a major effect on the national economy and are frequently linked to early death and morbidity.

Essential components of the food supply include both fresh and processed foods. Food security, or the availability of enough food, and nutrition security, or the quality of food that satisfies human nutritional needs, are both facilitated by processed food. Many food producers draw in customers by developing sensory qualities that satisfy taste, which is the main factor influencing food purchases. This strategy is still necessary for efforts to enhance the food supply, such as when developing new processed foods that make it easier to reduce or eliminate nutrients that are sensitive to public health, including fat, sugar, and salt, or when developing foods that are unlikely to be regularly consumed. Taste, value, convenience, sustainability, and nutrition are the main factors influencing consumer food purchases. We may now spend less money on food and less time shopping and preparing because of changes in our lifestyles. Although there are benefits and drawbacks to food processing and formulation, the current suggestions to exclude all processed foods from the diet appear unreasonable and backward. Targeting food palatability is unlikely to be effective with food producers or consumers, and taxing goods based on their level of processing is likely to disproportionately harm the most vulnerable and food-insecure people. Therefore, public health strategy is unlikely to be based on making our food supply more costly and less desirable.[33] For many, going back to preparing everything from scratch will be challenging, if not impossible. Furthermore, many lower-income groups will find it challenging to adapt to diets that demand that they spend a larger percentage of their free time preparing meals and a larger percentage of their disposable cash on food. Therefore, it will be difficult or impossible for most consumers to lower the number of processed foods in their diet and still achieve their daily nutritional requirements, even though some segments of the population may be able to do so.[34] To keep meals easy and enticing while maintaining the right nutrient density for various populations, it is crucial to reformulate several aspects of the existing food supply. It is probably more feasible to improve the sustainability and healthfulness of the current food supply by making improvements to processed foods rather than eliminating them.[35]

Reformulation and advancements in food processing are crucial for reducing energy density, increasing nutrient density, and improving food supply sustainability. However, these efforts alone won't address public health issues unless new formulations maintain sensory appeal and positively impact eating habits. Sensory cues, such as shape and texture, influence eating habits and energy intake. Future research should consider the influence of sensory cues on food choice and intake behaviours and the interplay between sensory and nutritional qualities. Using recent advancements in food processing and formulation to reduce negative nutrient content while considering sensory qualities can moderate energy intake and make foods more appealing to consumers. Choosing nutrient-dense foods increases the likelihood of meeting dietary guidelines. Effective communication and cooperation between nutrition and food science professionals, the food industry, and other stakeholders can contribute to improving diets by offering a safe, enjoyable, economical, and sustainable food supply. Effective public policies and measures at local, national, and international levels are needed to minimize the production and use of these goods. A united political will involving the public, social movements, health experts, media, government policymakers, and the food sector is necessary.

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None.

5. Conflict of Interest

None.

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