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Review Paper

Empty Calories in Processed Foods: A Comprehensive Review of Dietary Implications

Yusuf Sarkingobir [1] and Yusuf Yahaya Miya[2]

[1]*Department of Environmental Education, Shehu Shagari University of Education Sokoto, Nigeria.*

[2]*Galaxy College of Health Technology Bauchi, Bauchi State, Nigeria*

*Corresponding Author Email: superoxidedismutase594@gmail.com

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Abstract

Proper food consumption is vital for human survival. The objective of this paper was to conduct a review of empty calories present in processes foods, effects, and relations. Empty calories such as junk foods, ultra-processed foods, u healthy foods, fast foods are foods consumed by many because of their luring properties. However, they contain high amount of added solid fat or added sugars or sodium or additives or all. The presence of contents of empty calories elicit many effects such as obesity, diabetes, heart disease, fatigue, mental disorders, insatiety, etc. Empty calories possessed high amounts of added calories that are not properly metabolized into useful nutrients by the body. Therein, presence of excess added sugar, excess solid fat, and excess sodium is harmful. Added sugar causes insulin resistance and other comorbidities, solid fat causes clogging of blood vessels and further aftermaths, and sodium elicit hypertension. However, there is little or zero presence of micronutrients (vitamins and minerals) in empty calories, a situation that may spur micronutrients deficiencies and further impacts. Additionally, the additives, containers (plastics) are harmful to health as well. People easily become addicted to empty calories due to natural love for sugar, poor awareness, cheapness of the products, etc. It is emphatic to say that, government should regularly and carefully monitor consumption and buying of empty calories in the society, parents should monitor wards, teachers and health experts should educate the public on this pressing concern.

Introduction

Empty calories are denoted with common names such as "junk foods," "fast foods," "ultra-processed foods" "toxic foods" "obesogenic foods" etc (Lucan et al., 2010; Reedy et al., 2010; Oki & Cunningham, 2019; Khalid et al., 2020). Empty calories (EC) include the famous "ultra-processed foods" that are formulations containing chemicals or modified foods, additive containing foods to enhance texture, appearance, flavor (taste), and durability (Lane et al., 2023). Albeit, the distribution varies, but the intake of empty calories is significantly increasing among various age groups from all regions of the world (UNICEF, 2019). Empty calories are concerns to public health nutrition because of certain reasons such as, possible contamination, effects of additives, poor or zero contents of nutrients (vitamins and minerals), high salt (sodium content), highly -laden with added sugar, highly -laden with solid fat (UNICEF, 2019; Lane et al., 2023). Studies complain that the pattern of empty calories consumption has a great tendency of escalating chronic diseases, and inflammation (Vidya et al., 2015; Lane et al., 2023). Many of the empty calories facts are hidden to the consumers. They are not always vivid for wise selection, therefore consumers are often confused, and underrating the foods at disposals in schools, restaurants, homes, markets, canteens, etc, thus, consume them heedlessly (Collador-Soler et al., 2023). This lead to consumption of a lot of fats, salts, additives, pollutants, sugars, and calories. Sugars are ubiquitous in our environment and are becoming irresistible due palatability, and the instinctive tendency of humans for loving sweet taste, fats, and salt. This, has been capitalized by the food industries to divulge several EC foods into the normal human food system; hence, the rise in effects presently or in the near future (Nicklas & O'Neil, 2010; McGill, 2014; Collador-Soler et al., 2023).

Diet-linked diseases are forefront causes of disabilities and untimely deaths. Diseases such as heart disease, stroke, cancer, obesity, diabetes, hypertension, dyslipidemia, are all related to unhealthy diets consumption (Lucan et al., 2010; Fardet et al., 2021). Unhealthy eating pattern include excessive intake of diets high in solid fats, added sugars, and sodium laden foods; albeit healthy eating include diets rich in fruits, whole grains, vegetables, and other natural foods (Arya & Mishra, 2013; UNICEF, 2021). The paper objective is an overviewed review of empty calories, effects, and relations.

Calories

Metabolism is a general term constituting the entire chemical reactions occurring in the body, through nutrients utilization, so as energy for chemical oxidation of nutrients is provided, and

new or replaced body substances are made. Catabolism deals with processes that breakdown large molecules into smaller ones to release energy (ATP) and heat; while anabolism tends to synthesize large molecules from smaller entities using ATP. Energy is the ability to perform work. However, energy is measured in Joules or Calories. A kilocalorie is the amount of heat needed to elevate temperature of 1 liter of water by 1 degree Celsius (1^{o}C), about 3 million kilocalories are made during daily metabolic dealings in human body. It is noteworthy that, the nutritional value of fuels (carbohydrates, fats, proteins) taken from diets are expressed in kilojoules per gram. 1 gram of carbohydrates yield 17 kilojoules (4kcal), 1 gram of protein fuel provides 17kilojoules (4kcal), 1 gram of fat fuel yield 38 kilojoules (9kcal). Our body needs to maintain an energy balance, so as the intake and exhaustion are equal; because an energy intake that supersede utilization leads to obesity (overnutrition); while an energy intake that is low yield undernutrition. An energy balance is determined by metabolic rate, the rate at which energy from fuels is released (Styrer, 1988).

Dietary Concerns in Youngsters

Healthy eating pattern is essential to health, especially in young people due to their rapid growth, and rapid body changes. All components of health in youngsters depend on proper nutrition (Collador-Soler et al., 2023). However, youngsters like their usual ideal of deviating from the status quo, are more prone to engage in unhealthy dietary intake. Some of the eating concerns in youngsters include:

- Skipping of meals (irregular meals): Due to seeking for independence, peer associations; youngsters tend to leave home, as well as home -made meals for outside eating or group eating, they mostly skip meals in the process.
- Empty calories excessive consumption- Because youngsters skip home -based foods, they can use empty calories as substitute or replacement. Other issues such as recreation, events, exercise, reading, parties, ceremonies, clubs, etc encourage youngsters to take excessive empty calories. The empty calories used as fast foods by youngsters are deficient in vital nutrients (such as fibre, calcium, riboflavin, iron, vitamin A) and excessive in fat, sugar, sodium, etc. This lead to overnutrition (overweight and obesity, and undernutrition (micronutrients deficiencies) (Sharma, 2015).
- Drug abuse is a pervasive thing among youngsters - Drugs such as alcohols are empty calories, and many youngsters mix other drugs with empty calories (such as soft drink

beverages) to make stronger mixture. This cause effects of empty calories to manifest among youngsters, therewith, drugs containing heavy metals such as Pb, Cr, Cr affect availability of vital essential metals such as Ca, Zn, Fe etc (Whiteland, 2023; Lane et al., 2024).

Empty Calories Defined

Calories are measures of energy. Human body require energy to make metabolic functions and physical activities. Children of 4-12 years need 1500 calories daily, youth of 13 years and above need about 2000 calories daily, while adults need 2000 calories every day. Empty calories are calories that essentially don't contain any nutritional benefits (such as vitamins, minerals or quasi) required for growth and functions of the body properly (Stenesh, 1998; Horowilzt et al., 2023). Empty calories (EC) are located in foods containing added sugar and added fats, exclusive sugars or fats or rich in salt (sodium) (Rezaei, 2017; Mageswari et al., 2021; UNICEF, 2021; Abdulrahman et al., 2022). The habit of empty calories is to increase calorie consumption, but provide insignificant or zero nutrients. Solid fats are types of fats that exist at solid state at room temperature, such as beef fat, butter, etc. Solid fats are either natural or artificial in nature. Added sugars are sugar substances such as in form of syrup incorporated (added) into foods during processing. Children of under 6 months are not allowed to take added sugars, 1-6 years old can have 3 spoons, 7-18 years old can take 6 spoons, and adults can take 9 spoons daily; albeit these are subject to corrections and update over the next coming years (Liebman, 2012; Johar, 2016; Kim et al., 2018).

Foods Containing Empty Calories

Every food that contains added sugar or added solid fat, that provide little or nothing in terms of nutritional value (such as micronutrients vitamins and minerals) is regarded as empty calories food. Examples of artificial foods that are regarded as empty calories are as follows (Tables 1 and 2 shows some empty calories foods and quantities of sugars added) (Jia et al., 2022; British Nutrition Foundation, 2023):

- Cakes, donuts, pastries, cookies (contain solid fats)
- Cheese (contains solid fats)
- Ice cream (contains solid fat added and added sugar)
- Pizza (have solid fat)
- Sodas, sport drinks, energy drinks (have added sugars)

- Sausages
- Bacon
- Ribs
- Gums
- White rice
- Mustard
- Mayonnaise
- Alcoholic beverages
- Fast foods
- Chocolate bars
- Candies
- Macaroni
- Sphagetti
- Refined cereals
- White pasta
- Flavored drinks
- Biscuits
- Refined cereals (Zehra et al., 2018; Awuchi et al., 2020; Lalnunthara & Kumar, 2020; Sheena, 2020; Shamsol & Fisol, 2023).

Table 1: Some sugars amounts in processed foods

N	Food	Amounts of calories present
1	1 can of sport drink	122 calories of sugars added
2	1 can of soda drink	126 calories added sugars
3	1 chocolate piece	196 calories of sugars
4	1 flavored yoghurt	48 calories of added sugars

Source: British Nutrition Foundation, (2023)

Table 2: Sugars in form of spoons present in some empty calories

N	Empty calories food	Amounts of added sugars
1	Coke	9 teaspoons
2	Energy drink	5 teaspoons
3	Sport drink	8 teaspoons

4	Starbucks white chocolate mocha	18 teaspoons
5	Flavored yoghurt	5 teaspoons
6	Chocolate cake	12 teaspoons
7	Flavored cereal	4 teaspoons

Source: British Nutrition Foundation, (2023)

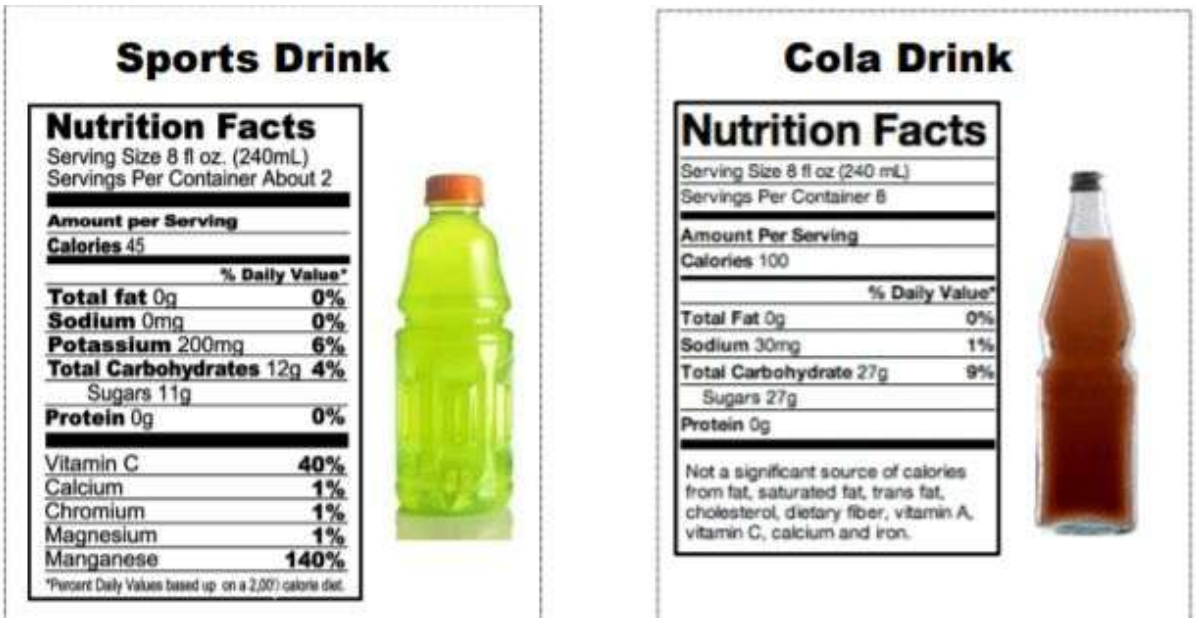

Figure 1: Typical Compositions of empty calories; Source: Yale-Griffin Prevention Research Center, (2015)

Food groups and Nutrients in Foods

Food is an entity being it solid or liquid that is taken for nutritional benefits of energy production, growth, reproduction, repair, and metabolic regulation. Foods contain varied valuable nutrients, some nutrients are more concentrated in certain food groups, that is why foods are grouped to aid food choice and interventions against malnutrition (Stenesh, 1998). Some major food groups in the tropics are classified as follows:

1. Milk group -This group belongs to the dairy products such as milk, cheese
2. Meat group -This group belongs to meat such as in eggs, meat, crabs, sea food, seeds, nuts, etc. The group members here vary, but yield energy, proteins, vitamins and minerals
3. Cereal group -This group is dedicated for maize, rice, guinea corn, oats, barley, etc. The group provide carbohydrates, vitamins (B complex), Fe, Mg, protein. They are mostly staple foods.

4. Starchy fruit/tuber group -Examples of this group are yams, potato, cocoyam, plantain, sweet potato. They are providers of energy carbohydrate, vitamins and nutrients, as well as phytochemicals.
5. Fruit/vegetable group - This group include tomatoes, pumpkins, leaves (cabbage and spinach), flowers such as sunflower, roots (carrots). They contain water, vitamins and certain minerals.
6. Empty calorie food- This include alcoholic, beverages, carbonated drinks (Rajweer & Monika, 2012; Das, 2015; Kaur, 2017; Meena et al., 2023).

Nutrients in Foods

Food nutrients include carbohydrates, fats, oils, proteins, vitamins, water, and minerals. Carbohydrates are great food nutrients serving as source of energy or calories. 45 percent to 65 percent of calories for humans should be delivered by carbohydrates. Carbohydrates are simple and complex types. Simple carbohydrates include sucrose (from cane sugar, corn); lactose (from milk) that yield glucose and galactose; fructose (from fruits); and glucose (mainly from fruits, honey, vegetables, cereals) (Sheena, 2020; Nagothi, 2021). Some labels that show high sugar include, brown sugar, corn syrup, agave, sucrose syrup, fructose, honey, molasses, raw sugar, sorbitol, maltose, invert sugar, dextrose, dextrin. However, complex sugars include, starches (from potatoes, it is a glucose joined together); fiber is indigestible roughage by human (is found in grains, wheat bran, vegetables, nuts) (Zehra et al., 2018; UNICEF, 2021).

Proteins helps maintained and build tissues, proteins are useful in regulation of body processes, (for example as hormones and enzymes, messengers, neurotransmitters), and proteins serve the body as energy source when carbohydrates and fats are scarce. Proteins contain amino acids that serve in diverse array of functions (such as carbon skeleton source, and ad neurotransmitters). Proteins can be found in foods including, eggs, meat, dairy products (Nagothi, 2021; UNICEF, 2021).

Fats are foods nutrients for various purposes such as aroma, texture, flavor, and they are present in cheese, ice cream. While in the human body fats provide energy (about every gram of fat contains 9 calories of energy). It is suggested that 20 percent to 35 percent human calories should be provided by fats. Fat is required to absorb, store, and circulate vitamins E, A, K, D in the human body; and essential fatty acids are obtained from fats. Fats are useful in cushioning internal body parts such as liver, and help in maintaining body temperature. A major fat of concern is called cholesterol (all needed cholesterol is made internally by the liver, there is no much need for importation). Cholesterol is obtained from animal fats or sources. A cholesterol

is covered with protein called lipoprotein to form low density lipoprotein (LDL) and high density lipoprotein (HDL). LDL stimulates build-up of clogged arteries, while the HDL take up cholesterol from tissues to avoid clog-up of arteries (Arya & Mishra, 2013; Al-Ibrahim & Jackson, 2019).

Vitamins are nutrients used to carry out metabolic needs, but they are micronutrients. Vitamins are two types, namely, fat-soluble vitamins (such as A, K, E, D) and water-soluble vitamins (vitamin B complex) (Shamsol & Fisol, 2023). Vitamins are organic chemical compounds found in natural foodstuffs to aid growth and physiological processes. Vitamins function by assisting enzymes to carry out metabolism (of foods). Humans have to import vitamins from the foods, because only few vitamins are obtained from microbes present in the gut. Deficiency of vitamins occur due to failure to consume or utilized vitamins at the right amount, a situation that leads to negative consequences. Deficiency occur due to failure in absorption (prolonged vomiting, prolonged diarrhea), insufficiency of bile salts (preventing absorption of fat soluble vitamins), consumption of empty calories, liver disease, diseased gut, drugs interference (antagonism), and insufficiency of substrate (such as amino acids in the case of some vitamins) (Mayo Clinic News Network, 2018). Fat-soluble vitamins are shown in Tables 3; while water-soluble vitamins are in Table 4.

Table 3: Fat-soluble vitamins needed by man

Vitamin	Possible dietary sources	Function	Deficiency of vitamin causes
Vitamin A	Fish liver oil, plants having carotenoids such as green leafy ones	Concerned with bone, teeth (growth), vision, lactation, reproduction	Dry and rough skin, night blindness
Vitamin D	Liver oil	Concern with normal growth, absorption of phosphorus and calcium, use of phosphorus and calcium for bone development	Rickets

Vitamin E	Egg yolk, palm oil, corn oil, nuts, green leaves		
Vitamin K	Spinach, cabbage, cauliflower	Needed by the liver in the synthesis of prothrombin	Low concentration of prothrombin in the blood, tendency of hemorrhage

Source: Styrer (1988)

Table 4: Water-soluble vitamins functions and effects of deficiencies

Vitamin	Vitamin Source	Function	Deficiency of Vitamin Causes
Thiamine	Whole grain cereals, beans, peas, nuts, egg yolk	Carbohydrates metabolism because it gives pyrophosphate (a cocarboxylase that act as coenzyme of decarboxylase enzyme)	Beriberi characterized with anorexia, weight loss, edema, debility, peripheral neuritis, enlarged heart, high levels of pyruvic acid, and lactic acid
Riboflavin	Same as Thiamine	Act as prosthetic group for many enzymes because it accept H atoms, required for metabolisms of all foods	Glossitis, Seborrheic dermatitis, cheilosis

Niacin	Fish, yeast, poultry, legumes, potatoes, peanuts	Necessary for release of energy from foods	Pellagra (fatigue, backbone, anorexia, headache, sore throat, anemia, dermatitis, diarrhea, delusions, confusion, dementia)
Pantothenic acid	Widely distributed	Components of coenzyme A, synthesis of phospholipids, cholesterol, steroids hormones, pyruvic acid oxidation, and synthesis of fatty acids	No deficiency in humans
Pyridoxine	Plant products, animal products	Serve as prosthetic group of transaminases, transulfarases, decarboxylases	No deficiency in humans
Biotin	Liver, pancreas, kidney, egg yolk, intestinal bacteria	Pyruvate metabolism, certain amino acids	No deficiency in humans

		deamination, fixation of CO2	
Vitamin B12	Liver, milk, kidney, eggs, cheese	Extrinsic factor in maturation of red cells. It contains cobalt and involved in nucleic acid synthesis, purine metabolism	Pernicious anemia
Folic acid, including glutamic and tyrosine, pteridine, para-aminobenzoic acid	Lean beef, yeast, green leafy vegetables, kidney, intestinal bacteria, liver	It is transformed to active form by ascorbic acid. The folic acid group act in the synthesis of nucleoproteins, purines, and pyrimidines. Red cells maturation requires folic acid.	Anemia
Choline	Egg yolk is famous source	Normal nutrition (lipotropic action), synthesis of phospholipids	Anorexia, lack of growth, emaciation, fatty livers, and dehydration
Inositol	Synthesized in the intestinal tract	Lipoproteins agent, prevent fatty liver	Fatty liver
Vitamin C	Green vegetables, kale,	Absorption of iron facilitation,	Susceptibility to infection

	potatoes, berries, pineapple, spinach, citrus fruits	controls production of collagen, essential in making dentine, bone, and cartilage, concerts folic acid to active form	increased, growth retardation, scurvy, poor wound repair

Source: Styrer (1988)

Factors Causing Excessive Empty Cal**ories Intake**

Empty calories are accessible, available, cheap, and looking very attractive in the environment; therefore, some of the factors responsible for rise in empty calories intake are as follows;

- Lack of appropriate laws- Even in European countries, there are no mandatory laws forcing companies to clearly identify added calories (sugars) and other harmful substances in foods. This give manufacturer chance to use languages that are not properly understood by consumers or are ploys to woo consumers into empty calories consumption.
- Human innate nature and flavor learning - Humans from childhood are known to prefer sweet, salty, and related food tastes than others such as water or bitter substances. Therefore, that sweet or flavored nature empty calories serve as rewards that incite the brain of consumers to demand for more processed foods. Humans naturally likes flavored than unflavored foods.
- Insatiety - Due to the substances of the empty calories, humans usually feel unsatisfied upon consuming these foods; therefore, they tend to take more. Empty Calories usually have high glycemic index, an ability to raise the blood glucose level instantly and extinct at short time, a behavior that instigate insatiety.
- Urbanization -Due to urbanization, cities are growing many people are devising ways to prepare foods with artificial ingredients; companies are becoming rampant with a view to provide processed foods for the teeming urban population. There are changes

in lifestyle, and a lot of modernization changes that make empty calories accessible, available, and cheap sometimes compared to the natural foods.

- Poverty- Due to poverty many people could not afford good foods, therefore on many occasions rely on cheap fast foods even if they are aware of the consequences of empty calories. People are on many occasions unable to buy costly natural foods; thus compelled to buy low-quality unhealthy foods prepared through processing methods.
- Poor awareness- Due to poor nutritional literacy (awareness) owing to lack of education, health talks, poor labelling of foods; many people are dragged into empty calories. Instead of using vivid words like sugars, producers use things like dextrose, molasses, honey, syrup, nectar, cane sugar etc in order to woo customers.
- Cheap nature and accessibility - Empty calories are cheap and available every in many places such as schools, markets, transports, homes, shuttles, recreations, events, ceremonies, etc; this encourage consumption significantly.
- Poor social amenities - In developing countries foods are produced mostly from rural areas that have no enough ways to preserve foods using natural methods, using electricity; and are unable to provide food for the whole populations. Therefore, most foods (vegetables, fruits) are scarce, costly; thereby chasing away people towards empty calories. Likewise, in a move to provide foods needed and desired excessive processing methods are used to provide foods for the populace (Mayo Clinic News Network, 2018; Khalid et al., 2020; Lane et al., 2024).

Added Solid Fats

Solid fats exist as solid entities at room temperature, such as margarine, butter, lard, and shortening. They are highly rich in saturated fats (raising LDL, bad cholesterol) levels and therefore increasing the risk of cardiovascular diseases. Food containing added solid fats include, ribs, bacon, hot dogs, cheese, sausages, butter, pizza, desserts, and margarine (Molnar & Garcia, 2005; Paglia, 2019; Jia et al., 2022; Horowilz et al., 2023). Some types of fats are as follows:

- Trans fats- They are made through adding hydrogen to oil, and should be avoided. The process of hydrogenation aid in making food to stay longer. However, it is a source of LDL (bad) cholesterol. For instance, in snack, margarine, baked foods, fried foods, these fats are found (Sharma, 2015).

Empty Calories in Processed Foods

- Saturated fats- They are fats existing as solid in room temperature. They are source of LDL (bad) cholesterol, therefore harmful to health. They can be seen in ribs, cheese, processed milk, processed meat, etc.
- Unsaturated fats- Unsaturated fats are either mono or poly compounds, but importantly oils at room temperature. These can be found in fishes, walnuts, soy beans, vegetable oils, plants; and are good for consumption (Nicklas & O'Neil, 2015).

Noteworthy, frequent intake of empty calories is linked with heart disease, hypertension, cancer, stroke (due to high cholesterol, high sodium for instance) (British Nutrition Foundation, 2023).

Foods Containing Nutrients/Nutrients-Densed

Nutrients-densed food are the types of foods that supply the body with needed nutrients such as vitamins, antioxidants, minerals, and phytochemicals for instance (Kim et al., 2018). Some of the nutritious food materials are enumerated as follows:

- Brown rice
- Oats
- Brown bread
- Vegetables
- Nuts
- Fishes
- Potatoes
- Yams
- Soybeans
- Skim milk
- Fruits (Stenesh, 1998; Mixon & Davis, 2020; Fardet et al., 2021).

Sugar types, and effects of consumption

Sugar is natural (intrinsic) or free substance characterized with sweet taste. Natural sugar is healthy one obtained by eating natural products such as fruits, while free or added sugar is deliberately incorporated in foods. Mostly, the empty calories contain high added sugar content, therewith, are components that have high glycemic index; that in turn strongly affect hormones by increasing hunger (or reducing hunger for a short time in contrast with normal natural foods), and consequently reducing satiety (The Reagents of the University of Michigan, 2012;

Shridhar et al., 2015; Vidya et al., 2015; Krazl & Maillow, 2022). Therefore, consumers of these foods take much of the empty calories before becoming satiated. Likewise, consumers become hungry easily, thus want more and frequently. This cause weight gain (accumulation) and obesity, as well as heart disease. Moreover, carbohydrates (sugars) entities are released from empty calories easily and rapidly enters the blood, elevating blood glucose level, as well elevating insulin level, which can lead to insulin resistance or type two diabetes (Jia et al., 2022; Nuanchankong et al., 2024). Refined sugar is easily digested and absorbed, therefore easily exhausted leading to symptoms such as lack of energy, tiredness, poor sleep, hunger, and craving (Jia et al., 2022). Free sugar consumption was shown by studies as a factors linked with consequences such as the ones enumerated below:

- Overweight and obesity - Consumption of free sugar was shown to be a factor linked with overweight and obesity (Reedy & Krebs-Smith, 2010).
- Empty calories or free sugar intake put many people to the risk of cardiovascular diseases, and diabetes- High free sugar intake elicit cardiovascular problems and type two diabetes (Reedy & Krebs-Smith, 2010).
- Gastrointestinal Problems - Excessive sugar intake can elicit bloating, flatulence, growth faltering, abdominal pain, and chronic diarrhea
- Behavior modification - High intake of free sugar cause behavior modifications (Johar, 2016). The empty calories elicit the body to release dopamine, the happy hormone, in turn making consumers happier during intake, thereby instigating reward and addiction (Johar, 2016).
- Insatiety -Free sugar intake cause insatiety, as well as addiction (Johar, 2016)
- Dental caries- High free sugar intake causes dental caries
- Nutrients deficiencies - Excess sugar consumption lead to deficiency of Fe, Ca, and vitamin A, because too much empty calories consumption deprived consumers from micronutrients needed by the body (Brunk, 2008; Lucan et al., 2010; McGill, 2014; Das, 2015; Sharlin, 2019; Meena et al., 2023).

Empty Calories Contain Harmful Additives

It is not a news, it is certain that, empty calories foods have undergone series of processes before being released to the public consumption. However, processing of these empty calories foods require addition of certain chemicals for preservation. In turn, these preservatives consumption is not well -guarded or well monitored; there ith, chemical preservatives can elicit

human health effects (Sharma, 2015; Thakur et al., 2022; Shankar et al., 2024). Some of the preservatives or additives are as follows:

- Color enhancers- Found in cheese, snack, margarine, candies. Examples of color enhancers are: Safron, oleoresin, anatto extract etc.
- Fa replacers- Fat replacers are found in frozen dessert, cake, dairy products. Examples of fat replaces are: guar gum, xanthan gum, modified starch, cellulose gel, etc.
- Flavor enhancers- Flavor enhancers are found in such as spices, candies, ice cream, soft drinks, etc. Examples of flavor enhancers include Monosodium Glutamate (MSG), inosinate.
- Sweeteners- Examples of food with added sweeteners include, beverages, baked products, confections, many processed foods; while examples of sweeteners include, sucrose, mannitol, corn syrup, aspartame, saccharin, neotame, sorbitol, sucralose, glucose, etc.
- Preservatives - Preservatives can be certainly found in snacks, baked foods, beverages, margarine, juices; while examples of preservatives include, sodium nitrite, ascorbic acid, EDTA, potassium sorbate, sodium benzoate, etc.
- Stabilizers - Some of them are found in snacks, cake, desserts, dairy products. Examples of stabilizers are: gelatin, pectin, xanthan gum.
- Yeast- Yeast is used in bread, baked foods.
- Leavening agents - For instance, leavening agents are present in bread, baked products. Examples of leavening agents include, soda, and calcium carbonate.
- Emulsifiers - Chocolate, desserts, margarine, are foods containing emulsifiers such as soy lecithin, sorbitan monostearate.
- Anticaking agents - Confectioners and baked foods contain anticaking agents such as calcium silicate, citrate, silicon dioxide (Mirza et al., 2017; Udah, 2021; Thakur et al., 2022; Shankar et al., 2024).

Nevertheless, effects of some food preservatives are as follows:

- Saccharin is carcinogenic, and elicit obesity, hypertension, renal and liver problems (Thakur et al., 2022).
- Sulfites are fatal
- MSG causes headache, nausea, palpitations
- Aspartame causes depression, headache, rashes, dizziness (Awuchi et al., 2020).
- Sorbates cause contact dermatitis, urticaria

- Benzoates elicit allergies, palpitations, headache,
- Nitrates and nitriles cause stomach cancer (Sharma, 2015)
- Sucralose causes cough, anxiety, depression, anger, itchy eyes, chest pain
- Annatto causes irritable bowel syndrome, stomach pain, and swelling
- Acesulfame K leads to nausea, kidney effects, cancer, depression (Mirza et al., 2017; Udah, 2021; Gupta & Yadav, 2021; Thakur et al., 2022; Shankar et al., 2024).

Most of the Empty Calories Are Susceptible to Contamination with Harmful Plastic Additives

Most of the empty calories foods are in direct contact with plastic containers for one reason or the other most especially because plastics are ubiquitous in our life. Plastics are polymers made through assembly of monomers to give products with moldable abilities. There are types of plastics that are in contact with foods as enumerated below:

- Polyethylene terepthalene polymers are found as containers in soft drinks, biscuits trays, salad domes, etc
- High density polyethylene (HDPE) polymers are used in containers of ice creams, milk bottles, and shopping bags.
- Polyvinyl chloride (PVC) resins are found in many bottles
- Low density polyethylene (LDPE) resins are found in garbage bags
- Polypropylene resin is found in items such as kettles, bottles, potato chips, lunch boxes, and straws.
- Polystyrene (PS) resins are present in cutlery, food insulations.
- Other plastics resins are diversely used to store empty calories foods in our daily life (Umar et al., 2022; Sarkingobir et al., 2023).

Nevertheless, plastics acting as containers or wrappers of empty calories (processed) foods posed threat to public health, because the plastics allow migration of their harmful additives or chemicals into foods due to pressure (heat, mechanical, etc). Plastics contain chemicals such as additives, monomers, and pollutants (heavy metals) that when ingested cause health problems in humans or animals. Plastics can detach endocrine disruptors such as DDT, PCBs, nonyphenols, micro plastics, and other dangerous substances that cause oxidative stress, inflammation, damage to vital organs etc when released into human body by action of heat or any appropriate pressure (Valdivia et al., 2021; Lane at al., 2023; Sarkingobir et al., 2023; Oeji-Olorumtoba et al., 2024; Abdel Ghani et al., 2024).

Conclusion

In conclusion, it is known that, empty calories are processed foods containing zero or minute nutrients and are laden with energy, sugar, fat, and sodium (or some related combinations that are harmful to health). Empty calories are numerous and ubiquitous, while causing diseases or morbidities such as obesity, diabetes, hypertension, etc. They are mostly having potential to elicit addiction. Certainly, curbing the menace of excessive consumption of empty calories is multitasking and diverse. All efforts should be on desk to curb the prevalence of empty calories consumption. There are healthy tips that should be adopted for prevention of empty calories excessive intake in the society so as to safeguard public health. Some of the suggestions are mentioned as follows: Individuals should substitute their diets against the empty calories with natural foods that are available in the environment. The behavior or habit the empty calories consumption should be reduced by all and sundry to the barest minimum. It should be the duty of government to provide subsidy to food systems so that healthy foods are available and accessible at low cost to all environments (such as homes, schools, etc). Likewise, governments should provide locally -based natural and ideal ways of foods preservations, transportation, and trading (such as roads, electricity, etc). In addition, government should make laws that are strictly implemented to guide empty calories selling and buying in communities and societies. The turn of health workers and scholars is to make research, advocacy, health education, and awareness creation with a view to significantly reduce intake of empty calories to prevent many adverse effects in human populations. Parents should properly watch out and screen intake of empty calories at home and even schools. Parents can make sure that home-based foods are properly and timely cooked at home and be surely consumed not skipped. By providing enough money or homemade foods to students at school a lot of adversities could be greatly prevented.

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