

Review Article

Effects of Fast Foods in Relation to Free Radicals and Antioxidants

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Abstract: Fast foods is a part of the new life. One third of adults the United Saudi Kingdom (U.S) eat fast foods. About 7% of American report eating fast food every day, certain groups are more likely to be more frequent users. Youth are the biggest consumers; adolescents and young adults get 20% and 31.5% of their total daily calories from fast food, respectively. When fast foods frequently replace nutritious foods in diet, it can lead to poor nutrition and poor health in digestive and cardiovascular systems, respiratory system, and central nervous system. The effects of fast food on the body are related to the formation of excess free radicals. These free radicals are a kind of cellular "exhaust" a by-product of metabolism. Free radicals are produced as cells use oxygen to convert the food into energy. The body is designed to deal with these free radicals. It has highly efficient ways of grabbing and neutralizing these renegade particles before they can do harm. The free radicals that occur naturally within the body didn't cause damage, but the excess of the free radicals is the cause of life-shortening damage. This extra load results from two key factors: an overabundance of toxins and a shortage of antioxidants. Antioxidants is the key to prevent the damage of free radicals by neutralizing their effect to prevent them from harming the body. The purpose of this review is to highlight the three main areas of research, which are interlinked. Study involving fast foods, free radicals and antioxidants. So, the objective of this study was to study the harmful effects of fast foods which related to the formation of excess amount of free radicals and provide a better insight into the mechanisms of antioxidants in prevention the damage of free radicals on the body.

Keywords: Fast Foods, Free Radicals, Antioxidants, Healthy Foods

1. Introduction

Fast foods is a part of the new life. One third of adults the United Saudi Kingdom (U.S) eat fast foods. About 7% of American report eating fast food every day, certain groups are more likely to be more frequent users. Youth are the biggest consumers; adolescents and young adults get 20% and 31.5% of their total daily calories from fast food, respectively. Fast foods can't be adequately described by its nutrients alone since combinations of nutrients and methods of packaging and presentation may make fast foods even more attractive [26]. Fast food is high in calories, sugar, fat, and sodium. In addition, it is highly processed, palatable, and energy dense. The majority of the fiber and a portion of the vitamins and minerals

present in original food are extracted in processing. Sugar, salt, and other additives are used to boost flavor. The end product is packaged and sold conveniently to deliver the contents, along with a drink that provides high levels of sugar and caffeine.

The problem of fast foods and excess free radicals which result from excessive eating of fast foods is how to fight free radicals so that they are rendered harmless.

Nature has an answer to the problem of fast foods and free radicals; in foods that are rich in antioxidants. So it makes sense to eat healthy foods which rich in antioxidants and avoid junk foods. There are a number of ways to counteract free radicals beginning with diet and perhaps utilizing supplements. Two of the most powerful antioxidants are vitamins E and C. Some minerals such as selenium, manganese, copper and zinc

are also potent antioxidants so the key is to find foods richest in those vitamins and minerals to add to diet. However, beta carotene and catechins are antioxidants as well. Unfortunately, diets are comprised of highly processed foods that have lost most of those nutrients. So, addition of fresh, whole foods daily is important to increase supply of antioxidants. [26]

2. Definition

Fast foods are characterized as quick, easily accessible and cheap alternatives to home-cooked meals, according to the National Institutes of Health (NIH). They also tend to be high in saturated fat, sugar, salt and calories. Fast foods are often described in nutritional terms as “high fat”, “high sugar”, “highly palatable” or as a “refined foods”. Processed foods are proposed to be addictive substances and bingeing is an addictive behavior. Their definition of refined foods include sweeteners, sugar-sweetened beverages, frozen potatoes and cereal [26]. Nutritional components of fast foods that may be addictive may include: 1) Sugar: There is some evidence that sugar may be addictive in humans. Ifland *et al.* provide anecdotal reports from self-identified food addicts who describe withdrawal as feeling “irritable”, “shaky”, “anxious” and “depressed”. Experimental studies show that subjects will use sugar to treat psychological symptoms. [26].; 2) Fat: The high fat content of fast food is vital to its rewarding properties. Fat intake has traditionally been assumed to be the major determinant of weight gain. *Animal studies* suggesting that it is the fat *content* and not the type of fat present in fast foods that encourages overeating. [27]. *Human studies* have identified a “high-fat phenotype” among human subjects, characterized by a preference for high fat foods and weak satiety in response to them, which may act as a risk factor for obesity. [30]; 3) Caffeine: Soda is an integral part of the fast food meal. If the soda accompanying the sample meal. Soft drink manufacturers identify caffeine as a flavoring agent in their beverages, but only 8% of frequent soda drinkers can detect the difference in a blinded comparison of a caffeine-containing and caffeine free cola. Thus, the most likely function of the caffeine in soda is to increase the salience of an already highly rewarding (high sugar) beverage. *Future directions*: While adolescents and children get their caffeine from soft drinks and chocolate, adults get most of their caffeine from coffee and tea. [32]; 4) Salt: Animal studies support the potentially addictive properties of salt are currently confined to animal models. Studies in rats show mesolimbic dopamine signaling, salt craving, in response to salt withdrawal interpreted as a potential sign of opiate withdrawal. Like sugar, these models rely on salt restriction to get an effect. [33-34-35].

3. Effects of Fast Foods on Human Health

Food is fuel for the body and has a direct impact on overall health. Fast foods refer to foods that can be served quickly. In many cases, that means foods that are highly processed and contains large amounts of carbohydrates, added sugar,

unhealthy fats, and salt (sodium). These foods generally contain a high number of calories but offer little or no nutritional value.

Studies showed that children and adolescents take in more calories in fast food and other restaurants than at home. Eating out added between 160 and 310 extra calories a day. According to the National Institutes of Health, some fast food meals give a whole day's worth of calories. When fast foods frequently replaces nutritious foods in diet, it can lead to poor nutrition and poor health. [3].

3.1. Digestive System

Many fast foods and drinks are loaded with Carbohydrates and, consequently, a lot of calories. Digestive system breaks carbohydrates down into sugar (glucose), which it then releases into bloodstream. Pancreas responds by releasing insulin, which is needed to transport sugar to cells throughout the body. As the sugar is absorbed, blood sugar levels drop. When blood sugar gets low, pancreas releases another hormone called glucagon. Glucagon stimulates the liver to use the stored sugars. When everything is working in sync, blood sugar levels stay within a normal range. Taking of carbohydrates in high amounts, it causes a spike in blood sugar. That can alter the normal insulin response. Frequent spikes in blood sugar may be a contributing factor in insulin resistance and type 2 diabetes. [3].

3.2. Cardiovascular System

According to the American Heart Association, most Americans take in twice as many sugars as is recommended for optimal health. All those extra calories add up to extra weight, a contributing factor in heart disease. Trans fats, often found in fast food, are known to raise LDL cholesterol levels. That's the undesirable kind of cholesterol. It can also lower HDL cholesterol. That's the good cholesterol. Trans fats may also increase risk of developing type 2 diabetes. According to the American Heart Association, children who have a high-sodium diet are at twice the risk for developing high blood pressure than children on a low-sodium diet. Excess sodium may also increase risk for kidney stones, kidney disease, and stomach cancer. High cholesterol and high blood pressure are among the top risk factors for heart disease and stroke. [4]

3.3. Respiratory System

A recent study showed that children who eat fast foods at least three times a week are at increased risk of asthma and rhinitis (congested, drippy nose). [3]

3.4. Central Nervous System

A recent study showed that eating fast foods may be linked to depression. People who eat fast food are 51 percent more likely to develop depression than those who eat little to no fast foods. [3]

3.5. Skin and Bones

According to the Mayo Clinic, fast foods that are high in

carbohydrates increase blood sugar levels and they may also trigger acne. Also, other study showed a higher risk of eczema (inflamed, irritated patches of skin) among children with a diet high in fast foods. When foods high in carbohydrates and sugar consumed, bacteria residing in mouth produce acids. Those acids destroy tooth enamel, a contributing factor in dental cavities. When the enamel of tooth is lost, it can't be replaced. Poor oral health has also been linked to other health problems. Excess sodium in fast foods also increase risk of developing osteoporosis (thin, fragile bones). [6]

Generally the harmful effects of fast food on the body are related to the formation of excess free radicals.

4. The Chemistry of Free Radicals

The human body is composed of many different types of cells. Cells are composed of many different types of molecules. Molecules consist of one or more atoms of one or more elements joined by chemical bonds. Atoms consist of a nucleus, neutrons, protons and electrons. The number of protons (positively charged particles) in the nucleus of atom determines the number of electrons (negatively charged particles) surrounding the atom. Electrons are involved in chemical reactions and are the substance that bonds atoms together to form molecules. Electrons surround, or "orbit" an atom in one or more shells. The inner most shell is full when it has two electrons. When the first shell is full, electrons begin to fill the second shell. When the second shell has eight electrons, it is full, and so on. The most important structural feature of an atom for determining its chemical behavior is the number of electrons in its outer shell. A substance that has a full outer shell tends not to enter in chemical reactions (an inert substance). Because atoms seek to reach a state of maximum stability, an atom will try to fill its outer shell by: Gaining or losing electrons to either fill or empty its outer shell OR Sharing its electrons by bonding together with other atoms in order to complete its outer shell. Atoms often complete their outer shells by sharing electrons with other atoms. By sharing electrons, the atoms are bound together and satisfy the conditions of maximum stability for the molecule. [5-42].

5. Free Radicals Formation

Normally, bonds don't split in a way that leaves a molecule with an odd, unpaired electron. But when weak bonds split, free radicals are formed. Free radicals are very unstable and react quickly with other compounds, trying to capture the needed electron to gain stability. Generally, free radicals attack the nearest stable molecule, "stealing" its electron. When the "attacked" molecule loses its electron, it becomes a free radical itself, beginning a chain reaction. Once the process is started, it can cascade, finally resulting in the disruption of a living cell. Some free radicals arise normally during metabolism. Sometimes cells of immune systems purposefully create them to neutralize viruses and bacteria. However, environmental factors such as pollution, radiation,

cigarette smoke and herbicides can also spawn free radicals. Normally, the body can handle free radicals, but if antioxidants are unavailable, or if the free-radical production becomes excessive, damage can occur. Of particular importance is that free radical damage accumulates with age. [5]

6. Effect of Free Radicals on the Cells

In their reckless quest for electrons, free radicals do a lot of structural damage to healthy cells. Injured cells can't function properly and may even die. Most vulnerable to free radical attack is the cell membrane, which surrounds each cell and guards its jellylike interior. The cell membrane is a sophisticated, highly selective barrier whose all-important job is to guard access to the cell. It decides what gets in, what stays in, and what is expelled. Inside each cell are many subcellular structures called organelles. Each organelle is wrapped in its own protective outer membrane and performs a highly specialized function. Mitochondria, for example, transform oxygen and food into energy, which the cell uses to carry out its tasks. Lysosomes scarf up and digest cellular garbage, which is then either recycled or jettisoned. The cell's nucleus is also an organelle. It houses DNA, the cell's genetic blueprint. When a cell membrane or an organelle membrane is damaged by free radicals, it loses its protective properties. This puts the health of the entire cell at risk. The cell membrane is a pushover for free radical attack because it is composed primarily of easily oxidized fatty acids. Highly charged free radical particles rip into the cell membrane, literally puncturing holes in it. A damaged cell membrane loses its selectivity. When this happens, transportation of nutrients, oxygen, and water into the cell and removal of waste products from the cell become compromised. In much the same way, free radical damage to an organelle's membrane sabotages the organelle's function. When mitochondria are injured, it can't produce the energy necessary to drive the cell's machinery. If damage to the mitochondrial membrane is extensive, the cell dies. Free radicals can even bang their way through the protective membrane surrounding the nucleus, gaining access to the DNA molecules housed inside. [42]

7. Diseases Caused by Free Radicals

If free radicals happen to break the DNA molecules in order to snatch electrons, the cell dies, or loses its ability to replicate, or replicates abnormally, a process known as mutation, where it can give rise to the collections of abnormal cells that known as cancer. But cancer isn't the only health problem for which free radicals are responsible. Cumulative free radical damage contributes to all sorts of organ- and tissue-specific diseases, including allergies, Alzheimer's disease, arthritis, atherosclerosis, cataracts, infections, macular degeneration, multiple sclerosis, and Parkinson's disease. In fact, researchers now agree that all chronic degenerative diseases, are caused by free radical damage. [36-40-41]

7.1. Immune Cells

Of all the body cells, immune cells are the most likely victims of free radical attack. Immune cells scavenge free radicals. If injured, immune cells are less able to do their job. In the short run, their impairment usually doesn't produce symptoms. Over time, persistent fatigue, recurrent infections, and allergies may be among the first signs of immune erosion. If free radicals continue their attack on immune cells, and if the cells never get a chance to heal, the accumulated damage weakens the immune system even more. Eventually, this opens a potential Pandora's box of disorders caused by altered immune function. Free radical damage to an immune cell's protective outer membrane or DNA can be especially ominous (dangerous). Once damaged, an immune cell loses its ability to differentiate between good guys and bad guys. One of two scenarios, neither good, then unfolds. In the first, immune cells mistake friends for foes and begin attacking healthy tissues. This is known as an autoimmune disease, examples of which include lupus, multiple sclerosis, and rheumatoid arthritis. In the second scenario, immune cells mistake foes for friends. For example, they may fail to recognize cancer cells and, rather than annihilating them, ignore them and allow them to multiply. [39]

7.2. Aging

Prolonged exposure to free radicals actually fast-forwards the aging process. One of the clearest manifestations of cumulative free radical damage is a phenomenon known as cross-linking. Cross-linking affects protein, enzyme, DNA, and RNA molecules. Because of cross-linking, the elastic, flexible tissue of youth gives way to the wrinkled skin, stiff joints, and hardened arteries of old age [4-10-37].

8. Causes of Overproduction of Free Radicals

The free radicals that occur naturally within the body should be no cause for concern. It's the excess free radicals, the ones that the body is not prepared to handle, that cause life-shortening damage. Overeating of fast foods increase the level of cholesterol. Cholesterol is harmful. It is not the cholesterol which causes the problem, but the oxidized cholesterol, the cholesterol which has been damaged by free radicals. also, high fat content of fast foods is bad that polyunsaturated fat has multiple double bonds which can become oxidized and cause an increased production of free radicals and increased incidence of colon cancer. [42-43]

8.1. Meat

In a non-vegetarian diet, there is increased overall mortality, an increased incidence of heart disease, diabetes, colon cancer, breast cancer, ovarian cancer and a higher fracture rate. A high fracture rate occurs because a high protein diet, a high meat diet, causes change in the pH, makes it slightly acidic and calcium leaches out of the bones. [38]

8.2. Mental Distress

When somebody is under anger, anxiety, tension, or stress, it creates chemicals (cortisone and catecholamines) which react with different organs and cells and ultimately create free radicals. After some time, disease starts occurring wherever the deficiency is in the body.

8.3. Alcohol&Smoking

Alcohol& smoking are major producer of free radicals. It damages the liver, causes cirrhosis, damages the heart, causes myocardiopathy and damages the brain. All these free radicals that damage the lung so that almost every smoker gets bronchitis and emphysema by time. [43]

8.4. Food Preservatives and Pesticides

Pesticides kill the pest by creating free radicals. Consuming of food Preservatives will cause accumulative damage due to free radicals production.

8.5. Environmental Pollution

All the exhaust fumes coming from cars cause a lot of pollution and it damages lungs and other systems. [43]

8.6. Sunlight

Exposure for all those who work on the farm and in the south creates all these problems of aging of the skin.

8.7. Chemotherapy and Radiation

Kill tumour cells by producing too many free radicals. Their effects are toxic because they also damage normal cells. [43]

The optimum longevity-promoting lifestyle, then, has two key components: First, it maximizes antioxidant intake from foods and supplements; and second, it minimizes factors that promote the formation of free radicals.

9. Antioxidants

An antioxidant is a molecule stable enough to donate an electron to a rampaging free radical and neutralize it, thus reducing its capacity to damage. These antioxidants delay or inhibit cellular damage mainly through their free radical scavenging property. Some of such antioxidants, including glutathione, ubiquinol, and uric acid, are produced during normal metabolism in the body. Other lighter antioxidants are found in the diet. Although there are several enzymes system within the body that scavenge free radicals, the principle micronutrient (vitamins) antioxidants are vitamin E (α -tocopherol), vitamin C (ascorbic acid), and B-carotene. The body cannot manufacture these micronutrients, so they must be supplied in the diet. [8-9-10].

9.1. Mechanism of Action of Antioxidants

Two principle mechanisms of action have been proposed for antioxidants. The first is a chain- breaking mechanism by

which the primary antioxidant donates an electron to the free radical present in the systems. The second mechanism involves removal of ROS/reactive nitrogen species initiators (secondary antioxidants) by quenching chain-initiating catalyst. Antioxidants may exert their effect on biological systems by different mechanisms including electron donation, metal ion chelation, co-antioxidants, or by gene expression regulation. [11-12].

The antioxidants acting in the defense systems act at different levels such as preventive, radical scavenging, repair and de novo, and the fourth line of defense, i.e., the adaptation.

The first line of defense is the preventive antioxidants, which suppress the formation of free radicals.

Glutathione peroxidase, glutathione-S-transferase, phospholipid hydroperoxide glutathione peroxidase (PHGPX), and peroxidase are known to decompose lipid hydroperoxides to corresponding alcohols. PHGPX is unique in that it can reduce hydroperoxides of phospholipids integrated into biomembranes. Glutathione peroxidase and catalase reduce hydrogen peroxide to water.

The second line of defense is the antioxidants that scavenge the active radicals to suppress chain initiation and/or break the chain propagation reactions. Various endogenous radical-scavenging antioxidants are known: some are hydrophilic and others are lipophilic. Vitamin C, uric acid, bilirubin, albumin, and thiols are hydrophilic, radical-scavenging antioxidants, while vitamin E and ubiquinol are lipophilic radical-scavenging antioxidants. Vitamin E is accepted as the most potent radical-scavenging lipophilic antioxidant.

The third line of defense is the repair and *de novo* antioxidants. The proteolytic enzymes, proteinases, proteases, and peptidases, present in the cytosol and in the mitochondria of mammalian cells, recognize, degrade, and remove oxidatively modified proteins and prevent the accumulation of oxidized proteins.

There is another important function called adaptation where the signal for the production and reactions of free radicals induces formation and transport of the appropriate antioxidant to the right site. [12-13].

9.2. Types of Antioxidants

Types of antioxidants include both of enzymatic antioxidants and non-enzymatic antioxidants. Enzymatic antioxidants include: 1) Superoxide dismutases: are a class of closely related enzymes that catalyze the breakdown of the superoxide anion into oxygen and hydrogen peroxide. Superoxide dismutases are present in almost all aerobic cells and in extracellular fluids. [14-15].; 2) Catalases: are common enzyme found in nearly all living organisms, which are exposed to oxygen, where it functions to catalyze the decomposition of hydrogen peroxide to water and oxygen. [16]., and 3) Glutathione systems: the glutathione system includes glutathione, glutathione reductase, glutathione peroxidases, and glutathione S-transferases. This system is found in animals, plants, and microorganisms. Glutathione peroxidase is an enzyme containing four selenium-cofactors

that catalyze the breakdown of hydrogen peroxide and organic hydroperoxides. These enzymes are at particularly high levels in the liver and also serve in detoxification metabolism. [16-17].

Non enzymatic antioxidants include: 1) Ascorbic acid: is a reducing agent and can reduce and thereby neutralize ROS such as hydrogen peroxide. In addition to its direct antioxidant effects, ascorbic acid is also a substrate for the antioxidant enzyme ascorbate peroxidase. [19-20]; 2) Glutathione: is a cysteine-containing peptide found in most forms of aerobic life. Glutathione has antioxidant properties since the thiol group in its cysteine moiety is a reducing agent and can be reversibly oxidized and reduced. Due to its high concentration and central role in maintaining the cell's redox state, glutathione is one of the most important cellular antioxidants. [10].; 3) Tocopherols and tocotrienols (Vitamin E): is the collective name for a set of eight related tocopherols and tocotrienols, which are fat-soluble vitamins with antioxidant properties.[22].;

4) Uric acid: accounts for roughly half the antioxidant ability of plasma. In fact, uric acid may have substituted for ascorbate in human evolution. However, like ascorbate, uric acid can also mediate the production of active oxygen species. [23].

9.3. Plants as Source of Antioxidants

There are several reports showing antioxidant potential of fruits. Strong antioxidant activities have been found in berries, cherries, citrus, prunes, and olives. Green and black teas have been extensively studied in the recent past for antioxidant properties since they contain up to 30% of the dry weight as phenolic compounds [24-25]. In addition to endogenous antioxidant defense systems, consumption of dietary and plant-derived antioxidants appears to be a suitable alternative. Getting enough antioxidants in diet, to neutralize free radicals can be quite a challenge. For example, blueberries are an amazing source of antioxidants. Dietary and other components of plants form a major source of antioxidants. Antioxidants are found in many fruits and vegetables. Some foods Inhibit the Free Radicals and have particularly high antioxidant properties. These foods would include:

- (a) Vitamin C – oranges, blackcurrants, kiwi fruit, mangoes, broccoli, spinach, capsicum and strawberries.
- (b) Vitamin E – vegetable oils (such as wheat germ oil), avocados, nuts, seeds and whole grains.
- (c) Selenium – seafood, offal, lean meat and whole grains.
- (d) Manganese – seafood, lean meat, milk and nuts.
- (e) Copper – seafood, lean meat, milk and nuts.
- (f) Zinc– seafood, lean meat, milk and nuts.
- (g) Beta-carotene – pumpkin, mangoes, apricots, carrots, spinach and parsley.
- (h) Catechins – red wine and tea.

9.4. Supplements as Source of Antioxidants

Most people choose to add fresh, whole foods to their diets

as a way of increasing free radical fighting antioxidants, but there are supplements that can be utilized as well. Taking supplement that offers a massive antioxidant content is regarded as an easy and less time consuming solution. Choosing the right supplement will help to protect the body against free radicals, and the irreversible damage they cause.

Before taking any supplements, contact primary health physician to ascertain what is safe to take based on medical history.

According to the NIH, many fast foods are still cooked with a large amount of oil and butter. many fast food chains have responded to growing public awareness about nutrition by offering some food that is lower in fat and calories than their normal fare. In general, fruits and vegetables must be included in fast food restaurants menus. The NIH says people with heart disease, high blood pressure and diabetes must use caution when eating fast food because it tends to be high in fat, sugar and sodium. According to the American Heart Association (AHA), fast food can be good for the heart with a little planning. Requesting fruits, vegetables, a wheat bun and holding the mayonnais and sauces can improve the nutritional value of a fast food meal. So, fast foods can be healthy if the consumers follow some guidelines such as:

- (a) Avoid supersized and value-sized items, and go for the smallest size.
- (b) Avoid fried and breaded items, such as crispy chicken sandwiches and breaded fish fillets. Choose turkey, chicken breast, lean ham, or lean roast beef instead.
- (c) Pay attention to the descriptions on the menu. Dishes labeled deep-fried, pan-fried, baked, batter-dipped, breaded, creamy, crispy, scalloped, or au gratin are usually high in calories, unhealthy fats, and sodium.
- (d) Many menu items can be made healthier with few substitutions. For example, requesting wheat bun or whole-grain bread for sandwich.
- (e) Reading the nutrition facts before order can make a huge difference.

Finally, the best way to ensure adequate intake of the antioxidant nutrients is through a balanced diet consisting of 5-8 servings of fruits and vegetables per day. So, our food should be our medicine. Our medicine should be our food.

10. Conclusion

When fast foods frequently replaces nutritious foods in diet, excessive free radicals are formed. Free radicals are dangerous to health. That they can cause life threatening illness, and even death. Free radicals mean atoms, molecules, or ions that cause a chemical reaction in the body. They basically attack and damage other molecules that are present there. The body is able to deal with some of these radicals naturally, but if excessive damage is caused, it can lead to severe illness and irreparable damage to the body. Free radicals are seen as the cause of many illnesses including many cancers. Another unwanted change to the body that is attributed to radicals is DNA damage. Free radicals damage contributes to the etiology of many chronic health problems such as

cardiovascular and inflammatory disease, cataract, and cancer. There is scientific evidence that reducing damage caused by radicals can reduce effects of aging and extend lifespan. Nature's Answer to Free Radicals – Antioxidants.

Finally, we concluded that the harmful effects of fast foods are related to the formation of excess amount of free radicals. Antioxidants are very important in prevention the induced tissue damage of free radicals on the body by preventing the formation of free radicals, scavenging them, or by promoting their decomposition. Antioxidants neutralize the effect of radicals to prevent them from harming the body. Antioxidants are the best defense against free radicals.

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