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Review Article

Food Quality: Hygiene, Contaminations and Quality Testing

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Abstract

Food quality is assessed from physical and chemical properties, and low levels of microbial contaminants which affect the health of consumers. Besides, consumers generally assess the quality from external appearance parameters like texture, flavour, colour, consistency, size and shape etc. As per standard norms, food quality is determined after taking into account all the properties involving sensory value, suitability value and health value. In addition, for food quality, psychological or notional value based on conceptions, opinions and expectations of consumers are also important. Food hygiene is also of utmost importance. The World Health Organization (WHO) has prescribed certain key precautions for ensuring food hygiene. There are certain controversies also while people talk about food quality. Nowadays, many institutes are present to test food quality. Monde Selection in Brussels, Begium is the oldest international institute established in 1961 which is supported by the International Institute for Quality Selections in Brussels, Belgium. This institute grants 'quality label' to products after tasting and testing under the banner of Monde Selection International Quality Institute. Here, the process of careful and appreciative tasting of various foods called as 'Degustation' has been briefly described. The political value of foods has been briefly discussed. Physical, chemical and microbial contaminations have also been discussed.

Keywords: Degustation; Health value; Holistic assessment; Microbial contaminants; Sensory value

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Introduction

Food is a basic requirement especially for animals including humans. Food is an edible substance of generally plant or animal origin comprised of nutritive constituents such as carbohydrates, lipids, proteins, minerals and vitamins, which is essential for life. Of course, a few foods may be of microbial origin. Food is responsible to produce energy as a result of its metabolism within the body, helps in the growth, and also health of the animal concerned including humans. In most of the studies related to nutrition, emphasis has been on food consumed by humans. In humans, food is considered to meet emotional, social and psychological requirements. Although, food is beneficial to the person, it sometimes acts as a carrier of certain diseases caused by the pathogenic microbes which may lead even to death [1,2]. The contaminants in a food product affect food quality. Food quality is generally defined by external factors like texture, flavour, and external appearance such as colour, gloss, consistency, size and shape among others which attract consumers. However, internal factors such as physical, chemical and microbial contaminants are also of utmost importance as they affect the health of consumers. Almost all the Governments have formulated laws for food quality and administrative controls are set up for spontaneous monitoring and to ensure food quality.

As per laws of almost all the countries, maintaining food quality is an essential duty of the manufacturer. On failing in maintenance of food quality, penalties/punishments are prescribed in laws. It is considered globally that food consumers are prone to any type of contamination in the food [3]. There are certain contaminations which may be present in the food due to carelessness of the people working in the organization dealing with food manufacturing. On the other hand, if any manufacturer or stockist or retailer intentionally performs adulteration of food, that is considered to be even more dangerous. Nowadays, there are laws almost in all the countries which make it mandatory for the manufacturer to put labels indicating ingredients and their amount in the food. It is important since many people may be allergic to certain ingredients or may not like to eat any particular ingredient. In order to ensure healthy life, food safety is very important, therefore, in this mini-review, a brief discussion has been done on various factors such as food hygiene, various contaminants and quality testing for various contaminants affecting the food quality. The process of careful and appreciative tasting of various foods, known as degustation, has also been described.

Food Hygiene

It is to be understood that good sanitary conditions are very important at the place and in the vicinity where raw food components are processed to manufacture a particular food. The area must be fully clean to manufacture safe, good quality, and hygienic food for the consumer. According to the World Health Organization (WHO), food hygiene includes the conditions and measures required to ensure safety of the food from production to consumption (https://www.who.int/foodsafety/areas_work/food-hygiene/en/). There are number of points at which food may get contaminated. These include harvesting or slaughtering, processing, storage, distribution, transport and preparation among others. Any carelessness either intentionally or unintentionally may cause food borne diseases and even death of the consumer. In common language, it is called food poisoning.

The WHO has various health educational programs in order to help its member countries to keep proper food hygienic conditions. These programs are meant for people involved in handling of food at various stages and also for the consumers.

According to WHO, the following precautions must be taken while handling various foodstuffs (https://www.who.int/foodsafety/publications/consumer/en/5keys_en.pdf?ua=1):

- Since many pathogenic microbes prevail in soil, water, outer surfaces of animals and humans, these microbes may be transferred to the foodstuff through hands, through utensils and cutting boards being wiped by clothes and may cause food borne diseases, it is important to take following precautions:
- Everyone must wash hands after using wash room and toilet, and also before touching/ handling food.
- All the utensils, and other peripherals used in the preparation of food must be thoroughly clean and sanitized.
- Insects, pests and animals must be away from kitchen and nearby areas, and foodstuffs.
- Since poultry products, seafood, raw foods, meats and their juices are prone to pathogenic microbes, and from these, microbes may be transferred to foodstuffs during food preparation and storage, it is recommended to take the following precautions:
- One must always keep poultry products, seafood, meats away from other foods.
- One must use separate knives, cutting boards, utensils for foodstuffs prone to microbial contamination, e.g. poultry products, seafood and meats.
- Raw as well as cooked food must be kept in separate containers in order to avoid transfer of microbes from raw food to cooked food.
- Since mostly pathogenic microbes get killed at a temperature of 70°C or above, proper cooking at a temperature of more than 70°C (preferably 100°C) must be carried out. Special precautions must be taken with foods such as poultry products, meats, joints of meats, and sea foods among others. It is important to re-heat cooked food before eating/ serving it.
- Since, microbes multiply fast at room temperature, it is essential to store cooked food either below 5°C (in a refrigerator) or above 60°C. At temperatures above 60°C or below 5°C, mostly microbes either do not multiply or multiply at a much slower rate. However, it is pertinent to mention that some microbes, known as thermophilic microbes, are able to multiply even at a temperature below 5°C. It is preferable to take the following precautions:
- Cooked food must not be left at room temperature for more than two hours (https://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get- answers/food-safety-fact-sheets/safe-food-handling/danger-zone-40-f-140-f/ct_index).
- All cooked foods as well as perishable foods must be refrigerated and temperature of the refrigerator must be set between 2 to 4°C.
- It is necessary to re-heat the cooked food at a temperature more than 70°C (preferably boiling at 100°C) before serving to eat.
- It is recommended not to store food for a much longer time even in a refrigerator.
- It is recommended not to thaw frozen food at room temperature.
- Since raw food/ materials may be contaminated with microbes, it is recommended to wash raw food thoroughly with clean water and must be peeled, if possible. Water and ice are also prone to microbial contamination, therefore, it is important to ensure that water being used in washing and cooking must be clean. It is always preferable to take the following precautions:
- Water to be used must be clean, and if not, necessary treatment(s) must be carried out to make it clean.
- It is always preferable to use fresh and wholesome foods.
- It is preferable to use foods which have been processed for safety, e.g. pasteurized milk.
- One must make a habit to wash fruits and vegetables thoroughly especially if eaten raw.
- One must always check expiry date before use. No foodstuff after the expiry date may be consumed.

Physical, Chemical and Microbial Contaminants in Food

Many times, food gets contaminated with physical, chemical or microbial contaminants (https://www.foodsafety.com.au/faq/what-are-the-different-types-of-food-contamination).

Physical contaminants: It has been observed that due to negligence or carelessness of the workers involved in food processing and cooking, people find objects like fingernails, hair, small pieces of plastic and glass, soil and dust (https://www.campdenbri.co.uk/services/physical-contaminants.php). However, eminent, reputed restaurants take care to avoid contamination by physical objects and make it compulsory for chefs, waiters etc to wear disposable gloves and head caps.

Chemical contaminants: Many times, raw foodstuffs such as vegetables and grains get contaminated with toxic chemicals used to prevent pests and herbs among others. Sometimes, food is intentionally or unintentionally contaminated with chemical pesticides, toxins, herbicides, additives and adulterants (https://www.foodsafety.com.au/resources/articles/food-safety-and-the-different-types-of-food-contamination). Therefore, it is recommended to wash the vegetables and grains thoroughly with clean water before their processing. Sometimes, chemical preservatives are added in processed foods to avoid growth of fungi and bacteria. Water used in cooking food may also be contaminated with certain toxic substances. Some manufacturers intentionally adulterate foods e.g. condiments and vegetables to make them attractive in physical appearance for the consumers. It has been observed that many vendors use chemicals for ripening of fruits and/ or for longer shelf life. If these toxic chemicals are consumed in larger amounts, there may be food poisoning.

Microbial contaminants: A large number of microbes are found in nature. Out of these, only a few are pathogenic to humans. It has been shown that out of many pathogenic microbes, only a few are capable to contaminate foodstuffs and cause diseases if they enter inside the body [1].

A number of steps exist between food leaving the farm and reaching the dining table. These steps constitute the 'food production chain'. There is always a probability for food to be contaminated with pathogenic microbe(s) during the food production chain [4]. There is always a probability of microbial contamination at each different stage depending upon its plant or animal origin.

There may be microbial contamination when plant originated food is at the farm itself. The sources of microbial contamination are water used for irrigation, pesticides, manures used as fertilizers, wild

animals and labourers working on the farm themselves [5]. The contamination of pathogenic *Escherichia coli* strain O157:H7 in lettuce through irrigating water has been reported [6,7]. This *E. coli* strain has also been reported in other vegetables and fruits. Besides, animal originated foods such as ground beef, chicken, pork, milk and milk products have also been found contaminated with this *E. coli* strain. The chances of water contamination are higher when faecal matter is in its surroundings. This strain, if it enters the body, may cause diarrhea, hemorrhagic colitis, pain in abdomen, vomiting or even sometimes kidney failure [1].

Similarly, many other pathogenic bacteria such as *Salmonella typhimurium* and *Vibrio vulnificus* have been found to be transferred in the body through contaminated food which was infected by water (https://www.eatright.org/homefoodsafety/safety-tips/food-poisoning/most-common-foodborne-pathogens). *Salmonella* and *E. coli* have also been reported to be present in manures where these may survive for a much longer time. It is also shown that the *E. coli* strain develops acid resistance and survives in the human stomach and colon of grain feed animals [8-10].

Wild animals wandering in surroundings have also been reported to be carriers of *Campylobacter* sp. and other pathogenic bacteria. The *Campylobacter* sp. cause diarrhea, cramps, fever and vomiting among other symptoms (https://www.who.int/news-room/fact-sheets/detail/campylobacter).

There may be contamination of the food during the harvesting period. The carriers of these pathogenic microbes are knives, choppers and containers such as trailers, boxes, bins, and truck beds. The equipment used for harvesting may also be carriers for certain bacteria.

Unhygienic conditions at the slaughter site are also responsible for bacterial contamination. This microbial transfer and resulting contamination has been shown on farms where food animals are raised for poultry and meat products, feedlots during transport, lairage before and during slaughter, and during further processing [11]. If infected foodstuffs are fed to poultry animals, it may result in infected chickens and their eggs by food poisoning bacteria [10]. In addition, infection of poultry animals may occur through drinking water, insects, rodents, dogs, cats, faeces, and clothes via the surrounding environment. Also, birds can spread bacteria [12].

There are also chances of contamination during post-harvesting due to contamination of equipment, unhygienic practices of workers, and use of poor wash water. Many times, bacteria are able to form biofilms on or near working sites, and equipment especially if washing/cleaning is not done properly [13,14].

Although it is considered that packaging is a defense against external factors including microbes, however, packaging material itself may sometimes be contaminated with microbes which can then contaminate the food.

Many other pathogenic bacteria such as *Clostridium perfringens*, *Staphylococcus aureus*, *Clostridium* sp., *Listeria monocytogenes*, *Bacillus cereus*, *Toxoplasma gondii*, *Shigella* sp., *Entamoeba hystolytica* and *Cyclospora* sp. have been reported to contaminate foodstuffs throughout the food production chain. Bintsis (2018) has reviewed the status of microbial pollution and food safety [15].

Quality Testing Institutes and Quality Testing Parameters

Realizing the requirements, nowadays, many domestic and international Quality Institutes have been established which inform Governments and consumers about the higher quality products. One of the oldest institutes is Monde Selection, established in 1961 at Brussels, Belgium which grants annual non-competitive awards open to food, drink and cosmetic products. This institute is supported by a commercial company named International Institute for Quality Selections, Brussels, Belgium. This institute grants a 'quality label' to the products after tasting and testing under the banner of Monde Selection International Quality Institute.

The process of careful and appreciative tasting of various foods is called 'Degustation'. It involves sampling of all signature dishes of a chef in one sitting. Generally, it is consisted of eight or more courses and accompanied by a matching wine degustation complementing each course. A signature dish is the name given to a recipe which identifies a restaurant or a chef. It must be unique and allows an informed gastronome to name a chef in a blind test (https://en.wikipedia.org/wiki/Degustation). The criteria which are tested at the Monde Selection are sensory analysis, chemical and bacteriological analyses, nutrition and health claims, and the utilization notice. The granting of the quality label is based on taste, health, labeling, packaging, eco-friendly nature, and innovation. Being in Europe, this institute mostly follows the European Food Laws.

Generally, when food quality is discussed, contradictions also occur due to self interests of the producers, processors, sellers or even consumers. According to researchers, it is difficult to define quality scientifically. Food quality is determined after taking into account all the properties involving sensory value, suitability value and health value. The value is considered to be a neutral term in the sense of condition. For food quality, psychological or notional value based on conceptions, opinions and expectations of consumers are also taken into account. Without well-defined characteristics, foods are considered to have a cultural value too, which is determined by food habits of the people or a certain group of population, supply rate and price in the market (https://link.springer.com/chapter/10.1007%2F978-3-642-78025-7_2).

The political value of foods is decided on the prospects of import, especially from developing countries, production amount, handling the surplus amount, and food aid. The ecological value is assessed on the consequences a food places to the environment due to its production and processing as well as their interactions and feedbacks. After considering all these criteria, it is sometimes called a holistic assessment of food quality.

It has been observed that people in developed countries are well aware about food quality. However, people in poor and developing countries do not pay much attention to food quality and hygiene. Even educated people don't bother to read the label on the foodstuff indicating ingredients, manufacturing and expiry dates. Food poisoning is much more common in poor families staying in slum areas due to unhygienic conditions.

Conclusion

Maintaining good food quality is very important for good health. Processing and packaging under hygienic conditions is also important. There are chances of physical, chemical and microbial contami-

nation in the food. There is a need for increased awareness about food quality and hygienic conditions, especially in poor and developing countries. More research must be carried out in the area of food quality maintenance.

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