IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Concept Of Food Spoilage W.S.R. To *Annaraksha*

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Abstract: *Ahara* is one of the three pillars of Ayurveda. Main aim of Ayurveda is to maintain good health i.e., free from diseases. *Ahara* plays an important role in achieving it. The dietetic principles of Ayurveda handle the idea of *Ahara*, from food collecting to food storage, from quantity required to how to eat, when to eat. Now there is a drastic drift in the method of preparation and storage of food items due to urbanisation and also there is less access to fresh foods. All food harbour one or more types of microorganisms as they depend on food for nutrients necessary for their growth and development. Food spoilage is the process in which food deteriorates to the point it is not edible to humans or its quality of edibility becomes reduced. Food spoiling organisms grow at different rates depending on temperature, moisture content, and other factors. These characteristics also determine how long food is edible and nutritious. *Annaraksha* practices offer a variety of methods, for determining whether food, contains any hazardous substances.

Index Terms - *Ahara*, Food spoilage, *Annaraksha*

I. INTRODUCTION

Ahara is one among the *Traya Upasthambha* of Ayurveda[1]. It is the concept that deals with principles of dietetics from method of collection of food to its storage, from quantity to time of having food, to procedures to be followed while eating to safety of food. *Ahara* is primarily preventive in nature, focusing on nutrition and lifestyle choices. Acharya Kashyapa considers *Ahara* as *Mahabhaishajya*[2]. *Ahara* is any substance which is consumed in the form of food and drinks and processed by the action of teeth (mastication), saliva, oral cavity and later on engulfed and helps in the nourishment of the body[3]. Wholesome food is responsible for the formation of the body and happiness, on contrast unwholesome food gives rise to diseases and unhappiness[4]. *Ahara* sustains life of all beings. It imparts *Varna*, clarity, good and pleasant voice, *Pushti, Bala, Medha*[5]. The quantity of *Ahara* depends upon *Agnibala, Desha, Prakriti* etc. The western concept of dietetics gives more emphasis on its physical characteristics i.e., the amount of nutrients presents in it whereas the concept of *Ahara* revolves around how different food kinds affect digestion, *Dosha* equilibrium, and mental clarity. According to Ayurveda, almost all diseases start off physically as a result of an inefficient metabolism system, which typically results in weak and unbalanced functioning.

Food is a material that is mostly made up of protein, carbohydrates, fats, and other nutrients that are needed by the body to provide energy and support growth and other critical functions. Digestion aids in the body's absorption and utilization of food, which is essential to nourishment. In nutrition, diet is the sum of food consumed by a person or other organism and dietetics is the application of the science of nutrition to the human being in health and disease. Nutrients are categorized into two groups according to the quantity that the human body needs for proper metabolism, growth, and physical health. Proteins, carbs, and fats are examples of macronutrients; vitamins and minerals are examples of micronutrients.

Microbes can spoil food, can cause food borne diseases and interestingly some of them are useful. Food microbiology concerns with the interactions between microorganisms, food and us the community. It encompasses topics such as food safety, home disease prevention, food hygiene, food spoilage, fermented foods and beverages, the utilization of microorganisms in producing food ingredients and processing aids, microbiological considerations in quality control, traditional and innovative techniques for analyzing food microbiology, and various aspects of food legislation.

FOOD SPOILAGE:

Any changes in the visual, smell and texture of food that makes it unacceptable for consumption. It is the process in which food deteriorates to the point it is not edible to humans or its quality of edibility becomes reduced[6]. Microbial food spoilage occurs as a consequence of either microbial growth in a food or release of microbial extracellular and intracellular (following cell lysis) enzymes in the food environment[7]. Some of the indicators linked to the spoilage of various food types include alterations in color, scent, and consistency; development of slime; buildup of gas (or foam); and accumulation of liquid (exudate, purge). Microorganisms have to get into the food from one or more sources; the food environment (pH, water activity, oxidation-reduction potential, nutrients, inhibitory agents) should favor growth of one or more types of these contaminating microorganisms; the food must be stored at a temperature that enables one or more types to multiply; and finally, the food must be stored under conditions of growth for sufficient length of time for the multiplying microbial types to attain the high numbers necessary to cause the detectable changes in a food[8]. Food spoilage is attributed to various factors, such as the proliferation and actions of microorganisms—primarily bacteria, yeasts, and molds alongside the enzymatic activities of food enzymes (leading to enzymatic browning), infestation by insects, parasites, and rodents, chemical alterations within the food (such as the oxidation of fats resulting in rancidity and non-enzymatic browning reactions), and physical transformations induced by freezing or drying processes, among others.

Physical changes:
Physical alterations occurring during food spoilage may include changes in appearance, such as discoloration or the formation of spots, alterations in texture, such as softening or hardening, and changes in consistency, such as the development of slime or the separation of liquids from solids. Additionally, physical manifestations of spoilage can involve the presence of mold, the formation of gas pockets or bulges, and the development of off-putting odors. One of the common examples we see in our day-to-day life is Freezer burn which is a condition when frozen food has been damaged by dehydration and oxidation. Generally caused by food not being securely wrapped in air- tight packaging[9].

Chemical changes:
The chemical changes that occur in a food due to spoilage depend primarily upon the composition of food. The changes vary depending upon the source of the food i.e. plant foods are primarily carbohydrate-rich, while animal foods are rich in proteins and fats, hence the changes will differ. The two major chemical changes which occur during the processing and storage of foods and lead to a deterioration in sensory quality are lipid oxidation and non-enzymatic browning. Chemical reactions are also responsible for changes in the color and flavor of foods during processing and storage. Lipid oxidation rate and course of reaction is influenced by light, local oxygen concentration, high temperature, the presence of catalysts (generally transition metals such as iron and copper) and water activity. Non-enzymic browning is one of the major causes of deterioration which occurs during storage of dried and concentrated foods. The non-enzymic browning, or Maillard reaction, can be divided into three stages: a) early Maillard reactions which are chemically well-defined steps without browning; b) advanced Maillard reactions which lead to the formation of volatile or soluble substances; and c) final Maillard reactions leading to insoluble brown polymers[10].

Microbial changes:
The two major groups of micro-organisms found in foods are bacteria and fungi, the latter consisting of yeasts and molds. Bacteria are generally the fastest growing, so that in conditions favorable to both, bacteria will usually outgrow fungi. The species of micro-organisms which cause the spoilage of particular foods are influenced by two factors which includes the nature of the foods and their surroundings. These factors are referred to as intrinsic and extrinsic parameters. The intrinsic parameters are an inherent part of the food: pH, water activity, nutrient content, antimicrobial constituents and biological structures. The extrinsic parameters of foods are those properties of the storage environment that affect both the foods and their microorganisms.

The growth rate of the micro-organisms responsible for spoilage primarily depends on these extrinsic parameters i.e., temperature, relative humidity and gas compositions of the surrounding atmosphere[11].

Food spoilage-in Ayurveda:
According to Acharya Charaka, the rivers carrying rain water which are vitiated by the mud, insects, snakes, mice and dirt are responsible for all kinds of diseases. The water which is slimy, full of parasites and vitiated by leaves, moss and mud, of high density, having bad taste and odor is not wholesome[12]. In Bhavaprakasha Nighantu the features of water that should not be used are mentioned[13]. It also mentions that the milk having properties like different color, bad taste, *Gratitha* etc. should be avoided[14]. Those which belongs to *Shaka Varga* which are being infested with pests, *Jeerna, Akalotha* etc. are to be avoided[15].

HAZARDS OF FOOD SPOILAGE

An estimated 600 million, almost 1 in 10 people in the world fall ill after eating contaminated food and 4,20,000 die every year, resulting in the loss of 33 million healthy life years (DALYs). Children under 5 years of age carry 40% of the foodborne disease burden, with 125 000 deaths every year. Foodborne diseases impede socioeconomic development by straining health care systems and harming national economies, tourism and trade. Salmonella, Campylobacter and enterohaemorrhagic Escherichia coli affects millions annually. Symptoms can be fever, headache, nausea, vomiting, abdominal pain and diarrhea. Vibrio cholerae can infect people through contaminated water or food. Symptoms may include abdominal pain, vomiting and profuse watery diarrhea, which quickly lead to severe dehydration and possibly death[16].

FOOD PRESERVATION

It is the process of treating and handling food with an aim to stop or slow down its spoilage while maintaining its nutritional value, texture and flavor. It either kills the microbes or prevents their growth. Some of the techniques include- Drying or dehydration is the process of removing water from a solid or liquid food by means of evaporation. The purpose of drying is to obtain a solid product with sufficiently low water content. It is one of the oldest methods of food preservation[17]. Pasteurization is a physical preservation technique in which food is heated up to a specific temperature to destroy spoilage-causing microorganisms and enzymes. Almost all the pathogenic bacteria, yeasts, and molds are destroyed by this process[18]. Heat preservation by applying heat all thermophobic microbes are killed, salting which helps in removing moisture, fermentation by which acid is produced as a byproduct which prevents bacterial growth, drying which helps in slowing down the action of enzymes and removes moisture, aseptic packaging by means of rapidly heating the food products and immediately packing them in aseptic containers[19].
Some of the food preservation techniques mentioned in our classics includes *Agni Sannikarsha* which denotes the transformation of properties to the desired one with the help of fire i.e., by cooking, roasting etc. and *Kala Prakarsha* which discuss about artificial storing, for specified period of time and duration mentioned in Ahara Vidhi Vishesha Ayatana[20]. Acharya Susrutha quoted the vessels for proper storage of food items which includes *Tamra Patra* for *Jala, Krishnaloha Patra* for *Gritha, Rajata Patra* for *Peyadi Padartas* etc[21].

CONCEPT OF ANNARAKSHA

Annaraksha Adhyaya of Ashtangasamgraha deals with food safety i.e., it explains how to save food from contamination and different toxicants. It also provides guidance on various techniques for testing food, whether it's in its raw form or already prepared, to detect the presence of harmful substances. This includes distinct approaches tailored to different types of food sources. Condiments mixed with poison becomes dry quickly, fumes coming out while boiling becomes dark colored, accumulation of foams, appearance of lines or striae and bubbles can be found in water mixed with poison. Appearance of coppery-red lines in milk, black lines in wines, blue lines in curd, light brown lines in ghee, green lines in honey etc. indicates that they are being poisoned[22]. The royal physician should carefully inspect the washing of fruits, roots, leaves, water for washing other articles and preparing food by smelling those which can be smelt, touching those which can be examined by touch, sprinkle poison detectors over them and re-examine them after one *nadika*[23]. It also deals with purification of *Vishajushta Jala*, *Vayu* etc. The concept of *Garavisha*, *Vishakanya* are also being explained in this chapter.

IV. CONCLUSION

Today fruits and vegetables are susceptible to the growth of microorganisms**.** The interaction between microorganisms and food causes deterioration in nutritional value of the food**.** These had put greater responsibility on food producers and handlers to ensure food safety**.** Access to sufficient amounts of safe and nutritious food is key to sustaining life and promoting good health. By implementing proper storage methods, temperature control, and hygiene practices, individuals and food businesses can minimize the risk of spoilage and prolong the shelf life of food products. Additionally, ongoing research and advancements in food preservation technologies play a crucial role in combating food spoilage and ensuring a sustainable food supply chain. Ultimately, prioritizing food safety measures not only safeguards consumer health but also reduces food waste and supports a healthier environment.

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