Main Factors Affecting The Growth And Development Of Microorganisms

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ABSTRACT

The article discusses the activity of microorganisms in soils, their role in increasing soil fertility, symbiotic relationships, and the process of nitrogen fixation. Information about nitrogen-fixing bacteria and their characteristics is provided.

Keywords: Microorganism, aerobes, anaerobes, saprophytes, symbiosis, mycorrhiza, nitrogen fixation, nitrogen-fixing bacteria, bacteria, actinomycetes.

Introduction. It is known that a wide variety of living organisms inhabit the Earth, and each of them has its own characteristics and place in the biocenosis. Among them, the importance of microorganisms is incomparable. When their diversity, lifestyle, and activities are studied, it is found that they possess numerous unique properties. In particular, they have the ability to supply plants with essential nutrients such as nitrogen or phosphorus.

Microorganisms are the smallest living organisms and mainly consist of a single cell. Most microorganisms belong to lower plant life forms such as bacteria, molds, and yeasts. There are also some microorganisms belonging to lower animal forms (protists or protozoa). Microorganisms are widespread in nature due to their high resistance, rapid reproduction ability, and capacity to adapt to various conditions such as temperature, humidity, and lack of moisture. However, their activity significantly depends on physical, chemical, and biological environmental factors [4].

Physical factors such as temperature, various forms of radiation, osmotic pressure, and moisture significantly affect the activity of microorganisms and enzymes [2].

Environmental temperature affects the activity, growth rate, and reproduction of microorganisms. There are three groups of microorganisms distinguished by their temperature preferences: psychrophilic (psychrophiles), mesophilic (mesophiles), and thermophilic (thermophiles). Deviations from the optimal temperature range affect microbial activity, and high temperatures have a stronger effect than low temperatures. High temperatures can lead to the death of microorganisms due to irreversible changes in the cell.

The life of microorganisms is closely related to environmental conditions. The better the environmental conditions, the faster the development of the organism. Microorganisms adapt to environmental conditions.Without understanding the relationship between the organism and the environment, it is impossible to direct and control the life of microorganisms in the desired way. All environmental factors that greatly influence the development of

microorganisms can be divided into three main groups: 1-physical; 2-chemical; 3-biological.

Among the physical factors, moisture, the concentration of substances dissolved in the medium – the osmotic pressure of the medium, radiant energy, and temperature are of great importance.

Among chemical factors, the reaction of the medium (pH), oxidation-reduction conditions in it, and the effect of toxic substances are important for the vital activity of microorganisms.

Among biological factors, the influence of biologically active substances (vitamins, antibiotics, etc.) on microorganisms, as well as the relationships between microorganisms and with other organisms, are studied. The effect of the external environment on microorganisms.

The Effect of Physical Factors on Microorganisms. Physical factors are of great importance in the life of microorganisms. The microbial cell consists of 75–85% water, and its metabolism and vital activity are associated with water. A certain amount of water is required for the growth and development of microorganisms. Therefore, if the amount of water in the environment decreases below the optimal level, the reproduction of microorganisms stops. Each type of microorganism requires a specific optimal amount of water in the environment. Most nutrients cannot enter the cell unless they are dissolved in water.

Some microorganisms are very sensitive to water deficiency in the environment. Others can survive for a long time in a dried state. Even after decades, they retain their viability. However, in a dried state, the life functions of microorganisms stop.

For example, acetic acid bacteria are very sensitive to moisture and quickly die after drying; staphylococci – microbes causing purulent infections, and bacteria causing typhoid and tuberculosis are resistant to drying and can survive for several months. Lactic acid bacteria can also survive for several months and years in a dried state. Therefore, dried lactic acid bacteria are used in dairy plants to produce dairy products.

Most yeasts are resistant to drying. For example, dried baker's yeast remains alive for more than 2 years. Especially bacterial and mold spores are resistant to dryness. For example, viable bacterial spores were found in mammoth remains located in the tundra, and their age exceeded 3000 years. Drying is used to preserve a number of food products (fruits, vegetables, eggs, and milk are stored in dried form). Grain, flour, cereals, and others are also stored dried.

The reason dry products do not spoil is that they lack the amount of moisture necessary for microorganisms, so microbes cannot feed. If products become moist, favorable conditions arise for the development of microorganisms.

Some molds can grow on food products when the relative humidity of the air is 70 percent. Most molds can grow minimally when the relative humidity is 75–80 percent. Relative humidity depends on temperature. If the temperature decreases, the relative humidity of the air increases. In this case, water vapor condenses as droplets on the surface of products. These droplets cause the development of microorganisms. It should be noted that bacteria can grow only in sufficient moisture. Molds can grow even in low moisture. The reason is that the osmotic pressure in mold cells is higher than in bacterial cells.

Bacteria and molds in dried products remain alive for a long time, and some remain viable for ten or more years. Therefore, if all dry products become moist, microbiological processes accelerate, and the product spoils quickly. The number of bacteria in dry products varies and depends on the drying method and type of product. One gram of dried products may contain several million microbes, while one gram of dried vegetables may contain tens of millions of microbes.

The concentration of dissolved substances in the medium greatly affects microorganisms. In nature, microorganisms live in substrates with different amounts of dissolved substances and varying osmotic pressures. For example, some microorganisms live in fresh water under osmotic pressure less than 1 atmosphere. Others live in salty water of seas and lakes under osmotic pressures equal to tens or hundreds of atmospheres. Depending on

their habitat, the osmotic pressure inside microbial cells varies. In some molds, the pressure of cell sap reaches up to 200 atm, while in soil bacteria it ranges from 50–80 atm.

Some microorganisms are very sensitive to the osmotic pressure of the environment and the concentration of dissolved substances in it. If the amount of substances in the environment exceeds the optimal level, the cells undergo plasmolysis. In this case, nutrient entry into the cell stops. Under such conditions, some microorganisms remain alive for a long time, while others die.

More than 3 percent table salt slows down the life processes of most microorganisms. A 20–25 percent salt concentration stops the life activity of most microorganisms.

Molds tolerate changes in the concentration of substances in the environment better than bacteria. Lactic acid bacteria and putrefactive bacteria are very sensitive to salt concentration in the environment. A 2–3 percent salt concentration slows their development, while a 10 percent salt concentration stops their vital activity.

Food poisoning-causing bacteria and some paratyphoid bacteria are sensitive to salt, and their growth stops in environments containing 6–9 percent salt.

However, some microorganisms can adapt to the osmotic pressure of the environment; they possess osmoregulation ability. Microorganisms that can normally develop only in environments with high osmotic pressure are called osmophilic microorganisms. Salt-resistant osmophilic microorganisms are called halophiles (salt-loving).

Conclusion. In practice, salt and sugar are used to create high osmotic pressure for preserving many products and goods, while sugar is used in high concentrations, around 70 percent. It should be noted that microorganisms in such products, including disease-causing ones, do not lose viability for a long time, but their life activity temporarily stops.

Sometimes salted products spoil due to the development of halophilic bacteria introduced with salt. Jam, marmalade, and other products containing large amounts of sugar also spoil due to contamination by osmophilic molds and yeasts. To protect such products from spoilage, thermal treatment should be applied.

Temperature is another important environmental factor determining the growth and development of microorganisms. The life of each microorganism occurs within a certain temperature range; outside this range, life ceases. Some microorganisms have a narrow temperature range, while others have a broad range measured by tens of degrees.

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