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METHODS OF MICROORGANISM CULTIVATION

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ABSTRACT

This article discusses the methods of cultivation of microorganisms, their theoretical foundations, and practical significance. Cultivation of microorganisms under artificial conditions is one of the key areas of microbiology, virology, and immunology. The study analyzes the methods of growing bacteria, fungi, and viruses in solid, liquid, and semi-solid culture media. In addition, aerobic and anaerobic cultivation techniques, as well as the importance of sterilization and aseptic conditions, are examined. The results indicate that optimal temperature, pH level, nutrient composition, and oxygen availability are essential factors for effective microbial growth. The findings of this study can be widely applied in clinical diagnostics, pharmaceutical production, and biotechnology.

Keywords: Microorganisms, cultivation methods, culture media, sterilization, incubation, aerobic and anaerobic conditions, pure culture, colonies, laboratory diagnostics, bacteriological method, selective media, differential media.

INTRODUCTION

The cultivation and controlled growth of microorganisms is one of the primary research directions in microbiology, virology, and immunology. By cultivating microorganisms under artificial conditions, their biochemical characteristics, growth mechanisms, genetic potential, and pathogenic properties can be studied. Additionally, microorganism cultivation plays an important role in laboratory diagnostics, antibiotic production, vaccine development, biotechnological processes, and environmental monitoring.

The main goal of microorganism cultivation is to rapidly and stably propagate them in laboratory conditions and to study their various physiological and biochemical properties. For this purpose, solid (agar-based), liquid (broth), and semi-solid media are used. Each medium affects the growth rate, morphology, and metabolic activity of microorganisms. Special conditions must be created for aerobic and anaerobic microorganisms. Aerobic microorganisms grow in the presence of oxygen, while anaerobic microorganisms are oxygen-sensitive and are propagated in specialized conditions and containers.

Furthermore, aseptic techniques and sterilization methods are critical for preventing contamination of microorganisms. In modern microbiology and virology, cultivation methods are widely applied not only in research and diagnostic processes but also in pharmaceutical and biotechnological applications for developing innovative products. Therefore, a deep understanding of microorganism cultivation methods and their correct practical application is scientifically and practically relevant.

MATERIALS AND METHODS

Microorganisms:

Gram-positive and Gram-negative bacteria (e.g., Escherichia coli, Staphylococcus aureus).

Fungi (Saccharomyces cerevisiae, Candida albicans).

Viruses (e.g., influenza virus, adenovirus) handled under safe laboratory classes.

Culture media:

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Solid: Luria-Bertani (LB) agar, Sabouraud dextrose agar.

Liquid: LB broth, Sabouraud dextrose broth.

Semi-solid: 0.5–0.7% agar broth.

Equipment:

Autoclave and sterile filters (for sterilization).

Microscopes and cover glasses.

Incubators (for aerobic and anaerobic conditions).

Petri dishes, pipettes, inoculating loops/brushes.

Preparation of culture media:

Culture media were prepared in solid, liquid, and semi-solid forms. Agar was added to solid and semi-solid media. Prepared media were sterilized in an autoclave at 121°C for 15–20 minutes. Liquid media were sterilized using filtration.

Inoculation of microorganisms:

Bacteria and fungi were inoculated into Petri dishes or liquid media using an inoculating loop or pipette.

Viruses were inoculated into appropriate cell lines.

Growth conditions:

Aerobic microorganisms were grown in incubators at 37°C with oxygen supply.

Anaerobic microorganisms were cultivated using anaerobic chambers or gas packs.

Fungi were grown at 25–30°C.

Monitoring and analysis of growth:

In liquid media, growth was measured using optical density (OD600).

On solid media, colony number, morphology, and color were assessed.

In semi-solid media, growth on the surface of the semi-solid layer was observed.

Table 1. Growth conditions of microorganisms

Microorganism type	**Culture medium**	**Temperature (°C)**	**Growth duration**	**Aerobic/Anaerobic**
E. coli	LB agar/liquid	37	18–24 hours	Aerobic
S. aureus	LB agar/liquid	37	24 hours	Aerobic
S. cerevisiae	Sabouraud agar/broth	25–30	48 hours	Aerobic
Candida albicans	Sabouraud agar/broth	25–30	48 hours	Aerobic
Anaerobic bacteria	Anaerobic broth	37	24–48 hours	Anaerobic

Figure 1: Growth of bacterial colonies on a Petri dish..

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Figure 2: Specialized incubator or gas pack used for cultivating microorganisms under anaerobic conditions.

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RESULTS

During the study, the growth of microorganisms in solid, liquid, and semi-solid culture media was observed. Growth rates and colony morphology varied under aerobic and anaerobic conditions.

Bacteria and fungi:

Escherichia coli and *Staphylococcus aureus* grew rapidly in LB medium under aerobic conditions. On solid media, colonies were round, smooth, and translucent, while in liquid media, optical density (OD600) reached 0.8–1.0.

Saccharomyces cerevisiae and *Candida albicans* grew more slowly in Sabouraud medium at 25–30°C, but aggregation and filament formation were observed in semi-solid media.

Anaerobic microorganisms:

Anaerobic bacteria grew only under anaerobic conditions; no growth was observed under aerobic conditions, confirming their oxygen sensitivity.

Effect of growth parameters:

Temperature, pH, and nutrient composition significantly influenced microbial growth rates. Under optimal conditions, colony size and growth rate were maximal.

Disruption of sterilization or aseptic conditions led to contamination, increasing the risk of misinterpreting results.

Table 2. Growth results of microorganisms

Microorganism	Culture medium	Temperature (°C)	Growth rate	Colony morphology / OD600
E. coli	LB agar/liquid	37	Fast (18–24 h)	Round, smooth / 0.9
S. aureus	LB agar/liquid	37	Fast (24 h)	Round, smooth / 0.85
S. cerevisiae	Sabouraud agar	25–30	Moderate (48 h)	Filamentous / 0.7
C. albicans	Sabouraud agar	25–30	Moderate (48 h)	Filamentous / 0.75
Anaerobic bacteria	Anaerobic broth	37	Noticeable (24–48 h)	Round, dense / 0.65

Figure 1: Growth of bacterial colonies (*E. coli* and *S. aureus*) on solid media.

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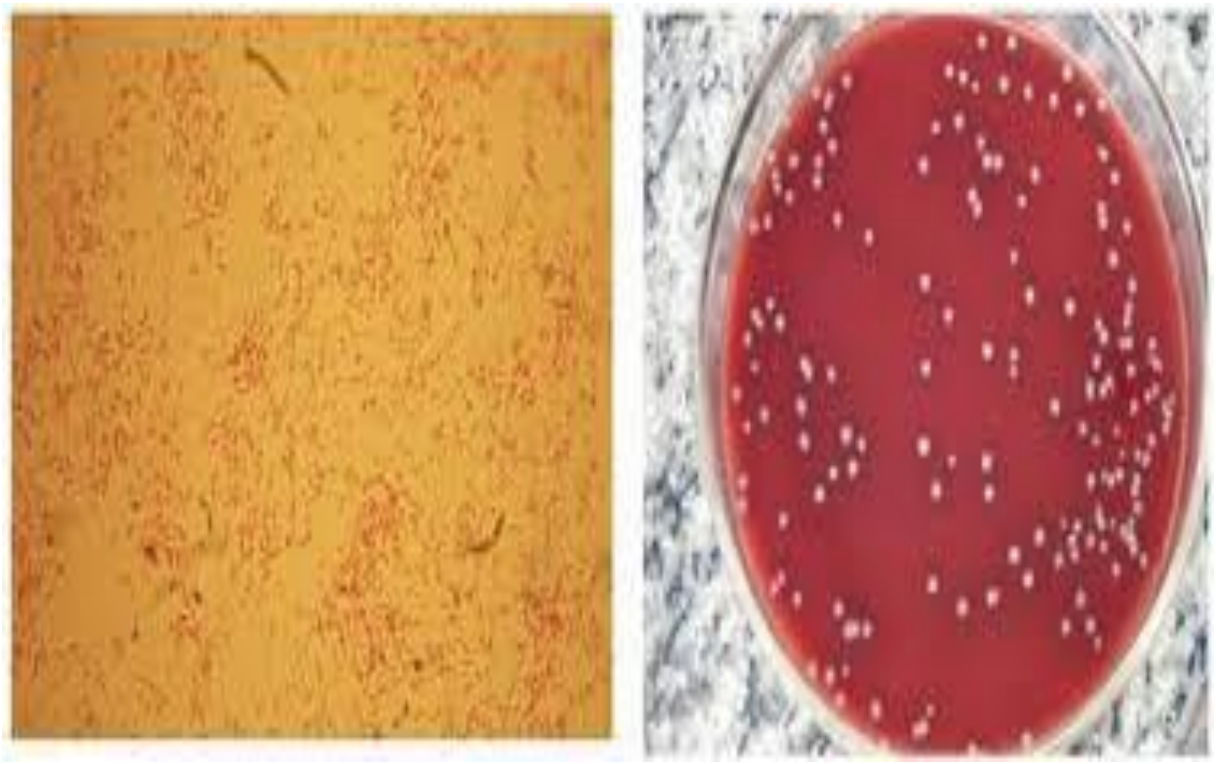
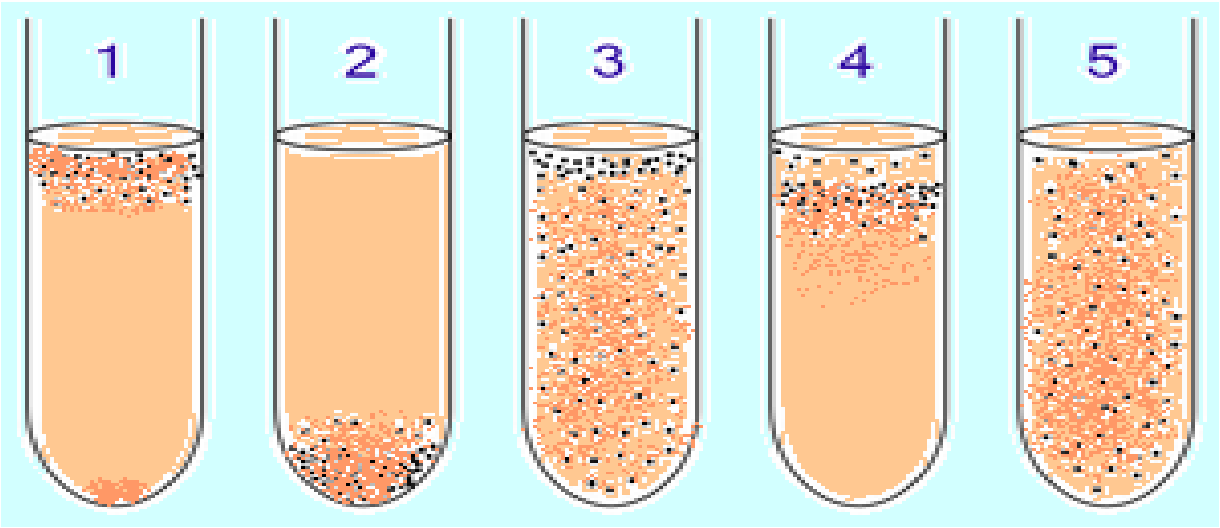


Figure 2: Development of bacterial colonies under anaerobic conditions.



DISCUSSION

The study results confirmed the effectiveness of different microorganism cultivation methods and highlighted the influence of various conditions on growth processes. The growth characteristics of aerobic and anaerobic microorganisms, as well as the differences observed in solid, liquid, and semi-solid culture media, are consistent with previous scientific research. Aerobic bacteria such as Escherichia coli and Staphylococcus aureus grew rapidly in LB medium, which can be explained by their high metabolic activity under optimal conditions. In contrast, fungi such as Saccharomyces cerevisiae and Candida albicans exhibited slower growth rates, reflecting their preference for lower temperatures and more complex nutrient compositions. Filament formation in semi-solid media demonstrates the morphological adaptation mechanisms of fungi. Anaerobic bacteria grew only under specialized conditions, confirming their oxygen sensitivity. This aligns with previous microbiological studies, highlighting the necessity of gas packs and anaerobic chambers for cultivating anaerobic microorganisms. Furthermore, violations of sterilization and aseptic procedures significantly reduced

the reliability of results, emphasizing the importance of contamination control in microbiological experiments. The findings indicate that optimal temperature, pH, nutrient composition, and oxygen availability are simultaneously biologically and practically crucial for microorganism cultivation. These results support effective microbial growth in laboratory diagnostics, pharmaceutical production, and biotechnological processes. Additionally, the study provides a deeper understanding of microbial growth mechanisms in various media and serves as a scientific basis for developing new cultivation strategies.

CONCLUSION

The study results allowed the identification of effective methods for microorganism cultivation and the examination of their growth characteristics under various conditions. Aerobic and anaerobic microorganisms, as well as bacteria and fungi, exhibit significant differences in growth rate and morphology depending on the culture medium and temperature conditions. Optimal temperature, pH, nutrient composition, and oxygen supply ensure efficient microbial growth. These findings serve as a foundation for stable and reliable microorganism cultivation in laboratory diagnostics, the pharmaceutical industry, and biotechnology. Moreover, understanding microbial growth under artificial conditions provides an important platform for future scientific research and the development of innovative applications.

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