DIPLOMA ONE YEAR COURSE IN FOOD PROCESSING EXAMINATION 2014

Model Answer (Set I)

Subject:-Food Microbiology **Paper Code:- 405102**

Group A

(Q1).1.a,2.b,3.c,4.b,5.d,6.c,7.a,8.c, 9.d,10.d.

Q.2 a. The theory of spontaneous generation, i.e., the generation of some form of life from nonliving objects The idea that life routinely arises from non-life was supported by Aristotle (Circa 350 BC). According to him, it was: "readily observable that aphids arise from the dew which falls on plants, fleas from putrid matter, mice from dirty hay". This belief remained unchallenged for more than 2000 years. From ancient times, spontaneous generation was thought to be the origin of many organisms (such as rats and flies) that routinely appeared in certain materials. Microorganisms always appeared suddenly in certain materials (meat juices or plant extracts, for example) that had previously been free of them. It seemed logical that microbes were products of spontaneous generation (the formation of living things from inanimate matter).

Needham versus Spallanzani: He boiled chicken broth, put it in a flask, and sealed it. Microorganisms could develop in it only by spontaneous generation. Experiments with gravy seemed to show that life could be generated from non-living materials. But an Italian priest and professor named Lazzaro Spallanzani was not convinced. According to him, perhaps microorganisms entered the broth after boiling but before sealing. Therefore, Spallanzani put broth in a flask, sealed it, and then boiled it. No microorganisms appeared in the cooled broth. Still the critics were not persuaded. Spallanzani didn't disprove spontaneous generation, they said, he just proved that spontaneous generation required air. Gradually, spontaneous generation was rejected as the origin of visible organisms. **Francesco Redi,**. In 1665 he did experiments with covered and uncovered jars of meat. He showed that maggots (fly larvae) developed only in meat that flies could reach to lay eggs on. Apparently, spontaneous generation did not occur, at least in the case of flies. Instead, flies and by extension all living things come only from preexisting living things. Still, many people believed that microorganisms were an exception to this rule.

Louis Pasteur (1822-1895) entered to counter the argument that air was necessary for spontaneous generation. Pasteur used barriers that allowed free passage of air but not microorganisms. In his most famous experiment, Pasteur boiled meat broth in a flask and then drew out and curved the neck of the flask in a flame in the shape of a swan's neck (Fig. No microorganisms grew in the flask. But when he tilted the flask so some broth flowed into the curved neck and then tilted it back so the broth was returned to the base of the flask, the broth quickly became cloudy with the growth of microbial cells. Gravity had caused the microbial cells that had entered the flask to settle at the low point of the neck. They never reached the broth in the base until they were washed into it.

Thus, Pasteur convinced the scientific world that spontaneous generation of microorganisms does not occur even in the presence of air. Pasteur's simple but elegant experiments grounded microbiology in scientific reality. Microorganisms could now be studied by rational scientific means. Probably the most famous contribution to

microbiology by Pasteur is the heating process he developed to kill spoilage microbes while still preserving flavor.

Ans .b. Fermentation: **Fermentation** is a metabolic process that converts sugar to acids, gases and/or alcohol. It occurs in yeast and bacteria, but also in oxygen-starved muscle cells, as in the case of lactic acid fermentation. Fermentation is also used more broadly to refer to the bulk growth of microorganisms on a growth medium. French microbiologist Louis Pasteur is often remembered for his insights into fermentation and its microbial causes. The science of fermentation is known as zymology

Industrial fermentation processes may be divided into two main types, with various combinations and modifications. These are **batch fermentations** and **continuous fermentations.**

Batch fermentations

A tank of fermenter is filled with the prepared mash of raw materials to be fermented. The temperature and pH for microbial fermentation is properly adjusted, and occassionally nutritive supplements are added to the prepared mash. The mash is steam-sterilized in a pure culture process. The inoculum of a pure culture is added to the fermenter, from a separate pure culture vessel. Fermentation proceeds, and after the proper time the contents of the fermenter, are taken out for further processing. The fermenter is cleaned and the process is repeated. Thus each fermentation is a discontinuous process divided into batches.

Continuous fermentation

Growth of microorganisms during batch fermentation confirms to the characteristic growth curve, with a lag phase followed by a logarithmic phase. This, in turn, is terminated by progressive decrements in the rate of growth until the stationary phase is reached. This is because of limitation of one or more of the essential nutrients. In continuous fermentation, the substrate is added to the fermneter continously at a fixed rate. This maintains the organisms in the logarithmic growth phase. The fermentation products are taken out continuously. The design and arrangements for continuous fermentation are somewhat complex.

Aerobic fermentations

A number of industrial processes, although called 'fermentations',are carried on by microorganisms under aerobic conditions. In older aerobic processes it was necessary to furnish a large surface area by exposing fermentation media to air. In modern fermentation processes aerobic conditions are maintained in a closed fermenter with *submerged cultures.* The contents of the fermenter are agitated with au impeller and aerated by forcing sterilized air.

Anaerobic fermentations Basically a fermenter designed to operate under micro-aerophilic or anaerobic conditions will be the same as that designed to operate under aerobic conditions, except that arrangements for intense agitation and aeration are unnecessary. Many anaerobic fermentations do, however, require mild aeration for the initial growth phase, and sufficient N agitation for mixing and maintenance of temperature.

Ans 2.c. Bacteria, like all living cells, require energy and nutrients to build proteins and structural membranes and drive biochemical processes. Bacteria require sources of carbon, nitrogen, phosphorous, iron and a large number of other minerals. Carbon, nitrogen and water are used in highest quantities. The nutritional requirements for bacteria can be grouped according to the carbon source and the energy source.

A Autotrophs

Autotrophs are bacteria which obtain their nutrition from inorganic compounds. Carbon dioxide is typically the sole source of cellular carbon. Autotrophs will use hydrogen sulfide, ammonia or hydrogen gas to reduce carbon into necessary sugars. Nitrifying bacteria, which oxidize ammonia to create nitrites and nitrates, are an example of bacteria which use autotrophic nutrition.

B. Heterotrophs

Bacteria that require organic sources of carbon such as sugars, fats and amino acids are termed heterotrophs. Saprophytic bacteria are an example. They attain their nutrition from dead organic matter. Using enzymes, these bacteria will breakd own complex compounds and use the nutrients to release energy. Saprophytic bacteria are essentially decomposers and play an important role in ecosystem by releasing simpler products which plants and animals can use.

C.Phototrophs

Phototrophic bacteria absorb light energy, then utilize this in photosynthesis to create cellular energy. There are two types of phototrophs; those which do not produce oxygen as a byproduct are termed anaerobic phototrophs, while those which do produce oxygen are termed aerobic phototrophs. Both autotrophs and heterotrophs can be phototrophs. Cyanobacteria are an example of bacteria which execute photoautotrophic nutrition.

D. Chemotrophs

These bacteria obtain chemical energy from their surroundings and convert it into adenosine triphosphate (ATP) for cellular use. Chemotrophs attain energy from oxidation-reduction reactions of inorganic compounds such ammonia, hydrogen sulfide and iron. For instance, sulfur bacteria is a chemoautotroph which produces energy by oxidizing hydrogen sulfide into sulfur and water.

E.Lithotrophs

Lithotrophs are bacteria which use reduced inorganic compounds as the electron donor (H-donor) in anaerobic or aerobic respiration.

Ans 3.A.Scientist & their contribution:

a. Leeuwenhoek First saw bacteria & named animalcules. Design first simple microscope. Father of Microbiology
b. Louis Pasteur,: Define term Fermentation. Pasteur was able to prove that living cells, the yeast, were responsible for forming alcohol from sugar, and that contaminating microorganisms found in ordinary air could turn the ferments sour. Next, he identified the microorganisms responsible for both normal and abnormal fermentations, and found that through heating wine, beer, milk, or vinegar briefly, certain living organisms could be killed, thereby sterilizing or 'pasteurizing' the substances. Gave term pasteurization
c. Robert Koch : proved that microorganisms (germs, as they were and are still sometimes called) cause disease. He showed further that specific microorganisms cause specific diseases. Koch also introduced higher scientific

standards of rigor to microbiology, as exemplified by those called Koch's postulates.

d. Lazzaro Splanzanni Spallanzani put broth in a flask, sealed it, and then boiled it. No microorganisms appeared in the cooled broth. Still the critics were not persuaded. Spallanzani didn't disprove spontaneous generation, they said, he just proved that spontaneous generation required air. Gradually, spontaneous generation was rejected as the origin of visible organisms.
e. **Francesco Redi,**. In 1665 he did experiments with covered and uncovered jars of meat. He showed that maggots (fly larvae) developed only in meat that flies could reach to lay eggs on. Apparently, spontaneous.generation did not occur, at least in the case of flies. Instead, flies and by extension all living things come only from preexisting living things. Still, many people believed that microorganisms were an exception to this rule.

Ans 3.B. Probiotics . The term **probiotic** is currently used to name ingested microorganisms associated with beneficial effects to humans and animals. Introduction of the concept is generally attributed to Nobel Prize recipient Eli Metchnikoff, who in 1907 suggested that "the dependence of the intestinal microbes on the food makes it possible to adopt measures to modify the flora in our bodies and to replace the harmful microbes by useful microbes.

Health benefits: An estimated 100 trillion microorganisms representing more than 500 different species inhabit every normal, healthy bowel. These microorganisms (or microflora) generally don't make us sick; most are helpful. Gut-dwelling bacteria keep pathogens (harmful microorganisms) in check, aid digestion and nutrient absorption, and contribute to **immune function.**

The best case for probiotic therapy has been in the treatment of **diarrhea**. Controlled trials have shown that *Lactobacillus GG* can shorten the course of infectious diarrhea in infants and children (but not adults)..

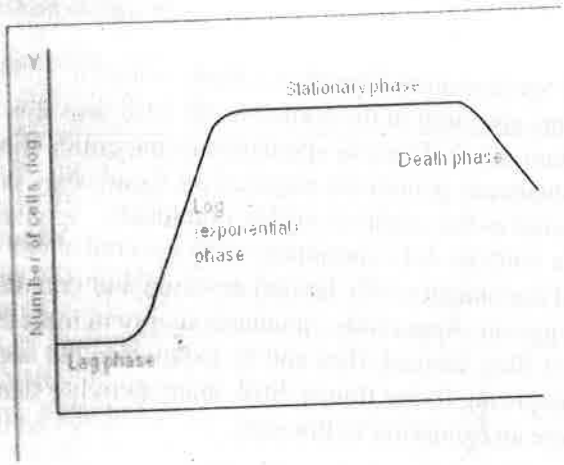
Probiotic therapy may also help people with **Crohn's disease** and irritable bowel syndrome..

Probiotics may also be of use in **maintaining urogenital health.** The dominant *Lactobacilli*

Probiotics are generally considered safe — they're already present in a normal digestive system.

Ans.3.c. Growth curve of Bacteria

5.

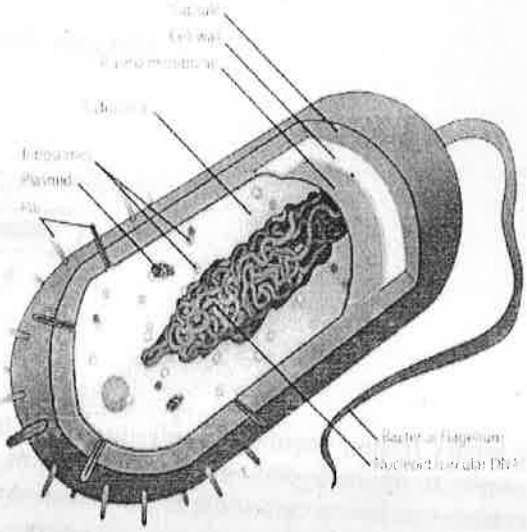


Bacterial growth in batch culture can be modeled with four different phases: **lag phase** (A), **log phase** or exponential phase (B), **stationary phase** (C), and **death phase** (D). In the book "black" the bacterial growth phase classified 7 stages like - (A) lag phase (B) early log phase (C) log/exponential phase (D) early stationary phase (E) stationary phase (F) early death phase (G) death phase.

1. During **lag phase**, bacteria adapt themselves to growth conditions. It is the period where the individual bacteria are maturing and not yet able to divide. During the lag phase of the bacterial growth cycle, synthesis of RNA, enzymes and other molecules occurs.
2. The **log phase** (sometimes called the logarithmic phase or the *exponential phase*) is a period characterized by cell doubling. The number of new bacteria appearing per unit time is proportional to the present population. If growth is not limited, doubling will continue at a constant rate so both the number of cells and the rate of population increase doubles with each consecutive time period. For this type of exponential growth, plotting the natural logarithm of cell number against time produces a straight line. The slope of this line is the specific growth rate of the organism, which is a measure of the number of divisions per cell per unit time. The actual rate of this growth (i.e. the slope of the line in the figure) depends upon the growth conditions, which affect the frequency of cell division events and the probability of both daughter cells surviving.,
3. The **stationary phase** is often due to a growth-limiting factor such as the depletion of an essential nutrient, and/or the formation of an inhibitory product such as an organic acid. Stationary phase results from a situation in which growth rate and death rate are equal. The number of new cells created is limited by the growth factor and as a result the rate of cell growth matches the rate of cell death. The result is a "smooth," horizontal linear part of the curve during the stationary phase.
4. At **death phase**,(Decline phase) bacteria die. This could be due to lack of nutrients, a temperature which is too high or low, or the wrong living conditions

Group B

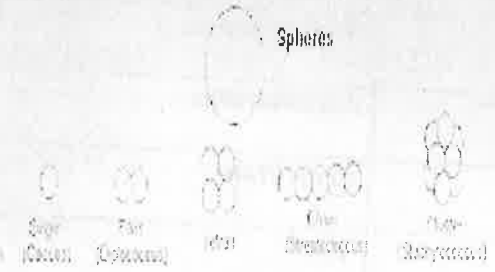
Ans.4.Bacteria cell structure



Different arrangement of cell.

(Sphere) Coccus-single cell
Diplococcus: Pair
Streptococcus:coccus in chain
Staphyllococcus: coccus in cluster

Rod shape as Bacillus,diplobacillus,Streptobacillus Staphylobacillus



Ans.5. Different Mode of division in bacteria

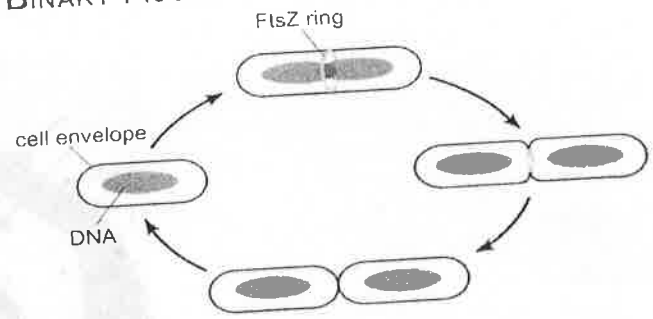
Binary Fission

Most bacteria rely on binary fission for propagation. Conceptually this is a simple process; a cell just needs to grow to twice its starting size and then split in two. But, to remain viable and competitive, a bacterium must divide at the right time, in the right place, and must provide each offspring with a complete copy of its essential genetic material. Bacterial cell division is studied in many research laboratories throughout the world. These investigations are uncovering the genetic mechanisms that regulate and drive bacterial cell division. Understanding the mechanics of this process is of great interest because it may

7.

allow for the design of new chemicals or novel antibiotics that specifically target and interfere with cell division in bacteria.

BINARY FISSION:



Before binary fission occurs, the cell must copy its genetic material (DNA) and segregate these copies to opposite ends of the cell. Then the many types of proteins that comprise the cell division machinery assemble at the future division site. A key component of this machinery is the protein FtsZ. Protein monomers of FtsZ assemble into a ring-like structure at the center of a cell. Other components of the division apparatus then assemble at the FtsZ ring. This machinery is positioned so that division splits the cytoplasm and does not damage DNA in the process. As division occurs, the cytoplasm is cleaved in two, and in many bacteria, new cell wall is synthesized. The order and timing of these processes (DNA replication, DNA segregation, division site selection, invagination of the cell envelope and synthesis of new cell wall) are tightly controlled.

Ans. 8.- Useful Bacteria

S.no	Microorganism	Benefits
1	*Lactobacillus*	Curd, ghee,butter
2	*Penicillum*	Cheese, antibiotics
3	*Yeast*	Bread,beer,wine
4	*Agaricus*	Mushroom
5	*Streptococcus*	Curd,butter
6	*Vinegar*	acetobacter

Rohit Kumar

Harmful Microorganism:

Sl.no	Microrganism	Benefits
1	*Salmonella*	Salmonellosis
2	*streptococcus*	Mastitis in bovine
3	*E.coli*	Colitis in water
4	*Mycobacterium*	Tuberculosis
5	*Clostridium*	Spoilage in canned product
6	*Ervinia*	Spoilage in vegetable