UNIT – 5

a) Fermentation Methods and General Requirements

Fermentation Methods:

1. **Batch Fermentation:**
    - **Characteristics:** All components added at the beginning, and the process runs until completion.
    - **Advantages:** Simple, easy to control.
    - **Disadvantages:** Productivity may be limited.
2. **Continuous Fermentation:**
    - **Characteristics:** Continuous addition of nutrients and removal of products.
    - **Advantages:** High productivity, continuous operation.
    - **Disadvantages:** Complex setup, potential for contamination.
3. **Fed-Batch Fermentation:**
    - **Characteristics:** Continuous addition of nutrients during fermentation.
    - **Advantages:** Combines aspects of both batch and continuous fermentation.

General Requirements:

1. **Microorganisms:**
    - Chosen based on the product of interest (e.g., bacteria, yeast, fungi).
    - Strain selection is crucial for productivity.
2. **Media:**
    - Composition tailored to the nutritional needs of the microorganism.
    - May include carbon and nitrogen sources, minerals, and vitamins.
3. **Equipment:**
    - Fermenter vessels with temperature, pH, and agitation controls.
    - Monitoring instruments for process parameters.
4. **Sterilization Methods:**
    - Autoclaving, filtration, or chemical sterilization to eliminate contaminants.
5. **Aeration Process:**
    - Supplying oxygen for aerobic microorganisms.
    - Controlled airflow to optimize growth.
6. **Stirring:**

- Ensures even distribution of nutrients and oxygen.
- Prevents clumping of microorganisms.

b) Large Scale Production Fermenter Design and Various Controls

Fermenter Design:

1. **Vessel Design:**
    - Stainless steel or glass-lined vessels for durability and corrosion resistance.
    - Cooling jackets or coils for temperature control.
2. **Agitation System:**
    - Stirrers or impellers to enhance mixing and prevent clumping.
    - Adjustable speed for control.
3. **Aeration System:**
    - Spargers or diffusers for efficient oxygen transfer.
    - Controls for aeration rate and oxygen concentration.
4. **Temperature Control:**
    - Cooling or heating systems to maintain optimal temperature.
    - Automated control systems.
5. **pH Control:**
    - Addition of acids or bases to maintain optimal pH.
    - pH probes and controllers for automation.
6. **Nutrient Feeding System:**
    - Pumps for controlled addition of nutrients.
    - Fed-batch systems for continuous nutrient supply.

Various Controls:

1. **Temperature Control:**
    - Maintained at the optimal temperature for microbial growth.
2. **pH Control:**
    - Monitored and adjusted to ensure a favorable environment for microorganisms.
3. **Aeration Control:**
    - Adjusted to optimize oxygen transfer rates.

4. **Agitation Control:**
    - Regulated to prevent settling and enhance nutrient distribution.
5. **Nutrient Feeding Control:**
    - Controlled addition of nutrients to maintain optimal conditions.

c) Study of the Production of - Penicillins, Citric Acid, Vitamin B12, Glutamic Acid, Griseofulvin

Penicillins:

- **Microorganism:** Penicillium spp.
- **Media:** Nutrient-rich with carbon and nitrogen sources.
- **Fermentation Conditions:** Aerobic conditions with controlled temperature and pH.
- **Harvest:** Penicillin extracted from the culture.

Citric Acid:

- **Microorganism:** Aspergillus niger.
- **Media:** Sugars as carbon source.
- **Fermentation Conditions:** Aerobic conditions with controlled temperature and pH.
- **Harvest:** Citric acid recovered from the culture.

Vitamin B12:

- **Microorganism:** Propionibacterium shermanii.
- **Media:** Complex media with cobalt ions.
- **Fermentation Conditions:** Anaerobic conditions with controlled temperature and pH.
- **Harvest:** Vitamin B12 extracted from the culture.

Glutamic Acid:

- **Microorganism:** Corynebacterium glutamicum.
- **Media:** Carbon sources like glucose or molasses.
- **Fermentation Conditions:** Aerobic conditions with controlled temperature and pH.
- **Harvest:** Glutamic acid recovered from the culture.

Griseofulvin:

- **Microorganism:** Penicillium griseofulvum.
- **Media:** Complex media.
- **Fermentation Conditions:** Aerobic conditions with controlled temperature and pH.

- **Harvest:** Griseofulvin extracted from the culture.

d) Blood Products: Collection, Processing, and Storage of Whole Human Blood, Dried Human Plasma, Plasma Substitutes

Whole Human Blood:

1. **Collection:**
    - Aseptic collection from donors into sterile bags with anticoagulants.
    - Separation into components (plasma, RBCs, platelets) using centrifugation.
2. **Processing:**
    - Leukocyte reduction for some applications.
    - Blood typing and screening for infectious diseases.
3. **Storage:**
    - Refrigeration for short-term storage.
    - Cryopreservation for long-term storage of certain components.

Dried Human Plasma:

1. **Collection:**
    - Similar to whole blood collection.
    - Plasma separated and freeze-dried.
2. **Processing:**
    - Removal of water to form a stable, dry powder.
    - Preservation of clotting factors.
3. **Storage:**
    - Shelf-stable at room temperature.
    - Reconstituted with sterile water before use.

Plasma Substitutes:

1. **Collection:**
    - Synthetically produced or derived from human or animal sources.
2. **Processing:**
    - Purification to remove contaminants.
    - Formulation with electrolytes to mimic blood plasma.
3. **Storage:**
    - Generally stored in liquid form.

- Must be compatible with the recipient's blood type.

Understanding the principles of fermentation, large-scale production, and blood product processing is essential for professionals in biotechnology, pharmaceuticals, and healthcare. These processes play a crucial role in the production of various bioproducts and therapeutic interventions.