

CHAPTER 7

FOOD AND BIOPROCESS ENGINEERING DISCIPLINE

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COURSE SYNOPSIS

Food and Bioprocess Engineering

Introduction to food and bioprocess engineering profession: Definition of food and bioprocess engineering. Specializations/ Options in food and bioprocess engineering. Use of various implements and equipment in food and bioprocess engineering for various operations/process. Prospects and job opportunities in food and bioprocess engineering as a profession. Relevant regulatory bodies and societies in food and bioprocess engineering. The role of food and bioprocess engineers in advancement of humanity.

7.0 INTRODUCTION TO FOOD AND BIOPROCESS ENGINEERING DISCIPLINE

7.1 DEFINITIONS

Food – It is simply any substance consumed to provide nutritional support for the body. In a broad sense, food is any edible substance (usually of animal or plant origin), consisting of nourishing and nutritive components such as carbohydrate, fat and oil, protein, essential minerals and vitamins, which when ingested and assimilated through digestion sustains life, generates energy and provide growth, maintenance and development of human body.

Bioprocess – Bioprocess is any specific operation that uses complete living cells or their components (e.g bacteria, enzymes etc.) to obtain desired end products.

Engineering –It is the discipline and profession that deals with acquisition and application of scientific, mathematical, economic, social, and practical knowledge to design, build and maintain structures, machines, devices, systems, materials and processes that safely realize a solution to the needs of the society.

Also, it is the field of study in which the knowledge of mathematical and natural sciences gained by study, experience and practice is applied with a good sense of judgment to develop ways to economically utilize the materials and forces of nature for the benefit of mankind.

Bioprocess Engineering- It is the alteration or application of renewable materials to generate value-added products. It deals with the design and development of equipment and processes for manufacturing of products such as food, feed, pharmaceuticals, nutraceuticals, chemicals, papers, fuel etc. from biological(living) materials.

Food Engineering –It is branch of engineering that deals with design, construction, maintenance and operation of food processing equipment.

It can also be defined as the application of relevant engineering principles to food and other raw materials for the production of useful edible products and by-products.

The main objective of Food and Bioprocess Engineering is to develop quality value added products in good quantity from food materials and other relevant living organisms.

The Food and Bioprocess Engineering program is designed to capture the essential features of both food science and engineering education. The programme provides opportunity to work on pilot-plant studies and manufacturing systems. In short, Food and Bioprocess Engineering graduates are engineers with a strong food science education.

7.2 Specialization- Options in Food and Bioprocess Engineering

Some of the areas of focus of Food and Bioprocess Engineering profession are stated below:

7.2.1 Machine Design Engineering:

It is the branch of food and bioprocess engineering that deals with the development of machines and equipment needed in the production of processed food and bioprocessed products. In the development of new products, many unit operations are involved; some of which are-handling of raw materials, cleaning, material separation, size reduction, forming, pumping, mixing, heat addition, heat reduction. All these operations require the use of one or more machines/equipment, as a result of these, engineering and scientific streams of knowledge are used to design, modify or develop new machines/equipment needed for the specific operations to take place.

7.2.2 Storage and Packaging Engineering:

Storage is the safe keeping of products in condition (s) that would maintain their best quality and quantity until when they would be needed. Packaging is an aspect

of post-production process that deals with confinements in which manufactured products are kept. Packaging may be done to give products better appearance, for proper handling and transporting of products, ease of marketing the products, improvement of product quality etc. This branch of food and bioprocess engineering requires a sound knowledge of engineering behaviours of products and materials under various environmental, production and storage conditions. Information obtained via rigorous engineering/field experiments and tests would help to know the shelf life of manufactured products in storage and packaging materials/containers. It would also help to know when packaging containers/materials for specific products are to be modified or changed based on market trends and consumers reactions. Modification or manufacturing of new storage and packaging containers would be achieved via engineering activities.

7.2.3 Food Bioprocess Engineering:

This is another option in food and bioprocess engineering programme. It mainly deals with the thorough monitoring and control of process conditions. Therefore, knowledge of modelling (especially with computer) is required. (*It should not be confused with food and bioprocess engineering!*). Some processes are involved when specific food and bio-products are to be developed. Some of the processes are: fermentation, clarification, homogenization, pasteurization, drying, freezing, cooling, addition of materials etc. In carrying out process operations, proper care must be taken before, during and after the operation in order to ensure that the quality and quantity of manufactured products are not adversely affected. To achieve that, proper control of governing process conditions must be ensured; in some cases, automation of operations is done.

7.2.4 Bioenvironmental Engineering

It is the use of living organisms coupled with engineering principles to clean up the environment or environmental components.

7.2.5 Biotechnology

It is the use of living organisms, tissues, cells or their molecular components to alter the genetic make-up of living organisms so as to be able to produce another useful products. Biotechnology has been used in the field of medicine to produce antibiotics and vaccines; in agriculture to produce new varieties of plants and breeds of animals. It was also used during world war to produce biological weapons.

7.3 USE OF VARIOUS EQUIPMENT IN FOOD AND BIOPROCESS ENGINEERING

The following are common equipment used in food and bioprocess engineering:

SN	Equipment	Operations
1	Bioreactors	Fermentation operation, biogas production etc.
2	Dryers	Reducing the moisture contents of materials/products.
3	Mixers	For ensuring homogeneous distribution of raw materials.
4	Water baths	For maintaining the temperature of products.
5	Refrigerator	For reducing cooling of products/materials.
6	Autoclave	For sterilization operation.
7	Pulping machine, Cutting machines, Crushers, Shredder, Grinding machine etc.	For size reduction of materials/products.
8	Shaping equipment	For shape forming.
9	Pumps, Fans	For moving fluids, cleaning of equipment.
10	Silos, Bins etc.	For storing products/materials
11	Expellers, Extruders etc.	For liberating oils from oil bearing materials. For liberating liquid extracts from materials.
12	Desiccators	For maintaining the moisture content of products/materials
13	Ovens/moisture meters	For determining the moisture content of material.
14	Sieve Shakers	For determining the

		particle size of material/product.
15	Conveyors, Elevators etc.	For material handling and movement from one point to another during operation.
16	Canning and Bottling Machines	For precise measurement products of into cans and bottles
17	Sealing Machine	Covering of products in containers.



Portable Leaf Area Meter: An instrument for determining surface area of leaves.



Laboratory Oven Model H-30100.4F (O°-300°): An instrument for determining the moisture content of agricultural and biological materials.



TESTO 645 Temperature and Relative Humidity Measurement Data Logger with probe_ A device for measuring temperature and relative humidity of produce in a structure.



IKA Digital Bomb Calorimeter with Digital Cooling System Supply Water Model KV 600:

An instrument used in measuring the heat of combustion of a particular reaction.



Moisture Meter: An instrument for determining the moisture content of materials



Motorized Sieve Shakers: An instrument for determining the particle size of materials/products

7.4 PROSPECTS AND JOB OPPORTUNITIES IN FOOD AND BIOPROCESS ENGINEERING

Human race cannot do without food and other bio-products for her existence and proper functioning. Recall the maxim: *“a hungry man is an angry man”*. Therefore, there are many job opportunities for Food and Bioprocess Engineering graduates in various sectors of human endeavours.

7.4.1 Food and Allied Products Industries

There are various food and allied products industries all over the world. Some of the industries are: Breweries, Fruit juice and Soft drink industries, Beverage industries, Flour making industries, Pharmaceutical industries, Paper Mills, Confectionery industries, Dairy Products Industries, Biofuel Industries, Agricultural commodity processing Industries (Tomato Processing, rice mills, Sugar making industries, Meat and Sea Food Processing, Oil Seeds Processing, Rubber Processing etc.)

7.4.2. International Corporations/Agencies

There are many international corporations/agencies with job opportunities. These bodies have several units/department of which food programmes are included. Some of them are: Food and Agricultural Organization (FAO), United Nations Agencies, World Bank Assisted Programmes, New Partnership for Africa Development (NEPAD), International Fund for Agricultural Development (IFAD), International Institute for Tropical Agriculture etc.

7.4.3. Government Agencies/Ministries/Parastatals

The following are some of the government agencies/ministries/parastatals with job opportunities. Federal and State ministries of Agriculture, National Centre for Agricultural Mechanization (NCAM), Nigerian Stored Products Research Institute (NSPRI), Raw Materials and Development Council, National Cocoa Research Institute, Federal Grain Reserve Centres, Standard Organization of Nigeria (SON), National Agency for Food, Drug, Administration and Control (NAFDAC), Military and Paramilitary Bodies, Government Banks (Central Bank of Nigeria, Bank of Industry, Bank of Agriculture) etc.

7.4.4 Tertiary Institutions

Some tertiary institutions in Nigeria and many in abroad are offering courses in Food and bioprocess engineering or as options in Agricultural Engineering. Yearly, the number of tertiary institutions keeps increasing; therefore more manpower is needed to fill up the new institutions and also to replace retired or mobilized personnel.

7.4.5 Self Employment

Food and Bioprocess Engineers can decide to stand on their own after the acquisition of necessary qualification and experience. They can work as independent researchers or venture into equipment sales and servicing; design and construction of machines, manufacturing and sales of processed products; consultancy services or contract staff to organized bodies.

7.5 RELEVANT PROFESSIONAL BODIES

A Food and Bioprocess Engineer in Nigeria for now, is permitted to register with Nigerian Institution of Agricultural Engineers (NIAE). The Nigerian Society of Engineers (NSE) which he/she should also be a member four years after graduation also permits member to join another related society under NSE.

He must also be a member of Council for the Regulation of Engineering in Nigeria (COREN). It is important to note that the title “**Engr.**” before his name must not be used (it is unlawful and punishable) unless he/she has registered with COREN. Other professional bodies are West African Society of Agricultural Engineers (WASAE), American Society of Agricultural and Biological Engineers (ASABE), and any other specific or related ones

7.6 THE ROLE OF FOOD AND BIOPROCESS ENGINEERS IN ADVANCEMENT OF HUMANITY

- (i) Bridging the knowledge gap between theory and practice in matters relating to engineering aspects of development of processed food and bio-products.
- (ii) Identification and provision of feasible solutions to problems related to food processing, storage and utilization.
- (iii) Development of new products and processes that are beneficial to the society through research.
- (iv) Standardization of food and bioprocess engineering equipment, procedures and facilities brought from abroad.
- (v) Formulating, implementing, enforcing and reviewing food and bioprocess policies, programmes and projects that will address the needs of the society.
- (vi) Rendering useful services to the community, private organizations, international organizations and government in form of advice and intellectual opinions.
- (vii) Training of young Engineers, interested groups/association and individuals.
- (viii) Projecting and protecting the good image of the engineering profession at large.

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