



**ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY**

**B. Tech (Food Technology)**

Course No.: **FDST 111**

Credit Hours: **2 (2+0)**

**THEORY STUDY MATERIAL**

**FOOD PRODUCTION TRENDS AND PROGRAMMES**

Prepared by

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**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**DETAILED LECTURE OUTLINES**

1. Course No. : **FDST - 111**
  2. Title: **Food Production Trends and Programmes**
  3. Credit hours: **2 (2+0)**
  4. **General Objective:** To impart knowledge to the students about advanced technology in food science and recent trends adapted in food science and technology.
  5. **Specific Objectives:**
    - a) Theory: By the end of the course, the students will be able to –
      - i. Know about terminology regarding food technology and various research stations of agriculture located in different places and their importance in agriculture
      - ii. Learn about different technological processes of food industry, classification of foods according to market, food crops and its Post Harvest Technology, World Food Day, growth of Indian Food processing industry, recent technologies of food technology and their principles and applications
    - b) Practical: No practical component
- A. Theory Lecture Outlines:**
1. Introduction - Food Science and Technology
  2. Definition - Food science, Food technology and their sub discipline, difference between Food Science and Technology
  3. Status of food processing industry in India and abroad
  4. Reasons for slow growth of Indian food industry- scope for expansion of market - Dairy, Bakery, Confectionary, Beverages and Snack foods etc.
  5. Potential and prospects of Indian food Industry
  6. Popularity of Indian foods- National and International Projects/Institute and their food products
  7. Magnitude and Interdependent activities and processing agencies
  8. Ministry of Food Processing - Objectives and its function to develop the food processing industry. APEDA - Agricultural Processed Food Products Export Development Authority
  9. Food characteristics - Food nutrients-Proteins, Fats, Carbohydrates, Vitamins and Minerals - Functions - Sources
  10. Classification of foods based on pH - Low acid food, medium acid food, highly acid food and acid food - Definition and Examples

11. Types of foods - Convenience food, definition, characteristics and classification - Ready- to-Eat foods, Ready-to-use-foods and beverages
12. The point to be kept in mind while purchasing convenience foods - Advantages and disadvantages of convenience foods - flow chart for some ready to eat products
13. New food product development - Strategies for new product development - Recent trends for processing of food, its principle and application, new techniques for new food product development - Genetically modified foods - Advantages and disadvantages
14. Functional foods - formulated foods - Special foods - Imitation meat food / meat imitation - meat food - definitions - Advantages and disadvantages
15. Food demand and supply - food requirements - factors affecting on food demands - present market segments of food process industry in India
16. Features of food processing industry to meet the needs - processed food industry in India - further priorities in food production need
17. Food losses and factors affecting food losses - physical, chemical, physiological and biological factors
18. Programmes and strategies to eliminate the food losses - Post harvest management, Importance of value addition and methods of storages
19. Packaging of processed food - Definition for modified atmospheric packaging - Vacuum packaging – Aseptic packaging for improving the shelf life of perishable foods.
20. Different types of losses - priorities - Scope of value addition in fruit and vegetables
21. Food availability area and production of fruits, vegetables, spices, rice, wheat, milk etc Nutrient management
22. Development of disease resistant varieties - Organic farming for improvement of the food Production
23. Classification of crops - Average area, production, nutritional composition, cereals and millets, pulse based food crops
24. Classification of food crops - Oil seeds, Fiber crops, sugar crops and their nutritional composition
25. Year wise production trends, comparison of food grains and future need
26. Production and estimated post harvest losses - Development programmes, Research organization - Potential of income and employment generation through post harvest operation
27. Programmes for food production - programme implementation - Brown revolution - Yellow revolution - Blue revolution - Production increase for growing population in India
28. Programmes for food production - food security - factors affecting on food security - Green revolution - White revolution
29. Globalization of food Industries, food standards to meet global market - global demands for Food

30. World Food Day - Importance for theme - Agricultural growth and plan for elimination of Hunger
31. Present trends of consumption - further requirement - consumer change of aptitude in food product consumption
32. National and International trends in food handling, processing and marketing

B. **Practical class outlines:** No practical component

**References:**

- Potter N.N. Food Science. 3rd Edn. (1978) AVI Publishing Co. Inc, West Port, USA.
- Herson A.C and Null A.D. Canned Foods Thermal Processing and Microbiology. Churchill Ltd., London.
- Vijayaraghavan K. Agricultural Administration in India.
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- Desai B.M., Gupta N.V. and Namboodri. Food Processing Industries. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Graft and Saguy. Food Product Development (From concept to market place). CBS Publishers, New Delhi.

## Lectures 1 and 2

1. *Introduction - Food Science and Technology*
2. *Definition - Food science, Food technology and their sub discipline, difference between Food Science and Technology*

### **FOOD SCIENCE AND TECHNOLOGY**

**Food Science** is a discipline concerned with the technical aspects of the food beginning with harvesting, or slaughtering the live stock and ending with its cooking and consumption. It is considered one of the agricultural sciences and is usually different from the field of Nutrition.

Food Science has been defined by Margaret (1968) as: "The application of the basic science and engineering to study the fundamental, physical, biological and biochemical nature of foods and the principles of processing and marketing of food".

Dennis R Helmand, the International Food Technologists (IFT) president in October 2006 has described Food Science as an discipline in which engineering, biological and physical science are used to study the nature of foods, the cause of deterioration, the principles underlying food processing and improvement of foods for consuming public.

**Food Technology:** Food Technology can be defined as: "science dealing with knowledge of doing things efficiently and effectively".

**Difference between Food Science and Food Technology:** Food science and Food technology maintain a special relationship with several basic disciplines as well as with other applied specializations. Food science and food technology are not two separate subjects, the relation between Food Science and technology is subtle and complex.

Food Technology deals with engineering and other scientific as well as technical problems involved in transforming edible raw materials and other ingredients into nutritious and appetizing food products. Food science is concerned with the basic scientific facts about foods where as food technology is concerned with the processing of raw materials into foods that meet the human needs and works.

**Objectives for the study of Food Science and Food Technology can be listed as follows:**

- 1) Food Science helps us to understand theory of foods.  
E.g.: The methods that can be used to store and preserve food to maintain quality and prevent spoilage
- 2) Food science and food technology demonstrates how food is stored, preserved, processed and transported and has been responsible for development of new technique for preserving and processing food on a commercial scale and for packaging, in such a way that it can be sold conveniently.
- 3) Food science and food technology are relatively a new field. They have begun to achieve a degree of technical maturity in its development nationally and internationally.

- 4) Food Science deals with study of fact of physical, chemical and biological science as they influence processing and preservation of food.
- 5) They also help to understand the nature and composition of foods including color, texture, consistency and keeping quality depending on the constituents present in it.
- 6) They study the changes that occur in foods during storage, preparation and processing.
- 7) They help to learn the ideal methods of food storage, preparation and processing to conserve the nutritive value and increase acceptability.
- 8) They help to learn the selection of good quality and nutritive foods keeping into consideration the economic standard of the family.
- 9) They help to improve the digestibility of foods. The digestibility of food is affected by the composition of food, processing and method of preparation.
- 10) They help to maintain the safety of foods. In India, the food standards have been set by ISI, Agmark, FPO and BIS.
- 11) Studying food science and food technology helps us to understand their importance of food in life.

**Sub-disciplines of Food Science:** The various sub-disciplines in Food Science are as follows:

- (1) **Food Safety** is a scientific discipline which describes handling, preparation and storage of foods in ways that prevent the food borne illness. In developed countries the main issue is simply the availability of adequate and safe water as it is a critical item.
- (2) **Food Microbiology** is the study of microbes which inhabit, create and contaminate the food. Although some of the micro organisms cause food spoilage, 'good' bacteria such as pro-biotics are becoming increasingly implying Food Science. Micro organisms also help in the production of food items like cheese, yoghurt and fermented products like bread, wine and beer.
- (3) **Food Preservation** is the process of treating and handling foods to stop or slow down spoilage (loss of quality, edibility and nutritive value) caused or accelerated by micro organisms. Some methods use benign bacteria, yeast, fungi to add specific qualities to preserved foods (cheese, wine). While maintaining or creating nutritive value, texture and flavor is important in preserving its value in foods.  
Common methods of applying these processes include drying, spray drying, freeze drying, freezing, vaccum packing, caning, preservation in syrup, sugar crystallization, food irradiation and adding preservatives.
- (4) **Food Engineering** is a multi-disciplinary program which combines science, microbiology and engineering education to food and related industries. It includes but is not limited to the application of agricultural engineering and chemical engineering principles to food materials. It includes research and development of new foods, biological and pharmaceutical products, development and operation, manufacturing, packing, distribution systems for drug or food products.

- (5) **New Product Development (NPD)** is used to describe the complete process of bringing new products of services to the market. It involves two parallel path ways – one where in the ideas are generated, product designed as well as detailed engineering and second one involves market research and analysis.
- (6) **Sensory Analysis / Sensory Evaluation** is a scientific discipline that applies the principles of experimental design and statistical analysis to use to human senses (sight, smell, taste, touch and hearing) for the purpose of evaluating consumer products. The discipline required panel of human assessors by whom the products are tested and the responses recorded. By statistically analyzing the results possible inferences can be made.
- (7) **Food Chemistry** is a sub-division of sensory evaluation where in the study of chemical processes and interactions of all biological and non-biological components of foods are carried out. It also encompasses as to how products change under certain food processing techniques and the way to enhance or prevent them from happening.  
Ex.: A process to prevent browning of cut apples is the application of lime juice or salt to them.
- (8) **Food Packing** - the packing of foods require protection, tampering resistance and special physical, chemical or biological needs. It also shows the product label with nutritional information of the foods being consumed.
- (9) **Molecular Gastronomy** is a scientific discipline involving the study of physical and chemical processes that occur in cooking. It pertains to mechanics behind the transformation of ingredients in cooking and the social, artistic and technical components of culinary and gastronomic phenomena.
- (10) **Food Technology / Food Tech** is the application of food science to selection, preservation, processing, packaging, distribution and use of safe, nutritious and wholesome foods.
- (11) **Food Physics** deals with the physical aspects of foods such as viscosity, creaminess and texture.

### Lecture 3

#### 3. *Status of food processing industry in India and abroad*

## **STATUS OF FOOD PROCESSING INDUSTRY IN INDIA AND ABROAD**

In India first Food Processing Industry was established in 1942. Food processing industry has a large spectrum of industries, producing fruits and vegetables, bakery products, confectionary, marine products and meat products. India is rather agricultural basic and is in a position to emerge as world leader in food processing technology.

The production of fruits and vegetables is confined to 43 and 101 million tons, against world production of 341 million and 441 million tons respectively. India's share in world production is about 9% in fruits, 9.3% in vegetables. India is 3<sup>rd</sup> largest producer of fruits after Brazil and USA and 2<sup>nd</sup> in vegetables after China. It produces about 65% of world mangoes and bananas, 12% of World's onions. India has a potential production of mushrooms after China, Taiwan and Korea. The mushrooms exported from china are not catching the world market demand due to toxicity, associated with mushrooms. The mushrooms produced by Taiwan and India are just competitive due to higher value and demand.

In India, 52% of total land is cultivated against 11% in the world. All the 15 major climates of the world are available with snow bound Himalayas to hot humid southern peninsula, Thar Desert to heavy rain areas all exist in India. There are 20 agro-climatic regions and nearly 46 out the 60 soil types are present in the country. Sunshine hours and day length are ideally suited round the year for cultivation of crops.

**India's share in world production and area for major crops:**

Particulars	Production (%)	Area (%)	India Production	Rank Area
Wheat	11.49	11.20	2	2
Rice	21.49	25.50	2	1
Pulses	26.00	36.60	1	1
Ground Nut	28.60	35.20	1	1
Sugar cane	22.60	20.00	2	2
Tea	28.30	18.50	1	2

- India is center for biodiversity in plants, animals, insects, micro organisms and account for 17% animal, 12% plant and 10% fish generic resources in the world.
- In the live stock sector, India has 16% of cattle, 57% of buffaloes, 17% of goats and 5% sheep population of the world.
- Agriculture contributes 24.2% of GDP, 15.2% of total exports and provides employment to 58.4% of country's work force.
- India has a very large livestock according to 2005 data the livestock population was 941.8 million of this 287 millions of cattle, 75 millions of buffaloes, 70 million bullocks, 110 million goats, 5.4 million sheep, 10 million pigs and 310 million poultry birds. There is a good scope for increasing the production of meat and poultry products.
- Food Product Order (FPO) was passed in 1955 to ensure the consumers good quality and maintaining hygienic standards. It is estimated that about 30 to 35% of fruits and vegetables of about Rs. 3,000 Crores are crushed due to poor harvesting facility.
- With a costal line of about 8000 km of which A.P. costal line is 932 Km, 28,000 km rivers, 3 million hectares of reservoirs (lakes), 1.4 million hectares of brackish water area, India has vast potential for marine and inland fishing area of about 9 million metric tons.
- There has been huge cattle migration that is taking place every year as the owners whether in M.P. Rajasthan and Gujarat lead them to areas where they can find precious food. Estimates done by national preservation of Agra show that there is a tremendous shortage of food around 31%, which is, expected rise further.
- India's cattle population numbering more than 272 million is quietly and steadily achieving away large areas of the percent as grown human and animals complete for food and more and more land is brought under cultivation. Cattle serving for food are degrading the land all over India. In the quest for food, cattle's are taking by their owners to wildlife parks and sanctuaries, damaging the forest and passing on livestock diseases to wild animals which have no humanity. The Indian bison and spotted deer ended contacting the mouth disease and died of it.

- India has 3600 licensed laboratories. However only a couple is mechanized and hygienic, “All Kabir stores” at Hyderabad costing about Rs. 78 Crores and “Punjab meat limited” costing about Rs. 48 Crores, where started with high technology machines. The machinery includes automatic cleaners, liners, mobile platforms and power saws which are imported from Europe. Indian meat industry is evaluating and enquiring the potential for meat exports in order to supply hygienically processed meat to consumers and it is estimated that they could raise many fold from Rs. 389 Crores (1994-95). The director of Punjab Meat Limited suggested that it is shaking for a country with a large livestock population, to be economically less than 1% of the Global bounded meat trends.
- There is a considerable scope for increasing production of meat and meat products as regards to export markets.
- As mentioned in FICCI report of October 2004, India is the –
  - (a) Second highest fruits and vegetables producer in the world (134.4 million tonnes) with cold storage facilities for only 10% of the produce.
  - (b) Second highest producer of milk with cold storage capacity of 70, 000 tonnes
  - (c) Fifth largest producer of eggs. Investment in cold chain required to store 20% of the surplus meat and poultry products during the 10<sup>th</sup> plan is 500 crores.
  - (d) Sixth largest producer of fish with harvesting volumes of 5.2 million tonnes. Investment required is estimated to be 350 crores of rupees.
- In spite of these vast natural resources and abundant agricultural produce, India ranks below 10<sup>th</sup> in the export of food products. Conservative estimates put the processing levels in the fruits and vegetables sector at 2%, meat and poultry at 2%, by way of modern dairies at 14%, bulk meat de-boning of tuna at 21%. Currently, the food processing sector though is nascent, constitutes of 14% manufacturing GDP amounting to product value of 2, 80, 000 crores of rupees. It employs 130 lakh persons and is supposed to increase at an annual rate of 7%.

The total production of food grains and cereals in the country is estimated at around 205 Million tons.

<b>Food Item</b>	<b>Production in millions of tons</b>
Rice	90
Wheat	75
Coarse grain	35
Oil seeds	26
Vegetables	76
Fruits	60

**India is exporting:**

<b>Products</b>	<b>Amount in Crores of Rs.</b>
Fruits and vegetables waste	165
Marine products	3000
Meat and meat products	140
Raw fruits and vegetables	380

(This raw fruits and vegetables include onion, tomato, banana, mango and apple.

The following exports may be increased many folds:

1. **Cereal Products:** Include wheat based foods like aerated buns, breads, puffs, pastry, soups, breakfast foods, barley based products etc.
2. **Fruits and Vegetables:** These include dehydrated and canned vegetables, nuts, soups, juices, Jellies, drinks.
3. **Sugars and confectionary:** These include coffee, drinks, syrups, Honey, Cakes, table jellies, cool drinks.
4. **Meat and Poultry:** These include meat pickles, processed meat, egg powder, egg cakes.
5. **Fish Products:** These include canned fish products such as: Marley, tuna and also consumer products such as fish cakes, sea food meat, fish chips.
6. **Others:** Juices in consumer packs, soybean based products, breakfast meals, ready to eat, ready to serve foods (parotas, coffee, drinks, cutlets, biscuits).

**AREAS WHERE PROCESSING CAN BE INCREASED IN INDIA:**

- a) Fruits and Vegetables soups, pickles.
- b) Dairy products cheese, butter.
- c) Poultry pickles, bakery (cakes).
- d) Bakery biscuits, cakes, puff.
- e) Convenience foods omelets, cutlets, biscuits.
- f) Frozen foods ice cream
- g) Beverages and confectionary cool drinks, chocolates.
- h) Meat and fish pickles, tuna etc...

**Inter dependence of dairy and food industry:** There has been variety of food where milk and its products were utilized. Cereal products like bread, breakfast foods, pizza, grated cheese in sandwich, fruits, fruit shakes, cream in different variety of soups, sugar, preserve and confections, biscuits, coffee, drinks, etc. A variety of infant foods, malt based products such as: Boost, Horlicks, Ceralac.

**Indian Dairy Industry:** India has one of the largest livestock productions (i.e. 825 million). 50% of buffaloes and 20% cows, in the world are found in India. Most of which are milch cows and milch buffaloes. The milk surplus states in India are U.P, Punjab, Haryana, Rajasthan, Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu.

**Milk Consumption Pattern:**

Product	Consumption %
Liquid Milk	46
Ghee	28
Curd	07
Butter	06
Condensed milk	05
Milk Powder	5.5
Infant food	04
Cheese / Paneer	02
Others	01

Total milk production	-	90 million tons
Value	-	85000 Crores
Milk processed	-	14 %
Household consumption	-	43 %
Growth rate of Indian Industry	-	4 %
Per capita Milk availabilities	-	231g/day

**Grain Milling Sector:** India produces about 200 million tons of different food grains every year. All major grains like paddy, wheat, maize, barley and millets like jowar, bajra, Ragi (Finger millet) are produced in the country. India is self sufficient in grain production and it is the second largest rice producer with 20% share.

**Milk Industry:** India is largest milk producing country in the world. Cheese and condensed milk production stands at 5000 and 11,000 tons respectively.

**Soft drink sector:** Pepsi, Cola. The major products are nonalcoholic, flavored or sweetened, beverages, Colas, Orange and lemon juices are some of the accepted tastes in India. Currently it is estimated that 65% prefer non-alcoholic drinks.

**Packaged and Convenience Food Sector:** Packaged food products sector have been slow in India because of its 250 million strong middle classes. But due to growing organization and change of food habits, the demand has been rising to a good scope and there is enough market potential rating to be exploited through development efforts.

### **The Indian Food Processing Industry:**

The food processing industry has an important role to play in linking the famers to final consumers in domestic as well as international market. Food processing combined with marketing has the potential to solve the basis problems of agricultural surplus, wastage, rural jobs and better remuneration to the growers. In the next ten years, the food production is expected to be doubled. These produce, if processed and marketed smartly can make India to become a leading food supplier to the world.

India with a population of 1.28 billion (growing at 1.7% per annum) provides a large growing market for food products. Food products are the single largest component of private consumption expenditure, accounting for as much as 49% of total spending. Furthermore, the upward mobility of income classes and increasing need for convenience and hygiene is driving demand for

- (a) Non perishable and non food staples
- (b) Processed foods.

Also with globalization of trade and availability of high speed logistics, food retailers in developed countries are sourcing a year round supply of fruits and vegetables from developing countries. Thus availability should be year round for local consumption and export of fruits, vegetables, meat, and poultry products and ready to eat processes foods.

The processed food industry has to introduce innovative new products of high quality at low cost in small package sizes in ready to eat format to cash on this booming industry. HLL, ITC, MTR and others have introduced some innovative heat and eat dishes with reasonably good packaging. But there is lot of manual handling and hence food hygiene and quality is suspect.

Multinational companies have entered the food value chain in India. Cargill and Congra in agri-inputs, Tropicana in food processing and Metro in Wholesaling are global leaders. Local companies like Dabur, MTR, ITC, Godrej and AMUL are aggressive across the value chains. Multiple restaurant chains such as Mc Donald's, Pizza Hut, Dominos, Coffee day, Qwiky's, Saravana Bhavan and Sagar Chains are growing rapidly. However the pace is slow in the food sector compared to the other sectors such as the IT and pharma. There is no billion dollar player in India in the food industry where as China and Philippines have several large players with sales exceeding one billion dollars per annum.

#### **Lecture 4**

4. *Reasons for slow growth of Indian food industry- scope for expansion of market - Dairy, Bakery, Confectionary, Beverages and Snack foods etc.*

### **REASONS FOR SLOW GROWTH OF INDIAN FOOD INDUSTRY**

- 1) The fundamental cause of poor performance in Indian food industry can be traced to the lack of latest technologies, modern ideas, sanitation and hygiene.
- 2) Due to low overall purchasing power of the vast section of Indian population, the demand for food has never been translated itself into efficient marketing demand. Large section of Indian population goes to bed with empty stomach (hunger) every evening; but in India food industry does not respond to this hunger.
- 3) The moderate climate over the Indian subcontinent, there are no wide fluctuations the availability of fruit and vegetables and the need for food preservation has not been felt in India.
- 4) The sophisticated cereal technology has made slow progress in India.
- 5) A large vegetarian population and by cost of milk and milk products has provided little problems to the growth of meat and dairying Industry cattle in India have been more a source of power and fertilizer than meat.
- 6) High cost and high prices have taken the products beyond the reach of common man and made the products un competitive in the market the possible reasons can be traced high taxes, high cost of machinery due to high Rs. High interest rates and high incidence of taxes.
- 7) Lack of strong horticultural base has made it difficult for the Industry to procure the quality of fruits and vegetables for producing good quality finished products economically. The bulk of foods and vegetable are graded scientifically for the purpose of processing.
- 8) The farmers are also not able to make proper washing, packing, trading and storing arrangements. There is a lack of integration in production and processing making it difficult for the Industry to get adequate quantity of raw materials of appropriate quality.
- 9) The cost of transformation also hamper transformation of raw materials from production to the processing sides as also from processing sides to the market to good quality conditions.
- 10) Infrastructures bottle necks such as supply of power lack of modern slaughters lack of scoring machinery at the level of retail trade have also affected the Industry.
- 11) Lack of attention research and development (R & D) and communication gap between Industry and R & D instructions have prevented the industry from developing new products with reducing cost, introduced new technologies and process which are suitable to Indian conditions.
- 12) Non-availability of finances at reasonable interest rates.
- 13) The industry has been concentrating only on few products in few markets. For instants with regards to processed fruits and vegetables, the Industry has been dependent on

export of mango-based products to USSR and to some extent in U.K. and Saudi Arabia. As regards marine products are exported to and frozen products are exported to Japan and U.S.A.

- 14) Difficulties in populating the processed items through the media due to high rates. The increased acceptability of processed food products requires changes in traditional eating habits. As also provision of information regarding the quality and nutritional value and other advantages of processed food products. This can be bought through advertisements and promotional activities in the media.
- 15) One of the major problems faced by exporters in lack of information about food norms, quality norms and market trends in other countries.
- 16) In developed countries processed food and fresh food prices are usually within a reasonable range. At times processed foods are even cheaper than fresh foods but in Indian processed food prices per higher than fresh food.
- 17) There has been a drawdown of taxation for the portable product along with Income tax reduction for food and vegetables. The whole pursuable sector should be treated in a similar fashion.
- 18) Lack of infrastructure and post harvest losses multiply the eminent losses leading to an increase in the cost of processed foods. Multiple city of regulatory all authorities also add to cost of processed food.
- 19) Cost of packaging is the other major constraint sector food processing Industry. Cost of packaging ranges from 10 to 64 % of production cost.

Keeping in view these factors, which are achieved by processing, there is an urgent need to take measures to reduce processing cost and preserve the food from changes / losses and avail the processed food cheaper rate.

## Lecture 5

### *5. Potential and prospects of Indian food Industry*

## **SCOPE FOR EXPANSION OF MARKET**

The scope for expansion of market domestically and internationally is immense. The form in which food is consumed has been changing according to requirement, taste, standard of living, life style, development in R&D production, processing, preservation and storage.

The market potential in India is huge. The realization of this potential will require:

- a) Demand creation in urban area as well as rural area through publicity by media and news papers.
- b) Establishment of retail trade network with good and hygienic storage capabilities.
- c) Adoption of good package system with low cost.
- d) Lowering of cost and prizes through better management induction in incidence of taxes and duties both at central and state levels on processed food on packaging material, raw material and machineries, And also reduction in cost of transportation of raw materials and other inputs. The interest rate also can be reduced.
- e) The up gradation of food product quality through introduction of modernization, technological innovation, development of new products with long shelf life.
- f) Harmonization of food loss awareness, quality management systems like ISO 9000, ISO 22000 and HACCP (Hazard analysis critical control point) due to mass production.
- g) The observed fragmentation of the food supply chain. We need to improve on post harvest handling. Cleaning, Grading, packaging and storage.
- h) Infrastructure of food industry should be improved.

- i) Deficiencies exist for grading and packing besides pre cool their form site which could feed into a formalized food chain.
- j) The amendments and modifications of agriculture produce; marketing commodities at food facilitate the reduction in cost as well as allow the festering of beneficial relation ship between the relevant players.
- k) Government subsidy scheme, partnership bank relation should be created and implemented to develop infrastructure. Financing institutions are required to give proper push to Food Industry.
- l) Institutions need to engage both fundamental and applied research and keep abreast of global demands.
- m) India has very wide range of eating habits and food product. Such products and processes need to be in article form, where necessary improved up on and protective.
- n) Research and development on ethic foods shall not only address regional needs but open up a market amongst all over to India market.

## **POTENTIAL AND PROSPECTS OF INDIAN FOOD INDUSTRY**

Food processing industry is going to be a leading Industrial sector in the world by overtaking petroleum, automobiles and Information Technology (IT) from their existing leading positions.

India is one of the largest producers of food crops in world. We are 2<sup>nd</sup> largest producers of fruits and vegetables, Rice and the largest producers of milk in the world. Being perishable in nature, considerable wastage of 30-40% of fruits and vegetables occurs every year due inadequate infrastructures like transportation, cold storage, refrigeration, poor storage and poor marketing facilities. Food processing Industry places an important role in the economy of India and is rightly said to be "Sunrise Industry". Along with food processing Industry, the government should play a proactive and major role to improve the demand in both, India and abroad.

The growth of potential of food processing Industry is enormous and it is expected that the demand for food production will double in next 10 years and the consumption of value added food products will grow at fast rate. This growth of food processing industry, gives immense benefit to the economy, rising Agricultural yield, meeting productivity, creating employment and raising the standards of very large number of people throughout the country especially in rural areas.

Economic liberalization and consumer prosperity is opening up new opportunity for diversification of food processing sector. The food processing industry ranks 5<sup>th</sup> in size in country and employs 20 lacks workers which consist of 20% of the country's Industrial labor force. It counts for 14% of total Industry out-put with 5.5% of GDP. The turnover of the Industry is estimated to be Rs.1, 44,000 crores (nearly). Indian brands are yet to be developed in the International markets due to poor efforts at international marketing.

Post harvest management of fruits and vegetables plays a very important role in the development of Agriculture sector. Insufficient infrastructures at the level of farms and un-hygienic market, with poor protection from sun and rain, they're by causing a considerable impact on post harvest losses, particularly for the more perishable products.

## Lectures 6 and 7

1. *Popularity of Indian foods- National and International Projects/Institute and their food products*
2. *Magnitude and Interdependent activities and processing agencies*

### **BRIEF HISTORY OF THE WORLD FOOD PROCESSING INDUSTRY**

- Food processing is the largest industrial sector in USA valued at Rs. 20,000 crores.
- In Europe about 67% of produce is processed which is valued at Rs. 15,000 crores.
- In Thailand, food processing Industry constitutes 60% of country economy, significantly, of which 19% is in small scale industry.
- China is emerging fast as one of the world's larger processor of all kinds of food products covering fruits, vegetables, mushrooms etc.
- In Brazil, economy has its major scale contributed by Food processing industry permanently by oranges.
- India is the land of spices producing all varieties worth over Rs. 3,500 crores amount and accounts 25-30% of world production which are processed for value addition and exports. It grows 22 million tons of oil seeds, coffee, tea, coca, etc.
- India is largest milk producer in world and about 15% of the total milk is produced is processed through the organized sector and 2% of meat and poultry and 4% fish is processed. It is expected that the annual growth rate in next 5 years is set to the 7.3% far above.

#### **Size of top 20 food processing countries in the world:**

1.

Country	Amount in Crores
USA	42,500
UK	14,500
Malaysia	2,100
India	513

2. India which is able to use 189.74 million hectares of crop growing land and produces annually as follows;

Item	Production/Annum*	Position
Milk	90	1 <sup>st</sup>
Fruits and Vegetables	328	2 <sup>nd</sup>
Live-stock	825	1 <sup>st</sup>
Food grains	205	3 <sup>rd</sup>
Fish	6.2	7 <sup>th</sup>
Eggs	-	5 <sup>th</sup>

\*in million tons

**Comparison of turnover of food processing industry:** Combined turnover of top 300 companies in India is less than that of one single food processing company "Philip marries" of USA having a turnover of over Rs. 1,80,000 crores and more than 1,00,000 crores of Cargill, Unilever, Nestle etc. Our Multi-national companies (MNC) turnover of Rs. 250 to 2000 crores.

#### **Popularity of Indian foods:**

Indian food products are getting extremely popular as

- Indian food business at Brazil is estimated at Rs.16, 300 crores in a year.
- The no of Indian restaurants in London today are 3,800 and in Briton about 9,000 which are more than total number of restaurants in Mumbai and Delhi taken together.
- In UK supermarkets the value of ready-made Indian meals is estimated at Rs.735 crores in a year.
- “Noon PLC” producing Indian food products in London has a turnover of Rs.183 crores.
- In Tokyo which has over 250 Indian restaurants.
- Indian curries have pushed a turnover of Indian food products to Rs.14, 500 crores in UK alone.
- The last two years, one Indian restaurant had been opened almost every day on an average in France.

### **Criteria for success of food processing industry:**

1. The clarity of direction: A company needs to understand the government policies, international standards and policies, funding agencies which give loans to the companies. Also clarity of thought about the product developed should be there. The developmental ideas need to be put to use by the food technologists effectively ironing out the draw backs that crop up in the process of product development. There has to be effective consumer testing to make a new product successful in the market. Positive feed backs helps to successfully launch a product where as negative feedback helps n correcting the drawbacks of the products.
2. The financial resources: For any food processing industry to be developed, there is a need for encouragement from government. Added to that, the interest rates on loans taken should be conducive for better utilization and establishment of new industries. In India due to high tax rates on machinery, raw materials and finished products, the profits from sale of finished goods is not desirable. This too can act as a hindrance for the popularity of processed goods. Government subsidy schemes with strong financial and monetary benefits to the food industry will help in the development of this sector. This sector has been neglected for a very long time. Proper awareness regarding the various financial sources would be of great help to the enthusiastic entrepreneurs to take up food processing on a larger scale.

The substances of these criteria, some international and national levels for the following projects are insisted.

### **International Projects:**

- Mc. Donald’s: 40 Million customers per day in its 25,000 out lets in 155 Countries.
- Dominos Pizza: Sells millions of pizzas per day, 700 branches, 6,400 stores and 1, 30,000 workers.
- Campbell Soups: 2.5 billion bowls and 440 million cans per annum.
- Heinz: Turnover 4, 500 crores and most popular product is Tomato ketchup.
- Tropicana (Pepsi and Cola): Processing capacity 7,000 million tons of oranges, 6.80 million liters of juice per day. Transportation of Tropicana having with refrigerated carries 600 million liter every week, 1.6 million long trains carries 4 million liters juice from Florida to New York.

### **National Projects:**

- National Dairy Development Board (NDDB): Milk and milk products, fruits and vegetables products and edible oils. It was established at Anand in 1965 to help provide facilities for

increasing milk production, marketing and promotion of dairy industries. It provides market support to producers of milk in rural areas and supplies liquid milk, dairy products like ghee, skimmed milk powder, whole milk powder, butter, chocolate at reasonable prices. It is instrumental in developing efficient systems in handling, processing and marketing of milk and milk products. Also helps in setting up infrastructure facilities for milk processing, transportation and marketing the milk and milk products throughout India.

- **Marine Product Export Development Authority (MPEDA):** It was setup in 1972 to undertake promotional work relating to the export of marine products. Its role includes development of off shore and deep sea fishing, prompting shrimp farming using latest technologies adopting measures required for diversifying export products and markets, modernizing sea food industry, use of new technologies for value addition, extending marketing services and assuming quality control of fishery products. Sea food industry accounts for exports worth 6800 crores of rupees in 2002 -2003.
- **National Horticultural Board (NHB):** It was set up in 1984 and the objectives include:
  - (a) Promote: Development of horticulture industry in India.
  - (b) To help co-ordinate, stimulate, sustain production and processing of fruits and vegetables.
  - (c) To establish sound infra structure in the field of production, processing and marketing with focus on post harvest management to decrease losses.
  - (d) To assist in the establishment of growers societies so as to bring improvement in their socio – economic status.
  - (e) To provide technological, financial and other assistance to various market organisations.
  - (f) To provide market information and build data base in horticulture.NHB promotes infrastructure which include grading and packing centers, pre-cooling units, cold storage, auction platforms and refrigerated transport facilities.
- Agro Dutch Food Limited: Mushrooms farming and processing.
- Dynamics Dairy: Milk and milk products.
- Venkateswara Hatcheries: Poultry, farming and processing.
- Rajan Pillaris: Processed and packed nuts like cashew nuts.
- Allan Sons and Hind Industries: Meat Processing.
- Satyam overseas: Basmati rice processing and exporting.
- Haldirams: Traditional Indian sweets.

## **GROWTH OF FOOD PROCESSING INDUSTRIES**

- (1) **Grain Processing:** Due to the efforts of DOFPI from time to time, the number of modernized rice mills has gone from zero in 1970 to 35088 in 2001. With improvement in milling availability of bran is estimated to be 34 lakh tonnes in 1999 – 2000. Thirteen regional extension service centers were setup in various stages with Agricultural Universities / Research Institutes for propagating the benefits of modernization of rice milling industry and byproducts utilization.

The post harvest technology center at IIT, Kharagpur is engaged not only in teaching but also in research and development aspects relating to engineering of rice processing and byproducts utilization. It also under takes R&D as per the industry needs.

For wheat producing no licensing is required. So there are 105 million tonnes of wheat that is converted to wheat products by about 820 roller flour mills in the country.

- (2) **Consumer Food Industries:** The consumer food industry mainly consists of ready to eat or ready to cook products like pasta products, cocoa based products, bakery products, biscuits, soft drinks and so on.
- (a) **Bakery:** Bakery industry in India is probably the largest among the processed food industries with a steady increase in production. The two major bakery items are bread and biscuits accounting for 82% of the total bakery products. The annual production of bakery products which include bread, biscuits, pastries, cakes, buns, rusk is from the unorganized sector and exceeds about 30 lakh tonnes. The production of bread and biscuits in India is 15 lakh tonnes and 11 lakh tonnes respectively by organized and unorganized sectors. Other wheat products comprise noodles; vermicelli, macaroni and spaghetti are also gaining popularity.
- (b) **Cocoa products:** there are 20 units engaged in the manufacture of cocoa products like chocolate, drinking chocolates, cocoa butter substitutes, and cocoa based malted milk foods with a production of 34 thousand tonnes annually.
- (c) **Soft drinks:** the estimated production of these increased from 6230 million bottles in 1999-2000 to 6540 million bottles by 2000-2001.
- (d) **Beer and Alcoholic beverages:** The estimated output is 4 lakh kilograms per annum from 36 units manufacturing beer under license from government of India.
- (3) **Fruits and Vegetables Processing Industries:** The estimated installed capacity of fruit and vegetable processing industries increased from 21 lakh tonnes in 1999-2000 to 21.1 lakh tonnes in 2000-2001. The production of processed fruits and vegetables in the country has increased from 9.8 lakh tonnes in 1999-2000 to 9.9 lakh tonnes in 2000-2001. The number of licenses given by FPO increased from 5198 to 5293.
- (4) **Milk and Milk Products:** India's milk production is expected to touch 81 million tonnes during 2000-2001 from 78 million tonnes during 1999-2000. There had been increase in the estimated production of milk powder including infant milk foods from 2.25 lakh tonnes in 1999-2000 to 2.3 lakh tonnes in 2000-2001. Malted food products have increased from 66, 000 tonnes in 1999-2000 to 67, 000 tonnes in 2000-2001, cheese production in organized sector in 2000-2001 is 7500 tonnes, condensed milk is 11, 000 tonnes in 1999-2000 to 11, 500 tonnes in 2000-2001.
- (5) **Meat and Poultry Processing:** The production of meat and meat products has shown an increase between 1994 and 1998.

Products	In thousand of tonnes				
	1994	1995	1996	1997	1998
Meat and Goat meat	637	647	669	670	675
Pork meat	366	420	420	420	420
Poultry meat	442	578	480	580	600
Cattle meat (beef)	1290	1292	1292	1292	1292
Buffalo meat	1200	1204	1204	1205	1210

The total meat production is 4.5 million tonnes per annum which includes meat products also. The slaughtered rate in population of animals is about 6% in case of cattle, 10% with buffaloes, 99% for pigs, 31% for sheep and 39% for goats. The production of value added meat and meat products are steadily increasing.

- (6) **Fish Processing:** 55% of fish in India is from marine sources. Production of fish from both marine and inland sources decreased from 5.39 million tonnes in 1997-1998 to 5.26 million

tonnes in 1998-1999. Processing of marine products into canned and frozen products is for export market.

- (7) **Processed Products:** Export of processed fruits and vegetables in 2000-2001 is to the tune of Rs. 525 crores against Rs. 656 crores in 1999-2000. Export of animal products is about Rs.950 crores in 2000-2001 against Rs.879 crores in 1999-2000. Export of cereal based products is Rs. 4895 crores in 2000-2001 against Rs.6335 in 1999-2000. Export of marine products increased from Rs. 5117 crores to Rs. 5875 crores during the same period.

**Vision 2015 of Food Processing Industry:** A vision, strategy and action plan has been finalized for giving a post to food processing sector. The objective is to increase the level of processing the perishable foods from 6 to 20%, value addition from 20 to 35% and share in global food trade from 1.6 to 3%. The level of processing of fruits and vegetables is envisaged to increase from present 2.2 to 10% and 15% in 2010 and 2015 respectively.

### Lecture 8

*8. Ministry of Food Processing - Objectives and its function to develop the food processing industry. APEDA - Agricultural Processed Food Products Export Development Authority*

## **MINISTRY OF FOOD PROCESSING INDUSTRY (MOFPI)**

The Ministry of Food Processing Industries (MOFPI) was set in July 1998. It is under the Ministry of Agriculture. A strong and effective food processing sector plays a significant role in diversification and commercialization of agriculture, improve value addition of agricultural produce, generate employment, enhance farmer's income and create surplus for export of agro foods. The Department of Food Processing Industries is concerned with the formation and implementation of the policies and plans for Food Processing Industries within the overall national priorities and objectives.

**Products handle by the Food Processing Ministry:** The products looked after by the ministry in the allocation of business are:

- Fruit and vegetables processing industry (including freezing and dehydration).
- Food grain milling industry.
- Dairy products like milk powder, infant milk food, malted food, ghee, butter and condensed milk.
- Processing and refrigeration of poultry, eggs, meat and meat products.
- Fish processing including canning and freezing.
- Planning, development and control of and assistance to industries relating to bread, oilseeds, edible meals, breakfast foods, biscuits, confectionary, malt extract, protein isolate, high protein foods, weaning food and extended food products including ready to eat food products.
- Beer including non alcoholic beer
- Alcohol drinks from non-molasses base.
- Aerated water / soft drinks and other processed food
- Specialised packaging for food processing industry.
- Establishment and servicing of Development councils for food processing industry.
- Technical assistance and advice to food processing industry.

**Goals and Objectives:** The Department of Food Processing Industries is the nodal agency of the Government of India for processing foods and is responsible for developing a strong and vibrant food processing sector with emphasis on the following –

- Stimulating demand for application processed foods

- Achieving maximum value addition and by products utilization.
- Creating increased job opportunities particularly in rural areas.
- Enabling farmers to reap benefits of modern technology.
- Creating surplus for exports.
- Providing policy support, promotional initiatives and physical facilities to promote value added exports.

In the era of economic liberalization where the private, public and co-operative sectors are playing their rightful role in the development of Food processing sector, the department acts as a catalyst for bring in greater investment into this sector, guiding and helping the industry in a proper direction, encouraging exports and creating a conducive environment for healthy growth of Food Processing Industry. With this overview, the **main objectives** of Ministry of Food Processing Industries (MOFPI) can be summed up as follows:

- Better utilization and value addition of agricultural produce for the enhancement of income of farmers.
- Minimizing wastage all stages in food processing chain by development of infrastructure for storage, transportation and processing of agro-food produce.
- Induction of modern technology into the food processing industry from both domestic and external sources.
- Maximum utilization of agricultural residues and byproducts of primary agriculture of the food processing Industry.
- To encourage the research and development in food processing for product and process development and improve packaging.
- To provide policy support, promotional initiatives and physical facilities to promote value added exports.

### **Functions of Ministry of Food Processing Industries (MOFPI):**

#### (1) Policy support:

- Formulation and implementation of policies for food processing industries within overall national priorities and objectives.
- Facilitating the creation of a conducive policy environment for healthy growth of food processing sector.
- Promoting nationalization of tariffs and duties relating to food processing sector.

#### (2) Developmental responsibilities:

- Assistance under various plan schemes.
- Widening the R and D base in food processing by involvement of various R and D institutes and support to various R and D activities, packing with special innovations and traditional technologies.
- Human resource development for entrepreneurs as well as workers engaged in food processing industry by up-gradation of their skills.
- Assistance for setting up of analytical and testing labs, active participation in the laying down of food standards as well as their harmonization with International standards.

#### (3) Promotional activities: In order to create awareness about the potential and prospects of food processing industry in the country, this ministry provides -

- Assistance for organization of workshops, seminars, exhibitions and fairs.
- Assistance to studies / surveys.
- Assistance to publications and films.

#### (4) Regulatory Functions: Implementation of Food Product Order.

**Food Product Order (FPO):** It was promulgated under Essential Commodities act in 1955 aiming at regulating sanitary and hygienic conditions in the manufacture of fruit and vegetable products. Licensing under this order lays down the minimum requirement for –

- Sanitary and hygienic conditions in the premises, surroundings and personnel.
- Water to be used for processing.
- Machinery and equipments.
- Product standards.
- Besides these, the maximum limit for preservatives, additives and contaminants have also been specified for various products.

The regulatory functions are carried out at ministry level and also through the directorates of fruits and vegetables preservation. This has four regional offices at Delhi, Kolkata, Chennai and Mumbai under Deputy Directors.

**Functions of Regional Office:** Implementation of food product order 1955 Act under section B of essential commodities Act.

- For grant of food product license for manufacture of fruit and vegetable products including sweets and aerated water and synthetic syrups (non fruit syrups) (E.g.: Rasna).
- For inspection of factories to ensure that the products manufactured as per specification following under FPO 1955 and ensure the provision of sanitary and hygienic conditions, analysis of prepared products and if any variation in the standards, to suggest reprocessing and destruction of products. To detect unauthorized production by providing license and guide those in case of mislabeling additional items and manufacturing procedures.

**Development functions:** Guiding Industries to set up fruit processing industry by new technology or by new innovations, improving process of to obtain maximum output from fruits and vegetables, marketing label requirements of products, suggesting for suitable products, packaging as per latest trend.

**Preachment inspection of food products for export:** Continues expansion of Fruits and vegetables products for export by the development of fruit pulp juices export, where the samples are drawn online, cut out for analysis. The quality certificate after conditions is also issued as per request of parties under preachment. (Quality control INSPP in 1963).

**Financial assistance:** By visiting factories as per instruction to manufactures, grant of FPO license in case of fruits and vegetable units, food parks, bakery units, infrastructural units for food processing industry.

## **AGRICULTURAL PROCESSED FOOD PRODUCTS EXPORT DEVELOPMENT AUTHORITY (APEDA)**

APEDA was established by the Government of India under Ministry of Commerce on Feb 13 1986 under the agricultural and Processed Food Products Export Authority Act, 1985. The main responsibility of APEDA is export promotion of fruits and vegetable products, meat and meat products, poultry products, dairy products, confectionary, biscuits and bakery products, honey, jaggery, sugar, cocoa products, alcoholic and non-alcoholic beverages, pickles, chutneys, papads, cereals (non-basmati rice) and other processed foods.

APEDA furthers development of agriculture commodities and processed foods as well as promotes their exports. Its goals are to maximize foreign exchange earnings through increased Agro exports. To provide better income to farmers through higher yields, value realization and to

create employment opportunity in rural area by value added export of farm produce through APEDA, market export had increased from Rs. 7,366 crores in 1999-2000 to Rs. 14,124 crores in 2003-2004.

**Objectives:** The main objectives for establishing APEDA are as follows:

- (1) To maximize foreign exchange earnings through increased agro-exports for providing higher income to farmers through high unit value realization.
- (2) To create employment opportunities in rural areas by encouraging value added exports to farm products.
- (3) To implement schemes for providing financial assistance to improve post harvest facilities to boost their export.

APEDA has brought qualitative changes in agricultural marketing systems and environment, has increased the credence of the agri business in products. The example are export of grapes from Maharashtra and Karnataka, strawberry and mushroom from Punjab and Haryana, litchi from Andhra Pradesh, Uttar Pradesh and Bihar, cut flowers from Delhi, Haryana and Karnataka. The effort made by APEDA has brought significant impact on growth of exports of scheduled products.

**Developmental programs:** APEDA has built link between Indian producers and global markets. It has undertaken the following development programs to achieve the objectives for which it has been set up in the country –

- a. Development of database on products, market and services.
- b. Publicity and information dissemination.
- c. Inviting official and business delegations from abroad, organisation of product promotions and visit of official and trade delegations abroad.
- d. Participation in international fairs in India and abroad as well as organisation of buyer seller meets and other business interactions.
- e. Information dissemination through APEDA's new letter, feedback series and library.
- f. Providing recommendatory, advisory and other support services to trade and industry.
- g. Problem solving in government agencies and organisation, RBI and customs related to import export procedures.
- h. Offer financial assistance under various schemes, which seek to promote and develop agro exports.

**Assistance schemes of APEDA:** Offers financial Assistance under various schemes, which seek to promote and develop AGRO exports. Some of the activities, which are eligible for financial assistance, are:

- Scheme for market development
- Scheme for quality development
- Scheme for infrastructure development
- Scheme for research development and
- Scheme for transportation assistance.

The activities for financial assistance from APEDA include:

- Strengthening of market intelligence and data base through studies and surveys.
- Quality up-gradation.
- Development of infrastructural facilities.
- Research and Development.
- Development of Packaging facilities.

- Human Resource development.
- Up-gradation of meat processing facilities.

### Lecture 9

#### 9. Food characteristics - Food nutrients-Proteins, Fats, Carbohydrates, Vitamins and Minerals - Functions - Sources

## FOOD CHARACTERISTICS

Man needs a wide range of nutrients to perform various functions in the body and to lead a healthy life. The nutrients include proteins, fats, carbohydrates, vitamins and minerals. These nutrients are chemical substances which are present in the food we eat daily. The food containing these nutrients which we consume daily are classified as cereals, legumes (pulses), nuts and oilseeds, vegetables, fruits, milk and its products and fleshy foods (fish, meat and poultry). Depending on relative concentration of these nutrients, foods can be classified as -

- (a) Protein rich foods – fleshy foods, legumes (pulses).
- (b) Carbohydrate rich foods - cereals, sugars, refined foods like bakery items
- (c) Fat rich foods - oils, nuts, butter, ghee.

(1) **Proteins:** Proteins are extremely complex nitrogenous units of structure made up of building blocks called amino acids. All biochemical reactions within the body are catalyzed by protein enzymes and all structural tissues of the body contain proteins. So the importance of proteins in all aspects of life cannot be over emphasized. The dietary proteins perform all three functions of nutrients i.e. growth, maintenance, repair of body tissues and regulation of key processes in the body.

Functions: The key functions of proteins include -

- Proteins are required for body building.
- They are components of muscles, other tissues and body fluids like blood.
- They help in the maintenance and repair of existing tissues in the body.
- They are present in bones and teeth as collagen.
- Proteins help in muscle contractions with two types of enzymes – actin and myosin powered by hydrolysis of ATP.
- Many hormones like insulin, gastric juices and growth hormones are produced by various glands either as proteins or peptides.
- The protein, hemoglobin present in blood acts as a carrier of oxygen molecules.
- Proteins play an important role in transport of nutrients across the intestinal wall into the blood.
- The water balance between extracellular and intracellular components is achieved by dissolved protein and ions.
- Protein in blood serves as buffers maintaining the pH of blood with application of H<sup>+</sup> and OH<sup>-</sup> ions.
- The body fights infections through antibodies which are defensive proteins.
- Proteins provide 4 kcal energy / gram of food.

Proteins are composed of amino acids which are divided into –

- (a) Essential amino acids – are the ones which cannot be synthesized in the body at a rate sufficient to meet the needs of growth and maintenance of tissues. They are to be supplied through the diet.
- (b) Non-essential amino acids – are the ones that the body can synthesize in adequate amounts if nitrogen is available in diet.

- (c) Conditionally essential amino acids – are needed in diet unless precursors are available for synthesis. Ex.: In intestinal metabolic dysfunctions, arginine cannot be synthesized in the body and then it has to be given through diet.
- (d) Mostly children, pregnant and lactating women need additional protein for synthesis of new proteins.

The requirement of protein is 1g / Kg body weight, during pregnancy an additional intake of 15g / day, Lactation 0-6 months it is 25g / day and 6-12 months it is 18g / day.

Sources:

- Meat, fish, egg, pulses, oil seeds, nuts, soybeans, cereals and millets, bread, dry beans, peas, peanut butter when combined with small amounts of egg, cheese, meat, fish and poultry give just as good an assortment of amino acids as a large amount of animal foods.
- Soya bean is the richest source with 40% protein followed by watermelon seeds (34%), wheat germ (29%) and ground nuts (26%).
- Although cereals have low protein content, as they are being consumed in bulk, good amount of protein is consumed. The quality of protein in rice is better than that of wheat.
- In vegetarian diets, a combination of cereal grains and legumes provide satisfactory biological value.

(2) **Fats / Lipids:** Lipids is usually used when discussing metabolism of fats in the body where as fats is used to describe the fatty component of foods in the diets.

Lipids are classified as follows -

- a. Simple lipids – These are esters of fatty acids with certain alcohols
  - Fats and oils – esters of fatty acids with glycerol.
  - Waxes – esters of fatty acids with long chain aliphatic or cyclic alcohols.
- b. Compound lipids - These are the esters of fatty acids which on hydrolysis yield other substances along with fatty acids and alcohols.
  - Phospholipids – these yield phosphoric acid, fatty acids, alcohol and a nitrogenous base like lecithin, cephalin and spingomyelin.
  - Glycolipids – these yield mono / oligosaccharides along with phospholipids.
  - Lipoproteins – possess cholesterol esters and phospholipids.
  - Amino lipids – yield amino acids.
- c. Derived lipids.

Functions: the important functions include –

- These fats are essential constituents of membranes of every cell in the body.
- They serve as energy reserves. It is present in the body in fat cells (adiposities) and as adipose tissue. The woman's body has about 18 to 24% of body weight where as men have about 15 to 18% normally.
- They help in the regulation of body functions through prostaglandins, prostacyclins, thromboxanes and leukotrienes.
- The sub cutaneous fat present beneath the skin acts as an insulating material to the body and is effective in preventing the heat loss.
- Deposits of fat around vital organs like kidneys and heart protect them from physical shock.
- It provides satiety value to the food. Each gram of fat yields about 9 kcal of energy.
- It prolongs the stay of food in the stomach and helps to delay the onset of hunger pangs.
- It acts as a carrier of soluble vitamins A, D, K and E in the body.

- The presence of fat or its addition adds palatability to food by improving the texture and flavor.

Sources:

- Fats in the diet can be of two kinds the “visible and invisible” fat.
- The visible fats are those derived from animal sources like butter, ghee which are solid fats and those derived from vegetable sources like ground nuts, mustard, coconut, safflower, til which are liquid fats.
- Hydrogenated vegetable oil known as vanaspati is a solid fat and which is popular in India.
- The invisible fats are present in food are cereals, pulses, oilseeds, soybean, nuts, milk, eggs and meat. Part of the body requirements are met by invisible fats.

(3) **Carbohydrates:** The carbohydrates are sugars or polymers of sugar like starch. They are classified as –

- (a) Free sugars – monosaccharides and disaccharides.
- (b) Carbohydrates other than free sugars - 80% soluble in ethanol.
- (c) Carbohydrates which are 80% insoluble in ethanol are termed as polysaccharides.

Functions: Carbohydrate functions are as follows:

- Carbohydrates are the source of energy to the body. One gram yields about 4 kcal of energy.
- The body uses the carbohydrates as source of energy when adequately supplied and spares the protein for body building. If diets are lacking in carbohydrates, dietary proteins are oxidized as source of energy. This function of carbohydrates serving as a source of energy and preventing the dietary proteins from being oxidized is called as “Protein sparing action of carbohydrates”.
- In oxidation of fat, acetyl Co A formed from oxidation of fatty acids react with oxalo acetic acid from carbohydrates and amino acid metabolism to form citric acid which is oxidized through TCA cycle to oxalo acetic acid. If adequate amounts of carbohydrates are not consumed, intermediate products of fat oxidation are accumulated.
- Glucose is indispensable for normal working of central nervous system.
- Carbohydrates are required for muscular work as a source of energy.
- Carbohydrates are involved in detoxifying and regulating the influence of protein and fat metabolism.
- The normal working of heart muscles require glucose as a source of energy. In hypoglycemia, a definite adverse change in the working of heart muscles is observed.
- Excess of calories fed as carbohydrates is stored as fat in adipose tissue and this is used when the body requires energy.
- Lactose, a disaccharide promotes the growth of desirable bacteria which help in the synthesis of B – complex vitamins. Lactose also enhances the absorption of calcium.
- Dietary fiber as no nutritive value but helps in the peristaltic movement and prevents many degenerative diseases.
- The carbon skeleton for synthesis of alanine, aspartic acid and glutamic acid are provided by glucose.

Sources: The major sources are sugar, jaggery, sago, rice, dried dates, skimmed milk powder, whole milk powder, wheat, potatoes, sweet potatoes and sweets.

- (4) **Vitamins:** These are group of unrelated organic substances occurring in many foods in small amounts and necessary in trace amounts for normal metabolic functioning of the body. They are classified as
- (a) Water soluble vitamins – B complex and C vitamins.
  - (b) Fat soluble vitamins – A, D, E and K.

(a) **Water soluble vitamins:**

- (i) Thiamine (vitamin B<sub>1</sub>): Its deficiency in the body causes beri – beri.
  - Is involved in the conversion of amino acid tryptophan to niacin.
  - Thiamine as co-enzyme thiamine pyrophosphate (TPP) is required for the metabolism of glucose.
  - It is involved in the transmission of high frequency impulses across nerve synapses.
  - Sources are whole cereals like wheat, millets, raw hand pound rice, parboiled rice and bran from rice grains.
- (ii) Riboflavin (vitamin B<sub>2</sub>): Its deficiency causes angular stomatitis.
  - Helps in the release of energy from glucose, fatty acids and amino acids.
  - Helps in the conversion of amino acids tryptophan to niacin.
  - Helps in the conversion of B<sub>6</sub> and folate to their active co-enzymes and storage forms.
  - Sources: Milk, milk products, eggs, liver, green leafy vegetables. Tender leaves have more riboflavin than mature ones.
- (iii) Niacin (vitamin B<sub>3</sub>): Its deficiency causes pellagra.
  - It plays an important role release of energy from all energy yielding nutrients like carbohydrates, fats, protein and alcohol.
  - It is required for the synthesis of DNA and RNA from proteins, fats and 5 chain carbon sugars (pentoses).
  - Biochemically Niacin is part of many co-enzymes NAD and NADP.
  - Sources: Whole cereals, pulses, nut and meat are good sources along with ground nuts in particular.
- (iv) Folic acid: Its deficiency causes Megaloblastic anemia.
  - Required for normal growth and division of cells.
  - Acts as a co-enzyme in transmethylation reactions. Ex.: Homocystein to methionine, ethanolamine to choline and uracil to thymine).
  - Helps in the conversion of phenyl alanine to tyrosine.
  - Sources: Both animal and plant foods. Fresh green leafy vegetables, liver and pulses are good sources of this vitamin.
- (v) Cynacobalamine (vitamin B<sub>12</sub>): Its deficiency causes pernicious anemia.
  - Essential in DNA synthesis.
  - Acts as a co-enzyme in the conversion of Homocystein to methionine.
  - It is required for synthesis of myelin, the white sheath of lipo-protein that surrounds the nerve fibers.
  - It is involved in the degradation of fatty acids with odd number of carbon atoms.
  - Sources: Synthesized from bacteria. Fermented foods are good source of this vitamin.
- (vi) Pyridoxine (vitamin B<sub>6</sub>): Its deficiency causes dermatitis.
  - Acts as a co-enzyme in protein metabolism.
  - Acts as co-enzyme in carbohydrate and fat metabolism also.
  - Sources: Wheat, meat and pulses are rich sources.

(vii) **Ascorbic acid (vitamin-C)**: It is also called as anti scorbitic acid. Its deficiency causes Scurvy. Vitamin-C is a strong reducing agent and an anti oxidant.

- It is required for collagen formation.
- It helps in the synthesis of neurotransmitter nor-epinephrine.
- It is involved in the hydroxylation of tryptophan to serotonin (5-hydroxy tryptophan).
- Sources: Amla is the richest sources followed by guava, lime juice, orange, pineapple, mango, cabbage, spouted grains, followed by green leafy vegetables drumstick, agathi, amaranths and spinach. Sources like meat, milk, cereals and pulses are poor sources.

(b) **Fat soluble vitamins:**

(i) Retinol (vitamin A): Its deficiency causes night blindness, cessation of growth, Bitot's spots, keratomalacia, conjunctival xerosis and corneal xerosis.

- It plays an important role in vision in dim light.
- Growth plateau is seen when reserves of this vitamin are depleted with rapid weight loss and ultimate death.
- Influences the immune system and reproduction.
- Sources: Animal foods like eggs and fish liver oil have high biological value, fish liver oil is the richest source of vitamin A and green leafy vegetables, yellow orange, fruits and vegetables like mango, papaya and carrot are sources of  $\beta$ -carotene which is a precursor to vitamin A. Red palm oil is the richest source of  $\beta$ -carotene.

(ii) Vitamin D: It exists in two forms -  $D_3$  Cholecalciferol which is from animal sources and  $D_2$  is Ergocalciferol from plant source. Its deficiency causes rickets in infancy and child hood and osteomalacia in adults.

- Required for calcium homeostasis
- Required for bone formation and maintenance.
- Helps in insulin secretion.
- Operation of immune system and
- Development of female reproductive system and skin.
- Sources: Marine fish, egg yolk, butter and milk. Vitamin  $D_3$  is found in moderate amount in liver.

(iii)  $\alpha$  - Tocopherol (vitamin E): Its deficiency occurs in premature infants and adults with defect in fat absorption resulting in the hemolysis of RBC leading to vitamin E induced anemia.

- It mainly acts as an antioxidant.
- Helps in the prevention of lipid peroxidation proving first line defense to the body.
- It helps in the cleansing of free radicals.
- It helps in the prevention of ageing.
- It is involved in the sparing of trace element Selenium within the body and in protecting Vitamin A against oxidative damage.
- Sources: Vegetable oils and whole grains are the richest natural sources of vitamin E. Rice bran oil has high amounts of these unsaponifiable compounds. Generally plant sources are rich in vitamin E than animal sources.

(iv) Vitamin K: Scientist Dan named it as koagulation vitamin present as vitamin K1 – phyloquinone and vitamin K2 – menaquinone 4 and menaquinone 13.

- The main and only function of this vitamin is that it helps in blood clotting where prothrombin is converted to thrombin and fibrinogen is converted to fibrin.
- Sources: Richest source is Green Leafy vegetables but is found in fruits, tubers, seeds, dairy and meat products. Generally diets provide it and it is not required to be supplemented.

### **Minerals and Trace Elements:**

- A large number of minerals and trace metals are present in the body as part of body structural component and catalysts in the body reactions.
- Bones and teeth are made up of calcium, magnesium and phosphorus.
- In normal adults, the calcium to phosphorous ratio is little under 1:1 where as in bone it is little over 2:1.
- Phosphorous helps in mineralization of bones and teeth, energy transaction, absorption and transportation of nutrients, regulation of protein activity, acid – base balance as well as in ATP, ADP and other co-enzymes.
- Iron is present in hemoglobin of blood and helps in the transport and storage of oxygen. It acts as a co-factor of enzymes that help in the oxidation of nutrients to release energy. Its deficiency cause anemia.
- Iodine plays an important role in the synthesis of thyroxin which plays an important role in regulating growth and development. Its deficiency causes goiter.
- Copper is essential for the maintenance of normal hemoglobin status and is part of many enzyme systems.
- Fluorine help in prevention of tooth decay but excess amounts results in fluorosis.
- Zinc is present in every cell of the body and is essential for normal growth, development, reproduction and immunity.
- Chromium potentiates insulin action and influences carbohydrate, lipid and protein metabolism.
- Minerals like molybdenum, zinc, copper, manganese, magnesium, activate large number of enzyme systems which are required for body metabolism.
- Sodium and potassium (electrolytes) are important elements present in fluids within and outside the cells along with ions like chloride and bicarbonate.
- Other trace metals are selenium, cobalt, silicon, arsenic, nickel and vanadium. They are of significance in human nutrition.
- Selenium is an important trace element and along with vitamin-E is required for maintaining liver integrity.
- Cobalt is an important trace element as it forms part of vitamin B<sub>12</sub>.

Another classification of foods is based on their body function and it is as follows:

- Foods for body building: Foods rich in proteins, minerals and vitamins.
- Foods for energy: Foods rich in carbohydrates, fats and proteins.
- Foods for regulating body process: Food rich in minerals, vitamins, proteins are the major cellular structural elements. These are for biochemical catalysis and are important regulators of gene expression. The above nutrients are present in almost all foods in varying proportions as far as the science and technology is concerned.

The foods are broadly clarification as:

- a) Plant foods: Such as cereals, millets, legumes, nuts and oil seeds, spices and condiments and miscellany foods.
- b) Animal foods: Such as milk, meat, fish, egg and poultry

### Lecture – 10

10. *Classification of foods based on pH - Low acid food, medium acid food, highly acid food and acid food - Definition and Examples*

## **CLASSIFICATION OF FOODS ON THE BASIS OF pH**

Definition: pH is defined as: “the negative logarithmic of  $H^+$  ion concentration”. It is expressed as reaction of field i.e. between acid and base. pH scale ranges from 0 to 14 in the scale. pH has direct role in prolonging shelf life of products. Excellent keeping quality of foods is related to pH. E.g.: Salt drinks, fermented milk, pickles, fruits, sauerkraut.

- (a) **Low acid foods**: pH of 5 and higher. This includes peas, maize, corn, beans etc. which gets spoiled by thermophilic, mesophilic and spore forming organisms like *Clostridium butylinum* and *Clostridium nitrificans*.
- (b) **Medium acid foods**: pH of 5.0 to 4.5. This class includes meat and vegetable mixtures, soups, sauces, fish, which gets spoiled by thermophilic, mesophilic organisms such as *Bacillus coagulans* and *Clostridium butylinum*. Destruction of these organisms need pressure process also.
- (c) **Acid Foods**: pH of 4.5 to 3.7. These include tomatoes, pears, pineapples and figs. They are spoiled by non-spore forming type organisms like *Clostridium pasteurianum*. This can be preserved by processing in boiling water temperatures.
- (d) **Highly Acidic foods**: pH is 3.7 and below. This includes pickles, citrus juices etc. In these group bacteria spores can be easily destroyed at pH 3. So spore generation is negligible.

It is considered that pH 4.5 is dividing line between acid and non acid foods. The pH above 4.5 required processing and a temperature of 118 - 121<sup>0</sup> c to keep it fit for consumption and avoid microbial activity.

### Lectures – 11 and 12

11. *Types of foods - Convenience food, definition, characteristics and classification - Ready-to-Eat foods, Ready-to-use-foods and beverages*
12. *The point to be kept in mind while purchasing convenience foods - Advantages and disadvantages of convenience foods - flow chart for some ready to eat products*

## **CONVENIENCE FOODS**

**Introduction:**

- Technology reduces cost and competitive.
- Indigenous manufacturing but adopt a technology
- Higher level of value addition.
- Co processing and package.
- By competitive technology

- Ensure safety and quality standards.

**Types of foods:** The foods are broadly classified into processed, semi processed, ready to eat foods and fast foods.

The processed, semi processed and ready to eat food are called convenience foods. Technological development of food processing equipments, process and packaging material, have got revolution in the development of convenience food sector as for the necessity of taste, nutritional requirements of consumers. Food processors like MTR foods, ITC foods, Priya foods, ADF foods and many others are developing newer and newer products to meet the demand of Indian palate. The ready to eat food business reported that it had a turnover of Rs. 60-80 Crores. The best example of convenient food is processed canned food. Today more number of women are working than before and hence looking for products convenient to cook fast. The Indian food and dairy industries has the opportunity of supplying new and different forms of food with more consumer convenience, enhanced nutritional values and which includes shelf life at reasonable cost.

**Characteristics of conveniences foods:**

- The food must have undergone considerable amount of food preparation by the manufacture before it reaches the retailer.
- It must require minimal cooking or processing before consumption by consumer.
- The preparation time before consumption should be minimal.

**Definition:** It can be defined as: “Foods that have under gone major processing by manufacturer, such that they require little or no secondary processing and cooking before consumption”.

This means, apart from warming, thawing, cooking, frying, diluting and reconstitution, the food is ready-to-eat.

**Classification of conveniences food:** They are classified into three major categories.

1. Ready to eat foods.
2. Ready to use foods.
3. Beverages.

(1) **READY TO EAT FOODS (RTE):** The food which can be directly consumed from the package with or without warming or thawing and without preparations.

Examples:

- Dairy snacks like *processed cheese, cheese spreads, bread spreads,*
- Dairy sweets like gulab jamuns, rasagullas, peda, burfi
- Other sweets like sohan papdi and sohan halwa
- biscuits
- breads,
- snacks like chips, wafers,
- retort processed foods like paneer curries, dhal fries
- frozen foods like ice cream, dosa, idli, chicken kebabs

(2) **READY TO USE FOODS (RTU):** The foods which need some preparations like cooking, frying, reconstitution, dilution etc. before consumption. These include:

Examples:

- Masalas like butter chicken mix, garam masalas, and ginger/garlic paste.

- Fresh cut vegetables like carrots, potato, cauliflower, radish, beans, cabbage etc. which are sorted, washed and cut into slices, cubes, shreds and modified atmospherically packed,
- Ready-to Cook (RTC) like noodles, instant rava idli mix etc,
- Ready-to-Fry (RTF) like papads, color gold fingers, wafers, chicken samosa etc,
- Ready-to-Reconstitute (RTR) like Khoa power, Kulfi mix power, instant ice cream mix, instant gulab jamun mix etc and
- Breakfast cereals like corn flakes, wheat flakes, honey crunch, corn flakes, strawberry corn flakes etc. which need some preparation like addition of milk, fruits if desired before consumption.

(3) **BEVERAGES:** This is further divided into two types:

- Ready-to-drink (RTD) which can be directly consumed from the container i.e., like RTD fruit based milk drinks from mango, apple, strawberry etc; Horlicks malt shakes in different flavors and Boost in Tetrapak which has shelf-life of 4 months. Britannia has launched sweet lassi and cold coffee in Tetrapak which have self-life of 6 months. Other drinks like flavored milk, fruits juices like mango, apple, orange, pineapple etc. in Tetrapak also come under this category.
- Ready-to-Serve (RTS) which needs some preparations like dilution, reconstitution before consumption. These include fruit juice concentrate, in different flavors like Tropicana, Spicy tomato rasam style soup, Chicken soup and fruits juices like Kissan orange squash and Instant Soup powders, Instant juice powders like Rasna.

**Factors to be kept in mind while purchasing convenience foods:**

- a) All the packs should possess the ISI mark.
- b) The weight should be same as on the container.
- c) Expiry date and manufacturing date should be observed.
- d) The brand name should be of high standard companies.

**Advantages:**

1. Convenience foods are suitable to all segments of population including army, airways, railways and even patients with suitable supplements.
2. These are quickly and easily prepared products and save time as they require few cooking skills.
3. Convenience products are always available in ready to use forms.
4. The consumer may get a variety of foods such as; fruits, vegetables, food meat, fish and soups all round the year for reasonable prices.
5. The production, storage and sale of industrially prepared products are subjected to strict regulations and controls. Properly stored ready to use product are bacteriologically safer than fresh foods.
6. Modern production techniques and preservation methods minimized nutritional loss of pre cooked products, no more vitamins or minerals are lost than in home kitchen.
7. Nutrients and vitamins of food sensory stimulating property (taste, smell, mouth feel) are in most cases preserved.
8. They are useful to elderly, handicapped persons who cannot devote much time for cooking.
9. For most of the Indian families, it may not possible to purchase all equipments like oven, refrigerators, mixers and grinders etc. for preparation of food. But, readymade mixes can be prepared into any food products.

**Disadvantages:**

1. Ready to eat food are sold either open or packed. Open foods are most exposed to environmental pollution and handling, packed foods may not have labels and reports are not available in literature on the quality of foods. So, these foods are not advisable in terms of microbiological safety for human consumption.
2. Packed foods may not have proper labels regarding quality, nutrient content and date of manufacture. Therefore these foods are suitable in terms of nutrition and microbial safety for human consumption.
3. Convenience foods often contain more fats, so that, its energy content is also very high and these products may not be suitable for obese and cardiovascular patients. These sources of fat may be vegetable or animal.
4. The salt content is also high and sometimes iodized salt may not be used.
5. Most of prepared dishes may not provide full meal. The content of minerals, vitamins, bulk fibers may be inadequate.
6. Ready to use products are very expensive. So, the products may not be available to all groups of people.
7. Some people are sensitive to certain substances or additives, such as: artificial preservatives, coloring materials, flavored compounds. So we must study label before use.
8. In market, very few shops have refrigeration facility and the unsold food is sold on next day. This will lead to food poisoning. Once, open packet or container for one time preparation result to contamination and textural changes at the time of second preparation.

**PREPARATION OF READY TO USE (OR) READY TO EAT PRODUCTS:**

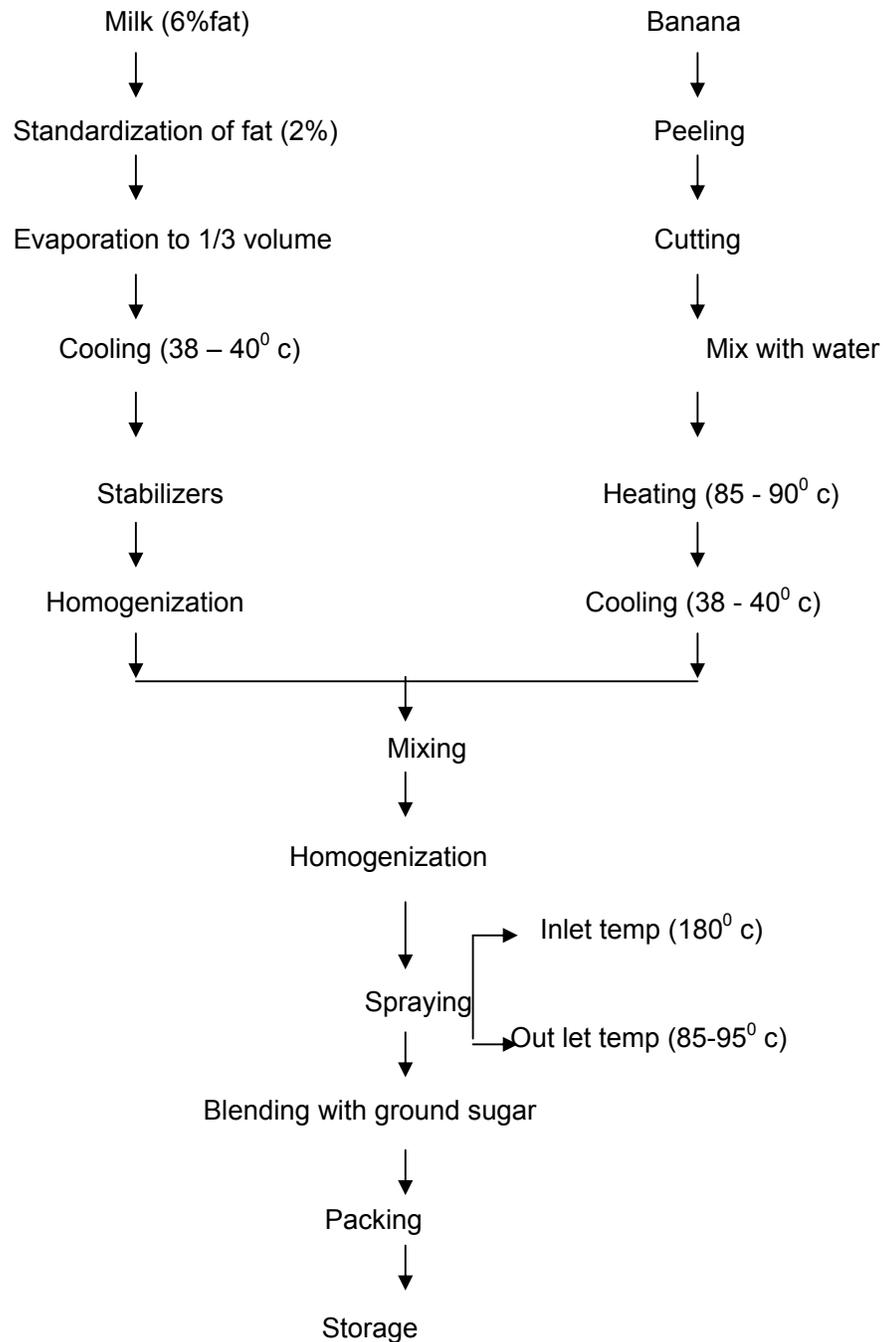
- (1) **Special food products:** Foods with particular nutritional advantages, which includes products for health management for people with specific metabolic disorders. Ex.: lactose intolerance and for diabetics, those who are unable to digest nutrients from normal diet., and those who need special nutritional requisition like sport persons and for those food intake requires special compositional standards. Ex.: Basis infant formula, weaning, slimming foods, foods for special medical purposes.

Existing infant formula being currently marketed in India do not offer the bio protective features that are essential to protect the health of milk fed babies. "Whey" basic beverage with defined content of minerals, trace elements, vitamins and other substances with nutritional effect may enhance the physical performance of sport persons.

Products marketed for the particular segments population. Ex.: Children, single person household and senior citizen are likely to be dominant in future food market.

- (2) **Fabricated and formulated foods:** Products that have been designed and engineered, with the ingredients, in new form, with or without additives and processing procedure or produced by blending, structuring or by shaping of ingredients. A trend towards the modification of new food is likely to become accelerated in future. This is because future consumer will demand for better nutrient balance in food products to ensure health and fitness. An ideal product should be with proper packaging; preparation and cooking and improved quality characteristic such as flavor, texture and mouth feel tasty. Hence, there is a real need as well as opportunity for food product manufacture to develop food products, which are in need to meet the above mentioned criteria.

(3) Preparation of ready to use Banana milk shake powder flow chart:



Ripened bananas are peeled out manually and cut out into circular pieces and portable water was added to fruit pieces and heated to 85-90° followed by cooling to 38° - 40°c. Fresh (cooled) milk was standardized to 2 % fat and condensed to 32-36% of total solids. Here, then add stabilizer and Homogenized the milk and banana pulp mixes was again Homogenized and spray dry by using centrifugal spinning disc atomizer to obtain ready to use banana milk shake powder.

(4) **Multipurpose foods:** It consists of 75% ground nut powder and 25% Bengal gram powder having about 40% protein. It is usually given to children suffering from vitamin and calorie deficiency and pregnant women. It can be mixed in wheat dough to improve the protein content to give to children between 0 to 4 years.

- (5) **Canned foods:** In the canning of foods one of the most factors effecting the stabilization times and temperatures is by actual pH value of acidity in the food. pH value has a great influence upon distractions of microorganisms.
- (6) **Instant Idli mix:** Idli mix is prepared by a process developed by CFTRI, Mysore. 500g of this mix gives about 25-30 idlis. It is prepared by mixing parboiled rice, black gram dhal, and yeast powder. Before use water should be added to the mix and left for 15 min and idlis are put for steaming in a suitable vessel.
- (7) **Bread production operations:** It is made from wheat, they are two types:
- (a) Winter which define season demand. They are also called as soft wheat and hard wheat. “Soft wheat” is referred to as winter wheat and yield of wheat flour is low in protein content, absorb less water and is good for food preparations like cake, soft dough biscuits and cookies. But is unsuitable for bread making.
- (b) “Hard wheat” referred to as spring wheat which yields strong flour, high in protein, absorb more water and has got good gas retention power, good mixing and fermentation tolerance. The hard wheat is good for bread making, which yields have a strong elastic property, so necessary to hold CO<sub>2</sub> produced by yeast and other gasses. At the bakery the bread making process begins from flour held in bulk bin conveyed onto a mixture where it is blended with the remaining bread formulae ingredients.
- The dough is kneaded and dumped into, through and they are placed in fermentation room for several hours with controlled temperature from humidity to permit yeast to develop flavor and odor. Then the dough stray are emptied into dough divider machines. These dividers cut the dough cake onto one leaf pieces. Dividing causes a cut surface on each dough face which allow the gas to escape and to seal the cut surface and pieces are put through rounded.

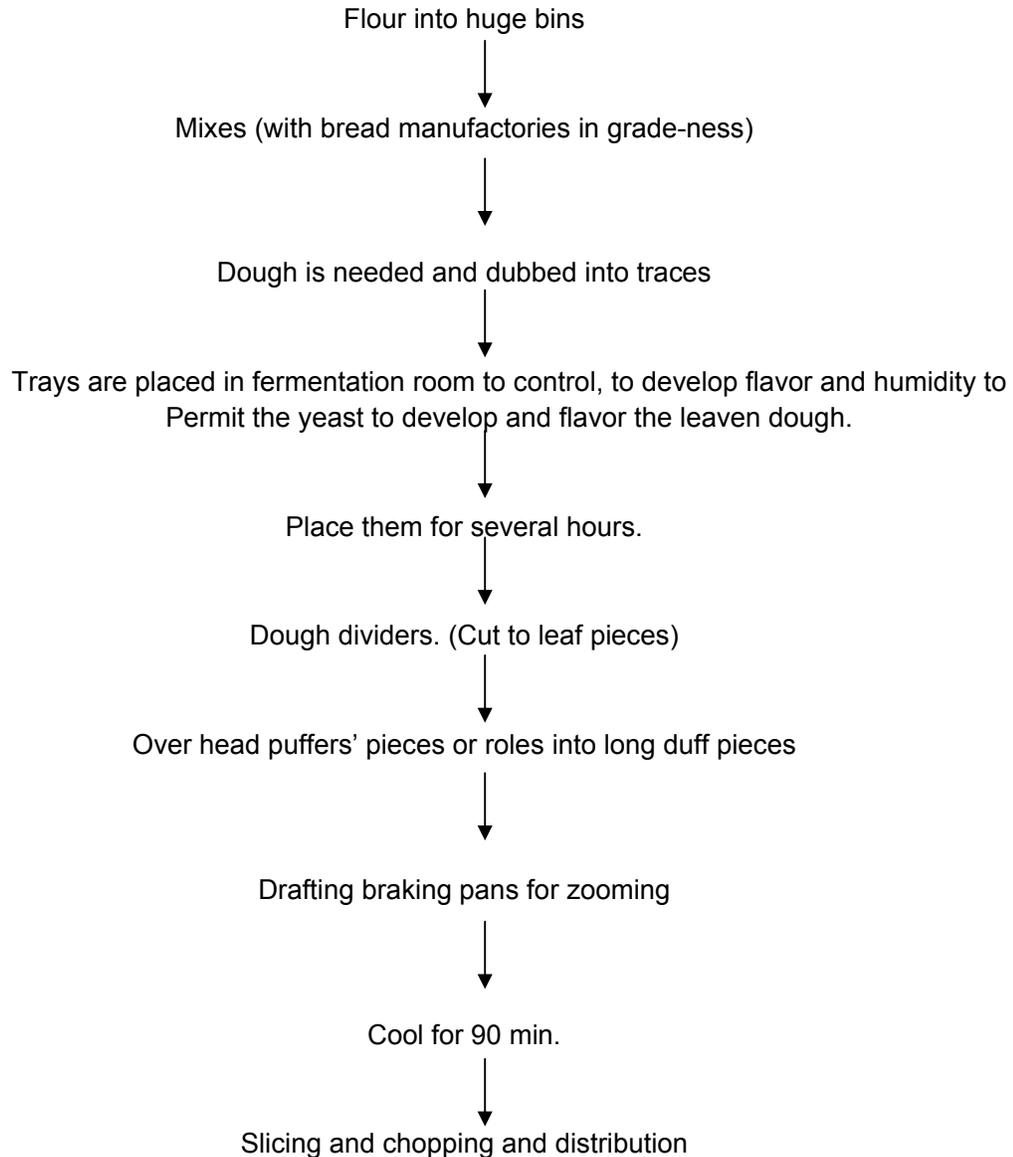
**Millets cassis out flowing powder:**

- Receiving and storing wheat
- Clean the wheat
- Conditioning the wheat (moisture and temperature of wheat for best milling).
- Milled wheat into flour and its by-products.
- Divide the flour into batches for desired properties and store the finished product.

**Process of wheat flour:** The actual milling is done with a roller in the course of brining bread to number of checks to protect consumer.

- U.S. feudal grading of wheat quality.
- Miller’s quality control tests.
- Feudal standards of Identity acceptable bread formulas.
- Food and Drug administration standards for approved chemicals and bread.
- Bakery quality control tests like FDA for the sanitary conditions of the bakery.
- Check up’s at the bakery and in supermarket by state and local inspectors to ensure the honest weight of baked loaf.

**Flow chart for bread producing operation:**

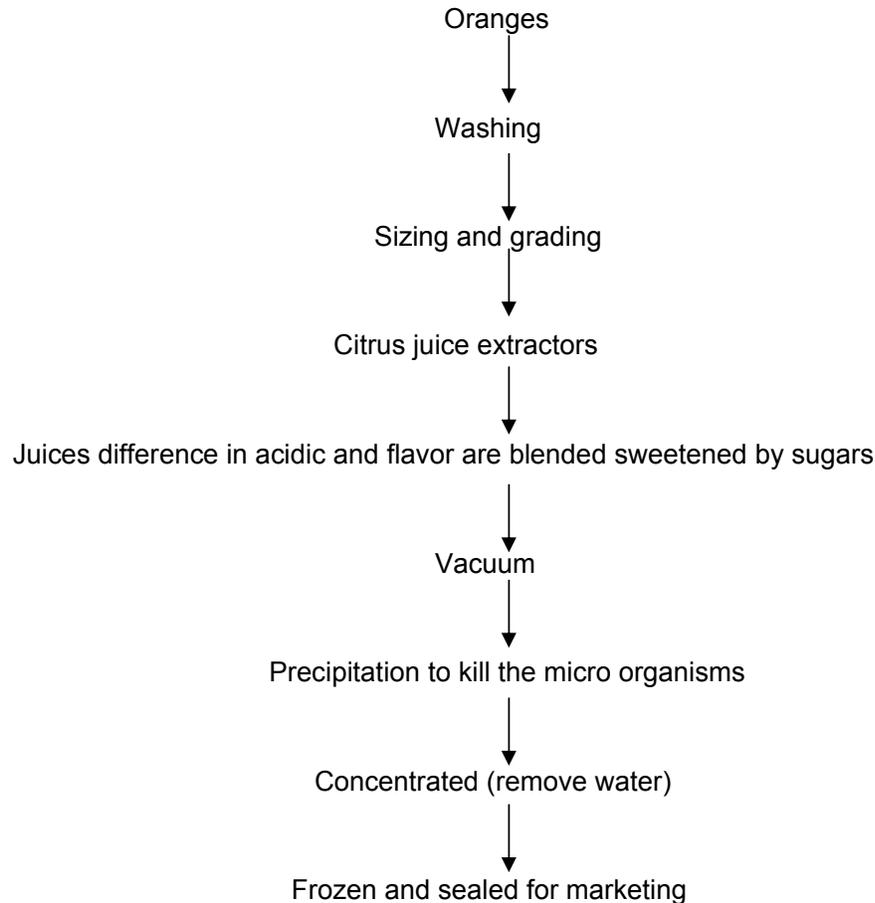


(8) **Frozen orange juice concentrate:** This product has largely replaced fresh orange juice in U.S, usual juice. There are several varieties of oranges used for juice; the best quality is Homosassa, person brown, Washington, novel and Valencia. These varieties differ in their flavor, color, acidity of juice and other aspects. The different parts of orange contain Volatile flavor compounds, sugar, enzymes, acids, proteins, fats, pigments and Vitamins.

The mixtures of these endings in the juices depend upon the varieties of orange, growing conditions, degree of refiners, and the method of squatting or extracting the juice, the flavor, color and storage ability of juice depends upon these components of juice on processing.

The natural orange juice contains 12% solids. If we are making 94% concentrate the solids must be 48% by multiple vacuum evaporated. However when orange juice is concentrated by vacuum evaporated. However, when orange juice is consented some of the flavor may be lost; it is common practice to over concentrate to about 60% solids and adds back fresh orange juice to strengthen orange juice to the desired 48% solids. The frozen concentrated orange juice is filled into cans and sealed for ready consumption.

### Flow chart for frozen orange juice:



### Lecture – 13

13. *New food product development - Strategies for new product development - Recent trends for processing of food, its principle and application, new techniques for new food product development - Genetically modified foods - Advantages and disadvantages*

## **NEW FOOD PRODUCT DEVELOPMENT**

The reason for development of new food products in the food may be attributed to the following factors:

- New products are defined as the life blood of companies.
- A sudden change in the economic status of middle class has resulted in increased purchasing power.
- Change in the perception of customers about the nutritional quality and safety.
- Greater exposure to qualitative products through advertisements in internet, mass and print media.
- Agronomic liberalization and globalization has a direct and indirect effect on the Indian economy resulting in increasing of income.
- The increased demand for new food products is due to the development of new processes. Future market and products will be determined by the growing demand of customers for products like convenience foods, genetically modified foods with a lot of change in taste, texture, freshness and appearance.
- Indian food manufacturers and food technologists should develop products taking into account consumer choice and taste. The companies that adapt the changes according to consumer needs and taste will be winners on global basis.

- Apart from tapping on profits because of the enormous potential for food products, the Indian food industry should focus on developing not only convenience foods but also therapeutic and nutraceutical foods.

**Strategies for New Food Product Development:** It should be kept in mind that the new products in domestic and overseas market will depend on quality, resources, value addition, processing facilities and trade opportunities. New Food Product Development requires inputs from various areas. The chief features for success are as follows:

- (a) Demand created for the new product must be filled up by right product which must meet the customer's need.
- (b) Blend or modify or adapt the available process technologies with the new technologies.
- (c) Manage the process of innovation by introducing new ideas or ways of doing things differently.
- (d) Management support in terms of processing, packing and marketing.
- (e) Product development is not an accident but a systematic approach to create and develop on the application of expert knowledge from a wide range of disciplines.
- (f) Taste and texture will be contributing to new product development market in the next century.
- (g) It is necessary to make manufacturing the secret weapon to marketing.

**New Products using Advanced Technologies:** In the recent years development of new concepts and new technology has resulted in the introduction of many new products in the market. The technologies which have influenced on development of new foods consist with quality and economic are:

1. **Development of membrane technology:** such as ultra-filtrations, difiltrations, micro filtrations, Nano-filtrations, reverse osmosis etc. Membrane technology can be applied successfully in filtration, concentration and fractionation of food products.
2. **Microwave heating:** For Pasteurization, Sterilization is used for inactivation of micro organisms.
3. **Hurdle technology:** Application of multiple hurdles. Ex.: High temperatures, low temperatures, redox potential, oxidation, which acts to prevent or retards microbial growth successfully to result in stable product at room temperature.
4. **High pressure Technology:** Food is subjected to high hydrostatic pressure to enhance the shelf-life and causing least damage to sensitive nutrients, vitamins, colors, flavors and texture.
5. **Modified atmospheric packaging (MAP):** Replacement of air in the package by different mixture of gas increases the shelf-life which can be increased to (50-400 %). With this type of packaging method, the products can be distributed over long distance with few delivery frequencies.
6. **Use of modern centrifugation technologies:** Bactocatch, Bactotherm, fat replaces like polydextrose, sucrose polyesters, lactofuse, cellulose, gel polyglycerol ester.
7. **Pro-biotic drinks:** Pro-biotic used to strengthen the system or becoming one of the favorite prefix in the food and beverage industries.

8. **Sugar replacements:** Isomalt: The ISOMALT–L.M, a tailor made sugar replacement is commonly used for milk, dark and white chocolates as well as, all kinds of cream fillings. ISOMALT- LM is in fine quality powder and is used for best results. It has a particle size, of 0.1 mm with 90% distribution in the product. ISOMALT- LM can replace sugar in the ratio 1:1, so recipe need not be changed to manufacture ISOMALT- LM chocolate.
9. **AB Enzymes:** Leading enzyme suppliers, AB enzymes will feature to new enzymes preparations, VERNON-292 and VERNON-393. They are improved versions of well received VERNON by baking and milling industries. This new enzyme preparation continues to achieve higher baking value and superior duff properties whereas VERNON- 292 is used to achieve for high baking value and finer homogeneous pore structures it also improves dough properties, a perfected “break and shred” where as VERNON- 393 increases dry stable duff and offer better performance in retarded and frozen dough.
10. **New food bericap: (Double seal for beverages):** Bericap, a double seal combines the strength of lined and line less single piece bottle closures. The double seal range has properties that can handle high carbonation, with- stand different climatic conditions, less permeable to oxygen and opens hole more quickly.
11. **Citro-fresh: (Cleaning agent of foods):** Cleaning agent of food industry. Citro-fresh is a multipurpose disinfectant that kills bacteria, viruses and fungus. It is completely natural and is suitable for washing fruits and vegetables for commercial and home consumption. It is used in, sea foods, meat and poultry, fruits and vegetables industry to minimize the risk of bacterial spoilage and contamination.
12. **PFA (Prevention of Food Adulteration):** For sugar free confectionary industry. To allow sugar free confectionary product, is going to give a pull to the industry. Till recently sugar free confectionary products including sugar free chewing gums, were not permitted by PFA.

**Application of biotechnology in food industry for product development:** In recent years, the food industry has begun to experience vast potential. Biotechnology offers for improving new foods and food production process through “*precise engineering*”. In the coming years, consumers will realize that genetically modified foods will be part of human diet for many years. Without any negative consequences, more significantly we will see the products of food biotechnology with unquestionable, tangible (more benefits) to the consumers. These include designer foods, healthy cooking oil from peanuts and Soya which increases cancer fighting antioxidants in everyday activities, tasty fat free foods, long shelf-life natural foods, anti-ageing foods and other benefit of biotechnology will increase safety of food due to more sensitive and rapid detection of microbial and chemical hazards and availability of natural and non mutagenic, effective bio-preservatives.

**Special Food Products:** These are the foods with particular advantages contributing to health management for people with specific metabolic disorders.

Ex.: Foods for patients with lactose intolerance, diabetes.

These foods include –

- Those who are unable to digest specific nutrients.
- Those who have special requirement for digestion like sports persons.
- Those whose requirements are different from that of adults like that of infants and geriatric persons.
- Sliming foods,
- Foods for traditional ceremonies.

Existing infant formulae being marketed in India are nutrient enriched proteins essential for growth and development of milk feeding infants. Ex.: Whey based beverages with definite content of minerals and vitamins have better nutritional affect to enhance the physical performance of sports person.

Products marketed for a particular segment of the population. Ex.: Single households and working women are likely to dominate the market in future.

**Genetically Modified Foods (GMF):** Biotechnology foods steps into genetically modified foods to overcome the demand of food production and process safely. Genetic Engineering or biotechnology can be defined as: "Manipulation of plant, animal or microbial genomes, via; introduction of a characterized DNA segments". The basic principle of genetic engineering is that genetic material can be transferred from a cell of one species to another unrelated species, and made it to express itself in the recipient cell. This technique is also known as "recombined DNA Technology". The tools of biotechnology or genetic engineering can be used in food industry to improve texture, color, flavor, stress tolerance and yield, disease resistance and to improve self-life etc. of the product.

Advantages of GMF: Pest resistance, Virus resistance, ripening control for improving nutritional composition, phytase production to retard microbial growth.

Disadvantages of GMF: Antibiotic resistance and allergency.

#### **Lecture - 14**

14. *Functional foods - formulated foods - Special foods - Imitation meat food / meat imitation - meat food - definitions - Advantages and disadvantages*

### **FUNCTIONAL FOODS**

The concept of functional foods was introduced in 1980 by Japanese to regulate the use of food for medicinal purposes. Recently, the research was started to isolate or purify the food from some specific bioactive compounds called "Nutraceuticals" that are generally sold in medicinal form not associated and demonstrated to physiological benefits (or) provide protection against chronic diseases.

Functional foods play important role in promoting health and reducing health risks. Functional foods may be defined as those with a traditional counter part, while nutraceuticals are those derived from different edible source but consumed in medical form like tablets or capsules or pills. Nutraceuticals can be prepared from chemical synthesis, fermentation and genetic engineering. They include a range of agri food ingredients or Photochemical extracted from edible plants or animal products.

Ex.: Amylosulphides from garlic, this having cholesterol lowering properties. Lycopene from tomato, is having antioxidant property. Nutraceuticals can be intake as in the form of fortification, supplements or consume directly as genetically enriched foods.

Food for woman became a bonafide trend, where two major brands launched national companies for female specific breakfast foods. They are "Quaker Oat Company" and "Harmony breakfast Cereals Company". These two brands represent products, specially formulated for female health with more effect of Ingredients such as soy calcium, folic acid, Iron on specific conditions. Quaker Oat meal is in a position as a hot-healthy cholesterol reducing food i.e. popular with woman where as Hormone meals features crunchy vanilla and Almond clusters, in

its food mix. The functional foods also known as designer foods medical foods, fortified foods, nutritional foods, nutraceutical foods, therapeutic foods and healthy foods.

Advantages of Functional Foods:

- Helps to reduce cardio vascular risk through the antioxidants and flavanoids.
- Reduce the risk of cancer as they are rich in antioxidants like vitamin C, vitamin E and Selenium.
- Helps in the reduction of obesity by using non-traditional or novel foods rich in dietary fiber.
- Functional foods control immunity with water and fat soluble vitamins, PUFA (n-3 and n-6 fatty acids), amino acids like arginine and glutamic acid.
- Dietary factors modulation with functional foods can reduce the process of aging.

**Designer Meat Foods:** It is necessary to avoid harmful components, which gives negative physiological effect, by increasing the concentration of beneficial components such as antioxidants, vitamins, essential fatty acids, minerals, pro-biotics etc.

**Types of designer meat foods:** Designer meat products are classified into 4 groups:

1. Low fat meat products: The saturated fat is replaced with unsaturated or non-meat ingredients because the saturated fat is responsible for high serum cholesterol level and other major reasons for certain diseases like heart diseases, obesity, etc.
2. Low sodium meat products: Salt is an important additive in daily food activities. It is reported that 20-30% of salt intake is by meat and meat products. High intakes of sodium will results to development of hypertension and cardio-vascular diseases. In these products the sodium content is reduced by reducing the level of salt added during processing to a minimum level. Replace all or part of salt being used with salt substitutes like phosphate, lactate, potassium sorbate and glutamate.
3. Nitrate reduced meat products: It is the critical agent in meat product processing as it stabilizes the color, flavor and improves textural properties and impact preservative effect especially growth of microbes such as Clostridium butylinum. Excess consumption of nitrates and nitrosamines improves the risk of cancer. The nitrate can be replaced by erythrosine and niacin.
4. Other types: Products which are prepared with plant proteins, dairy proteins, oligosaccharides, plant proteins, dairy proteins vegetables oils, synthetic lipids, bioactive ingredients, photochemical pro-biotics and dietary fibers.

**Lecture – 15**

15. *Food demand and supply - food requirements - factors affecting on food demands - present market segments of food process industry in India*

**DEMAND AND SUPPLY**

- Demands created for new product must be filled up by right product to meet the consumer need.
- Blend/modify/adopt the available process, technologies and manage the process of innovation.
- Develop secret weapons for marketing the products.

Creation of new product by reconstituting the already existing products using new technology is required to keep in phase with change in the consumer food pattern and social trends. Product development is not an accident but systematic approach to new creation depending on the application of expert knowledge from a wide range of discipline. Taste and texture will continue to be the major market forces in the development of food industry.

**Food demand and supply requirements:** About 40% of our people are living below the poverty line. They face problems for day-to-day existence without enough money to get simple food. Often not even for a nut meal. So the 1st responsibility of any civilized society is to ensure availability of food for these people and hunger must be eliminated. Keeping this view, the increased agricultural production should aim not only at dabbling, but perhaps a tripling of food grain production.

Production of Food grains has been increasing both in terms of absolute quality and also percentage vice. In recent times all over India an increase in food production is there to meet the demand. Demand and supply equation of agriculture commodities should defend the agenda of research and management system for next century.

Providing basic food for population and elimination of hunger should be the 1<sup>st</sup> item on the agenda. World population today is about 6.2 billion and it will be over 8 billion by 2020-'25 and nearly 10.5 billion by end of this century. So, the food production must be doubled to meet the demand of the food.

**Salient features of food processing industry (FPI) to meet the needs of this food demand:**

- Unlike, other Industries FPI is having seasonality in their production cycle. This is so because; supply of their raw materials is characterized by seasonality. So, the FPI must procure most of the raw materials during the harvest season and a little after. So that they can process them (raw materials) during and after the season. The marketing of processed food is however round the year as their demand.
- The high perishable commodities such as; milk, fish, egg, fruits and vegetables require greater speed and care in handling, transportation, storage and processing.
- The development of available resources for the development of grain mills, edible oils, sugar and dairy products should be received at higher severalty. The location of food processing industries at rural areas will help to reduce the labor cost and nearer to raw materials will also lead to reduction in food losses.
- The food processing Industries requires quantity and quality of raw material because of changes in weather conditions damage crops and live-stock from pesticides, insects and diseases. So, it is requires development of disease resistance seeds, pest resistance seeds.etc.

**Factors Effecting Food Demand:**

1. Population: In India is 1.2 billion and it is projected at 1.3 billion by 2020.
2. Consumption: Economic growth is another factor. If people earn more, their economic conditions will grow and consumption rates also rises. So, it is necessary to increase the production as per the people's economical growth. So, it will be a happy day when our poor have enough to eat.

3. Life style: Trend is growing towards consumption of meat products with the increasing in the income and it is also increasing the consumption of non-vegetarian food products like cereals.
4. Projection for Supply input: Based on many other factors and variables. Our food industry need at least 7% growth rate to reach developed countries status.

**Projected household demand for food in India upon 7% Income growth**

Commodity	Annual household demand in MMT			
	1995	2000	2010	2020
Food grains	185	208.6	266	343
Milk	62	83	153	271
Edible oil	5	6	9	13
Vegetables	65	80	117	168
Fruits	16	22	42	81
Meat, Fish, Eggs	4	6	13	27
Sugar	11	13	17	22

\*MMT: Million metric tons.

In order to achieve the above mention target are possible only by

1. Irrigation
2. Fertilizers
3. High yielding varieties and Agricultural credits.

**Magnitudes and interdependent activities and food processing agencies:** Food Industry is very large and employs  $\frac{1}{4}$ <sup>th</sup> of work force. This is greater than combined number of employees in steel, automobiles, chemical, manufacturing, and communications.

The food industry produces, processes, transports and distributes fermented, formulated and dehydrated products on consumers demand utilized by 1.5 million people.

**Inter dependent activities:** The production of specific foods in highly advanced and organized food Industry is a systematic and synthetic process. The food manufactures doesn't simply decide 5000 tones of margin and then do so. If he did, he might find himself at one end enable to produce necessary oils at a competitive price and at the other hand without a ready and adequate outlet for his product. To gain insight into over all process, he should know the technology of typical food products.

**Other factors influencing the Food Processing Industry:** Indian society is predominately agrarian. Hence the food processing industry should provide:

- (a) Food security – access to food to all people at all times.
- (b) Food availability – production of food should be sufficient.
- (c) Food accessibility – people should be able to buy available food.

But as the population is increasing and food losses of around 30 – 40%, it becomes a challenge to convert the agricultural and allied produce into foods or value added products so that another 117 million people will have food. India is processing < 7% of the total farm produce whereas China processes 23%, Philippines processes 40% and UK processes 200%.

**Factors influencing consumers to seek Processed Foods:**

- (1) Emerging urban and rural middle class population with requisite purchasing power.
- (2) Social and cultural changes are strongly influenced by the communication media.
- (3) Changing demographic patterns.
- (4) Increase in the working women's population.

- (5) Consumer perception towards packaged and processed products.
- (6) Increased competitiveness with alternate and substitute products.
- (7) Entry of modern and self service markets.

**The major Food Processing Industries in India are:**

- Fruits and vegetables processing industry
- Beverages
- Confectionaries
- Marine products
- Meat products
- Milk and milk products.

India has the maximum agricultural resources and is in a position to be the world leader in Food Processing Industry because of the following reasons:

- (1) The production of fruits and vegetables in India is 43 and 101.43 million tonnes against world production of 341 and 441 million tonnes respectively.
- (2) India share in world production is 8.1% in fruits and 9.3% in vegetables.
- (3) India is the third largest producer of fruits after Brazil and USA and 2<sup>nd</sup> in vegetables after China.
- (4) India produces 65% of world's mangoes and bananas where as 12% of world's onions.
- (5) In mushroom production, India comes after China and Korea.
- (6) Mushrooms of India and Taiwan are in higher demand as they are valued better than China's mushrooms which are associated with toxicants.

India's share in world production and area for major food crops

Particulars	Production (%)	Occupation area (%)	India's rank in production	India's rank in area
Wheat	11.99	17.20	2 <sup>nd</sup>	2 <sup>nd</sup>
Rice	21.49	28.50	2 <sup>nd</sup>	1 <sup>st</sup>
Pulses	26.0	36.60	1 <sup>st</sup>	1 <sup>st</sup>
Ground nuts	28.6	35.20	1 <sup>st</sup>	1 <sup>st</sup>
Sugar cane	22.6	20.0	2 <sup>nd</sup>	2 <sup>nd</sup>
Tea	28.30	13.50	1 <sup>st</sup>	2 <sup>nd</sup>

The Indian food processing industry structure reveals that only 55% of the food production is contributed by the small scale and organized sector where as the remaining 42% is being produced in the unorganized sector.

**Size of the market:** As per year 2005

Food Industry	Amount in Crores of Rs.
Oil Industry	50,000
Packed Milk	36,000
Fresh Poultry	27,000
Sugar	24,000
Packed atta	15,000
Soft drink	10,500
Bakery	10,500

India has high live stock population as per the 2005 data. The live stock population was 941.3 millions of which there are 287 million cattle, 75 million buffaloes, 70 million bullocks, 110 million goats, 5.4 million sheep, 10 million pigs and 310 million poultry birds. This provides a good scope for increasing the production and processing of meat and poultry products.

The estimated loss of fruits and vegetables is about Rs. 3, 000 crores due to lack of post harvest facilities. India has a coastal line of about 7500 Km, 2800 Km of rivers, 3 million hectares of lakes and 1.4 million hectares of brackish water area with vast potential for marine and inland fisheries.

India has 3600 licensed labs or slaughter houses with mechanized processing facilities. Alkabar slaughter house is about Rs. 78 crores and Punjab Meat Processing Limited costs about Rs.48 crores. The high technology includes machinery like automatic cleaners, mobile platforms and power saws imported from Europe.

There is scope for increased the production of meat and milk products with regard to export market. India exports fruits and vegetables worth Rs.165 crores, meat products of Rs. 380 crores including onions, banana and tomatoes as well as marine products worth Re. 300 crores.

The following sectors can be improved further:

- (1) Cereal based products: includes wheat based foods like aerated buns, breads, rolls, puffs, pastries, soups, breakfast and other bakery items.
- (2) Fruits and Vegetables: It includes dehydrated and canned vegetables, jellies, nuts, soups, juices and fruit drinks.
- (3) Sugar and Confectionaries: These include coffee drinks, syrups, honey, cakes, puddings and table jellies.
- (4) Meat and poultry: It includes meat, processed meat products, meat pickles, chicken products and chicken pickles.
- (5) Fish products: It includes canned fish products like tuna along with consumer products like fish cakes, sea foods, fish chips and fish pickle.
- (6) Others: Juices in consumer packs, soya based products, breakfast meats, ready to serve and ready to eat items.

**Areas where processing can be potentially increased:**

- a. Fruits and Vegetables - soups and pickles.
- b. Dairy products - cheese, butter, dried milk powder.
- c. Meat, poultry and fish - pickles and canned products.
- d. Bakery - puffs, cakes and biscuits.
- e. Convenience foods - cutlets, drinks, ready to eat, ready to serve and ready to use products
- f. Frozen foods - ice creams
- g. Confectionaries - chocolates
- h. Beverages - soft drinks, squashes and juice powders.

**Position of Indian Dairy Industry:** India has the largest live stock population with 825 million animals. Total milk production is 90 metric tonnes valued at Rs. 85, 000 crores. The Indian dairy industry is processing only 145 of the total milk produced. India stands first in the milk production with a growth rate of 4% where as food industry it is 7 – 9%. The per capita consumption is 231 ml / day.

**Status of grain milling sector:** India produces about 200 metric tonnes of food grains annually. All major crops like rice, wheat, maize, barley and millets like jowar, bajra and ragi are produced in India. India is self sufficient in grain production, second largest rice producer and shares about 20% of world's production.

Soft drink industry: The major products are non-alcoholic, flavored and sweetened beverages, colas, orange and lemon juices. Currently 65% of Indian populations prefer the non-alcoholic beverages.

**Packaged and convenience food sector:** The strong middle class of about 250 million people has not been very encouraging towards the used of packaged foods. But now that the food processing industry is highly organized and changing food habits has created enough potential for the development of this sector.

**Constraints faced by the Food Processing Industry:**

- (1) Non availability of right quality raw material.
- (2) Seasonal excesses and scarcity of raw materials causes fluctuation of prices.
- (3) High taxation.
- (4) Stream lining of food laws.
- (5) Complicated administrative and legislative processes.
- (6) Lack of interface between farmers, processors and research institutes.
- (7) Lack of awareness of intellectual property rights and indifference about the quality systems.
- (8) Unpreparedness of the food industry to meet the challenges of WTO agreement.

**Lecture – 16**

16. *Features of food processing industry to meet the needs - processed food industry in India - further priorities in food production need*

**TRENDS IN FOOD PRODUCTION AND AVAILABILITY**

**(1) Agricultural Population:**

	<b>1979 -1981</b>	<b>2004</b>
India	441 (64%)	560 (52%)
World	2219 (50%)	2600 (41%)

Values in parenthesis are percentage of total population.

**(2) Food Production:**

<b>Foods</b>		<b>1979 -1981(MT)</b>		<b>2004 (MT)</b>	
Cereals	India	138.0	8.3%	232.0	10.2%
	World	1573.0		2270.0	
Fruits and Vegetables	India	56.5	9.0%	127.6	9.2%
	World	629.7		1383.7	
Meat	India	2.62	1.92%	6.03	2.32%
	World	136.22		260.1	

**(3) India’s ranking in world production:**

- (a) India stands first in the production of beans, chickpea, lentils, millets, pigeon pea, pulses, banana, mango, okra, peas, tea, sesame seeds, castor seeds, buffalo and goat milk and buffalo meat.
- (b) India ranks second in the production of rice, wheat, cabbage, cauliflower, garlic, lemon, onion, pumpkin, cashew nut, ground nuts, sugar cane, cow milk and goat meat.

**(4) Status of Productivity in India between 2002 – 2004 (MT):**

- (a) Cereals: Rice – 63, wheat – 48, sorghum – 77, maize – 90.

- (b) Pulses: Dry peas - 57, pigeon pea – 13, chick pea – 29, dry beans – 110, ground nuts in shell – 72, soya beans – 68.
- (c) Live stock: Buffalo meat – 16, chicken meat - 134, duck meat – 48, goat meat – 141, pig meat – 168.
- (d) Milk products: Buffalo milk – 2, cow milk (fresh, whole) - 113, goat milk – 33.
- (e) Others: Hen eggs – 55, honey-15.

(5) **Production of major food commodities in 2004:**

Commodity	World	India	
		Quantity (MT)	% Share in the world
Cereals	2270.36	232.36	10.2
Pulses	61.12	14.50	23.7
Oil seeds	142.13	9.70	6.8
Fruits and vegetables	1383.65	127.56	9.2
Roots and tubers	718.20	32.60	4.5
Stimulants	15.0	1.13	7.5
Milk	622.14	91.0	14.6
Meat	260.10	6.03	2.3
Eggs	62.97	2.46	3.9
Fish	195.63	6.13	3.1

(6) **Food needs in India:**

- (a) Minimum dietary requirement in 1979 -81 - 1780 kcal/ person/day.
- (b) Minimum dietary requirement in 2004 - 1820 kcal/ person/day.

(7) **Trends in Food Consumption:**

Foods	Units	1979 -1981		2002 - 2004	
		India	World	India	World
Energy	Kcal / person / day	2080	2550	2470	2810
Protein	g / person / day	51	67	64	83
Fat	g / person / day	33	59	51	76
Carbohydrates	g / person / day	77	-	71	64
		410	-	428	-

(8) **Food consumption expenditure:** Indian food consumption expenditure of total consumption (%) is given below:

	Before 1990	2004
Rural	63.8	54.0
Urban	55.9	41.6
National	64.0	49.5

(9) **Indicators:**

Indicators	India		World	
	1979 - 81	2002 - 04	1979 - 81	2002 - 04
Prevalence of under nourishment (millions)	261.3	209.5	944.8	863.9
Life expectancy at birth (years)	54	63	63	67
Child Mortality Rate (per 1000 live births)	173	87	118	80

(10) **Food Balance sheet (in MMT):**

Items	Production		Export (-)		Imports (+)		Consumption (-)	
	India	World	India	World	India	World	India	World
Cereals	187.0	1180.0	8.0	295.0	0.05	244.0	164.0	943.0
Vegetable oils	6.3	102.0	0.26	50.0	5.09	46.0	10.0	70.0
Sugars & sweeteners	29.0	177.0	1.6	52.0	0.07	49.0	26.0	158.0
Roots & tubers	32.0	691.0	0.06	36.0	0.02	42.0	25.0	399.0
Milk	88.0	602.0	0.31	79.0	0.04	74.0	70.0	495.0
Meat	6.0	246.0	0.31	28.0	-	11.0	5.41	243.0

(11) **Area and production of horticulture crops ( 2003 – 2004):**

Item	Area (million hectares)	Production (MT)
Fruits	4.0	47.5
Vegetables	6.2	59.0
Spices	2.4	3.2
Coconut	2.0	12.5
Cashew	0.9	0.6
Others	1.7	2.0

(12) **Average Intake of foods (per cu/day) as % RDI:**

Foods	1975 - 1977	2005 - 2006
Cereals	110	86
Pulses	85	70
Green leafy vegetables	20	40
Other vegetables	90	82
Roots and tubers	112	120
Milk and milk products	77	55
Fats and oils	70	70
Sugar and jaggery	77	47

(13) **Average Intake of nutrients (per cu/day) as % RDI:**

	1975 - 1977	2005 - 2006
Proteins	103	83
Energy	97	76
Calcium	152	110
Iron	108	43
Vitamin	41	43
Thiamine	125	100
Riboflavin	57	64
Niacin	92	92
Vitamin C	98	110

(14) **Distribution (%) of households with Protein Calorie Adequacy:**

Food Stuff	1975-1977	1988-1990	1996-1998	2005-2006
Protein	78	84	80	73
Energy	58	53	48	30

(15) **Per capita food production in India (Kg / person / year):**

Items	1969 – 71		2001 - 2003	
	Production (metric tonnes)	Consumption (g/person/day)	Production (metric tonnes)	Consumption (g/person/day)
Cereals & products	163	401	178	428
Pulses & products	20	45	12	32
Oil crops(excluding products)	25	15	29	17
Vegetable oils & products	05	11	06	27
Fruits & products	29	70	43	101
Vegetables & products	47	118	73	184
Starchy roots & products	20	47	30	65
Nuts & products	-	-	01	-
Sugars & sweeteners	21	53	27	67
Beverage crops	01	01	01	02
Spices	01	04	03	07
Milk & products	39	92	84	182
Animal fats & products	01	02	03	07
Meat & products	01	10	05	14
Eggs & products	01	01	02	05
Fish, sea foods & products	03	08	06	13

\*Required Daily intake

(16) **Average intake of Food Stuff (per Cu/day) as % RDI\* by period of Survey:**

Food Stuff	1975-1977	1988-1990	1996-1998	2005-2006
Cereals	110	102	98	86
Pulses	85	80	68	70
Green leafy vegetables	20	23	38	40
Other vegetables	90	82	78	82
Roots and tubers	112	82	88	120
Milk and milk products	77	61	57	55
Fats and oils	70	65	60	70
Sugar and jaggery	77	97	70	47

\*Required Daily intake

(17) **Average intake of Food Stuff (per Cu/day) as % RDI\* by period of Survey:**

Nutrients	1975-1977	1988-1990	1996-1998	2005-2006
Protein	103	97	90	82
Energy	97	94	87	76
Calcium	152	141	130	110
Iron	108	97	89	53
Vitamin A	41	47	50	43
Thiamine	125	108	100	100
Riboflavin	57	66	64	43
Niacin	92	89	79	92
Vitamin C	98	93	106	110

\*Required Daily intake

(18) **Average intake of Food Stuffs (g/cu/day):**

Food Stuff	1990-1991	2000-2001	*RDA
Cereals	521	457	460
Pulses	37	34	40
Green leafy vegetables	14	18	40
Other vegetables	53	57	60
Milk and milk products	88	75	150
Fats and oils	14	14	20
Sugar and jaggery	13	17	30

(19) **Nutrient Intake (% RDA\* per day):**

Nutrients	1989 - 1990		2000 - 2001	
	Men	Women	Men	Women
Protein	102.7	109.4	97.8	96.0
Energy	97.1	114.2	92.0	100.3
Calcium	164.8	138.3	133.0	112.8
Vitamin A	48.2	48.5	40.3	36.3
Thiamine	91.7	111.1	116.7	133.3
Riboflavin	64.3	72.7	5.1	54.5
Niacin	88.8	107.5	109.9	123.3
Vitamin C	115.0	115.0	127.5	112.5

(20) **Average Daily intake of Foods (% RDA\* per day) by Gender:**

Food Stuff	1 – 3 years children		4 – 6 years children		Adults	
	Boys	Girls	Boys	Girls	Men	Women
Cereals	74	80	79	76	95	99
Pulses	36	36	62	54	65	85
Green leafy vegetables	14	17	19	23	18	45
Other vegetables	69	67	86	37	125	95
Roots and tubers	219	232	181	166	138	150
Milk and milk products	31	26	27	23	67	57
Fats and oils	18	19	33	20	60	35
Sugar and jaggery	32	31	26	26	46	57

(21) **Average Daily intake of Nutrients (% RDA\* per day) by Gender:**

Nutrients	1 – 3 years children		4 – 6 years children		Adults	
	Boys	Girls	Boys	Girls	Men	Women
Protein	83	87	90	87	91	90
Energy	54	57	59	57	88	97
Calcium	40	40	52	49	105	86
Iron	35	38	38	37	50	38
Vitamin A	14	14	17	16	20	16
Thiamine	67	67	67	67	108	122
Riboflavin	43	43	30	30	50	55
Niacin	56	61	68	65	101	118
Vitamin C	30	32	37	36	83	73
Folic acid	58	60	66	64	-	-

\*Required Daily intake

## Lecture – 17

### 17. Food losses and factors affecting food losses - physical, chemical, physiological and biological factors

#### **FOOD LOSSES AND FACTORS EFFECTING ON FOOD LOSSES**

Food challenging of feeding ever growing human population cannot be met by the increase of food production alone. In order to make further progress it requires inputs of improved seeds, fertilizers, pesticides and advanced post harvest technology of preservation and utilization apart from improved production practices and irrigation. The losses during growing crops and post harvest handling, processing, storage and distribution system ranging from 20 and 60% in some of the countries. It is estimated that 6 –11% of food grains are lost during post harvest operations. If these losses are minimized the shortage of foods in many country could be probably eliminated.

#### **The factors effecting food losses:**

1. Physical factors: Temperature and humidity.
2. Chemical factors: Moisture, enzymes
3. Physiological factors: Respiration and heating.
4. Biological factors: Insects, Mould, Fungi, Mites, Microorganisms and rodents.

**Food Deterioration:** Food undergoes deterioration without storage. It depends on moisture content of food and other factors like heat, cold or refrigeration, humidity and microorganisms.

#### **Shelf-life of some foods:**

Food item	No. of days
Fish	1 - 2
Poultry	1 - 2
Fish (dried fish)	360
Fruits	1 - 7
Dried fruits	360
Leafy vegetables	172
Dried seeds	360

**Major reasons for food spoilage:** There are several factors, which effect for the spoilage of foods. These factors are:

1. Growth and activity of microorganisms (bacteria yeast and moulds).
2. Activity of food enzymes and other chemical reactions within the food.
3. Insects, parasites and rodents, inappropriate temperature.
4. Moisture.
5. Reaction with oxygen, light and time.

**Preservation Methods:** The basic objectives of food preservation are to minimize the food losses and food spoilage. Food preservation is essential to carry the food from time of plenty to the time of scarcity.

**Preservation of meat:** Basically, in the case of meat products, the microorganisms contaminate the flesh through the skin and through equipments like knife, bowls etc; during slaughtering of

beef. The eggs in general are sterile, but the shell of egg can be contaminated through the cavity and this cavity enables to the entry of spoilage microorganisms.

**The Fruits and nuts:** The microorganisms enter through the shell, which are weak and broken.

**Milk products:** In case of milk, contamination may takes place due to several reasons, like udder, teats, milker's hands, utensils and through milk sets etc.

**Role of Microorganisms in food losses:** The losses of the food occur due to microorganism like bacteria, yeast, moulds, etc. The bacteria and yeast can be contributed for the typical off-flavors and they are responsible for gas production.

Moulds are long and grow by network and produce mould spores. Microorganisms usually attack all the food constitutes. Ex.: *Aspergillus niger*.

- (1) Multiplication of Bacteria: Bacteria increases by cell division, depending upon the type of bacteria and favorable growth conditions like heat, moisture, nutrients and light.
- (2) Enzymes: The enzymatic activities are balanced in living tissues. Pepsin is essential to digest proteins in stomach. Some enzymes are useful in the manufacture of cheese etc.
- (3) Insects, parasites and rodents: Insects open the food for microbial spoilage. Many a time's excreta of rodents or the insects will also contribute to microbial spoilage. The insects are controlled by fumigation with ethylene.
- (4) Hot Temperature: For every 10 °C rise in storage temperature, the rate of chemical reaction is doubled. This includes both enzymatic and non-enzymatic reactions. Excess heat leads to losses of proteins, vitamins and other constituents of food product.
- (5) Cold Temperature: In extreme cold temperature the skin will shrink leaving susceptible for microbial attack. At cold temperatures of 5-6 °C may also affect certain fruits and vegetables like banana, lemons, etc. Tomatoes should be stored at more than 12 °C.
- (6) Moisture: Higher the moisture content lower is the shelf life of food product.
- (7) Air and Oxygen: The availability of air and oxygen contributes for growth of moulds. The oxidizing effect may affect the availability of vitamin A and vitamin C.
- (8) Light: Riboflavin, vitamin A, vitamin C are affected by light. Milk may develop some light flavor.
- (9) Time: For almost all foods, time is an important factor in products like cheese and wines where fermentation time is required.
- (10) Improper marketing infrastructure: Proper post harvest handling has capacity -
  - (a) To meet the food needs of growing population.
  - (b) Provide nutritive foods.
  - (c) Encourage the use of value added foods.

In India 80% of people live in villages and 70% are dependent on agriculture. So it is essential to evolve application technologies which can be established as agriculture based in rural industries.

The purpose of post harvest processing like drying, milling, threshing, grading, parboiling, shortening, grinding, extracting, cold storage, packaging, marketing is to enhance the quality of food products and agricultural produce.

**Shelf life at different Temperature of Food**

Item	0° C	15° C	20° C
Fish	2-7 days	1 day	Less than one day
Poultry	5-18 days	1 day	< one day
Dry meat & Fish	2 years	1 year	100 days
Fruits	2-180 days	1-10 days	1-7 days
Dry fruits	2 years	1 year	100 days
Leafy vegetables	3-20 days	1-7 days	1-3 days
Flesh	6-10 days	1 day	< one day

**Different factors of food losses in fruits and vegetables processing industry:**

- Poor post harvest handling.
- Lack of adequate transportation at a time.
- Improper storage facilities and poor processing techniques.
- Unavailability of continuous power supply in pre-cooling arrangement at harvesting.
- Critical shortage in grading and cleaning arrangement.
- Unsafe handling, packaging and storage facilities of perishable products.
- Lack of processing machinery Technology.
- Un-development of R & D
- Lack of knowledge regarding food loss and regulatory agencies.
- Improper marketing infrastructures.

**Post harvest management:** Post harvest management of fruit and vegetables plays an important role in the overall development of Agricultural sector. Planning for improved post harvest management and loss reduction is necessary to a full understanding of food system. Available marketing information can be used to plan as to which crop and varieties to grow, when to grow, when to harvest and in what quantities. Support in the form of information and marketing, extensive services to farmers is very important. Farmers and other operating in the marketing and in post harvest system are unlikely to accept a new post harvest techniques unless the benefits can be show to exit the cost by a factor and sufficient to justify the risk involved. Insufficient infrastructure at the farm and unhygienic markets, poor protection from sun and rain causes considerable impact on post harvest losses particularly for the more perishable products.

**Packaging of Processed Food:** To prevent the food losses in recent years, many new packaging concepts were introduced like:

- Modified atmospheric packaging
- Vacuum packaging
- Aseptic packaging.

## Lecture – 18

18. *Programmes and strategies to eliminate the food losses - Post harvest management, Importance of value addition and methods of storages*

### **FOOD PRESERVATION**

- When food is available in abundance for present use, it needs to be preserved for future.
- Fruits and vegetables have short growing season and preservation makes them available throughout the year and also avoids wastage of the surplus crop.
- Foods bought when they are plentiful are cheaper and of good quality as well as money can be saved by buying and preserving the foods for future use.
- Preservation in some cases produces different form of the products. Ex.: Grapes upon drying are called raisins and can also be stored as grape squash.
- Preserved foods can be easily distributed and can be made available at all places and all times.
- Many foods cannot be preserved as such and required some sort of treatment.

**Food Spoilage:** When foods spoil, they undergo physical and chemical changes that render them inedible or hazardous to eat.

#### **Chief causes of Food Spoilage:**

- Growth of micro organisms like bacteria, yeast and moulds.
- Action of enzymes that are normally present in foods.
- Additional causes of spoilage are non-enzymatic reactions like oxidation, mechanical damage like brushing, by rodents and insects.

#### **Types of Food Spoilage:**

- Bread – moulds like aspergillus, pencilium
- Fruits and vegetables – moulds
- Pickles – yeast
- Fresh meat – putrifaction by pseudomonas and clostridium
- Cured meat – moulds like aspergillus
- Fish – discoloration and putrifaction by pseudomonas
- Eggs and poultry – putrifaction.

#### **Methods of Food Preservation:**

General principle – Preventing or retarding cause of spoilage by –

- Microbial decomposition
- Enzymatic and non-enzymatic chemical reactions
- Damage by mechanical causes
- Damage by insects and rodents

No method of preservation will improve the original quality of a food product.

#### **Various methods of Food Preservation:**

1. Low Temperature: Inhibition of growth and destruction of micro organisms to certain extent.

Freezing: (i) Slow freezing: - 4 °C to – 29 °C for 3 to 72 hrs.

(ii) Quick freezing: - 32 °C to – 40 °C, Large quantities can be frozen in a short period of time.

(iii) Dehydro freezing: Drying to about 50% of the original weight and volume.

2. High Temperature: Temperature and time vary for different foods.
  - a. Pasteurization – The temperature used is  $< 100^{\circ}\text{C}$ . Heating may be by steam, dry heat or electric current.
  - b. Canning – Application of temperature that are high enough to destroy all micro organisms plus air tight sealing in a sterilized container will prevent re-contamination.
  - c. Tin cans coated with steel and glass containers are most commonly used.
  - d. Aluminum and plastics can also be used.
  
3. Preservatives: Chemical agents which serve to retard, hinder or mask undesirable changes in foods caused by micro organisms, enzymes in foods and chemical reactions.  
 Ex.: Sodium or potassium metabisulphites which are colorless and sodium benzoate which is colored.
  
4. High Osmotic Pressure: High concentration of sugar – jams and jellies  
 High concentration of salt – pickles and sauces.
  
5. Drying: The different types of drying are as follows:
  - (a) Freeze drying, sun drying and solar drying: fruits, vegetables and nuts.
  - (b) Mechanical drying: Drum drying – flours and vegetables  
 Roller drying - vegetables
  - (c) Osmotic drying: Salted fish
  - (d) Spray drying: Milk powders
  - (e) Drying with smoke: cured meats

#### Lecture – 19

19. *Packaging of processed food - Definition for modified atmospheric packaging - Vacuum packaging – Aseptic packaging for improving the shelf life of perishable foods.*

### **Packaging of Foods**

Packing is art of presenting a product in a scientific and technological way and advances have revolutionarised packing to a great extent. About 40 years ago there used to be bottles or vessels or gunny bags for packing. Now-a-days neatly packaged branded grocery items are available in departmental stores.

Three major objectives of packing:

- Protection
- Preservation
- Promotion

**Materials used for packing are:**

(a) Conventional Methods:

- Tin and Aluminum which are costly
- Glass bottles and jars can be easily broken and heavy for transportation due to weight.
- Paper and waxed paper wrappings, paper cartons, card board and plastic containers can dwindle the natural resources if used extensively.

(b) New materials: Polytirene, polyvinyls, polyvinydines and its derivatives, vinyl acetate, polyethylene, polypropylene, polyesters and poly combinates.

**Packing to improve shelf life of perishable foods:**

- Vacuum packing
- Modified atmosphere packing
- Shrink wrap packing: heat shrinkable thermoplastic film is wrapped to achieve a skin tight package. Canned food product bottles and jars are can be shrink wrapped.
- Packing material should be eco-friendly or environmentally friendly.
- No hazards to man or environment.
- Corrugated boxes are eco-friendly and preferably for exporting.

**Points to be considered for designing packing systems:**

- (1) Products details: Physical state, weight, size, chemical composition, vulnerability to environment and fragility.
- (2) Distribution: Method of distribution by road, rail, sea, air or combination of two or three modes.
- (3) Handling: cargo handling, manually or mechanical means.
- (4) Destination Market: In the case of export market the details regarding the importing country's laws and regulations.
- (5) Packing cost: Details of material cost include storage cost, packing operational cost, distribution cost, insurance cost and development cost.

**Laws related to packing:** Standard of weights and measures (packing commodities) rules was introduced in 1977.

**Labeling:** Every package should have label stating:

- Name and address of manufacturer and packer with written content.
- Common or generic name of the product.
- Quantity – weight / number.
- Month and year manufactured.
- Retail sale price.
- It size are relevant – dimensions of the commodity.

**An export package should indicate:**

- Intended for export.
- Identify the product for its net weight and measure.
- Name and address of the manufacturer.

Indian Institute of Packing: Southern region center is located at Chennai under the Ministry of Commerce and offers research and development, consultancy, information and other services.

Nutrition Facts:

1. Serve size: Ex:  $\frac{1}{2}$  cup = 114g, Servings / container = 4

2. Amount / serving: Calories = 260 calories

Calories from fat = 120 calories  
Total fat = 13 g  
Cholesterol = 30 mg

3. Vitamin and mineral content.

4. % daily value - % daily values are based on a 2000 calorie diet. Daily values may be higher or lower depending on calorie needs. % daily value

Ex:	Total fat	13 g	20
	Saturated fat	05 g	25
	Cholesterol	30 mg	10
	Sodium	660 mg	28

At present there are no rules in India which require compulsory nutritional labeling on food products.

**Advantages of Packaging:** Packaging is useful in marketing function as the commodities packed are viewed to have good preservation. They protect the quality and quantity of produce during transit and storage. The main advantages are as follows:

- (1) It protects the goods against breakage, spoilage, leakage or pilferage during their movement from production to consumption point.
- (2) The packaging of some commodities involves compression which reduces the bulk like cotton, jute and wool.
- (3) It facilitates the handling of commodities, especially fruits like apples, mangoes, etc during storage and transportation.
- (4) It helps in quality identification, product differentiation, branding and advertisement of the products. Ex.: AMUL ghee and butter.
- (5) It helps in reducing the marketing costs by reducing the handling and retailing costs.
- (6) It helps in checking adulteration.
- (7) It ensures the cleanliness of the products.
- (8) Packaging with labeling facilitates the coverage of instructions to buyers as how to use or preserve the commodities. The labels show the composition of the products.
- (9) It prolongs the storage quality of products by providing protection from ill effects of weather, especially for fruits, vegetables and other perishable goods.

**Packing materials and new inventions in packaging:** There are many new developments in the use of materials for packaging the products. Most of these have been in the area of packaging for consumers with a view of making the commodity more attractive. The usage of fiber board containers, polyethene, pollyshells (polyethene and cellofan) and multi wall paper bags are some of the innovations in this direction.

Although packaging is advantageous, it adds to the cost of the products. Some of these are rather fanciful and more to cost than to the utility of the product. In order to reduce the packaging costs unnecessary use of fancy packing material should be avoided. In general the materials used should have –

- (1) **Protective strength:** The material used for packaging must have enough strength to protect goods from breakage, leakage, spoilage and pilferage.
- (2) **Attractive:** The material should be attractive to tempt the onlooker to try it.

- (3) **Consumer convenience:** The packaging material should be used and packets be made of such size as is convenient and suits the consumer needs.
- (4) **Economy:** It should be cheap and material used in packaging should be used for domestic and other purposes after the contents are used. In case the material cannot be used, it should be bio-degradable.
- (5) **Free from chemical reactions:** Packaging materials should not give rise to adverse chemical reactions and should conform to safety standards prescribed by health authorities.

Based on the commodities, the packaging materials vary. It is also based on the commodity's perishability and stage of marketability.

- (1) The food grains and oil seeds are for whole sale market and are usually packaged in gunny bags where as sugar in jute bags. In recent years, bags made of jute blended with synthetics are used for packaging of commodities like cement and fertilizers.
- (2) For fresh fruits, wooden carters and straw board boxes or bamboo baskets are used. But now- a-days, non conventional packaging materials are being viewed due to cost considerations. Some of them are polyethene foam wrappers using tissue papers, plastic trays and corrugated board cartoons.
- (3) Vegetables are normally packed in jute bags, bamboo baskets and expensive wooden boxes. Normally the materials used are -
  - (a) Jute bags for packaging of less perishable vegetables like cabbage, carrot, radish, beans, turnip, brinjal and cucurbita.
  - (b) Bamboo baskets and wooden baskets are used to pack tomatoes, cauliflower and chillies.
  - (c) Corrugated fiber board (CFB) is used to pack vegetables for export markets.
  - (d) Corrugated craft paper cartons are good alternative for packaging vegetables instead of wooden and bamboo boxes.
  - (e) Plastics: It includes plastic film bags, plastic nets, corrugated board trays, molded plastic trays and plastic hollow boards for packaging of vegetables.

Packaging should be such that the maximum utilization of space should be there while transportation is done.

- (4) **Processed foods:** Packaging materials used for processed foods are as follows:
  - (a) Tin containers – these are easily malleable, ductile and can be put to other use by consumers. The thickness, tolerance and surface finish influence the efficiency of tin containers.
  - (b) Glass containers – They are chemically inert, impermeable, non-porous and generally more hygienic.
  - (c) Polyethene – This is extensively used as it is low cost, light weight, flexible and convenient to use. By extrusion or blow molding process, they can be converted into flexible, semi rigid or rigid containers in the form of wraps, bags and pouches.
  - (d) Aluminum foils - foils preserve the freshness, flavor and texture of sensitive products like butter and cooked foods. They protect the contents from light, color, odor, moisture or bacteria. These can be embossed, printed and coated.

The packing industry is in its infancy but with consumer awareness, improvement in living standards and demand for packaged agricultural commodities, the growth of

packaging industry is envisaged at 12%. During 2000, the total used of all packaging material is around 9.33 million tonnes.

### **Types of Packaging:**

- (1) Vaccum packaging: This is the simplest and most common method of modifying the internal gaseous atmosphere in a pack. The product is placed in a pack made of plastic film or laminate of low oxygen permeability. Air is then evacuated and the package is sealed. Evacuated package collapse around the product.

The main significance behind the technique is to extend the shelf life of the processed food products. Products having high fat content like fried items become rancid due to the reaction with oxygen making the product bitter and unacceptable to consumer. In order to reduce the oxygen available within the package, it is needed to evacuate the air inside the package. This technique is most suitable for powdery products like skimmed milk powder, tea dust and not suitable for granular or flaked or baked products as they get crushed due to evacuation of air from the package.

- (2) Modified Atmosphere Packing (MAP): MAP modifies the internal atmosphere of foods. It is primarily applied to fresh or minimally processed foods that are still undergoing respiration. It is also used as a packaging technique for baked foods, coffee beans, tea, dairy products, dehydrated products, processed meat to keep the meat pigment looking desirable. It is also used for nuts and snack foods.

MAP contains the food under a gaseous environment that differs from air in order to control normal product respiration and growth of micro organisms. Nitrogen gas which is odorless, tasteless, colorless, non-toxic and non-inflammable is most widely used for the modification of atmosphere. This modification offers protection from spoilage, oxidation, dehydration, weight loss and freezer burn as well as extend shelf life of the products.

- (3) Aseptic packing: It is defined as a procedure consisting of sterilization of packaging material or container, filling of commercially sterile product in a sterile environment and producing containers which are tight enough to prevent contamination. The term "Aseptic" implies the absence or exclusion of any unwanted organisms from the product, package or other specific areas while the term "hermetic" is used to indicate suitable mechanical properties to exclude the entrance of bacteria into the package or more stringent to prevent the passage of micro organisms, gas or vapor into or from the container.

Most commonly used packing material for aseptic packing is "Tetrapak" which is laminated comprising layer of paper, polyethene and aluminum foil. Paper makes the package still, plastic makes it water tight and aluminum foil protects the contents against light and oxygen. "Tetrapak" has developed a packaging system that can preserve products without use of refrigeration. Fluid products can be preserved by this process; the product is heated for a very brief period at ultra high temperature (UTH) and then flows through a closed system to the packaging machine, where it is filled into a sterile packaging material under sterile conditions. Packaged in this manner, the products retain their taste and nutritive value.

- (4) Controlled Atmosphere Packaging (CAP): Both CAP and CAS permit only controlled oxygen and carbon dioxide exchange. The gases mainly used in CAP or CAS are oxygen, carbon dioxide, ethylene concentrate and water vapor for high quality foods for worldwide distribution.

## Lectures – 20 to 22

20. *Different types of losses - priorities - Scope of value addition in fruit and vegetables*

21. *Food availability area and production of fruits, vegetables, spices, rice, wheat, milk etc  
Nutrient management*

22. *Development of disease resistant varieties - Organic farming for improvement of the food  
Production*

### **POST HARVEST MANAGEMENT AND VALUE ADDED PRODUCTS**

Post harvesting technology is interdisciplinary science and techniques applied to Agricultural produce after harvest for its protection, conservation, processing, packaging, distribution and utilization to meet food and nutritional requirement of people in relation to their needs by stimulating agricultural production. To prevent post harvest losses, improve nutrition and add value to the products, and the process of development. Post harvest technology and its purpose to use needs must improve political will scientific creativity, technological innovations & institutions capable of interdisciplinary R & D all of which must respond in an integrated manner to the developmental needs.

Post harvest technology has capability to meet food requirements of growing population by eliminating food losses, making more nutritive food items from low grade raw commodity by proper processing, percentage prettification, petrify low grade food, organic wastes and by-products into nutritive animal food. In India 80% of people are living in villages and 70% are depended on agriculture, so it is possible to evolve appropriate technology, which can establish agriculture. The purpose of post harvesting process like threshing, drying, storage, parboiling, milling, grading, oil extraction, juice extraction, ginning, cold storage, packing, transport etc. are maintained to exchange quality of products and make it for marketing.

**Different types of losses:** The method of drying paddy affect the amount of breakage during milling, modern rice mills give more output turnoff rice and better quality. During milling process bran is reported and used for extracting of rice bran oil. Husk can be used for fuel purpose. Due to using old and outdated method of paddy milling, improper and inefficient method of storage of paddy rice, transport and handling the loss is about 9% in production. It is estimated that the 10% of food grains produced in India are loosed in processing and storage.

The traditional methods of storage are responsible for 6% losses. If better methods of processing and storage are adopted the losses could be reduced to 23% estimated that 10-15% horticulture crops such as vegetable and fruits losses due to lack of proper methods of processing and storage. The loss in monitory terms is estimated to be about 20 crores annually.

Proper methods of processing, storage, packaging, transport and marketing are required for export of crops such as jute, tea, tobacco, mango, cashew nut, spices, and condiments.

#### **Estimated Post harvest losses of rice in south and south East Asia:**

<b>Operation</b>	<b>Range of losses (%)</b>
Harvesting	1-3
Threshing	2-6
Drying	1-5
Handling	2-7
Milling	2-10
Storing	2-6
<b>Total</b>	<b>10-37</b>

Major efforts are being made to develop improved varieties, better cultural practices, more effective irrigation systems, adequate disease and insect control. Loss of food crops refer to main different kinds of loss produced by variety of factors like weight loss, loss of food values, loss of economic values, loss of quality and acceptability and their seeds. Weight loss can result from spoilage or eaten by insects. For example in Bombay city, estimate that at least 3600 tons of cereals are lost annually from rodents damage. Loss of food values can be caused by over exposure to sun which destroys certain vitamins by the use of high temperature, and during artificial drying, which causes thiamine loss in rice by the development of fungi or by insect attack.

**Priorities:** A grain saved is a grain produced. For the present more attention is needed on primary, which includes cleaning and grading, drying, dehydration, storage and milling, packaging and transportation. India is yet to make a sound beginning on this aspect. As an example, losses in case of the following are given below:

Grains	Losses %
Paddy	11 to 12
Wheat	8 to 9
Rape seeds and mustard	10 to 17
Other Grains	10 to 11
Fruit and vegetables	30 to 40

It would take many years of effort to achieve the target to increase to this level of crops.

**In-general the following aspect may be given priority:**

- Popularization of methods, techniques to reduce post harvest losses of all types of crops.
- Simple and effective storage system for grain crops and vegetables and efforts are given to increase bulk storage, space through public or private agencies.
- Development of post harvest techniques for special crops like mango, banana and other fruits and vegetables.
- The country is striving to increase oil seed production on one side and we are losing oil in the form of rice bran on other side. Insufficient methods of oil extractions are prevalent in rural areas.
- Processing of special fruits and nuts like banana, mango, pineapple etc and similarly processing and canning, storage facilities of the produce to come out on integral part of this proposal.
- Large-scale introduction of bran mills in village.
- Establishment of dhal mills in pulses growing areas as a village corporative program.
- Emphasis on cottage industry involving village women for manufacture of food products.
- Popularization of low cost engineering storage structures.
- Starch production from maize and potato and oil product from maize.
- Strengthening of research base with adequate financial support.

**Scope of value addition in fruits and vegetables:**

- It helps to control post harvest losses and wastage in food grains, fruits, vegetables and other energy products. It basically includes the efficiency of food supply chain and processing of Agriculture products.
- Processing of Agricultural products, developing appropriate technology and equipment for processing, storage and handling of raw and processed products.

- Improvement in efficient and out-put of the exhibiting machinery providing technical skills to the small scale and medium scale processing industries.
- Inland marketing and export of value added products.
- Processing of Agricultural or food products is important as crop or food production.
- Training and retraining to right kind of human resources.
- Prevention of losses policy support to generate employment system of marketing is required.
- Infrastructure report should be supportive to the industrial growth and educate the producer, processor and seller regarding quality.
- Universities should establish quality testing laboratories and train graduates in quality.
- Mandating levels of processed food products establishment of agro-food industries in rural areas for value addition and employment generation by processing the food material.

#### Production and Estimated Post Harvest Losses

Types of food	Appropriate level of production (PHL)					Monitory value in Rs.
	Quantity	Average Price/ton	Value in Rs.(Crores)	%	Quantity Million tons.	
Durable (Cereals, pulses, oil seeds)	215	10000	215000	10	215	21500
Semi perishable	40	3000	12000	20	80	24000
Perishable (fruits, vegetables, milk, meat, eggs)	140	15000	21000	25	35	52500
<b>Total</b>	<b>395</b>	<b>11063</b>	<b>437000</b>	<b>17.5</b>	<b>64.5</b>	<b>76400</b>

**Post harvest industries:** Post harvest food grains include following main components.

- Harvesting and threshing,
- Drying and storage,
- Processing (conservation, transformation of grains, paddy into rice and wheat into flour).
- Utilization by consumer including home processing.

**Other component of system includes:**

- Transformation and distribution
- Marketing
- Grading and quality control
- Pest control
- Packaging
- Communication between producers and consumers
- Information and advisory systems
- Manufacture and supply of essential equipments and machinery
- Financial control (Price stabilization)
- Management and integration of total system

**Research and Development Organizations:**

- CFTRI is one of the oldest and major research organization set by government in India. The ICAR has established.
- CIPHET at Ludhiana
- CIAE at Bangalore
- CPRI at Shimla

- CPCRI at Kerala
- IISR
- PDVR

PDVR at Varanasi project directorate on vegetable Research. The ICAR has National Research Centers for horticultures, banana, grapes, onions, garlic, mushroom, cashew and oil palm at different locations which deal with post harvest management and Research for respective crops. The paddy processing research center (PRRC) at Thanjavur, is an autonomous body under central food processing ministry. The post harvest technology organized at IIT (Kharagpur), NDRI at Karnal deals with milk and meat. Many state Agricultural Universities conduct Research and Developmental activities on Food Processing Research.

**Potential of income and Employment Generation through Post Harvest Operation:** Use of appropriate PHT reduces post production, storage losses, adds value to the product, generates employment in village and establishes agro-industries in rural sector. Presently, the farmers selling their products without any processing if they do primary processing and value addition in villages. It will generate more income and employment in rural sector. The processing of food, feed, oil seeds and sugar cane will generate employment in rural areas and can avoid food losses.

If, agro processing center is established in each big villages or for a group of small villages for primary processing this will generate employment for about 4-5% and will increase income of farmers or processors by 15-20%.

**Potential of income and employment generation in other areas:**

- Annual production like fodder, boiling, poultry feed industries.
- Fish production and transport of fish yield etc.
- Dairying – processing of milk and making dairy products, maintenance of dairy farms.
- Energy management in Agriculture like use of biomass and solar energy.
- Wasteland develops like management of trees and grass.
- Water shed management.

In order to take advantage of agricultural engineering and technology for generating income and employment in rural areas following action was suggested.

- Bringing awareness at rural people for the new development in Agricultural engineering and technology in different fields and areas.
- Organizing training program for farmers and agriculture conferences for the use of new technology.
- Mass production of different types of Agriculture machinery for farmers.
- Starting agro-processing centers in each village for primary processing of food grains, fruits and vegetables.
- Providing institutional credits for purchase of agro-machinery and starting agro-processing centers.
- Developing market network for purchase and supply of processed material from agro-processing centers.
- Developing proper network and infrastructures for popularization of agriculture machinery, for crop production and setting of agro-processing centers.

## Processed Food Industries

Presently about 22,000 large and medium processed Food industries are available in India.

### Processed Food Industries:

- Milk and its products (330)
- Cereals and horticulture based food products
- Sugar mills (500)
- Beverages: Alcoholic & Non-alcoholic
- Edible Oils
- Solvent extraction
- Refining Plants
- Vanaspati (1320)
- Soft drinks
- Meat, fish, and poultry products
- Confectionary

There are about 1000 and 3500 number of flour rice mills, which are considered as large to medium scale. There are small and thin food industries in India.

### Current market for processed foods:

Food category	Value in Rs. Billion
I. <u>Basic Food:</u> Packaged meat food, spices, salt, edible oil, sugar, Poultry, egg and wheat.	1469
II. <u>Bakery products:</u> Biscuits and cakes.	56.09
III. <u>Dairy products:</u> Ghee, milk, sweet, Ice creams, butter, cheese, milk powder.	61.1
IV. <u>Processed fruits and vegetable:</u> Pickles, beverages, ketchups, soups.	7.6
V. <u>Snacks:</u> Traditional & western.	16.3
VI. <u>Confectionary:</u> Chocolates, chewing gums, bubblegum,	21.5
VII. <u>Convenience Food:</u> Instant foods, noodles, breakfast cereals.	2.7
<b>Total market cereals</b>	<b>1635</b>

There are two types of foods with 5 segments in the Indian market.

1. Basic foods - Which includes essential pack foods.
2. Processed foods - Basic, premium and cultivate food products.

### Present market segment of food process industry in India

#### 1. Basic foods:

- a) Essential - Oilseeds, grains, fruits and Vegetables, milk, meat, egg, poultry, sugar,
- b) Packaged foods - Rice, pulses, edible oils, fruits and Vegetables, flour, sugar, milk, meat and poultry.

## 2. Processed foods:

- a) Basic - Biscuits, bread, pickles, snacks, Tea, Coffee.
- b) Premium food - Instant noodles, soups, instant milk, breakfast cereals, Potato chips, Jams, fruits and alcoholic drinks, bear, chocolates, confectionary, cakes and nonalcoholic drinks.
- c) Ultimate foods - Aseptically packaged foods, (UHT milk), ready to eat Foods, ultra heat temperature, meals, frozen foods, micro wave ready to package food, processed meat, canned foods and health foods.

The current market of processed food Industry is 1365 Billion. It is indicated that they are still hidden scope for the development of processed fruits and vegetables contents in confectionary food Industry.

### **The magnitude and intensity of crops grown in a region depends on following:**

- Soil condition bio-climatic, socio-economic status of farmers and opportunities for marketing.
- The growing period is variable from one Agro climatic zone for other. They effect vegetative and reproductive growth, this leads to difference in potential yields.
- The seedling time and methodology employed, crop establishment and climatic conditions during growing seed are also considered.

**Nutrient Management:** Integrated nutrient supply and management supply or sustainable crop production lay the combined use of organic manures and bio fertilizers to promote inherent nutrient supplying capacity of soil. The role of bio-fertilizers as components of integrated management system may be helpful in sustaining system of farmers system. Bio-fertilizers are available at very low prices.

**Biological Fertilizers Utilization:** They are generally referred as microbiological inoculants. They are products containing active strains of bacteria and algae alone or in combinations. This may help in crop productivity by fixing biological nitrogen. They also help in volatilization of insoluble fertilizers, stimulating plant growth or by the decomposition of plant residues.

**Development of disease resistant varieties:** Farmers profit and crop production can be enhanced either by developing of disease resistant and high yielding variety from existing one or by reducing the cost of cultivation through good resources management technology.

**New Techniques:** Production levels can be improved through breeding better cultivation environment, input management etc. The factor, such as low remunerations from cultivation of crops, discriminative Government policies (Lack of both input and subsidies output price innovations), competition from commercial crops like oil seeds, introduction of irrigation facilities and better accesses to market and research should orient to aim at selection of one or more system from several alternative systems, to determine optimum combination of inputs that the lowest cost of input per unit is achieved.

**Organic farming:** The concept of healthy food and organic farming is catching up very fast all over the world over. In this technique, the organic materials are recycled by the action of soil micro-organisms and bacteria. Seed cakes, oil meals have been recognized as natural fertilizers for better yield. Mustard and ground nut produces are slow but their nourishment is in right prepositions and stays for longer period. This not only leads to higher yield but improves quality of products like taste, flavor, composition etc.

The market for these products is in European Union (E.U) and in USA and estimated to be growing at more than 20% per annum.

**Resource Conservation:** The effect of intensive agro-practices, increasing population, climatic changes, environmental pollution, soil erosion and water dilution are all threatening sustainability and water deficient for agricultural resources. The council had established National birds, plants, fish and animal and microbial genetic resources. The research efforts have successfully generated technologies conserve resources and economic use of resources.

**Organizations responsible for quality and quantity Instructions:**

- Agmark
- Directorate of plant protection
- FPO - Fruit Product Order
- DOFPI - Department of Food Processing Industry
- BIS - Bureau of Indian Standards
- APEDA- Agricultural Processed Food Products Export Development Authority

**Lecture – 23**

23. Classification of crops - Average area, production, nutritional composition, cereals and millets, pulse based food crops

**Area and Production of Horticultural Crops**

Commodities	2002 - 2003		2003 - 2004	
	Area (Million hectares)	Production (M.T.)	Area	Production
Fruits	3.8	45.2	4	47.5
Vegetables	6	84.8	6.2	90
Spices	2.4	3.1	2.4	3-2
Coconut	1.9	12.1	2	12.2
Cashew	0.8	0.5	0.9	0.6
Arecot	0.3	0.4	0.3	0.4
Others	1.5	2	1.5	2.0
<b>Total</b>	<b>16.8</b>	<b>148.1</b>	<b>17.2</b>	<b>166.1</b>

**Rice Bran Oil Potential and Actual Exploitation (1999-00 to 2003-04)**

Category	2003-04	2002-03	2001-02	200-01	1999-00
Paddy production Million MT	129.60	109.10	139.90	127.50	135.10
Rice production Million MT	86.40	72.70	93.30	85.00	89.70
Total Rice Bran potential, Million MT (7.5 % of Rice)	6.48	5.45	7.00	6.38	6.73
Rice Bran Oil Potential, Lakh MT (15 % Recovery)	9.72	8.18	10.50	9.57	10.10
Rice Bran Processing, Lakh MT	40.00	38.00	36.00	33.00	33.10
RBO production edible Lakh MT	6.00	5.50	4.30	3.80	3.70
Non-edible Lakh MT	0.50	0.50	1.20	1.20	1.30
Total Lakh MT	6.50	6.00	5.50	5.00	5.00
Untapped potential Rice Bran Oil, Lakh MT	3.22	2.51	4.70	4.80	4.20
Percentage of Exploitation	67 %	69 %	55 %	50%	54 %

Now-a-days, India is one of the biggest Agriculture products producing country. For that the values of milk, sugarcane, Oilseeds, fruits and vegetables are valued at Rs. 1350, Rs 840, Rs 760, Rs 600, Rs 420, Rs 520 billion with a total of Rs. 5,200 billion for Agriculture produce.

### Production and Revenue of Agricultural Produce

Crop	Production million tonnes	Values Rs. (Billions)
Rice	90	350
Wheat	70	760
Cereals	31	155
Maize	11	55
Pulses	38.4	268
9 Major oilseed	21	420
Fruits and Vegetables	130	520
Sugarcane	300	600
Coconut	15	45
Eggs	35	43
Meat	48	144
Milk	84.6	840
<b>Total</b>	-	<b>5200</b>

### Lectures – 24 and 25

24. Classification of crops - Average area, production, nutritional composition, cereals and millets, pulse based food crops

25. Classification of food crops - Oil seeds, Fiber crops, sugar crops and their nutritional composition

### CLASSIFICATION OF THE FOOD CROPS

Food crops are mainly divided into following types:

1. Cereals and millets
2. Pulses
3. Oil seeds
4. Fiber crops
5. Forage
6. Sugar crops

Cereals & Millets	Pulses	Oil seeds	Fiber crops	Forage	Sugar crops
Rice	Cowpea	Ground nut	Cotton	Oats	Sugarcane
Wheat	Soybean	Sesame	Jute	Egyptian	Sugar beet
Maize	Field pea	Castor	Sun hemp	Lucerne	
Sorghum	Pigeon pea	Sun flower		Napier	
Bajra	Chick pea	Rapeseed &		Grass	
Finger millet	Green gram	Mustard		Berseem	
Pearl millet	Black gram	Linseed			
Kodo		Safflower			
Kakan					

## 1. CEREALS AND MILLETS:

(a) **Rice:** Rice is the world's leading food crop being cultivated in area of over 155 million hectares, with a production of 596 million tons in world. In terms of area and production it is second to wheat. India has the largest area (44.8million hectares), followed by China and Indonesia. In respect of production India ranks second with 190 million tons of paddy next to China 200 million tons. It is the staple food for more than 70% of population in India and source of livelihood for 120 – 150 million rural households.

### Composition:

Moisture	-	6 to 7%
Protein	-	6 to 7%
Fat	-	0.5 to 0.6%
Carbohydrates	-	78%
Energy	-	345 kcal / 100g
Minerals	-	0.6%
Fiber	-	0.2%

(b) **Wheat:** It is cultivated in an area of 215 million hectares with a production of 584 million tonnes of grains. In production China stands 1<sup>st</sup> and India ranks second. In India, Punjab gives higher yield per hectare i.e. 4,332 kg followed by Haryana 3916 kg. India accounts about 12% of total wheat production of the world. 26.6 million hectares and 72 million tonnes in India.

Wheat contains more proteins than other cereals. Wheat proteins are the characteristic substances of the “gluten”. In bakery products “gluten” provides the structural frame work for the familiar spongy and cellular texture to bread and other backed products. It is the second important food crops next to rice in India (720.6 million tonnes).

### Composition:

Moisture	-	12.8%
Proteins	-	12.1%
Fat	-	1.5%
Carbohydrates	-	69%
Energy	-	340 Kcal / 100g
Minerals	-	2.7%
Fiber	-	1.9%

(c) **Maize:** It is one of the most important cereal crops in the world's agricultural economy both as food for man and feed to animal. It is a miracle crop. It has very high yield potential; there is no other cereal of earth which has so immense potentiality and i.e. Why it is called “Queen of cereals”. Maize is grown in almost all states of India. It occupies 6.4 million hectares. This accounts about 23% of total area with a production of 12.44 million tonnes. It is next to rice, wheat and jowar with regards to area and production in India. It is utilized in many ways like other grain crops. Over 85% of maize produced in the country is consumed as food. In the world, the area of maize production is 139 million hectares, with a production of 600 million tonnes of grains.

### Composition:

Moisture	-	14.9%
Protein	-	11%
Fat	-	4%
Carbohydrates	-	70%
Energy	-	342Kcal / 100g
Minerals	-	1.5%
Fiber	-	2.3%
Albuminoids	-	10.47%

- (d) **Sorghum:** It is fourth in importance among the world leading cereals, being cultivated over an area of 43.3 million hectares with a production of 62.8 million tonnes. Among the sorghum growing countries, India stands first in acreage (10.14 million hectares) but 2<sup>nd</sup> (8.8 million tonnes) in production. The USA stands first in production.

Composition:

Moisture	-	10 to 12%
Protein	-	10 to 12%
Fat	-	1.9%
Carbohydrates	-	70%
Energy	-	340 Kcal / 100g
Minerals	-	1.4%
Fiber	-	2%

- (e) **Bajra:** It is one of the major coarse grains. It is considered as a “poor man’s food”. It is also called as pearl millet. The grains of bajra are superior in nutritive values than sorghum grains, but inferior in feeding value. In India it is grown in an area of about 8.9 million hectares. With a total production of 11.79 million tonnes. Pearl millet grains are eaten in the form of cooked like rice; chapattis are prepared out of flour like maize or sorghum flour.

Composition:

Moisture	-	12.4%
Protein	-	11.6%
Fat	-	5%
Carbohydrates	-	68%
Energy	-	361 Kcal / 100g
Minerals	-	2.7%
Fiber	-	1.5%

- (f) **Barley:** It is one of the important cereals in the world and with an acreage area of 56.4 million hectares and with a production of 130 million tonnes of grains. In India, the total area of 0.7 million hectares with 1.37 million tonnes of production. It is used, for feeding of livestock and poultries and as malt for the production of beer and other liquors like whisky, brandy etc.

Composition:

Moisture	-	12.5%
Protein	-	11.5%
Fat	-	5.0%
Carbohydrates	-	69.6%
Energy	-	336 Kcal / 100g
Minerals	-	2.3%
Fiber	-	3.9%
Albuminoids	-	11.5 %

- (g) **Finger Millet:** In India the area of cultivation is 2.67 million hectares in 1960 but is reduced to 1.8 million hectares in 2003 with total production of 2.9 million tonnes. Finger millet is also known as “Manduva or Ragi”.

Composition:

Moisture	-	13.1%
Proteins	-	7.3%
Fat	-	1.3%
Carbohydrates	-	72%
Energy	-	349 Kcal / 100g

Minerals	-	2.7%
Fiber	-	3.6%
Calcium	-	0.34%
Phosphorous	-	0.28%

- (h) **Prosom or Cheena Millet:** It is used as cooked grain, flour for chapattis. It can be used for making kheer and it has high protein content.

Composition:

Proteins	-	12.4%
Fat	-	1.15%
Carbohydrates	-	68.9%
Minerals	-	3.4%
Fiber	-	2.2%

- (i) **Barnyard Millet:** It is mostly eaten by the poor classes, but it is also used in beer industry, feeding the cattle and for birds and for rice puddings. The digestibility is 40 %. The grain is eaten more by poor classes. It is used in beer Industry and for feed to cattle. These grains are also used as food and are cooked like rice.

Composition:

Protein	-	6.2 %
Carbohydrates	-	65.5 %
Minerals	-	4.4 %
Fiber	-	9.5 %

- (j) **Kodo:** The grains are recommended as a substitute for rice for patients suffering from diabetics.

Composition:

Protein	-	8.3%
Fat	-	1.4%
Carbohydrates	-	65.6%
Minerals	-	2.9%

- (k) **Kakan:** It is also known as “Foxtail Millet” or “Italian millet” or “German millet”. The grains are cooked like rice. It is also utilized in the form of flour for making chapattis. The grains are used for feeding of cage birds, cattle and horse.

Composition:

Protein	-	12.3%
Fat	-	4.7%
Carbohydrates	-	60.6%
Minerals	-	3.2%

2. **PULSES:** In India total production of food grains is about 209 million tonnes out of these 14.4 million tonnes was contributed by pulses. The production of cereals had been increased by 460% Since 1950-51. But, the production of pulses had increased only by 178%. So there is a shortage of pulses in the country. The availability of pulses per capita per day has proportionately declined from 71g in 1955 to 36 g in 1998, instead of minimum requirement of 70 g per capita/day.

- (a) **Chick Pea:** It is one of the important pulses in India. Chickpea is cultivated over an area of 12 million hectares with production of 9.2 million tonnes of grains. It is the most important pulse crop in India, occupying an area of 7.1 million hectares with a production of 5.75 million

tonnes. Chickpea is commonly known as “Bengal gram dhal” and is eaten both fried or boiled or salted.

Composition:

Moisture	-	10%
Protein	-	20.8%
Fat	-	5.6%
Carbohydrates	-	60%
Energy	-	372 Kcal / 100g
Minerals	-	2.7%
Fiber	-	1.2%

- (b) **Lentil:** It is grown in 1.34 million hectares with a total production of 0.88 million tonnes of grain. India ranks first in the world with respect to production and acreage followed by Turkey. It is mostly eaten as dhal. Its color is deep orange, red or orange yellow. It is cooked easily and is good for patients also.

Composition:

Moisture	-	12%
Protein	-	25%
Fat	-	0.7%
Carbohydrates	-	57%
Energy	-	343 Kcal / 100g
Minerals	-	2.1%
Fiber	-	0.7%

It is also rich in calcium, phosphorous, iron, and niacin.

- (c) **Field Pea:** Cultivated over an area of 5.9 million hectares with a production of 11 million tonnes in the world. In India, it is cultivated in 0.73 million hectares and with a production of 0.72 million tonnes.

Composition:

Moisture	-	10%
Protein	-	25%
Fat	-	0.8%
Carbohydrates	-	60.1%
Energy	-	347 Kcal / 100g
Minerals	-	3.2%
Calcium	-	0.64%

- (d) **Pigeon Pea:** It is commonly known as “red gram dhal” or “arhar”. After chick pea, it is second most important pulse crop in the country. It accounts for about 15.6% of total pulses area and 18.7% of total pulse production of the country. It is rich in source of proteins and mainly eaten in the form of dhal.

Seeds of pigeon pea are also rich in iron and Iodine. It is also rich in Amino acids like lysine, cystine and tyrosine. It is one of the most cultivated pulse crops in India next to chick pea over an area of 3.4 million hectares and a production of 2.43 million tones.

Composition:

Moisture	-	13%
Protein	-	22%
Fat	-	1.7%
Carbohydrates	-	58%
Energy	-	335 Kcal / 100g
Minerals	-	3.5%

Fiber - 1.5%

- (e) **Green gram:** It is excellent source of high quality protein with 25% content. It is also called as “Moong dhal”. It is consumed as dhal. In India the area production is 3.1 million hectares with total production of 1.3 million tonnes.

Composition:

Moisture	-	10%
Protein	-	25%
Fat	-	1.2%
Carbohydrates	-	60%
Energy	-	348 Kcal / 100g
Minerals	-	3.5%
Fiber	-	0.8%

- (f) **Black gram:** It is consumed in the form of dhal. It is cultivated over an area of 3.1 million hectares and a production of 1.49 million tonnes.

Composition:

Moisture	-	11%
Protein	-	24%
Fat	-	1.4%
Carbohydrates	-	60%
Energy	-	347 Kcal / 100g
Minerals	-	3.2%
Fiber	-	0.9%

It is the richest source of phosphoric acid. (5 to 10 times more than other foods).

- (g) **Cowpea:** Cowpea is commonly known as “lobia” being rich in protein and containing many other nutrients. It is known as “vegetable meat.”

Composition:

Moisture	-	13.4%
Proteins	-	24%
Fat	-	1%
Carbohydrates	-	55%
Energy	-	323 Kcal / 100g
Minerals	-	3.2%
Fiber	-	3.8%

It is a rich source of calcium, phosphorous and iron.

- (h) **Soybean:** Soybean is one of the important crops in world. It is cultivated over an area of 83.7 million hectares with a production of 189.37 million tonnes. Production of soybean in India at present is restricted only to Madhya Pradesh, Uttar Pradesh, Maharashtra and Rajasthan. Soybean contains very high nutritional value.

Composition:

Moisture	-	8.1%
High quality proteins	-	43%
Fat / Oil	-	20%
Carbohydrates	-	21%
Energy	-	432 Kcal / 100g
Minerals	-	4.6%
Fiber	-	3.7%

Soybean oil is used for the manufacturing of vanaspati, ghee and several other industrial products. It is used for making high protein food for children. It is a rich source of

vitamin A and vitamin C. A large number of Indian and Western dishes such as bread, chapatti, milk, sweets, tofu etc.; can be prepared with soybean.

### 3. OIL SEEDS:

(a) **Ground nut:** The most important groundnut growing countries are China, U.S.A, India and Nigeria. World wide it is growing in an area of 26.45 million hectares with a production of 35.66 million tonnes. In India it is grown over an area of 6.9 million hectares with a production of 8.32 million tonnes.

Among all the oil seed crops, groundnut is having 40% acreage and 60% production in country. Ground nut is also known as; “peanut / earth-nut / monkey-nut / Moong phalli / pend”. Groundnut oil is mainly used in the manufacture of vegetables oils.

Composition:

Moisture	-	3%
Protein	-	25%
Fat / Oil	-	40%
Carbohydrates	-	26%
Energy	-	567 Kcal / 100g
Minerals	-	2.4%
Fiber	-	3.1%

One gram of groundnut seed supplies 5.8 food calories when compared with sugar 4 cal / g, whole wheat 3.5 cal / g and whole bread 2.6 cal / g.

Composition of seed cake:

Nitrogen	-	7.8%
Phosphorus	-	1.5%
Potassium	-	1.5%

(b) **Sesame:** It is commonly known as “til”. India occupies 38% total acreage with a production of 26% in worldwide. It is grown over an area of 1.77 million hectares and with a production of 0.8 million tonnes. India nearly produces 0.82 million tonnes of seeds.

Composition:

Moisture	-	6 to 7%
Protein	-	17 to 32%
Fat / Oil	-	50%
Carbohydrates	-	24%
Energy	-	573 Kcal / 100g
Minerals	-	6 to 7%
Fiber	-	12%

The seed cake is eaten by poor people by mixing it with sugar. It is also used for cattle feed.

Composition of seed cake:

Nitrogen	-	6%
Phosphorus	-	2%
Potassium	-	1%

(c) **Castor:** India grows about 26% world acreage with 36% total outputs. Castor oil finds a number of uses for domestic, medicinal and Industrial purpose. It contains very good percentage of hydraulic fatty acid (18%). Castor is used as lubricant in all parts of machinery. In India it is cultivated over 0.7 million hectares with a production of 0.8 million tonnes.

- (d) **Mustard and Rapeseed:** This is known by different names in hill places. In India production of rapeseed is 6.2 million tonnes and 5.4 million hectares in acreage.

Ex: Sarson, rai or rayas, toria or lohi.

Composition:

Moisture	-	8.5%
Protein	-	20%
Fat / Oil	-	40%
Carbohydrates	-	24%
Energy	-	541 Kcal / 100g
Minerals	-	4.2%
Fiber	-	1.8%

- (e) **Linseed:** It is one of the important crops in the world and cultivated over an area of 3.5 million hectares with a production of 0.18 million tonnes. The seed contains a good percentage of oil of 33 - 47% in different varieties. The seed cake left after the oil is pressed out is most valuable feeding cake for cattle.

Composition:

Moisture	-	6.5%
Protein	-	20%
Fat / Oil	-	37%
Carbohydrates	-	29%
Energy	-	530 Kcal / 100g
Minerals	-	2.4%
Fiber	-	4.8%

- (f) **Safflower:** The seed contains 24 - 36% of oil. The oil is as good as sunflower having enough amount of Linoleic acid (78%) which is useful for patients suffering from heart disease. It has good dyeing properties and is used in manufacturing varnishes.

It is grown over an area of 1.2 million hectares with a production of 0.13 million tonnes. India ranks first in world in respect of acreage of about 60% of world' production.

Composition:

Moisture	-	6%
Protein	-	13.5%
Fat / Oil	-	26%
Carbohydrates	-	18%
Energy	-	356 Kcal / 100g
Minerals	-	2.6%
Fiber	-	34.9%

Composition of seed cake:

Nitrogen	-	5%
Phosphorus	-	1.4%
Potash	-	1.2%

- (g) **Sunflower:** It is popularly known as "suraj muchhi". It has 45 - 50% of good quality oil. The oil of sunflower is light yellow in colour and it is hydrogenated oil. The hydrogenated oil contains 40 - 44% high quality protein. It is used for the manufacturing of baby protein. In India it is grown in 2.27 million hectares with a production of 1.25 million tonnes. These oil seeds are world-wide cultivated in an area of 22.8 million hectares, with a production of 28.5 million tonnes.

Composition:

Moisture	-	6%
Protein	-	20%
Fat / Oil	-	52%
Carbohydrates	-	18%
Energy	-	620 Kcal / 100g
Minerals	-	3.7%
Fiber	-	1%

**5. SUGAR CROPS:**

(a) **Sugar cane:** It is the main source of sugar, in India. It ranks first in production. Sugar juice is used for making white sugar and brown sugar. The main by-products of sugarcane industry are bagasses and Molasses. Bagasses are mainly used in the preparation of paper and plastics. Molasses is used in the industry for the manufacturing of methyl alcohol, citric acid, furl butyl alcohol etc. Rum is the best potable spirit made from molasses. In India production area is 4.36 million hectares with total production 289.6 million tonnes. In the world, the area is 19.4 million hectares with a total production of 12.74 million tonnes.

Composition:

Moisture	-	0.4%
Carbohydrates	-	99.4%
Energy	-	398 Kcal / 100g
Minerals	-	0.1%

(b) **Sugar beet:** Sugar beet plant efficiently converts solar energy into stored energy. It provides more than 45% world sugar requirements.

**5. FIBER CROPS:**

(a) **Cotton:** It is an important fiber crop of global significance, cultivated in tropical and sub-tropical climates. It is the major cash crop of India and accounts for 65% of the fiber used in the textile industry. By way of exports, foreign exchange earnings of cotton amount to about Rs. 76,000 crores which is one-third of the total foreign exchange earnings of our country.

India has the largest acreage 91.32 lakh hectares under cotton at global level and has the productivity of 503 Kg per hectares and ranks second in production (270 lakh bales) after China.

(b) **Jute:** Jute and Mesta fiber together known as "raw jute" in the trade are ideal natural packaging material for such retailing services. India exports 16% of its jute fiber to USA.

**Production of various crops in 2005 - 2006**

Ground nut	1079 million tonnes
Sugar cane	64473 million tonnes
Cotton	273 million tonnes
Soya bean	980 million tonnes
Sun flower	548 million tonnes
Milk	90.7 million tonnes
Eggs	45.2 billions
Wool	44.5 millions of Kg
Potatoes	250 million tonnes
Tobacco	991.8 million tonnes

### Lectures 26 to 28

26. *Production and estimated post harvest losses - Development programmes, Research organization - Potential of income and employment generation through post harvest operation*
27. *Programmes for food production - programme implementation - Brown revolution - Yellow revolution - Blue revolution - Production increase for growing population in India*
28. *Programmes for food production - food security - factors affecting on food security - Green revolution - White revolution*

## **PROGRAMS FOR FOOD PRODUCTION**

India has traveled along way to reach from era of scarcity to plenty from low capacity; less efficient processing need mechanized large scale commercial units. In half of 20<sup>th</sup> century country had many additions in the Agricultural Sector, white revolution in country for larger production of milk, and Green revolution for self-sufficiency in rice. Yellow and blue revolutions are for more oil and protein.

### **BROWN REVOLUTION**

A Brown revolution is happening in the tribal areas of Visakhapatnam district. The tribal people were taught and encouraged to grow “socially responsible and environment friendly” coffee to cater to the demand from developed countries.

The Coffee Board has embarked upon the challenging campaign of promoting the coffee grown in these remote areas as niche coffee for markets in the West. Niche coffee, determined by consistent quality and the socio-economic well-being of the local people, is a \$55-billion market world-wide. Although the tribal people of Visakhapatnam district have been growing coffee since the 1970s, it is only recently, particularly after eyeing the organic market, that it is being given a thrust. Some 30,000 tribal people of Andhra Pradesh, who once practiced slash-and-burn “*Podu*” (shifting) cultivation, are now growing coffee as a shade crop under the canopy of silver oak.

What the tribal people of Visakhapatnam district are cultivating may be a minuscule part of India’s annual coffee production of around 3lakh tones. But, according to the coffee board, what is significant is that apart from regenerating the forest cover in those parts of the Eastern Ghats where it is cultivated, coffee has helped at the micro level by boosting the income of the tribal people. Their per hectare income from coffee is estimated at Rs.15,000 compared to Rs.10,000 for pineapple, Rs.1,500 for Niger seeds and Rs.1,000 for maize.

However, it is not just a case of the good intentions of the coffee board and the ITDA of Paderu to help the tribal people. Some argue that there could even be a sound marketing base to all this. World over, there is a burgeoning demand for organic coffee. In those areas of Karnataka, Tamil Nadu and Kerala where over 90% of India’s coffee is grown, any shift to organic coffee cultivation would necessitate a break in cultivation as the soil has to be left fallow for a few years to wash out traces of chemicals. But the tribal areas of Visakhapatnam can cultivate organic coffee as no chemical fertilizers or pesticides are used, as much owing to financial constraints as the lack of exposure to modern methods of cultivation.

## YELLOW REVOLUTION

India's oilseed's output in 2008-09 is estimated to be 28.16 million tonnes, which is quite deficient as the demand stood at 45.46 million tonnes. The output in 2009-10 is projected to fall due to deficient monsoon this year. It has stood at 25 million tonnes since 1998-99. Oilseeds production accounts for 7.4 per cent of the global production and is considered as the fourth-largest edible oil country in the world.

The earlier policy allowing free import of oilseeds was detrimental to the interests of oilseeds growing farmers and a set-back on development of oilseeds for achieving self-sufficiency. As a result, the country remained dependent on imported edible oils. There has been a significant increase in imports of crude palm oil from Malaysia and Indonesia.

The 'yellow revolution' in oilseeds owes its earlier success to a spectacular increase in output to 22 and 24.75 million tonnes in 1994-95 and 1998-99 from 10.83 and 11 million tonnes in 1985-86 and 1986-87. But thereafter, we have not been able to achieve self-sufficiency in oilseeds. Current production is not enough to meet the needs of cooking oils of our growing population.

The annual demand has risen to over 125 lakh tonnes whereas production is hardly around 75 lakh tonnes. Ignoring the ground realities and blindly following the World Bank's flawed prescription, India started the process of phased liberalization of edible oil imports from 1994-95 to meet the shortage of oil seeds by imports every year from Argentina, Brazil, Malaysia and Indonesia and Indian markets were flooded with palm and soya oil. Annual oilseeds imports, which account for about five million tonnes, cost Rs 15,873.6 crores in 2008-09 from Rs 10,942.54 crores in 2007-08. It is estimated that the demand in 2020 may touch 20.8 million tonnes, requiring a production of 60 million tonnes of oilseeds, and that the per capita oil consumption may rise to 16 kg annually.

**Consumption:** Edible oil is an important constituent of the Indian diet. Besides being a source of energy, they add a special flavor and palatability to food. The annual per capita consumption is 11.1 kg against the world average of 14.5 kg and the average of 26 kg in developed countries. Edible oil consumption is likely to increase with rising of per capita income. However, the daily in-take of fat should not contribute more than 15-20 per cent calories. There is potential to produce about 25 lakh tonnes of oil from non-conventional sources, but hardly about eight lakh tonnes are being utilized. It is important to work out a strategy to exploit maximum potential from these sources.

The spectacular success of the yellow revolution in 1998-99 could be attributed to an increase in the cultivable area to about 26 million hectares and an integrated approach that gave over-riding priority through a technology mission. Aimed at accelerating self-reliance in oilseeds, the approach adopted envisaged developing and taking modern technological inputs to farmers, thereby providing them incentive prices and storage and processing facilities.

The National Dairy Board was entrusted with the task to develop groundnut production in Gujarat through farmers' oilseeds societies. The national Oilseeds and Vegetable Oils Development Board was entrusted to popularize oilseeds in non-traditional areas. Also, an oilseeds production thrust project was initiated to accelerate production of four major oilseeds — groundnut, mustard-rape seed, soybean and sunflower.

**Low productivity:** The integrated oilseeds development program was initiated in different states with more than 3,000 oilseed societies involving 13 lakh farmers and 25 lakh hectares of land. Despite these efforts, our oilseeds productivity continues to be as low as 944 kg per hectare when compared to the world level at 1,632 kg per hectare.

At present, there is not much scope to expand the cultivable area under oilseeds. The continuing shortage of cooking oils would suggest that the Oilseeds Technology Mission and growing oil palms have had little impact. These energy-rich crops suffer from a number of constraints as they are grown in poor environment and are susceptible to pests and diseases. Besides, farmers preferred to grow high-yielding cereals to earn higher profits. However, in the recent past, improved technology has been developed to boost output.

As major crops, oilseeds meet the country's needs for edible oils. A second yellow revolution is crying need of the hour. Also, a technical breakthrough in dry land farming is needed to maximize yield, productivity and farm income. Achieving the aim of making the country self-sufficient in oilseeds would have a great impact on agriculture and the economy and would help reduce dependence on foreign markets.

In a complete reversal of the objectives enshrined in the ongoing Technology Mission for Oilseeds, imports of vegetable oil between November 1998 and July 1999 have risen three-fold. Compared to 1.02 million tonnes in 1997-98, the imports multiplied to 2.98 million tonnes. In 1999-2000, India bought five million tonnes of edible oil, once again emerging as one of the biggest importer.

## **BLUE REVOLUTION**

In the 1960s, India made headlines with its Green Revolution, using high-yielding varieties and improved technology to more than double its output of wheat between 1965 and 1972. Today, India is pushing ahead with a Blue Revolution, the rapid increase of fish production in small ponds and water bodies, a boon to small farmers, the nation's nutrition and its gross domestic product.

The Indian fisheries sector, which 50 years ago produced only 600 000 tonnes of fish, today produces 5 million tonnes, including 1.6 million tonnes from freshwater aquaculture. Although the yield from marine fisheries has stagnated, freshwater aquaculture is growing at a healthy 6 percent a year.

"Fish culture was an art in India. We had to make it a science," said Dr V.R.P. Sinha, the founding director of the Central Institute of Freshwater Aquaculture (CIFA), India's largest centre of its kind and the source of much of the science that has driven the growth of Indian inland aquaculture. The institute began the challenging task of turning what was a minor village tradition into a science that not only could increase the tonnage of fish per volume of water but also cope with inevitable problems that come with more intensive production, such as how to feed fish economically and how to deal with sudden outbreaks of disease brought on by crowded conditions.

Founded only 11 years ago, CIFA was born on a tract of empty land not far from the Bay of Bengal in Orissa State, about nine hours by train south of Calcutta. Today, it has over 500 ponds, laboratories, training facilities and hatcheries and conducts research on carp, catfish, prawns and mollusks. According to CIFA's Director, Dr. S. Ayyappan, the Indian market can absorb an estimated 4.5 million tonnes. Of the 2.2 million hectares of freshwater bodies, only 8, 00, 000 hectares are currently utilized. Even India's vast distances, hot climate and vegetarian

tradition do not place insurmountable obstacles in the way of expansion. Fish is packed on ice and trucked long distances in refrigerated trucks. If the ice melts, a stop is made at an ice plant en route to redress the fish, which is sold fresh.

"While it is true that India is known as a vegetarian culture, one fact is that 55 percent of Indians are non-vegetarian. Our present annual per caput consumption of fish is 8 kilos per person, while the global average is 12 kilos. So there is a lot of room to grow. In the next 10 to 15 years India will be the leader in the world of fish production. India may have started out slow but sometimes it is better to be slow as the technical support is of a high order. The science is here to stay.

## GREEN REVOLUTION

The introduction of high yielding varieties of seeds after 1965 along with increased use of fertilizers and better irrigation is collectively known as "Green Revolution". It has made India self sufficient in food grains by improving the agriculture in India. Father of Indian green revolution is Dr. M. S. Swaminathan. Famines in India, once accepted as inevitable have not returned since the introduction of the green revolution crops. Wheat produced the best results in high yielding variety of seeds.

### Grain production and Population of India:

	1950	1960	1970	1980	1990	2000
Food grain production (MT)	50.8	82.0	108.4	129.6	176.4	201.6
Food grains import (MT)	4.8	10.4	7.5	0.80	0.3	-
Buffer stock (MT)	-	2.0	-	15.5	20.8	40.0
Population (Millions)	361	439	548	683	846	1000

MT – metric tonnes

When British left India in 1947, India was still haunted by the memories of Bengal famine of 1943 where four million people died. Food security became one of the main concerns of independent India leading to green revolution on one hand and legislative measures to ensure that businessmen would never again be able to hoard food for reasons of profit.

The green revolution spread over a period of 1967-68 to 1977-78 and changed India's status from being a food deficit country to world's leading agricultural nation. There were three basic elements in the method of green revolution –

- (1) Continued expansion of farming areas
- (2) Double cropping of existing farm land
- (3) Using seeds with improved genetics

(1) **Continued expansion of farming areas:** The cultivable land was being increased from 1947 but was not enough to meet the rising demands. Still green revolution continued with quantitative expansion of farmlands although it is not the striking feature of green revolution.

(2) **Double cropping of existing farm land:** This is the primary feature of green revolution where in two crops were grown per season than one. Previously crops were dependent on natural monsoon but improvement in irrigation facilities by building dams resulted in preventing the wastage of large volumes of natural monsoon water. Thus double cropping was possible.

- (3) **Using seeds with improved genetics:** This is the scientific aspect of green revolution where in strains of high yielding varieties (HYV) seeds were developed for rice, wheat, millets and corn. The credit for developing HYV seeds goes to ICAR.

**Advantages of Green Revolution:** They can be categorized into the following:

- (1) Statistical results of Green revolution:
  - (a) Green Revolution resulted in record output of 131 million tonnes in 1978-79 making India one of the largest agricultural producers. No other country could match this record in the level of success.
  - (b) Yield per unit of farm land improved by 30% from 1947 to 1979.
  - (c) The crop area under HYV varieties increased from 7 to 22% of the total cultivated area in 10 years.
- (2) Economic results of Green Revolution:
  - (a) Crops under HYV required more water, fertilizers, pesticides, fungicides and other chemicals resulting in growth of local manufacturing sector which provided new jobs and contributed to the country GDP.
  - (b) Increased irrigation created new dams which were used to create hydro electric power and in turn boosted industrial growth thus providing jobs and improving the quality of life of people in villages.
  - (c) Green revolution helped India in paying back its loan to World Bank and thus improved its credit worthiness in the eyes of lending agencies.
  - (d) It helped in sending farmers to developed countries like Canada where there was shortage of farm labor. This helped the farmers to contribute to foreign exchange earnings.
- (3) **Sociological results of Green Revolution:** Green revolution provided many jobs through agriculture and industries that came up with the hydro electric power stations associated with huge dams.
- (4) **Political results of Green Revolution:** India transformed itself from being a starving nation to an exporter of food thus gaining admiration of different countries.
- (5) **Others:**
  - (a) Newer seeds were developed for better yield.
  - (b) Better employment in villages because of multiple crops.
  - (c) Better scientific methods are being developed.
  - (d) Control of insects and pests.

**Limitations of Green Revolution:** They are as follows:

- (1) Even today, India's agricultural output sometimes falls short of demand as onions were imported in 1998 and sugar in 2001.
- (2) HYV seeds concept could not be extended to all crops and regions in India. Punjab and Haryana showed the best results of green revolution followed by West Bengal.
- (3) There are still places like Kalahandi in Orissa where famine like situation has been existing many years and starvation deaths too were reported.
- (4) It cannot be considered to be hundred percent success.
- (5) Green revolution benefited the owners of large farms as they were able to adapt new technologies, fertilizers, seeds and credits but small farmers either remained unaffected or harmed.

- (6) Unnecessary mechanization was seen due to green revolution resulting in lower rural wages and employment.
- (7) Green revolution spread only in irrigated and high potential rain fed areas and not to regions where there was water scarcity.
- (8) Excess and inappropriate use of fertilizers and pesticides polluted water bodies causing death of beneficial insects and wildlife leading to loss of bio-diversity.
- (9) Degradation of land was seen due to employing of two to three crop rotation patterns
- (10) Heavy crop rotation resulted in increased weeds as there was no time to employ proper weed removal system.
- (11) Water table has gone down due to excess cultivation of crops. Now-a-days water has to be harvested from 300 to 400 feet while previously it was 40 to 50 feet.
- (12) Loss of old seeds is seen as newer HYVs are being developed. Many indigenous grains are lost this way.
- (13) Water bodies are being contaminated which is indirectly affecting the health of the people.

## WHITE REVOLUTION

Operation Flood was a rural development program started by India's National Dairy Development Board (NDDB) in 1970. One of the largest of its kind, the program objective was to create a nationwide milk grid. It resulted in making India one of the largest producers of milk and milk products, and hence is also called the White Revolution of India. It also helped reduce malpractices by milk traders and merchants. Varghese Kurien (chairman of NDDB at that time) gave the professional management skills and necessary thrust to the cooperative, and is considered the architect of India's White Revolution (Operation Flood).

The bedrock of Operation Flood has been village milk producers' cooperatives, which procure milk and provide inputs and services, making modern management and technology available to members. Operation Flood's objectives included:

- Increase milk production ("a flood of milk")
- Augment rural incomes
- Fair prices for consumers

**Program Implementation:** Operation Flood was implemented in three phases:

**Phase I:** Traditionally, India has been an importer of dairy products. Phase I (1970–1980) was financed by the sale of skimmed milk powder and butter oil and linking of 18 of India's premier milk sheds with consumers in India's major metropolitan cities like Delhi, Mumbai, Kolkata and Chennai, thus establishing mother dairies in four metros.

**Phase II:** Phase II (1981–1985) increased the milk sheds from 18 to 136; 290 urban markets expanded the outlets for milk. By the end of 1985, a self-sustaining system of 43,000 village cooperatives with 4.25 million milk producers were covered. Domestic milk powder production increased from 22,000 tons in the pre-project year to 140,000 tons by 1989, all of the increase coming from dairies set up under Operation Flood. Direct marketing of milk by producers' cooperatives increased by several million liters a day.

**Phase III:** Phase III (1985–1996) enabled dairy cooperatives to expand and strengthen the infrastructure required to procure and market increasing volumes of milk. Veterinary first-aid health care services, feed and artificial insemination services for cooperative members were extended, along with intensified member education.

Phase III consolidated India's dairy cooperative movement, adding 30,000 new dairy cooperatives to the 42,000 existing societies organized during Phase II. Milk sheds peaked to

173 in 1988-89 with the numbers of women members and Women's Dairy Cooperative Societies increasing significantly. Phase III gave increased emphasis to research and development in animal health and animal nutrition. Innovations like vaccine for Theileriosis, bypassing protein feed and urea-molasses mineral blocks, all contributed to the enhanced productivity of milch animals.

**Far reaching consequences:** The year 1995-96 marked the termination of Operation Flood III and at its conclusion, 72,744 DCSs in 170 milk sheds and having a total membership of 93.14 lakh had been organized. The targets set have either been effectively achieved or exceeded.

The conditions for long-term growth in procurement have been created. An assured market and remunerative producer prices for raw milk, technical input services including balanced cattle feed and emergency veterinary health services have all contributed to sustained increases in milk production. Three state-of-the-art dairies designed to produce quality products for both the domestic and export markets have been commissioned.

While the demand for milk was raising under Operation Flood the total cattle population remained more or less static. If milk production had to be increased the buffalo and milk breeds of cattle had to be upgraded. With this objective in mind, thrust was given to intensive research and development in animal husbandry.

- Cost reduction and technology management.
- Modernization of process and plant technology.
- Interventions for productivity increase.

The story of Operation Flood can be seen through three angles. One is to consider what it did to the dairy industry. Another point of view is from the eyes of the small farmer as it has revolutionized their way of life. Operation Flood has also established a pattern of success for other countries to follow.

**Effects of the White Revolution:** The white revolution gave a major boost to the dairy sector in India in the late 1960s by producing milk in rural areas through smallholder producer cooperatives and moving industrially- processed milk from these small holder sources to the urban demand centers, thus, establishing a much needed linkage between the rural producers and urban consumers. The United Nations has commended India's "White Revolution," saying a sharp increase in the production of milk has achieved twin goals of raising incomes of rural poor families and nutrition status of the people.

India's milk production rose from around 30 million tonnes in 1980 to an estimated 87 million tonnes by 2003 and despite increasing population, availability per person rose from less than 50 kilo calories per day in 1980 to 80 kilo calories per day in 2000, a report on hunger by the Food and Agriculture Organization (FAO) said. The report forecasts that India's dairy production will triple by 2020. "With government policies that facilitate rural credit and provide essential support services to promote milk production, the White Revolution will continue to play a significant role in reducing poverty and hunger."

FAO estimates that increasing milk production has boosted the incomes of 80 to 100 million families, the vast majority of whom are marginal or small farmers whose plots are often too small to support their families and landless laborers who depend on common grazing lands and forests for fodder.

**Matching demand and supply:** The white revolution carried on the extensive dairy development programs on the supply side, and this coupled with the increasing demand for value added milk products on the consumer side along with the country's population growth, increased urbanization and higher income, led to increased demand for milk. The various other factors contributing to the growth in milk production are given below:

- In the India diet, milk and milk products play a significant role.
- With a large lacto- vegetarian population, milk and dairy products are an important source of protein in diet.
- There is a perceptible shift towards the value- added food habits in which milk products form a large part.
- On the supply side, technological progress in the production and processing sectors, institutional factors and infrastructure played an important role.

**White Revolution and Gender Revolution:** The White revolution did not only affect the Indian Economy but the Indian social scenario as well. Initially, women were hesitant about depositing milk with the dairy. But through intensive training sessions, they began to see the benefits of associating with the dairy. On an average, a woman is able to deposit one to two litres of milk per day. The women associated with the dairy say that it is not the higher price they get for their milk that makes them keep coming back.

**Criticisms:** Some critics of the project argue that the emphasis on foreign cow breeds has been instrumental in the decimation of Indian breeds. Foreign breeds give higher yields, but require more feed and are not suited to Indian conditions. Critics also argue that the focus on the dairy sector during this period came at the expense of development, research, and extension work in other areas of Indian agriculture.

There is also the criticism that the product from the White Revolution, namely milk and dairy products (like food grains from the harvests using Green Revolution methods and practices) is qualitatively, not exactly 'technically', inferior to the product obtained employing traditional methods and practices geared to smaller population levels which had only to be 'scaled up' for larger populations.

Moreover, the developed countries' heavy subsidies on dairy products pose an obstruction to the Indian Dairy growth. The distortion of global dairy prices due to heavy subsidies by the European Union and the U.S.A, besides other developed countries, has rendered Indian Dairy products non- competitive in the international market. There has been a consistent rise in India's share in world milk production — from 9.9 per cent in 1990 to 12.3 per cent in 1996 and further to 14.5 per cent in 2003. India is now the world's largest milk producer.

#### Lecture - 29

#### *29. Globalization of food Industries, food standards to meet global market - global demands for Food*

### **GLOBALIZATION**

India is a signatory (member) of the WTO, along with the other 146 countries. This is bold step that our Government has taken which will have reaching in our International trade. The Globalization in food Industries means the food industry can do their business anywhere in the world; but, with specific standard and quality. Some of the impacts of Globalization are:

#### **Impact of Globalization on food industry:**

- The globalization has given rise to new challenges in the production and service sectors.
- It has brought about free flow of ideas, technologies, services, resources between nations.
- Production efficiency is denoted just at output or input, but in globalization it includes in terms of speed, quality, safety and environmental conservation ability.
- Government tax policies for raw materials, production and business.
- Global enterprises, setting of processing units and large companies diversifying food.

- To meet the globalization demand it is necessary to educate the traders, millers, farmers, regarding quality requirements and familiarities with the food standards in view to food safety. The production of value added products should be improved through proper processing technologies and it will be the key for our exporting and domestic business.
- As per WTO, quality is the important parameter for the global business; it means manufacturing of good food crop is not enough; it must be free from harmful additives, preservatives and microbes. This can be achieved by GMP (good manufacturing practices) and HACCP and ISO-9000 standards and food safety standards.
- The WTO agreement on agriculture includes –
  - (a) Market access
  - (b) Domestic support
  - (c) Export subsidies

#### **Global agriculture and its challenges:**

- World population estimate for 2025 is 8 billion.
- 60% live in rural areas and 60 – 80% are dependent on agriculture and farming.
- Food requirement has put tremendous pressure on land, water and other natural resources.
- Major challenges are –
  - (a) To reduce poverty and hunger
  - (b) Improve economic growth
  - (c) Increased food production
  - (d) Decreased degradation of natural resources

#### **Present scenario in Indian Agriculture:**

- Average crop yield has increased by 1.6 % annually over the last three decades due to marked increase in –
  - (a) Irrigation area
  - (b) Use of modern inputs especially fertilizers
  - (c) Increased crop intensity
- Since 1980, live stock sector has grown faster at 5% annually due to rapid growth of milk, poultry and fish production.

#### **Factors affecting agricultural crop production:**

- (1) Resources like irrigation, rainfall and soil fertility influence crop production.
- (2) Technology related factors covering not only seeds, fertilizers and water technologies but others like marketing, storage and processing too influence it.
- (3) Household factors like food, fodder and investment capital too influence it. Self sufficiency is required.
- (4) Price related factors like output and input prices, trade policies and other economic policies influence prices directly or indirectly.
- (5) Institutional and infrastructure related factors like farm size, tenancy arrangement, research, extension and marketing systems as well as government regulatory policies.
- (6) Other factors like rapid technological changes in agricultural production, improved rural infrastructure and changing consumer preferences too influence crop production.

**Technology:** Improved technologies can be targeted for high value food commodities to –

- (a) Increased availability
- (b) Minimize post harvest losses
- (c) Enhance shelf life

- (d) Improve commodity traits as per consumer preferences like shape, color, size and nutrition.

**Policy Support:** By establishing institutions like –

- (a) Agricultural and processed food products export development authority (APEDA)
- (b) National horticulture development board (NHDB)
- (c) Providing new incentives to private sector for promoting agro processing of high value commodities.

**Infrastructural Development:** as per type of crops like cereals and perishable foods, infrastructural needs vary.

**Institutional arrangements:** They are in the form of contract or co-operative farming which integrates production with market.

**Farming systems in Indian agriculture:**

- (1) Rain fed agro ecosystem (AES) occupies an important place in Indian agriculture –
  - (a) Covering 68% of cultivated are (96 million hectares)
  - (b) Supporting 40% of human population.
  - (c) Producing 44% of food requirements.
- (2) Population below poverty line are 44%.
- (3) Population dependent on agriculture may reach 600 million by 2025 and presently it is 410 million.
- (4) Average size of farm holding is reduced to 85 million out of which 105 million operational holdings are less than one hectare.

### Lecture - 30

*30. World Food Day - Importance for theme - Agricultural growth and plan for elimination of Hunger*

## **WORLD FOOD DAY**

The Food and Agriculture Organization of the United Nations celebrates “World Food Day” each year on 16 October, the day on which the Organization was founded in 1945. World Food Day (WFD) was established by FAO's Member Countries at the Organization's 20th General Conference in November 1979.

The Hungarian Delegation, lead by the former Hungarian Minister of Agriculture and Food, Dr. Pal Romany has played an active role at the 20th Session of the FAO Conference and suggested the idea of celebrating the WFD worldwide. It has since been observed every year in more than 150 countries, raising awareness of the issues behind poverty and hunger. Since 1981, World Food Day has adopted a different theme each year, in order to highlight areas needed for action and provide a common focus.

Seventy percent of the world's hungry people live in rural areas, where agriculture either puts food in stomachs directly or, through employment in a flourishing agricultural and food processing sector puts money to buy food into people's pockets. At the World Food Summit in 1996, Heads of State and Government from around the world committed themselves to promoting public and private investments in agriculture as a contribution to the goal of reducing by half the number of hungry people by 2015.

The first Millennium Development Goal reiterates the target of reducing hunger and extreme poverty by half by that date. Yet an estimated 854 million people around the world remain undernourished. The current extent of food security across the world was highlighted in a report by FAO released October 9 2006, which said that 40 countries were facing food emergencies and required external assistance.

Many studies have shown how agricultural growth reduces poverty and hunger, even more than urban or industrial growth. For example, the only group of countries to reduce hunger during the 1990s was the group in which the agriculture sector grew. Looking back at the figures for the last 30 years, it can be shown that those countries that have invested and continue to invest most in agriculture – both public and private – now experience the lowest levels of undernourishment

**Previous themes:**

Year	Theme
2011	Food price – from crisis to stability.
2010	United against hunger
2009	Achieving food security in times of crises
2008	World food security : The challenges to climate changes and Bio-energy
2007	The Right to Food
2006	Investing in agriculture for food security
2005	Agriculture and Intercultural Dialogue
2004	Biodiversity for Food Security
2003	Working Together for an International Alliance Against Hunger
2002	Water: Source of Food Security
2001	Fight Hunger to Reduce Poverty
2000	A Millennium Free from Hunger
1999	Youth Against Hunger
1998	Women Feed The World
1997	Investing in Food Security
1996	Fighting Hunger and Malnutrition
1995	Food For All
1994	Water For Life
1993	Harvesting Nature's Diversity
1992	Food and Nutrition
1991	Trees for Life
1990	Food for the Future
1989	Food and the Environment
1988	Rural Youth
1987	Small Farmers

1986	Fishermen and Fishing Communities
1985	Rural Poverty
1984	Women in Agriculture
1983	Food Security
1982	Food Comes First
1981	Food Comes First

### Lecture - 31

31. *Present trends of consumption - further requirement - consumer change of aptitude in food product consumption*

## **FOOD CONSUMPTION AND NEEDS**

India is the seventh largest country in area and second most populous country in the world. India constitutes 2.4% of world's land area and 14.6% of world's population. The diet consumed by the vast majority consists predominately of cereals with small amounts of legumes and vegetables, negligible amounts of milk, eggs, meat and fish. The birth rate in India is 40 and death rate is 20 per 1000 live births, at a rate of net increase in population by 2%.

**Patterns of diets consumed in different states in India:** Consumption of milk and pulses is high in states of Gujarat, Punjab, Madhya Pradesh, Uttar Pradesh and Rajasthan while moderate in Andhra Pradesh, Bihar, Maharashtra, Karnataka and West Bengal and low in Jammu and Kashmir, Kerala and Tamil Nadu. The diets predominately consist of cereals and millets. Consumption of oil and green leafy vegetables is low. Consumption of fish and meat is high in states of Kerala, West Bengal and Maharashtra.

### **Food availability for consumption in relation to requirement for a Balanced diet**

<b>Food stuff</b>	<b>Food availability (g/person/day)</b>	<b>Requirement for balance diet (g/person/day)</b>	<b>Production (million tonnes)</b>
Cereals	395	500	110
Pulses	51	60	13
Nuts and oil seeds	05	25	05
Green leafy and other vegetables	53	100	22
Fruits	44	40	08
Milk and milk products	108	110	24
Fats and oils	10	15	03
Sugar and jaggery	46	40	08
Fleshy foods	12	35	03

(1) **Cereals:** The consumption is about 395 g/day/person compared to requirement of 370 g for a balanced diet. In view of inadequate calorie intake due to shortage of oils, fats, meat, fish and milk, it is necessary to make up the calorie deficit by increasing the consumption of cereals to 500g. Cereals are cheap source of calories compared to oils and fats. Also they provide fair amount of vitamins, minerals, protein and B complex vitamins.

(2) **Pulses:** The availability is 52 g/day/person and the requirement in a balanced diet is 60 g.

- (3) **Nuts and oilseeds:** They are used as a source of oils and fats. The requirement of ground nuts is 16 g/day/person and can be increased by another 12.5 g. The oil seed meal is a rich source of protein and can be used in the production of processed protein foods suitable for supplementing the diets of children and vulnerable groups. Nuts and oilseeds may be used in the preparation of milk substitutes.
- (4) **Milk:** Milk availability is 108 g/day/person where as the requirement in balanced diet is 180 g. There is a great shortage in milk supply and little prospect of increasing the per capita milk production. The milk shortage can be made up with the production of milk substitutes from oil seeds and nuts.
- (5) **Meat, fish and eggs:** The estimated availability of these is 12 g/day/person compared to the requirement of 35 g. There is an acute shortage and the per capita increase appreciable amount in near future is not possible. Hence cheaper sources of proteins like legumes and oil seed meals may be substituted in the diets.
- (6) **Oils and fats:** The mean availability is 10 g/day/person with 15g being the requirement in a balanced diet. Cereals are cheaper source of calories and oils provide additional calories, vitamins and minerals. Efforts should be made to increase the production of nuts an oil seeds and utilize oil seed meals for production of supplementary foods for infants and preschool children.

#### Food Consumption Patterns (g / day / person)

Food Stuff	Andhra Pradesh	India	Suggested allowance in balanced diet
Rice	335	241	-
Wheat	10	84	-
Millet and other cereals	121	109	-
Total cereals and millets	446	434	370
Green leafy vegetables	09	21	110
Other vegetables	34	71	125
Pulses	29	34	70
Fruits	01	10	37
Fats and oils	11	12	38
Milk and milk products	65	69	180
Meat, fish and egg	11	14	35
Sugar and jaggery	09	19	40
Condiments	22	18	-

### NUTRIENT REQUIREMENT AND AVAILABILITY

The diets of in general are lacking in calories, protein, certain vitamins (b-complex, folic acid and vitamin A) and minerals (iron and calcium). Protein calorie malnutrition (PCM) is widely prevalent among preschool children and infants. Diseases due to vitamin A and iron deficiency are present among children, expectant and nursing mothers. The major nutritional deficiencies in our country are PCM, Vitamin A deficiency (Night blindness), Iron deficiency anemia, Iodine deficiency disorder (IDD) and Fluorosis.

#### **Causes of the nutrient deficiency diseases:**

- Large increase in population

- Low purchasing power
- Illiteracy, ignorance, superstitions, food fads and fallacies
- Low per capita availability of land and productivity of soils
- Low availability of mills (cereal processing)
- Low industrialization (presence of food industries)
- Unhygienic or unsanitary conditions leading to large instances of infectious diseases which aggravate malnutrition

**Diets consumed in Developing Countries:** Most of the developing countries are based predominately on roots and tubers with small amounts of pulses, animal foods and milk. The calorie intake in most countries is inadequate to meet the needs of the population. A deficit of 10 to 20% in calorie intake indicates that substantial portion of the country's population don't get enough food to eat and hence suffer from malnutrition. The protein intake in most countries is low and is reflected by high incidence of PCM among weaned infants and preschool children in developing countries. The diets are also deficit in vitamin A, folic acid and iron.

- (1) **Cereals:** Inadequate production of cereals is the main cause for prevalence of under nutrition in developing countries. Daily intake per person is 350 to 450g. It should be increased to 600g to provide about 2100 Kcal that is 90% of the total calorie requirement of 2400 Kcal.
- (2) **Pulses:** The per capita consumption in developing countries is 10 to 40g. As pulses are cheap source of protein, the minimum per capita production can be increased to atleast 50 g/day.
- (3) **Nuts and oilseeds:** The per capita daily production in developing countries is 8 to 40g. As nuts and oilseeds are good sources of protein and fat, they can be increased to 75 g/day. This will meet the requirement for the production of oil for edible purpose. Edible oil seed meals can be used in processed protein foods suitable for supplementing the diets of children, pregnant and lactating women. Oil seeds and nuts can be used for preparation of milk substitutes.
- (4) **Oils and fats:** The per capita production of oils and fats varies between 8 to 27 g/day in developing countries. It will be desirable to increase this availability to atleast 15 g/day immediately and to 25 g/day in due course as fats and oils provide essential fatty acids.
- (5) **Sugars and Jaggery:** The per capita daily availability of sugar and jaggery in developing countries varies between 8 to 66g. The production can be limited to 44 g/day as the available land can be used for the cultivation of cereals, pulses and oil seeds.
- (6) **Vegetables:** The per capita production varies between 50 to 400 g/day. Since the per capital availability of cultivable land is low, the production of vegetables, roots and tubers can be restricted to 200 g/day. Half the quantity can be green leafy vegetables as they are rich source of carotene, ascorbic acid, folic acid and minerals.
- (7) **Fruits:** The per capita availability is 26 to 85 g/day and can be restricted to 50 g/day.
- (8) **Milk:** Daily per capita availability is 13 to 208g. As milk is essential for infants, the production should be increased to 110 g/day immediately and 220 g/day in due course. Ground nut protein has been used in the preparation of toned vegetable milk.
- (9) **Meat, fish and eggs:** Daily per capita availability of these is 9 to 108g. Most countries produce adequate amounts of these foods. Production in some developing countries can be increased to 25 g/day immediately and to 40 g/day in due course.

## **Role of Various Organisations in Maintaining Health and Nutrition**

**I. International Organisations:** The various international organisations are as follows:

- (a) **World Health Organisation:** (WHO): This is an agency of United Nations. The head quarter is in Geneva and came into function on 7<sup>th</sup> April 1948, which is celebrated as World Health Day. On this day, every year a theme is chosen pertaining to certain aspects of public health.

**Objectives:** the attainment of most optimum level of health of people which would enable them to lead a socially, economically and mentally productive life.

**Functions:**

1. **Feeding special food:** Cheap and nutritious foods for babies and infants specially protein rich foods. They try to educate on the importance of correct foods basically to mothers because they are involved in selection, preparation and handling of food.
2. **Research Work:** Conducts medical research on human reproduction, drug evaluation, pollution, sanitary conditions and different types of medical disorders as well as their treatment. Main function of WHO is to sponsor training and research for medical practitioners of different countries.

**Other functions:**

- Involved in Monitoring of National health planning.
- Utilisation of natural resources
- Serve in case of major calamities like floods, famine and earth quakes.
- At present directing funds to the undeveloped countries to accelerate growth of primary health care in rural areas.
- Collaborating with the Indian government in programs of medical research in epidemics like cholera, typhoid, occupational hazards, medical technology and pathology.
- Take care of almost all communicable diseases. Ex: Global emancipation from small pox.
- Involved directly in the battle against AIDS.
- Immunization against common diseases during childhood is being given priority by WHO program.
- Publishes mortality and morbidity statistics related to health problems.
- Involved in nutrition programs by promoting general awareness of the prevalence of deficiencies and supporting the development and application of improved methods of prevention, detection and control of diseases.
- Provided technical and other support to countries for preventing and managing nutritional problems.

- (b) **Food and Agricultural Organisation**: (FAO): It was established in October 1945. Its mandate is to raise the levels of nutrition and standard of living to improve agricultural productivity thus bettering the conditions of rural populations.

Motto of FAO - FIAT PANIS (let there be bread)

**Functions:**

- Collect, interpret and disseminate information relating to nutrition food and agriculture including fisheries, marine products and forestry.
  - Promote and recommend action plans both national and international related to –
    - Scientific, technological, social and economic research related to nutrition, food and agriculture.
    - Education to conservation of natural resources and adaptation of improved methods of agricultural products.
    - Improvement of processing, marketing and distribution of food and agricultural products.
    - Adaptation of policies to provide adequate agricultural credit.
    - Adaptation of international policies with regards to agricultural commodity arrangement.
  - Provide technical assistance to governments.
  - Work to alleviate poverty and hunger.
  - Promotes agricultural development, improved nutrition and food security (access of food to all people at all times to lead an active and healthy life).
  - Plays an important role in dealing with food and agricultural emergencies.
  - Specific priority in encouraging sustainable agricultural and rural development along term strategy for conservation and management of natural resources.
  - It aims to meet needs of both present and future generations through programs that do not degrade environment and are technically appropriate, economically viable and socially acceptable.
  - FAO is active in-land and water development, plant and animal products, forestry, fisheries, economic and social policy, investment, nutrition, food standards as well as commodities and trade.
- (c) **United Nations International Children's Educational Fund**: (UNICEF): First started in 1946 and is a voluntary organisation.
- Relieves suffering of children from various diseases.
  - Responds rapidly in crisis by helping to recreate a sense of stability and normalcy in children when war, food and other disruptions occur.
  - Mandate – advocate for children's rights and help to meet their needs.
  - Works for solution to the problems of poor children and their needs.

- Care to offer the best possible start in life helping to prevent childhood illness and death making pregnancy and child birth safe.
- It combats discrimination and co-operates with communities to ensure that girls and boys attend school.
- Set up a network for maternal and child welfare centers in developing countries with the following objectives –
  - Prenatal and postnatal checkups
  - To immunize children against diseases
  - To distribute supplements
  - To educate mother in the care of feeding of children
- UNICEF assisted many countries to fight hunger and malnutrition
- Involved in direct distribution of food and provide an opportunity for nutrition education of mothers.
- Helped in development of milk processing industries.
- Programs supported by UNICEF are –
  - Fish farming
  - Poultry rising
  - Gardening
  - Digging of wells
  - Testing of protein mixtures
  - Iodization of salt in areas endemic with goiter

(d) **Co-operative for Assistance and Relief Everywhere**: (CARE): Started in North America.

- One of the world’s largest, independent, non-profit, non sectarian international relief and development organisation.
- Provides both emergency aid, long term development assistance and help to “vulnerable people” so that they can take charge of their lives and make a better future for them.

**II. National Organisations:** The various national organisations include -

(a) **National Institute of Nutrition**: It is located at Hyderabad and is started in 1918. One of the permanent research institutes of ICMR which is under the ministry of health and family welfare.

**Objectives:**

- To identify various dietary and nutrition problems prevalent among different segments of population and continuously monitor the diet and nutrition situation in the country.
- To evaluate suitable methods of prevention and control of nutritional problems.
- To conduct operational research for planning and implementation of nation nutrition program.
- To investigate nutritional deficiencies, nutrient interaction and food toxicities.
- To provide training and orientation in nutrition to key health problems.
- To disseminate health and nutrition information through appropriate extension activities.
- To integrate nutrition research with other health, agricultural and economic programs as envisaged by the government.
- To advise government and other organisations on problems of nutrition.

**Activities:** There are four activities –

- (i) Clinical studies – Nutritional disorders like pellagra, degenerative diseases like diabetes, cancer, and cardio vascular diseases.
- (ii) Laboratory studies – Food Chemistry, immunology, microbiology, endocrinology, physiology, toxicology, laboratory animal breeding and experimentation.
- (iii) Community studies – Operational research, diet and nutrition surveys, evaluating ongoing nutrition programs and conducting studies on socio-cultural aspects of nutrition.
- (iv) Teaching programs – PhD and MD degrees, orientation and short duration programs and publications.

**(b) Nutrition Foundation of India:** (NFI): Founded by Dr. C. Gopalan in 1980.

- Non government, non-profit voluntary institution dedicated to the cause of eradication of under-nutrition.
- It is an approved scientific research body of the Government of India.

**Objectives:**

- Focus on nutritional problems related to malnutrition, magnitude, implications, action plans for their control.
- Initiate, conduct and support action oriented research in nutrition, production and distribution of foods.
- Disseminate nutrition information.
- Planning, evaluation and implementation of nutrition programs.
- Deals with dietary and nutritional management of nutrition related chronic degenerative diseases.

- Publication to give up to date information through bulletins, conferences and symposia proceedings.

(c) **Food and Nutrition Board**: It is under the department of Women and Child Welfare having offices at Delhi, Mumbai, Kolkata and Chennai.

**Activities:**

- Nutrition education and orientation.
- Training in home scale preservation of fruits and vegetables.
- Monitoring of supplementary feeding under ICDS.
- Development and distribution of educational or training material.
- Mass awareness campaigns
- Advocacy and sensitization of policy makers and program managers.
- Follow up action on National Nutrition Policy which aims at eradicating malnutrition.

(d) **Central Food Technological Research Institute**: (CFTRI): It is located at Mysore and started in 21<sup>st</sup> Oct 1950.

- It is a constituent lab of Council for Scientific and Industrial Research (CSIR), New Delhi.
- Promotes and aids the conservation of food resources as well as maximize the utilization and value addition for economic growth thus contributing to food security through science and technology.
- A regional center is present at Hyderabad.
- It has about 15 R &D departments which attained excellence in every discipline of Food Science and Technology.
- It gives man power training to industry personnel.

**Activities:**

- Technology transfer on cost basis.
- Human resource development.
- Industrial services with prescribed fees.
- Project identification and evaluation.
- Preparation of industry feasible project reports for processes and products.
- Market research.
- Identification of post harvest problems.
- Assistance in process control, quality assurance packing and product diversification.
- Machinery selection, installation, operation of plants and operational research in food industries.

- Techno economic and pre-investment surveys.
  - Project engineering and design.
  - Resource inventories and publications.
  - Offers technologies in post harvest handling, storage and processing of food: developed more than 3000 processes in Food Science and Technology.
  - Fruit and vegetable products – fruit bars and fruit cereals with mango, banana, guava and apple.
  - Bakery products – Biscuit formulations with cocoa, cocoa cream, naturo, high protein and baking powder products.
  - Convenience foods – ready mix savories like idli, vada, dosa and chakli and ready mix sweets like jamun, jilebi, doughnut cake.
  - Cereal products – cereal flakes like rice, jowar and instant traditional foods like besibeli bath, puliogara, sambar and rasam.
  - Beverage products – preparation and usage of coffee concentrates as well as carbonated coffee beverages.
  - Food microbiology and fermented products – alcohol from banana, cashew apple, manua flower and baker’s yeast production.
  - Animal products – egg albumin flakes production, meat gravy concentrates and protein specialty.
  - Infant food – high protein and optimized 12% protein, lactose free milk based products.
  - Spirulina – the protein rich algae
- (e) **National Nutrition Monitoring Bureau**: (NNMB): Set up by ICMR in 1972 with Central Research Laboratory (CRL) of NIN, Hyderabad.
- Objectives:**
- To collect data on dietary intake and nutritional status on a continuous basis.
  - To evaluate the ongoing national nutrition programs.
- Activities:**
- Coordinating the activities of state units.
  - Responsible for sampling, training, supervision and analysis of data.
  - Linkage with national sample survey organisation.
- (f) **Child Survival and Safe Motherhood Program**: (CSSM): Started in 1992 with financial assistance of World Bank and UNICEF.
- Objectives:**
- Sustain and strengthen the ongoing Oral Rehydration Therapy (ORT) for children < 5 years of age and Universal Immunization Program (UIP).

- Introduction and expansion programs for control of acute respiratory infections in children < 5 years of age.
- Universalizing prophylaxis scheme for control of blindness due to vitamin A deficiency in children < 5 years of age.
- Prophylaxis scheme against nutritional anemia among pregnant and lactation mothers and children < 5 years of age through administration of iron and folic acid tablets.
- Improving new born and maternal care at community level.

**Activities:**

- Continuous supply of vaccines, cold chain equipment, ORS packets, needles and syringes.
- Training of health workers on recognition of pneumonia and treatment with cotrimoxazole which is supplied through CSSH drug kit.
- Give priority to anemia control measures and mass vitamin A doses program.
- Give high priority to speeding up training of traditional birth attendants.

(g) **Central Social Welfare Board**: Set up by Government of India in 1953.

**Functions:**

- Surveying the needs and requirements of voluntary welfare organization.
- Promotion and setting up of Social Welfare organization on a voluntary basis.
- Financial aid to deserving existing organizations and institutions.

(h) **Nutrition Society of India**: (NSI): Started in 1965 at NIN, Hyderabad to keep abreast of the latest developments in basic and applied aspect of Science and Nutrition. Also analyze issues related to Nutrition.

**Activities:**

- Involves scientists, programmers and policy makers throughout the country and abroad who are working in the by conducting annual conferences which provide forum for new ideas.
- Encourage innovations.
- Recognize important research findings.
- Increase awareness of the latest survey data and promotes action programs.

(i) **Committee on Science and Technology in Developing Countries**: (COSTED): The Dietetics association approached COSTED to provide facilities to store information and collaborate to run information center.

**Activities:**

- Collect information on dietetics from different chapters and dietetics associations abroad and store in computer.
- Publishes dietetics newsletter.

- Run refresher courses for dieticians every year.
- Prepare booklets for different courses for registration board examination.
- Maintain question bank for registration board examination and supply question papers when required.

## **MISCELLANEOUS**

### **ADVANCED TECHNIQUES:**

#### **Major Innovations in Food Technology (Recent Trends and Processes):**

- Energy saving multiple effect evaporators
- Spray dryer and fluid bed instaliser
- Continuous agitated sterilizers
- HTST Sterilizers (Indirect heat or steam injection interference) + Aseptic packaging
- Extrusion cooling

**Development of flexible packing:** Retort packs, hot filled aseptic packs, tetra packs, vaccum packs, oxygen barrier multi layer packs, multi compartment packs, bag in box and stand up pouches, easy open biodegradable or recyclable packs, bericap.

- Wet extrusion process – soya proteins
- Heat resistant amylase and glucose isomerase – glucose syrups and low calorie beverages.
- Fermentation of hydro carbons – single cell protein (SCP).
- Artificial sweetener – Isomalt.
- Continuous mechanical nitrogen and carbon dioxide freezers – complete frozen meals.
- UF, MF, reverse osmosis on organic and ceramic membranes – dairy applications.
- Continuous cheese making machine, yoghurt, bread, biscuit, pasta lines.
- Cleaning in place (CIP)
- Water jet cutting (WJC)

#### **Food Irradiation – cold sterilization:**

- Controlled atmospheric plus selective permeability films plus refrigeration – fruits and vegetables.
- Flesh separators and cryoprotectants – Surimi
- Continuous gelation and texturisation – sea food analogue
- Improved yeasts for baking or brewing – lactic acid starter culture
- Enzymatic transesterification of lipids – special margarine
- Super critical carbon dioxide extraction

#### **Processing combinations:**

- Production of food ingredients – protein concentrates hydro colloids, fibers, and flavour enzymes, WPC, SPC, WPI and SPI.
- Surface decontamination + clean room technology + vaccum packing + heat pasteurization + chilled storage – sour vide, cook chill and RTE meals.
- Washing + NaCl disinfection + slicing + MAP + chilled storage – minimal processing for fruits and vegetables.
- Ultra clean slicing + MAP (CO<sub>2</sub>) + high pressure processing (HPP) + chilled storage – pre sliced ham and cured meat.
- Mild pasteurization (or HPP) + chilled storage (high quality fruit juices and not for fruit concentrates).

**Packaging:**

- Active packing
- Non contact imaging methods
- Optical sorting

**Innovations or Technology with Lesser Impact****(1) Drying:**

- (a) Improved osmotic drying
- (b) Intermediate moisture foods (IMF)
- (c) Super heated steam drying
- (d) Jet impregnation drying – breakfast cereals
- (e) Freeze drying

**(2) Freezing:**

- (a) Freeze concentration of juice or wine
- (b) Ice nucleating / anti freezing bacteria and proteins
- (c) Ultra low temperature – extrusion of ice cream

**(3) Preservation and sanitation:**

- (a) Ohmic or inductive heating
- (b) High pressure processing (HPP)
- (c) Homogenization
- (d) High voltage pulsed electric fields (PEF) – cell permeability by PEF and intense pulsed light for surface treatment

**(4) Mass and heat transfer enhancement:**

- (a) Ultrasonic heating
- (b) Emulsification
- (c) Texturisation and extraction

**(5) Coating and encapsulation:**

- (a) Fluid bed coating
- (b) Micro encapsulation for protection and controlled release

**Major food process innovations / trends classified as:**

- (a) Physical techniques (including heating) – 40%
- (b) Chemical processes – 40%
- (c) Biotechnology – 20%
- (d) Concern a unit operation / product line – 50%
- (e) Specifically to food commodity – 50% ( fruits and vegetables – 20%, fish and meat – 20%, dairy – 20% and cereals – 15%)

**Food Technology issues from Physics****Material sciences (metals, plastics, glass, paper board, ceramics and alloys):**

1. Food packaging – mineral membranes, high pressure processing, nuclear physics accelerated electrons, irradiation and extrusion cooking
2. High pressure processing – mechanical separation techniques –
  - Various unit operations
  - Size reduction (cutting, grinding and homogenization)
  - Separation (filtration, sieving and centrifugation)
  - Recombination ( mixing, foaming)

3. Thermodynamics – heating, refrigeration, air conditioning techniques –
  - Multiple effect evaporator
  - Steam injector
  - Super heated steamed and sterilized
  - Fluid bed installation
  - Clean room temperature
  - CAP
4. Radar, electrical heating and lighting –
  - Microwave and high frequency heating
  - Ohmic heating
  - Infra red heating
  - UV and pulsed white light induction heating
5. Power electronics and rays
6. High voltage detectors of foreign bodies and shock waves

### **Food Technology issues from Chemistry**

- (1) Preservation – salt, sugar, acids, ethanol and other anti microbial agents like nitrous oxide, sorbates, benzoates, propionates, bacterions, sulphur dioxide and fumigants.
- (2) Solubilisation – hydrophobic solvents like hexane, detergent and carbon dioxide as well as polar solvents like ethanol and iso propyl alcohol.
- (3) Fat and oil modifications – degumming, neutralization, hydrogenation and trans-esterification.
- (4) Starch modification – reticulants or substitution agents
- (5) Protein modification – iso electric precipitants, reticulation or substitution agents.
- (6) CAP and MAP – CO<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub> and argon
- (7) Cleaning – detergents, NaCl and acids
- (8) Sanitation – NaCl, H<sub>2</sub>O<sub>2</sub>, O<sub>3</sub>, acid electrolysis and lactic acid
- (9) Synthetic foods – flavors, vitamins, artificial sweeteners and artificial pigments
- (10) Other food additives – anti oxidants, metal chelators, emulsifiers and bio active components.

### **Main Trends in Food Processing**

- (1) Enhance Safety (microbial and chilling techniques):
  - Use effective preservation technologies
  - Request short chilled storage
  - Increase hygiene, HACCP, quality issues and ISO standards
  - Process control and online sensors
  - Cleaning in place
  - Microbial and shelf life indicators
- (2) Increase Food Quality (freshness, more natural):
  - Reduce processing severity by avoiding overheating, use of HTST and new ways to deliver heat
  - Use non-thermal /minimal processing by using salt, sugar, acid, preservatives or additives

- Use combination processes (Hurdles technology) which can reduce extreme use of single technology. Ex.: cook – chill technique or refrigeration with MAP, naturally occurring anti-microbes or smart packing.
- Use sensors like electronic nose, time temperature interpreters, scale up and adapt traditional processes.

(3) Increase convenience:

- Ready to eat or cook foods
- Complete or microvable meals
- Instant or individual portions
- Long shelf life or easy to eat foods
- Boil in bag or light flexible packing
- Informative labeling

(4) Increase production and reduce production costs:

- Mass production – more uniform, less labor, energy, wastes and pollution
- High capacity continuous production lines, automation, online sensors and data storage and analysis, water saving and energy recovery.

(5) Formulate and restructure foods from individual ingredients with specific functional properties: – mix, blend, bind, shape, form, gel, emulsify and texture wise.

- Better control on shape, texture, convenience, composition, flavors, pigments, nutrients and bio active substitutes.
- Engineered and imitation foods, functional and tailored foods.

(6) Extend nutrition to improve health and prevent diseases:

- Select appropriate plant cultivators and animal species
- Maintain / increase nutrient content and bio availability during processing and storage
- Fortify the foods with nutrients and produce nutritionally balanced foods
- Reduce contents like salt, sugar, saturated fats and anti-nutritional factors
- Enrich foods with bioactive components and ensure stability during processing
- Develop functional foods with validated health claims for specific populations.

## ABBREVIATIONS

ICAR: Indian Council of Agricultural Research.

ICMR: Indian Council of Medical Research.

CFTRI: Central Food Technological Research Institute, Mysore.

CSIR: Council of Scientific and Industrial research.

NDDB: National Dairy Development Board, Anand, Gujarat.

CIPHET: Central Institute of Post Harvest Engineering and Technology, Ludhiana, Punjab.

CIAE: Central Institute of Agricultural Engineering.

APEDA: Agricultural Processed Food Products Export Development Authority.

MPEDA: Marine Product Export Development Authority.

NADC: National Cooperative Development Committee.

IIHR: Indian Institute of Horticultural Research. (Kassargud, Bangalore).

IISR: Indian Institute of Species Research.

IVRI: Indian Veterinary Research Institute.

NDRI: National Dairy Research Institute. (Karnal, Haryana).

CPRI: Central Potato Research Institute.  
CTRI: Central Tobacco Research Institute.  
NRDC: National Research Development Cooperation.  
CIFR: Central Institute of Fishery Technology.  
FAO: Food and Agricultural Organization.  
IRRI: International Rice Research Institute.  
AICRP: All India Crop Research Products.  
PHT: Post Harvest Technology, ANGRAU, Bapatla.  
APFE: Agricultural Processing and Food Engineering.  
UAS: University of Agricultural Sciences, Bangalore.  
CPCRI: Central Plantations Crop Research Institute, Trivandrum.  
NHB: National Horticultural Board.  
MOFPI: Ministry of Food Processing Industries.  
FPO: Fruit Product Order.  
HACCP: Hazard Analysis Critical Control Point.  
BIS: Bureau of Indian Standards.  
PFA: Prevention of Food Adulteration Act.  
Ag mark: Agricultural Marketing Inspection.  
GDP: Gross Domestic Product.  
WHO: World Health Organization.  
FDA: Food and Drug Administration.  
GMP: Good Manufacturing Practices.  
TQM: Total Quality Management.  
DOFPI: Department of Food Processing Industries.  
PCB: Pollution Control Board.  
PRRC: Paddy Processing Research Center.  
CIDA: Canadian International Development Agency.  
NABARD: National Bank for Rural Development.  
SSCA: State Seed Certification Agency.  
MMPO: Milk and Milk Product Order.

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