Ingredients
For
success

SMC

*Flavours & Fragrances*

• *Quality* • *Creativity* • *Reliability*

ISBN : 969-8543-14-7

standard
manufacturing
company (pvt.)
limited

4-Dayal Singh Mansion,
Shahrah-e-Quaid-e-Azam, Lahore 54000
Phones: 7122558-60, 7243973
Telex : 44477 PRFUM PK, Fax: 7233479
E-mail: info@smc.com.pk
Website: www.smc.com.pk

FOOD SCIENCE & TECHNOLOGY

J.A. Awan

# FOOD SCIENCE & Technology

J.A. Awan

Scanned by CamScanner

© 2005, Dr. J. A. Awan
**ISBN: 969-8543-14-7**

Citation: Awan JA. 2005. Food science and technology. Unitech Communications, Faisalabad.

Designed and printed by:
Pak TM Printers Al-Rehman Plaza,
Munshi Mohallah, Street No. 6,
Aminpur Bazaar, Faisalabad
Ph: 041-2639480, Fax: 041-2639480

Published by:
**Unitech Communications**
498 – B, Peoples Colony # 1,
Faisalabad – Pakistan.
Phone: 041 – 8542156
E-mail: awanjavaid@hotmail.com
awanja50@yahoo.com

**Price:**
**Local Rs. 160**
**Foreign $ 6.00**

# CONTENTS





Scanned by CamScanner

## PREFACE TO SECOND EDITION

This book formed part of "Elements of Food Spoilage and Preservation" that was first published in 1983 by the Institute of Management and Technology, Enugu, Nigeria. This was co-authored with Dr. J.C. Okaka, a competent food technologist. This edition was sold within one year and the second was published and sold in 1985. After joining the University of Agriculture, Faisalabad in 1988, I revised this book in accordance with the existing syllabus and published in 1995 as "Elements of Food Science and Technology". This was slightly revised, enlarged and reprinted in 1999.

The University Grants Commission (UGC) approved new curriculum in Food Technology in 2001. This curriculum became mandatory in all Universities offering Food Science and Technology at graduate level. "Elements of Food Science and Technology" became the recommended text for the first two courses in the discipline in this UGC approved curriculum.

"Elements of Food Science and Technology" was split into two in 2001: "Elements of Food Science and Technology—I" and "Food Processing and Preservation". UGC (now Higher Education Commission, HEC) further revised the curriculum in 2004. This book, "Food Science and Technology", meets the requirements of the course "Introduction to Food Science and Technology". The book has been revised in the light of the current knowledge and the syllabus approved by HEC. It also covers almost 50% of the introductory course in the curriculum adopted by Punjab Board of Technical Education for DAE in Food Technology. The students of Home Economics and Catering Science will also find this book easy to follow for their course in food spoilage and preservation.

The author is grateful to colleagues (especially Mr. Arshad Karim, Lahore) and students who have pointed out deficiencies in the previous edition. I am obliged to Mr. Babar Ehsan Bajwa for the assistance in updating this edition. Thanks also to Mr. Imran Ali Shah who has been very helpful in designing the book.

Dr. Javaid Aziz Awan

September 2005





# Chapter 1

## INTRODUCTION

Food is a necessity of life and must be consumed to sustain it. Scientifically, food may be defined as any substance that, when ingested, usually will supply nutrients such as carbohydrates, fats, proteins, vitamins, mineral elements and water that nourish the body. These furnish oxidative energy required to fuel body activities, provide materials for building and/or maintenance of body tissues and supply substances that act as regulators for body processes.

### 1.1 FOOD PROCESSING

Food processing involves any operation or operations that will alter the value of food. This may range from simple washing to the delicate and complicated processes of food preservation and developing new products. The main objectives are enhancement in shelf life, consumer convenience and preservation of nutrients. The food processing industry, therefore, is credited with all treatments received by food from its origin (land or sea) to the point in space and time when it is consumed. Thus, almost all foods are subject to processing of one type or another. Food processing is studied under the umbrella of Food Science and Technology.

### 1.2 FOOD SCIENCE

Food Science emerged as a discipline in the early 1950's as a result of accumulation of scientific information on food. It may be defined as a body of coherent and systematic knowledge that deals with understanding the nature and composition of food materials and their behaviour under various conditions to which they may be



Scanned by CamScanner

subjected. The study involves knowledge about the nature of food, i.e., its composition, behaviour when subjected to different conditions of processing, preservation and storage, the causes of spoilage and the principles underlying methods of processing and preservation. Moreover, Food Science may also be concerned with improving the quality of the product so that it reaches the consumer in an attractive, safe and nutritious form.

## 1.3 FOOD SCIENCE AND TECHNOLOGY

In the present day context, the terms, Food Science and Food Technology are often used synonymously. These describe the whole set of changes through which a food passes from the time of harvesting to consumption. In other words Food Science and Technology may be defined as the application of physics, chemistry, microbiology, engineering and nutrition to the handling, processing and storage of foods.

By definition, a food scientist or a food technoiogist is expected to be conversant with the problems connected with understanding the nature, handling, processing and storage of food. The subject is so vast and the problems so complex that it calls for a multidisciplinary approach. Usually a team of food scientists and technologists work together with experts in other disciplines to run a food processing industry. Therefore, a career in Food Science and Technology demands a broad educational background and the ability of the person to apply his knowledge whenever and wherever the need arise.

The food scientists and technologists are responsible for the safety, taste, appearance and nutrition of processed foods. They are expected to: -

a. select new and proper raw materials,
b. know the fundamental changes in composition and physical condition of food-stuffs that may occur during and subsequent to industrial processing,
c. develop new products, processes and equipment,
d. understand and control food manufacturing operations and
e. solve technical problems associated with food manufacturing, processing, storage and distribution.

Studies on food safety have triggered research into better detection methods for food-borne pathogens and toxins. Research on food toxicology, food allergies and sensitivities, emerging





pathogens, hazards to special population groups is the priorities of the food scientists of the day.

## 1.4 RELATIONSHIP WITH OTHER DISCIPLINES

Food Science and Technology involves application of the knowledge of some basic and applied sciences to the study, handling, processing, storage and distribution of foods. Primarily two distinct aspects in the field are recognized: -

a. The scientific aspects and
b. The technological aspects.

The study of Food Science is concerned with understanding the nature of food, causes of spoilage, etc. These are closely related to physics, chemistry and biology in many respects. On the other hand, the technological areas of food preservation and processing require knowledge in different fields of engineering, processing, manufacturing, packaging and sanitation. Food Science and Technology is made up of several components that include food chemistry, biochemistry, food microbiology, sensory analysis, food engineering, packaging and sanitation.

### 1.4.1 Physics

Physics has contributed immensely to the field of Food Science and Technology. Basic principles underlying heat exchange (cooling, heating), evaporation, etc., were discovered by physicists. The discovery of semi-conductors followed by transistors and chips has led to a revolution in the food industry. Furthermore, equipment used in food analysis has been developed by people with knowledge in physics. The measuring pH, relative humidity, permeability of gases and moisture in packaging materials and techniques for assessing the texture of both raw and processed foods have their origin in physics. The latest techniques used in food processing, including irradiation preservation and microwave heating, have been contributed by physicists.

### 1.4.2 Chemistry

The food molecules are complex, so also are the changes occurring in them. As such, the study of food chemistry is very complicated. Reactions occurring during spoilage and processing are of chemical or biochemical nature. The methods of food analysis, in most cases, are based on the characteristic properties of specific chemical groups like amino, carbonyl, carboxylic, phenolic and others. These methods have been evolved, in part, by the chemists.



Scanned by CamScanner

Other changes observed in foods may be of biochemical nature. These include the ripening process and subsequent spoilage of fruits and vegetable as a result of enzyme activity. The study and analysis of enzymes and flavouring components involves aspects of biochemistry. The discovery of synthetic rubber has led to the development of the whole new field of polymer chemistry. This in turn has promoted the production of tailor-made, non-rigid, plastic packages that protect foods from oxidative rancidity and loss of moisture vapours. Knowledge of chemistry and biochemistry, thus, is of immense value to the food technologist.

### 1.4.3 Biology

A number of biological sciences are of significance in the study of Food Science and Technology. In the breeding of new varieties suitable for processing, the know-how of botany, plant breeding, genetics and plant physiology are necessary. Knowledge of plant pathology, entomology and parasitology is essential to grow healthy plants and animals. These are also required to keep the commodities safe from the attack of pests in the field and in storage chambers. Study of human physiology enables one to understand how the food will act inside the body. It is also useful in establishing processes that will inactivate or destroy antinutrient factors or fortify the foods.

Microbiology is an important biological science associated with Food Science and Technology. Microorganisms are the chief spoilage agents in foods. Therefore, their control is desirable if food industry is to thrive. A number of processing techniques have been developed to achieve this goal, e.g., pasteurization, sterilization, irradiation, etc. Moreover, activities of some microorganisms are usefully exploited in such processes as the production of leavened bread or alcoholic beverages by yeasts and the use of lactic acid bacteria in the production of dairy (yoghurt, cheese), meat (sausages) and vegetable products (pickles). Some organic acids, antibiotics, enzymes, vitamins, steroids, etc. are produced by the proper utilisation of microorganisms.

### 1.4.4 Engineering

The conversion of raw agricultural commodities into finished products is an area where the role of engineering is prominent. Use of appropriate technology is essential to overcome short-term supply and long term-shortage. Several branches of engineering are indispensable in this regard. Chemical, biochemical, electrical, electronics and mechanical engineers have their role in developing





processes and equipment for commercial plants. Almost all the advances in thermal processing have been the result of creative engineers. The applications of computer technology, microwave heating and other similar techniques have now become an integral part of the food industry.

Designing and maintenance of commercial food processing plants and equipment are jobs that engage the services of engineers. The study of problems related to heat and mass transfer of food materials, process flow for batch and continuous processes as well as plant and factory design are some areas in which engineering sciences are indispensable. Because of the added advantages of a sound engineering background to the food scientist, educational programmes in Food Technology heavily weighted with courses customarily found in a chemical engineering curriculum have emerged under the name of "Food Engineering".

### 1.4.5 Computer Science

Computers have influenced methodology of analytical and industrial instrumentation by facilitating industrial operations, including inventory, process and quality controls. It has enabled development of new tools with powerful capabilities for studying the physiochemical properties of materials particularly at microscopic, submicroscopic and molecular levels. In fact, modern instrumentation including spectroscopy, microscopy, calorimetry and rheological analysis is simply inconceivable without computer assistance.

Computers have also been used for data storage and retrieval, communications (including data transmission) and data analysis. They have also been used for molecular modeling, allowing much improved insights into molecular architecture and behaviour of molecules. While at present such modeling is difficult for complex systems such as foods, considerable progress has been made.

## 1.5 CAREER OPPORTUNITIES

The discipline of Food Science and Technology is being offered in Pakistan at Diploma level (DAE) in Government College of Technology (a polytechnic institute) at Faisalabad and Sahiwal. It has also started at Women Polytechnic in Karachi for females. The universities awarding degrees at graduate and postgraduate levels are University of Agriculture Faisalabad, Barani Agricultural University Rawalpindi, Sindh Agricultural University Tandojam, University of Karachi, Karachi, NWFP Agricultural University Peshawar, Gomal University D.I. Khan, University of Azad Jammu



Scanned by CamScanner

and Kashmir Muzaffarabad (College of Agriculture, Rawalakot), G.C. University Sargodha and International University, Gilgit. The Colleges of Agriculture in Multan, D.G. Khan and Hasilpur only offer introductory courses for B.Sc. (Hons.) Agriculture. Graduates from these institutions can be found in every part of the country and abroad in industry, education or government organisations.

### 1.5.1 Career in Food Industry

Food processing is largest industry in the world in terms of manpower employed, while it ranks second in Pakistan. This industry has a constant demand for well-qualified graduates with strong scientific and technical skill base and who can apply these skills to improve the industry's delivery of convenient and high quality food products. In this industry food technologists are engaged in processing plants that convert raw food into products such as beverages, breakfast cereals, baked goods, dairy products, pickles, jams, snacks and convenience foods. They are also engaged in the food ingredient plants that process and manufacture salt, pepper, spices, flavours, colours, preservatives, antioxidants and others.

Food technologists work in quality assurance to secure that food in every stage of processing meets the government and consumer standards. They are busy in quality control of raw materials, ingredients, packaging materials, in-process testing, final batch release and ensuring the shelf life of processed products. They work in product development where there is no limit to the number of ways the food supply can be used. They prepare new products and standardise recipes. In the process development, they are responsible for innovations in processes. On the processing floor, the food technologists are busy in controlling men, machines and materials to guarantee production of safe and nourishing products within the budget.

A number of food technologists, after obtaining work experience, are diversifying their expertise by gaining an MBA degree. They work in managerial cadre in the food industry. Some graduates also find jobs with suppliers of food processing equipment, ingredients and supplies as technical sales executives.

### 1.5.2 Career in Food Service Organisations

With the opening of multinational food restaurants, the demand for food technologists has increased. Organizations such as KFC, McDonald, Pizza Hut, Uno Chicago Grill and others are employing food technologists, especially in quality assurance and product development sections.





### 1.5.3 Career in Teaching Institutions

Food Technologists opting for academic positions find jobs in institutions wherever this subject is offered. For this, a minimum of master's degree is required. However, for entry as instructor in polytechnics, DAE is sufficient. In the academic institutions, they are assigned various courses for teaching. In this capacity these food technologists keep themselves abreast with the latest developments in the discipline. The job description in the universities also includes conducting and supervising research.

### 1.5.4 Career in Research Institutes

There are numerous government research institutes in the country that employ food technologists as Scientific Officers or equivalent. Among these are PCSIR Laboratories, Pakistan Atomic Energy Commission Laboratories, Pakistan Agricultural Research Council, Agricultural Research Institutes and others. In these institutions the main thrust is to conduct basic and applied research in food chemistry, food microbiology, nutrition, food toxicology and product development. The Pakistan Atomic Energy Commission laboratories are busy in conducting research on the effects of irradiations on local foods. A postgraduate degree in Food Technology is preferred as the basic qualification.

### 1.5.5 Career in Other Organisations

Besides these, food professionals also enter extension wing of the Provincial Agriculture Departments as Agricultural Officers. In non-governmental organisations (NGOs), they are employed in social action programmes. Some have even meritoriously passed the civil service examination and are now in the civil services. Some professionals have even set up their own food processing business and are running it successfully. Others are working independently as consultants guiding the food industry. Of course, many have found jobs overseas. They are working in the Middle East, Europe, USA, Canada and Australia, as well as in other parts of the world.

### 1.5.6 Potential Openings

In addition to the above, job opportunities should be available for food professionals in Export Promotion Bureau of Pakistan, Public Analyst Laboratories, Tehsil Management Authorities, Provincial Food Departments, Ministry of Agriculture and other similar organisations. Presently, hardly any Food Technologist is found in these organisations due to the basic entry requirements that were framed a few decades ago.



Scanned by CamScanner

Large catering organisations, chain restaurants and airlines are demanding new, more convenient and a greater variety of foods. The need of health institutions (hospitals) is formulation of healthful diets for the healthy and sick with less sodium, sugar, fat and cholesterol. Food scientists and technologists can find openings in these organisations quite attractive, interesting and challenging.

### 1.6 PROFESSIONAL SOCIETY

The Pakistan Society of Food Scientists and Technologists (PSFST) is professional body of the food scientists and technologists in Pakistan. It is affiliated with the Institute of Food Technologists, U.S.A. The Head Office of this Society is located in the Institute of Food Science and Technology, University of Agriculture, Faisalabad. The objectives of the Society are to: -

a. promote the cause of Food Science and Technology and Nutrition,

b. improve the professional competence of Food Scientists and Technologists,

c. provide professional communications through technical publications, scientific meetings, seminars, symposia, lectures, workshops, etc. and

d. encourage education and training at all levels in various fields of Food Science and Technology.

The Society is working to create strong links between the private sector (food and allied industries) and the public sector (universities and research institutions). It holds annual Food Science Conferences and publishes Pakistan Journal of Food Sciences. The membership categories are Professional, Associate, Student, Emeritus, Honorary, Life and Corporate Members.

Prof. Dr. Muhammad Shafiq Chaudhry (Lahore) was the Founding President from 1990 to 1997. Prof. Dr. Muhammad Saeed (Peshawar) succeeded him for the next tenure (1998–99), while presently Dr. Wazir Hussain Shah (Peshawar) is the President. Prof. Dr. Javaid Aziz Awan has been the Secretary of the Society for a decade (1990–99), who has been succeeded by Prof. Dr. Faqir Muhammad Anjum (Faisalabad).





Chapter 2

# FOOD SOURCES & WORLD FOOD SITUATION

### 2.1 FOOD SOURCES

The sources of human food are primarily of plant and animal origin. Sometimes fish are separated from these and designated as seafoods (Table 2.1). Foods of plant origin grow in or on the soil. This group includes fruits, vegetables, roots, tubers, cereals, legumes, nuts, oilseeds, spices, etc.

There are numerous species of animals on the planet Earth. Out of these only a few are lawful for the Muslims. Among foods of animal origin are all split-hoofed ruminant mammals. These include cow, buffalo, camel, sheep, goat and similar animals. Game animals such as deer also fall in this category. Among the birds are those like hen, duck, turkey, quail, etc. Out of the numerous species living in the sea or waters, all kinds of fish are edible.

### 2.2 FOOD SUPPLY IN PAKISTAN

Pakistan is basically an agricultural country. The Indus basin irrigation system provides the required input for cultivation of food and cash crops. Wheat is the staple food and is grown all over the country. Most wheat is produced in Punjab, Sindh and parts of NWFP. In 2004–2005, 21,109,000 tonnes were produced from an area of 8,330,000 hectares. Rice and maize are cultivated in central Punjab, northern parts of NWFP and along River Indus in Sindh. In 2004–2005, the production of rice was 4,991,000 tonnes, while of



Scanned by CamScanner

maize it was 2,775,000 tonnes. Other important grains are bajra, jowar and barley. Substantial quantities of rice are exported.

**Table 2.1 Sources of human food based on origin**

| Source | Food group | Examples |
|---|---|---|
| Plant | Cereals/grains | Wheat, rice, maize, barley, bajra |
| | Pulses/ Legumes | Beans, lentils, chickpea, black gram, cowpeas, ground nuts |
| | Fruits | Mango, orange, banana, guava, |
| | Vegetables | Spinach, gourd, okra, turnips, potatoes, cauliflower, green peas |
| | Sugar | Sugar cane, sugar beet |
| | Oils and fats | Mustard, soybean, cotton seed oils |
| | Spices | Cumin, black pepper, cardamom |
| Animals | Animal meat | Beef, mutton, game animals |
| | Bird meat | Poultry, duck, turkey, game birds |
| | Fats | Butter, ghee, tallow |
| | Animal products | Milk, yoghurt, cheese, eggs |
| | Insect products | Honey |
| Marine | Fish | Sardines, salmon |
| | Crustaceans | Lobsters, crabs, shrimps |
| | Shellfish | Oyster, clams, |

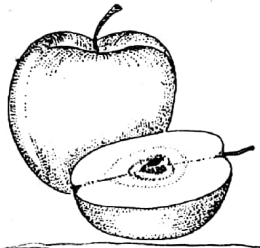
A variety of pulses are grown in south-eastern parts of NWFP, north and north-western Punjab, southern Punjab and parts of Sindh along the Indus River belt. Among the major pulses are gram, mung, mash, and lentils. The combined production of these and other pulses stood at 937,300 tonnes in 2004–2005.

Cottonseed, rapeseed/mustard, sunflower and canola are important sources of edible oil in Pakistan. The total production of oil from these crops was 842,000 tonnes in 2004-2005. The local production fails to meet the requirements; hence substantial quantities of palm, canola and soybean oils are imported.

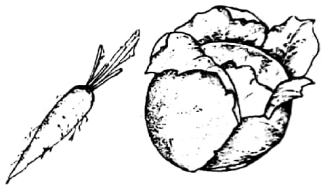




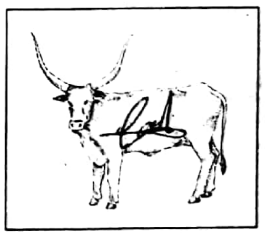
Sugarcane is grown as a cash crop and occupied about 947,000 hectares in 2004–2005 with a production of 45,316,000 tonnes. It serves as major raw material for the production of 'shakkar', 'gur' and white sugar. In 2004–2005, 2,961,300 tonnes sugar was produced by the sugar industry.



Pakistan is blessed with a climate that is suitable for cultivation of a large variety of fruits and vegetables. Among the prominent fruits are citrus, mango, apple, banana, apricot, almonds, grapes, guava, pear, peach, figs, plum, dates, etc. More recently strawberry and lychee have also flooded the markets. Owing to climatic variations, different fruits are grown in different provinces. While Kinnow and mangoes are primarily grown in Punjab, grapes and apples grow in NWFP and Balochistan. The total production of fruits in Pakistan stood at 3,138,000 tonnes in 2004–2005 of which 2,06,000 tonnes were exported. Pakistan is among the major date exporting countries in the world.



Among the vegetables potato, carrot, brinjal, cauliflower, cabbage, turnip, gourds, pumpkins, radish, spinach, tomatoes, green peas, okra, cucumber, onion, garlic, ginger, and others are grown in the country, especially near the cities. In some regions, a number of these are grown in greenhouses and are available almost all the year round. Vegetables provide essential vitamins, mineral elements and dietary fibre.



Buffaloes and cows are major sources of milk, while minor quantities are also obtained from goat, sheep and camel, but these normally do not enter the commerce. The production of milk stood at 29,472,000 tonnes in 2004–2005, which is quite below the requirements. Consequently, large quantities of powdered milk are imported.



Scanned by CamScanner

In Pakistan, main sources of animal protein are cattle, buffalo, goat, sheep and poultry (Table 2.2). Cattle and buffaloes are raised primarily for milk purposes. Young male calves and old cows and buffaloes enter the slaughterhouses. Sheep and goat are reared for meat. Broiler has occupied the market for poultry meat. Besides, the indigenous species (*desi*) are kept in small numbers at home and contribute to the poultry meat. Different breeds of layers are raised for the production of eggs that are sold for meat purposes after they become uneconomical.

Pakistan is rich in marine resources. There are about 600 marine species, out of which 400 are in the sea and 200 in the fresh waters. Only about 40 of these are of commercial significance. The riverine areas of Sindh consist of about 1,60,000 hectares, which is the largest source of fresh water fish. Other sources of fresh water fish are natural or man-made lakes (Manchhar, Hadero, Mehel Kohistan and Keti Bandar), reservoirs (Mangla, Tarbela and Hub Dams), Headworks and Barrages (Balloki, Trimu, Panjnad, Chashma, Jinnah, Kotri and Guddu), rivers as well as ponds. In 2004–2005, 1,70,100 million tonnes of inland water fish was caught. Some rivers in the Punjab, especially Ravi and Sind are heavily polluted with industrial and domestic effluents that have adversely affected the aquatic life in these waters. Fish gets contaminated with toxic chemicals, heavy metals and pathogenic organisms that bear adverse consequences on its eating quality and health of the consumer.

Marine fish is caught from the Arabian Sea. This is brought to Karachi, Gwador and other coastal cities, packed in ice and dispatched to inland cities or processed for export. During the year 2004–2005, total marine fish production was 5,73,600 million tonnes out of which 90,225 million tonnes were exported as fresh, frozen, dried, salted or smoked.

## 2.3 FOOD AND NUTRITION IN PAKISTAN

Food consumption pattern is different for the urban and the rural areas in Pakistan. The rural population consumes more cereals, fresh milk, butter, ghee, dry fruits and sugar. On the other hand, the urban people eat more of pulses, animal proteins (mutton, beef,





chicken) fruits and vegetables. Cereals, butter and ghee provide the required energy for work, hence are consumed more by the rural population. Most households in the rural areas keep at least one or more milch cattle or goats and are able to get fresh milk.

**Table 2.2 Livestock, sheep, goat and poultry production in 2004–2005**

| Animal/Bird | Numbers in millions | Meat production in 000 tonnes |
|---|---|---|
| Cattle | 24.2 | 1115 |
| Buffalo | 26.3 | |
| Camel | 0.8 | |
| Sheep | 24.9 | 740 |
| Goat | 56.7 | |
| Poultry | 366.0 | 416.0 |
| Eggs | 8529 | |

Source: GOP (2005)

Dietary pattern varies widely from one region to another but tends to weigh largely in favour of cereals (wheat, rice), pulses and meat (Table 2.3). Calories and protein availability is now 2,534 calories and 65.8 grams per adult per day, respectively. Malnutrition is one of the main reason behind high mortality rate among mothers and infants in the country. According to some estimates in 2004–2005, the total number of malnourished children in Pakistan was around 8 million, with iron and iodine deficiencies being the prevalent public health problems. To prevent some forms of malnourishment, the Government has taken initiatives to introduce "Tawana Pakistan" project and micronutrient deficiency control programmes. The main components of these are serving fresh meals in the schools and micronutrient supplementation (fortification and provision of vitamin A, iron and iodine).

## 2.4 FOOD SITUATION AND WORLD POPULATION

Population experts predict that about 73 million people will be added to the world's population each year between 1995 and 2020. About 97.5% of the increase is expected to occur in the developing world, whose share will rise to 84% of the total population by 2020. With ever-increasing population, low production efficiencies in the agricultural sector and reduced availability of agricultural land (land lost to urbanisation, erosion, water logging, salinisation, alkalinisation, etc.), the food-population gap is likely to widen.



Scanned by CamScanner

It is estimated that 25 per cent or more of the world's food production is lost after harvesting. These losses occur at the production sites, during processing, storage, distribution and marketing and in the home. Comparatively, losses are higher in developing countries of Africa, Asia and Latin America than in the developed nations. Food losses in Pakistan range from about 20 per cent in cereals to as high as 40 per cent in fruits and vegetables.

**Table 2.3 Food availability per capita**

| Item | 1949–50 | 1999-2000 | 2003–2004 (Estimated) |
|---|---|---|---|
| Cereals (Kg) | 139.30 | 163.50 | 144.70 |
| Pulses (Kg) | 13.90 | 7.20 | 8.00 |
| Sugar (Kg) | 17.10 | 26.40 | 30.50 |
| Milk (L) | 107.00 | 148.80 | 155.70 |
| Meat (Kg) | 9.80 | 18.70 | 18.80 |
| Eggs (Dozen) | 0.20 | 5.10 | 4.60 |
| Edible Oil (L) | 2.30 | 11.10 | 11.50 |
| Calories per day | 2078.00 | 2625.00 | 2529.00 |
| Protein per day (g) | 62.80 | 70.00 | 65.30 |

Source: GOP (2005)

Considering the present trend in agricultural sector of developing countries, food supply can be increased by 10 to 20 per cent by reducing postharvest losses. This can complement efforts spent on trying to improve the yield of food crops by advanced agronomic practices and increase in acreage. Food processing plays a pivotal role in ensuring that all efforts at increasing food supply are not lost to physical, chemical or biological forces.

## 2.5 WORLD-WIDE FOOD RELATED NUTRITION AND HEALTH CONDITIONS

Modern technologies have transformed the global food situation from widespread shortages and famine in the 1960's to one in which there is enough food for everyone, were it more equitably shared. Yet despite these achievements, some 1.2 billion people do not get enough to eat. Many more live on nutritionally inadequate diets. About 90% of the developing world's poor now live in Asia and





Sub-Saharan Africa, and these countries will also need to feed over one billion more people by 2020.

Following alarming facts reveal worldwide food related nutrition and health conditions (Okezie, 1998):

a. Some 792 million people in developing countries and 34 million in the developed world remain chronically hungry.

b. 2 billion people in developing countries experience micronutrient deficiencies (iron, iodine, vitamin A) and/or diet related non-communicable diseases (cardiovascular disease, obesity, diabetes, and some form of cancer).

c. 1.5 billion people (28% of the world population) suffer from iron deficiency anaemia, especially women of childbearing age.

d. 1 billion people live in iodine deficient areas, while 217 million are affected by goitre.

e. About 160 million pre-school children are malnourished, with serious implications for their future mental and physical capacities.

f. 13 million pre-school age children are affected by xerophthalmia; 5,00,000 become partially or totally blind each year.



Scanned by CamScanner

NOTES





Chapter 3

# DEVELOPMENTS IN FOOD INDUSTRY

## 3.1 FOOD PRESERVATION IN THE ANCIENT TIMES

Food science is the oldest science in the world. The primitive man gathered food as early as 1,00,000 years ago. In the Palaeolithic Period (before 15,000 BC), or the "Old Stone Age", man dried, roasted and pounded some of his farm produce. He used the back of the cave to store food. Later, in the Mesolithic Period (Middle Stone Age, 15,000 BC) the variety of food gathered was much more diversified and so were the processing techniques. In this period the techniques to dry fish, boil food and store for later use were discovered.

In the Neolithic Period (New Stone Age - 9,000 BC) man had settled in villages and used tools to cultivate land. Alcoholic and acetic fermentations, as well as extraction of oil from plant materials were started. Baking of leavened bread was introduced in Northern Iran around 6,000 BC.

In the Bronze Period (3,500 BC), man started settling in cities. The Egyptian tombs have left details of the cultural and food habits of that period. The Egyptians baked bread from cereals, prepared cakes and pastries and fermented grapes to produce wine. They brewed beer from cereals, especially barley, millet and corn. Butter and cheese making were discovered probably in Iraq at about



Scanned by CamScanner

Complete Chapter in final

Chapter 6

# FOOD CONSTITUENTS - I

Water, carbohydrates, lipids and proteins are usually present in large quantities in foods, while vitamins and inorganic materials are found in smaller amounts. Besides these nutritionally important components, foods also contain other constituents such as colours, flavours, organic acids and toxic substances.

## 6.1 WATER

Water is chemically composed of two molecules of hydrogen and one of oxygen. It has the chemical formula of $H_2O$. Water has a molecular weight of 18.01534, melting point at 1 atmosphere of 0.000°C and boiling point of 100.000°C. It exists in all the three forms, i.e., as gas, liquid, and solid. It is invariably present in liquid form in relatively large amounts in all foods except a few like common salt, sugar and vegetable cooking oils. Foods rich in water are fruits vegetables, meat, milk and beverages such as tea, coffee, carbonated drinks and '*lassi*' (Table 6.1).

The water molecule dissociates to yield $H^+$ and $OH^-$ ions: -

$$H_2O \longrightarrow H^+ + OH^-$$

Thus, it is both a proton donor and a proton acceptor, and hence is neutral. When an acid is added to water, it increases the proton donors ($H^+$) and makes the water acidic. The addition of an alkali increases the proton acceptors ($OH^-$) and makes the water alkaline.



Scanned by CamScanner