OBT351 FOOD, NUTRITION AND HEALTH L T P C 3 0 0 3

COURSE OBJECTIVES:

- Build knowledge and an overview on general aspects of nutrition and health.
- Distinguish the nutritive value of various food items, BMI calculation differentiating super junk, and functional foods in the market.
- To Solve the real-world problems based on nutrition and health.

UNIT-I FOOD AND MICROBIOLOGY OF HEALTH: 9

Food resources (plant, animal, microbes); Overview of current production systems; Overview of current production systems. Functional and "Super" Foods - role in optimal nutrition. Sugar, protein and fat substitutes. Food and behaviour- physiological disturbances in alcoholism, drug abuse and smoking. Food Related Laws: Inspection – Microbial Indicators of product quality – Indicators of food safety – 229 Microbiological safety of foods - control strategies – Hazard Analysis Critical Point System (HACCP concept)- Microbiological criteria

UNIT-II NUTRIENTS AND FOOD ADDITIVES: 9

Macro nutrients- carbohydrates, proteins and lipids. Micronutrients-Minerals: Calcium, Magnesium, Iron, Zinc, Copper and Selenium; Vitamins. Nutritional Physiology: Digestion, absorption, and utilization of major and minor nutrients. Biotechnology of food additives- Bioflavors and colors, microbial polysaccharides, recombinant enzymes in food sector.

UNIT-III NANO FOOD TECHNOLOGY: 9

Nano materials as food components, food packaging and nano materials, policies on usage of nano materials in foods. Food product development: steps involved in food product development, shelf-life assessment.

UNIT-IV FOOD RELATED NUTRITIONAL DISORDERS AND ENERGY CALCULATION: 9

Type I Disorders-Causes of life style and stress related diseases. Cardio-vascular diseases, hypertension, obesity. Type-II Disorders: Cancer, diabetics, ulcers, electrolyte and water imbalance. Health indices. Preventive and remedial measures. Energy balance and methods to calculate individual nutrient and energy needs. Planning a healthy diet.

UNIT-V CONSUMERS ON GM FOODS AND CONTEMPORARY ISSUES: 9

Global perspective of consumers on GM foods; Major concerns of transgenic, foods GM ingredients in food products. (labeling, bioavailability, safety aspects); regulatory agencies involved in GM foods, Case studies- GM foods.

TOTAL:45 PERIODS

TEXT BOOK(S):

1. P.J. Fellows.2009. Food Processing Technology -Principles and Practice (Third Edition). A volume in Woodhead Publishing Series in Food Science, Technology and Nutrition.
2. Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto, Robert E. Levin. 2015. Food Biotechnology. CRC Press. Second edition.

REFERENCE BOOKS:

1. Understanding Nutrition. 2010. Ellie Whitney, Sharon Rady Rolfes, 11e. Thompson Wadsworth.
2. Nutritional Sciences- From Fundamentals to Food.2013. Michelle McGuire, Kathy A. Beerman, 2 nd e. Thompson Wadsworth.
3. Yasmine Motarjemi, Huub Lelieveld, Food Safety Management - A Practical Guide for the Food Industry (2014), 1st Edition, Academic Press, London, UK

UNIT-I FOOD AND MICROBIOLOGY OF HEALTH

1.FOOD RESOURCES (PLANT, ANIMAL, MICROBES);

- It is of great importance that one understands where or what their source of food.
- A balanced diet is a necessity if one wants to lead a healthy life. This balanced diet involves different carbohydrates, minerals, vitamins, fats and so on. So, how does one ensure that a balanced diet is maintained?
- The first step is to know where do they come from so that we can understand the different nutrients provided by that particular item of food. Let's have a glimpse of food sources and plant and animal products we consume.

Food Sources

The sources of food are broadly classified into two groups, plants and animals and Microbes.

Food from Plants

- Plants are a source of a wide variety of nutrients required to keep the human body in perfect working condition.
- Humans consume everything from fruits, flowers, even the stem of some plants, leaves and stem-like lettuce, celery, roots of some plants like carrots, beetroot, and seeds like wheat, rice, etc.
- All food comes from plants, even animals depend on plants. Hence, we obtain food from plants directly or indirectly.
- The reason one is advised to consume fruits and vegetables on a daily basis is that it is a source of rich nutrients.
- Plants provide us with vegetables, coffee, cereals, pulses, fruits, sugar, spices, oil, etc. Different parts of the plants provide different food materials. Let us have a look at some of the food obtained from different parts of the plant.

Vegetables

Vegetables are obtained from the plants. Some nutrient-rich vegetables such as beetroot, turnip, spinach, cauliflower, etc. are obtained from plants. Roots, leaves, and stem of some plants are edible.

Roots

Radish, turnip, carrot, beetroot are some of the roots that are eaten as vegetables.

Stem

Potato and ginger are the stems that are eaten as vegetables.

Leaves

Spinach, cabbage, lettuce are the leaves eaten as vegetables.

Flowers

Broccoli and cauliflower are the flowers eaten in the form of vegetables.

Fruits

Fruits are a healthy source of food from plants. Orange, mango, apple, grapes are some of the fruits consumed by humans.

Cereals

Cereals include rice, wheat, maize, jowar, barley, etc. These are a rich source of nutrients provided by the plants.

Tea, Coffee

Coffee and tea are widely grown in the southern parts of India. These are also obtained from the plants. Not just these, sugar is also obtained from the plants. It is processed from the sugarcane plant.

OIL

Oil can be extracted from the seeds and leaves of the plants. Some of the plants producing oil are castor, mustard, and sunflower.

Spices

Cinnamon, cardamom, pepper, clove, cumin seeds, and ginger are obtained from the plants and used for cooking purposes.

Food From Animals

- Animal products are used as food directly or indirectly. Milk, eggs and meat are important examples of food from animals.
- Animal products too are a rich source of nutrients.
- The food chain is composed of exactly these animals starting with organisms that use the energy of the sun to the apex at which the organisms are predators and rely on producers.

Let us have a look at some of the food obtained from animals:

Milk

- Cows, buffaloes, sheep, goat, and camels are a great source of milk.
- Milk is also called as an ideal food. It is rich in vitamins, minerals, proteins, carbohydrates and fats.

Eggs

- Chickens, ducks, geese, and quails are raised for eggs and meat. The egg is a rich source of protein and vitamin.
- The yolk of the egg is mostly made up of egg. It also contains vitamins, phosphorus, calcium and iron.

Meat

Meat is of two types- red meat and white meat.

- The meat of cow, goat, sheep and pigs has a lot of fat and is called red meat.
- White meat contains less fat and is obtained from chicken and fish.
- White meat is healthier and can be easily digested as compared to the red meat.
- Meat is rich in proteins, vitamins, zinc, phosphorus and iron.

Food from microbes

- The study of the microorganisms that inhabit, create, or contaminate food.
- Microbes such as bacteria, molds, and yeasts are employed for the foods production and food ingredients such as production of wine, beer, bakery, and dairy products.
- Microbes are responsible, on the one hand, for the spoilage of food and disease and, on the other hand, they are used for the production of valuable material.
- Microbial diversity is truly staggering, yet all these microbes can be grouped into five major types: Viruses, Bacteria, Archaea, Fungi, and Protists.
- The major groups of microorganisms—namely bacteria, archaea, fungi (yeasts and molds), algae, protozoa, and viruses.
- Spoilage microorganisms are those that can grow in a food and cause undesirable changes in flavor, consistency (body and texture), color, or appearance.
- Microorganisms can derive energy from carbohydrates, alcohols, and amino acids. Most microorganisms will metabolize simple sugars such as glucose. Others can metabolize more complex carbohydrates, such as starch or cellulose, or glycogen found in muscle foods. Some microorganisms can use fats as an energy source.
- Nature uses microorganisms to carry out fermentation processes, and for thousands of years mankind has used yeasts, moulds and bacteria to make food products such as bread, beer, wine, vinegar, yoghurt and cheese, as well as fermented fish, meat and vegetables.
- Microbes contribute to digestion, produce vitamin K, promote development of the immune system, and detoxify harmful chemicals.

2.Overview of current production systems

Food Production System

- Food Production Systems
- Crop Production
- Fisheries Production
- Livestock Production
- Food Security and Food Prices
- Food production, processing, and marketing systems in developing countries are complex.
- The food production systems are highly fragmented and dependent on a large number of small-scale producers.

- The current farm structure constrains farmer's capacity to meet domestic and international food safety standards.
- Although this may have socioeconomic benefits as large quantities of food pass through a multitude of food handlers and middlemen, the risk of exposing food to unhygienic environments, contamination, and adulteration increases.
- Literacy rate for most farmers and food handlers in developing countries is low; this limits the number of farmers capable of adopting more sophisticated modern agricultural practices, food hygiene, and good food handling practices necessary to meet more stringent food safety requirements.
- However, innovative interventions such as organizing farmers into producer groups, establishing collection centers, contract farming arrangements, and creating public–private partnerships to assist farmers can overcome the farm size constraints.
- Contract farming and farmer groups' arrangement has been a success in meeting stringent food safety and quality standards in Kenya's fresh fruit and vegetable and India's spices, gherkin, and fruit and vegetable export sectors.
- This arrangement can also assist farmers in obtaining the capital required to make on-farm improvements, improving farming skills through joint extension provision and assistance in acquiring the required certifications.
- During the Green Revolution, use of high-yielding seeds together with chemical intensive agriculture that uses massive quantities of fertilizer and pesticides created diverse effects on soil and environmental contamination.
- This trend had serious implication on the current international food production system, which emphasizes on minimum use of chemical fertilizers and pesticides, thus posing serious challenges to management of food safety by developing countries.
- In the past decades, the structure of food production systems has radically changed with many small scale producers venturing into production of export crops with some successes and failures.
- Major food safety problems occur as a result of poor post harvest handling and storage of food and also due to inadequate facilities and infrastructure such as the absence or shortage of safe water supply, electricity, storage facilities including cold stores, transport networks, etc.

Crop Production

- Many studies of cropping systems have estimated impacts of observed climate changes on crop yields over the past half century, although they typically do not attempt to compare observed yields to a counterfactual baseline, and thus are not formal detection and attribution studies.
- These studies employ both mechanistic and statistical approaches and estimate impacts by running the models with observed historical climate and then computing trends in modeled outcomes.
- Based on these studies, there is medium confidence that climate trends have negatively affected wheat and maize production for many regions.
- Because many of these regional studies are for major producers, and a global study estimated negative impacts on these crops, there is also medium confidence for negative impacts on global aggregate production of wheat and maize.
- Effects on rice and soybean yields have been small in major production regions and globally .
- There is also high confidence that warming has benefitted crop production in some high-latitude regions, such as northeast China or the UK. More difficult to quantify with models is the impact of very extreme events on cropping systems, as by

definition these occur very rarely and models cannot be adequately calibrated and tested.

- Despite the difficulty of modeling the impacts of these events, they clearly have sizable impacts that are apparent immediately or soon after the event, and therefore not easily confused with effects of more slowly moving factors.
- For a subset of these events, climate research has evaluated whether anthropogenic activity has increased or decreased their likelihood.

Fisheries Production

- The global average consumption of fish and other products from fisheries and aquaculture in 2010 was 18.6 kg per person per year, derived from a total production of 148.5 million tonnes, of which 86% was used for direct human consumption.
- The total production arose from contributions of 77.4 and 11.2 million tonnes respectively from marine and inland capture fisheries, and 18.1 and 41.7 million tonnes respectively from marine and freshwater aquaculture (FAO, 2012).
- Fisheries make particular contributions to food security and more than 90% of the people engaged in the sector are employed in small-scale fisheries, many of whom are found in the poorer countries of the world.
- The detection and attribution of impacts are as confounded in inland and marine fisheries asin terrestrial food production systems.
- Overfishing, habitat modification, pollution, and inter annual to decadal climate variability can all have impacts that are difficult to separate from those directly attributable to climate change.

Livestock Production

- In comparison to crop and fish production, considerably less work has been published on observed impacts for other food production systems, such as livestock or aquaculture, and to our knowledge nothing has been published for hunting or collection of wild foods other than for capture fisheries.
- The relative lack of evidence reflects a lack of study in this topic, but not necessarily a lack of real-world impacts of observed climate trends.

Food Security and Food Prices

- Food production is an important aspect of food security and the evidence that climate change has affected food production implies some effect on food security.
- Yet quantifying this effect is an extremely difficult task, requiring assumptions about the many non-climate factors that interact with climate to determine food security.
- There is thus limited direct evidence that unambiguously links climate change to impacts on food security.
- One important aspect of food security is the prices of internationally traded food commodities.

- These prices reflect the overall balance of supply and demand, and the accessibility of food for consumers integrated with regional to global markets. Although food prices gradually declined for most of the 20th century since AR4 there have been several periods of rapid increases in international food prices.
- A major factor in recent price changes has been increased crop demand, notably via increased use in biofuel production related both to energy policy mandates and oil price fluctuations.
- Domestic policy reactions can also amplify international price responses to weather events, as was the case with export bans announced by several countries since 2007 (FAO, 2008).
- In a study of global production responses to climate trends estimated a price increase of 19% due to the impacts of temperature and precipitation trends on supply, or an increase of 6% once the beneficial yield effects of increased CO2 over the study period were considered.
- Because the price models were developed for a period ending in 2003, these estimates do not account for the policy responses witnessed in recent years which have amplified the price responses to weather.

3.Functional and "Super" Foods :

Superfoods":

- Superfood is a marketing term used to describe foods rich in nutrients and other bioactive compounds.
- Foods can have high nutritional quality and may exert specific functional effects (e.g. lower blood cholesterol levels).
- Super foods are considered to be beneficial for health and well-being, whereas functional foods are fortified or enhanced foods that may provide a health benefit beyond the traditional nutrient they contain.
- Super food is a nonmedical, marketing term that refers to natural foods supposed to be useful for health because they are rich in a particular antioxidant or any other nutrient.
- They are edibles that deliver the maximum amount of nutrients with minimum calories .
- They help pets fight disease, maintain healthy skin and shiny coat, improve healthy digestion, maintain joints and strong bones, fight tartar and bad breath, whiten teeth, detoxify the body system, boost immune system, promote longevity, boost energy, and maintain good health in general .
- Unlike super foods, functional foods are natural or processed foods .
- They contain considerable levels of biologically active components that impart health benefits beyond the basic essential nutrients .
- They also provide clinically proven and documented health benefits for the prevention, management, or treatment of chronic diseases .
- The philosophy of food as medicine was supported by Hippocrates in approximately 400 B.C. .

- This thinking is the foundation of functional foods used to clarify the idea that food can be a powerful deterrent and cure of many diseases and ailments.
- Hippocrates believed that the things eaten can help the body fend off disease and food should be the first line of disease defense, used as a disease preventative mechanism.

- In the past, many of the perceptions about healthy eating have focused on avoiding certain components in foods, such as fat and sugar. Nutritional research has shifted from the prevention of nutritional deficiencies, such as vitamin C and scurvy or niacin and pellagra, to the prevention of chronic diseases.

- Examples of super food and functional foods are oats, garlic, green tea, red grape juice, red wine, tomatoes, soy products, flaxseed, broccoli, cocoa, blueberries, carrots, sweet potatoes, pumpkin, onions, kale, cherries, and apples .

- Oats contain beta-glucan, a soluble fiber, which aids to reduce the risk of cardiovascular disease by lowering blood cholesterol.

- Garlic is rich in allicin and lowers cholesterol levels and blood pressure . It also stimulates immune function and slows the growth of cancer cells.

- Green tea contains polyphenols and may help prevent cancer . Red grape juice and red wine contain resveratrol, which aids in prevention of heart disease and cancer.

Functional Foods

- Functional foods are ingredients that offer health benefits that extend beyond their nutritional value. Some types contain supplements or other additional ingredients designed to improve health.

- Some examples include foods fortified with vitamins, minerals, probiotics, or fiber. Nutrient-rich ingredients like fruits, vegetables, nuts, seeds, and grains are often considered functional foods as well .

- Oats, for instance, contain a type of fiber called beta glucan, which has been shown to reduce inflammation, enhance immune function, and improve heart health.

- Similarly, fruits and vegetables are packed with antioxidants, which are beneficial compounds that help protect against disease

Examples of functional foods

- Functional foods are generally separated into two categories: conventional and modified.
- Conventional foods are natural, whole-food ingredients that are rich in important nutrients like vitamins, minerals, antioxidants, and heart-healthy fats.
- Meanwhile, modified foods have been fortified with additional ingredients, such as vitamins, minerals, probiotics, or fiber, to increase a food's health benefits.

Here are some examples of conventional functional foods:

- **Fruits:** berries, kiwi, pears, peaches, apples, oranges, bananas
- **Vegetables:** broccoli, cauliflower, kale, spinach, zucchini
- **Nuts:** almonds, cashews, pistachios, macadamia nuts, Brazil nuts
- **Seeds:** chia seeds, flax seeds, hemp seeds, pumpkin seeds
- **Legumes:** black beans, chickpeas, navy beans, lentils
- **Whole grains:** oats, barley, buckwheat, brown rice, couscous
- **Seafood:** salmon, sardines, anchovies, mackerel, cod
- **Fermented foods:** tempeh, kombucha, kimchi, kefir, sauerkraut
- **Herbs and spices:** turmeric, cinnamon, ginger, cayenne pepper
- **Beverages:** coffee, green tea, black tea

Here are some examples of modified functional foods:

- fortified juices
- fortified dairy products, such as milk and yogurt
- fortified milk alternatives, such as almond, rice, coconut, and cashew milk
- fortified grains, such as bread and pasta
- fortified cereal and granola
- fortified eggs

- The health effects rendered by functional foods are typically due to the bioactive compounds they contain.
- Different compounds can exert specific effects in the body, but most often work together to alter one or more physiological process in the body.

- To achieve the health benefits of the diverse compounds that different foods contain, it is important to consume foods in their whole form when possible.
- For example, whole grains contain the bran, germ and endosperm of the grain.
- Whole grains contain dietary fiber, B vitamins including folate, niacin, thiamine and riboflavin, as well as trace minerals such as iron, magnesium, and zinc.
- These particular nutrients are found in the outer layer of the grain or the bran that functions as a protective shell for the germ and endosperm inside.
- The germ contains phytochemicals such as polyphenols and lignans, vitamin E, and B vitamins.
- The endosperm provides carbohydrates, protein and energy
- It is thought that whole grain foods may lower cancer, heart disease and diabetes risk by reducing chronic inflammation and oxidative stress, preventing insulin resistance, reducing cholesterol levels, and improving gastrointestinal health.
- That consumption of whole grains can enhance health and promote disease prevention by exerting effects beyond meeting basic nutrition needs and are therefore deemed to a functional food.

4.SUGAR, PROTEIN AND FAT SUBSTITUTES:

FAT SUBSTITUTES

- **Fat substitutes** are ingredients, which are either chemically synthesized or derived from fats and oils through enzymatic modification.
- They mimic the role of fat in food: for example, provide texture to ice-creams or add moistness to baked products.

Types and Safety Concerns of Fat Substitutes

- Since fat plays an important role in the taste of food, several ingredients are combined to replicate the taste of a full-fat snack or meal.
- It may include a blend of proteins, dextrins, maltodextrins, fiber, emulsifiers and flavoring agents.
- An ideal fat substitute **replicates all attributes of fat**, simultaneously **reducing the fat and calorie content** of the food.
- Most fat substitutes must not be used for frying since they bind excessive water and denature or caramelize at high temperatures. However, they can be used for baking and retorting.

Fat substitutes possess physical properties of fat but cannot completely replace fat
ased on nutrient source, fat substitutes are divided into three categories:

- **Carbohydrate-based substitutes** like cellulose, gums, modified food starches, maltodextrin, oats or wheat fiber, dried plum paste
- **Protein-based substitutes** like egg, milk, soy, gelatin

- **Fat-based substitutes** like caprenin, olestra, benefat
- **Carbohydrate-based fat substitutes** duplicate thickness of fat and retain moisture. They are used as thickeners and stabilizers in baked goods, sauces, spreads, frostings, pureed fruits and soups. They provide between zero and four calories per gram. Most carbohydrate-based substitutes are generally regarded as safe (GRAS).
- **Fat-based substitutes** provide fewer calories per gram than fat since the chemical structure of the fat has been altered. Caprenin, a substitute for cocoa butter in chocolate bars, provides 5 calories per gram.
- **Olestra,** an FDA approved fat replacer, is made of table sugar and fatty acids from vegetable oils and comes closest to providing a taste of fat. It is used in fried savory snacks. The body cannot absorb olestra since digestive enzymes cannot break down such a large molecule. However, it affects, the **absorption of fat-soluble vitamins and may cause cramps and loose motion.**
- Carbohydrate and protein-based fat substitutes have a **negligible impact on digestion, absorption, or metabolism of other nutrients**.
- **Fat substitutes can be a part of a healthy diet if eaten in small amounts.**

Health Benefits of Fat Substitutes

- Promotes Calorie Control
- Helps in Weight Loss
- Reduces Risk of Non-Communicable Diseases.
- Protein-based fat substitutes made from milk, legumes, soy or egg replicate the creamy texture of fat and are used for preparing low-fat dairy products, baked goods, mayonnaise and salad dressings.
- Since protein-based substitutes are derived from dairy and eggs, they do not possess any health concerns.
- They are also used in frozen and refrigerated products. They provide one to two calories per gram and cannot be used for baking.

SUGAR SUBSTITUTES

Some people use products called sugar substitutes, also known as artificial sweeteners. They taste sweet like sugar but have fewer calories. Some have no calories.

Uses for sugar substitutes

- Many sugar substitutes taste sweeter than sugar. So very little is needed to sweeten foods and drinks. Other sugar substitutes called sugar alcohols are not as sweet as sugar.
- Sugar substitutes are in many kinds of foods and drinks labeled sugar-free or diet. That includes soft drinks, candy and baked goods.
- Some sugar substitutes also are sold on their own in packets or other containers. These can be added to foods or drinks at home

Safety of sugar substitutes

- Government health agencies oversee ingredients that product-makers add to food. These agencies check ingredients, such as sugar substitutes, before foods or drinks that contain them can go on sale. In the United States, the Food and Drug Administration (FDA) allows the following sugar substitutes to be used:

- Acesulfame potassium (Sweet One, Sunett).
- Advantame.
- Aspartame (NutraSweet, Equal).
- Neotame (Newtame).
- Saccharin (Sweet'N Low).
- Sucralose (Splenda).
- Luo han guo (Monk Fruit in the Raw).
- Purified stevia leaf extracts (Truvia, PureVia, others).
- Other countries, such as those in the European Union, have more sugar substitute options than does the United States.

- The FDA allows product-makers to use sugar alcohols, such as sorbitol and xylitol, too. The agency doesn't consider sugar alcohols to be food additives.

- The FDA and food safety agencies in other countries also suggest how much of a sugar substitute you can safely have each day. This amount is called the acceptable daily intake (ADI). It varies by a person's weight and the type of sugar substitute used. Acceptable daily intakes aren't the same everywhere. They're different in the United States and Europe, for example.

- In general, artificial sweeteners are safe in limited amounts for healthy people, including pregnant people. But limit or cut out sugar substitutes:

- If you're living with a rare genetic disease called phenylketonuria. Foods and drinks with aspartame can lead to serious health problems.
- If you have a bowel disease. Using sugar substitutes might make your symptoms flare up.
- Dietary guidelines for Americans say adults shouldn't give sugar substitutes to children under 2 years old. In general, experts need to do more studies to learn what long-term health effects sugar substitutes might have on children. Most studies have looked at the effects in adults.

Health benefits linked to sugar substitutes

- If you replace added sugar with sugar substitutes, it could lower your risk of getting tooth decay and cavities.

- Sugar substitutes also don't raise the level of sugar in the blood.

- For adults and children with overweight or obesity, sugar substitutes also might help manage weight in the short term. That's because sugar substitutes often are low in calories or have no calories. But it's not clear whether sugar substitutes can help people manage their weight over the long term.

Over time, it's most important to eat a healthy diet and get exercise.

5.Food and behaviour

- Despite the complexity of personal factors that can affect food behaviour, past behaviour, habit and hedonic appreciation are usually better predictors of actual food choice behaviour than psychological constructs like attitudes and intentions .
- With regard to food safety influences, habit and past experience have also been suggested as possible reasons for unsafe food behaviour.
- According to Fischer and Frewer (2008), people with responsibility for food preparation tend to prepare food often over a period of many years .
- This pattern of repetitious behaviour fits Aarts and Dijksterhuis' (2000) main criterion for habit formation: "when a behaviour has been performed many times in the past, future behaviour becomes increasingly under control of an automatised process" .
- Although habitual cooks may exhibit bad habits regarding food-preparation practices, in general, a positive relationship between habit and safe cooking is anticipated, as frequent exposure to a hazardous situation should lead to effective and efficient action adjustments.
- A life course approach to food choice suggests that life time experience and the totality of the changing
- temporal, social and historical contexts of our lives shape the way that we eat (138). While an individual's food trajectory may be fairly stable, major life events can act as key turning points or cause more subtle transitions.
- For example, stressful events such as exams can either increase or decrease energy intake in the short term .
- Widowhood has been associated with weight loss, eating more meals alone, more ready-made meals per week, fewer snacks and homemade meals, and less enjoyment.
- Postpartum weight gain in mothers was reported in women who felt they had increased access to food or reduced opportunity to exercise as a result of the pregnancy .
- The influences on food behaviour are complex and multi-factorial.
- The effects of each of these influences differ from population subgroup to subgroup and from person to person.
- The data available at this point does not allow quantification of each influence and given the number of factors that could be measured, may never do so.
- Improving knowledge appears to be an important first step in changing food behaviour, but clearly not a stand-alone solution.
- From a life course perspective, early influences appear to set an individual on a food behaviour trajectory that may affect how they prepare and eat food over a lifetime.
- Therefore an emphasis on early childhood and the family is merited. From a communications perspective, the data on socio-demographic differences offers a starting point for segmentation and development of targeted messages.
- For health practitioners, an emphasis on psychological factors, building self-efficacy, resilience and coping skills may offer alternative ways to improving food behaviour.

- Much work remains in measuring the influence of the wider environment. In particular the influence of the current economic climate may be a key area of future research.

6.Physiological disturbances in alcoholism, drug abuse and smoking

- People with **alcoholism** — technically known as alcohol dependence — have lost reliable control of their alcohol use.
- It doesn't matter what kind of alcohol someone drinks or even how much: Alcohol-dependent people are often unable to stop drinking once they start.
- Alcohol dependence is characterized by tolerance (the need to drink more to achieve the same "high") and withdrawal symptoms if drinking is suddenly stopped.
- Withdrawal symptoms may include nausea, sweating, restlessness, irritability, tremors, hallucinations and convulsions.
- Although severe alcohol problems get the most public attention, even mild to moderate problems cause substantial damage to individuals, their families and the community.

Disorders affect using alcoholism:

- Short-term effects include memory loss, hangovers, and blackouts.
- Long-term problems associated with heavy drinking include stomach ailments, heart problems, cancer, brain damage, serious memory loss and liver cirrhosis.
- Heavy drinkers also markedly increase their chances of dying from automobile accidents, homicide, and suicide.
- Although men are much more likely than women to develop alcoholism, women's health suffers more, even at lower levels of consumption.

Physiological disturbances in drug abuse

Ethnicity and Culture
Sexual Orientation
Socioeconomic Status and Homelessness
Developmental Issues and Aging
Co-Occurring Disorders: A Bidirectional Influence
Gender Differences in Metabolism and Effects
Liver and Other Organ Damage
Cardiac-Related Conditions
Reproductive Consequences

7.Food Related Laws

- Generally, Food Law may be divided in two parts: (1) a basic food act, and (2) regulations.
- The Act itself sets out broad principles, while regulations contain detailed provisions governing the different categories of products coming under the jurisdiction of each set of regulations.

- Sometimes food standards, hygienic provisions, lists of food additives, chemical tolerances, and so on are included in basic food control law.
- For effective administration of and enlightened compliance with the basic food law, detailed provisions are needed.
- In governments where there is a division between the responsibilities of the legislative and executive branches, the legislative branch enacts the basic law, while detailed regulations are elaborated and promulgated by the executive agency or agencies responsible for administering the law.
- Inclusion in the law of detailed specifications about food processing, food standards, hygienic practices, packaging and labeling, food additives, and pesticides may make for difficulties.
- Prompt revisions of regulations may become necessary because of new scientific knowledge, changes in food processing technology, or emergencies requiring quick action to protect public health.
- Such revisions can be made much more expeditiously by executive agencies than by legislative bodies.

Concerning the principles or general provisions to be included in basic food law, the following points should be stressed:

• Basic purposes and scope of the law

• Definitions of basic concepts

• Competence for implementation of the law

• Inspection and analytical procedures and facilities

• Enforcement, procedures for enforcement, penalties

• Regulations for additives, pesticides, contaminants

• Packaging and labeling

• Procedures for the preparation and amendment of the regulations for implementation of the law .

- The basic food law is intended to assure consumers that foods are pure and wholesome, safe to eat, and produced under sanitary conditions.
- Generally, food law prohibits importation and distribution of food products that are adulterated, or have labels that are false or misleading in any context.

Food Related- Inspection

- Food inspection is the process of examining and evaluating food products to ensure that they meet certain standards and requirements for quality and safety.
- The inspection can take place at various stages of the food production chain, from the initial raw material to the final product that reaches consumers.

Food inspection can cover a wide range of foods, including:

- Raw and cooked meat, poultry, and seafood
- Dairy products such as milk, cheese, and yogurt
- Eggs and egg products
- Fresh fruits and vegetables
- Processed foods such as canned goods and packaged snacks
- Bakery and pastry items
- Frozen foods
- Beverages including bottled water, soft drinks, and alcoholic beverage

Hygiene Inspections

- Cleanliness and hygiene of establishment, personal hygiene of staff.
- Ensures that food is prepared and served in a clean and sanitary environment. Helps prevent the spread of foodborne illnesses.
- Encourages staff to maintain high levels of personal hygiene.

Food Safety Inspections

- Safe storage, preparation, and cooking of food, prevention of contamination
- Identifies potential hazards and risks associated with food handling, storage, and preparation. Helps prevent foodborne illnesses and outbreaks. Helps ensure that food is safe to eat.

Structural Inspections

- Physical structure of establishment, including ventilation, lighting, and plumbing
- Helps ensure that the establishment is safe and functional for food preparation and service. Helps prevent contamination and the spread of foodborne illnesses.

Labelling Inspections

- Accuracy and compliance of food packaging and labelling with regulatory requirements
- Helps ensure that consumers are informed about the food they are buying and eating, including ingredients and potential allergens. Helps prevent allergic reactions and other adverse reactions to food.

Microbial Indicators of product quality

- Microbial contamination in food is determined by detecting indicator organisms.
- Detection of the coliform group, Escherichia coli, members of Enterobacteriaceae, and two members of Enterococcus (E. faecalis and E. faecium) in food and water are important signs of faecal contamination.
- Microbiological standards seem to be based on two principles: a primary prophylactic or protective rale to establish the probability that a given food is in safe and wholesome condition at the time of examination; and a secondary purpose, to exert indirect pressures on manufacturers of foods to compel them to adopt.
- Microbiology is important to food safety, production, processing, preservation, and storage. Microbes such as bacteria, molds, and yeasts are employed for the foods production and food ingredients such as production of wine, beer, bakery, and dairy products.
- Quality control allows microbiologists to monitor and protect against microbial impurities in biomanufacturing production systems. Protocols must be adhered to in order to control the environmental factors in production and maintain a sterile environment throughout the process.
- thousands of years, humans have used various physical methods of microbial control for food preservation. Common control methods include the application of high temperatures, radiation, filtration, and desiccation (drying).

8.Indicator of food safety

- The percent of households with access to basic sanitation service, or households with soap and water at a handwashing station on premises.
- Food safety indicators are used in multiple ways throughout the food supply chain.
- For example, food buyers use them to evaluate the quality, efficiency, or cost of their suppliers and to assess whether the food they are purchasing is safe.
- Governments use them to assess hygiene levels in food businesses throughout the supply chain to protect the health of consumers.
- In any context, however, developing a framework that clearly defines the food safety objectives is an important step in developing effective indicators to measure performance along the supply chain.
- To be either quantitative or qualitative. • To be unambiguous, easy to interpret, monitor and transparent. • Closely linked to the outcome. • Amenable to independent validation and verification. • Within the limits of existing resources.

PUBLIC HEALTH: INDICATORS OF FOODBORNE DISEASE BURDEN

- Reducing the occurrence of foodborne disease (FBD) is the primary goal of food safety systems, and metrics are useful to measure the adverse health outcomes for consumers that are associated with foodborne hazards.
- These indicators, and the associated data, are mainly derived from disease surveillance programs at different geographical scales.
- Outbreak and emergency response. Indicators are available that measure the ability and timeliness of outbreak response.
- While they are not an indicator of health burden per se, rapid investigation and response to outbreaks is directly linked to the ability to reduce the public health burden.
- Outbreak detection and its reporting to national authorities depends on the action of several actors, in particular consumers, healthcare providers, and state or local public health agencies.
- Setting measurable health targets. Indicators are used to assess the performance of food safety and public health systems, not only in absolute term, but also against measurable objectives developed using the same metrics.
- Exposure indicators. In addition to measuring disease outcomes, measures exist to assess the degree of exposure to some hazards, such as chemical hazards.
- Indicators Related to Knowledge, Attitude and Practices (KAP) of Consumers and Retail Food Service Workers

This meta-analysis reviewed 20 studies to assess consumers' knowledge and practices on a variety of food safety handling practice indicators related to:

• Consumption of raw or undercooked beef, eggs, shellfish and raw milk;

• Hygiene; • cross-contamination;

• Proper defrosting;

• Safe food holding; proper cold storage;

• Avoiding unsafe food sources; and

• Proper cooking and heating

Indicators Used by Civil Society Organizations

Percent of solved outbreaks, those with both an identified food and identified pathogen

• Reported outbreaks per hundred thousand population (with the caveat that the more outbreaks reported likely indicate that the public health system is working)

• Size of reported outbreaks (smaller outbreak size indicates that the contaminated food was identified and removed from the market more quickly)

• Pathogens associated with foodborne illnesses and outbreaks

• Location of consumption of food implicated in outbreak

• Use of a standardized outbreak investigation protocol

• Consumer access to foodborne illness reporting systems.

Food Hazard Standards and Indicators

Hazard indicators in the supply chain.

From the technical point of view, hazard metrics and indicators can encompass a range of scales and refer not only to the finished product but also to the performance of different stages of the supply chain.

Indicators of Food Industry Performance

The food industry, besides adhering to national or international standards, also uses voluntary performance indicators to track performance and internally evaluate their food safety systems, as well as to demonstrate compliance to standards established by their buyers.

Individual companies or commodity organizations may adopt standards specific to their context.

9. 229 Microbiological safety of foods

- Microbiology is important to food safety, production, processing, preservation, and storage.

- Microbes such as bacteria, molds, and yeasts are employed for the foods production and food ingredients such as production of wine, beer, bakery, and dairy products.

Testing for Bacterial Contamination of Food

- Bacteria are incredibly diverse and abundantly found in most of the natural world.
- The majority are beneficial to us in ways we may not fully realize or appreciate.
- A few, however, are not and will cause disease when we cross paths with them.
- Pathogenic (harm-causing) and potentially pathogenic bacteria may be found in unexpected places, such as in the food we eat, the water we drink or use for recreation, in soil, on surfaces in your home, and elsewhere.
- Unfortunately for us, the things we eat and drink are fairly common vehicles for disease transmission.
- And, because food and drink pass through our digestive tract, the most common symptoms of a foodborne disease are abdominal discomfort or pain, nausea, diarrhea, and/or vomiting. Gastrointestinal illnesses caused by foodborne microbes range in severity from mild to extremely debilitating, even fatal.
- The biological agents responsible for this type of disease may be viruses, bacteria, fungi, protozoa, or helminthes.
- To protect the public from disease, manufacturers and distributors of food consumed in the United States must prove that their food is pathogen-free before it can be offered for sale.
- Regulatory agencies at the local, state and federal levels (such as the Department of Agriculture and the Food and Drug Administration) require routine bacteriological testing to protect the public from acquiring a foodborne illness.
- Although many types of microbes may cause foodborne disease, the CDC and FDA currently considers the bacteria *Bacillus cereus*, *Campylobacter jejuni*, *Clostridium* spp., pathogenicstrainsof *Escherichiacoli*, *Listeria monocytogenes*, *Salmonella* spp., *Shi*

gella spp., *Staphylococcusaureus, Vibrio* spp.,and *Yersinia* spp.;theparasites *Crypt osporidium* and *Cyclospora;* and the Norwalk virus (norovirus) to be the most common and of the greatest concern in the United States.

- Although there are "rapid" methods available to detect bacterial contaminants in food that rely on DNA and antibody testing, plating samples on differential and selective culture media is a tried and true method.
- The disadvantage is that culture methods take more time, but the advantages include the simplicity of the tests and a higher level of both specificity and sensitivity.
- The relatively low number of bacteria present in a food sample limits the sensitivity of all of the various types of tests available to evaluate food safety, including those based on culture.
- A preliminary step called enrichment culture may be used to amplify the number of bacterial pathogens, by pre-incubating the food sample in a non-selective medium that promotes growth of any bacteria that might be in the sample.
- Many standard methods include a two-stage enrichment culture. The first step, or pre-enrichment, involves adding a specific amount (determined by weight, typically 10–25 grams) of the food to be tested in a large (100–250ml) volume of a non-selective broth medium.
- After an incubation period of 18–24 hours at 37°C, a small sample of the enrichment culture is transferred to one or more types of selective media designed to inhibit growth of competing microbes while allowing the target pathogen to multiply.
- Many such formulations are also differential, in that growth of the bacterial target will cause a characteristic chemical change in the appearance of the medium, thus "differentiating" the pathogen from other possible contaminants, such as spoilage organisms, that might also be in the food.
- We will be conducting our own investigation of food safety using a modified and scaled down adaptation of the standard laboratory methods, beginning with a pre-enrichment culture of food samples, followed by plated on several types of selective and differential media.
- Our determination of food contamination will be based on (a) growth of bacteria on the selective media and (b) observation of a specific biochemical reaction (usually a color change) characteristic for a particular type of pathogen. Note that these methods are based on bacterial phenotypes (traits), and more than one species of bacteria may have the same selective/differential traits. Therefore, definitive identification of a bacterium isolated from food requires additional testing.
- Numerous media formulations are available that permit the isolation and identification of pathogenic bacteria in food. Using the media described in Table 1, we will be testing food for contamination with EHEC (enterohemorrhagic *E. coli*) and other strains of *E. coli*, *S. aureus*, *B. cereus*, *Salmonella*, and *Shigella.*

10.CONTROL STRATEGIES IN FOOD SAFETY

Good agricultural practices (GAP), Good manufacturing practices (GMP), and Good hygienic practices (GHP).Food handlers can avoid contaminating food by: Washing and drying hands thoroughly. Stop hair, clothes, jewellery or phone touching food or surfaces (i.e. tie hair back, remove loose jewellery, cover open sores). Not touching ready-to-eat food with bare hands – use tongs and gloves. Identifying and managing all stages or activities within a food operation process that could have an effect on food safety.

1. Use Good Agricultural Practices

- Use approved pesticides and herbicides
- Practice proper irrigation and crop management
- Maintain clean and sanitary facilities

2. Develop and Implement Food Safety Plans

- Identify risks/hazards
- Set up a defence against bacteria before anything occurs

3. Maintain Good Hygiene Practices, Including Plant Sanitation

- According to HACCP principles, Sanitation is the fifth most important factor in ensuring food safety
- Establish and follow strict cleaning procedures
- Maintain cleanliness in all areas of the food establishment
- Properly sanitise all utensils, equipment, and food contact surfaces

4. Follow Proper Cooking Methods

- Cook food correctly
- Know how to cook different food types
- Use appropriately calibrated thermometers to ensure food has reached the correct temperature.

11.Microbiological criteria

Microbiological criteria give guidance on the acceptability of foodstuffs and their manufacturing processes. A microbiological criterion for food defines the acceptability of a product or a food lot, based on the absence or presence, or number of microorganisms including parasites, and/or quantity of their toxins/metabolites, per unit(s) of mass, volume, area or lot.

A microbiological criterion consists of:

- A statement of the microorganisms of concern and/or their toxins/metabolites and the reason for that concern ;
- The analytical methods for their detection and/or quantification ;
- A plan defining the number of field samples to be taken and the size of the analytical unit ;
- Microbiological limits considered appropriate to the food at the specified point(s) of the food chain ;
- The number of analytical units that should conform to these limits.

A microbiological criterion should also state:

- The food to which the criterion applies;
- The point(s) in the food chain where the criterion applies; and
- Any actions to be taken when the criterion is not met.

When applying a microbiological criterion for assessing products, it is essential, in order to make the best use of money and manpower, that only appropriate tests be applied to those foods and at those points in the food chain that offer maximum benefit in providing the consumer with a food that is safe and suitable for consumption

PURPOSES AND APPLICATION OF MICROBIOLOGICAL CRITERIA FOR FOODS

1 Application by regulatory authorities
Microbiological criteria can be used to define and check compliance with the microbiological requirements.

2.Application by a food business operator
Microbiological criteria may be applied by food business operators to formulate design requirements and to examine end-products as one of the measures to verify and/or validate the efficacy of the HACCP plan.

MICROBIOLOGICAL ASPECTS OF CRITERIA

Microorganisms, parasites and their toxins/metabolites of importance in a particular food

For the purpose of this document these include:

- bacteria, viruses, yeasts, moulds, and algae;
- parasitic protozoa and helminths;
- their toxins/metabolites.

Microbiological methods

Methods used to determine the suitability for consumption of highly perishable foods, or foods with a short shelf-life, should be chosen wherever possible so that the results of microbiological examinations are available before the foods are consumed or exceed their shelf-life.

The microbiological methods specified should be reasonable with regard to complexity, availability of media, equipment etc., ease of interpretation, time required and costs.

Microbiological limits

Limits used in criteria should be based on microbiological data appropriate to the food and should be applicable to a variety of similar products. They should therefore be based on data gathered at various production establishments operating under Good Hygienic Practices and applying the HACCP system.

12.Hazard Analysis Critical Point System (HACCP concept)

- HACCP is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product.
- It is a system which provides the framework for monitoring the total food system, from harvesting to consumption, to reduce the risk of foodborne illness.
- Critical control points are located at any step where hazards can be either prevented, eliminated, or reduced to acceptable levels.
- HACCP is a food safety system designed to identify and control hazards * that may occur in the food production process.
- The HACCP approach focuses on preventing potential problems that are critical to food safety known as 'critical control points' (CCP) through monitoring and controlling each step of the process.
- Hazard analysis is the most important principle used in the HACCP plan.
- This critical practice identifies the biological, chemical, or physical hazards that could occur at each step in your manufacturing process.

UNIT-II NUTRIENTS AND FOOD ADDITIVES

1.Macro nutrients- carbohydrates, proteins and lipids

Carbohydrates

- Carbohydrates – or carbs – are the body's primary fuel. They provide energy for your muscles and the central nervous system during movement and exercise.
- Wohlford says 45-65% of calories per day should come from carbohydrates. The amount depends on an individual's health goals and medical conditions.

Protein

- Protein is essential to many processes in the body. It provides structure to the tissue. That includes cell membranes, organs, muscle, hair, skin, nails, bones, tendons, ligaments and blood plasma.
- Proteins are involved in metabolic, hormonal and enzyme systems and help maintain acid-base balance in our bodies.
- The Recommended Dietary Allowance is 0.8 grams of protein per kilogram of body weight per day. For a person who weighs 150 pounds, that adds up to around 54 grams of protein per day.
- Individual needs will vary depending on age, activity level, medical conditions and health goals.

Fat

- Fat is vital for the body as an energy reserve, for insulation and protection of your organs, and for absorption and transport of fat-soluble vitamins.
- About 20-35% of your total daily calories should come from fat, with less than 10% of total daily calories from saturated fat.

Micronutrients: Types, Functions, Benefits

- The term micronutrients refers to vitamins and minerals, which can be divided into macrominerals, trace minerals and water- and fat-soluble vitamins.
- An adequate amount of micronutrients often means aiming for a balanced diet. Micronutrients are one of the major groups of nutrients your body needs.
- They include vitamins and minerals.

- Vitamins are necessary for energy production, immune function, blood clotting and other functions. Meanwhile, minerals play an important role in growth, bone health, fluid balance and several other processes.
- This article provides a detailed overview of micronutrients, their functions and implications of excess consumption or deficiency.
- The term micronutrients is used to describe vitamins and minerals in general.
- Macronutrients, on the other hand, include proteins, fats and carbohydrates.
- Your body needs smaller amounts of micronutrients relative to macronutrients. That's why they're labeled "micro."

- Humans must obtain micronutrients from food since your body cannot produce vitamins and minerals — for the most part. That's why they're also referred to as essential nutrients.
- Vitamins are organic compounds made by plants and animals which can be broken down by heat, acid or air. On the other hand, minerals are inorganic, exist in soil or water and cannot be broken down.
- When you eat, you consume the vitamins that plants and animals created or the minerals they absorbed.
- The micronutrient content of each food is different, so it's best to eat a variety of foods to get enough vitamins and minerals.
- An adequate intake of all micronutrients is necessary for optimal health, as each vitamin and mineral has a specific role in your body.
- Vitamins and minerals are vital for growth, immune function, brain development and many other important functions .

2.Nutritional Physiology:

Digestion

- Digestion is the mechanical and chemical breakdown of food substances into smaller components that are more easily absorbed into blood stream.
- Digestion is a form of catabolism that includes breakdown of large food molecules to smaller ones.
- Effective digestion involves both of these processes, and defects in either mechanical digestion or chemical digestion can lead to nutritional deficiencies and gastrointestinal pathologies.
- Digestion: Mechanical process: Breaking up food into smaller pieces. Chemical process: Breaking down food into molecules small enough to be absorbed into cells.

Absorption:

- Nutrient absorption - This comes after the breakdown of carbohydrates, proteins, fats, vitamins, and minerals, which are essential for energy production, growth, and cellular maintenance.
- Egestion of waste and toxins - The process eliminates indigestible components and harmful substances from the body.
- The process of gas or liquid which penetrate into the body of adsorbent is commonly known as absorption.
- The process of taking nutrients from the digestive system into the blood so they can be used in the body.
- The transport or delivery of digested nutrients to body tissues.
- There are three mechanisms that move nutrients from the lumen, or interior of the intestine, across the cell membrane and into the absorptive cell itself. They are passive, facilitated, and active absorption.

Nutritional Physiology : Utilization of major and minor nutrients:

- Macronutrients, which are required by the body in large amounts.
- Micronutrients, which are required by the body in small amounts.

In general, there are two types of nutrients:

- Macronutrients
- Micronutrients
- Above nutrients could be obtained from the environment.
- Macronutrients provide energy to a living being for the function of the metabolic system. They provide massive energy has it is converted used to obtain energy.
- Macronutrients include fats, proteins, and carbohydrates.
- Micronutrient provides essential components for metabolism to be carried out. They also build and repair damaged tissues in order to control the body process.
- Micronutrients include calcium, iron, vitamins, iron, minerals and vitamin C.

3.Biotechnology of food additives-

- Food additives are substances primarily added to processed foods, or other foods produced on an industrial scale, for technical purposes.
- e.g. To improve safety, increase the amount of time a food can be stored, or modify sensory properties of food.some commonly used food additives and colorants have been derived from microbial fermentation such as Arpink red™ from *Penicillium oxalicum*, riboflavin from *Ashbya gossypii*, and microalgal astaxanthin from *Haematococcus pluvialis*.
- Bioflavors and colors
- Food colours, flavours and additives are substances that are used to enhance the appearance, taste, texture, and overall eating experience of food.
- They are commonly used in the food industry to improve shelf life, add colour and flavour, and increase safety.
- The book of Food Colours, Flavours and Additives Technology Handbook is particularly important in the technological world, as they can be used to create new products or improve existing ones.
- Food colours, flavours and additives can come from a variety of sources including plants, animals, and even synthetics.

Microbial polysaccharides

- Microbial polysaccharides are high molecular weight carbohydrates produced by microorganisms such as bacteria, fungi, yeast, and algae.
- These polysaccharides include carbohydrates that are produced and accumulated inside the cells such as glycogen where they function as energy and carbon reserves.

- IT produced by a wide variety of microorganisms are generally water-soluble gums and possess novel and unique properties.
- Due to their low cost, these biopolymers have emerged as new and industrially important polymeric substances competing with natural gums obtained from marine algae and higher plants.
- Due to diversity in structure and physicochemical characteristics, microbial polysaccharides have found a wide range of applications as emulsifiers, stabilizers, binders, gelling agents, coagulants, and suspending agents in food industry.
- The unique rheological properties of these biopolymers are attributable to their high purity and regular structure which make them best suited for the food industry. Polysaccharides of microbial origin are nontoxic, biodegradable, environment friendly, and remain active at extreme temperature, pH, and salinity.
- Due to superior properties, these are good alternatives to and may replace synthetic and other natural water-soluble gums and may prove as novel polymers in the food industry as thickening, suspending, and gelling agents.
- Employing genetically modified microorganisms under controlled fermentation conditions may result in the production of new exopolysaccharides having novel superior properties, which may open up new areas of industrial applications.

4.Recombinant Enzymes In Food Sector

- Recombinant enzymes are increasingly used in the food industry, not only in traditional sectors such as dairy, bakery, brewing, and wine making, but also in new areas such as emulsifier and sweetener production.
- Recombinant enzymes represent a useful test system for studies requiring high levels of catabolic activity and the simplest system available to study interactions between a drug candidate and individual enzymes.
- Recombinant enzymes are used to improve an enzyme's characteristics, such as its activity, temperature optimum, and pH stability.

UNIT-III NANO FOOD TECHNOLOGY

1.Nano materials as food components

Interestingly, all foods which are plant or animal-based can include nanomaterials, including for example, DNA, which has a 2.5 nm width. In addition, milk encompasses nano-sized components including whey protein and lactose. Nowadays, nanotechnology is mainly used for packaging and nano sensing in the food sector.

Food Packaging and Nano Materials

- A nanomaterial is an engineered or manufactured material containing particles in the nanoscale range (1-1000 nm) in one or more external dimension, or in an internal or surface structure, or a material whose nanoscale particles have different properties or functions than macro-scale particles of the same material.
- This definition also applies to incidental nanoparticles, and those not intentionally engineered, but that are manufactured by-products and incorporated in company products.
- It is important to produce to packaging materials which possess resistance to steam and atmospheric gases. Moreover, mechanical and thermal stability are further additional desired properties for food packaging.
- Up to now, non-biodegradable petroleum-based plastic packaging materials have been used in food industry. Nowadays, with respect to the green approach, researchers have investigated nanomaterials in relation to food packaging. In Figure 1, the most used nanomaterials in food packaging are shown.

- In food packaging, silicon dioxide and titanium dioxide are the most commonly used nanoparticles.

- Silicon dioxide is used as a food colorant, anticaking agent, and drying agent for food preservation and packaging.

Metallic Nanomaterials

- Metal and metal oxide nanomaterials can be used in food packaging to enable antibacterial and antifungal properties of the packaging material.
- Ag, Cu metals, zinc, copper, iron, and titanium oxides have typically been the main nanoparticles used for this purpose.
- Ameen synthesized bi-metallic (copper and silver) nanoparticles to yield a maximum yield and achieved the inhibition of three human pathogens with this packaging material.

- Revealed that specifying the size of TiO_2 nanoparticles can prevent its harmful damage on human cells. They proposed a 110–300 nm scale as suitable range.

Carbon Nanomaterials

- Carbon nanomaterials provide a long shelf life, and exhibits no contamination effects on food.
- Carbon-based nanomaterials are synthesized mainly through the green routes.
- They provide antibacterial protection to the food, which is thereby being preserved as a result. In food packaging, carbon dots, graphene, and carbon nanotubes can be used.
- synthesized polylactic acid-graphene food packaging material to provide a mechanically stable, biodegradable, resistance against both oxygen and steam.
- This material was found to increase the shelf life of potato chips.

Organic Nanomaterials

- Natural and edible biopolymers (including starch, chitosan, gelatin, and agar) are used to protect food.
- Chitosan is known to be non-toxic in nature and mechanically stable. However, it has low moisture resistance.
- Therefore, researchers have since improved this property by reinforcing it with nanomaterials, termed as chitosan-based nanocomposite films.

Silicon Nanomaterials

- It has been reported that silica aerogel incorporation to the food packaging polyvinyl alcohol film exhibits an increased thermal stability and steam resistance for chocolate packaging.
- However, it has since been revealed that silica nanoparticles can be harmful to human cells.

2.POLICIES ON USAGE OF NANO MATERIALS IN FOODS

- If the Company uses any substance with nanomaterials with particle size below 500 nm in its food or beverage products or packaging, it shall provide a statement on the label specifying which nanomaterials are incorporated in the substance.
- A nanomaterial is an engineered or manufactured material containing particles in the nanoscale range (1-1000 nm) in one or more external dimension, or in an internal or surface structure, or a material whose nanoscale particles have different properties or functions than macro-scale particles of the same material.
- This definition also applies to incidental nanoparticles, and those not intentionally engineered, but that are manufactured by-products and incorporated in company products.
- Naturally-occurring organic nanoscale particles (e.g. milk proteins, essential minerals) are not considered engineered or manufactured materials for this purpose.
- The term “naturally occurring” excludes engineering or manufacturing processes that reduce the size of materials, as well as naturally-occurring inorganic nanomaterials, such as asbestos.
- Aggregates and agglomerates of nanoparticles are considered to be nanostructured substances.

Policy for Nanomaterials in Food and Food Packaging

- Nanotoxicology studies indicate a range of harms can be caused by ingestion, inhalation, and/or dermal exposure to a variety of nanomaterials.
- We are concerned that food companies may use, or inadvertently, as a result of supply chain management failures, incorporate nanomaterials in their food products, food ingredients, food contact surfaces, feed or food packaging before such materials have been proven safe for manufacture, consumption, and release into natural ecosystems on a life-cycle basis.

- To minimize the risks to consumers, employees, researchers, companies, and natural ecosystems, we have developed the following policy recommendations for the food industry that we believe can and should be followed with regard to the use of nanomaterials.

Recommended Action:

- Company adopts a public policy, readily viewable on its website, clearly explaining the Company's practices regarding use of nanomaterials in its food and beverage products and packaging, whether those use are in the research and development phase or in a commercialized product.
- The policy will include a description of the external and internal dimensions, the shape, and distribution of any nanomaterials used or allowed for use.
- The policy will include the company's understanding of the technical effects to be achieved by incorporation of nanomaterials and/or application of nanotechnologies in its products.
- The policy will include in an appendix a bibliography of peer reviewed studies used by company scientists and risk managers to determine environmental health, public health, and worker safety risks of the nanomaterials incorporated into their products.
- Company issues supplier standards clearly setting forth either a prohibition on the use of nanomaterials in food substances and food and beverage packaging, or adoption of and documentation of the company policy outlined in point one.
- If the Company uses any substance with nanomaterials with particle size below 500 nm in its food or beverage products or packaging, it shall provide a statement on the label specifying which nanomaterials are incorporated in the substance.
- Such statement should be near the mandatory nutrition labeling and readily viewable by consumers.
- Company shall also provide on its website any references to scientific studies that demonstrate the nanomaterials' safety at the particle size used.
- Company adopts and publishes a "hierarchy of hazard controls" approach to prevent exposure of its employees to nanomaterials via inhalation and dermal exposure during the manufacturing process.

3.Food product development

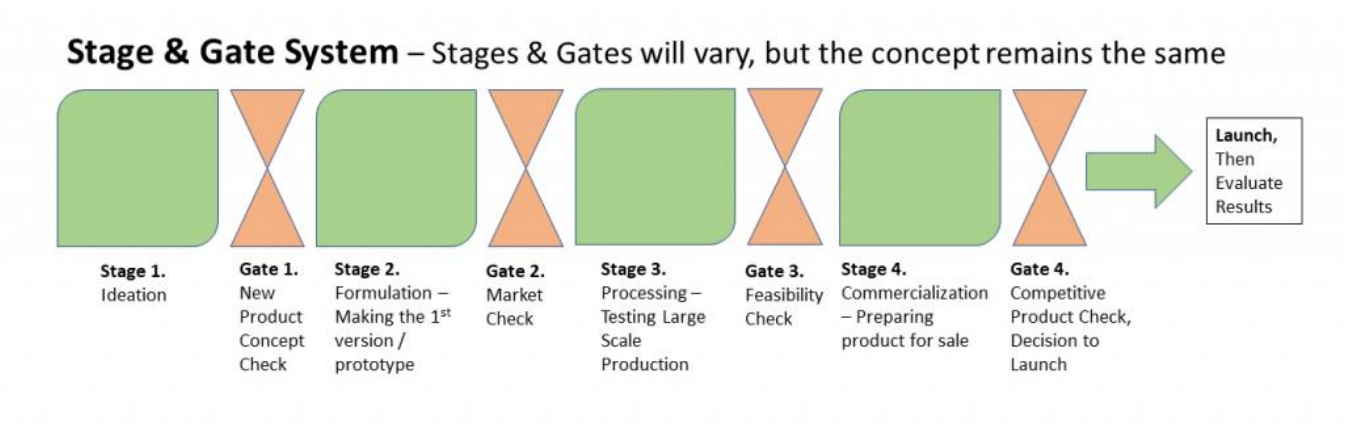
- The process of creating, processing, and commercializing a new food product
- The process generally takes a group of people from different disciplines working together to develop (or improve) a product.

Steps involved in Food Product Development

- Ideation
- Formulation
- Processing
- Commercialization

- At each stage, or even within the stages, there are checkpoints to decide to continue or stop the project.
- This can be done through a Stage and Gate System like the example shown here or it can be done in a modified system.

- The principle is the same, though, to develop new products strategically and use time and resources wisely.



- Typically, this Stage and Gate process works like a funnel. You may start with 12 to 15 ideas and then research and evaluate those ideas. Some ideas will get discarded because you will find the product concept already exists.
- Others will get discarded because the ingredients or processing will cost more than what consumers are willing to pay (based on products in the relevant category).
- Some ideas will seem great, but will be too niche and will not have a large enough target audience to be successful. Once the ideas have been narrowed down, the best 3 to 5 ideas may be moved to the Formulation stage.
- In this stage, the product will be made on a small scale and consumer testing will be done to confirm interest.
- Then products will go through the second gate to determine which products have enough consumer interest to continue.
- During the Processing stage, 2 to 3 products are scaled up on larger equipment. This helps determine production costs and efficiency. Food safety and quality testing also are done to determine how to produce a safe and consistent product.
- Shelf-life testing is conducted at the end of the Processing stage to make sure the product will remain at an acceptable and safe quality long enough for the product to made, shipped, purchased, and consumed.
- The third gate evaluates production, food safety, quality, and shelf life to decide which products can actually be made efficiently and consistently.
- The Commercialization stage includes work to get the product ready to sell on the grocery store shelves. Typically this includes the final costing, additional consumer sensory testing, and package design.
- The final gate makes sure that no errors or significant drawbacks have been missed before the product is launched.
- Through the Stage and Gate process, 12 to 15 ideas may get narrowed down to 1 or 2 products.
- The Stage and Gate process allows many ideas to be considered efficiently. The more viable the idea, the more time and work is needed.
- When an obstacle is found at a gate, no more time or resources are committed to that idea.
- Each company may work through the stages of product development a bit differently depending on resources, timelines, and product types being developed.
- In a product development course, a product is likely developed from start to finish, so more market, consumer, and product research will need to be done during the ideation stage to catch significant drawbacks.

Ideation

- Often the most difficult part of product development is coming up with the initial idea.
- Many food products exist in the marketplace, so coming up with a new food product that does not exist and consumers are interested in buying can be a challenge. It is best to simply jump in and start generating ideas.
- From there, concepts can be refined and narrowed down. Ideas can come from a variety of sources.
- Some ideas are for a brand-new product and some are for a line extension of an existing product.
- Once ideas have been generated, it is important to identify the target customer.
- Trends are followed closely to determine what is new and upcoming. Trends often spark ideas for new products.
- Trends change over time, so it is difficult to list current examples, but convenience products, comfort foods, and plant-based foods have been trending over the last few years.
- Some issues with ideation include regional vs. global preferences and market size vs. target market.
- Flavors that are commonly known and liked in the Midwest may not sell well in other parts of the country.
- Consumers outside of the Midwest may not like those flavors or may simply be unfamiliar with the flavors.
- If your target market is a small part of a product category and the product category itself is small, there may not be a large enough market share for your product.
- It also can be a challenge to realize that just because you like something, many others may not.
- We tend to develop products we like, but sometimes you may have to develop a product for a target audience that does not include you.

Formulation

- Making the new product!
- Procure ingredients and make them into a product on a small laboratory scale
- Produce a “gold standard” of the new product
- Possible issues
- Sourcing ingredients and ingredient costs
- Product shelf life (often not tested in formulation, but needs to be considered early in the process)
- Can the product really be made on a large scale?
- Avoid Patent and Copyright infringement

Processing

- The formulated product process is “scaled up” to produce greater volumes
- Often the process is “scaled up” more than once.
- Pilot plant testing
- Plant testing
- There are always product changes with scale-up.
- Quality & Proximate Analysis testing done to set specifications, determine food safety concerns, and estimate shelf life
- Processing experiments and runs allow a more accurate product cost to be determined (include processing efficiency, rework used, etc.).

Commercialization

- Once the new product has been made successfully, it is sent to commercialization to launch the new product into the store for sale.
- Steps include:
- determining packaging
- creating a label (logo, nutrition facts, etc.)
- finalizing costs
- developing advertising and/or literature for the product

After the launch of a new product:

- Determine if the new product was successful.
- Success can be measured by:
- Growing interest, increase in sales
- Market share
- Company sales revenue

Food product development: shelf-life assessment.

- For how long does this product remain within the designated quality parameters during normal production and storage conditions.
- The most direct way to estimate the shelf life of a product is to conduct simulation or real-time stability test that corresponds to the time of decay of a food under optimum storage conditions.
- Shelf-life studies are broken down into two categories: 1) Food Safety, which is directly concerned with potential pathogens and toxins which can cause illness in consumers; and 2) Food Quality, which is concerned with physical characteristics such as color, aroma, taste, and texture.

Methods for determining the shelf life of food

- Sensory Evaluation. Sensory evaluation is a method of determining the shelf life of food by analyzing its sensory properties such as appearance, taste, texture, and aroma.
- Microbiological Testing.
- Chemical Testing.
- Accelerated Shelf Life Testing.
- Conclusion

- The Length of the shelf-life of a product is dependent on the following factors:
- The types of ingredients
- Manufacturing process
- Type of packagi
- Storage conditions
- The shelf-life is indicated by labelling the product with a date mark, which can either be a “best before” or “use by” date, depending on the product.
- The shelf life of a food product begins when the product’s processing and packaging is complete and is ready to be distributed.
- By performing shelf-life testing, you are able to accurately define dates for your products, ensuring that the quality remains acceptable and safe for consumers.
- There 3 key areas of testing involved with shelf-life tests.
- The most critically important is the determination of the microbiological safety of the product.

- In other words, are there any ‘germs’ in the product that can cause food poisoning.
- In addition, testing for food spoilage ‘germs’ is integral to the shelf-life tests which tell us at what point does the product exceed the limit of allowable ‘germs’ to the point that it is no longer safe to consume.

UNIT-IV FOOD RELATED NUTRITIONAL DISORDERS AND ENERGY CALCULATION:

FOOD RELATED NUTRITIONAL DISORDERS: TYPE 1

- Nutrition disorders are diseases that occur when a person's dietary intake does not contain the right amount of nutrients for healthy functioning, or when a person cannot correctly absorb nutrients from food.

- Nutrition disorders can be caused by undernutrition, overnutrition or an incorrect balance of nutrients. **Nutritional disease**, any of the nutrient-related diseases and conditions that cause illness in humans.

- They may include deficiencies or excesses in the diet, obesity and eating disorders, and chronic diseases such as cardiovascular disease, hypertension, cancer, and diabetes mellitus.

- Nutritional diseases also include developmental abnormalities that can be prevented by diet, hereditary metabolic disorders that respond to dietary treatment, the interaction of foods and nutrients with drugs, food allergies and intolerances, and potential hazards in the food supply.

- All of these categories are described in this article. For a discussion of essential nutrients, dietary recommendations, and human nutritional needs and concerns throughout the life cycle, *see* nutrition, human.

FOOD RELATED NUTRITIONAL DISORDERS

Type I Disorders: Causes of life style

a. Diseases of the heart and blood vessels: coronary heart disease (CHD), atherosclerosis, hypertension and cardio vascular diseases.
b. Obesity
c. Diabetes mellitus

Type I Disorders: Cardio Vascular Diseases

- Saturated fats and trans fats can increase your blood pressure and raise your risk of coronary artery disease.

- Heart disease results from the narrowing of the arteries that supply the heart with blood through a process known as atherosclerosis.

- Fatty deposits (or plaque) gradually build up on the inside of the artery walls, narrowing the space in which blood can flow to the heart. Atherosclerosis can start when you are young, so by the time you reach middle age, it can be quite advanced.

- Processed meats like hotdogs, salami, sausage, bacon and deli meat are often preserved with salts and chemicals called nitrites. Experts believe that the salt and other preservatives can cause heart problems.

Highly refined and processed grains and carbohydrates, like white bread, white rice, sugary sweets, and low-fiber cereals can lead to spikes in blood sugar.

The processing often adds trans fats, sodium, and sugar, which can increase the liver's production of fat. Increased fat and blood sugar spikes can increase your risk for heart disease and diabetes.

Type I Disorders: HYPERTENSION

- Heavy alcohol consumption (more than two drinks a day) is associated with hypertension.
- Vegetarians, and particularly vegans (who consume no foods of animal origin, including milk and eggs) tend to have lower blood pressure than do meat eaters.
- A variety of drugs is used to treat hypertension, some of which have nutritional repercussions.
- Thiazide diuretics, for example, increase potassium loss from the body, usually necessitating the intake of additional potassium, which is particularly plentiful in foods such as bananas, citrus fruits, vegetables, and potatoes.
- Use of potassium-based salt substitutes is not advised without medical supervision.

Type I Disorders: OBESITY

- Obesity is a chronic, recurring complex disorder characterized by excess body weight.
- Obesity is influenced by a combination of factors that includes genetics, hormones, behavior, and the environment.
- Having the disease of obesity increases the risk of many disorders, such as diabetes, high blood pressure, heart disease, and certain cancers, and can result in early death.
- Increasing activity and reducing caloric intake are important components of treating obesity.
- Medications and weight-loss (bariatric) surgery are also important for long-term successful treatment for many people with obesity.
- Losing as little as 5 to 10% of body weight can help lessen weight-related problems, such as diabetes, high blood pressure, and high cholesterol levels.

Type I Disorders: kwashiorkor

- It is a form of malnutrition caused by a lack of protein in the diet.
- People who have kwashiorkor typically have an extremely emaciated appearance in all body parts except their ankles, feet, and belly, which swell with fluid.

Type I Disorders: Marasmus

- Marasmus is a deficiency of all macronutrients: carbohydrates, fats, and protein.
- If you have marasmus, you lack the fuel necessary to maintain normal body functions.
- People with marasmus are visibly depleted, severely underweight and emaciated.
- Marasmus is a severe manifestation of protein-energy malnutrition.
- It occurs as a result of total calorie insufficiency. This leads to overt loss of adipose tissue and muscle.
- The child may have a weight-for-height value that is more than 3 standard deviations below the average for age or sex.

FOOD RELATED NUTRITIONAL DISORDERS:TYPE II

Type-II Disorders Cancer

- High-fat, low-fibre diets may increase the risk of many cancers including bowel, lung, prostate and uterine cancers.
- Reducing alcohol intake and maintaining a healthy body weight may reduce the risk of many cancers.
- Eating 7 daily of a variety of grains, grain products, legumes, roots and tubers will also provide protective benefits against cancer.

Type I Disorders: Diabetes mellitus

- Diabetes mellitus (DM) is a disease of inadequate control of blood levels of glucose.
- Experiencing food and nutrition insecurity while having diabetes can lead to higher A1c levels, diabetes-related complications, hospitalizations, and poor mental health.
- A diet that includes plenty of vegetables, fruits, and lean proteins is important for diabetes management.
- Health care costs twice as much for people with diabetes as those who don't have diabetes

Type-II Disorders: Ulcers

It is now known that a peptic ulcer (a sore on the lining of the stomach or duodenum) is not caused by stress or eating spicy foods, as was once thought; rather, most peptic ulcers are caused by the infectious bacterial agent *Helicobacter pylori* and can be treated by a simple course of antibiotics. However, stress and dietary factors—such as coffee, other caffeinated beverages, and alcohol—can aggravate an existing ulcer.

Type-II Disorders: ELECTROLYTE

- Some foods that have electrolytes include leafy green vegetables such as spinach and kale, fruits such as dried apricots and prunes, and dairy products such as cheese and yogurt.
- Many bodily processes require electrolytes.
- They are necessary for nerve and muscle function, blood pressure regulation, and hydration.
- Electrolytes are substances that conduct electricity when they dissolve in water.
- In food and drink, electrolytes are present as essential minerals.

Many foods and drinks contain electrolytes, including:

- **Leafy green vegetables**
- **Fruits**
- **Dairy products**
- **Nuts and seeds**
- **Beans and lentils**
- **Table salt and salty foods**

Electrolytes in drinks

Some drinks are naturally rich in electrolytes, while others have undergone special formulation to provide electrolytes.

Drinks that naturally contain electrolytes include:

- Milk, which contains calcium and potassium
- Orange juice, which contains potassium and, sometimes, calcium
- Coconut water, which contains potassium, magnesium, sodium, and calcium and is naturally low in sugar
- Soy milk, which contains magnesium and potassium
- Tomato juice, which contains sodium

- Electrolytes from both foods and drinks contribute to a person's overall electrolyte levels. Most people can get enough electrolytes from their regular diet, and they do not need to supplement with sports drinks or oral rehydration supplements.

- The body regulates electrolyte levels efficiently. However, there are some situations in which people may benefit from using electrolyte drinks or oral rehydration supplements.

- During periods of vomiting and diarrhea, where dehydration and electrolyte losses occur, supplementation may be helpful to avoid an electrolyte imbalance.

- Those who engage in extreme workouts or sweat a lot while working out may also need to rehydrate and replace lost electrolytes using a sports drink.

What is an electrolyte imbalance?

An electrolyte imbalance happens when electrolyte levels in the blood are too high or too low. Such imbalances can cause health issues. In rare cases, they can be fatalTrusted Source.

Potential causes of an electrolyte imbalance include:

- intense exercise
- vomiting or diarrhea
- dehydration
- eating disorders
- kidney disease
- type 1 diabetes
- severe burns

- some medications, including diuretics

Mild imbalances may not cause many symptoms, but more severe imbalances can cause a wide range of symptoms. The symptoms that a person experiences will depend on the specific electrolyte and whether the amount is too high or too low.

- Blood pressure changes
- shortness of breath
- Confusion
- fatigue
- Nausea and vomiting
- Rapid or irregular heartbeat
- Weakness or difficulty moving
- Frequent or infrequent urination
- Extreme thirst
- fainting
- Seizure

If a person experiences these symptoms, they should seek medical help immediately

How to maintain electrolyte balance

The easiest way to maintain the optimal balance of electrolytes in the body is to eat a healthful diet that is rich in fruits, vegetables, and other good sources of these essential minerals. It is also important to stay hydrated, but without drinking too many fluids.

TYPE-II DISORDERS WATER IMBALANCE

- A disturbance of body water balance in which more fluid is lost from the body than is absorbed results in reduction in circulating blood volume and in **dehydration** of the tissues.
- In contrast, the rapid ingestion of large quantities of water can lead to overhydration (**water intoxication**).
- Disorders of water imbalance manifest as hyponatremia and hypernatremia.
- To diagnose these disorders, emergency physicians must maintain a high index of suspicion, especially in the high-risk patient, because clinical presentations may be nonspecific.

- water Imbalance. Two types of fluid imbalances are excessive fluid volume (also referred to as hypervolemia) and deficient fluid volume (also referred to as hypovolemia).
- Symptoms can progress quickly if not corrected: dry mouth, sunken eyes, poor skin turgor, cold hands and feet, weak and rapid pulse, rapid and shallow breathing, confusion, exhaustion, and coma.
- Loss of fluid constituting more than 10 percent of body weight may be fatal. The elderly (whose thirst sensation may be dulled), people who are ill, and those flying in airplanes are especially vulnerable to dehydration.
- Infants and children with chronic undernutrition who develop gastroenteritis may become severely dehydrated from diarrhea or vomiting. Treatment is with an intravenous or oral solution of glucose and salts.
-

Health Indices

- The Health Index provides a single value for health that can show how health changes over time.
- It can also be broken down to focus on specific topics to show the factors that influence these changes. The Health Index measures health at local authority, regional and national levels.
- It also enables comparison between geographic areas, health topics and combinations of the two over time. The overall Health Index score can be broken down into three areas of health, known as domains, which are: Healthy People Healthy Lives Healthy Places Each domain contains several subdomains, as shown in the Table of contents.
- These in turn contain a number of indicators. Each indicator provides a measure of a particular aspect of health. Where we are repurposing existing data for use in the Health Index, those data do not always measure health concepts in the ideal way for our purposes.
- Because of this we have selected the best available measures. This is an accepted method when constructing an index but may mean the data chosen may not cover the whole of that aspect of health. For example, the indicator for alcohol misuse consists of alcohol-related hospital admissions.
- We know that this does not measure all alcohol misuse, but it still indicates the patterns and trends expected to be present in alcohol misuse as a whole.
- The indicator descriptions in this article focus on defining each indicator and how it is measured, rather than detailing the underlying data.
- All data used in the Health Index come from publicly available sources, usually the Office for National Statistics (ONS) or other government departments.

Preventive and Remedial measures of nutritional disorders

Preventive measures

- Preventive nutrition messages targeted to adult men need to emphasize reducing intakes of total and saturated fat, cholesterol, and sodium and increasing intakes of complex carbohydrates.
- Eat smaller meals and snacks more frequently.
- Talk to your provider.
- Avoid non-nutritious beverages such as black coffee and tea; instead choose milk and juices.
- Try to eat more protein and fat, and less simple sugars.
- Walk or participate in light activity to stimulate your appetite.
- Drink beverages after a meal instead of before or during a meal so you do not feel as full.
- Choose high-protein and high-calorie snacks.
- Make food preparation an easy task. Choose foods that are easy to prepare and eat.

Remedial measures

- A good health care system that provides immunization, oral rehydration, periodic deworming, early diagnosis and proper treatment of common illnesses can go a long way in preventing malnutrition in the society.
- Importance of exclusive breastfeeding for six months and continuing to breast feed up to two years or beyond.

People can be educated on

- The nutritional quality of common foods
- Importance and nutritional quality of various locally available and culturally accepted low cost foods
- Importance of exclusive breastfeeding for six months and continuing to breast feed up to two years or beyond.
- Damage caused by irrational beliefs and cultural practices of feeding
- Recipes for preparing proper weaning foods and good supplementary food from locally available low cost foods.
- importance of including milk, eggs, meat or pulses in sufficient quantities in the diet to enhance the net dietary protein value.
- Importance of feeding children and adults during illness
- Importance and advantages of growing a kitchen garden
- Importance of immunizing their children and following proper sanitation in their day to day life.

Energy balance and methods to calculate individual nutrient and energy needs

Energy balance

- Energy balance is achieved when input (i.e. dietary energy intake) is equal to output (i.e. total energy expenditure), plus the energy cost of growth in childhood and pregnancy, or the energy cost to produce milk during lactation.
- When energy balance is maintained over a prolonged period, an individual is considered to be in a steady state.
- This can include short periods during which the day-to-day balance between intake and expenditure does not occur.

- An optimal steady state is achieved when energy intake compensates for total energy expenditure and allows for adequate growth in children, and pregnancy and lactation in women, without imposing metabolic, physiological or behavioural restrictions that limit the full expression of a person's biological, social and economic potential.

ENERGY NEEDS

2.1 DEFINITIONS

- An adequate, healthy diet must satisfy human needs for energy and all essential nutrients.
- Furthermore, dietary energy needs and recommendations cannot be considered in isolation of other nutrients in the diet, as the lack of one will influence the others.
- Thus, the following definitions are based on the assumption that requirements for energy will be fulfilled through the consumption of a diet that satisfies all nutrient needs.
- ***Energy requirement*** is the amount of food energy needed to balance energy expenditure in order to maintain body size, body composition and a level of necessary and desirable physical activity consistent with long-term good health.
- This includes the energy needed for the optimal growth and development of children, for the deposition of tissues during pregnancy, and for the secretion of milk during lactation consistent with the good health of mother and child.
- ***The recommended level of dietary energy intake*** for a population group is the mean energy requirement of the healthy, well-nourished individuals who constitute that group.
- Based on these definitions, a main objective for the assessment of energy requirements is the prescription of dietary energy intakes that are compatible with long-term good health.
- Therefore, the levels of energy intake recommended by this expert consultation are based on estimates of the requirements of *healthy, well-nourished individuals*.
- It is recognized that some populations have particular public health characteristics that are part of their usual, "normal" life. Foremost among these are population groups in many developing countries where there are numerous infants and children who suffer from mild to moderate degrees of malnutrition and who experience frequent episodes of infectious diseases, mostly diarrhoeal and respiratory infections. Special considerations are made in this report for such sub-populations.

2.1.1 Daily energy requirements and daily energy intakes

Energy requirements and recommended levels of intake are often referred to as *daily requirements* or *recommended daily intakes*.

These terms are used as a matter of convention and convenience, indicating that the requirement represents an average of energy needs over a certain number of days, and that the recommended energy intake is the amount of energy that should be ingested as a daily average over a certain period of time.

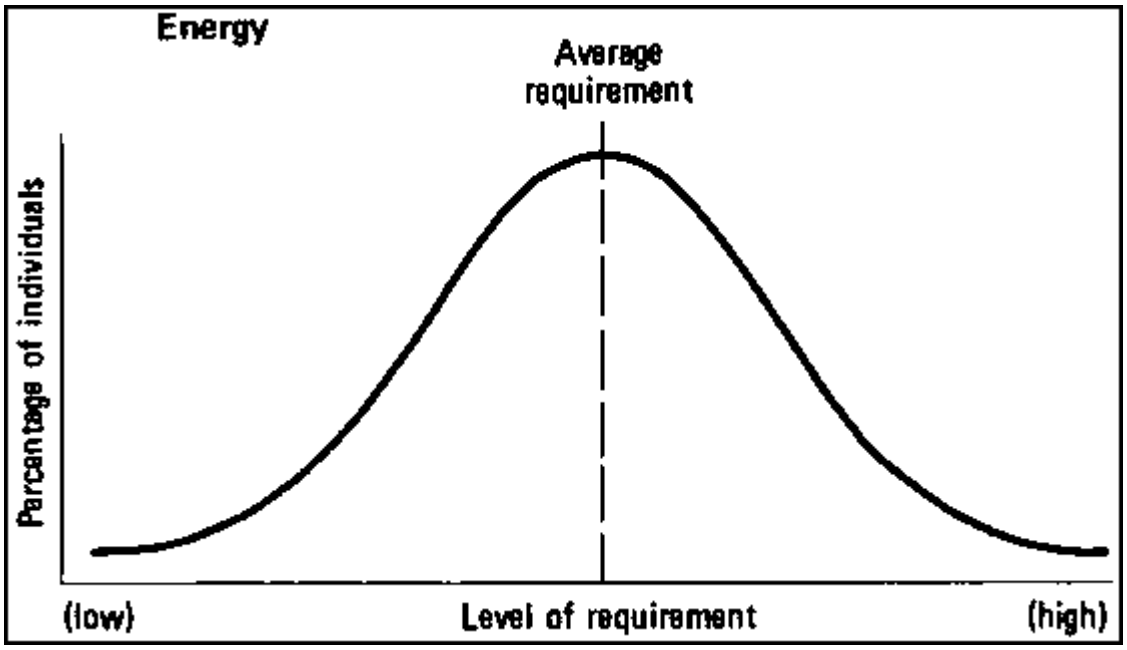
There is no implication that exactly this amount of energy must be consumed every day, nor that the requirement and recommended intake are constant, day after day.

Neither is there any biological basis for defining the number of days over which the requirement or intake must be averaged.

As a matter of convenience, taking into account that physical activity and eating habits may vary on some days of the week, periods of seven days are often used when estimating the average daily energy expenditure and recommended daily intake.

2.1.2 Average requirement and inter-individual variation

- Estimates of energy requirements are derived from measurements of individuals. Measurements of a collection of individuals of the same gender and similar age, body size and physical activity are grouped together to give the average energy requirement - or recommended level of dietary intake - for a *class* of people or a *population group*.
- These requirements are then used to predict the requirements and recommended levels of energy intake for other individuals with similar characteristics, but on whom measurements have not been made.
- Although individuals in a given class have been matched for characteristics that may affect requirements, such as gender, age, body size, body composition and lifestyle, there remain unknown factors that produce variations among individuals. Consequently, there is a distribution of requirements within the class or population group (WHO, 1985) (Figure 2.1).



<u>methods to calculate individual nutrient</u>

- When used to assess the nutrient content of diets, recipes, or commercial food products, a nutrient database should provide a complete nutrient profile for each food in the database.
- Chemical analyses for a wide range of nutrients in the many foods included in a database are not always practical.
- Therefore, some nutrient values must be estimated.
- Common methods for estimating nutrient values include
    - using values from a different but similar food,
    - calculating values from different forms of the same food,
    - calculating values from other components in the same food,
    - calculating values from household recipes or commercial product formulations for multicomponent foods,
    - converting values from information on the nutrient label of a commercial food product,
    - calculating values from a product standard,

1.**Using values from a different but similar food,**

- Using Nutrient Values from a Different, but Similar, Food Nutrient values from another food within the same genus or within the same family of foods may be used.
- It is important to consider the part of the plant (e.g., leaf, root, stem) when selecting a similar food for estimating nutrient values (Gebhardt, 1992).
- For example in the Brassica genus, it is appropriate to use nutrients from turnips for rutabagas since both are root vegetables, whereas it is not appropriate to use nutrient values from cabbage, a leaf vegetable.
- Color of the vegetable is also an important consideration when imputing the carotenoid or vitamin A content of a vegetable since the level of carotenoid is often related to the green or orange color.

2. Calculating Nutrient Values from a Different Form of the Same Food.

- Nutrient values calculated for a cooked or processed food from its raw values. Frequently, a nutrient value is known for a raw food, but the nutrient has not been chemically analyzed for the same food after cooking.
- To estimate the nutrient content of the cooked food, consideration must be given to both the cooked yield and the nutrient retention (McCarthy, 1992).
- Nutrient retention factors for vitamins and minerals have been determined for groups of foods and various cooking methods by the USDA, using data from paired samples of raw and cooked foods and the following formula (Murphy et al., 1975)

$$\%\ \text{true nutrient retention} = \frac{\text{nutrient content per g cooked food} \times \text{g cooked food}}{\text{nutrient content per g raw food} \times \text{g raw food}} \times 100.$$

3.Calculating Nutrient Values from Other Components in the Same Food

Specific calculations may be used to derive a nutrient value from one or more nutrients with a known value. Examples of calculations for selected nutrients are listed below.*(a) Energy.* The Atwater method of energy calculation uses factors to calculate energy from protein, fat, carbohydrate, and alcohol (Merrill *et al.,* 1973).The energy calculation using general Atwater factors is the following:

$$\begin{aligned}\text{energy (kcal)} = {} & (4\ \text{kcal/g protein} \times \text{g protein}) \\ & + (9\ \text{kcal/g fat} \times \text{g fat}) \\ & + (4\ \text{kcal/g carbohydrate} \times \text{g carbohydrate}) \\ & + (7\ \text{kcal/g alcohol} \times \text{g alcohol})\end{aligned}$$

4. **Calculating Nutrient Values from Household Recipes or Commercial Product Formulations for Multicomponent Foods**

Nutrient values for multicomponent foods can be calculated by summing nutrients of all ingredients contained in the food. For some multicomponent foods, recipes which provide a list of ingredients and their amounts are available.

For other foods,such as commercial products, ingredient lists, but not ingredient amounts, are available from the food manufacturer.

5.Converting Nutrient Values from Nutrient Label Information of a Commercial Food Product

In countries where there are voluntary or mandatory nutrition labeling regulations, nutrient information may be available from the package label of a commercial food product.

If the original analytic data cannot be obtained from the manufacturer, the information provided by the package label can be used to convert nutrient values to a 100-g basis.

Nutrition labeling regulations can be quite specific and vary by country.

Labeling values may have been manipulated to be in compliance with labeling regulations for rounding and therefore may not be in precise agreement with the original analytic data.

6.Calculating Nutrient Values from a Product Standard

- When a food item has nutrients added for enrichment or fortification purposes, the value for the nutrient can be estimated from a product standard if the analytic data are not available. Product standards will vary by country.
- In the United States, the standards of identity are published yearly by the Food and Drug Administration in the Code of ESTIMATING NUTRIENT VALUES FOR FOOD COMPOSITION DATABASES 111 Federal Regulations (Office of the Federal Register, 1995).
- For added nutrients in certain foods, a minimum and maximum level is given. For example, macaroni which is labeled as ‘‘enriched’’ must contain not less than 4 mg or more than 5 mg of thiamin per pound. If it is unknown whether the nutrient is usually added near the minimum or maximum level, the midpoint of the range can be used.
- For added nutrients in other foods, a single figure may be the minimum level, with averages left to good manufacturing practices.
- Vitamin A in milk must be added at a level not less than 2000 International Units per quart.
- If a nutrient is listed as ‘‘optional,’’ the usual practice of the industry in the particular country must be known to estimate the nutrient in a typical food sample.

PLANNING A HEALTHY DIET

A healthy diet is essential for good health and nutrition. It protects you against many chronic noncommunicable diseases, such as heart disease, diabetes and cancer.

Eating a variety of foods and consuming less salt, sugars and saturated and industrially-produced trans-fats, are essential for healthy diet.

Emphasizes fruits, vegetables, whole grains, and fat-free or low-fat milk and milk products.

Includes a variety of protein foods such as seafood, lean meats and poultry, eggs, legumes (beans and peas), soy products, nuts, and seeds.

Is low in added sugars, sodium, saturated fats, trans fats, and cholesterol.

A healthy eating plan gives your body the nutrients it needs every day while staying within your daily calorie goal for weight loss.

A healthy eating plan also will lower your risk for heart disease and other health conditions.

A healthy eating plan:

Base your meals on higher fibre starchy carbohydrate

- Emphasizes vegetables, fruits, whole grains, and fat-free or low-fat dairy products

- Includes lean meats, poultry, fish, beans, eggs, and nuts
- Limits saturated and *trans* fats, sodium, and added sugars
- Controls portion sizes

Calories

To lose weight, most people need to reduce the number of calories they get from food and beverages (energy IN) and increase their physical activity (energy OUT).

UNIT-V CONSUMERS ON GM FOODS AND CONTEMPORARY ISSUES:

Global perspective of consumers on GM foods

Genetic modification is a special set of gene technology that alters the genetic machinery of such living organisms as animals, plants or microorganisms. Combining genes from different organisms is known as recombinant DNA technology and the resulting organism is said to be 'Genetically modified (GM)', 'Genetically engineered' or 'Transgenic'.

The principal transgenic crops grown commercially in field are herbicide and insecticide resistant soybeans, corn, cotton and canola. Other crops grown commercially and/or field-tested are sweet potato resistant to a virus that could destroy most of the African harvest, rice with increased iron and vitamins that may alleviate chronic malnutrition in Asian countries and a variety of plants that are able to survive weather extremes.

There are bananas that produce human vaccines against infectious diseases such as hepatitis B, fish that mature more quickly, fruit and nut trees that yield years earlier and plants that produce new plastics with unique properties. Technologies for genetically modifying foods offer dramatic promise for meeting some areas of greatest challenge for the 21st century.

Like all new technologies, they also pose some risks, both known and unknown. Controversies and public concern surrounding GM foods and crops commonly focus on human and environmental safety, labelling and consumer choice, intellectual property rights, ethics, food security, poverty reduction and environmental conservation.

With this new technology on gene manipulation what are the risks of "tampering with Mother Nature"?, what effects will this have on the environment?, what are the health concerns that consumers should be aware of? and is recombinant technology really beneficial? This review will also address some major concerns about the safety, environmental and ecological risks and health hazards involved with GM foods and recombinant technology.

Genetically modified foods are foods produced from organisms that have had changes introduced into their DNA using the methods of genetic engineering as opposed to traditional cross breeding.[44][45] In the U.S., the Department of Agriculture (USDA) and the Food and Drug Administration (FDA) favor the use of the term *genetic engineering* over *genetic modification* as being more precise; the USDA defines *genetic modification* to include "genetic engineering or other more traditional methods".[46][47]

According to the World Health Organization, "Foods produced from or using GM organisms are often referred to as GM foods."[44]

What constitutes a genetically modified organism (GMO) is not clear and varies widely between countries, international bodies and other communities, has changed significantly over time, and was subject to numerous exceptions based on "convention", such as exclusion of mutation breeding from the EU definition.[48]

Even greater inconsistency and confusion is associated with various "Non-GMO" or "GMO-free" labelling schemes in food marketing, where even products such as water or salt, that do not contain any organic substances and genetic material (and thus cannot be genetically modified by definition) are being labelled to create an impression of being "more healthy.

Major concerns of transgenic in gm foods:

Transgenic has been used in genetic studies for a long time. They were used to demonstrate that DNA is the molecule that carries the genetic code and that oncogenes can cause cancer.

Potential health risks to humans include the possibility of exposure to new allergens in genetically modified foods, as well as the transfer of antibiotic-resistant genes to gut flora.

the risk of outcrossing, where genes from GMO foods pass into wild plants and other crops. a negative impact on insects and other species. reduction in other plant types, leading to a loss of biodiversity

The major risk from the production of the transgene will lie in the use of novel proteins or other molecules produced by the transgenic organisms. Either in the native form or, following modifications in the human body, such molecules could be inimical to human health.

The main disadvantages of transgenic animals are mutagenesis and function disorders, ecological problems, antibiotic resistance, and population of clones. Keywords: Transgenic animal, Monoclonal antibodies, Vaccines, Angiogenesis, Boon, Bane, and Cancer.

New methods for modifying the genome will underpin a resurgence of research using transgenic livestock. This will not only increase our understanding of basic biology in commercial species, but might also lead to the generation of animals that are more resistant to infectious disease.

A transgenic, or genetically modified, organism is one that has been altered through recombinant DNA technology, which involves either the combining of DNA from different genomes or the insertion of foreign DNA into a genome.

Foods GM ingredients in food products:

Genetically modified (GM) foods Food produced from or using genetically modified organisms (GMOs) is referred to as GM food.1 It could include processed foods such as oil used as a cooking medium or ready-to-eat snacks such as chips or breakfast cereal made from GM crops such as soya bean, corn, cottonseed, tomato and potato.

GM food from GM crops

GM crops are developed and marketed because of certain perceived advantages to producers or consumers, including crop protection from pests or diseases, tolerance to herbicides or increased nutritional value. There are, however, uncertainties around these claimed benefits of GM crops/foods as well as their safety to the health of humans, animals and the environment. Based on these concerns, the cultivation of GM crops and availability of GM foods is regulated across different parts of the world. GM corn, rapeseed, soya and cotton account for 99 per cent of the world's GM crop acres. India has allowed commercial cultivation of only GM Bt (Bacillus thuringiensis) cotton since 2002 (see Table 1: Common GM varieties globally marketed).

GM labelling approaches

Labelling of GM foods complements safety assessment while regulating GM foods. Taking into consideration its significance, countries have adopted a mix of different approaches to labelling which include: ♣ Mandatory or voluntary approach: While the EU, Australia, New Zealand, Brazil, South Korea and a few other countries have adopted mandatory labelling, USA and Canada permits voluntary labelling of GM foods. Some countries also permit voluntary GM-free labelling. ♣ Thresholds set for labelling exemption: Thresholds are based on quantity of GM DNA or weight of the GM ingredient in the total product. For example, Japan has adopted a limit of five per cent of GM ingredients (by weight) in the product, whereas the EU provides a limit of 0.9 per cent GM DNA per ingredient in view of adventitious

or technically unavoidable presence, which the producer is to prove (see Table 6: GM food labelling regulations in different countries).

Proposed labelling of GM foods in India

In India, as per Section 22 of the FSS Act, GM food is illegal until the FSSAI approves it, which it hasn't done so far. The FSSAI has recently proposed the draft FSS (Labelling and Display) Regulations, 2018, which also seeks to make labelling of GM food mandatory. These regulations have not been finalized yet. The regulation provides, 'all food products having total Genetically Engineered (GE) ingredients 5 per cent or more shall be labelled. The total GE ingredients shall be of top three ingredients in terms of their percentage in the product.' Clearly, the proposed threshold limit of five per cent for exemption is very relaxed, particularly for a country in which no edible GM crop is allowed to be cultivated. It seems to heavily rely on food manufacturers' self declaration of GM ingredients in a product. Further, it neither specifically addresses unintentional contamination nor does it mention specifications on size and colour of the text and placement of label as, for example, on the principal display panel. It also does not propose a symbol-based labelling as in Brazil; symbol-based labelling could prove very effective in India given the several languages other than English spoken here.

Foods GM ingredients in food products safety aspects:

Safety of GM crops and products has been a matter of concern for human health. Risk assessment on a case-by-case basis is critical for a country-level decision to allow or restrict GM foods. This is because various GMOs have different genes, which are inserted in multiple ways. Besides, studies used to evaluate the risk must take into account different populations and geographies.27 The WHO– FAO-led Codex Alimentarius28 provides detailed guidelines for assessing risks associated with GM foods. Typically, the following parameters are considered for risk assessment: • Toxicity—acute, sub-chronic and chronic • Allergenicity, i.e. the potential to provoke allergic reaction due to crossreaction with other allergens or from new unknown GM proteins • Composition analysis of major and minor nutrients to ascertain new or greater risks to nutritional status compared to traditional counterparts • Nutritional effects associated with genetic modification that could arise if GM DNA is inserted into the crop genome at a location where it modifies the existing DNA such that the nutritional content of the crop alters. • Stability of inserted gene to avoid its unintended escape into cells of the body or to bacteria in the gastrointestinal tract. This is particularly relevant if antibiotic-resistant genes, used as markers while creating GMOs, were to be transferred. • Unintended effects that could result from the gene insertion leading to formation of new or changed patterns of metabolites. The Indian Council of Medical Research (ICMR) has published Guidelines for the Safety Assessment of Foods Derived from Genetically Engineered Plants, (2008, updated 2012),29 based on guidelines by Codex Alimentarius, i.e. Conduct of Food Safety Assessment of Foods derived from Recombinant-DNA Plants (2003). Status check: Safety of GM foods in India In December 2017, a Parliamentary Committee report30 that examined the impact of GM crops on environment and human and animal health identified huge gaps with respect to the safety of GM crops. It noted the following key issues: ♣ There has been no Indian scientific study carried out so far to study the impact of GM crops on human health. ♣ Long-term effects on the human health have not been studied. ♣ The Department of Health Research has not taken any action with regard to examination of impact of GM crops on human health. ♣ The government should reconsider its decision to commercialize GM crops in the country as it has not been scientifically proven that GM crops have no adverse impact on human health. It is relying solely on studies that have not been done in India rather than on our own population and in the context of our climate and environment. ♣ It is very late in the day for the FSSAI to take a decision to label GM foods imported into the country. However, the committee strongly recommends that labelling on GM foods must be done with immediate effect.

Foods GM ingredients in food products bioavailability:

Bioavailability refers to the extent a substance or drug becomes completely available to its intended biological destination(s).

Bioavailability is an important explanatory step between the food source and potential health effects of its food components. Much of the health benefits of foods may be explained by additive, antagonistic and synergistic processes at the level of uptake and absorption of nutrients.

Direct methods measure the bioavailability of nutrients by tracking their levels in the blood, urine, feces, or other biological fluids or tissues. For example, you can measure the bioavailability of iron by analyzing the hemoglobin concentration or the ferritin level in the blood.

What is Bioavailability?

According to a review in *Frontiers in Nutrition*, bioavailability "is the fraction of an ingested nutrient that becomes available for use and storage in the body. It's the percent of a compound absorbed through the gut and retained in bodily tissue.

You don't absorb most of the nutrients you eat. (Bummer!) Did you know that calcium from dairy is only 40% bioavailable? Or that the vitamin K in kale is only 5% bioavailable?[*]

These are just estimates, though. Everyone's absorption of a given nutrient from a particular food will be slightly different.

Determining Bioavailability

Here are some factors that influence bioavailability:

- The presence of other nutrients**.** Example: calcium is better absorbed when consumed with vitamin D.[*]
- **The presence of anti-nutrients.** Example: grains, legumes, nuts, and seeds contain a compound called phytic acid which may inhibit mineral absorption.[*]
- **The form of the nutrient.** Example: heme iron from animal products is better absorbed than non-heme iron from plants.
- Biosafety" means the mechanism developed through policy and procedures to ensure the environmentally safe application of biotechnology which results to develop Genetically Modified Organisms (GMOs).

Regulatory agencies involved in GM foods

FDA regulates most human and animal food, including GMO foods. In doing so, FDA makes sure that foods that are GMOs or have GMO ingredients meet the same strict safety standards as all other foods.

the U.S. Food and Drug Administration (FDA), U.S. Environmental Protection Agency (EPA), and U.S. Department of Agriculture (USDA) ensure that GMOs are safe for human, plant, and animal health. These agencies also monitor the impact of GMOs on the environment.

Food Safety and Standards Authority of India (FSSAI) is the competent authority to regulate GM foods through the inclusion of "genetically modified or engineered food or food containing such ingredients" within the definition of food.

the Genetic Engineering Approvals Committee, a body under the Ministry of Environment and Forests (India) is responsible for approval of genetically engineered products in India. If the bill is passed, the responsibility will be taken over by the Environment Appraisal Panel, a sub-division of the BRAI.

The top biotech regulator in India is the Genetic Engineering Appraisal Committee (GEAC). The committee functions as a statutory body under the Environment Protection Act 1986 of the Ministry of Environment & Forests (MoEF).

Case studies- GM foods

Health risks associated with GM foods are concerned with toxins, allergens, or genetic hazards.

Some foods include ingredients (for example, soy beans) that have been genetically modified (GM), or are made using ingredients derived from GM organisms (for example, GM yeast)

A case study is a research approach that is used to generate an in-depth, multi-faceted understanding of a complex issue in its real-life context. It is an established research design that is used extensively in a wide variety of disciplines, particularly in the social sciences.

GM is a technology that involves inserting DNA into the genome of an organism. To produce a GM plant, new DNA is transferred into plant cells. Usually, the cells are then grown in tissue culture where they develop into plants.

A genetically modified organism contains DNA that has been altered using genetic engineering. Genetically modified animals are mainly used for research purposes, while genetically modified plants are common in today's food supply

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