Training Manual On

FOOD PROCESSING

and Preservation Techniques

National Agriculture Training Academy (NATA)
Gazipur-1701

Training Manual
On
Food Processing and Preservation Techniques

Duration: 5 days

National Agriculture Training Academy (NATA)
Gazipur-1701
www.nata.gov.bd

Training Manual On
Food Processing and Preservation Technique

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Preface

The authors expresse his endless gratitude to Almighty Allah for His never-ending grace and blessings for the successful completion of the Training Manual.

National Agriculture Training Academy (NATA) is preparing need based training manual and conducting training courses for class-I officers of seventeen organizations under MoA. Personnel of different organization need to investigate various parameters involved in food processing and preservation with respect to their influence on final product quality and safety, and understand the processing steps involved in a range of contemporary and novel manufacturing operations. The training course is organized to meet the special needs of the officials of seventeen organization under MoA.

The objectives of training is to understand the importance and implication of food processing for food security and a good nutrition during the whole year.

The authors wishe to express heartfelt thanks and gratitude to DG, NATA and Director (Training) for their scholastic guidance, valuable suggestions and criticism, continuous inspiration and constant encouragement, throughout the entire period of work and help in the preparation of this manual.

We believe that, this training manual will equip participants to work for food processing and food security.

Contents

PART- I
Introduction to National Agriculture Training Academy

1.1. The Academy: National Agriculture Training Academy (NATA) is the apex training institute for human resources development of class-1 officers under the Ministry of Agriculture (MoA) for providing training on diversified field of professional interest in agriculture sector. The Academy organizes various Agriculture discipline related training programs throughout the year. The Academy established in Gazipur as Central Extension Resources Development Institute (CERDI) on 14 March 1975 under the JICA project. Afterwards, ***on 27 June 1984,***CERDI was taken under Training Wing of Department of Agriculture Extension (DAE). ***On 03 April 2013,Government of the Peoples' Republic of Bangladesh abolished CERDI and established NATA as an attached Organization of the Ministry of Agriculture. On 07 June 2014, it's started to function.***

The first course the Academy hosted a 4 day long training course titled 'e-Agriculture & it's development initiatives'. A total of 120 participants from 16 organizations under MoA attended the training course in 3 batches started from 18-21 May 2015 (1st Batch); 25-28 May 2015(2nd Batch) and 07-10 June 2015 (3rd batch).

1.2. Location: The Academy is 25 km away from Dhaka city and 3 km away from Gazipur Chandana Chourasta junction towards Gazipur district head quarter. It is located adjacent to Bangladesh Rice Research Institute (BRRI) and occupied 49 acres of land. The Academy provides the trainees an ample scope to have free access to the adjacent Institutions like Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), Seed Certification Agency (SCA), Bangobondhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Telecommunication College, DC Office and other Government Offices in Gazipur.

1.3. Administration: A Director General in the rank of Additional Secretary to the government serves as head of the Academy assisted by two Director and 74 faculty members and support staffs.

1.4. Vision: To establish as a centre of excellence for development of competent human resources and a 'think tank' of knowledge-intensive governance of agriculture service.

1.5. Mission: Its mission is to develop a common platform of all organizations under the Ministry of Agriculture(MoA) for human resource development by imparting quality training, research & development and publications; to enhance linkage between education, research and extension to endow agriculture service delivery system; to network with reputed institutions of home and abroad for organizational capacity building and promote a culture of continuous learning to foster a knowledge-based governance of agriculture service.

1.6. Goals: The Academy has set some goals for achieving its Vision & Mission successfully. These are as follows:

i) Human resources development of class-1 or equivalent officers under the Ministry of Agricul (MoA) through training on diversified field of professional interest in agriculture service;
ii) conduct R&D, adaptive research demonstration and provide publication and library servic facilitate quality training;
iii) impart all sorts of in-service training with special emphasis on induction, foundation and senior course;
iv) help Govt. and policy makers in framing and analyzing agricultural policies and
v) organize seminars, workshops, symposiums and conferences on various issues of national sectoral interest.

1.7. Physical Facilities: The Academy is well equipped with physical facilities in organizing trai programs though it began its journey recently. Existing facilities of the Academy is given below:

- Office building-2
- Class room- 3
- Laboratory (Subject wise technical)
- Plant protection museum- 1
- Conference room- 1
- Auditorum-1
- Dormitory- 5
- Cafeteria- 1
- Greenhouse- 3
- Workshop-1
- Computer cum language lab-1
- Library
- Mosque
- Guest House-cum-day-care-centre-1
- Training Complex-1

1.8. Training Methodology: The Academy is keen enough to maintain the appropriatenes effectiveness of training programs. Designs of both short and long term training courses are reg improved and tailored to meet the beneficiary institution's needs and goals. The methods follow practice oriented rather than the theoretical discussions. Study tours arranged for the trainees to them to real practice in the field and society. There are some variations in the training method ba the nature and the purpose of the training course. With some exceptions, the Academy generally f the following methods:

a) Lecture,
b) Participatory discussion,
c) Case study,
d) Role-play,
e) Workshop &Seminar
f) Practical demonstration,
g) Brain storming,
h) Study visit and Games

NATA analyzes the training methods of worldwide similar training academies and regularly training methods accordingly. The Academy committed to maintain international standard.

1.9. Evaluation: Course Director and other faculty members are given responsibility to evaluate the participants. This course will be evaluated by pre and post test within 100 marks. on the other hand the participants are also given chance to evaluate the faculties and guest speakers in a prescribed form. The distribution of marks is as follows:

Sl. no.	Parameters	Marks
a)	Individual Assignment , Exercise, Practical Test	80
b)	Class Attendance and Overall conduct and discipline	20
	Total	**100**

1.10. Grading: The grade is decided on the basis of the score. The grading is as follows:

Marks Secured (%)	Grade
90-100	A^+
80-89	A
70-79	B^+
60-69	B
50-59	C

Note: If any participant fails to obtain 50% marks in the final assessment he/she will be treated as 'fail' and in that case she/he will not be given the successful completion certificate of the training course.

1.11. Sessions: Every day the session will start at 9.00 am in the morning and ends at 4:30 pm in the afternoon. There are two breaks started at 11.00 a.m. and 1.15 p.m. for tea and lunch with prayer respectively. Participants are advised to attain the class in time without fail for avoiding any kinds of disciplinary action.

Daily Schedule:

Activities	Duration
1st Session	09:00-10:00
2nd Session	10:00-11:00
Tea Break	11:00-11:15
3rd Session	11:15-12:15
4th Session	12:15-01:15
Lunch & Prayer	01:15-02:30
5th Session	02:30-03:30
6th Session	03:30-04:30

1.12. Norms to be followed during the training:

- No casual leave is allowed in training period.
- Participants living in the dormitory are advised to follow the norms of the dormitory.
- The campus area is a "Non Smoking Zone". Participants are advised to refrain from smoking inside the Academy.
- Participants are not allowed to enter the dormitory after 11:00pm at night.
- Participants have to maintain health rules during covid-19 situations.

1.13. Conclusion: Throughout the Training Programme, NATA Gazipur wants to develop the skill of the service holders and seeks cordial response and co-operation from all quarters for successful implementation the training course. All faculties and staffs of the Academy are always ready to serve the participants without showing any kinds of casualness.

PART- II

Manual Title:Food Processing &Preservation Techniques

Introduction : Food processing and preservation is a set of physical, chemical and biolog processes that are performed to prolong the shelf life of foods and at the same time retain the feat that determine their quality, like colour, texture, flavor and specially nutritional value. F preservation is achievedby destroying enzymes and microorganisms using heat (blanch pasteurization), or preventing their action by: removal of water, or increasing acidity or using temperatures.

Objectives: To understand the importance and how to do food processing for food security ar good nutrition during the whole year.

Aim: The module aims to enable participants to understand the purpose and principles of a rang food processing unit operations. This module will also enable the participants to investigate var parameters involved in food processing and preservation with respect to their influence on f product quality and safety, and understand the processing steps involved in a range of contempo and novel manufacturing operations

Learning outcomes: By the end of this module participants will be able to:

- understand the importance of food processing and preservation.
- explain purpose and principles food processing and preservation
- apply knowledge of micro-organisms and food chemistry to the principles of food preservation.
- develop proficiency skill in producing different processed fruits and vegetables food products
- make different processed food products with quality assurance
- Process of Packaging, Storing & marketing

Food Processing & Preservation consists of fore modules:

Sl. No.	Module name
1.	Introduction to Food and Food processing
2.	Hygiene and Food safety
3.	Food preservation and processing techniques
4.	Industrial Food Processing

Lesson plan of the four module:

Sl. No.	Name of Module	Content
1.	Introduction to Food and Food Processing	L-1:Concept on Safe and Nutritious Foods
		L-2:National Food Safety Policy, Rules & Regulations
		L-3: Food processing & preservation : Implications for assuring food security
		L-4: An overview on food processing and preservation
		L-5: GAP and SOP for preservation & processing of food
2.	Hygiene and Food safety	L-6:Overview on Washing and Cooling of fresh produces
		L-7: Overview on Minimal Processing of Fruits and Vegetables (Theory & Practical)
		L-8:Causes of food spoilage and remedies
3.	Food preservation and processing techniques	L-9: Principles and methods of food preservation
		L-10: Traditional food processing and preservation techniques
		L-11: Food Processing by Drying
		L-12:Food Processing and Preservation by Heat Treatments
		L-13: Food Processing by Frying (Theory & Practical)
		L-14: Principles and Methods of Osmotic dehydration
		L-15: Food Processing and Preservation by Fermentation (Theory & Practical)
		L-15: Principles and Methods of Pickling (Theory &practical)
		L-16: Food Preservation by increasing solids
		L-17: Preparation of Jam/Jelly/Marmalade (practical)
4.	Industrial Food Processing	L-19: Principles and Methods of Packaging &Industrial Food Processing
		L-20: Packaging of fresh and processed foods
		L-21: Good Manufacturing Practices

Lesson Plan-1

Title : Concept on Safe and Nutritious Foods Ref.No.14.1.1
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants Concept on Safe and Nutritious Foods which they apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- Discuss concept of food &nutrition
- explain factors affecting food and nutrition
- analysis role of health care professionals in food and Nutrition
- describe types of food
- explain Importance of food composition data to nutrition and public heal

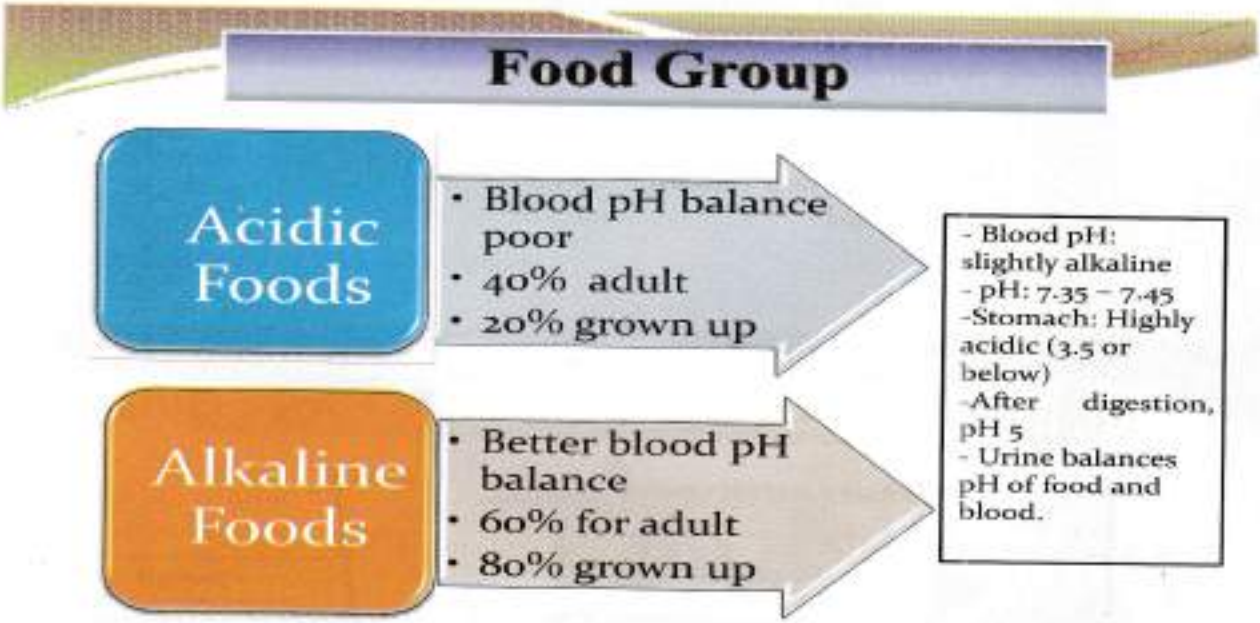
Content	Methods or Techniques	Resources or Aids	Time (Minut
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Concept on Food Types, composition • Importance: significance concept on food types and composition • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Concept of food & nutrition • Factors affecting food and nutrition • Analysis role of health care professionals in food and nutrition • Types of food • Importance of food composition data to nutrition and public health • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9
Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.			
Behavior/Performance	**Condition**		**Criteria**

Concept on Safe and Nutritious Foods

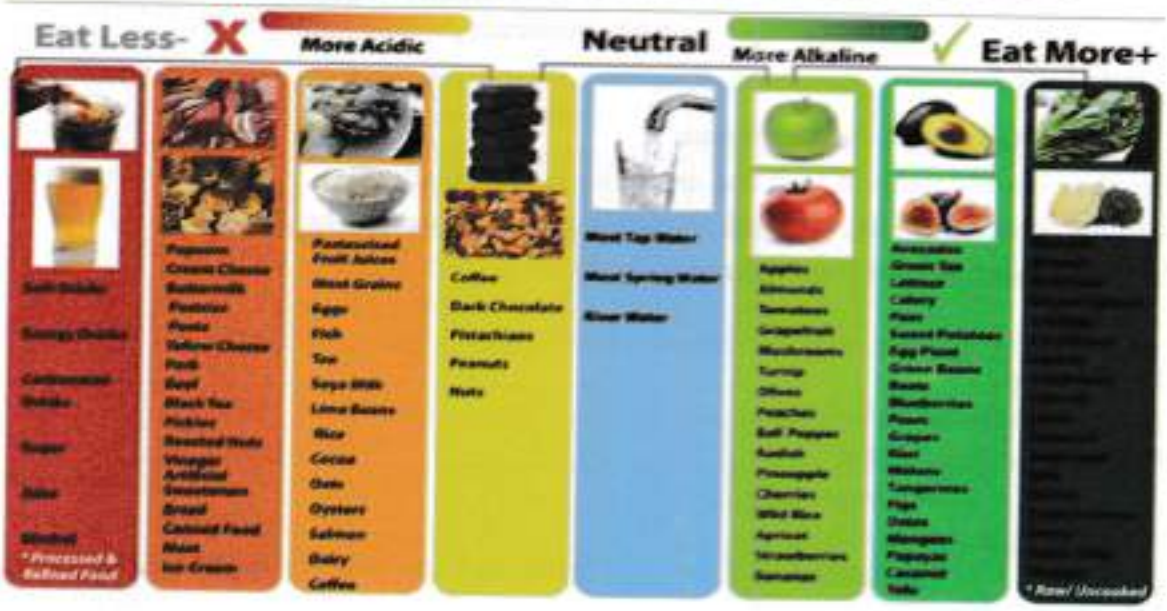
Prof. Dr. Gulzarul Aziz
BAU, Mymensingh

- Concepts Food : Any edible substance
- Diet :Amount and types of food and drinks we take regularly
- Nutrition :Process of utilizing foods Relation between food and health
- Nutrients :Substances of food utilized by body

☐ Food Groups
Food groups based on origins:
☐ Plant origin: Rice, wheat, …..
Fruits, vegetable, …
☐ Animal origin :Meat, fish, ….
Egg, milk, ….



Food Group



- Acidosis :When urine is too acidic
  Heartburn, cold hand and feet
  Night sweats
- Alkalosis :When urine is too alkaline
  Headaches
  Lower blood pressure
  More colds and sinusitis
  Easily tired

Importance of Agriculture & Processing

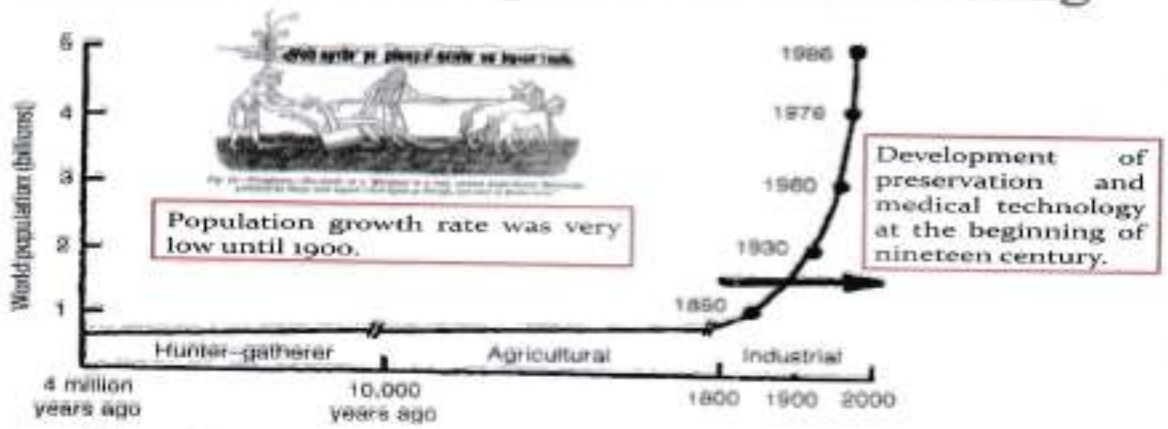


Figure: Forage to Farm to Agro-processing (Ref.: Nutrition Society)

Importance of Agriculture & Processing

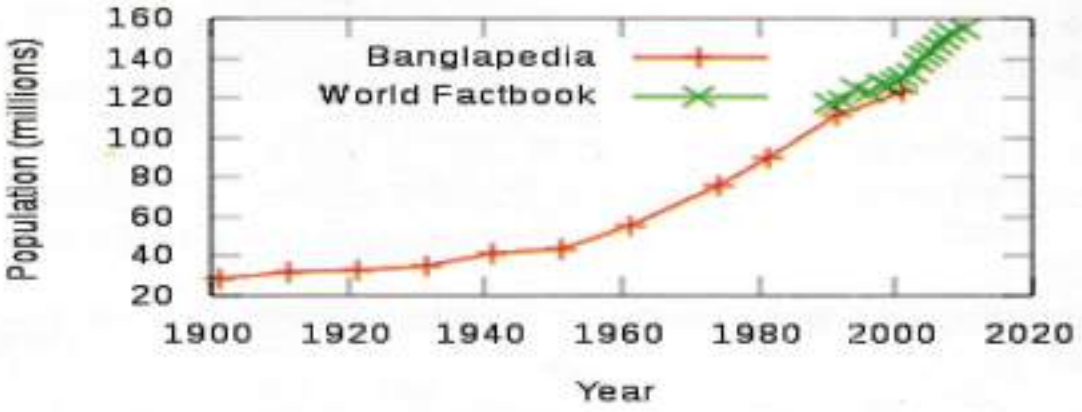


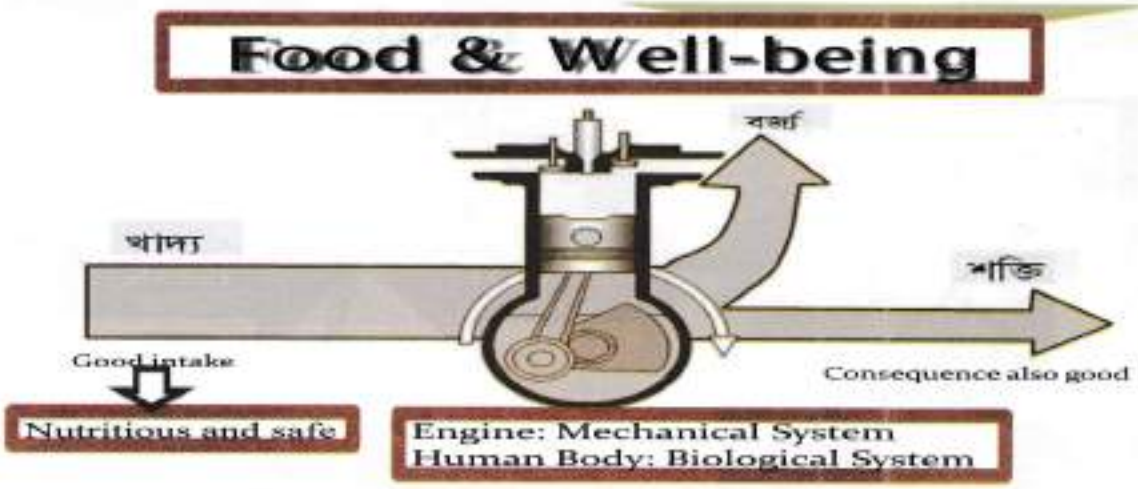
Figure: Demographics of Bangladesh(Ref.: Wikipedia)

Demerits of Food Processing

- Vitamin loss
- Vit-B and –C
- Decrease avialability

Merits of Food Processing

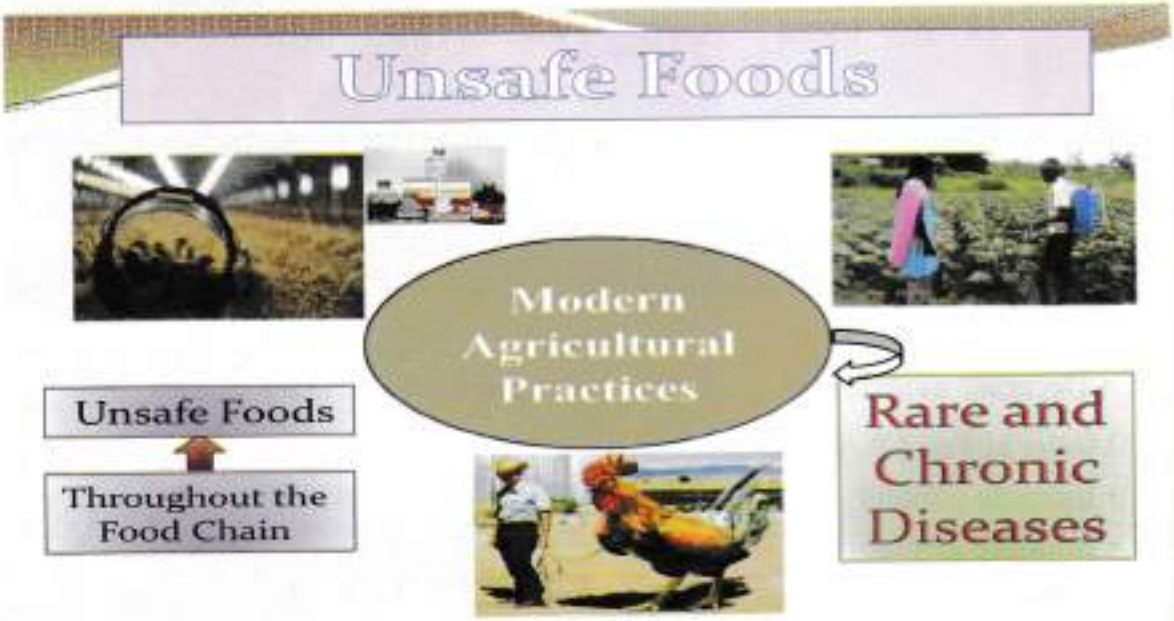
- Increase content
- Improve availability
- Parboil rice
- Carrot, Tomato and Pulses



Unsafe Foods

- **67% becoming poor due to visit Doctors**
- Hazards
- MAP
- Business

Practice/ Knowledge
Food
Health

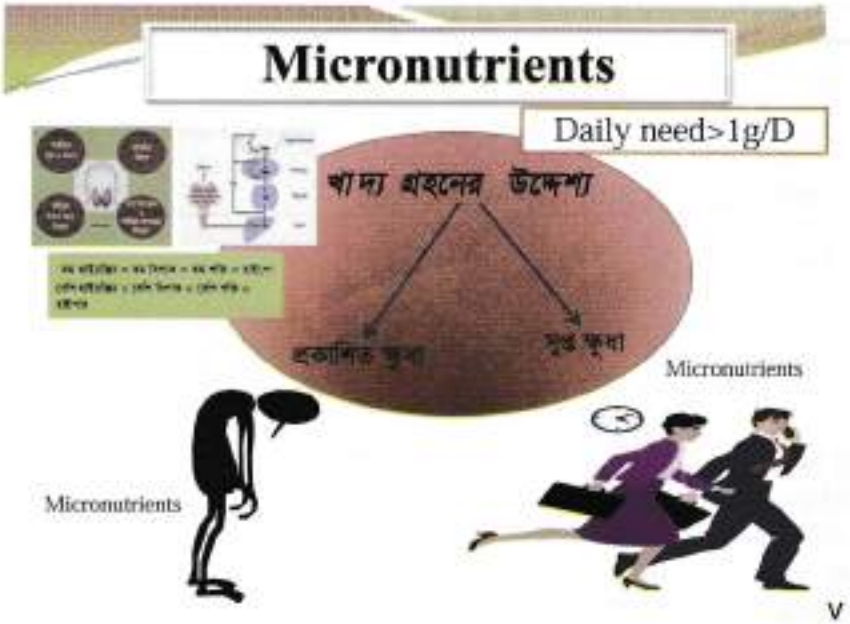


Unsafe Foods

Formalin in F&V

Production is the First Point to ensure:

- Safety
- Nutrition
- Supply



Diet Management

Food gives nutrients.

- Major part is water.
- Second highest is macronutrients.
- C, P and F
- All of them gives energy.
- Energy management is directly related to body weight.
- Knowledge of Diet Planning helps weight management.
- Energy Management Supply of energy = requirements or needs.
- Directly related to weight for adults
- Supply > Needs; calorie turns into fat
- gain weight – Overweight
- Supply < Needs; adipose tissue used up
- loss weight – Under weight
- 500Kcal excess/day; ½ kg gain in a week
- 100 Kcal excess/day; (3000 Kcal) or ½ kg gains in a Month;

5kg gains in a year 5Kcal less/day; 1/2kg loss in a

1 kg fat=7500Kcal
Walking a mile uses 100 to 125 Kcal
Staring one floor = 1 mile walking
One should not use stair up to 4 floors

- Weight management by Diet planning Diet planning: plan of your diet for optimum ene
- Requirements for diet planning
- Body status and Energy allowance
- BMI, Body weight and Height Ratio, Hip/Waist ratio
- Energy value of foods
- RDA of energy yielding foods
- Food Exchange
- Food Habit
- Body status

Body parameters

- Weight and Height ratio
- Internationally used parameter
- Body Mass Index (BMI)
- Used to assess body size of adult
- It is an importance indices for adult nutrition
- BMI = Weight (kg)/(height, m)^2
- BMI at obese associated diabetes and cardiovascular diseases
- Interpretation of BMI for adult

Lesson Plan-2

Title : National Food Safety Policy, Rules & Regulation Ref.No.14.1.2
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants concept National Food Safety Policy, Rules & Regulation, so that theyapply this policy, rules in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- discuss about National Food Safety Policy
- explain food safety acts
- deliver and reinforce the message of National Food Safety Policy, Rules & Regulation

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment (Q+A) • Topic: Concept on National Food Safety Policy • Importance: significance of National Food Safety Policy, Rules & Regulation • Outline of content	Lecture/ Discussion/ Q+A		6
Development • The Food Safety Acts, 2013 • Food Safety Rules • Food Safety Management System. • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9
Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.			
Behavior/Performance	**Condition**		**Criteria**

The Food Safety Act, 2013

Dr. Md. Burhan Uddin
Professor, BAU, Mymensingh

An Act to make provisions for the establishment of an efficient and effective authority and for regula through coordination, the activities relating to food production, import, processing, stock, supply, mark and sales, so as to ensure the rights toward access to safe food through appropriate application of scie process, upon repealing and reenacting the existing laws connected thereto. Whereas it is necessary to e the rights toward access to safe food for Whereas it is necessary to make provisions for the establishm an efficient and effective authority and for regulating, through coordination, the activities relating to production, import, processing, stock, supply, marketing and sales, so as to ensure the rights toward acc safe food through appropriate application of scientific process, upon repealing and reenacting the ex law connected thereto;

Institutional Structure of Food Safety System 3.

National Food Safety Management Advisory Council.

(1) To carry out the purposes of this Act, there shall be a council to be called the National Food Management Advisory Council for providing necessary advice and direction to the Authority concerned with the food safety management as to formulate policy and plan on food safety system, any other matter ancillary thereto.

(2) The Council shall consist of the following members, namely :øç

(a) Minister in charge of the Ministry of Food, who shall also be its President;

(b) Cabinet Secretary, who shall also be its Vice-President;

(c) a member of the Parliament nominated by the Speaker of the House of the Nation;

(d) Secretary, Ministry of Public Administration;

(e) Secretary, Ministry of Home Affairs;

(f) Secretary, Ministry of Health and Family Welfare;

(g) Secretary, Ministry of Commerce;

(h) Secretary, Ministry of Agriculture;

(i) Secretary, Ministry of Fisheries and Livestock;

(j) Secretary, Ministry of Environment and Forest;

(k) Secretary, Ministry of Industries;

(l) Secretary, Ministry of Science and Technology;

(m) Secretary, Ministry of Information;

(n) Secretary, Local Government Division;

(o) Secretary, Finance Division;

(p) Secretary, Legislative and Parliamentary Affairs Division;

(q) Chairman, Bangladesh Council of Scientific and Industrial Research;

(r) Chairman, Bangladesh Atomic Energy Commission;

(s) Chairman, Bangladesh Food Safety Authority;

(t) Director General, Directorate of Health Services; (u) Director General, Directorate of Food; (v) Director General, Directorate of National Consumer Rights Protection; (w) Director General, Bangladesh Standards and Testing Institution; (x) Director General, Bangladesh Accreditation Board; (y) Director, Institute of Nutrition and Food Science, University of Dhaka; (z) Chairman, Department of Chemistry, University of Dhaka; (za) President, Federation of Bangladesh Chambers of Commerce and Industries; (zb) a City Corporation Mayor and a Upazilla Parisad Chairman nominated by the Government; and (zc) Secretary, Ministry of Food, who shall also be its MemberSecretary. 6278 বাংলাদেশ গেজেট, অতিরিক্ত, এপ্রিল ২৮, 2016 (3) Save as the members referred to in clauses (c) and (zb) of sub-section (2), other members of the Council shall be ex-officio members of the Council. (4) The Council may, if necessary, co-opt any relevant person as a member of the Council.

Prohibitions related to Food Safety Management System

23. Use of poisonous elements.

No person shall, directly or indirectly, by himself or by any other person acting on his behalf, use or include in any article of food any chemical or ingredient or substance (such as: calcium carbide, formalin, sodium cyclamate), insecticides or pesticides (such as: DDT, PCB oil, etc.), or intoxicated food colour of flavouring matter, whether attractive or not, or any other intoxicated additives or processing aids, which may cause injury or toxicity to human health in any article of food; or shall store, market or sell any such article of food or food ingredient possessing such matter.

24. **Use of radioactive, heavy metals etc. in excess of acceptable limit.**

No person shall, directly or indirectly, by himself or by any other person acting on his behalf, use or include in any article of food or food ingredient any radioactive or irradiated matter or naturally of otherwise occurring similar matter or heavy metal in violation of maximum acceptable limit prescribed by regulations or by any other law for the time being in force.

25. Production, import or marketing of adulterated article of food or food ingredient, etc.

No person shall, directly or indirectly, with an intention to sell, by himself or by any other person acting on his behalf, produce or import, process, store, supply or sell any adulterated article of food or food ingredient.

26. Production of sub-standard food, etc.

No person shall, directly or indirectly, with an intention to sell, by himself or by any other person acting on his behalf, produce or import, process, store, distribute, or sell any article of food or food ingredient which is of sub-standard for human consumption in comparison with the standard prescribed by regulations.

27. Uses of food additives or processing aids. No person shall, directly or indirectly, by himself by any other person acting on his behalf, use or include in any additive or processing aid in viol of maximum acceptable limit prescribed by regulations in any article of food or food ingredie shall import, process, store, distribute or sell such article of food or food ingredient possessing matter.

28. Keeping of used industrial oil, industrial waste, adulterants, pollutants, etc. in establishment.

No person shall, directly or indirectly, by himself or by any other person acting on his behalf, ke allow to keep in his food establishment any used industrial oil, industrial waste or adulterants wi intention to mix them with any article of food or food ingredient.

29. Expired article of food or food ingredients.

No person shall, directly or indirectly, by himself or by any other person acting on his behalf, im process, store, supply or sell any article of food or food ingredient after the date of its expiry.

30. Uses of growth promoters, insecticides, pesticides or drug residues, microbes, etc.

No person shall, directly or indirectly, by himself or by any other person acting on his behalf, us include in any article of food or food ingredient any insecticide or pesticide residue, veterinar aquaculture drug residue, hormone, antibiotic or growth promoters residue, solvent residue, ac ingredients of drugs, microbes or parasites in excess to the maximum residue limit prescribed regulations or by any other law for the time being in force; or shall store, market or sell any s article of food or food ingredient possessing such matter.

31. Genetically modified food, organic food, functional food, proprietary food, etc.

No person shall, directly or indirectly, by himself or by any other person acting on his behalf, wit taking approval in the manner prescribed by regulations or under any other law for the time being force, produce, import, process, store, distribute or sell any genetically modified or engineered fo organic food, irradiated food, proprietary food, novel food, functional food, foods for special die uses, nutraceuticals and any such other food.

Explanation.

In this sectionøç (a) "proprietary food" or "novel food" means any food for which no standards is specified but is not unsafe and which does not contain any substance or matter prohibited regulations; (b) "food for special dietary uses", "functional food", "nutraceutical food" or "he supplement" means any food prepared in compliance with the special formula and maintained qualities prescribed by regulations to meet the necessity of special dietary for any special substantial physical condition or any special diseases or illness; (c) "organic food" means any fo produced in accordance with specified organic production process; and (d) "genetically modified engineered food" means any article of food or food ingredient composed of or containing genetic modified or engineered organisms obtained through modern biotechnology, or produced from but containing genetically modified or engineered organisms obtained through modern biotechnology.

32. Food packaging and labelling.
No person shall, directly or indirectly, by himself or by any other person acting on his behalf,øç (a) manufacture, distribute or sell any packaged food or food ingredient which is not packaged, marked and labelled in such manner as may be prescribed by regulations or any other law for the time being in force; (b) inscribe any false information or claim, or any mischieving or misleading information on the label mentioned in clause (a) concerning the food contained in the package or concerning the quantity or the nutritive value implying medicinal or therapeutic claims or in relation to the place of origin of the said food; (c) manufacture, distribute or sell any packaged food or food ingredient without complying with the obligation of labelling it with a representation of clear information about the production, packaging and expiry date of food and traceability information in the manner prescribed by regulations; and (d) sell any packaged food or food ingredient by changing or erasing any information inscribed on the label of the packaged food product or food ingredient.

33. Production, sale, etc. of food in unhygienic process regarded as hazardous to human health.
No person, by himself or by any other person acting on his behalf shall manufacture, import, process or sell any article of food or food ingredient in unhygienic process, in contravention of the conditions and in deviation from the standard process specified by regulations or under any other law for the time being in force, which may cause harm to human health.

34. Sale of diseased or decomposed fish, meat, milk, etc.
No person, by himself or by any other person acting on his behalf, shall produce, store, or sell diseased or decomposed fish or fish product or meat of diseased or dead animals or fowl or decomposed milk or egg or any food products made of such thing.

35. Food serving or catering in hotels, restaurants or food premises.øç
No person, by himself or by any other person acting on his behalf, who render food serving or catering services in a hotel, restaurant or food premises, shall cause hazard to human health through irresponsibility, negligence or carelessness in deviation from the standard prescribed by regulations or by any other law for the time being in force.

36. Manufacture of food by a person suffering from any contagious disease.
No person, by himself or by any other person acting on his behalf, shall cause any article of food or food ingredient to be prepared, stored or sold by a person who is suffering from any contagious disease.

37. Manufacture, sale, etc. of misbranded food.øç
No person, by himself or by any other person acting on his behalf shall, directly or indirectly, manufacture, import, store, distribute or sell any misbranded article of food or food ingredient similar or resembling to any article of food or food ingredient marketed in the name of any trade mark or in any trade name registered under the Trademark Act, 2009 (Act No, XIX of 2009).

38. Keeping and exhibiting the name, address and receipt or challan of the concerned parties.øç
Every food business operator or any other person acting on his behalf shall, while operating food business, keep

the name, address and receipt or challan of all parties involved in the manufacture, import, processing, storage, distribution or sale of any article of food or food ingredient; and shall be bound to exhibit the information to the Authority or any officer designated by it.

39. Production, sale, etc. of food without registration.
No person shall manufacture, import, process, store or sell any article of food or food ingredient without registering a food business which is mandatory under any law for the time being in force.

40. Rendering cooperation to the Authority or any person authorized by it.
Each food business operator or any person acting on his behalf shall, while operating food business, be bound to extend all kinds of cooperation to the Authority or to any officer designated by it at the time of inspection, investigation, sample collection or testing of anything related to food business.

41. False or misleading information in advertisement.
No person shall, with the intention of marketing or selling any article of food or food ingredient, cause harm to any consumer by giving any false or misleading information or statement in advertisement in contravention of the conditions for advertisement prescribed by regulations.

42. Making, printing or propagating of false advertisement.
(1) No person shall make, print, publish or propagate any advertisement containing false information as to quality, nature, standard etc. of any article of food or food ingredient through which people may be misguided.
(2) In a suit filed under this section, the defendant, for defending himself, shall have to prove that
(a) he was not aware of such false advertisement or he has not come to know despite due diligence; and (b) he, as a maker, printer, publisher or propagator has made, printed, published or propagated the advertisement in usual course of business.
(3) Where any complaint is lodged against any person under this section in any court, the court shall, unless otherwise proved, presume that such manufacturer or seller has made the endeavor or rendered the assistance to, print, publish or propagate such advertisement.

Inspection and Seizure of Food
Appointment of inspectors and assigning of their duties.øç
(1) The Authority shall appoint such numbers of Food Safety Inspectors, as may be necessary, for discharging the duties assigned to them under this Act.
(2) Notwithstanding anything contained in sub-section (1), the Authority may, for special purpose, with the approval of the Government or any other local authority, assign the duties of a Food Safety Inspector to any government officer or any officer of the local authority, and such officer shall, while discharging his duties, be deemed to be a Food Safety Inspector for the purposes of this Act. (3) Notwithstanding anything contained in sub-section (1) or (2), no person shall be appointed as Food Safety

Inspector or entrusted with the duties of a Food Safety Inspector, if he is involved, directly or indirectly, in any trade or business relating to production or marketing of food. 52. Duties and responsibilities of Inspector.øç(1) The Inspector shall discharge the following duties and responsibilities, namely :øç (a) to make regular inspection of any food establishment as per the direction of the Authority; (b) where applicable, to examine the terms and conditions of any licence for a food establishment; (c) to collect a sample of any food or food ingredient and send it to a Food Analyst for analysis or test, if it appears to him that such article of food or food ingredient is being manufactured, stored, sold or exhibited to sell, in deviation of the provisions of this act or any other existing law; (d) to receive, preserve and seize samples of food, and to preserve all records of inspection and to provide copies thereof, according to the direction of the Food Court; (e) to make inquiries and inspections, where necessary, to identify whether the article of food or food ingredient is being produced, stored or marketed in deviation of the provisions of this act or any other existing law; (f) to make search into a vehicle suspicious of carrying any unsafe food, by stopping it for a minimum reasonable time; (g) where the licence or registration of the food business of a person is revoked or suspended in a proceeding under this Act, to keep records of the name and address of the person and the nature and location of the food business; (h) to keep records of court orders passed in every proceeding conducted under this Act; (i) to send a copy of the court order passed in a proceeding filed or lodged under this Act to the Authority; (j) to seize any article of food or food ingredient suspected to be banned for importing or marketing; (k) to hold inquiry or investigation, as the case may be, upon receipt of any complaint as to the deviation of any provision of this Act; (l) to seize adulterated food; and (m) to discharge such other duties as may be directed by the Authority or the Food Court.

Power to seize adulterated food.

(1) An Inspector may, at any time other than the time from midnight to dawn,øç (a) inspect any distribution premises or supply routes, stock premises, or the condition of substance to be used in food, its place or its processing; and (b) examine any ingredient used or to be used in food or any container or receptacle used for manufacturing or marketing any food. (2) No person shall resist or cause to resist any Inspector from inspecting or examining anything under sub-section (1). (3) While making an inspection or examination under sub-section (1), if the Inspector has reasons to believe that any living or active ingredient or any বাংলাদেশ গেজেট, অতিরিক্ত, এপ্রিল 28, 2016 6301 container or any of its component, which is kept for use in manufacturing or marketing a food, is injurious to or unwholesome for human health or adulterated, he may seize all such things or all foods made of such things. (4) No person shall resist or cause to resist the act of seizing anything under sub-section (3). (5) If any food, ingredient or substance which is believed to be adulterated is under sub-section (3), the Inspector seizing it shall, forthwith separating the sample of it in accordance with the provisions of section 48, divide and hand over the same in the prescribed manner. (6) If any living or active thing or any container or any of its component or any article of food made of them is seized under sub-section (3), the person seizing it shalløç (a) immediately remove such living or active thing, container or its component; and (b) after removal, keep them in safe place by marking and sealing in the prescribed manner, and take necessary measures according to the provisions of section 56 or section 57, as the case may be. (7) No person shall resist or cause to resist an act of removing anything under the provisions of this section, and remove any living or active thing, food ingredient or container from the safe custody as kept under clause (b) of subsection (6) or hand over the same from safe custody. 56. Destruction of living or active ingredient, etc.øç(1) If any living or active thing, article of food, food ingredient, substance or container is seized

under sub-section (3) of section 55 by an Inspector or any person so empowered by any author such things may be instantly destroyed in presence of the owner or of the person in whose poss such things have been found, or in presence of two witnesses on the written consent of the own If such consent is not given, the living or active thing or article of food or food ingredi substance so seized shall forthwith be destroyed if such things are found perishable or injur human health or unwholesome as human food to the judgment of the Inspector or of the auth person seizing such things under sub-section (3) of section 55. (3) All the expenses incurr taking measures under sub-sections (1) and (2) shall be realized as public demand from the per whose possession such living or active thing or article of food or food ingredient or substa container has been found at the time of seizure. ৬৩০২ বাংলাদেশ গেজেট, অতিরিক্ত, এপ্রিল ২৮, 20 Disposal of seized living or active thing or article of food or food ingredient or substa container.-øç(1) If any living or active thing or any ingredient or substance or container is sei an Inspector or any person authorized in this behalf by the Authority as specified in sub-section section 55, and such living or active thing or article of food or food ingredient or substa container is not destroyed according to section 56, the person from whose possession such have been seized shall be informed to the effect that the seized things shall be produced be Magistrate having local jurisdiction. (2) Whether any complaint is made or not under this Act other law for the time being in force, if any living or active thing or any ingredient or any subs or any container is produced before a Magistrate to consider the matter under sub-section (1), the Magistrate, after taking such evidence as he may deem fit, thinks thatøç (a) such food or liv active thing or article of food or food ingredient or substance is injurious to human hea unwholesome as human food or contaminated or adulterated; or (b) for sale purpose, such con is used to manufacture or preserve any adulterated food, or any other food injurious to human or unwholesome as human food or contaminated food, or contains any material, ingredie substance which is injurious to human health or unwholesome as human food, he shall confi such living or active thing or article of food or food ingredient or substance or container in fav the Authority and ask the Authority to forthwith destroy them, and if so asked, the Authority destroy it or take measures to otherwise dispose of it.

SCHEDULE
(See Section 58)

Sl. No	Sections	Description of offences	Impossible penalty for the offences committed first time	Imposable penalty for repetition of offences
1	2	3	4	5
(1)	23	To use or include any chemical or its ingredients or substance, insecticides or pesticides or food colour or flavouring matter, or any other intoxicated additives or processing aid in any article of food which my cause injury of toxicity to human health or store, market or sell any article of food or food ingredient possessing such matter.	Imprisonment for a period not exceeding five years but not less than four years, or a fine not exceeding Taka ten lac but not less than Taka five lac, or with both.	Imprisonment for five years or a fine of Taka twenty lac, or with both.
(2)	24	To use or include any radioactive or irradiated matter or naturally or otherwise occurring similar matter or heavy metal, in violation of maximum acceptable limit set out by regulations of under any other law for the time being in force, in any article of food or food ingredient.	mprisonment for a period not exceeding four years but not less than three years, or a fine not exceeding Taka eight lac but not less than Taka four lac, or with both.	Imprisonment for four years or a fine of Taka sixteen lac, or with both.
(3)	25	With an intention to sell, to produce, or import, process, store, supply or sell any adulterated article of food or food ingredient.	Imprisonment for a period not exceeding three years but not less than one year, or a fine not exceeding Taka six lac but not less than Taka three lac, or with both.	Imprisonment for three years or a fine of Taka twelve lac, or with both.
(4)	26	To produce or import, process, store, distribute or sell any article of food or food ingredient which is of sub-standard for human consumption in comparison with the standard set out by regulations	Imprisonment for a period not exceeding three years but not less than one year, or a fine not exceeding Taka six lac but not less than Taka three lac, or with both.	Imprisonment for three years or a fine of Taka twelve lac, or with both.
(5)	27	To use or include any food additive or processing aid in violation of maximum acceptable limit set out by regulations, in any article of food or food ingredient; or import, process, store, distribute or sell such produced food or food ingredient processing such matter.	Imprisonment for a period not exceeding three years but not less than one year, or a fine not exceeding Taka six lac but not less than Taka three lac, or with both.	Imprisonment for three years or a fine of Taka twelve lac, or with both.

(6)	28	To keep or permit to keep in his food establishment, any oil for industrial use or industrial waste or adulterant with intention of mixing with any article of food or food ingredient.	Imprisonment for a period not exceeding three years but not less than one year, or a fine not exceeding Taka six lac but not less than Taka three lac, or with both.	Ir
(7)	29	To import, process, store, distribute or sell any article of food or food ingredients after the date of its expiry.	Imprisonment for a period not exceeding three years but not less than one year, or a fine not exceeding Taka six lac but not less than Taka four lac, or with both.	Ir
(8)	30	To use or include any insecticide or pesticide residue, veterinary or aquaculture drug residue, hormone, antibiotic or growth promoters residue, solvent residue, active ingredients of drugs, microbes or parasites in any food or food ingredient in excessive quantity than the recommended maximum residue limit as determined by regulations or under any other law for the time being in force; or store, market or sell any such article of food or food ingredient possessing such matter.	Imprisonment for a period not exceeding three years but not less than one year, or a fine not exceeding Taka six lac but not less than Taka three lac, or with both.	Ir
(9)	31	To produce, import, process, store, distribute or sell any genetically modified food, engineered food, organic food, irradiated food, proprietary food, novel food, functional food, foods for special dietary uses, nutraceuticals and any such other food without taking approval in the manner prescribed by regulations or under any other law for the time being in force.	Imprisonment for a period not exceeding three years but not less than one year, or a fine not exceeding Taka six lac but not less than Taka three lac, or with both.	
(10)	32(a)	To manufacture, distribute or sell any packages food or food ingredient which are not packaged, marked and labeled in the manner as may be prescribed by regulations or under any other law for the time being in force.	Imprisonment for a period not exceeding two years but not less than one year, or a fine not exceeding Taka four lac but not less than Taka two lac, or with both.	
(11)	32(b)	To inscribe any false information or claim, or any mischieving or misleading information on the label mentioned in clause (a) of section 32 concerning the food contained in the package or concerning the quantity of the nutritive value implying medicinal	Imprisonment for a period not exceeding two years but not less than one year, or a fine not exceeding Taka four lac but not less than Taka two lac, or with both.	

(12)	32(c)	To manufacture, distribute or sell any packaged food or food ingredient without complying with the obligation of labelling it with a representation of clear information about the production, packaging and expiry date of food and traceability information in the manner prescribed by regulations.	Imprisonment for a period not exceeding two years but not less than one year, or a fine not exceeding Taka four lac but not less than Taka two lac, or with both.	Imprisonment for two years or a fine of Taka eight lac, or with both.
(13)	32(d)	To sell any packaged food or food ingredient by changing or erasing any information inscribed on the label of the packaged food product or food ingredient	Imprisonment for a period not exceeding two years but not less than one year, or a fine not exceeding Taka four lac but not less than Taka two lac, or with both.	Imprisonment for two years or a fine of Taka eight lac, or with both.
(14)	33	To manufacture, import, process or sell any article of food or food ingredient in unhygienic process, in contravention of the conditions and in deviation from the standard process specified by regulations or under any other law for the time being in force, which may cause harm to human health.	Imprisonment for a period not exceeding three years but not less than one year, or a fine not exceeding Taka six lac but not less than Taka three lac, or with both.	Imprisonment for three years or a fine of Taka twelve lac, or with both.
(15)	34	To produce, store or sell diseased or decomposed fish or fish product or meat of diseased or dead animals or fowl or decomposed milk or egg or any food products made of such thing.	Imprisonment for a period not exceeding three years but not less than one year, or a fine not exceeding Taka six lac but not less than Taka three lac, or with both.	Imprisonment for three years or a fine of Taka twelve lac, or with both.
(16)	35	To cause hazard to human health through irresponsibility, negligence or carelessness in deviation from the standard prescribed by regulations or under any other law for the time being in force, while rendering food serving or catering services in a hotel, restaurant or food premises, by himself or by any other person acting on his behalf.	Imprisonment for a period not exceeding three years but not less than one year, or a fine not exceeding Taka six lac but not less than Taka three lac, or with both.	Imprisonment for three years or a fine of Taka twelve lac, or with both.
(17)	36	To cause to manufacture, store or sell any article of food or food ingredient by any person who is suffering from any contagious diseases.	Imprisonment for a period not exceeding two years but not less than one year, or a fine not exceeding Taka four lac but not less than Taka two lac, or with both.	Imprisonment for two years or a fine of Taka eight lac, or with both.
(18)	37	To manufacture, import, store, distribute or sell any misbranded article of food or food ingredient similar or resembling to any article of food or food ingredient marketed in the name of any trade mark or in any trade name registered under the Trademark Act, 2009 (Act No, XIX of 2009).	Imprisonment for a period not exceeding three years but not less than one year, or a fine not exceeding Taka six lac but not less than Taka three lac, or with both.	Imprisonment for three years or a fine of Taka twelve lac, or with both.

(19)	38	While operating food business, not to keep the name, address and receipt or challan of all parties involved in the manufacture, import, processing, storage, distribution or sale of any article of food or food ingredient, and to exhibit the information to the Authority or any officer designated by it.	Imprisonment for a period not exceeding one year but not less than six months, or a fine not exceeding Taka two lac but not less than Taka one lac, or with both.	Impriso for on or a fi Taka fi or with
(20)	39	To manufacture, import, process, store, distribute or sell of any article of food or food ingredient without registration which is mandatory under any other law for the time being in force.	Imprisonment for a period not exceeding one year but not less than six months, or a fine not exceeding Taka two lac but not less than Taka one lac, or with both.	Impris for o or a Taka or w
(21)	40	While operating food business, not to extend all kinds of cooperation to the Authority or to any officer designated by it at the time of inspection, investigation, sample collection or testing of anything related to food business.	Imprisonment for a period not exceeding one year but not less than six months, or a fine not exceeding Taka two lac but not less than Taka one lac, or with both.	Impri for or a Taka or w
(22)	41	With the intention of marketing or selling any article of food or food ingredient, to give any false or misleading information or statement in advertisement in contravention of the conditions for advertisement prescribed by regulations.	Imprisonment for a period not exceeding one year but not less than six months, or a fine not exceeding Taka two lac but not less than Taka one lac, or with both.	Impr for or Tak or
(23)	42	To make, print, publish or propagate any advertisement containing false information as to quality, nature, standard etc. of any article of food or food ingredient.	Imprisonment for a period not exceeding one year but not less than six months, or a fine not exceeding Taka two lac but not less than Taka one lac, or with both.	Imp fo or Tak or

Lesson Plan-3

Title : Food Processing & Preservation:Implications for Food security Ref.No.14.1.3

Target people : Grade-9 and above officers under MoA

Time : 60 minutes.

Aims /Rationale : To teach participants concept of safety nets, analyzing the risk of becoming food insecure, creates health and wellness in the community and apply to this in their relevant field.

Learning Outcomes : After completion of training session the participants will be able to:

- discuss about safety nets
- explain analyzing the risk of becoming food insecure
- create health and wellness in the community
- deliver and reinforce the message of safe and nutritious food

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Concept on safe and nutritious foods • Inportance: Food Processing & Preservation: Implication • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Safety nets • Analyzing the risk of becoming food insecure • Health and wellness in the community • Deliver and reinforce the message of safe and nutritious food. • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

Behavior/Performance **Condition** **Criteria**

Lesson-3
Processing & Preservation:Implications for Food security

Dr. Md. Burhan Uddin
Professor, BAU, Mymensinh

Nutrition: An interdisciplinary science that studies food and health with a focus on the nutrie chemical properties of foods.

Basic Concepts:

1. food is a basic need of humans
2. foods provide energy, nutrients & other substances required for health
3. health problems related to nutrition originate within cells
4. poor nutrition can result from both inadequate and excessive nutrient intake
5. humans have adaptive mechanisms for managing fluctuations in nutrient intake
6. malnutrition can result from poor diets, disease, genetic factors or a combination of these fac
7. some groups of people are at a higher risk of becoming malnourished than others
8. poor nutrition can influence the development of certain chronic diseases
9. adequacy, variety, and balance are key points in a healthful diet. 10. there are no "good" or " foods

Food security: Access at all times to sufficient supply to safe nutritious foods.

Food insecurity: Limited access or uncertain availability of safe, nutritious food and limited acc or ability to aquaria them in socially acceptable ways.

ex. situation in Syria creating problem for civilians to access food they need.

- creates greater risk of developing chronic disease Possible reasons for food insecurity/chro disease: -lack of information

-cost of eating healthy/access

-inexpensive foods and their level of nutrition

- poverty -absence of supermarkets aka accessibility

-limited opportunity to exercise

-limited access to cooking facilities (kitchens, ovens, running water etc.)

second basic concept : Foods Provide Energy, Nutrients, & Other Substances Required for Healt

Nutrients: chemical substances used by the body that help sustain growth and development categories.These are water, protein, carbs fats, vitamins, minerals. Energy nutrientsare Prote Carbs and Fats.

Third basic concept : Health Problems Related to Nutrition Originate Within Cells. Red Blo Cell production is promoted by Iron. Lack of leads to lack of hemoglobin and circulation of oxyg in the body. i.e nutrient deficiency.

Fourth basic concept: ex. obesity. we need carbs and fats, but too much and it will become stored fat in the body. Excessive.Poor Nutrition Can Result From Both Inadequate and Excessive Nutrient Intake.

3 nutritional deficiencies

1. Under Consumption :happens in developing nations (malnutrition)
2. Over Consumption: the typical American diet (obesity)
3. Under Nutrition: Comes from refined foods, lack of micronutrients

Fifth basic concept: Humans Have Adaptive Mechanisms for Managing Fluctuations In Nutrient Intake.

Sixth basic concept: Malnutrition Can Result From Poor Diets, Disease, Genetic Factors, or a Combination of These Factors.

Seventh basic concept: Some Groups of People are at Higher Risk of Becoming Malnourished Than Others. - elderly, sick, athletes, immunity deficiencies (i.e. cancer patients), pregnancy.

eighth basic concept: - being overweight can lead to high blood pressure and related complications - stroke, atherosclerosis (build up in arteries), heart attack or failure, kidney failure -cavities -health of the colon (sand which meat, beef jerky, pickles) Poor Nutrition Can Influence the Development of Certain Chronic Diseases

ninth basic concept : - fruits, vegetables, breads/cereals/potatoes, meats/alternative, foods containing fats/sugars, milk/dairy foods. Adequacy, Variety, and Balance are Key Points of a Healthful Diet.

Tenth basic concept : ex. rotting food: toxic and will make you sick ex. hamburger: not nutritious, but its also not toxic There are No "Good" or "Bad" Foods.

Nutritious Food: A "nutritious" food as a food that in the context where it is consumed and by the individual that consumes it, provides beneficial nutrients (e.g. vitamins, major and trace minerals, essential amino acids, essential fatty acids, dietary fiber) and minimizes potentially harmful elements (e.g. anti-nutrients, quantities of saturated fats and sugars). The contextual or target group qualification is necessary because particular vulnerable groups have special needs, which can make a given food nutritious for them while being potentially undesirable for others. For example, a one-year old infant needs foods that are energy- and nutrient-dense, while this might be undesirable for an adult who might receive excessive amounts of some micronutrients or an adolescent at risk of obesity. Similarly, high

energy density is of importance for individuals suffering from acute malnutrition, whereas l density may be preferable for overweight individuals.

Safe and Nutritious Foods : Specifically, safe food is that in which attributes derived from chain (pathogens, parasites and contaminants, including agrochemicals and food chain my that could cause adverse health outcomes do not exceed internationally agreed thresholds.

Typology of Nutritious foods:

Characteristic	Description	Examples of food cat
High inherent nutritional value	Naturally contains micronutrients, dietary fiber, high quality protein and/or essential fats in significant quantities ii. No major anti-nutritional or harmful qualities when consumed in recommended quantities.	Rich sources of nutri Fruits and vegetables legumes; nuts and see unsweetened dairy pr eggs; fish, lean meat
Enhanced nutritional value	Foods with some inherent nutritional value that become more nutritious through the addition of nutrients (i.e. fortification) or changes to the processing procedures. No major anti-nutritional or harmful qualities.	Fortified staple grains mitigating loss of ger dietary fiber in grain
Some inherent nutritional value	Foods with some inherent nutritional value for which potentially harmful elements have been minimized	Minimally sweetened products; low fat iv, s and minimally proces meat; low sugar fortif biscuits
Source of added nutrients	A condiment, food or product that enhances the nutritional value of foods or diets to which it is added v .	Iodized salt; fortified oil; micronutrient pow lipid-based nutrient supplements

Lesson Plan-4

Title : An Overview on food processing and preservation Ref.No.14.1.4
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants food processing and preservation, so that they can apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- discuss about importance of food processing and preservation
- explain methods of food processing and preservation
- nutrition services

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Overview on food processing and preservation • Importance: significance food processing and preservation • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Concept of food processing and preservation • Factors affecting food processing and preservation • Importance of food processing and preservation • Different method of food processing and preservation • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

Behavior/Performance	Condition	Criteria

Lesson-4

An Overview on Food Processing and Preservation

DR. MD. Mayen
Deputy Director
NATA, Gazipur.

Introduction

➢ Increased demand for foods with
✓ adequate nutrients
✓ sensory satisfaction
✓ additive free
➢ Thermal treatment of foods safe but high heating results in unacceptable quality and retention.
➢ The modern technologies employ reduced stress on foods that avoid undesirable chan extend the shelf life.
➢ The modern techniques are non-thermal or semi-thermal which are effective for inactiv microorganisms and enzymes.
➢ Non-thermal processing is effectively combined with thermal processing to provide impro safety and quality.

Some established modern technologies :

- High Pressure Processing
- Pulsed Electric Fields Processing
- Membrane Processes
- Ultrasound Processing
- Ohmic Heating
- Food Irradiation
- Radio-Frequency Processing
- Application of Ozone in Food Processing
- Minimal Processing of fruits and vegetables

High Pressure Processing (HPP)

➢ HPP is a cold pasteurization technique
➢ Pressures above 400 MPa / 58,000 psi at cold (refrigeration) or ambient temperature inact microbes and enzymes.
➢ HPP offers the food safety while meeting consumer demand for fresher-sensory and n quality.

The key advantages of HPP:

- Flexible size and geometry of the sample during processing
- Possibilities of low temperature treatment
- Availability of a waste-free, environment-friendly technology

High Pressure Processing

Products, already sealed in its final package, are introduced into a vessel and subjected to a high level of isostatic pressure (applies equal pressure in all directions) (300–600MPa/43,500-87,000 psi) transmitted by water

Pulse Electric Field (PEF) Processing

➢ PEF is a non-thermal method that uses short pulses of electricity for microbial inactivation and minimal detrimental effect on food quality.

➢ PEF improves the extraction rates of juices, sugars, coloring agents and other active substances and significantly extends shelf life.

➢ PEF technology involves the application of pulses of high voltage to liquid or semi-solid foods placed between two electrodes.

Membrane Technology

➢ Liquid foods (fruit juices and natural colors) extracted from their sources have high-water load.

➢ Evaporation by heating results in a loss of fresh flavors, color and gives "cooked" taste.

➢ Therefore, newer technologies are such as ultrafiltration (UF), nano-filtration (NF), reverse osmosis (RO), direct osmosis (DO) etc. are continued to develop.

➢ Applications:

• Purify & concentrate fruit juices, fermented liquors, vegetable oils etc. Fractionate food ingredients, for example; milk can be converted to whey protein solution, casein solution etc

➢ In Membrane Technology particles are separated on the basis of their molecular size and shape with the use of pressure and specially designed semi-permeable membranes.

Food Irradiation

➢ Food is exposed to doses of ionizing energy, or radiation.

➢ Irradiation of foods inactivates (low dose)/ kills (high dose) the insects, moulds and bacteria but sometime cannot kill viruses.

➢ There is a common misconception that irradiated food is radioactive.

▪ The radiation used to process foods is very different from the radioactive fallout that occurs after, for example, a nuclear accident.

▪ In food processing, the radioactive sources are not permitted to generate gamma, electrons or x-rays of high energy to make food radioactive.

▪ The World Health Organization (WHO), the American Dietetic Association and the Scientific Committee of the European Union support food irradiation.

➢ Gamma rays and x-rays (from a high-energy electron beam or powerful x-rays) pass through the food just like microwaves in a microwave oven, which can be switched on or off.

Application of Ozone

➢ Ozone has been used commercially for the treatment of drinking water since 1906.

➢ Increasingly employed in the food industry for sanitizing food-contact surfaces and products (fruits, vegetables, and meat) preservation.

➢ It is a broad-spectrum antimicrobial agent that is active against a range of food-borne pathogens.

➢ Ozone readily reverts to oxygen, an end-product that leaves no residue on contact surfaces.

➢ Use of ozonated water for sanitation in food plants prevents biofilm formation, results clean runoff water. ➢ Hence, environmental friendly.

Application of Ozone Ozone gas is generally created on-site by a generator via an electrical ch from oxygen. The gas is pumped into water, and the ozonated water is used as a rinse, mist, s bath.

Minimal Processing of Fruits and Vegetables

➢ In this system fresh fruits and vegetables are subjected to basic processing steps e.g., trimming, cutting, washing, disinfection, rinsing, etc.

➢ These commodities contain exclusively natural ingredients, and they are kept under chi polymeric films or in modified atmosphere packaging (MAP) conditions.

➢ The products need no further processing before use, offering high quality products with litt at a reasonable price.

Food Preservation Methods

Based on the mode of action, the major food preservation techniques can be categorized as
(1) slowing down or inhibiting chemical deterioration and microbial growth,
(2) directly inactivating bacteria, yeasts, molds, or enzymes, and
(3) avoiding recontamination before and after processing.

A number of techniques or methods from the above categories are shown in Figure 1.3. W currently used traditional preservation procedures continue in one or more of these three wa have recently been great efforts to improve the quality of food products principally to requirements of consumers through the 8 Handbook of Food Preservation, Second Editi preservation methods Inhibition Low-temperature storage Reduction of water activity Dec oxygen Increase of carbon dioxide Acidification Fermentation Adding preservatives antioxidants Control of pH Freezing Drying Concentration Surface coating Structural modi Chemical modifications Gas removal Changes in phase transition

Food Preservation

Food preservation is a key part of food processing. Preserving food is a form of processing it, other forms of food processing require the food to be preserved first. There are many diffe preservation methods in use, some of which can be done at home and others that require t commercial food manufacturing equipment.

Methods of food preservation that anybody can do at home include:

- Baking food in an oven to dry it out
- Air-drying food
- Potting
- Blanching
- Jellying
- Freezing
- Fermentation
- Preserving in salt or sugar
- Pickling
- Preserving food in alcohol
- Preserving food in olive oil
- Canning

The goal of many of these food preservation methods is to completely block air from reaching the food and causing a chemical reaction that results in spoilage. This includes the moisture within the food evaporating and contact between food tissues and oxygen causing oxidation.

There are also food preservation methods that can be done at home with pieces of specialized equipment. These include:

- Pressure canning
- Freeze drying
- Smoking
- Vacuum sealing
- Dehydration

A few examples of these preservation methods in use are:

- Smoking meats with a smoker
- Using an at-home freeze dryer to freeze dry berries
- Using a vacuum sealer to completely eliminate oxygen within a plastic storage bag

Some food preservation methods are reserved for those with access to industrial food processing equipment. These include:

- Irradiation
- Pasteurization
- Controlled organism use
- Pulsed electrical field processing
- Modified atmosphere preservation
- High-pressure preservation

Lesson Plan-5

Ref.No.14.1.5

Title : GAP and SOP
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims/Rationale : To teach participants GAP and SOP principleswhich they apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- identify GAP and SOP
- discuss principles of GAP
- explain Components of GAP
- illustrate the importance of GAP/SOP
- discuss Mitigation Measures of On-Farm Deficiencies

Content	Methods or Techniques	Resources or Aids	Time (Minute
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic: GAP and sop • Importance: significance of GAP and SOP • Outline of content	Lecture/ Discussion/ Q+A		6
Development • GAP and SOP • principles of GAP • Components of GAP • the importance of GAP/SOP • Mitigation Measures of On-Farm Deficiencies • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

Behavior/Performance	Condition	Criteria

Lesson-5
Good Agricultural Practices (GAP) and Standard Operating Procedure (SOP)

Mahmud Hasan
Deputy Director
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What is GAP

GAP is a set of ***principles, regulations and technical Recommendations***applicable to production, processing, and transporting addressing human health care, environment protection and improvement of working conditions.

Main focuses:

- Reduction of risks from insects and pathogens
- Heavy metals and pesticide residues
- Ensure worker health and safety and
- Protect the sustainability of the environment.

Why the GAP/SOP??

…..Serious problem facing Bangladesh on Plant Quarantine Pests/Produce Quality and Safety…. Interceptions:

Interception of consignment is aggravating the situation at an alarming stage.

2 major causes:

-Harmful Organisms

-Documentary faults

a. Snake, bottle,spong,ridge and wax gourds,teasel gourd, bitter gourd, yard long bean -*Fruits fly, Thrips*

b. Brinjal-Thrips

c. *Mango- Fruit fly, weevils*

d. Guava, litchi- Pest free

Better Packaging

Elements and Objectives of the GAP Standard

Elements	Quality Objectives
Water source	Physical, chemical and biological safety
Cultivation site	
Use of agro-chemicals	
Product storage & on-site transportation	
Data records	Trace back (Traceability)
Pest-free products and occurrence of plant diseases	Freedom from pests
Quality management in agricultural production	Customer satisfaction
Harvesting and Post-harvest management	

Principles of GAP

Current Deficiencies in On-Farm Practices

- Farmers not aware on importance of quality inputs
- Stakeholders are mostly ignorance about SPS and TBT measures

- Knowledge deficiencies

- In-sufficient quality control of agro-chemicals
- Weak inspection and auditing of farms
- No established maturity index of FVs
- Rough handlings; untimely harvesting, tools/containers
- In adequate field sorting, grading and packaging
- Absence of use friendly basic communication documents
- No quality standards and certification system.

Mitigation Measures of On-Farm Deficiencies

- Aware farmers & dealers on importance of quality inputs
- Increase knowledge base & train on SPS and TBT measures
- Develop qualified officers & staff –*Increase knowledge base*
- Strictly control quality of agro-chemicals
- Strengthen inspection and auditing of farms/dealers shop
- Establish maturity index of FVs
- Carefully handle and harvest timely using tools
- Use clean containers and safe water to wash
- Practice field sorting, grading and packaging
- Develop user friendly communication materials
- Establish quality standards and certification system.

On-Farm Safety and Quality Hazards

- Presence of heavy metals- *arsenic, lead & cadmium)*
- Polluted water - *irrigation and washing*
- Use of untreated manure

– *spread microbial pathogen*

- Imbalanced use of chemical fertilizers

– *degrade the soil and pollute water*

- Indiscriminate /over uses of pesticides

–*residual effects on human health, ecology and environment.*

- Use of banned pesticides

– *cheap/ unawareness about banned pesticides*

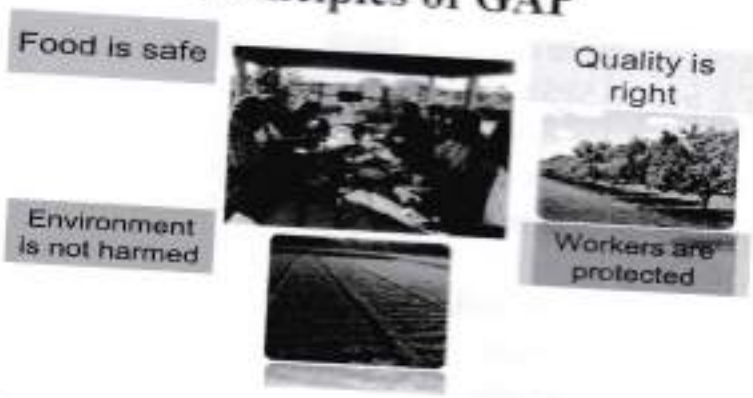
- Ignore recommended pre-harvest intervals (PHI) – *ignorance/negligence*
- Risk-averse farmers believe that reducing use of pesticides would significantly reduce their yield
- Farmers are not well aware about the dangers of pesticides.
- Unware of the correct product or dose of pesticides – *cheap/ unawareness about banned pesticides*
- Farm level knowledge on microbial and chemical contamination is inadequate
- Pesticide spillage is quite common and empty packets/containers are usually not disposed properly.

Components of GAP

1. Location
2. Farming environment and practices
3. Water quality and irrigation
4. Crop protection
5. Pre and postharvest management
6. Workers' health and hygiene,

and Record keeping.

Principles of GAP



Standard Operating Procedure

No matter what kind of operation you run, **SOP** can help to avoid and manage risk and improve the efficiency of your operation.

The purpose of SOPs is to make sure everyone to manage the operation smoothly and correctly.

Some other good reasons for writing SOPs include:

- Making everyone's work more consistent.
- Letting workers in on the tips and tricks you use to make things work.
- Helping you comply with Good Agricultural Practices (GAP)

Production of Fruits & Vegetables

Application of GAP

1. Quality Plan

Practice 1. Practices that are critical to managing producequality& safety during production, harvesting and PHH areidentified in a quality plan for the crop grown.

2. Planting materials

Practice 2. Crop varieties are selected to satisfy market requirements.

Practice 3. Planting materials are ofgood quality.

3. Fertilizers and Soil Additives

Practice 4.Nutrient application is to be based on recommendations.

Practice 5. Equipment used to apply fertilizers and soil additives is maintained in working condition and checked for effective operation.

Practice 6.Areas and facilities for composting of organic materials are located, constructed and maintained to prevent contamination of crops by diseases.

Practice 7. Application of fertilizers and soil additives is recorded, detailing the name of the product, date, treatment location, application rate and method, and operator name.

4. Water

Practice 8. Irrigation use is based on crop water requirements, water availability, and soil moisture levels. \

Practice 9. Record of irrigation use is to be kept, detailing the crop, date, location, and volume of water applied or duration of irrigation.

5.Agrochemical

Practice 10. Employers and workers should be trained to a level appropriate to their area of responsibility for chemical application.

Practice 11. Crop protection measures are appropriate for the control of pests.

Practice 12. IPM systems are used where possible.

Practice 13. Chemicals are only obtained from licensed suppliers.

Practice 14. Chemicals used on crops are approved & applied as per label directions or a permit issued by a competent authority.

Practice 15. Equipment used to apply chemicals is maintained and checked for effective operation.

Practice 16. The application of chemicals is recorded for each crop, detailing the chemical used, reason for application, treatment location, date, rate and method of application, weather conditions, and operator name etc.

6. Traceability and Recall

Practice 17. Each separate production site is to be identified by a name or code. The name or code is to be placed on the site and recorded on a property map. The site name or code must recorded on all documents and records that refer

Practice 18. Employers and workers have appropriate knowledge or are trained in their area of responsibility relevant to GAP and a record of training is to be kept.

7. Documents and Records

Practice 19. Records of GAPs are to be kept for a minimum period of at least two years or for a longer period if required by government legislation or customers. 8. Review of Practices

Lesson Plan-6

Title : Overview on Washing and Cooling of fresh produces Ref.No.

Target people : Grade-9 and above officers under MoA

Time : 60 minutes.

Aims /Rationale : To teach participants Overview on Washing and Cooling of fresh p which they apply in their relevant field.

Learning Outcomes : After completion of training session the participants will be able to:

- discuss importance of Washing and Cooling of fresh produces
- explain Washing and Cooling of fresh produces

Content	Methods or Techniques	Resources or Aids	(M
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Overview on Washing and Cooling of fresh produces • Importance: significance of Washing and Cooling of fresh produces • Outline of content	Lecture/ Discussion/ Q+A		
Development • Importance of Washing and Cooling of fresh produces • Methods of Washing and Cooling of fresh produces • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. available in the class room.

Behavior/Performance **Condition** **Crite**

Lesson-6
Overview on Washing and Cooling of fresh produces

Cooling: Cooling of vegetables after water blanching or steaming is performed in order to avoid excessive softening of the tissues and has to follow immediately after these operations; one exception is the case of vegetables for drying which can be transferred directly to drying equipment without cooling.

Natural cooling is not recommended because is too long and generates significant losses in vitamin C content. Cooling in pre-cooled air (from special installations) is sometimes used for vegetables that will be frozen

Cooling in water can be achieved by sprays or by immersion; in any case the vegetables have to reach a temperature value under 37° C as soon as possible. Too long a cooling time generates supplementary losses in valuable hydrosoluble substances; in order to avoid this, the temperature of the cooling water has to be as low as possible.

Washing: Washing is used not only to remove field soil and surface micro-organisms but also to remove fungicides, insecticides and other pesticides, since there are laws specifying maximum levels of these materials that may be retained on the vegetable; and in most cases the allowable residual level is virtually zero. Washing water contains detergents or other sanitisers that can essentially completely remove these residues.

The washing equipment, like all equipment subsequently used, will depend upon the size, shape and fragility of the particular kind of vegetable:

flotation cleaner for peas and other small vegetables; rotary washer in which vegetables are tumbled while they are sprayed with jets of water; this type of washer should not be used to clean fragile vegetables;

Post-harvest water Water is used in a number of post-harvest activities, e.g. in dump tanks and hydrocoolers, as a mixing agent for post-harvest treatment with waxes or fungicides or simply as a washing and rinsing agent. In order to reduce the risk of produce contamination, proper water quality is essential in all post-harvest activities. Pathogens present on freshly harvested fruit and vegetables can accumulate in water handling systems, as a result of which such post-harvest water can contaminate other products. When using water in post-harvest treatment procedures, the following practices should be kept in mind.

Post-harvest water

- Water used for post-harvest processes must be safe and sanitary (pathogen free).
- Do not use untreated or not sanitized water (e.g. water from rivers or ponds) for post-harvest treatment.
- Routinely inspect and maintain all equipment for sanitizing process water (e.g. filters, chlorine injectors).
- Water sanitation may involve addition of a sanitizing agent such as liquid chlorine or sodium hypochlorite.

• Change water in product holding tanks or hydrocoolers frequently.
• Filter or change water used for washing frequently and prevent saturation with organic solids from the soil.
• Clean and sanitize all water contact surfaces regularly.

On field cooling

As highly perishable commodities, fruits and vegetables are extremely sensitive to high temperatures. Consequently, specific heat reduction and on-site cooling practices can significantly enhance the quality and shelf life of freshly harvested produce. There are various basic principles that can be followed:

• Minimization of exposure to high temperatures and sunlight by means of night or early morning harvesting;
• Shading and ventilation of harvested products on site;
• Active cooling by water or ice in tanks. The benefits of immediate cooling after harvest for fresh produce are multiple:
• Reduction of field heat lowers respiration and ethylene production rates;
• Minimization of spoilage, limitation of microbial growth and reduction of water losses.
• Do not leave freshly harvested produce in direct sunlight.
• Prevent contamination by bird droppings if shading harvested produce under trees.
• When cooling products on site in water tanks, make sure water and ice is well sanitized and of proper quality.

On field packing

Some products, such as grapes and berries, are not washed and furtherprocessed prior to packing. They are packed in the field after harvesting.Field packing generates a situation where contamination can easilyoccur.

• Make sure that all workers strictly follow good hygiene and sanitation practices.
• Containers and all packing material should be handled with care and kept clean from dirt and contaminants.

Cooling Procedures: Immediately after harvest, fresh produce temperature can be high. To extend the shelf life of fresh produce and to sustain quality of fruits and vegetables, products are generally cooled within 24 hours after harvesting. Cooling also helps to inhibit the growth of pathogenic bacteria in fresh produce. In the cooling process, excessive heat is removed from the product by a cooling medium, in most cases by air, water or ice. For the commercial cooling of fresh fruits and vegetables, many different cooling methods are available. Regardless of the cooling method, care must be taken to ensure that the cooling medium does not contaminate the product.It is important to know the principles of each cooling method in order to be able to identify potential hazards associated with them. The most common cooling methods for fresh produce include:

Room cooling: Heat is transferred from the produce to cold air being circulated around stacked containers or pallets of produce in a closed room. The cooling rate is slow. The cooling process can be speeded up by additional air circulation or ceiling jet cooling.

Forced air cooling: Similar to room cooling, but the cold air is actively forced to move through the containers of produce, providing greater air circulation resulting in faster cooling.

Hydro-cooling: Heat is transferred from the produce to cold water that is showering or rinsing down over the product. The cooling rate is rapid. Can only be applied to water-tolerating commodities. As cooling water is recirculated, proper sanitation is critical.

Package icing :Cooling is facilitated by direct contact of produce with ice. Ice is crushed or flaked and packed over the product. Provides fast initial cooling, but cooling rate slows down as ice melts. Only applicable with commodities that tolerate direct contact with ice (e.g. root and stem vegetables). Proper quality of ice is critical.

Vacuum cooling: Cooling occurs from vaporization of water in the produce that is placed in an airtight vacuum chamber. As the heat energy needed for vaporization is taken from the produce itself, the produce cools down. Primarily used for leaf vegetables. Produce loses weight by water vaporization. Maintaining proper water quality is crucial.

GOOD MANUFACTURING PRACTICES

Proper air cooling procedures

- Maintain sanitary conditions in the facility, especially in the air source area (no dust, chemicals or waste).
- Exclude animals and locate compost storage and waste deposits far from the air source area.
- Properly maintain the air system and change filters regularly.
- Keep inside of cooling room clean and in sanitary condition.
- Prevent dripping of condensed or evaporated water on produce.
- Prevent chemical contamination of produce by refrigerants (leaky cooling systems).

Proper water and ice cooling procedures

- Water and ice for cooling must be free of pathogenic microbes (potable quality).
- Regularly perform microbial testing of water used for cooling and icing.
- Ice must be produced from sanitized water and stored under sanitary conditions.
- Cooling water that is being recirculated must be sanitized (e.g. by chlorine).
- Frequently check chlorine concentration in cooling water and replace accordingly.
- Place water settling and filters in the cooling water system to remove organic material.
- Regularly replace cooling water that is being recirculated as cooling agent (daily at a minimum).
- Frequently clean and inspect cooling equipment and maintain properly.
- Prevent chemical contamination of produce by refrigerants (leaky cooling systems).

Lesson Plan-7

Title : Overview of minimal processing of fruits and vegetables Ref.No. 14.2.7
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants minimal processing of fruits and vegetables, so that they can apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- define minimal processing
- describe importance of minimal processing
- discuss the present status of minimal processingin bangladesh
- list down different techniques of minimal processing
- develop skill to utilization minimal processing techniques

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic: minimal processing of fruits and vegetables • Importance: significance of minimal processing of fruits and vegetables • Outline of content	Lecture/ Discussion/ Q+A		6
Development • different techniques of minimal processing • Treatments to extend the shelf-life of minimally processed fruits and vegetables • present status of minimal processingin bangladesh. • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

Behavior/Performance **Condition** **Criteria**

Lesson-7
Overview of minimal processing of fruits and vegetables

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PHTS, HRC, BARI

What is minimal processing ?

❖ Minimal processing" also termed as: Lightly processing, partially processing, ready-to-eat, pre-prepared, fresh cut etc.
❖ It has been trimmed, peeled, washed and cut into 100% usable product
❖ Then packaged and kept into refrigerator to offer consumers high nutrition, convenience and value while still maintaining freshness.

Why is minimal processing?

❖ Consumers are very much conscious about their health.
❖ Fresh fruits and vegetables are full of vitamins, minerals, fibres and phytochemicals
❖ People are busy and eat meals outside their homes
❖ Increase in number of working women, they like to prepare the food at home but they don't have time
❖ Fruits and Vegetables are to be prepared at the production site, pre-packed products helps in reducing the garbage problems in the cities
❖ Fresh cut fruits and vegetable may meet the above demand as it is nutritious, convenient, easy handling and easy to eat.

Problems in minimal processing

❖ Minimal processed produce are highly perishable.
❖ Cell integrity and tissue is disrupted during peeling, sizing and cutting.
❖ Enzymatic and respiratory activity is increased
❖ Microbes attack it easily
❖ Results browning and produce bad smell.
❖ Reduce the shelf-life of minimally processed fruits and vegetables drastically

Treatments to extend the shelf-life of minimally processed fruits and vegetables A. Use of sanitizers Chlorine: It (200 ppm) has been widely used in fresh produce washes to inactivate microbes and ensure quality.

Ozone: It (less than 1 ppm) is a strong antimicrobial agent with high reactivity, and penetrability. GRAS produce.
Calcinated Calcium: The heated scallop shell powder; calcinated calcium (CC) was investigated as potential sanitizers (1.5 g/L) to maintain storage quality and microbial safety of fresh produce.
Electrolyzed water (EW): Electrolyzed water the second most popular sanitizer in Korea (Kim, 2008) is considered as an environment-friendly sanitizer compared to chlorine.

B. Use of organic acid Organic acids such as citric acid and ascorbic acid have been applied for preserving physicochemical qualities and preventing microbial growth at levels that did not adversely affect taste and flavor (Yildiz, 1994).

C. Heat treatments It is one of effective and non chemical postharvest treatments that has been us to prevent the microbial quality, browning, and maintaining texture in various fresh-cut vegetabl (Das & Kim, 2010). It is often applied for 30 seconds to a few minutes at temperatures of 40-60 (Kim, 2007; Kim et al., 2011).

D. Use of edible coatings: Edible coatings were found to be able to extend shelf life of fresh-c products by decreasing respiration and senescence and protecting aroma, texture and colou Commonly used to form edible coatings include chitosan, starch, cellulose, alginate, carrageenan, zei gluten, whey, carnauba, beeswax and fatty acids.

E. Natural antimicrobials: Plant extracts such as : Ginger, Cinnamon @ at 500 ppm, may play ro in reducing microbial infestation in some fresh cut produce.

F. Firming agents: Calcium chloride solutions @ 0.5 to 1.0 percent may be useful in increasing shel life.

G. Use of ultraviolet radiation Non-ionizing, artificial ultraviolet-C (UV-C) radiation is extensivel used in a broad range of antimicrobial applications. Treatment with ultraviolet energy could offe several advantages to fresh-cut fruit processors as it does not leave any residue, and does not hav legal restrictions.

Packaging of minimal processed fruits & vegetables:

• Major requirements:

- Control moisture loss, gas transfer
- Protection against external physical or mechanical damage
- Ensure of food safety
- Maintain the quality
- Compliance with regulatory requirements and guidelines
- Attractive
- Cost effective

– Facilitate transport, handling, storage and marketing

Present status of minimal processed F&V in super shop

Prince BazarLtd., Shwapno, Agora, Meena Bazar etc.
Pineapple, guava, pomegranate, hog palm, pomelo, papaya etc.
Bitter gourd, mixed vegetables, cucumber, carrot, sweet gourd etc.
Mixed vegetable – around 20 kg/day
Storage temp: 15±1°C, R.H: 20±3%
Shelf life: 1-2days
Profit: 20-30%
Total bacterial count (TBC) ranged 1.3×104 to 4.0×104 cfu/g.

Present status of fresh cut in street vendors

Cucumber, pineapple, guava, hog palm, carrot, oliveetc.
Processing: Washed with tap water, but same water is used several times and makes darty
Daily sale: Cucmber and hog palm - around 40 kg (highest sale)
Profit: more than 50%
Shelf life: Need to sale in a day
Total bacterial count (TBC) in tested samples ranged from 2.6x105 to 8.5x106cfu/g.

Lesson Plan-8

Title : **Causes of food spoilage and remedies** Ref. No. 14.2.8
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants identify causes of spoilage, signs of food spoilage, food poisoning, micro-organisms responsible for spoilingwhich they apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- identify causes of spoilage
- discuss Signs of food spoilage
- explain food poisoning
- discuss micro-organisms responsible for spoiling

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Causes of food spoilage • Importance: significance causes of food spoilage • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Identify causes of spoilage • Signs of food spoilage • Food poisoning • Micro-organisms responsible for spoiling • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

Behavior/Performance **Condition** **Criteria**

Lesson -8
Causes of Food Spoilage and remedies

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Food production occurs at specific areas and at certain periods of the year due to variation in weather conditions. Food therefore has to be collected and stored for use during periods of low or no food production. However, storage is complicated by the fact that food begin to deteriorate shortly after harvest, gather or slaughter.

Food spoilage is defined as damage or injury to food rendering in unsuitable for human

consumption. In another word Any change in appearance, smell, or taste of a food product that makes it unpalatable to the consumer.

Food must be considered spoiled if it is contaminated with pathogenic microorganisms or various poisonous agents, such as pesticides, heavy metals etc.

Table 1: Storage life of some foods

Food product	Storage life (days) at 21°C
Raw beef and mutton	1-2
Raw fish	1-2
Raw poultry	1-2
Dried salted or smoked meat and fish	360 or more
Fresh fruits	1-7
Dried fruits	360 or more
Leafy vegetables	1-2
Root crops	1-20
Dried seeds	360 or more

In most cases there does not need to be an evident sign of spoilage, the food might look normal and only after eating it or by careful bacteriological and toxicological investigation, one is able to realize the defect. Food decay or decomposition is implied when the term spoiled is used.

Causes of food spoilage:

(a). Growth and activity of microorganisms Bacteria, yeasts and molds are microorganisms that cause food spoilage. They produce various enzymes that decompose the various constituents of food.

(b). Enzyme activity: Action of enzymes found inherently in plant or animal tissues start the decomposition of various food components after death of plant or animal.

(c). Chemical reactions: These are reactions that are not catalysed by enzymes.,e.g. oxidation of fat.

(d). Vermin. Vermin includes weevils, ants, rats, cocroaches, mice, birds, larval stages of some insects. Vermin are important due to:

(i). Aesthetic aspect of their presence,

(ii) Possible transmision of pathogenic agents,

(iii). Consumption of food.

(e). Physical changes. These include those changes caused by freezing, burning, drying, pressure, etc.

Microbial spoilage of food:

Bacteria, yeasts and molds are the major causes of food spoilage. They produce various enzymes that decompose the various constituents of food.Molds are the major causes of spoilage of foods with reduced water activity e.g dry cereals and cereal product. Bacteria spoil foods with relatively high water activity such as milk and products.

Sources of microorganisms in food:

The primary sources of microorganisms in food include:

1. Soil and water
2. Plant and plant products
3. Food utensils
4. Intestinal tract of man and animals
5. Food handlers
6. Animal hides and skins
7. Air and dust

Factors affecting microbial growth in food:

a)Intrinsic factors:

These are inherent in the food. They include:

- Hydrogen ion concentration (pH), moisture content, nutrient content of the food, antimicrobial substances and biological structures.

1.Hydrogen ion concentration (pH):

Most bacteria grow best at neutral or weakly alkaline pH usually between 6.8 and 7.5. Some bacteria can grow within a narrow pH range of 4.5 and 9.0, e.g. salmonella. Other microorganisms especially yeasts and molds and some bacteria grow within a wide pH range, e.g. molds grow between 1.5 to 11.0, while yeasts grow between 1.5 and 8.5.

Table 2: pH values of some food products

Food type	Range of pH values
Beef	5.1 - 6.2
Chicken	6.2 – 6.4
Milk	6.3 – 6.8
Cheese	4.9 - 5.9
Fish	6.6 - 6.8
Oyester	4.8 - 6.3
Fruits	< 4.5 (most < 3.5)
Vegetables	3.0 – 6.1

Microorganisms that are able to grow in acid environment are called acidophilic microorganisms. These microorganisms are able to grow at pH of around 2.0.
Yeasts and molds grow under acid conditions.
Other microorganisms such as vibrio cholerae are sensitive to acids and prefer alkaline conditions.

Most bacteria are killed in strong acid or strong alkaline environment except Mycobacteria.

Table 3: Minimum and maximum pH for growth of some specific microorganism

Microorganism	Minimum	Maximum
Escherihia coli	4.4	9.0
Salmonella typhi	4.5	8.8
All bacteria	4.0	9.0
Molds	1.5	11.0
Yeast	1.5	8.5

2.Moisture content:The effect of moisture is in terms of water activity: -the amount of free water in food medium.The amount of free water is important for growth of microorganisms. If there is lack this free water microorganisms will not grow. Water activity is defined as the vapour pressure of food substance to that of water at the same temperature. (Aw = VPFood/VPWater).

The water activity is therefore equal to 1.0. Food products have a water activity of less than 1.0. saturated salt solution has a water activity of 0.75. Salting and drying reduces the water activity of food product.

Table 4: Water activity of some food products.

Food Product	Water activity
Raw meat and milk	0.99- 1.0
Luncheon meat	0.95
Boiled ham, sliced bacon	0.90
Dried grains	0.80

Water activity level: Growth of microorganisms is greatly affected by the level of water activity(Aw) in the food.Inhibition of growth occurs if the water activity for food is lowered beyond an organism's minimum level of water activity that is necessary for growth. Microorganisms have varied minimum water activity requirements that supports their growth in food.

Table 5: Minimum water activity that supports growth of some microorganisms

Microorganism	Water activity
Clostridium botulinum,	0.95
Bacillus cereus,	0.95
Pseudmonas aeroginosa,	0.95
Salmonella spp.	0.95
Staphylococcus aureus (anaerobic), Candida spp., Saccharomyces	0.90
Staphylococcus aureus (aerobic)	0.86
Penicillium spp.	0.82
Most spoilage yeast	0.88
Most spoilage molds	0.80
Osmotic yeast	0.70

3. Nutrients content of the food:
Microorganisms require proteins, carbohydrates, lipids, water, energy, nitrogen, sulphur, phosphorus, vitamins, and minerals for growth. Various foods have specific nutrients that help in microbial growth. Foods such as milk, meat and eggs contain a number of nutrients that are required by microorganisms.These foods are hence susceptible to microbial spoilage.

Antimicrobial substances:
Antimicrobial substances in food inhibit microbial growth. Various foods have inherent antimicrobial substances that prevent (inhibit) microbial attack.Such inhibitors are like lactinin and anti-coliform factors in milk and lysozyme in eggs.

Biological structures:
Some foods have biological structures that prevent microbial entry. For example, meat has fascia, skin and other membranes that prevent microbial entry.Eggs have shell and inner membranes that prevent yolk and egg white from infection.

(b). Extrinsic factors: Are factors external to the food that affect microbial growth. They include:
1. Temperature of storage,

1. Presence and concentration of gases in the environment
2. Relative humidity of food storage environment.

1.Temperature:The growth of microorganisms is affected by the environmental temperatures. Various microorganisms are able to grow at certain temperatures and not others. Bacteria can therefore be divided into the following groups depending upon their optimum temperature of growth.
(i). Pyshrophilic microorganisms:These grow best at about 20oC but also down to -10oC in unfrozen media. Psychrophilic bacteria can cause food spoilage at low temperatures. Several of the microorganisms found in the soil and water belong to this group.

(ii). Mesophilic bacteria: These organisms grow between 25oC and 40oC, with an optimum growth temperature close to 37oC.Some such as Pseudomonas aeroginosa may grow at even lower temperatures between 5-43oC.None of the mesophilic bacteria are able to grow below 5oC or above 45oC. Most pathogenic bacteria belong to this group.

(ii). Thermophilic bacteria: These grow at temperatures above 45oC. Often their optimum growth temperatures is between 50oC and 70oC. Growth of some bacteria occur at 80oC.Bacteria in this group are mainly spore formers and are of importance in the food industry especially in processed foods.

Note that:The effect of temperature on microbial growth also depends upon other environmental conditions such as:
-Growth factors in the nutrient medium,
-pH of the food, and
-Water activity.
2. Concentration of gases in the environment:
This relates to the presence and concentration of gases in the food environment. Various microorganisms require for growth, either high oxygen tension (aerobic), low oxygen tension(microaerobic) or absence of oxygen (anaerobic).Some microorganisms may grow either in high oxygen tension, or in the absence of oxygen (facultative anaerobes).

Foods affected by various groups:
-Anaerobic or facultatively anaerobic sporeformers are most likely to grow in canned foods .
-Microaerophilic bacteria are most likely to grow in vacuum packed foods since they have low oxygen tension, while
-Aerobic bacteria are likely to grow on the surface of raw meat.
-Aerobic molds will grow in insufficiently dried or salted products

3. Relative humidity:Relative humidiy is the amount of moisture in the atmosphere or food environment.
Foods with low water activity placed at high humidity environment take up water, increase their water activity and get spoiled easily.
For example, dry grains stored in a environment with high humidity will take up water and undergo mold spoilage.

Lesson Plan-9

Title : Principles and methods of food preservation Ref.No.14.3.9
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants Identify principles of food preservation, methods of foods preservation which they apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- explain need for food preservation
- discuss principles of food preservation
- explain methods of foods preservation
- discuss method of dehydration

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Principles and methods of food preservation • Importance: Principles and methods of food preservation • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Need for food preservation • Principles of food preservation • Methods of food preservation • Important consideration for food preservation • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9
Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.			
Behavior/Performance	**Condition**		**Criteria**

Lesson-9
Principles and methods of food preservation

– Prof. Dr. Abdullah Iqbal
BAU, Mymensingh

Introduction

• Food preservation is the process of treating and handling food to stop or slow down spoilage (loss quality, edibility or nutritional value) and thus allow for longer storage.

Purposes of commercial food preservation

1) To preserve foods in transit from the producer to the consumer by preventing undesirable changes
2) To smooth out irregularities in production, especially to overcome the hardships of season; 3) T ensure, as per as possible that local or seasonal surpluses are not wasted;
4) To facilitate handling which is done primarily through various forms of packaging.

Why Preserve at Home?

• Save food from a "time of plenty" to a "time of need"
• Prevent spoilage until food can be eaten
• Know what is in the food Personal satisfaction

Principles of Food Preservation

1) Prevention or delay of microbial decomposition
a) By keeping out microorganisms (asepsis)
b) By removal of microorganisms e.g. by filtration
c) By hindering the growth and activity of microorganisms e.g. by lowering temperature drying, anaerobic conditions' or chemicals etc.
d) By killing the microorganisms e.g. by heat or radiation

2. Prevention or delay of self- decomposition of the food
a) By destruction or inactivation of enzymes, e.g. by blanching
b) By prevention or delay of purely chemical reactions, e.g. prevention of oxidation by mean of an antioxidant
3) Prevention of damage because of insects, animals, mechanical causes etc.

Methods of Food Preservation

1) Asepsis, or keeping out microorganisms.
2) Removal of microorganisms.
3) Maintenance of anaerobic conditions, e.g., in a sealed, evacuated container.
4) Use of high temperatures
5) Use of low temperatures
6) Drying; this includes the tying up/binding of water by solutes, hydrophilic colloids etc
7. Use of chemical preservatives, either developed by microorganisms or added
8) Irradiation
9) Mechanical destruction of microorganisms, e.g., by grinding, high pressures etc (not used industrially)
l0) Combinations of two or more of the above methods.

1. Asepsis or keeping out microorganisms

• The inner tissues of healthy plants and animals usually are free from microorganisms, and if any microorganisms are present they are unlikely to initiate spoilage.

• when the protective covering is damaged or decomposed, the inner tissues are subjected to decomposition by microorganisms .

• In food industries attention should be given to the prevention of contamination of foods from the raw materials to the finished products.

• Food technologist should be concerned with the load and kinds of the microorganisms. The kinds are important as:

• they may include spoilage organisms, those desirable in fermentation, or even pathogenic m.o.

Important consideration of Asepsis

a) Packaging of foods- to prevent primarily contamination during handling,
b) Use of hermetically sealed container- to prevent canned foods
c) Proper handling of raw materials
d) Maintaining good sanitary conditions of working people, machineries and factory premises
e) Waste disposal.

2. Removal of microorganisms

• It is not always effective in food preservation,

• Removal may be accomplished by means of filtration, centrifugation, washing, or trimming.

• Important considerations for removal of microorganisms:

a) Filter aid should be bacteria proof and sterilized
b) Proper trimming
c) Pasteurization to kill the vegetative cells.

3. Maintenance of anaerobic conditions

• A preservative factor in sealed, packaged foods may be the anaerobic conditions in the container.

• A complete fill, evacuation of the unfilled space (the head space in a can), or replacement of air by CO2 or by an inert gas such as nitrogen will bring about anaerobic conditions.

Important considerations:

a) Leak proof package (aluminum foil)
b) Pasteurization
c) Cost of packaging instrument
d) Unit package

4. Use of High Temperature

4 (a) Pasteurization

• Pasteurization is a heat treatment that kills part but not all the microorganisms present and usually involves the application of temperatures below 1000C. It is the heating of milk or dairy products to a temperatures that destroys nearly all of the microorganisms present in the products without seriously affecting the composition and properties of the product

• Heating milk products to at least 1430F (61.70C) and holding at such temperature for at least 30 minutes, or to at least 1600F (710C) and holding at such temperature for at least 15 seconds in approved and properly operated equipment."

• All pathogens are killed during pasteurization.

4(b) Heating at about 1000C

Blanching fresh vegetables before freezing and drying involves briefly at about 1000C. During baking, the internal temperature of bread, cake, or other bakery products approaches but never reaches 1000C as long as moisture is present, although the oven is much hotter. Simmering is incipient a gentle boiling, with the temperature about 1000C.

• In roasting meat the internal temperature reaches only in the range within 600C to 850C.
• Frying gets the outside of the food very hot, but the center ordinarily does not reach 1000C.
• Cooking in the food industry, implies a specific time and temperature for a thermal process.

4(c) Heating above 1000C

• Usually Canning is frequently used application of such type of heating.
• Brief History: During Napoleon, in 1790, France was in war and facing problems of supplying meat to soldiers due to putrefaction of meat during transit and storage.
• Napoleon declared a prize of 12,000 francs for inventing useful methods of preserving meats and other foodstuffs for longer period.
• Nicolas Appert, a French confectioner won the prize.
• Canning may be defined as the preservation of foods in hermetically sealed containers by the application of heat. The minimum requirement
• most heat resistant bacteria *Clostridium botulinum*likely to be present in foods.
• The pH of food has a very important role
• In acid foods the microorganisms are less heat resistant and it is easier to kill them
• The lower limit of growth of *C. baturirutm*is at pH 4.5. Food with pH values 4.5 or above, steam pressure is used to process at high temperatures .

5. Use of low temperature

• Low temperatures are used to retard chemical reactions and action of food enzymes and to slow down or stop the growth and activity of microorganisms in food;
• The lower the temperature, the slower will be the chemical reactions, enzyme action, and microbial growth;
• a low enough temperature will prevent the growth of any microorganisms.

Chilling Chilling temperature: above freezing and below 150C (0 to 150C)

• Chilling storage is widely used because it results effective short-term preservation by retarding:
a) Growth of M.O.
b) Postharvest and post-slaughter metabolic activities
c) Deteriorative chemical reactions
d) Moisture loss

Freezing

• Sharp freezing/Slow freezing: -150C to -290C, freezing may take from 3 to 72 hr;
• Quick freezing: The freezing method in a relatively short time. 30 min or less and -17.8 to -45.60C
• Example: freezing of fish in brine or of berries in special syrups,
• Nitrogen freezing: A method for the overseas shipment of frozen, packaged foods.
• Certain fruits and vegetables, fish, shrimp, and mushrooms now are being frozen by means of liquid nitrogen.

Dehydrofreezing: For dehydrofreezing, fruits and vegetables have about half their moisture removed before freezing

6. Drying

- Drying is one of the oldest methods of preserving food.
- Dehydration vs Sun drying:
- Dehydration implies control over climatic conditions within a chamber. Sun drying is at the mercy of elements.
- Dried fruits from a dehydration unit can have better quality than sun dried counterparts
- Less land is required for drying activity, Sun drying for fruits requires one unit of drying surface per 20 units of cropland.
- Sanitary conditions
- Cost
- Yield: The yield of dehydrator is higher as sugar is lost due to continued respiration of tissues during sun drying and also due to fermentation.
- The color of sun dried fruits may be superior to dehydrated fruit under optimum conditions of operation of both
- Weather conditions??
- Different types of dryer are used for drying……

7. Preservation by food additives

- A food additive is a substance or mixture of substances, other than basic food stuff, which is present in food as a result of any aspect of production, processing, storage or packaging. The term does not include chance contamination" (WHO, 1965).

8. Food Irradiation

Exposure of foods to ionizing radiation in form of gamma radiation, X-rays and electron beams to destroy microorganisms;

- Radappertisation- commercial sterilisation
- Radicidation- in which the treatment is intended to destroy organisms of public
- health significance (Pasteurization)
- c) Radurisation- in which the treatment is aimed simply at the prolongation of storage life by a general reduction in the level of vegetrtive bacteria (Chilling).
- Radiation disinfestation-where the targets are insect pests.
- Sprout inhibition in stored vegetables and growth inhibition in mushrooms
- 9) Mechanical destruction of microorganisms, e.g., by grinding, high pressures etc (not used industrially)
- 10) Combinations of two or more of the above methods.

Consumer demand for foods

- Fewer synthetic additives,
- Fewer changes during processing'
- 'healthy' or 'natural' image.
- This demands effect on food processing industry to launch food products:

- Free from synthetic additives
- low-fat,
- sugar-free
- low-salt
- Supplemented with vitamins, minerals and probiotic cultures
- Organic products

Motivation and changes of food industry

- improved quality assurance and quality control
- reduces production costs
- reduce wastage
- increases production efficiency,automation

Lesson Plan- 10

Title : Traditional food processing and preservation techniques Ref.No.14.2.10
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants about traditional food processing and preservation techniques, so that they can compareto the modern techniques and also apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:
- explain on advances of food processing and preservation techniques
- describetraditional food processing and preservation techniques
- develop future plan for food processing and preservation

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Traditional food processing and preservation techniques • Importance: significance of inaditional food processing and preservation • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Advances food processing and preservation techniques • Exclusive Traditional food processing and preservation techniques • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9
Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.			
Behavior/Performance	**Condition**		**Criteria**

Lesson-10
Traditional food processing and preservation techniques

Prof. Dr. Abdullah Iqbal
Professor
BAU, Mymensingh

Introduction

➢ Increased demand for foods with
✓ adequate nutrients
✓ sensory satisfaction
✓ additive free

➢ Thermal treatment of foods safe but high heating results in unacceptable quality and nutrient retention.

➢ The modern technologies employ reduced stress on foods that avoid undesirable changes and extend the shelf life.

➢ The modern techniques are non-thermal or semi-thermal which are effective for inactivation of microorganisms and enzymes.

➢ Non-thermal processing is effectively combined with thermal processing to provide improved food safety and quality. Some established modern technologies :

- High Pressure Processing
- Pulsed Electric Fields Processing
- Membrane Processes
- Ultrasound Processing
- Ohmic Heating
- Food Irradiation
- Radio-Frequency Processing
- Application of Ozone in Food Processing
- Minimal Processing of fruits and vegetables

High Pressure Processing (HPP)

➢ HPP is a cold pasteurization technique

➢ Pressures above 400 MPa / 58,000 psi at cold (refrigeration) or ambient temperature inactivate the microbes and enzymes.

➢ HPP offers the food safety while meeting consumer demand for fresher-sensory and nutritional quality. The key advantages of HPP:

- Flexible size and geometry of the sample during processing
- Possibilities of low temperature treatment
- Availability of a waste-free, environment-friendly technology

High Pressure Processing

Products, already sealed in its final package, are introduced into a vessel and subjected to a high level of isostatic pressure (applies equal pressure in all directions) (300–600MPa/43,500-87,000 psi) transmitted by water

Pulse Electric Field (PEF) Processing

➢ PEF is a non-thermal method that uses short pulses of electricity for microbial inactivation and minimal detrimental effect on food quality.

➢ PEF improves the extraction rates of juices, sugars, coloring agents and other active substances and significantly extends shelf life.

➢ PEF technology involves the application of pulses of high voltage to liquid or semi-solid foods placed between two electrodes.

Membrane Technology

➢ Liquid foods (fruit juices and natural colors) extracted from their sources have high-water load.
➢ Evaporation by heating results in a loss of fresh flavors, color and gives "cooked" taste.
➢ Therefore, newer technologies are such as ultrafiltration (UF), nano-filtration (NF), reverse osmosis (RO), direct osmosis (DO) etc. are continued to develop.
➢ Applications:
• Purify & concentrate fruit juices, fermented liquors, vegetable oils etc. Fractionate food ingredients, for example; milk can be converted to whey protein solution, casein solution etc
➢ In Membrane Technology particles are separated on the basis of their molecular size and shape with the use of pressure and specially designed semi-permeable membranes.

Food Irradiation

➢ Food is exposed to doses of ionizing energy, or radiation.
➢ Irradiation of foods inactivates (low dose)/ kills (high dose) the insects, moulds and bacteria but sometime cannot kill viruses.
➢ There is a common misconception that irradiated food is radioactive.

▪ The radiation used to process foods is very different from the radioactive fallout that occurs after, for example, a nuclear accident.
▪ In food processing, the radioactive sources are not permitted to generate gamma, electrons or x-rays of high energy to make food radioactive.
▪ The World Health Organization (WHO), the American Dietetic Association and the Scientific Committee of the European Union support food irradiation.

➢ Gamma rays and x-rays (from a high-energy electron beam or powerful x-rays) pass through the food just like microwaves in a microwave oven, which can be switched on or off.

Application of Ozone

➢ Ozone has been used commercially for the treatment of drinking water since 1906.
➢ Increasingly employed in the food industry for sanitizing food-contact surfaces and products (fruits, vegetables, and meat) preservation.
➢ It is a broad-spectrum antimicrobial agent that is active against a range of food-borne pathogens.
➢ Ozone readily reverts to oxygen, an end-product that leaves no residue on contact surfaces.
➢ Use of ozonated water for sanitation in food plants prevents biofilm formation, results clean runoff water.
➢ Hence, environmental friendly.

Application of Ozone Ozone gas is generally created on-site by a generator via an electrical charge or from oxygen. The gas is pumped into water, and the ozonated water is used as a rinse, mist, spray or bath.

Minimal Processing of Fruits and Vegetables

➢ In this system fresh fruits and vegetables are subjected to basic processing steps e.g., peeling, trimming, cutting, washing, disinfection, rinsing, etc.
➢ These commodities contain exclusively natural ingredients, and they are kept under chilling in polymeric films or in modified atmosphere packaging (MAP) conditions.
➢ The products need no further processing before use, offering high quality products with little waste at a reasonable price.

Lesson Plan-11

Title : Food processing by drying. Ref. No.14.2.11
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants about Drying purposes, factors that affect the rate of drying, the basics of drying and types of drying, factors to consider when selecting a dryer and apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- explain main purposes of drying
- describe factors that affect the rate of drying
- discuss the basics of drying
- explain types of drying
- illustrate factors to consider when selecting a dryer

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Food processing by drying • Importance: significance of Food processing by drying • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Drying main purposes: • Factors that affect the rateof drying • The basics of drying • Types of drying • Factors to consider when selecting a dryer • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9
Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.			
Behavior/Performance	**Condition**		**Criteria**

lesson-11
Food Processing by Drying

Dr. Md. Ayub Hossain
CSO, BARI

Drying Scenario in Bangladesh

- Each year a huge amount of seasonal fruits produced in Bangladesh
- These fruits ripe all together within a short duration
- This seasonal fruits is highly perishable but has high nutritive value
- Harvesting season the losses of fruits 20-30%
- If these fruits are preserved by drying ensuring quality, consumers would have the taste of these seasonal fruits all round the year.
- Drying is very popular in many countries, and has potential export market in Europe and Middle east

Drying Scenario in Bangladesh

- Spoilage and loss of grain (2-3%)
- Mold development Propagate diseases in the grain may release toxins into the grain
- Insect infestation
- Loss of food quality- bitter taste
- Loss of seed viability
- Low price

Grain Drying

Drying:

- Dryingis the removal of moisture from a product.
- Drying is done to reduce the moisture content of grain to the safe level so that it can be processed or store without deterioration of the quality.
- Dehydrationis a term to dry the product up to the final or storage moisture content.
- Generally drying used for field crops and dehydration is used in the case of high moisture crops such as fruits, vegetables, fishes and meats.

Advantages of crop drying

- Permits long time storage of grain without deterioration
- Permits continuous supply of product throughout the year
- Permits early harvest which reduces field damage and shattering loss
- Permits the farmers to have better quality product
- Makes products available during off season
- Make the products light weight
- Make the product marketable.

Disadvantages of Drying

- Reduces neutrinos of products
- Requires open space or dryer
- Drying is costly operation

- Over drying hampers seed germination
- Un even drying creates fissures in the grain and grain breaks
- Drying changes original taste

Crop Drying Drying Depends on

- ❑ Air temperature
- ❑ Air relative humidity
- ❑ Air velocity
- ❑ Surface area or surface exposure
- ❑ Moisture content (high or low)
- ❑ Type and variety of crop

Crop Drying Mechanism

✓ Grain is hygroscopic in nature. It absorbs or rejects moisture from or to the environment.

✓ During drying hot air is passed through the grains and it picks up and carries moisture from the grains

✓ Air and grain and are cooled down by evaporation i.e. evaporative cooling happens.

✓ Then again heat is provided by convection and to conduction and to the air and grain and further evaporation takes place.

✓ About 540 kCal heat is required to evaporate one kg of free water. But it requires 500 kCalheat to evaporate one kg of water from grains.

Drying Methods There are two Methods of Drying -

1. Thin Layer Drying

- When products are placed in single or thin layer (20 cm thickness of grain bed)
- Generally high moisture and sticky products are dried in thin layer (Fruits & vegetables)

2. Deep Bed Drying

- When products are placed in thick layer (>20 cm thickness of grain bed)
- Generally low moisture products are dried in deep bed (Cereal Grains)

Types of Dryers

Dryer

Mechanical Dryer	Solar Dryer
➢ Flat Bed Dryer	➢ Natural Convection
➢ Batch dryer	➢ Forced convection
➢ Continuous flow dryer	➢ Cabinet
➢ Vacuum Dryer	➢ Box
➢ Rotary Dryer	➢ Tunnel
➢ Fluidized Bed dryer	➢ Roof type
➢ Freeze Dryer	➢ Green house
➢ Pneumatic Dryer	➢ Hybrid

The Sun and Energy

• The Sun is a perpetual source of energy

• The sun is a giant nuclear fusion, or thermonuclear, reactor that runs on hydrogen fuel • The earth receives only about one billionth of the Sun's energy

• The available solar energy resources on the earth surface is 1012 W

Solar Energy

• Less than 0.02% of available resources are sufficient to entirely replace fossil fuels and nuclear power as an energy source

• Solar energy that falls in one hour on the earth surface is sufficient to meet up the energy demand of one year

• The amount of solar energy reaching the surface of the planet is in one year it is about twice a the Earth's non-renewable resources

Advantages of Solar energy

• **Solar energy is**

❖ Abundant

❖ Free of supply

❖ Clean

❖ Non-pollutant

❖ Politics free

Lesson Plan12

Title : Food processing and preservation by Heat Treatment Ref.No.14.2.14
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants about Food processing and preservation by canning and sterilization and apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- explain Food processing and preservation by canning and sterilization
- describe proper canning techniques and equipment
- discuss Quality Changes During Canning
- explainEnergy supply and requirements

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Food processing and preservation by heat Treatment • Importance: significance heat Treatment • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Food processing and preservation by Heat Treatment • Proper heat treatment techniques and equipment • Quality Changes during heat treatment • Energy supply and requirements • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

Behavior/Performance **Condition** **Criteria**

Lesson-12
Food Processing and Preservation by Heat Treatments

Prof. Dr. Abdullah Iqbal
Professor
BAU, Mymensingh

• **Introduction Food processing:** Transformation of raw materials consumer-ready products

• **Food preservation:**
✓ stabilizes food products/ increase shelf-life
✓ prevents or reduces negative changes in quality.
• Commonly used processing and preservation technologies:
✓ physical e.g., milling, heating, freezing, chilling, dehydration, and packaging
✓ chemical e.g., reduction of pH, use of preservatives, additives

Objectives of food preservation
• To preserve the wholesomeness, nutritive and sensory qualities of foods.
• To smooth out irregularities in supply.
• To ensure the local or seasonal surpluses are not wasted.
• To facilitate handling; e.g., packaging, reduction of volume

Causes of Spoilage Spoilage may be due to one or more of the following:
• Growth and activity of microorganisms
• Insects
• Action of the enzymes of the plant or animal food
• Chemical reactions
• Physical changes; caused by freezing, burning etc.

Method of food preservation
• Asepsis (keeping out of microorganisms)
• Removal of microorganisms (m. o.)
• Maintenance of inconvenient condition for m.o. e.g. in a sealed or evacuated container, tying up solutes etc.
• Use of high temperature
• Use of low temperature
• Drying; removal of water
• Use of chemical preservatives
• Use of radiation
• Mechanical destruction of m.o. e.g. by grinding, high pressure etc.
• Combinations of two or more of the above methods

Preservation by high temperature

High temperature preservation methods:

- Blanching
- Pasteurization
- Sterilization
- Canning
- Bottling

Pasteurization

Pasteurization is a heat treatment to kill pathogenic organism in food.

➢ Normally it is done to milk and beverages.

Advantages

- Kill pathogenic m.o.
- Inactivate enzyme and remove off flavour
- Minimum effect on nutrient
- Keep the juice particles uniformly dispersed
- Can extent the shelf life for a good time

Two types of pasteurization

- *Low temperature long time (LTLT):* In case of milk; 62.8oC (142oF) for 30 minutes
- *High temperature short time (HTST):* 71.7oC for at least 15 sec

Batch type pasteurization;

✓ ***Continuous type pasteurization;***

- **Sterilization** Complete destruction of m.o. by heat treatment.
- Two main categories; i) Batch system; placed in containers such as cans, bottles and plastic pouches ii) continuous flow system; UHT processes involves heating at 140 °C to 150 °C for 1 to 3 seconds.
- Maximum condition may apply: 121oC temperature for 15 min into pressure cooker or retort.

Differences between Pasteurization and Sterilization

Factor	Pasteurization	Sterilization
Shelf-life	Short time	Long time
Killing of M. O.	Partly	Completely
Temperature	70 to 80 °C	110° C to 121 ° C

Change of food properties	Low	High
Food type to be treated	Heat sensitive foods	Heat resistant foods
Factor	Pasteurization	Sterilization
Shelf-life	Short time	Long time
Killing of M. O.	Partly	Completely
Temperature	70 to 80 °C	110° C to 121 ° C
Change of food properties	Low	High
Food type to be treated	Heat sensitive foods	Heat resistant foods

Canning Canning is a method of preservation of foods being enclosed in a hermetically sealed container. Cans are normally made of tinplate, aluminium and other modifications.

Can formation:
A conventional tinplate container is composed of 3 parts: cylindrical body and 2 ends or lids.

Canning of fish (Sardine Fish in oil)
1. Descaling:
2. Beheading:
3. Washing: with clean water.
4. Brining: dip in 25% brine (salt) solution for 10 min.
5. Washing: quick washing in clean water.
6. Packing in cans: Pack the fishes in the can (e.g. can capacity 120 gms) by putting fish in head-to-tail position with belly upright.
7. Pre-cooking: Pre-cook the fish in can for 20 min.
8. Draining of water:
9. Addition of oil: edible oil is added to each can(@21mL per 2-3 oz of fish)
10. Exhausting: The filled cans are exhausted for 7-8 min.
✓ steam exhausting or
✓ heating the filled cans at the can centre temperature of about 77oC.

11. Seaming: The exhausted cans are double seamed kept inverted position.
12. Washing the cans with detergent (1-1.5% Na3PO4 solution at 80oC)
13. Processing (Retorting): The sealed cans are heated in retort at 10 psi for 1 hour.
14. Cooling the cans with clean water
15. Labeling and storing:

Bottling
- Bottles are safe containers for home preservation of products.
- Although their initial cost is high, they are reusable.
- The products look attractive through the glass and do not develop metallic flavor.
- However, tin cans are preferred to bottles for lighter and cheaper.

Preservation by Low Temperature

Low temperature;

✓ retards chemical reactions
✓ retards enzymic reactions
✓ slow down or stop growth of microorganisms in food. Low temperature methods:
• Chilling/ Cold storage
• Freezing

Chilling

➢ Storage of foods above freezing and below 15oC; short-term preservation.
➢ The storage performance greatly depends on:
• Temperature
• Humidity: Too low R. H. results loss of moisture, softening of vegetables too high R. H. favors the growth of MOs.
• Ventilation: Proper ventilation helps to
✓ control uniform air velocity
✓ maintain a uniform R. H. throughout the room,
✓ remove odors and
✓ prevent development of stale odors and flavors.

Method of chilling *Pre-cooling with moving air:* *Disadvantage;* excessive dehydration of products.
Hydro cooling: The products to be cooled are immersed in/ flooded over/ sprayed with cool water.
Pre-cooling with ice: Pre-cooling with crushed ice is simple and effective *Disadvantage;* discoloration may occur when crushed ice is used as direct contact to the products

Vacuum cooling: *Principle;* reduced vapor pressure on a liquid decrease boiling point. Hence, rapid evaporation of moisture from the surface causes evaporative cooling. Rapid cooling, effective for porous products with free water. *Advantage;* Increased shelf-life due to uniform cooling throughout the body without any temperature gradient. *Disadvantage;* sometimes excess moisture loss from products due to lack of technical care regarding required pressure, temperature and time of cooling.

Freezing

It is done at the temperature between 0oC to -45oC.
• Long-term preservation method.

Freezing methods

✓ freezing in air
✓ indirect contact freezing
✓ immersion freezing
✓ cryogenic freezing

Freezing in air

• Air is the most common freezing medium.
• Two types - still air freezing and forced air freezing *Freezing in Still Air:* ➢ The freezer consists of an insulated room maintained at -10 to -45°C.
➢ Products placed on aluminum trays is kept on shelves made of pipes or coils through which the refrigerant is circulated.
➢ The time taken for freezing may be 12 hours or more.
➢ Least expensive, but the slowest method.

Air Blast Freezer: • Consists of an insulated room or a tunnel.
• Products get frozen by being in contact with the vigorously moving cold air that picks up heat.
• Air is cooled by blowing through the finned cooling coil of the refrigeration system. • Temperature is maintained at -35 to -40°C.

Indirect contact freezing:
• Refrigerant does not come into direct contact with the products.
• Refrigerant is circulated through hollow plates which absorb heat from the products.
• The freezers are equipped with hydraulic systems to move the plates closer or apart.

Immersion Freezing:
• Freezing is achieved by immersion in, or spraying liquid refrigerant; propylene glycol, glycerol etc.
• Allows intimate contact of product surface with freezing medium.

Cryogenic Freezing:
• Very rapid freezing by exposing the products to an extremely cool freezant.
• The common food grade cryogenic freezants are boiling nitrogen and boiling or subliming carbon dioxide.
• Cryogenic freezing is much faster than other freezing; for example, shrimp is frozen in 9 minutes in a cryogenic freezer whereas 12 minutes in immersion freezing and 1-2 hours in contact plate and air blast freezers

Food preservation by Drying
Drying is lowering the concentration of water so the m.o. cannot grow.
• Drying can be performed in sun drying or by mechanical drying (dehydration).

Sun Drying
➢ Solar and wind energies are used in natural drying process.
➢ Essential requirements for better sun drying:
• Sufficiently high air temperature; 35-40°C will be ideal
• Sufficiently low RH to reduce aw discomfortable for bacterial growth.
• RH above 70-75% will not help dry the fish to the desired level.
• Use of raised platforms provide better air movement and prevent contamination by dust or sand

Mechanical Drying The mechanical drying is more rapid process performed under controlled conditions of temperature, humidity and air flow. Different types of Mechanical Dryer:
• Solar dryer
• Cabinet dryer
• Oven dryer
• Vacuum dryer
• Forced convection dryer
• Kiln dryer
• Tunnel dryer
• Spray dryer

Lesson Plan-13

Title : Food processing by frying Ref.No.14.3.13
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants about frying,steps of dehydration during frying and apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- define frying and theory of frying the main types of frying.
- discuss the factors which influence frying time and temperature
- explain the main changes of frying on quality of final products.
- explain steps of dehydration during frying

Content		Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Food processing by frying • Importance: significance of food processing by frying • Outline of content		Lecture/ Discussion/ Q+A		6
Development • frying and the main types of frying. • changes of frying on quality of products. • Steps of dehydration during frying • Check attention by making wrong statement • Feedback(Q+A)		Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning		Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

Behavior/Performance	Condition	Criteria

Lesson-13
Food Processing by Frying

M G Ferdous Chowdhury
SSO,BARI

General information regarding food frying

Shallow frying
A small quantity of pre-heated fat or oil in shallow pan or on a flat surface.

Advantages
a) Quick cooking method
b) No loss of soluble nutrients
c) Good colour

Disadvantages
a) Not easily digested
b) Requires constant supervision
Examples : vegetables (potatoes, onions, cauliflower) BARI, Joydebpur, Gazipur

Deep frying
-Pre-heated deep oil or fat.
-to modify the rapid penetration of the intense heat.
-the food is placed into deep pre-heated oil/fat, fried until cooked

Advantages
a) Quick cooking
b) No loss of soluble nutrients
c) Ensures good colour
Disadvantages
a) Not easily digested
b) Safety hazard
Examples: potatoes (chips)

Deep frying
-deep fat frying
-food is submerged in hot fat or oil
-conventional frying
-a deep fryer is used
-industrially, a pressure fryer/vacuum fryer
-deep frying perform using oil
- deep frying foods cook quickly
-all sides simultaneously
- as oil has a high rate of heat conduction

Processed chips available in the market

- Banana chips
- Apple chip,
- French fries
- Fried chicken
- Jackfruit chips
- Potato chips
- Deep fried pizza
- Finger steaks

Optimization of Processing Methods for Banana Fruit Chips Materials Variety used : Unripe MeherSagar banana

Packages used

✓ Polypropylene
✓ Double polypropylene
✓ High density polypropylene
✓ Metalex foil.

Conclusion

➢ Banana chips prepared by above methods and stored in metalex foil can be preserved more than 8 weeks.
➢ After opening the packets, all the chips should consumed and should not keep for further storage

Effect of Semi-vacuum Frying Temperature and Packaging on The Quality Attributes of Chips Prepared From Jackfruit Bulbs

o Unknown commercial matured jackfruits (65-75 days) were collected from Shreepur Cotton orchard, Gazipur.
o The jackfruits were washed, peeled, removed the seed from bulb and sliced length wise.
o Finally, the jackfruit slices were fried in the semi-vacuum fryer machine at 95 mbar vacuum pressure of different frying temperature. Overall Conclusions Jackfruit slices dipped into 105oC for 10 mins frying by vegetable oil and preserved chips into HDPE performed better among treatments.
✓ The experiment will be conducted as repetition for the next year for more confirmation.

Lesson Plan-14

Ref.No.14.3.14

Title : Osmotic dehydration
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants about Application of Osmosis in Food Processing, Osmotic Process Parameter, Mass transfer phenomena during osmotic dehydrationand apply in their relevant field.

Learning Outcomes : After completion of training session the participants will be able to:

- explain application of osmosis in food processing
- describe parameters Influencing the osmotic process
- discuss raw materials characters for osmotic dehydration
- explain steps of dehydration during frying
- mass transfer phenomena during osmotic dehydration

Content		Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Osmotic dehydration • Importance: significance osmotic dehydration • Outline of content		Lecture/ Discussion/ Q+A		6
Development • Application of Osmosis in Food Processing • Parameters Influencing the Osmotic Process • Raw Materials Characters for Osmotic Dehydration • Steps of dehydration during frying • Osmotic Process Parameter • Mass transfer phenomena during osmotic dehydration • Advantages of Osmotic Dehydration • Check attention by making wrong statement • Feedback(Q+A)		Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning		Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

	Behavior/Performance	Condition	Criteria

Lesson-14
Osmotic Dehydration

- Dr. Mohammad Mainuddin Molla
SSO, BARI

Dehydration Vs Osmotic dehydration

Dehydration	Osmotic dehydration
Conversion of a liquid product to a dry (solid) product	• Removal of water by immersing the food in a salt or sugars solution. • Water is transferred from food to the solution by virtue of the difference in osmotic pressure.
Involves (almost) complete removal of water.	ves partial removal of water.

Dehydration Vs. Evaporation

Dehydration	Evaporation
Conversion of a liquid product to a dry (solid) product	Concentration of a liquid product to a liquid product
Involves (almost) complete removal of water	Involves partial removal of water
It does stop the growth of microbes	It does not stop the growth of microbes
Dehydration involves almost complete removal of water from a product	Drying involves complete removal of water
Dehydration process follow osmotic process means helps to go sugar syrup penetrate into the product	Drying processes usually involve rise in temperature of the product
It is near to drying	It is bone drying
It can consume directly	It needs to rehydration before consumtion

Dehydration Dehydration is the process of removing water or moisture from a food product. Removing moisture from the foods makes them smaller and lighter.

Why dehydration

- ❖ Make water loss much more rapid.
- ❖ To preserve food for long time by

-reduction in rate of microbial growth and
-other chemical reactions at low water activity.

- ❖ Reduction in transportation and storage cost
- ❖ Possible savings in packaging costs

(packaging a solid product as opposed to a liquid product)

Advantages of dehydration/osmotic dehydration

The main advantages of using OD:

- ❖ Reduction of process temperature
- ❖ Sweeter or salty taste of dehydrated product
- ❖ Reduction of 20-30% energy consumption and
- ❖ Shorter drying time (Yetenayet and Hosahalli, 2010).
- ❖ Improves the nutritional, functional and organoleptic properties of the product
- ❖ Greater sensory resemblance between the dehydrated and natural products (Tortoe, 2010; Ahmed et al. 2016).
- ❖ The left over osmotic solution can also be utilized in beverage industries, thereby enhancing process economy or it may be re-used for further drying (Tortoe, 2010; Agnieszka et al., 2016).
- ❖ Does not require any sophisticated equipment (Nazaneenet *al*., 2017). How dehydration preserve foods

- Foods can be spoiled by food microorganisms or through enzymatic reactions within the food.
- Bacteria, yeast, and molds must have a sufficient amount of moisture around them to grow and cause spoilage.
- Reducing the moisture content of food prevents the growth of these spoilage-causing microorganisms and
- Slows down enzymatic reactions that take place within food. The combination of these events helps to preserve food.

Dehydration methods The development of dehydration technology can be divided into four groups: 1. Cabinet or bed type dryers: hot air flowing 2. Spray dryers/drum dryers: Dehydration of, powder or slurries or Purees 3. Freeze dehydration/Osmotic dehydration: Fruits and vegetables 4. High vacuum/microwave drying: Take place at molecular or atomic levels

Before dehydration what's need

- ❖ Sanitizing and hygiene
- ❖ Adequate hand washing facilities
- ❖ Adequate ventilation of the processing room
- ❖ Adequate storage facilities

Factors affecting dehydration/Osmotic dehydration process The influence of main process variables:

1. Osmotic agent:

- ❖ The common osmotic agent are salt, sugar, honey, sucrose, glucose, fructose, sorbitol, glycerol, glucose syrup, corn syrup, maple syrup, starch, fructo-oligosaccharides, maltodextrin and ethanol.

- ❖ Sugar and salt solutions proved to be the best choices based on effectiveness, convenience and flavor.
- ❖ Sugar solution reduces browning by preventing oxygen entrance, provides stability to pigments and helps retain volatile compounds during drying of osmotically treated materials

2. Concentration and composition of the osmotic solution:

- ❖ Increase of solution concentration results in the increase in water loss and solid gain rates (Phisut, 2012).
- ❖ Less concentrated sucrose solution leads to minimal loss of water and solid gain ratios (Tortoe, 2010).

3.Temperature:

❖ Temperatures above 45°C can cause undesirable changes in color, flavor and aroma, as well as changes in the food cell wall.

❖ Initially, the water loss and solid gain increases as temperature increases up to 50°C.

4. Immersion time

❖ The increase in immersion time leads to higher loss of moisture during osmotic dehydration (Ispir and Torul, 2009; Mundada*et al.*, 2011).

❖ Solid gain and weight loss of the produce during osmosis attain equilibrium state with respect to time (Ispir and Torul, 2009; Phisut, 2012).

5. Agitation:

❖ Highly concentrated viscous sugar solutions creates major problems such as floating of food pieces hindering the contact between food material and the osmotic solution, causing a reduction in the mass transfer rates (Phisut, 2012).

❖ So agitation or stirring process can be applied during osmotic dehydration. Ratio of solution to sample: ❖ Most of researchers used the sample to solution ratio ranging from 1:1 to 1:5 in order to study the mass transfer kinetics by following changes in concentration of solution and other factors.

❖ A ratio of 1:2 or 1:3 is optimum for practical purposes (Tiwari, 2005).

7. Reuse of osmotic solution: The solution remained after osmotic treatment of fruits has been suggested to be applied for other food preparations such as:

❖ Jams

❖ Syrup for fruit canning

❖ Mixing with fruit juices

❖ Fruity soft drinks

❖ Pharmaceutical and food industries as a natural additives and

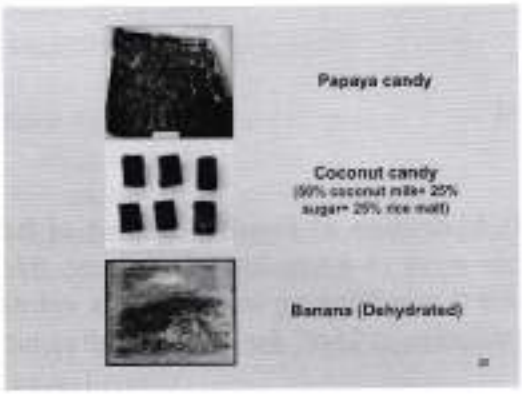
❖ Animal feed production.

Flow chart for dehydration/osmotic dehydration process Dehydration of Foods Selection of fresh fruits Sorting, grading, washing and peeling Cut into suitable sizes (6-8 cm long and 2 cm thick) Keeping the slices into 1% KMS solution Blanching at 90°C for 2 min Dipping into 45o Brix solution with 1% KMS solution for 30 mins. Immersing the slices into solution at 25oC for 12 hrs Adding citric acid (0.5%) with 2.0% KMS

Osmo-dehydrated foods

Taking fruit, washing, sorting, grading and peeling
Cut into suitable size
Dipping into 25°Brix solution containing 1% KMS with 0.5% citric acid for 1.5 hrs
Heating gradually and turned it from 25°Brix to 50°Brix
Take out the product from syrup solution
Transfer it to dehydrated tray
Dehydrating at 50°C
Storing at HDPE/PP pouch at ambient condition/refrigeration temp.

BARI developed dehydration/osmotic dehydration products



Conclusion

Dehydration/Osmotic dehydration provides some benefits such as reducing the damage of heat to the flavor, color, inhibiting the browning of enzymes and decreases the energy costs.

This process could be used on small scale for development of self-entrepreneurs and home scale industries. Consumption of such nutritional and valued products could be popularized through exhibition and media.

Lesson Plan-15

Title : Food processing and preservationby Fermentation Ref.No. 14.3.15
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants about Fermentation Preserves Foods, Benefits of Fermenting, Microbial Contamination of Foods and apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- explain main advantages of fermentation.
- discuss the factors that affect on quality and safety of fermented food
- describe the microorganisms used to fermented foods and the benefits from this microorganisms.
- explain how the fermentation can preserved food

Content		Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Fermentation as method of food processing and preservation • Importance: significance fermentation as method of food processing and preservation • Outline of content		Lecture/ Discussion/ Q+A		6
Development • main advantages of fermentation. • the factors that affect on quality and safety of fermented food • how the fermentation can preserved food • the effect of fermentation on quality of final product. • Check attention by making wrong statement • Feedback(Q+A)		Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning		Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

	Behavior/Performance	Condition	Criteria

Lesson-15
Food processing and preservation by Fermentation

Prof. Dr. Md. Shahjahan
Garman University, Gazipur

Fermentation in food processing is the process of converting carbohydrates to alcohol or organic acids using microorganisms—yeasts or bacteria—under anaerobic conditions.

Fermentation usually implies that the action of microorganisms is desired. The science of fermentation is known as zymology or zymurgy
How fermentation preserves food

During fermentation, organisms produce acetic acid, alcohol and lactic acid, which are all "bio-preservatives" that retain nutrients and prevent spoilage.
Lactic acid acts as a preservative by reducing pH, which inhibits the growth of harmful bacteria.

Benefits of fermentation
There are several benefits to fermenting food.

- Fermentation serves to enhance the digestion of food.
- Fermentation enhances the flavors of some foods.
- Fermenting makes foods more edible by changing chemical compounds, or predigesting, the foods for us.
- Fermentation increases nutritional values with the biochemical exchange it produces, and allows us to live healthier lives. Here are a few examples:
- The sprouting of grains, seeds, and nuts, multiplies the amino acid, vitamin, and mineral content and antioxidant qualities of the starting product.
- Fermented beans are easier for our bodies to digest, like the proteins found in soy beans that are nearly indigestible until fermented.
- Fermented dairy products, like, cheese, yogurt, and kifir, can be consumed by those not able to digest the raw milk, and aid the digestion and well-being for those with lactose intolerance and autism
- When vegetables like cabbage and cucumbers are left to steep and sit until the sugars are broken down to promote the growth of bacteria, this is when the vegetables are fermented.
- Fermented foods are also filled with beneficial bacteria that work as reinforcement for the good bacteria in the digestive system. Since 70 percent to 80 percent of the immune system lies in the gut, having proper balance of gut flora is important
- Vinegar is used to leach out certain flavors and compounds from plant materials to make healthy and tasty additions to our meals.

Types of fermentation There are two types of fermentation:
1. Alcoholic fermentation
2. Lactic acid fermentation.

1. Alcoholic or ethanol fermentation

- During ethanol fermentation glucose is converted to ethanol (C_2H_5OH) and CO_2.
- One glucose molecule is converted into two ethanol molecules and two carbon dioxide molecules.
- Ethanol fermentation produces ATP, ethanol and CO_2 as by-products

• Ethanol fermentation / yeast fermentation have wide practical applications in the production of alcoholic beverages, ethanol and bread.

2. Lactic Acid Bacteria Fermentation (LA fermentation)

• Lactic acid fermentation is done by lactic acid bacterial (LAB) cultures with chemical preservation, using salt and acid to preserve various foods such as milk, cereals, meat, fruits and vegetables.
• LA fermentation maintain and improve the nutritional and sensory features of food commodities.
• Lactic acid fermentation retains all the natural plant ingredients while improving the quality and taste.
• LA fermentation enhances the organoleptic and nutritional quality of the fermented fruits and vegetables and retains the nutrients and coloured pigments.

Some products made by Lactic Acid Bacteria fermentation.

Pickle – It's a product prepared by lactic acid bacteria (LAB) fermentation of sugar present in pieces of fruits and vegetables. The prepared product is rich in Lactic acid and only the beneficial bacteria that can tolerate lactic acid pH survive.

B. Sauerkraut

It is basically a finely cut cabbage that has been fermented by various lactic acid bacteria. Sauerkraut usually has a long shelf life and a distinctive sour flavor.

Yogurt

Yogurt is basically a fermented product prepared from milk. The main method of producing yogurt is through the lactic acid fermentation of milk with harmless bacteria. The primary bacteria used are typically Lactobacillus bulgaricus and Streptococcus thermophiles.

D. Kimchi

It is basically a Korean dish. It is a staple food inKorean cuisine, is a traditional side dish made

from salted and fermented vegetables, most commonlynapa cabbage and Korean radishes, with a variety of seasonings including chili powder, garlic and , ginger.

Acetic Acid Bacteria fermentation

AAB are a group of gram-negative bacteria which oxidize sugars or ethanol and produce acetic acid during fermentation. Several species of acetic acid bacteria are used in industry for production of certain foods and chemicals. Vinegar is formed when acetic acid bacteria is added to alcoholic beverages.

The Difference between pickling and fermenting

Pickling involves soaking foods in an acidic liquid to achieve a sour flavor; when foods are fermented, the sour flavor is a result of a chemical reaction between a food's sugars and naturally present bacteria — no added acid required.

Lesson Plan- 16

Title : Principles and methods of Pickling (Theory &practical) Ref. No. 14.3.16
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants about pickling History, Pickling Process, Possible health hazards of pickled vegetables and apply in their relevant field.
Learning Outcomes : After completion of training session the participants will be able to:

- explain pickling History
- describe Popularity of pickles around the world
- explain Pickling Process
- possible health hazards of pickled vegetables

Content		Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Pickling • Importance: significance Pickling • Outline of content		Lecture/ Discussion/ Q+A		6
Development • Pickling History • Popularity of pickles around the world • Pickling Process • Possible health hazards of pickled vegetables • Check attention by making wrong statement • Feedback(Q+A)		Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning		Discussion/ Q+A		9
	Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.			
	Behavior/Performance	**Condition**		**Criteria**

Lesson Plan-17

Title : Food preservation by increasing solids(Practical) Ref.No.14.3.17
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants about Importantsteps forFood preservation by increasing solids to help to conserve food products and apply in their own field.
Learning Outcomes : After completion of training session the participants will be able to:
- describe important factors Food preservation by increasing solids
- explainthe main process.

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Food preservation by freezing. • Importance: significance Food preservation by increasing solids • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Describe important factors Food preservation by increasing solids • Explain the main process. • Steps • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

Behavior/Performance **Condition** **Criteria**

Lesson-17
Food Preservation by increasing solids

Md. Hafizuddin khan
CSO, PHTD
BARI, Gazipur

Why is Postharvest Important?

1. Increase Food Security
2. More Value Added
3. To reduce the pressure on environment
4. Reduce impact of unfair trade
5. Decrease unemployment rate
6. Increase the quality of food
7. Increase of agriculture productivity is difficult rather than to reduce the post harvest losses.

ফসলেরঅপচয় ঘটে মূলত

- জীবাণুর আক্রমণ
- রাসায়নিক বিক্রিয়ায়
- এনজাইমের কার্যকলাপের ফলে জীবানু ও এনজাইম এর কার্যকারিতা প্রভাবিত হয় প্রধানত
- তাপমাত্রা
- আর্দ্রতা
- অম্লতা
- প্রিজারভেটিভের উপস্থিতি
- বাতাসের উপস্থিতি

চিনি ও এসিড সংযোজন করে সংরক্ষণ

চিনি ও এসিড সংযোজন করে জেলী, জ্যাম, মোরব্বা ও ক্যান্ডি তৈরী করে বিভিন্ন ধরনের ফল সংরক্ষণ করা হয়।

- জেলীঃ জেলী তৈরী করার সময় ফলের রস ব্যবহার করা হয়।

Lesson Plan -18

Title : Preparation of Jam/Jelly/Marmalade Ref.No.14.2.18
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants about Important factors which affect cooling the foods, freezing of food change its original taste and nutrition value and how refrigeration help to conserve food products.
Learning Outcomes : After completion of training session the participants will be able to:

- Describeimportant factors which affect cooling the foods.
- explainthe main difference between the slow and fast freezing process.
- discuss freezing of food change its original taste and nutrition value
- explain refrigeration help to conserve food products

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic:Food preservation by cooling. • Importance: significance Food preservation by cooling • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Important factors which affect cooling the foods. • THE main difference between the slow and fast freezing process. • Freezing of food change its original taste and nutrition value • How refrigeration help to conserve food products • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

Behavior/Performance **Condition** **Criteria**

Lesson-18
Preparation of Jam/Jelly/Marmalade

Md. Hafizuddin khan
CSO, PHTD
BARI, Gazipur

1.- General information

Jams, marmalades, preserves and conserves are fruit products preserved by sugar. These products differ in gel consistency, ingredients and how the fruit is prepared. They are easy to make at home.

- **Jams** are made from crushed or ground fruit and usually have a thick consistency due to high pectin content.
- **Marmalade** is a jelly with pieces of fruit suspended in it. Citrus peel and juice are frequently the basis of marmalade.
- **Preserves** contain whole fruit or small pieces of fruit in a thick sugar syrup.
- **Conserves** are jams made from a mixture of fruits. They usually contain citrus fruit, nuts and raisins.

Ingredients and their roles

Fruit gives the product its special flavor and provides pectin for thickening.

Pectin provides thickening or gel formation.

- All fruits contain some pectin.
- Apples, crabapples, gooseberries, some plums, highbush cranberries and citrus peel contain large amounts of pectin.
- Fruits like blueberries, strawberries, cherries or huckleberries contain little pectin. You can make thicker products with these fruits by combining them with fruit rich in pectin or with powdered or liquid pectin.

Acid

must be present to form gel in marmalades and thickening in jams, preserves and conserves.

- For fruits lacking in natural acid, like strawberries, recipes call for lemon juice or other citrus fruit.
- Commercial pectin products contain organic acids that increase the acid content of fruits.

Sugar aids in gel formation, develops flavor by adding sweetness, and acts as a preservative.

- Corn syrup or honey can replace half of the sugar in a recipe.
- Use light colored, mild-flavored honey; too much honey can overpower the fruit flavor.

2. Processing details for jam and marmalade production Suitability for small-scale production Jams, jellies and marmalades are increasing in importance in many countries, particularly in wealthy urban areas. When made properly, jams and marmalades are safe products due to the high acid and sugar content. It is essential that a survey is carried out to determine the potential market for the product before starting on production. A successful business depends on a good market for the Product. Too often, small-scale processors decide to make jam because there is an abundant supply of raw material, with no evaluation of the demand for the product.

Constraints to production

Preserves require a large quantity of sugar. In many cases, refined white sugar has to be bought from urban centres and may be expensive. The availability of fruits is seasonal. Fruits must be semi-processed and stored for use later in the season, or a sequence of fruits should be used to allow year-round production.

A high working capital is needed to purchase fruits in mid-season when the prices are low. 2.1.- Preparation of the fruit Fruit should be washed in clean water, peeled and the stones removed. Fruit should be as fresh as possible and slightly under-ripe. Over-ripe and/or bruised fruit will not make good jam as it has low levels of pectin and/or acid. The jam will not set. Accurate scales are needed to make sure that the correct amounts of ingredients are used each time. Two sets of scales are needed - one with a large capacity for sugar and fruit and a smaller set for pectin and citric acid. 2.2.-Pulp/Juice Extraction To produce a clear juice for jelly, the juice should be filtered using a muslin cloth bag. The pH of the juice or pulp should be 3.0 to 3.3. It is measured using a pH meter and adjusted by adding citric acid or sodium bicarbonate (if the acidity is too high, for example with limes). Pectin is added to the pulp at this stage. Follow the instructions on the package.

2.3.- Added Ingredients Pectin Pectins are naturally present in fruits. Some fruits contain higer levels than others. The richest sources are citrus peels, passion fruit and apple. Strawberries and melon contain low levels. In general, the pectin level decreases as the fruit matures. Low-pectin fruits are often mixed with high pectin fruits to achieve the correct level. Pectin is needed to make the fruit set into a gel. Although it is possible to get a good preserve using the pectin in the fruit, it is better to buy pectin powder or solution and add a known amount to the fruit juice or pulp. This will produce a standardised gel each time and there will be less risk of a batch failing to set. Pectin can be bought, either as a light brown powder or a dark liquid concentrate. It is usually supplied as '150 grade' (or 150 SAG) which indicates the ratio of the weight of sugar to pectin that will give a standard strength of gel when the preserve is boiled to 65% soluble solids. 5 SAG is normally enough to produce a good gel.

There are two main types of pectin - high methoxyl (HM) - low methoxyl (LM). High methoxyl pectins form gels in high solid jams (above 55% solids) and in a pH range 2.0- 3.5. Low methoxyl pectins do not need sugar or acid to form a gel, instead they use calcium salts. LM pectins form a gel with a wide range of solids (10-80%) within a broad pH range of 2.5- 6.5. Pectins may be either slow or fast setting. For most preserves a slow setting type is needed so it can set in the jar. If pieces of fruit are suspended in the gel, or if large volumes of jam are being made, a fast setting pectin is needed. In both types, the concentration of pectin varies from 0.2-0.7% depending on the type of fruit being used.

2.4.Heat Treatment There are two stages of heating. First, the fruit should be heated gently to soften the flesh and extract the pectin. This is followed by rapid boiling to evaporate the water until the final sugar content is reached. The end-point of boiling is measured using a refractometer (this measures the sugar concentration). A jam thermometer can also be used to assess the end point accurate than using a refractometer.

2.5.Filling The jars should be clean and sterilised. The ja
Hotter than this and condensation will form under the lid.
allowing mould to grow. Colder than this and the jam will be
filled to about 9/10ths of their volume.

2.6.-Packaging It is preferable to use glass jars with new metal
also be used, but they look less professional and there is more ri
foil lids can also be used if available as these tend to be cheaper th

B. Pi
Pineapp
Papaya pu
Cane sugar
Apple pectin (
Citric acid 182g
Fresh ground ginge

as less sugar, the

Preparation.

A. Lime marmalade:

1 litre lime juice ,20g sodium bicarbonate, 3kg sugar, 1200g 5SAG pectin (made from 40g pectin, 200g sugar and 960ml water), few drops green food colour, 200g sugared lime peel shreds.

1. Marmalade is made according to the basic jam/marmalade method. However, there are a few quality assurance points that must be observed:

2. Limes have a very high level of acidity (pH 2.7- 2.9) which means that they need to be treated differently to most other fruits.

3. Fruit preserves need a pH of between 3.0 and 3.3 to enable the pectin to make a strong gel. Therefore the pH of lime juice has to be increased by adding sodium bicarbonate (baking powder).

4. The amount of sodium bicarbonate added varies according to the variety and acidity of the lime. The acidity is measured using a pH meter if one is available. If one is not available, then a series of tests must be carried out to find the correct amount of sodium bicarbonate to add to make a good gel. About 20g sodium bicarbonate per litre of juice is a good starting point.

5. One of the problems of making marmalade is to ensure that the peel pieces are evenly distributed throughout the gel, not floating at the top. This is achieved by soaking the peel in sugar so that it has the same density as the gel.

6. After squeezing out the juice, the lime peel must be shredded into very thin slices about 1- 2.5cm long. The shreds are saturated in sugar.

7. The shredded peel is mixed with sugar (1kg peel and 1kg sugar) and left in a sealed container for one week, stirring occasionally. After this time, the shreds will be floating in a dense syrup. Sodium metabisulphate (1g per kg peel) can be added to prevent the growth of mould and yeast.

8. Extraction of the lime juice is time consuming and tedious. Use of a small juicer is recommended. The juice is very acidic and therefore should not be collected in metallic containers. Only use food-grade plastic, stainless steel or wooden utensils. The juice must be filtered or strained to remove any pulp.

9. Fruit juice can be preserved for later use by adding 3g sodium metabisulphate per litre of juice and storing in a sealed container.

10. The lime juice, bicarbonate and half the sugar are placed in the pan, brought to the boil and boiled for 3 - 5 minutes with steady stirring (it is impossible to state boiling times exactly, as this depends on the heat source etc).

11. The remaining half of the sugar, peel, pectin and green colour are added and boiling continued until the required sugar level (68%) is reached (as measured either by refractometer or jam boiling thermometer).

B. Pineapple-papaya jam :

Pineapple pulp 11.4kg
Papaya pulp 11.4kg
Cane sugar 22.8kg
Apple pectin (150 grade) 171g
Citric acid 182g
Fresh ground ginger 214g

1. Remove and discard the ends of the pineapples. Remove the skin and take out the central core. Prepare a pulp by passing the fruit pieces through a pulping machine fitted with a 100mm screen sieve.
2. Peel the papaya, halve the fruits and remove the seeds. Pulp in the pulping machine using a 100mm screen sieve.
3. If ginger root is used as a flavouting, peel and macerate it using a Kenwood blender until it has a very fine paste-like consistency.
4. Place the weighed fruit pulp into a stainless steel steam jacketed kettle and heat to about 43°C, stirring constantly.
5. Turn off the heat. Add the pectin (that has previously been mixed with about ten times its weight with some of the pre-weighed sugar) and stir continuously to prevent the pectin from clotting.
6. When the pectin has dissolved, add the remainder of the sugar and dissolve completely in the mixture. Turn on the heat and stir the mixture until the jam starts to boil vigorously. Continue stirring until the jam is almost at its finishing point (105°C).
7. Add the citric acid and ginger if it is being used.
8. After the jam has reached 105°C, it is tested for the end point. This is determined by removing samples of the jam at intervals and measuring the total soluble solids (TSS) in a refractometer. The sample must be cooled before it is measured. When the required TSS has been reached, the jam is taken off the heat and any surface foam is removed.
9. The hot jam is quickly poured into hot sterile jars. The jars are sterilised by boiling in water for 30 minutes. They should be hot when they are filled to avoid them cracking when the hot jam is poured in.
10. The jars are fitted with sterile lids and sealed. The jars are then inverted for about 3 minutes to ensure that the lids are sterilised.
11. The filled jars are cooled in clean running water until they are slightly higher than room temperature. They are air-dried and labelled.

C. Mango Jam Mangoes
- ripe and under-ripe - Sugar 60% of the weight of prepared mango - Lemon juice - 2 spoons per kg mango

1. Wash and peel the mangoes using a stainless steel knife. Cut into small chunks and weigh. Weigh out the sugar (equal to 60% the weight of mango).
2. Add 70% of the weighed out sugar to the mango pieces, plus 2 spoons of lemon juice per kg of mango. Heat the mixture, stirring all the time, until the total solids is 55° Brix as measured by a refractometer.
3. Add the remaining 30% of sugar plus 2 spoons lemon juice per kg mango. Heat again. Stir well during heating until the total soluble solids is 67-68°Brix.
4. Hot fill the jam into clean sterile jars. The jam should be stirred in the jars to eliminate any air that may have got in. Seal the jars with sterile screw caps.
5. Cool to room temperature. Label the jars and store in a cool dry place.

D.Tropical fruit jam - pineapple, guava, papaya

-6kg peeled fruit
-3kg sugar
-50ml lemon juice

This is an extra quality jam that is prepared with less sugar than normal. Because it has less sugar, the jam must be stored in a refrigerator after opening, or consumed within a few days.

1. Sort the fruit, discard any unripe, over-ripe or damaged fruit.
2. Wash in clean water and leave to drain.
3. Peel with a stainless steel knife and cut into halves or quarters depending on the size of the fruit. Place the pieces in a large stainless steel cooking pan.
4. Cook on a low heat, stirring continually with a wooden spoon to prevent the jam from sticking to the bottom of the pan. Simmer for 15 minutes.
5. Turn up the heat and cook for a further 15 minutes, stirring continually.
6. Add 1kg sugar and dissolve rapidly. Cook for 30 minutes. Add 50ml lemon juice.
7. Add the remaining 2kg of sugar, dissolve rapidly and boil for 15-20 minutes until the product reaches setting point.
8. Remove from the heat, cool to about 85°C and pour into clean, sterilised jars.
9. Cover with clean sterile lids, cool to room temperature and label.

Lesson Plan- 19

Title : Principles and Methods of Packaging & Industrial Food Processing Ref.No. 14.4.19
Target people : Grade-9 and above officers under MoA \
Time : 60 minutes.
Aims /Rationale : To teach participants about the concepts of minimum food packaging technologies, based on principles of food preservation and their integration with the food products', consumers' and markets' essential needs.
Learning Outcomes : After completion of training session the participants will be able to:

- select Packaging techniques and materials
- mentionTypical packaging
- discuss Short term and long term storage
- describe Packaging materials

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic: Packaging in fresh and processed foods. • Importance: significance of Packaging in fresh and processed foods • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Typical packaging • Select Packaging techniques and materials • Short term and long term storage • Packaging materials • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

Behavior/Performance **Condition** **Criteria**

Lesson-19
Principles and Methods of Packaging & Industrial Food Processing

S.M. Maruf Kabir
Head of Quality Control
PRAN-RFL Group

Advances in Packaging Methods, Processes and Systems: 1.Introduction Worldwide sales of processed food have reached more than $2 trillion. Of this, packaged foods take up almost $1 trillion. Research has shown that the increase of incomes in traditionally less economically developed countries has led to a rise in standards of living. Consequently, consumers in these countries have switched from staples such as rice and barley to processed food . Packaging is the cornerstone of the food processing industry [3]. In fact, the processing and packaging industry transforms food from one stage to another based on appropriate techniques and methods, and the entire chain of events can be subsumed under this one phrase. As seen in Figure 1, packaging consists of a diverse array of options. Processing and packaging includes under its banner five important stages. It is driven by health and hygiene factors, food safety, high quality, fresh tasting, and balanced vitamins and nutrients [4]. Other important aspects of food processing and packaging are toxin removal, marketing and distribution, maintenance of taste, year-round availability, and long shelf-life [5]. There are other benefits as well. Processed foods are preserved longer, protected from dust, moisture, and microorganisms, and are odor-free. The advent of machineries, robotics, and automation technology has driven down the overall cost of processed food versus original food products. The California Institute of Food and Agricultural Research at the University of California, Davis reported that research areas for the food processing and packaging industry [6] would include (i) optimization of equipment and utilities; (ii) food safety and security; (iii) supply chain waste reduction; (iv) development of seasonal infrastructure; and (v) advanced automation and control methods. In summary, the productivity of a typical food processing plant depends on (i) pre-preparation; (ii) processing and preservation methods; (iii) packaging materials; (iv) systems for material flow; (v) automation, instrumentation, and control scheme; (vi) degree of smartness in the sensors; (vii) sophistication in the machineries and mechanisms (including application of robotics); (viii) inspection methods; (ix) printing methods; (x) security identification; (xi) graphic design and digital work flow; (xii) sanitation and sterilization; and (xiii) factory-wide execution management strategy including supply-chain management.

2. Materials and Advanced Packaging Methods This section presents several types of packaging materials followed by advanced packaging methods. Packaging materials are selected based on the specific food types. Oxygen-sensitive foods require packaging with barrier properties that can prevent spoilage due to oxidation. Plastics have been used for Challenges 2014, 5 376 a long time, but sustainable and green protocols recommend forgoing plastics for other materials that are biodegradable and environmentally friendly. As most packaging generates waste, there is renewed focus on creating sustainable packaging and some of the examples of those materials are polylactide acid (PLA) plastics, sugar cane pulp, fiber composite, starch-based films, and so on. Woods and glass are also used as packaging materials for a long time. Aluminum packaging provides an impermeable barrier to protect food. It is chemically neutral, non-toxic and non-tainting. Some foods need to be kept in a dark environment [15–19]. Aluminum is good in this respect [20]. Efficient packaging can mean cheaper, safer, and more hygienic foods. Active packaging is one of the ideas where the packaging material itself interacts with the food to confer longer shelf-life, higher safety, and improved hygiene. The presence of iron in such an approach slows down the oxidation process. Yet another approach is modified atmosphere packaging (MAP), whereby the package atmosphere has an artificially reduced oxygen level and inflated carbon dioxide level.

Smart packaging, an advanced active packaging, relates to use of sensors. Fuzzy logic and neural networks have been incorporated to develop intelligent sensors [18] that have soft thresholds between reject–accept classifications of food. Nanotechnology-based packaging, another level of packaging principle, is drawing attention recently. This approach is concerned with molecularlevel material manipulation that can reduce spoilage or oxidation. Furthermore, there is secure hygienic production, processing and shipment. Nanotechnology-based sensors and coating materials can be used for pathogen and contaminant detection and tracing. Nanoscale silica spheres [16–18] filled with molecules of a fluorescent dye have already been developed and are compatible with meat packaging, where they are able to detect the presence of the poisonous E. coli 0157 bacteria [19]. Food monitoring based on anti-counterfeit technologies is currently in the research and development stage at various companies. Important research studies in nanotechnology-based smart packaging are barrier, mechanical and heat-resistance properties, sensing and signaling microbiological and biochemical changes, and traceability. Moreover, sustainability has emerged as the new face of the packaging industry, and one essential tool that can be used to trigger sustainability is Life Cycle Inventory (LCI). LCI provides a detailed description of how a raw material is extracted until the end of its life and includes: (i) material and energy used in the packaging; (ii) wastes involved in the process; (iii) percentage of gases emitted into the air per package; (iv) usage of water over the entire life cycle of a package; and (v) whether the packaging material is dumped into the land or recycled or reused. Thus, inclusion of lifecycle information into the packaging system is gaining momentum.

Lesson Plan-20

Title : Packaging in fresh and processed foods. Ref.No. 14.4.20
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants about Packaging in fresh and processed foods which can applied in own field.
Learning Outcomes : After completion of training session the participants will be able to:

- select Packaging techniques and materials
- mention typical packaging
- discuss Short term and long term storage
- describe Packaging materials

Content	Methods or Techniques	Resources or Aids	Time (Minute)
Introduction • Ice breaking/Greetings • Linkage with previous learning/experience • Pre-assessment(Q+A) • Topic: Packaging in fresh and processed foods. • Importance: significance of Packaging in fresh and processed foods • Outline of content	Lecture/ Discussion/ Q+A		6
Development • Typical packaging • Select Packaging techniques and materials • Short term and long term storage • Packaging materials • Check attention by making wrong statement • Feedback(Q+A)	Lecture/ Discussion/ Q+A		45
Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9
Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room. **Behavior/Performance** **Condition** **Criteria**			

Lesson-20

Packaging of Fresh and Processed Food Products

Md. Eskander Hossain
SA, AD

Perishable commodity
Any commodity which might get spoiled after a week of proper handling and shipping condition.
Processed Food

Fully processed convenience foods/ready to Eat foods;
These comes in packets which have to be heated and are ready to be served. They are either packed in pouches or vacuum sealed package.

Semi processed convenience foods; Products that require some cooking procedures to give finishing touches by the customer are known as processed foods. One minute noodles, idlimixes, gulabjaman, upmamixes, soupmixes, cake and baked products mixes are examples.

Dehydrated food; Products that have been subjected to dehydration constitute this group. Powder for makingsouth indian dishes, soups, dhokla and bakery products along with cakes are all dehydrated food products.

Packaging; is defined as a mean or system by which a fresh produce or processed product will reach from the production center to ultimate consumer in safe & sound condition at an affordable price.

Main function of packaging;
1. To assemble the product into convenient units for handling
2. To protect the produce duringstorage and marketing (Protection)

Why packaging?
* Horticultural produce has limited shelf life of a few hours to few weeks at ambient condition
*packaging is required for food preservation, protection and for safe transportation of products during storage and handling.

Packaging requirements:
*Products cannot delay or prevent fresh fruits and vegetable from spoilage incorrect packaging can accelerate spoilage
* Packaging can serve to protect against contamination, damage and most importantly against

excess moisture loss.
* Protect fruits and vegetable from pathogens.
* Size, shape, weight limitation
* they must be non-toxic and compatible with the specific foods
* Sanitary protection
* Gas and odor protection
* Light protection
* Resistance to impact
* Transparency
*Tamperproof
* Appearance, printability
* Low cost

Types of packaging Materials

*Natural materials

*Wood -Pallets

- Pallets Bins

-Wire-Bound Crete's Wooden crates and Lugs

-Wooden Baskets and Hampers

Corrugated Fireboard

* Pulp containers
* Paper and Mesh Bags
* Plastic Bags
* Shrink Wrap
* Rigid Plastic Packages
* Plastic field boxes

Modified Atmosphere Packaging (MAP)

* A technique used for prolonging the shelf-life of fresh foods.
* The air surrounding the food in the package is changed to another composition.
* MAP is used with various types of products. The mixture of gases in the package depends on the type of products, packaging materials and storage temperature.

Equilibrium modified atmosphere packaging (EMAP)

*Among fresh-cut produce EMAP is the most commonly used packaging technology

* When packaging vegetables and fruits the gas atmosphere of packaging is of a lower level of O2 and a heightened level of CO2

*this kind of package slows down the normal respiration of the product to prolong its shelf-life

Lesson Plan-21

Ref.No. 14.4.21

Title : Good manufacturing practices.
Target people : Grade-9 and above officers under MoA
Time : 60 minutes.
Aims /Rationale : To teach participants about, the concepts of minimum food packaging technologies, based on principles of food preservation and their integration with the food products', consumers' and markets' essential needs.
Learning Outcomes : After completion of training session the participants will be able to:

- select Packaging techniques and materials
- mention typical packaging
- discuss Short term and long term storage
- describe Packaging materials

Content	Methods or Techniques	Resources or Aids	Time (Minute)
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Conclusion • Assessment of ILOs • Summarization by using (KWs) • Motivation(Application of learning) • References • Forward planning	Discussion/ Q+A		9

Equipment and aids: Multimedia, White board, Documentary, Marker, Pointer, Duster, etc. to be available in the class room.

Behavior/Performance **Condition** **Criteria**

Lesson-21
Good Manufacturing Practice (GMP)

S.M. Maruf Kabir
Head of Quality Control
PRAN-RFL Group

- Good Manufacturing Practice (GMP) is a package of system to obtain a safe and wholesome food through a proper design and monitoring and control of manufacturing process and facilities.

- GMP is a daily practice guidelines for a food processing industry in the corner of quality management, personnel & training, premises &equipment's, documentation, production & its area, quality assurance, storage area and hygiene & sanitation. GMP always protects the quality of product as well as preserve the benefit of a food industry and its consumer satisfaction with minimum product loss to equate quality of product with survival and growth of the business.

- Quality Assurance is a vital part of a food processing industry. It has a broad jurisdiction concerning quality of product individually or collectively. QA justify the quality of a product by using standard specification, sampling frequency and its specific parameters analysis. So such department must be formed by R&D, quality audit, quality control, microbiology, toxicology, raw materials, processing development and packaging material testing department to obtain a instant quality of the product of a food processing industry.

- HACCP means hazard analysis critical control point. Any type of hazard like chemical, physical and biological are identified and its preventive measure are pointed out and made a solving system. HACCP is a safe guard of a food product as well a human consumption. Processing method evaluation, identification and monitoring of critical control point (CCPs) are carried out by HACCP implementation and verification. Improvement of product quality is a natural aftermath of such activities.

Essence of GMP for processed food products:

- To manufacture safe and wholesome food product.
- To maximize consumer satisfaction.
- To minimize product loss.
- Comply with regulatory and sanitary codes.
- To equate product quality with survival and growth of the business.

Basic Requirement of GMP

- Quality Management
- Personnel and Training
- Premise and Equipment
- Documentation
- Production
- Quality Control
- Contract Manufacture and Analysis
- Complaints, Product Recall and Returned Products
- Self-inspection and Quality Audits
- Validation

Quality Management in Food Plant:

Basic elements of Quality Management in the Food Plant are

- To establish a "Quality System" or appropriate infrastructure to GMP encompassing the organizational structure, procedure, processes and resources.
- To take systematic nations necessary to ensure adequate confidence that a product or service will satisfy a given requirements for quality.
- To set quality objectives.
- The attainment of quality objective is the responsibility of senior/top management and requires the participation and commitments by staff in all departments, by company's suppliers and by the distributors.

Quality Policy:

- Overall intentions and directions of an organization as quality as formally expressed by top management. The quality policy will be relevant to the supplier's organizational goals and the expectation and needs of its customers.

How to Achieve the Quality Objective!

- Establish a comprehensively designed and correctly implemented system of Quality Assurance incorporating Good Manufacturing Practice and Quality Control.
- Document and monitor the effectiveness of Quality Objectives.
- Resource adequately all parts of Quality Assurance system with competent personnel, suitable and sufficient premises, equipment and facilities. Ensure compliance with additional legal responsibilities by the holder of manufacturing Licenses and for the Quality Control.

Terms Relating to Quality:

- **Quality**—the totality of its attributes and properties which bear upon its fitness for its intended use. Quality indicates the essential nature of a thing.

Terms Relating to Quality:

Quality Control-It is the essential part of Good Manufacturing Practice which is concerned with Sampling, Specifications, Testing as well as the organization, documentation and release procedures which ensure that the necessary and relevant tests

- are carried out and that materials are not released for use, nor product released for sale, or supply, until their quality has been judged to be satisfactory. Quality Control is not only confined to laboratory operation. But the involvement and commitment of all concerned at all stages are mandatory towards the achievement of Quality Objective.

- **Quality Assurance** – Quality Assurance (QA) is a wide-ranging subject which covers all matters which influence the Quality of a product individually or collectively.

Quality Assurance Functions:

- Designing and developing the products as per requirements of Good Manufacturing Practice (GMP) and Good Laboratory Practice (GLP).
- Specifying production and control operations clearly and adopting GMP.
- Specifying clearly the key personnel (Managerial) responsibilities.
- Making necessary management for the manufacturing, supply and use of proper starting and packaging materials.
- Carrying out necessary controls on raw materials, intermediate products and other in process controls and validations.Correct processing of finished products and checking the quality according to defined procedures

- Products are not sold or supplied before QA has certified that each production batch has been produced and controlled in accordance with the requirements of the Marketing Authorization as well as quality Standards.
- Making satisfactory arrangements to exist as far as possible that the products are stored, distributed and subsequently handled so that quality is maintained throughout their shelf life.
- Establishing a procedure of self-inspection or quality audit which regularly appraises the effectiveness and applicability of the Quality Assurance System.

GMP Guidelines for Quality Assurance:

- Quality Assurance should be designed to suit the operations to be carried out in them. Sufficient spaces should be given to avoid mix-ups and cross-contamination.
- There should be adequate space for sampling reference standards and records.
- Provision for sufficient ventilation, separate air handling units, AC facilities, prevention fumes, harmful gases etc. should be available.
- A separate room may be needed for instruments to protect them against electrical interference, vibration, contact with excessive moisture and external factors.
- Laboratory must be AC.
- Microbiological room must be taped door and heap filter (0.2μ) with laminar flow must be used on the ventilators of the room.

Requirements of GMP for Personnel:

- The current GMP guide highlights code of practice for qualified persons and described their duties and responsibilities in greater detail. It also recommends about the adequacy of qualified persons for industry, their education, training, practical experience, professional code of conduct, delegation of duties and finally the disciplinary measures to deal with cases of misconduct.
- The requirement spoil out that manufacturer must have an organization chart with written clearly understood job descriptions and adequate authority to carry out their responsibilities. There should be no gaps or unexpected overlaps in the responsibilities of those personnel concerned with the application of GMP.
- The key personnel, being heads of production and quality control are the responsible for all production and quality control activities. They should be full time personnel.

GMP Guidelines for Training:

- Training and personnel development are in separable. Product quality depends a lot on engaging right people for the right job.

Benefits of Organized Training Program:

- Better Understanding of Process, People and Equipment.
- Uniformity and Consistency in Manufacturing.
- Higher Quality Attainment.
- Increased Productivity.
- Faster Response

Guidelines for Training:

- A well written Training Program should contain the following: • Give training for all new staff at recruitment appropriate to the duties assigned to them. • Offer training to all personnel who work the manufacturing and quality control areas maintenance and clearing personnel on the basic principle of GMP.

• Conduct specific training of personnel working in sterile and clean areas or in areas where contamination is a hazard and where highly potent, toxic or sensitive materials are handled. • Conduct training on GMP on a continuing basis and at frequent and regular intervals so that knowledge of GMP remain fresh in the memory of employees. • Maintain training record of personnel and make periodic assessment of the effectiveness of the training program. • After training appraise the performance of the employees to determine whether they have proper knowledge for the jobs they are assigned to. Discuss the concept of Quality Control/Assurance and all measures capable of improving its understanding and implementation during the training session. So • that trainees learn how noncompliance with standards and procedures can affect consumer, company and employee.

GMP Guidelines for Personal Hygiene and Sanitation

- Shelf life of a product depends on three conditions :
- Environment of the premises.
- Space Hygiene.
- Personal Hygiene.
- *Sanitation and Hygiene Programs are essential for following causes :*

• Product might be adversely affected.
• Product might fail to function as expected to be.
• A contaminated product might lead to serious fatal consequences.
• A chart of rules about cleanness, hygiene and prevention of contamination must be prepared and followed.

Requirements of GMP for Premises

- General Requirements for suitable premises are :
- Ideal Layout and Design
- Weather Protection
- Segregation of activities
- Air Handling System
- Serious Block
- Utility Services
- Construction
- Sanitation
- Lighting and Ventilation
- Changing Room
- Toilets
- Canteen and Praying Room
- Safety Measures
- Engineering Backup
- Maintenance Facilities

GMP Guidelines for Production Areas:

- Provide adequate working space for the operation of equipment as applicable to the actual manufacturing operations required.
- Maintenance workshops should be located away from production areas.
- Production and storage areas should not directly connect to toilets.
- Premises should preferably be laid out in such a way as to allow the production to take place in areas connected in a logical order corresponding to the sequence of operations and to the requisite cleanliness level.

- The adequacy of working and in process storage space should permit the orderly and logical positioning of equipment and materials so as to minimize the risk of confusion between different products or their components to avoid cross contamination and to minimize the risk of omission or wrong application of any of the manufacturing and control steps.
- Pipe work, light fillings, ventilation points and other services should be designed and suited to avoid creation of recess that are difficult to clean.
- Drains should be of adequate size and equipped to prevent back-flow. Drains should be covered.
- Provision should be made for proper and safe storage of waste materials and their subsequent disposal in a sanitary manner at regular and frequent intervals.
- Production areas should be effectively ventilated with air control facilities appropriate to the products handled and to the operations undertaken.
- Rodenticides, insecticides, fumigating agents and sanitizing materials should be stored separately and should not be allowed to contaminate equipment materials and products.

GMP Guidelines for Storage Areas:

- Storage areas should be of adequate space to allow orderly placement of various categories of materials and products.
- Storage areas should be suitable for effective separation of quarantined materials and products.
- Special and segregated areas should be available for storage of toxic substances and dangerous chemicals.
- Segregated storage should be provided for rejected recalled and returned materials and products.
- Safe and secure storage arrangements for different labels as well as other printed materials to avoid mix-up.

Equipment used for the manufacture of the food product should be:

- Easy to clean and wash the equipment.
- Preserve and make operation & maintenance.
- Easy opera table as possible.
- Calibrate where necessary as per SOP at a regular interval and kept records.
- Locally available of spares.
- Separate and making the defective and out of calibrating equipment.
- Ensure clean and wash after processing.

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