

5th Semester	RAG5D001	Food Packaging & Storage Technology	L-T-P 3-0-0	3 CREDITS
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Module I (6 hours)

Factors affecting shelf life of food material during storage, product characteristics, environmental factors, temperature, relative humidity, gas atmosphere, light, enzymatic reactions; Chemical reactions, lipid oxidation, non-enzymatic browning, color changes, flavor changes, nutritional changes, physical changes, microbiological changes; Food infection, food intoxication and allergy; Packaging of foods, environmental considerations; Packaging systems, types: flexible and rigid; retail and bulk; levels of packaging; packaging materials, their key properties and applications; Metals used in packaging, and electrolytic chromium coated steel, lacquering; Metal cans, manufacture of two piece and three piece cans.

Module II (6 hours)

Plastic packaging - polymers and lamination used in food packaging and their barrier properties; Manufacture of plastic packaging materials; Glass containers-types, manufacture of glass containers, closures for glass containers; Paper and paper board packaging, its manufacturing process, modification of barrier properties and characteristics of paper/ boards; Other packaging materials: edible films, laminates, retortable pouches and trays, cloth materials, wooden containers, composite containers, regenerated cellulose, cellulose acetate; Retort pouches: introduction, manufacturing of pouches, filling and sealing, quality assurance, shelf life.

Module III (6 hours)

Advantages of different packaging materials and their effect on packed commodities. Retortable pouches and advantages; advantages of glass, metals, containers, advantages of plastics and paper packaging; disadvantages of different packaging materials; effect of these materials on packed commodities. Disadvantages of glass, metals, plastic, retortable pouches; Controlled atmospheric storage and modified atmospheric packaging; Shrink and cling packaging, shrink packaging, plastics used for shrink wrapping, polypropylene, poly vinyl chloride, polyethylene.

Module IV (7 hours)

Vacuum and gas packaging, gas flushing, compensated vacuum, the evacuation stage, gas flushing stage; Active packaging, smart packaging; Packaging requirement for raw and processed foods, and their selection of packaging materials; Effect of packaging materials on food commodities: packaging materials for cereals and snack foods, packaging materials for carbonated beverages, metal cans, glass bottles, pet bottles; Packaging materials for milk powders, metal cans, multilayer pouches, packaging materials for vegetable oils, metal, glass bottles, plastic bottles, multilayer pouches; Economics of plastic packaging: introduction, economic factors of plastic packages, development cost, one-time costs, package material costs, packaging

machinery costs other than one-time, packaging process costs, distribution costs, main factors for cost analysis of plastic package, rigid container, injection molding (im), blow molding, thermoforming.

Module V (5 hours)

Disposal and recycle of packaging waste, Package testing: testing methods for flexible materials, rigid materials and semi rigid materials; Tests for paper (thickness, bursting strength, breaking length, stiffness, tear resistance, folding endurance, ply bond test, surface oil absorption test; Tests for plastic film and laminates (thickness, tensile strength, gloss, haze, burning test to identify polymer; Tests for glass containers (visual defects, colour, dimensions, impact strength, etc.), foil (thickness, pin holes); Tests for metal containers (pressure test, product compatibility).

Module VI (5 hours)

Processing of fruits and vegetables, spices, condiments; Characteristics and properties of horticultural crops important for processing; Preservation Technology: General methods, description, advantages and disadvantages of different methods of preservation, Flowcharts for preparation of different finished products, Food supply chain; Sorting and grading equipment; Peeling: methods and devices; Slicing of horticultural crops: equipment for slicing, shredding, crushing, chopping, juice extraction etc.; Blanching: methods, effects on food (nutrition, colour, pigment, texture)

Module VII (5 hours)

Packaging requirements for Horticulture produce, packaging materials commonly used for raw and processed fruits and vegetables products, bulk and retail packages and packaging machines, Quality control in fruit and vegetable processing industry.

Books

1. Coles R, McDowell D, Kirwan, M J. (2003). Food Packaging Technology. Blackwell Publishing Co.
2. Gordon L. Robertson. (2005). Food Packaging: Principles and Practice. Second Edition. Taylor and Francis
3. Gosby N.T. (2001). Food packaging materials. Applied Science Publication
4. John, P J.(2008). A Handbook on Food Packaging. Narendra Publishing House,
5. Mahadevia M, Gowramma RV. (2007). Food packaging materials. Tata McGrew Hill
6. Robertson G L. (2001). Food Packaging and Shelf life: A Practical Guide. Narendra Publishing House
7. Mangaraj, S, Dash, S K, Swain S. and Ali, N. 2017. Agricultural Process Engineering Vol II (Post Harvest Unit Operations). Kalyani Publishers, New Delhi. 428 p.
8. Mangaraj, S, Ali, N. Swain S. and **Dash, S K** 2017. Agricultural Process Engineering Vol III (Storage Engineering and Technology). Kalyani Publishers, New Delhi. 348 p.