

POSTGRADUATE INSTITUTE OF SCIENCE UNIVERSITY OF PERADENIYA



M.Sc. in Postharvest Technology of Fruits and Vegetables 2015/2016

1. INTRODUCTION

Tropical fruits and vegetables are products with excellent market prospects in the world. In spite of the considerably rich collection of exotic varieties of fruits and vegetables, the South Asia has not exploited the potential economic benefits that the fresh produce can attract from the world market. The fruit and vegetable production is often in excess of the local demand and the surplus could be meaningfully utilized by careful postharvest management of the produce. Surveys have revealed that a substantial portion of the harvest is wasted in the region annually due to improper harvesting and postharvest practices, disease and lack of facilities and technology to extend their storage life. This continues to cause heavy losses in revenue to the grower, wholesaler, retailers and exporter and inconvenience to the consumer and lowers export potential of these commodities.

The reduction of losses and maintenance of quality and freshness of harvested products prior to consumption are extremely important in both local and export markets. Further, export of fruits to distant markets needs special technology that ensures that the consumer receives a good quality product and value for money. The postharvest handling of fruits and vegetables presents many technical problems, most of them deriving from the inherent attributes of the commodity. These commodities are composed of living and metabolizing tissues. The functional characteristics of these tissues, their capacity to withstand the stresses of time, temperature and physical handling, to resist infection and spoilage and maintain quality constitute the basis for successful storage, handling and distribution practices. There are fundamental differences between temperate and tropical products. For example temperate fruits such as apples and oranges are relatively easy to handle, store and transport. Tropical fruits, in contrast, have evolved to decompose quickly after maturity in an environment where there is no impediment to immediate seed germination.

Technical knowledge needed for successful postharvest handling of tropical perishable produce spans many disciplines - chemistry, physiology, biochemistry, pathology, entomology, engineering and molecular biology. This Diploma/M.Sc. programme, designed within this multidisciplinary framework, is intended to impart scientific knowledge and technology of postharvest management of fruits and vegetables for those engaged or seek employment in fruit and vegetable industry.

2. OBJECTIVES OF THE PROGRAMME

This is a specialized programme designed for the fruit and vegetable handling, marketing and export sector. The main objectives are to provide,

- a) the latest scientific basis and technological background that, while ensuring reduction of losses, enables successful postharvest handling and management, preservation and processing of fresh fruits and vegetables for both local and export market,

- b) exposure to current trends and developments in marketing systems, quality and safety standards, packaging and value addition, requirements and limitations in the overseas market, and,
- c) scientific understanding on the nature and the cause of postharvest diseases, disorders and pest problems, develop skills in their diagnosis, forecasting and implementation of rapid, appropriate and economical measures to rectify them, tackle diseases and fruit fly problems in international trade.

3. PROGRAMME ELIGIBILITY

Applicants seeking admission to this programme should have at least a degree in Biological or Agricultural Science or a degree with Botany as a subject from a recognized university or equivalent qualifications. Those graduates who have experience in fruit and vegetable sector are encouraged to apply. Candidates are expected to display a genuine interest and motivation towards the area of study. The final selection will be made after an oral interview. The medium of instruction and examination will be English, consequently the candidates will be expected to possess a good working knowledge in English. Only up to 15 places would be available in a given year.

4. PROGRAMME FEE

	M.Sc. programme fee
local candidates	Rs. 130,000/-
SAARC countries	US \$ 3,100/-
other countries	US \$ 6,100/-

Programme fees shall be paid in two instalments (*50% at the registration and the balance 50% within six months from registration*). Other payments including registration fee, medical fee, library subscription, examination fee and deposits (science and library) should be paid according to the procedure stipulated by the PGIS.

5. THE PROGRAMME STRUCTURE AND DURATION

This is a full-time programme consisting of course work and a research project. Course work will be conducted within two semesters of 15 - weeks each. The entire programme duration will be about 18 months inclusive of the time allocated for research project. Satisfactory completion of a minimum of 24 credits of course work (with a GPA of not less than 3.00) is required for the programme in addition to the six credits allocated for the full-time research project. Continuous attendance is compulsory during the period of research work. (*The student who does not satisfy the above criteria but obtains a GPA in the range 2.75 to 2.99 for course work is eligible for the Diploma in Postharvest Technology of Fruits and Vegetables but not the M.Sc. Degree*). Continuous attendance is compulsory during the period of research work. After successfully completing the research project, the student is eligible for the award of the M.Sc. Degree. Based on the performance by students in the taught courses, PGIS may upgrade the registration of such students to M.Phil. or Ph.D. programmes.

Programme Summary

Course Code	Course	Lecture hrs.	Practical hrs.	No. of Credits
Semester I				
PL 501	Economical and social aspects of fruits and vegetables	15	30	2
PL 502	Pre-and postharvest physiology/biochemistry of fresh produce and ethylene in postharvest technology	15	30	2
PL 503	Postharvest losses of fruits & vegetables	15	30	2
PL 505	Postharvest handling and quality assurance of perishables	15	30	2
PL 516	Postharvest diseases and disorders and their control	15	30	2
PL 518	Insect pests in postharvest products and their cont	15	30	2
Semester II				
PL 504	Biostatistics #	15	30	0
PL 506	Packaging and Packing house operations	15	30	2
PL 507	Transportation, storage of fruits and vegetables	15	30	2
PL 517	Postharvest logistics for perishable crops	15	30	2
PL 519	Fruit and vegetable processing	15	30	2
PL 520	Texture of Fruits and vegetables	15	30	2
PL 521	Microflora & mycotoxins in fresh & processed produce	15	30	2
PL 522	Marketing management for postharvest operations	15	30	2
PL 523	Independent Study			1
PL 599	Research Project			6
	Total			33

Non – credit course, but a minimum of a C grade is required.

6. PROGRAMME CONTENTS

PL 501: Economical and Social aspects of fruits and vegetables (2 credits: 15 hours lectures and 30 hours laboratory work)

An overview of nutrients in food with special reference to contribution of fruits and vegetables to human nutrition; common nutritional problems in Sri Lanka and the role of fruits and vegetables in alleviating them; fruits and vegetables as industrial raw material; important phytoconstituents in fruits and vegetables; traditional methods of postharvest handling.

PL 502: Pre and postharvest physiology/biochemistry of fresh produce and ethylene in postharvest technology (2 credits: 15 hours lectures and 30 hours practical work)

Product growth, maturation, fruit ripening, vegetable hardening, senescence and abscission and their physiology and biochemistry; respiration patterns, climacteric and non-climacteric fruits; fruit ripening and associated changes.

Properties of ethylene, biosynthesis and mechanism of action of ethylene and its role in fruit ripening, senescence; systems for ethylene treatment; ethylene generators; deleterious effects of ethylene; control of ethylene in postharvest environment; ethylene exclusion and removal; transduction of ethylene signal; recombinant DNA technology in postharvest technology.

PL 503: Postharvest losses of fruits and vegetables
(2 credits: 15 hours lectures and 30 hours laboratory work)

Type and extent of losses; the causes, where and how the losses occur; procedures of loss assessment; methods of loss reduction; nutritional losses due to postharvest handling, practical exercises on these topics.

PL 504: Biostatistics (non credit course; pre-requisite for the research project)
(15 hrs. lectures + 30 hours practicals)

Principles of probability, introduction to statistical terms; measures of center dispersion; population distribution types; test of significance, t-test, z-test, goodness of fit; nonparametric tests, correlation and linear regression; analysis of variance & experimental design; suitability of standard designs for specific experiments; time series data handling.

PL 505: Postharvest handling and quality assurance of perishables
(2 credits: 15 hours lectures and 30 hours laboratory work)

General introduction, harvesting indices, determination of maturity indices, maturity standards; harvesting systems and mechanization; effect of pre harvest practices and harvesting conditions on postharvest quality and possible losses; management of field heat; sorting and grading, fruit sizing, cleaning and washing, waxing, film wrapping etc., vegetable cleaning, trimming, curing etc. role of wholesaling and retailing; product handling by wholesale receivers, retailers; ethylene damage; container handling.

Quality assurance: quality components; quality criteria in standard for fresh fruits and vegetables; factors affecting quality; methods for quality evaluation; appearance quality, textural quality, flavour quality, nutritional value and safety factors.

PL 506- Packaging and Packing house operations
(2 credits: 15 hours lectures and 30 hours laboratory work)

Fundamentals and purpose of packaging; package development criteria, selection of packaging materials to minimize waste, enhance productivity, profitability and suitability of the commodity; packaging that minimizes impacts, protects from compression and vibration bruises, ensures immobilization and facilitates temperature management; hand packing operations; mechanical packs; testing and quality control; environmental standards.

PL 507- Transportation, storage of fruits and vegetables
(2 credits: 15 hours lectures and 30 hours practical work)

Transport equipment; product transit temperature management; cold chains; refrigeration and air circulation system; shipping packages; modified atmosphere transport; product compatibility in mixed loads; measures to prevent impact, vibration and heat damage etc.

Structure and procedure; storage facilities; forced air cooling and hydro cooling; vacuum cooling; low budget storage; use of ice, wet gunny bags, etc., underground storage.

CA and MA storage, fundamentals of MA and CA storage, physiological effects, materials used, factor affecting and commercial applications of CA and MA; carbon monoxide as a supplement; ethylene removal in MA; CO₂ and O₂ control potential benefits and harmful effects of CA and MA storage; requirements for a CA storage room; hypo baric and low pressure systems during transport and storage; commodity generated modified atmosphere; methods of atmospheric modification; MA during transit, in shipping containers; CA storage structures, equipment and monitoring of environmental conditions; methods of gas mixing, sampling and analysis; recommended MA and CA conditions for individual commodities, calcium and fruit storage potential of fruits.

PL 516: Postharvest diseases and disorders and their control
(2 credits: 15 hours lectures and 30 hours practical work)

Introduction, extent of loss due to disease, disease causal agents, factors affecting postharvest disease, quiescent infection with reference to *Colletotrichum*; biochemical factors governing quiescence, wound pathogens, mechanism of disease development, natural resistance mechanisms in fruits and vegetables against fungal pathogens, diseases of major fruits and vegetables, control of postharvest disease: chemical control, sanitation, biological control, control using physical methods i.e. hot water treatment, control by manipulation of host defense system; preharvest treatment for postharvest disease control; disease suppression by handling practices; sulphur dioxide fumigation, organic(natural) pesticides; treatments for control of post harvest diseases of selected commodities.

PL 517: Postharvest logistics for perishable crops
(2 credits: 15 hrs. lectures & 30 hours practicals)

Introduction to methods of cold storage, application environment; logistics problems & their complexity; modeling the logistics problem; complexity of resolution; model tree, robustness of models; selection of a simple model, non-mathematical tabular presentation of the selected model; resolution of an example problem with assumed parameter values, use of a linear programming package on PC; parameter estimation; system installation and use.

PL 518: Insect pests in postharvest products and their control
(2 credits: 15 hrs. lectures & 30 hours practicals)

Insect pests in harvested commodities; damage assessment, taxonomy of pests and preharvest & postharvest control methods; fruit fly control. History and the need of quarantine; international agreements; plant quarantine activities in Sri Lanka; pathways of pest entry, risk analysis, prevention of entry; pest free areas; pests of quarantine significance relevant to postharvest management of fruits.

PL 519: Fruit and Vegetable processing
(2 credits: 15 hrs. lectures & 30 hours practicals)

Methods of preservation and processing; product quality in relation to processing; enzymatic and non-enzymatic browning in processing; preservation by chemical additives, dehydration and freezing; processing and nutrition in relation to composition; role of fruits and vegetables in diet. Practical exercise to assay PPO activity, overcome browning; SO₂ analysis; osmotic and conventional dehydration of fruits; preparation of ready to serve drinks; determination of crude fibre and vitamin C as an index of postharvest quality; utilization of horticultural waste for pectin production; freezing and preservation of vegetables.

Introduction criteria for selection of fruits and vegetables to be minimally processed; preparation, packaging and storage; minimal processing of durian, jackfruit, mangosteen, pineapple, papaya; young coconut; problems associated with minimally processed fruits and possible solutions; health hazards.

PL520: Texture of Fruits and vegetables
(2 credits: 15 hrs. lectures & 30 hours practicals)

Introduction; texture of plant based food. Plant cell walls, cell wall polysaccharide; composition, spatial arrangement, interaction and linkages. Cell wall models, texture and cell walls. Consumer acceptance of Fruits and Vegetables, texture characteristics, instrumental texture analysis, mechanical properties of food material, sensory evaluation of fruits and vegetables and plant food products. Textural changes of Fruits and vegetables and plant food products. Textural changes in fruits and vegetables during growth, ripening, storage and after processing.

PL 521: Microflora & mycotoxins in fresh and processed produce
(2 credits: 15 hrs. lectures & 30 hours practicals)

Fresh and processed products as major habitats for microbial growth; soil and water as potential sources of their contamination; microflora associated with fresh and processed produce and their activities; food spoilage and factors affecting food spoilage; initial contaminants of fresh and processed products; natural inhibitors in plant products; food borne diseases-infections and intoxications; chemical and bacterial intoxications; exo and endotoxins; history, definition of mycotoxins, extraction and quantification; detoxification methods; international tolerance levels.

PL 522: Marketing management for postharvest operations
(2 credits: 15 hrs. lectures & 30 hours practicals)

Introduction to marketing concept, marketing environment, consumer and organizational buying behaviour, market segmentation, product and producer policy, new product development, pricing, marketing communication, logistics management, marketing strategy, marketing theory as applied to post harvest operations, managing and marketing mix in relation to postharvest operations.

PL 523: Independent Study

Students will gather information on 10 selected topics given and present them in the form of essays/seminars. Students will also be involved in an industry related study for a short period and present findings in a report and a seminar.

PL 599: Research project
(6 credits: 3-6 months duration)

Each student will be assigned a research problem during first semester when the preparatory work of the project could be commenced. The research work should be commenced in the second semester. The candidates will be given the option of selecting a research problem in a preferred area that falls within the disciplines of courses undertaken. The project could be conducted at the department of Botany or at his/her working place, if facilities are available. However, in the latter case the work has to be supervised by an external supervisor at the work place, in addition to the supervisor appointed by the board of study of plant sciences. At the end of the research project the candidates are required to present their results in the form of dissertation and a seminar.

7. PROGRAMME EVALUATION

Programme evaluation will be as stipulated in the PGIS Hand Book.

8. TEACHING PANEL

Dr. C. Abayasekara, Dept. of Botany, Faculty of Science, University of Peradeniya
B.Sc. (Perad.), Ph.D. (Perad.)

Dr. K. Abeywickrama, Dept. of Botany, University of Kelaniya
Sri Lanka *B.Sc. (Colombo), M.Sc.(Maryland), PhD (Maryland)*

Prof. N. K. B. Adikaram, Dept. of Botany, Faculty of Science, Univ. of Peradeniya
B.Sc. (Cey.), Ph.D. (Belfast)

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Dr. W. A. M. Daundasekera, Dept. of Botany, Faculty of Science, Univ. of Peradeniya.
B.Sc. (Perad.), Ph.D. (Cranfield)

Mr. S. Ekanayake, Food Research Centre, HORDI, Gannoruwa
B.Sc. (Perad.), M. Sc. (India)

- Dr. R. Ekanayake, Head, Pathology Division, National Plant Quarantine Department, Department of Agriculture, Katunayake. *B.Sc., Ph.D. (Perad)*
- Dr. S. Hewage, Food Research Centre, HORDI, Gannoruwa
B.Sc. Agric. (Perad.), Ph.D. (London)
- Ms. A. M. Karunaratne, Dept. of Botany, Faculty of Science, Univ. of Peradeniya
B.Sc. (Perad.), M.Sc. (Nebraska)
- Dr. S. Kodituwakku, Department of Agriculture Economics, Faculty of Agriculture, University of Peradeniya.
- Dr. R. M. S. Ratnayake, Dept. of Botany, Faculty of Science, Univ. of Peradeniya. *B.sc. (Perad.), M.Sc. (Otago,NZ) PhD. (Auckland,NZ)*
- Dr. S. Samita, Department of Crop Science, Faculty of Agriculture, University of Peradeniya
B.Sc. Agric. (Perad.), M.Phil. (Cey.), Ph.D. (Edin.)
- Dr. D. Weerawewa, Dept. of Biological Science, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Polgolla. *B.Sc. (Perad.), Ph.D. (Perad.)*
- Dr. S. W. Wijeratnam, Postharvest Technology Unit, Industrial & technological Institute, Baudhaloka Mawatha, Colombo 7. *B.Sc., Ph.D. (London)*
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PROGRAMME COORDINATORS

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