

DOCTORATE PROGRAM IN AGRICULTURAL AND VETERINARY SCIENCES

Postharvest physiology of perishables plant products

I. IDENTIFICATION OF THE CURRICULAR UNIT	
Code	AG108198
Semester in which it is taught	Summer
Day(s) on which it is taught	Monday to Friday, to be defined
Schedule(s)	to be defined
Pre-requirements	Graduate students
Weekly direct hours	
Indirect hours per week	
Credits	2
General Coordinator (GC)	Victor Escalona Ana Silveira Reinaldo Campos
Emails (GC)	vescalona@uchile.cl acsilver@fagro.edu.uy reinaldo.campos.vargas@gmail.com
Assistant	Mónica Flores
Email Assistant	monicafloresr@ug.uchile.cl

II. PARTICIPATING ACADEMICS			
First-Family names	Academic Degree	University where he/she obtained his/her degree	Organization of affiliation
Victor Escalona https://www.uchile.cl/portafolio-academico/impresion.jsf?username=vescalona	Doctor	Universidad Politécnica de Cartagena	Universidad de Chile
Ana Silveira https://exportcvuy.ani.org.uy/CvEstatico/?urlId=0603d5085cc32279230f7ad12286bd5238365ae3ec5c4aeaff51a542ec2a48ebf56a981570c9dc1495a5550a3d78f2cfc6205728c404047bf99611dc0067e70a&formato=pdf&convocatoria=21	Doctor	Universidad Politécnica de Cartagena	Universidad de la República
Reinaldo Campos https://publons.com/researcher/1283140/reinaldo-campos-	PhD	Universidad de California	Universidad de Chile

vargas/			
Luis Luchsinger https://www.uchile.cl/portafolio-academico/impresion.jsf?username=lluchsin	PhD	Universidad de Maryland	Universidad de Chile
José Luis Henríquez https://www.uchile.cl/portafolio-academico/impresion.jsf?username=jhenriqu	PhD	Univesidad del Estado de Oregon	Universidad de Chile
Bruno Defilippi https://www.inia.cl/alimentos/2020/07/01/bruno-defilippi-bruzzone/	PhD	Universidad de California	INIA, Universidad de Chile
Karinna Estay https://publons.com/researcher/4009159/karinna-estay/	PhD	Universidad de California	Universidad de Chile
Dulce Rivera	Doctor	Universidad Autónoma de Querétaro	Universidad Autónoma de Querétaro
Sergio Tonetto de Freitas http://lattes.cnpq.br/3380632710108888			
Mónica Flores	Doctor(C)	Universidad de Chile	Universidad de Chile

III. PURPOSE

The course aims to contribute to the formation of skills in physiology, biochemistry and postharvest technologies for the preservation of fresh fruits and vegetables through the analysis and design of combined strategies.

It seeks a multidisciplinary vision of different areas of science and engineering to better apply treatments that reduce the metabolism of perishable fresh produce while maintaining its nutritional / functional value.

The use of postharvest treatments and their effect on reducing sensory quality and rots will be studied in depth, optimizing the use of environmentally friendly barrier technologies.

Among the knowledge that will be addressed are the physiological and biochemical responses of plants to different types of stress, the synthesis of bioactive compounds, defense mechanisms against pathogens, ripening processes and hormones, engineering and physical tools to understand the processes of heat transfer and cooling of fruits and vegetables and aspects related to sensory quality and consumer preferences.

IV. SPECIFIC COMPETENCE(S)

SC: To understand mechanisms of action and apply postharvest technologies in the conservation and

sensory quality, microbiology and nutrition of fruits and vegetables with a multidisciplinary approach.

V. GENERIC COMPETENCE(S)

GC: To communicate his/her ideas orally and in writing, using expression strategies, relevant to the area of science, to generate scientific proposals in Spanish and English, for various audiences.

GC: To use critical thinking skills, related to the analysis and synthesis of information, which allow him/her to debate and defend his position, through explanations supported by valid and reliable evidence.

VI. TEACHING METHODOLOGY

The course contemplates class sessions with expository/participatory classes dictated by different specialists. Also group works and exhibitions will be made for discussion and critical analysis of scientific works that support each session. Students will be evaluated in terms of their participation in written and oral works conducted in the group sessions and through a test at the end of the course.

VII. EVALUATION

Evaluation type	Learning Outcome Assessing (No.)	Date	Weighting
Directed work. Seminar 1	RA1	Week 1	20%
Directed work. Article 2	RA2	Week 2	20%
Directed work. Technical data sheet	RA, RA4	Week 3	20%
Written test	RA1, RA2, RA3, RA4	Week 4	40%

VIII. BASIC OR MANDATORY BIBLIOGRAPHY

N°	Título	Autores	Año	Fuente
1	Postharvest losses of fruit and vegetables during retail and in consumers' homes: Quantifications, causes, and means of prevention	R. Porata, A. Lichter, L.A. Terry, R. Harker, J. Buzby	2018	Postharvest Biology and Technology 139: 135–149
1	Postharvest losses and waste	E.M. Yahia, J.M. Fonseca, L. Kitinoja	2019	Postharvest Technology of Perishable Horticultural Commodities 43 Elsevier Inc. https://doi.org/10.1016/B978-0-12-813276-0.00002-X
2	Identification of preharvest factors determining postharvest ripening behaviors in 'Hass' avocado under long term storage	S.A. Rivera, R. Ferreyr, P. Robledo, G. Selles, M. Lu Arpaia, J. Saavedra, B.G. Defilippi	2017	Scientia Horticulturae 216: 29–37
2	Preharvest or a combination of	M.E. García-Pastor, M. Serrano, F. Guillén, P.J.	2020	Postharvest Biology and Technology 167: 111226

	preharvest and postharvest treatments with methyl jasmonate reduced chilling injury, by maintaining higher unsaturated fatty acids, and increased aril colour and phenolics content in pomegranate	Zapata, D. Valero		
2	The effects of organic and conventional farm management and harvest time on the polyphenol content in different raspberry cultivars	A. Ponder, E. Hallmann	2019	Food Chemistry 301: 125295
3	A review of new directions in managing fruit and vegetable processing by products	J. Majerska, A. Michalska, A. Figiel	2019	Trends in Food Science & Technology 88: 207–219
3	Fresh fruit and vegetables: contributions to food and nutrition security	S. McMullin, B. Stadlmayr, R. Roothaert, R. Jamnadass	2019	Encyclopedia of Food Security and Sustainability, Volume 3 https://doi.org/10.1016/B978-0-08-100596-5.21534-5
4	Postharvest chemical and physical deterioration of fruit and vegetables	A.K. Thompson	2010	Chemical Deterioration and Physical Instability of Food and Beverages Woodhead Publishing Series in Food Science, Technology and Nutrition. https://doi.org/10.1533/9781845699260.3.483
4	Biochemical bases of appearance and texture changes in fresh-cut fruit and vegetables	P.M.A. Toivonen, D.A. Brummell	2008	Postharvest Biology and Technology 48: 1–14
5	Biochemical and physiological changes of star apple fruit (<i>Chrysophyllum cainito</i>) during different “on plant” maturation and ripening stages	R.S. Williams, N. Benkeblia	2018	Scientia Horticulturae 236: 36–42
5	Ethylene scavengers for the preservation of fruits and vegetables: A review	H. Wei, F. Seidi, T. Zhang, Y. Jin, H. Xiao	2021	Food Chemistry 337: 127750
5	Molecular biology of	B. Cara, J.J. Giovannoni	2008	Plant Science 175: 106–113

	ethylene during tomato fruit development and maturation			
6	Changes during the ripening of the very late season Spanish peach cultivar Calanda Feasibility of using CIELAB coordinates as maturity indices	A. Ferrer, S. Remón, A. I. Negueruela, R. Oria	2005	Scientia Horticulturae 105: 435–446
6	Fruit maturity, harvesting and quality standards	K. Prasad, S. Jacob, M. Wasim Siddiqui	2018	Preharvest Modulation of Postharvest Fruit and Vegetable Quality http://dx.doi.org/10.1016/B978-0-12-809807-3.00002-0 Elsevier
7	Postharvest pathology of tropical and subtropical fruit and strategies for decay control	S. Droby	2011	Postharvest Biology and Technology of Tropical and Subtropical Fruits. Woodhead Publishing Series in Food Science, Technology and Nutrition. https://doi.org/10.1533/9780857093622.194
7	Postharvest diseases of fruits and vegetables and their management	D. Singh, R.R. Sharma	2018	Postharvest Disinfection of Fruits and Vegetables https://doi.org/10.1016/B978-0-12-812698-1.00001-7
8	Postharvest precooling of fruit and vegetables: A review	Y. Duan, G. Wang, O. Amos Fawole, P. Verboven, X. Zhang, D. Wu, U. Linus Opara, B. Nicolai, K. Chen	2020	Trends in Food Science & Technology 100: 278–291
8	Forced-convective cooling of citrus fruit: Cooling conditions and energy consumption in relation to package design	T. Defraeye, R. Lambrecht, M. Admasu Delele, A. Ambaw Tsige, U. Linus Opara, P. Cronjé, P. Verboven, B. Nicolai	2014	Journal of Food Engineering 121: 118–127
9	Biological basis for CA and MA	M.E. Saltveit	2020	Controlled and Modified Atmospheres for Fresh and Fresh-Cut Produce https://doi.org/10.1016/B978-0-12-804599-2.00002-8
9	Controlled atmosphere storage: Effect on fruit and vegetables	A. Valdez Fragoso, H. Mujica-Paz	2016	Encyclopedia of Food and Health http://dx.doi.org/10.1016/B978-0-12-384947-2.00197-5
10	Efficacy of gaseous	L. Pinto, L. Caputo, L.	2017	Food Microbiology 66: 190 -

	ozone to counteract postharvest table grape sour rot	Quintieri, S. de Candia, F. Baruzzi		198
10	Hairline, a postharvest cracking disorder in table grapes induced by sulfur dioxide	J.P. Zoffoli, B.A. Latorre, P. Naranjo	2008	Postharvest Biology and Technology 47: 90–97
11	Changes in fruit firmness, cell wall composition and cell wall degrading enzymes in postharvest blueberries during storage	H. Chen, S. Cao, X. Fang, H. Mu, H. Yang, X. Wang, Qi. Xu, H. Gao	2015	Scientia Horticulturae 188: 44–48
11	Effects of cuticular wax on the postharvest quality of blueberry fruit	W. Chu, H. Gao, H. Chen , X. Fang , Y. Zheng	2018	Food Chemistry 239: 68–74
11	Harvest and Postharvest Factors Affecting Bruise Damage of Fresh Fruits	Z. Hussein, O.A. Fawole, U. Linus Opara	2020	Horticultural Plant Journal 6 (1): 1–13.
12	Changes in biochemistry of fresh produce in response to ozone postharvest treatment	S. Shezi, L. Samukelo Magwaza, A. Mditshwa, S. Zeray Tesfay	2020	Scientia Horticulturae 269: 109397
13	Postharvest technologies to maintain the quality of tropical and subtropical fruits	E.M. Yahia, J. De Jesus Ornelas-Paz, A. Elansari	2011	Postharvest Biology and Technology of Tropical and Subtropical Fruits. Woodhead Publishing Series in Food Science, Technology and Nutrition. https://doi.org/10.1533/9780857093622.142
13	Postharvest pathology of tropical and subtropical fruit and strategies for decay control	S. Droby, M. Wisniewski, N. Benkeblia	2011	Postharvest Biology and Technology of Tropical and Subtropical Fruits. Woodhead Publishing Series in Food Science, Technology and Nutrition. https://doi.org/10.1533/9780857093622.194
14	Postharvest quality of fruits and vegetables: An overview	I.M. Brasil, M. Siddiqui	2018	Preharvest Modulation of Postharvest Fruit and Vegetable Quality, Elsevier. http://dx.doi.org/10.1016/B978-0-12-809807-3.00001-9
14	Light quality manipulation improves	Z.S. Ilića, E. Fallikb	2017	Environmental and Experimental Botany 139: 79–



	vegetable quality at harvest and postharvest: A review			90
IX. PROGRAMME				
Knowledge Axis 1	Introduction to agronomic, biochemical and nutritional aspects of postharvest fruits and vegetables.			
Learning Outcome 1	Get an overview of the general situation of postharvest technologies.			
Description of the	Seminar 1: Between 30 and 50% of the fresh fruits and vegetables harvested in the			
	leaves cultivated in a hydroponic system			
15	Leafy vegetables: Baby leaves	M.I. Gil, Y. Garrido	2020	Controlled and Modified Atmospheres for Fresh and Fresh-Cut Produce https://doi.org/10.1016/B978-0-12-804599-2.00066-1
16	A cross-cultural analysis of children's vegetable preferences	K. Estay, S. Pan, F. Zhong, C. Capitaine, J. Guinard	2019	Appetite 142: 104346
16	Fruit and vegetable consumption in children and their mothers. Moderating effects of child sensory sensitivity	H. Coulthard, J. Blissett	2009	Appetite 52: 410–415
16	Sensory variety in shape and color influences fruit and vegetable intake, liking, and purchase intentions in some subsets of adults: A randomized pilot experiment	M. Vadiveloo, L. Principato, V. Morwitz, J. Mattei	2019	Food Quality and Preference 71: 301–310
16	The relationship between children's and mothers' vegetable liking in Chile, China and the United States	K. Estay, S. Pan, F. Zhong, J. Guinard	2020	Food Quality and Preference 86: 104000



evaluation(s)	world are lost. To reduce these losses, the principles of postharvest conservation of these fresh products must be understood. Among the aspects to be discussed are the effect of environmental and cultivation conditions on the characteristics of the fresh products harvested. In addition, changes in these products' physiology and biochemistry affect the concentration of nutritional compounds under different growing and storage conditions. In general, products with high metabolism have a shorter shelf life than those with lower metabolism rates. In groups of 2 students, a written and oral presentation based on one of the aspects covered during this first unit should be presented. The written work should not exceed five pages, letter size (references included), written in Arial 11 font and 1.5 line spacing each, using the APA reference style. The oral presentation will be 10 min plus 5 min for discussion, and both exercises will be presented during the group activity. Recommended bibliography: 1-2-3-4.						
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Date	Schedule	Subject	Methodology	Bibliography (N°)	Teacher	Direct Hours	Indirect Hours
Week 1, day 1	09:00 - 9:35	1. Introduction. Review of postharvest situation	Expository/Active Class	1	Victor Escalona / Ana Silveira	1	3
	9:35 – 9:55	Break					
	9:55 – 10:30	2. Environmental factors affecting postharvest quality of fresh produces.	Expository/Active Class	2	Dulce Rivera	1	3
Week 1, day 2	9:00 – 9:35	3. Nutritional composition of fruit and vegetables.	Expository/Active Class	3	Dulce Rivera	1	3
	9:35 – 9:55	Break					
	9:55 – 10:30	4. Physiology and biochemistry of fruit and vegetables.	Expository/Active Class	4	Reinaldo Campos	1	3
Week 1, day 3	9:00 – 10:30	I. Group experience and seminars	Expository/Active Class	1, 2, 3, 4	Reinaldo Campos	2	6

Knowledge Axis 2	Ripening, senescence and deterioration of fresh products. Cooling systems and refrigerated conservation.
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Learning Outcome 2		Apply physiological and biochemical foundations to understand the ripening of climacteric and non-climacteric fruits. Likewise, it is based on the deterioration and senescence of the different vegetable organs and refrigeration and conservation principles at low temperatures.					
Description of the evaluations		Elaboration of a review article. In groups of two students, they will have to write a review article on some of the biochemical processes of maturation and senescence that determine the postharvest life of fresh produce. For this, they will choose a metabolic pathway where the reactions that favor color changes, softening, and aroma synthesis in fruits and vegetables are described. They can also present a paper related to phytopathology and the interaction between microorganisms and products and develop the disease during postharvest conservation. The work may not exceed seven pages, letter size (references included), written in Arial 11 font and 1.5 line spacing each, using the APA reference style. This paper will be presented in 10 min plus 5 min for discussion during the group activity. Bibliography: 5, 6, 7, 8.					
Date	Schedule	Subject	Methodology	Bibliography (N°)	Teacher	Direct Hour	Indirect Hour
Week 2, day 1	09:00 - 9:35	5. Ethylene and maturation. Postharvest ethylene application techniques.	Expository/Active Class	5	Bruno Defilippi	1	3
	9:35 – 9:55	Break					
	9:55 – 10:30	6. Maturity Indices and quality attributes determination.	Expository/Active Class	6	Reinaldo Campos	1	3
Week 2, day 2	9:00 – 9:35	7. Postharvest pathology.	Expository/Active Class	7	José Luis Henríquez	1	3
	9:35 – 9:55	Break					
	9:55 – 10:30	8. Pre-coolings and cooling systems.	Expository/Active Class	8	Luis Luchsinger	1	3
Week 2, day 3	9:00 – 10:30	II. Group experience and seminars	Expository/Active Class	5, 6, 7, 8	Victor Escalona	2	6

Knowledge Axis 3	Effect of gas concentration on preserving fresh produce and addressing specific postharvest handling of significant species of economic importance.
Learning Outcome 3	Deepen the management of different species grouped according to their postharvest requirements.
Description of	Elaboration of the technical sheet: In groups of two students, a technical sheet should



the evaluations	be elaborated considering the appropriate technical specifications for the management of each species from harvest to commercialization to the final consumer. The work must be presented in a written and oral form on the day of the group						
Knowledge Axis 4	Addressing postharvest handling of tropical species and economically important vegetables and analyzing consumer preferences						
Learning Outcome 4	Deepen the handling of different tropical and vegetable species according to their postharvest requirements. To know and analyze the preferences of consumers according to the characteristics of the population.						
Description of the evaluations	There will be a synchronous test of alternatives during the group activity and some general conclusions as closing the course.						
Date	Schedule	Subject	Methodology	Bibliography (N°)	Teacher	Direct Hour	Indirect Hour
Week 4, day 4	09:00 - 09:35	13. Postharvest handling systems:	Expository/Active Class	13	Luis	1	3
	10:30	Table grapes.	Active Class		Luchsinger	1	3
Week 3, day 2	9:00 – 9:35	11. Postharvest handling systems: Berries.	Expository/Active Class	11	Victor Escalona	1	3
	9:35 – 9:55	Break					
	9:55 – 10:30	12. Postharvest handling systems: Pome fruits.	Expository/Active Class	12	Ana Silveira	1	3
Week 3, day 3	9:00 – 10:30	III. Group experience and seminars	Expository/Active Class	9, 10, 11, 12	Ana Silveira	2	6



1		Tropical fruits.					
	9:35 – 9:55	Break					
	9:55 – 10:30	14. Postharvest handling systems. Fruit vegetables.	Expository/Active Class	14		1	3
Week 4, day 2	9:00 – 9:35	15. Postharvest handling systems. Leafy vegetables.	Expository/Active Class	15	Victor Escalona	1	3
	9:35 – 9:55	Break					
	9:55 – 10:30	16. Sensory quality and preferences for fruits and vegetables.	Expository/Active Class	16	Karinna Estay	1	3
Week 4, day 3	9:00 – 10:30	III. Summer test and Group experience		13, 14, 15, 16	Ana Silveira / Victor Escalona	2	6