

Fresh Produce

Abbreviation: Fresh Prod.

Print: ISSN 1749-4788

Frequency and Peer status: Biannual, Peer reviewed

Scope and target readership: *Fresh Produce* only publishes original papers and review articles on research in the areas of postharvest storage, treatment, quality evaluation, packaging, handling and distribution of agronomic (including forage) and horticultural crops. Research results spanning from harvest to consumer will be considered.

Postharvest treatments of fresh product (but not food processing) as affecting the quality of processed product will be included. Interdisciplinary research is encouraged.

Market analyses, consumer trends, novel quarantine measures and legislature pertaining to the handling, marketing or distribution of fresh produce also fall into the scope of this journal.

Editor-in-Chief

Jaime A. Teixeira da Silva, Kagawa University, Japan

Technical Editor

Kasumi Shima, Japan

Statistics Advisor

Marcin Kozak, Warsaw University of Life Sciences, Poland

Editorial Board and Advisory Panels (Listed alphabetically)

Emmanuel Ohene Afoakwa, University of Ghana, Ghana

Dulce Antunes, University of Algarve, Portugal

Pankaj Kumar Bhowmik, Lethbridge Research Centre, Agriculture and Agri-Food Canada, Canada

Moutairou Egounlety, Université d'Abomey-Calavi, Benin

Esmail Fallahi, University of Idaho, USA

Manuel Fernandes-Ferreira, Universidade do Minho, Portugal

Jorge Fonseca, The University of Arizona, USA

Robert D. Hancock, Scottish Crop Research Institute, UK

Parigi Ramesh Kumar, Central Food Technological Research Institute, India

Sean Liu, Rutgers, The State University of New Jersey, USA

Barakat S. M. Mahmoud, Purdue University, USA

Silvia Valtueña Martínez, European Food Safety Authority, Italy

Noureddine Benkeblia, The University of the West Indies, Jamaica

Philippa C. Ojimekwe, Michael Okpara University of Agriculture, Nigeria

Jamuna Prakash, University of Mysore, India

Chandi Charan Rath, North Orissa University, India

Christoph Reichmuth, BBA Institute for Stored Product Protection, Germany

Michael Reid, University of California, Davis, USA

M. Mehdi Sharifani, Gorgan University of Agricultural Sciences & Natural Resources, Iran

Zora Singh, Curtin University of Technology, Australia

Dharini Sivakumar, University of Pretoria, South Africa

Iryna Smetanska, Institute for Vegetable and Ornamental Crops, Germany

Rong Tsao, Agriculture & Agri-Food Canada, Canada

Daniel Valero, University Miguel Hernandez, Spain

Supayang P. Voravuthikunchai, Prince of Songkla University, Thailand

Nigel Yee, Unitec, New Zealand

Lina Yonekura, National Food and Agricultural Research Organization, Japan

Global Science Books, Ltd.
Editorial Office
Miki cho Post Office, Kagawa ken, Kita gun
Miki cho, Ikenobe 3011-2, P.O. Box 7
761-0799, Japan



Head Office: Isleworth, United Kingdom
Accounting: Lagos, Portugal

GSB homepage: www.globalsciencebooks.info
Journals web-page: <http://www.globalsciencebooks.info/Journals/GSBJournals.html>
FP web-page: <http://www.globalsciencebooks.info/Journals/FP.html>
GSB Japan web-page: <http://www17.plala.or.jp/gsbjapan>
GSB™ is a trademark of Global Science Books, Ltd.

Fresh Produce ©2009 Global Science Books, Ltd.

All rights reserved. No parts of this journal may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording, or otherwise without written permission from Global Science Books, Ltd.

For additional copies, photocopies, bulk orders, or copyright permissions, please refer requests in writing to the above address, or apply online.

Cover photos: Example of different internal quality of mangosteens expressing normal flesh (bottom right) and translucent flesh (top left) (Teerachaichayut *et al.*, pp 60-63).

Disclaimers: All comments, conclusions, opinions, and recommendations are those of the author(s), and do not necessarily reflect the views of the publisher, or the Editor(s). GSB does not specifically endorse any product mentioned in any manuscript, and accepts product descriptions and details to be an integral part of the scientific content.

Printed in Japan on acid-free paper.
Published: July, 2009.

CONTENTS

Shukadev Mangaraj, Tridib Kumar Goswami (India) Modified Atmosphere Packaging of Fruits and Vegetables for Extending Shelf-Life: A Review	1
Neena Joshi (India), Valerie Orsat, G. S. Vijaya Raghavan (Canada) Physical Attributes of Different Cuts of Tomatoes during Hot Air Drying	32
Grace Oluwakemi Babarinde, Emmanuel Adedapo Akande, Folarin Anifowose (Nigeria) Effects of Different Drying Methods on Physico-Chemical and Microbial Properties of Tomato (<i>Lycopersicon esculentum</i> Mill) var. Roma	37
Ademoyegun Olufemi Temitope, Akin-Idowu Pamela Eloho, Ibitoye Dorcas Olubunmi (Nigeria) Lycopene Content in Tomatoes (<i>Lycopersicon esculentum</i> Mill): Effect of Thermal Heat and its Health Benefits	40
Noureddine Benkeblia (Jamaica), Norio Shiomi (Japan) Variation of Fructooligosaccharide Contents, Invertase, 1-SST, 1-FFT and 6G-FFT Activities in Green Asparagus Spears Stored under Different Temperature Regimes	44
Supraanee Manurakchinakorn, Sirikorn Thirawat (Thailand) Effect of Immersion Solution and Packaging on Quality of Fresh-cut 'Red Fire' Lettuce	51
Runu Chakraborty, Utpal Ray Chaudhuri, Debjani Dutta (India) Influence of Preservatives, Thermal Treatment and Storage Time on the Carotenoid Content of Mangoes	55
Sontisuk Teerachaichayut, Anupun Terdwongworakul, Jutamas Phonudom, Wanchaya Uamsatianporn (Thailand) The Robustness of PLS Models for Soluble Solids Content of Mangosteen using Near Infrared Reflectance Spectroscopy	60
Gérard Ngoh Newilah, Kodjo Tomekpe, Elie Fokou, François-Xavier Etoa (Cameroon) Physicochemical Changes during Ripening of Bananas Grown in Cameroon	64
Ejikeme Nwachukwu, Leonard Adamu (Nigeria) Effects of Gamma Irradiation on Post-Harvest Deterioration of Cassava (<i>Manihot esculenta</i> Crantz) Tuber by Fungi	71
Vadakkepulppara Ramachandran Nair Sinija, Hari Niwas Mishra (India) Total Polyphenols in Green Tea Samples by FT-NIR Spectroscopy	76

Fresh Produce

Shukadev Mangaraj, Tridib Kumar Goswami (India) Modified Atmosphere Packaging of Fruits and Vegetables for Extending Shelf-Life: A Review (pp 1-31)

ABSTRACT

Review: Fresh fruits and vegetables being living require oxygen (O₂) for their metabolic processes especially for respiration. Modified-atmosphere packaging (MAP) of fresh produce refers to the technique of sealing actively respiring produce in polymeric film packages to modify the O₂ and CO₂ concentration levels within the package atmosphere necessary to maintain the freshness and extend shelf-life. It is often desirable to generate an atmosphere low in O₂ and high in CO₂ concentration to influence the metabolism of the produce being packaged, or the activity of decay-causing organisms to increase storage life. In addition to atmosphere modification, MAP vastly improves moisture retention, which can have a greater influence on preserving quality. Furthermore, packaging isolates the produce from the external environment and helps to ensure conditions that, if not sterile, at least reduce exposure to pathogens and contaminants and physiological injuries. MAP is a dynamic process during which respiration and permeation takes place simultaneously. Hence MAP design requires the determination of intrinsic properties of the produce, i.e. respiration rate, optimum O₂ and CO₂ gas concentrations, and film permeability characteristics. The objective of MAP design is to define conditions that will create the optimum atmosphere inside the package best suited for extending shelf-life of a given produce with shortest possible time period. This can be done by matching the respiration rate of the packaged produce with the film permeation rate for O₂ and CO₂ gases. The details of review on all these aspects of MAP have been done and presented in the present paper.

Neena Joshi (India), Valerie Orsat, G. S. Vijaya Raghavan (Canada) Physical Attributes of Different Cuts of Tomatoes during Hot Air Drying (pp 32-36)

ABSTRACT

Original Research Paper: Different cuts of tomato, such as slices, wedges, quarters, halves, were dehydrated in a forced air drier. Effect of Inherent moisture levels (10 and 30%) in the drying tomato on the attributes such as color, texture, shrinkage and appearance was evaluated. This was done as there is a growing market preference for dried tomatoes with intermediate moisture values (10 and 30%). The variations in the moisture levels were brought about by varying the duration of drying. Duration of drying was respectively 397, 450, 850, 1310 minutes for slices, wedges, quarters and halves. Water activity was the least in slices (0.492) compared to the rest (0.655 to 0.690). Rehydration ratio of different cuts of dry tomato ranged between 15.4 and 21.5 g H₂O/10 g DM. Shrinkage in dehydrated tomato having 10% and 30% moisture ranged respectively from 14.4 to 29.2 mm and 12.9 to 28.3 mm. The color values (L, a, b) suggest that dehydrated tomato slices had superior color appeal. Considering the different parameters that were studied the tomato slices were found to lend themselves best to dehydration in a forced air dryer when compared to other cuts.

Grace Oluwakemi Babarinde, Emmanuel Adedapo Akande, Folarin Anifowose (Nigeria) Effects of Different Drying Methods on Physico-Chemical and Microbial Properties of Tomato (*Lycopersicon esculentum* Mill) var. Roma (pp 37-39)

ABSTRACT

Research Note: Different drying methods (sun drying, solar drying and oven drying at 50, 55 and 60°C) were evaluated for their effects on the quality of tomato (*Lycopersicon esculentum* Mill) var. 'Roma'. A fresh sample served as control. The fresh and dried tomatoes were evaluated for changes in total solids, ash content, titratable acidity, pH, lycopene, total carotenoids, ascorbic acid and total microbial and fungi count. The results of the total solids and ash content showed that sun-dried tomatoes had the lowest total solids (89.6%) and mineral retention was highest in the solar-dried samples (2.6%). The contents of ascorbic acid were significantly ($P < 0.05$) reduced after drying from 27.3 mg/100 g in the control sample to 11.4, 7.9 and 5.3 mg/100 g in sun-dried, solar-dried and 60°C oven-dried, respectively. Tomatoes dried in the oven had a significantly lower amount of ascorbic acid when compared to sun- and solar-dried tomatoes. There was a considerable increase in the carotenoids and lycopene contents of the dried samples. Carotenoids were best retained in samples dried at 60°C, and lycopene content was higher in tomatoes dried in the solar dryer. Tomatoes dried in the oven at 60°C had the least aerobic and fungal counts, which were higher in sun-dried samples.

Ademoyegun Olufemi Temitope, Akin-Idowu Pamela Eloho, Ibitoye Dorcas Olubunmi (Nigeria) Lycopene Content in

ABSTRACT

Original Research Paper: Lycopene is a phytonutrient and an antioxidant and this pigment is responsible for the characteristic deep red colour of ripe tomatoes and their products. It plays an important role in human health and epidemiological studies have shown it to reduce the risk of chronic diseases. The lycopene content and stability in tomato purée during cooking was studied. Eight different tomato cultivars ('NH158', 'Three lobed', 'Ronita', 'Small local', 'Leader', 'Lindo', 'Big local' and 'Cherry') were planted for evaluation. The tomato slurries were subjected to thermal heat for 1, 2 and 3 h and analyzed for lycopene content by spectrophotometry. The absorbance was read at 502 nm. The lycopene content ranged from 70.25 to 147.29 µg/g, 'Leader' having the highest and 'Lindo' the lowest. The percentage loss of lycopene content after 1 h boiling ranged from 13.58-42.99% among the cultivars. Values obtained for 2 and 3 h heating were similar, ranging from 24.66-85.30%. However, 'Three-lobed' and 'Cherry' retained more of their lycopene content than the other six cultivars. A further loss in the lycopene content was observed when subjected to 3 h cooking suggesting that lycopene is not stable when exposed to longer heating. The levels of lycopene in tomato and the potential influence of thermal heat on its availability in tomatoes and tomato-based foods would be of interest to the food industry, tomato improvement and public health intervention programmes. This paper also summarizes the current state of knowledge of the properties of lycopene, and its possible health benefits.

Noureddine Benkeblia (Jamaica), Norio Shiomi (Japan) Variation of Fructooligosaccharide Contents, Invertase, 1-SST, 1-FFT and 6G-FFT Activities in Green Asparagus Spears Stored under Different Temperature Regimes (pp 44-50)

ABSTRACT

Original Research Paper: Fresh spears of asparagus were stored in the dark at 4, 10 or 20°C for 14 days. During storage contents of glucose, fructose, sucrose, 1-kestose, neokestose and nystose, and activities of invertase, 1-KHE, 1-SST, 1-FFT and 6G-FFT were determined. Invertase activity decreased after two days at 4 and 10°C, while it increased after two days at 20°C and then also decreased progressively. 1-KHE activity also varied slightly at 4 and 10°C, while at 20°C, 1-KHE increased after two days, before decreasing after four days and remaining quite stable during the last 10 days of storage. 1-SST increased during the first four days at the three temperatures. During the last 10 days, 1-SST activity decreased progressively at 4°C but remained stable at 10 and 20°C. 1-FFT activity varied slightly but was high at 4°C and low at 20°C. The activity of 6G-FFT was similar to 1-FFT although its level was higher. Glucose was stable during the first week and decreased during the second week at 10 and 20°C while it increased at 4°C. Fructose decrease progressively at 10 and 20°C but increased considerably at 4°C. Sucrose content decreased progressively at 10 and 20°C but increased significantly at 4°C during the second week of storage. 1-kestose and neokestose showed a slight increase during the first days but decreased progressively during the ten last days of storage. Nystose content decreased progressively and the decrease was almost linear during storage although the final content at 20°C was lower. It was concluded that sugars contents of asparagus spears declined rapidly during the first four days of storage. This decline explains well the short shelf-life of the spears and the rapid loss of their quality attributes after few days.

Supranee Manurakchinakorn, Sirikorn Thirawut (Thailand) Effect of Immersion Solution and Packaging on Quality of Fresh-cut 'Red Fire' Lettuce (pp 51-54)

ABSTRACT

Original Research Paper: Shelf-life extension of fresh-cut 'Red Fire' lettuce by immersion in a solution consisting of 2 g/L citric acid and 1 g/L calcium chloride prior to modified atmosphere packaging (MAP) during 24 days of storage at 4°C was investigated. Polyethylene bag was used as a container for 3 packaging treatments including non-perforation, 2-hole perforation and 4-hole perforation. Visual quality (overall visual quality (OVQ), leaf edge browning (LEB) and russet spotting (RS)), weight loss and ascorbic acid content of the product were evaluated at 4-day intervals. Immersing fresh-cut lettuce in the mixed solution tended to retard loss of ascorbic acid and OVQ. Non-perforation MAP seemed to be superior for maintaining OVQ and delaying weight loss, compared with other MAP treatments. On the other hand, changes in LEB and ascorbic acid content were not apparently affected by different packaging treatments. Using immersion solution in combination with non-perforation MAP effectively maintained visual and nutritional qualities of fresh-cut lettuce, as a consequence of retaining fresh weight, ascorbic acid content, OVQ and delaying LEB. During 24 days of storage, discolouration of RS was not detected in all treatments, indicating that 'Red Fire' lettuce is not a RS sensitive cultivar.

Runu Chakraborty, Utpal Ray Chaudhuri, Debjani Dutta (India) Influence of Preservatives, Thermal Treatment and Storage

Time on the Carotenoid Content of Mangoes (pp 55-59)

ABSTRACT

Original Research Paper: To retain the carotenoid content of mangoes (cvs. 'Himsagar', 'Langra' and 'Fajli'), they were preserved in sucrose (50° Brix), 5% NaCl or 1% citric acid solutions. In addition, some of these mangoes were thermally treated at 70°C for 30 min while others were cooked under pressure (1 atm) at 121°C for 10 min. They were then stored in a chest freezer at -18°C for 80 days. The carotenoid content was found to be higher in thermally processed mangoes but decreased in untreated mangoes and those preserved in citric acid. The carotenoid content initially increased during the first 10 days of storage when the mangoes were treated with sucrose and NaCl solutions, after which it decreased.

Sontisuk Teerachaichayut, Anupun Terdwongworakul, Jutamas Phonudom, Wanchaya Uamsatianporn (Thailand) The Robustness of PLS Models for Soluble Solids Content of Mangosteen using Near Infrared Reflectance Spectroscopy (pp 60-63)

ABSTRACT

Original Research Paper: This research investigated the soluble solids content in translucent flesh which is an internal defect of mangosteen fruit (*Garcinia mangostana* L.). Near infrared (NIR) reflectance spectroscopy was used for the development of partial least squares calibration models for the prediction of the soluble solids content. Samples of 213 normal mangosteens and 87 translucent mangosteens were used for this experiment. Juice samples extracted from both normal flesh and translucent flesh were measured for their soluble solids contents. Diffuse reflectance spectra of juice samples were acquired in a range of 1100 to 2500 nm. In this research, a NIR spectrometer was able to predict the soluble solids content of mangosteen. The best model was developed with second derivative treatment. The calibration model of normal-flesh juice obtained high accuracy for prediction with a set of normal flesh samples (standard error of prediction (SEP) = 0.655, bias = 0.047) and poor accuracy for prediction with a set of translucent flesh samples (SEP = 1.245, bias = 0.224). The results indicate that NIR technology has high potential to develop calibration models for the prediction of the difference in quality of flesh in mangosteen.

Gérard Ngoh Newilah, Kodjo Tomekpe, Elie Fokou, François-Xavier Etoa (Cameroon) Physicochemical Changes during Ripening of Bananas Grown in Cameroon (pp 64-70)

ABSTRACT

Original Research Paper: Physico-chemical changes in the fruits of five and nine cultivars of cooking and dessert banana respectively were determined. The ripening stage was defined in terms of peel colour changes from green to yellow. At harvest, the fruit girth and length as well as the peel thickness vary significantly ($P < 0.05$) according to cultivars; cooking bananas exhibiting the highest values respectively (6.00 cm, 27.62 cm and 3.58 mm). During ripening, the peel dry matter content, pulp to peel ratio, total soluble solid and total titratable acidity of the pulp increased (from 8.63 to 24.20 g/100 g, 1.38 to 7.77, 1.27 to 19.3 g/l and 276.3 to 1491 mEq/100 g, respectively) while pulp firmness, pH and dry matter content of the pulps decreased respectively from 3.2 to 0.15 kg/cm², 6.34 to 4.48 and 40.12 to 18 g/100 g. These physicochemical characteristics coupled to pulp colour, fruit girth and length as well as other sensorial parameters are actually used by *Musa* breeders at CARBAP and food processors in Cameroon for the creation and selection of new hybrids with high agronomic performance and accepted by consumers as well as the production of good quality *Musa*-derived foods, respectively.

Ejikeme Nwachukwu, Leonard Adamu (Nigeria) Effects of Gamma Irradiation on Post-Harvest Deterioration of Cassava (*Manihot esculenta* Crantz) Tuber by Fungi (pp 71-75)

ABSTRACT

Original Research Paper: Three varieties of cassava (*Manihot esculenta* Crantz) (SMS 909-25, COL 2215 and COL 1734) that were gamma (γ) irradiated and non- γ irradiated were investigated for susceptibility to post-harvest fungal rot by five species of moulds (*Botryodiplodia theobromae*, *Penicillium oxalicum*, *Aspergillus niger*, *Fusarium solani* and *Macrophomina phaseolina*). These moulds were inoculated into tuber samples at wound depths of 10 mm with either single or paired cultures. The inoculated samples were stored in two environments (ambient temperature ($26 \pm 2^\circ\text{C}$) and polyethylene bags of 18 μm thickness). The most extensive rot development at ambient temperature was 13.50 ± 0.10 mm by *M. phaseolina* for single cultures while pair-cultures of *P. oxalicum* and *M. phaseolina* produced 19.50 ± 0.05 mm in irradiated cassava COL 2215 but 15.50 ± 0.71 mm by *M. phaseolina* for a single culture and 21.50 ± 0.71 mm for pair-culture of *P. oxalicum* and *M. phaseolina* in non-irradiated cassava. The minimum rot of 6.50 ± 0.05 mm by *P. oxalicum* and 13.00 ± 0.00 mm by *B. theobromae* and *A.*

niger occurred in irradiated cassava COL 1734 but *P. oxalicum* produced 8.50 ± 0.71 mm while *P. oxalicum* and *F. solani* produced 13.75 ± 0.72 mm in non-irradiated cassava. Generally, significant ($P > 0.05$) rot was recorded for non-irradiated than irradiated cassava varieties analyzed. In polyethylene bags storage, generally the highest zone of rot of 16.50 ± 0.05 mm by *M. phaseolina* and 21.63 ± 0.03 mm by *P. oxalicum* and *M. phaseolina* were observed in COL 2215. *M. phaseolina* showed the highest zone of rot development in γ and non- γ irradiated cassava varieties irrespective of the storage condition.

Vadakkepuppara Ramachandran Nair Sinija, Hari Niwas Mishra (India) Total Polyphenols in Green Tea Samples by FT-NIR Spectroscopy (pp 76-80)

ABSTRACT

Original Research Paper: The feasibility of measuring total polyphenols content in instant green tea powder and green tea granules was investigated by Fourier Transform Near-Infrared (FT-NIR) spectroscopy. The spectra were measured in diffused reflectance mode by keeping 8-10 g samples in a small sample bottle. A partial least square regression model was developed with vector normalization as the pre-processing method in the NIR region ($4000-12000 \text{ cm}^{-1}$ or 800-2500 nm). The developed model was validated using a cross validation technique. FT-NIR spectroscopy with chemometrics, using PLS – vector normalization as the pre-processing method – could predict the total polyphenols content in tea samples in terms of gallic acid accurately up to an R^2 value of 0.978 and a standard error of cross validation (RMSECV) value of 1.45 with 4 factors in the prediction model. The developed model was applied to predict total polyphenols in green tea samples within 30-60 min. The developed procedure was further validated with fresh samples which were not used for calibration and compared with spectroscopic method of polyphenol determination. The overall results demonstrate that NIR spectroscopy with multivariate calibration could be successfully applied as a rapid method not only to identify tea varieties but also to determine total polyphenols content in green tea samples.