IC-GU12 Joint Lecture Series 2023:

Recent Advances in Postharvest Biology and Technology for Achieving the Sustainable Development Goals

Abstract Book

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Responses Related to Postharvest Changes in Fruit and Vegetables After Short-Term Anoxia Treatment

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Abstract

The primary objective of postharvest storage is to retard metabolic and biochemical processes. Researchers have shown a longstanding interest in exploring the possibilities of anoxia treatment as a non-chemical method for preserving postharvest quality throughout storage. The anoxic condition refers to a state characterized by a restricted availability of oxygen, often below 0.05 kPa. In several instances, this objective is achieved through the implementation of short-term anoxia treatment on fruits and vegetables. The primary topic of this article pertains to the reactions exhibited by fruits and vegetables during the period of postharvest storage subsequent to undergoing a short-term anoxia treatment. The majority of studies have been conducted on other models such as pineapple, litchi, asparagus, and broccoli. The effects of anoxia treatment on the physicochemical qualities of those commodities are discussed. The research findings indicate that the application of anoxia is effective in preserving the quality of pineapples after harvest and mitigating physiological disorders, such as interior browning. This is achieved by inhibiting the activity of polyphenol oxidase (PPO). The anoxia treatment resulted in a deceleration of mass loss and the preservation of flesh color. However, it stimulated an increase in the respiration rate of the fruit. Furthermore, the PPO of fresh-cut pineapples subjected to anoxia treatment was observed to be lower compared to fresh-cut fruits that were not treated. Besides, the application of anoxic treatment to litchi fruit led to notable reductions in electrical conductivity and browning index, while also causing a delay in the escalation of PPO activity as compared to the control fruit. Further investigation has been conducted to examine the impact of pre-storage short-term anoxia treatment in conjunction with modified atmosphere packaging on the toughening of green asparagus spears. The subsequent increase in shear force was shown to be inhibited due to the reduction of fiber and lignin production. The observed effects of anoxic conditions can be substantiated by the increase in ethanol concentrations seen in treated product. The study revealed a positive correlation between

the duration of exposure and ethanol generation in broccoli florets. Additionally, it was shown that the decline in total ascorbic acid and chlorophyll content in broccoli florets occurred at a slower rate. Nevertheless, a greater concentration of ethanol was detected in the broccoli subjected to extensive anoxia treatment, resulting in the development of a darker color. It may be inferred that taking advantage of fruit and vegetables containing an optimal level of naturally occurring ethanol, induced through short anoxia treatment, represents a viable approach to impede the progression of physiological changes in stored products.

Silver Nanoparticles Applications for Preserving Quality of Mangosteen Fruit

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Abstract

Fruit rot disease caused by *Lasiodioplodia theobromae* is one factor that led to pericarp hardening of mangosteen. Our study found that silver nanoparticle (AgNPs) at 270 ppm completely suppressed *L. theobromae* either mycelium growth or spore germination. AgNPs treatment at 300 ppm significantly reduced the disease index (DI) in the artificially inoculated mangosteen fruit during stored at 25 °C. The effects of AgNPs on fruit rot disease and fruit quality were determined in the naturally infected mangosteen as compared to fungicide-treated fruits and non-treated fruits during storage at 13 °C. AgNPs treatment reduced fruit rot disease about 8-fold of the control fruits. Activity of plant defense-related enzymes: phenylalanine ammonia-lyase (PAL), peroxidase (POD), chitinase (CHI) and β-1,3-glucanase (GLU), and α-mangostin content was induced by AgNPs treatment. Further, AgNPs treatment delayed the ripening by slow down the increase of ethylene production and respiration rate resulted to reduce weight loss and pericarp hardening. Chlorophyll content in calyx, total soluble solids (TSS), titratable acidity (TA), pericarp color, and anthocyanin in the pericarp were maintained. This research indicated that AgNPs application can control fruit rot disease and preserve the quality of mangosteen fruit.

Physicochemical Characteristics and LC-HRMS Metabolite Profiling of *Tongar* Avocado Fruit with Different Maturity Stages

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Abstract

Tongar avocado (*Persea americana*) is one of the superior varieties of avocado from West Pasaman, West Sumatera, Indonesia. This plant has become a leading commodity in West Sumatra and has been widely consumed and marketed domestically and overseas. Tongar avocado fruit has a large size (500–900 g), good taste, and thin fruit skin, which are very different characteristics compared to other avocados. The maturity level of the avocado fruit needs to be considered before harvesting. This is because the degree of maturity affects its physicochemical properties and its metabolite profile. This study aims to compare the physicochemical properties and metabolite profiles of the Tongar avocado at harvest times of 165, 180, and 195 days after the flowers were developed. Geometric mean diameter (D_g), firmness, respiration rate, total soluble solids (TSS), and skin color were determined to evaluate the physicochemical characteristics for each harvest time of the avocado. We found physicochemical properties level of the Tongar avocado varied at the different maturity stages. In addition, metabolite profiling was also carried out using LC-HRMS, identifying 31 metabolites belonging to the fatty alcohol, furan derivative, phenolic, fatty acid, and miscellaneous groups. Most of the metabolites were abundant in the 165-day avocado harvest. This difference in harvest time can affect the avocado fruit's quality. So there is differences in the physicochemical properties and metabolite profile of Tongar avocado fruit at different maturity stages. Further studies are needed to identify the relationship between fruit quality and the metabolite profile of Tongar avocados.

Elucidating the Molecular Mechanism of Nobiletin Accumulation in Citrus Fruit

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Abstract

Nobiletin, a polymethoxylated flavone (PMF), is specifically accumulated in citrus fruit and has been reported to exhibit important health-supporting properties. Nobiletin has six methoxy groups at the 3′,4′,5,6,7,8-positions, and its methylation is catalyzed by *S*-adenosyl-L-methionine (SAM) dependent O-methyltransferases (OMTs). To date, although flavonoid accumulation has been extensively reported in different citrus cultivars, the molecular mechanism regulating the biosynthesis of PMFs, especially nobiletin, in citrus fruit is largely unknown. In this study, we investigated flavonoid accumulation in three citrus varieties, Ponkan mandarin (*Citrus reticulata* Blanco), Nou 6 ("King mandarin" × "Mukaku-kishu"), and Satsuma mandarin (*Citrus unshiu* Marc.), which accumulate different levels of nobiletin. Moreover, two novel O-methyltransferase genes (CitOMT1 and CitOMT2) were isolated, and their functions were investigated *in vitro*.

In the present study, five PMFs, nobiletin, tangeretin, sinensetin, 5-demethylnobiletin, and heptamethoxyflavone, were detected in the flavedos of the three citrus varieties. Among the three citrus varieties, Ponkan mandarin accumulated the highest PMF in the flavedo, followed by Nou 6. The total PMF content in Satsuma mandarin was much lower than that in the other two varieties. In the flavedo, nobiletin was the major PMF, and its level was significantly different among the three varieties. In Ponkan mandarin and Nou 6, a high amount of nobiletin was detected in the flavedos. In Satsuma mandarin, in contrast, the content of nobiletin in the flavedo was extremely low. The gene expression results showed that *CitOMT1* and *CitOMT2* were highly expressed in the two nobiletin abundant varieties of Ponkan mandarin and Nou 6. However, the expression levels of these two *OMTs* were low in the flavedo of Satsuma mandarin, in which only a small amount of nobiletin was accumulated.

The functional analysis showed that the recombinant protein of CitOMT1 had methylation activity to transfer a methyl group to 3′-hydroxy group of flavones, and the recombinant protein

of CitOMT2 had methylation activity to transfer a methyl group to 8-hydroxy group of flavones. Because methylation at the 3′-position and 8-position of flavones are vital for the nobiletin biosynthesis, *CitOMT1* and *CitOMT2* may be the key genes responsible for nobiletin biosynthesis in citrus fruit. The results presented in this study will provide new strategies to enhance nobiletin accumulation and improve the nutritional qualities of citrus fruit.