

甜樱桃果实成熟过程中糖累积与品质形成研究

王宝刚,李文生,侯玉茹,常虹,周家华,石磊,张开春

(北京市农林科学院林业果树研究所,北京 100093)

摘要:【目的】探明甜樱桃成熟过程中糖积累和品质形成的规律。【方法】以‘雷尼’和‘先锋’甜樱桃为试材,研究了果实成熟过程中可溶性糖以及硬度、果柄拉力、可滴定酸、总酚、抗坏血酸等品质的变化规律。【结果】甜樱桃果实中可溶性糖以葡萄糖、果糖和山梨醇为主。随着甜樱桃果实的成熟,其葡萄糖、果糖、山梨醇、可溶性固形物含量和糖固比例不断升高。‘雷尼’和‘先锋’樱桃的3种可溶性糖分别在成熟期3和成熟期5迅速积累,然后缓慢增加。果实的硬度和果柄拉力均随果实的成熟不断降低,总酚含量均在成熟期3时急速降低,之后趋于平稳。2个樱桃品种的可滴定酸、抗坏血酸含量和固酸比总体呈升高趋势,其中,‘雷尼’可滴定酸含量和固酸比在成熟期2之后趋于平稳。完熟期时‘雷尼’樱桃的可滴定酸含量和‘先锋’樱桃的抗坏血酸含量有所降低。2个樱桃品种的硬度、果柄拉力、可溶性固形物、葡萄糖、果糖、山梨醇6个指标之间均呈显著相关性。【结论】甜樱桃果实在成熟过程中糖含量呈上升趋势,成熟期3和成熟期5分别是‘雷尼’和‘先锋’樱桃糖积累的关键期,果实硬度、果柄拉力和总酚含量呈下降趋势,其他品质指标变化不一致。

关键词: 甜樱桃; 成熟; 品质; 可溶性糖

中图分类号: S662.5

文献标志码: A

文章编号: 1009-9980(2017)05-0576-08

Sugars accumulation and quality in the fruits of sweet cherry during ripening

WANG Baogang, LI Wensheng, HOU Yuru, CHANG Hong, ZHOU Jiahua, SHI Lei, ZHANG Kaichun

(Institute of Forestry and Pomology, Beijing Academy of Agriculture and Forestry Sciences, Beijing 100093, China)

Abstract: 【Objective】 Fruit quality is the most important character for the consumers, which mainly includes size, color, firmness, contents of sugar and acid as well as antioxidant substances. Many studies of sweet cherry have focused on changes of qualities, anthocyanidin and sugar content during fruit development. However, very few study on correlation between sugars accumulation and qualities development of sweet cherry fruit during ripening has been made so far. The objective of the study was to clarify the correlation between the sugars accumulation and quality development of sweet cherry during fruit ripening. 【Methods】 The changes of sugars and qualities (firmness, pulling force of peduncle, titratable acidity, total phenolic and ascorbic acid) of sweet cherry (*Prunus avium* L. ‘Rainer’, ‘Van’) were studied during the course of ripening. Uniform fruits of sweet cherry were taken as experimental sample from the hardcore period. Samplings were made on May 20(ripening period 1), May 23(ripening period 2), May 26 (ripening period 3), May 29 (ripening period 4), May 31 (ripening period 5) and June 8 (ripening period 6) 2016 respectively. The fruit soluble sugars and quality indicators were determined immediately after fruit harvest. The correlation of fruit firmness, soluble solids, titratable acidity, ascorbic acid, total phenolic, glucose, fructose, sorbitol and pulling force of peduncle were analyzed by SPSS 17.0. 【Results】 With the growth and development, fruit color changed from green to yellow, pink, and red gradually. Glucose, fructose and sorbitol were the major soluble sugar components of sweet cherry, and the glucose, fructose, sorbitol, soluble solids, sugar/SSC statistically increased during fruit ripening. Glucose content was the highest, followed by fruc-

收稿日期: 2016-11-07 接受日期: 2017-02-18

基金项目: 公益性行业(农业)科研专项(201303075);北京市农林科学院科技创新能力建设专项(KJ CX20170206)

作者简介: 王宝刚,男,副研究员,博士,主要从事果品物流及贮藏保鲜技术方面的研究。Tel:010-62595984, E-mail: fruit_postharvest@

tose, and sorbitol. Sucrose was not checked out in sweet cherry. The three soluble sugar contents of 'Rainer' and 'Van' accumulated quickly at ripening period 3 and 5 respectively. The glucose, fructose and sorbitol contents of 'Rainer' and 'Van' at harvest were 2.8, 3.6 and 6.7 times, and 1.9, 5.0 and 5.0 times as much as those at early growth periods respectively. The sugar/SSC of 'Rainer' and 'Van' were 90.3% and 97.6%, which were 1.8 times and 1.3 times as much as those at early growth period. The firmness and pulling force of peduncle decreased during fruit ripening, and total phenolic content decreased quickly at ripening period 3, and then decreased. The titratable acidity, ascorbic acid content and SSC/acid ratio showed the general upward trend, and titratable acidity and SSC/acid ratio of 'Rainer' decreased after ripening period 2. However, the titratable acidity of 'Rainer' and the ascorbic acid of 'Van' decreased at the fully ripe stage. There were significant correlations between glucose, fructose, sorbitol, soluble solids, firmness and pulling force of peduncle. 【Conclusion】The major soluble sugar components of sweet cherry were glucose, fructose and sorbitol. The sugar content increased during the course of ripening, and the ripening period 3 and 5 were the critical periods for sugars accumulation of 'Rainer' and 'Van' respectively. The firmness, pulling force of peduncle and total phenolic content decreased, during the course of ripening. The changes of other quality indicators of the two cultivars were different during the course of ripening.

Key words: Sweet cherry; Ripening; Quality; Soluble sugars

甜樱桃(*Prunus avium* L.), 又称大樱桃, 为蔷薇科李属樱桃亚属植物, 其果色鲜艳, 酸甜适口, 营养丰富, 深受广大消费者欢迎。近年来, 从美国、加拿大、智利、澳大利亚等国进口的甜樱桃, 由于其品质优良, 尤其是果个大, 果肉丰满, 果实硬度和可溶性固形物含量较高, 逐步受到了我国消费者的喜欢, 进口量也逐年增长。进口甜樱桃的贸易不断地冲击着国内甜樱桃市场, 而我国甜樱桃却难以走出国门, 究其原因就是国内甜樱桃品质整体水平较低, 加之甜樱桃皮薄、肉软、多汁, 属于不耐贮运的水果, 并且采收期正值高温季节, 极易出现果实软化、褐变、腐烂变质等现象, 这就给甜樱桃的运输和贮藏造成了困难, 给生产者和销售者带来了极大的损失^[1-2]。国内目前有关甜樱桃的运输和贮藏方面的研究较多^[3-5], 但要从根本上解决问题, 还需对甜樱桃果实品质形成方面进行深入地研究, 而这方面的研究较少, 这可能也是导致甜樱桃品质水平较低的因素之一。

果实品质是决定果实商品性状的重要因素, 主要包括以糖酸为核心的食用品质, 色泽为核心的外观品质, 以及抗氧化分子为核心的营养品质^[6-8]。近年来, 国内外学者对苹果^[9]、橘^[10]、橙^[11]、李^[12-13]等果实发育过程中品质的相关研究较多。对于甜樱桃发育过程的研究多集中在品质、花色苷及糖含量变化方面, 如王婷等^[14]对‘红灯’甜樱桃果实发育过程中糖代谢规律及相关酶活性变化进行了研究; 李振亭等^[15]对‘早大果’甜樱桃果实发育过程中糖的动态变化进行了

研究; 魏国芹等^[16]对山东泰安甜樱桃7个主栽品种果实发育过程中糖酸含量变化进行了研究; 崔天舒^[17]以‘早大果’‘红灯’‘雷尼’‘早红宝石’‘斯坦勒’‘先锋’‘布鲁克斯’和‘拉宾斯’8个甜樱桃品种为试材, 对果实风味品质及花色苷组分进行了研究, 而对甜樱桃糖积累与各品质指标之间相关性的研究较少。

笔者以生产主栽品种‘雷尼’和‘先锋’甜樱桃为试材, 研究了甜樱桃果实成熟过程中可溶性糖的积累情况以及基本理化品质的形成规律, 并对各指标的相关性进行分析, 研究结果可为甜樱桃栽培及物流运输提供理论依据和技术参考。

1 材料和方法

1.1 材料

供试甜樱桃品种为‘雷尼’和‘先锋’(*Prunus avium* L. ‘Rainer’, ‘Van’), 树龄均10 a(年), 砧木为CAB, 采自北京市海淀区上庄基地。

1.2 方法

1.2.1 甜樱桃成熟期采样 每个品种果实进入硬核期后, 定期选取大小均一、成熟度一致的果实作为样品。采样时间为2016年5月20日(成熟期1)、5月23日(成熟期2)、5月26日(成熟期3)、5月29日(成熟期4)、6月3日(成熟期5)、6月8日(成熟期6), 每个品种每次采样2 kg。果实采收后立即测定各项品质指标。

1.2.2 基本品质指标测定 甜樱桃果实硬度和果柄拉力采用质构仪(TA. XT. Plus, Stable Micro System,