

# 采收期对‘富平尖柿’生理特性的影响

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**摘要:**【目的】探索采收期对‘富平尖柿’的生理代谢影响, 寻找其最佳采收期, 提高果品商品品质。【方法】以‘富平尖柿’为试材, 采用对比试验法, 于10月13日开始, 每间隔5日, 采收一次柿果, 直至11月3日, 共采收5个批次, 调查了不同采收期采收的柿果的色泽、单果质量、硬度、水分、可溶性固形物含量、呼吸强度、总单宁、可溶性单宁、聚合单宁、原果胶、可溶性果胶、乙醇、乙醛含量及果胶酶、乙醇脱氢酶、多酚氧化酶(PPO)的活性变化, 分析了不同采收期对‘富平尖柿’的理化品质指标和生理特性影响。【结果】在试验采收期内, 随着采收期的延迟, ‘富平尖柿’的绿色变淡, 色泽变得更黄, 单果质量增加, 硬度降低, 水分含量增大, 可溶性固形物含量增高, 呼吸强度降低, 可溶性单宁含量减少, 聚合单宁含量增加, 原果胶含量降低, 可溶性果胶含量增多, 果胶酶活性增强, 乙醇、乙醛含量及乙醇脱氢酶、多酚氧化酶活性随采收期延迟先增高后降低, ‘富平尖柿’在霜降后5~10 d采收, 各种理化品质较好, 柿子能保持良好的硬度、色泽和内在品质。【结论】富平尖柿最适采收期位于霜降后5~10 d, 此时采收的‘富平尖柿’色泽好, 可溶性固形物含量高, 硬度适中, 果品商品性指标较好, 利于后期的运输保藏和加工操作。

**关键词:**‘富平尖柿’; 采收期; 生理生化指标; 生理特性; 柿果商品性

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## Effects of harvest date on physiological characteristics of ‘Fuping-jianshi’ persimmon

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**Abstract:**【Objective】‘Fuping-jianshi’ persimmon is an excellent astringent persimmon varieties used for dried persimmon production in China, however, the physiological characteristics of ‘Fuping-jianshi’ persimmon fruit are seldom studied. The fruits of ‘Fuping-jianshi’ persimmon were harvested in different date in order to explore the effects of harvest time on the physicochemical quality and the physiological metabolism of ‘Fuping-jianshi’ persimmon and to seek the optimum harvest time to improve the commodity quality of ‘Fuping-jianshi’ persimmon fruits. 【Methods】The five persimmon trees was choosed as fixed test fruit trees in orchard, five batches of the persimmon fruits were harvested from the fixed test fruit trees in different directions every 5 days in 20 days from 13 October to 3 November. The color, single fruit weight, hardness, moisture, soluble solid content, dynamic respiratory intensity, total tannin, soluble tannin, polymerization tannin, protopectin, soluble pectin, ethanol, acetaldehyde content, pectinase, ethanol dehydrogenase and polyphenol oxidase activity of the persimmon fruits harvested in different periods were investigated by sensory organs evaluation and quantitative determination methods with fruit hardness sclerometer, Saccharimeter, quick water determination apparatus, fruit respiratory intensity meter and plant ethanol, acetaldehyde, pectinase, ethanol dehydrogenase, polyphenol oxi-

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dase detection kit. The change rule of color, single fruit weight, hardness, moisture, soluble solid, respiratory intensity, total tannin, soluble tannin, polymerized tannin, protopectin, soluble pectin, ethanol, acetaldehyde, pectinase, ethanol dehydrogenase and polyphenol oxidase in the persimmon fruits harvested different time was discussed, the effects of harvest time on the these physicochemical and physiological metabolism index of ‘Fuping-jianshi’ persimmon were analyzed, with the method of comparative experiment. 【Results】The results showed that with the delay of harvest time, the green color of ‘Fuping-jianshi’ persimmon fruits gradually fades away, the fruits color became yellower, the weight of single persimmon fruit increases with the delay of harvesting time, the fruit average hardness decreases, water content and soluble solids content increases, dynamic respiratory intensity decreases, total tannin keep unchanged, soluble tannin content decrease, polymeric tannin content increases, protopectin content decreases, soluble pectin content increases, ethanol and acetaldehyde content increases first and then decreases. The activity of pectinase and polyphenol oxidase increased first and then decreased, alcohol dehydrogenase activity remained basically unchanged, with the delay of harvesting time. It was found that the later the persimmon fruits was harvested, the better the color of the persimmon fruit were, the heavier the average weight of the single persimmon fruits were, the soluble tannin in the persimmon fruit become gradually into polymeric tannin by ethanol dehydrogenase action to cause the astringency of the persimmon fruit fades, this is because the astringency of persimmon is related to the content of soluble tannin in persimmon, the more soluble tannins in persimmon, the more astringent persimmon taste, persimmon deastringency is that persimmon first undergoes anaerobic metabolism to produce ethanol, then ethanol is converted into acetaldehyde under the action of ethanol dehydrogenase. Acetaldehyde and soluble tannin are polymerized to form polymeric tannin, which makes persimmon lose astringent taste. Although above these changes are beneficial to improving the quality of persimmon, but the protopectin in the persimmon fruit is hydrolyzed generally into soluble pectin by pectinase action to cause persimmon fruit to soften, protopectin is an important substance to maintain the hardness of fruits, the more protopectin content in fruit is , the harder the fruit is, at the same time, the softening of persimmon fruits is related to its respiratory intensity, the higher the respiratory intensity, the faster the softening speed of persimmon is, therefore, in order to obtain good fruit hardness, it is necessary to harvest early in order to prevent persimmon from softening, which is in contradiction with late harvesting to improve internal quality. If the persimmon fruits is harvested too early, its yield is low and its quality is poor, if it is harvested too late, the persimmon fruits will become soft, which is not conducive to post-processing. therefore, in order to obtain good internal and external quality and hardness of persimmon, timely harvesting is necessary. Through comprehensive analysis, the result is drawn that when ‘Fuping-jianshi’ persimmon was harvested between 5 and 10 days after frost fall, the weight of the single persimmon fruits achieves maximum and stop growth, the fruits color had completely yellowed, the fruit keeps suitable hardness, the fruits soluble solids content reach to higher value, the fruits dynamic respiratory intensity value is lower, the physical and chemical quality of the persimmon fruits was better, the persimmon fruits could maintain good hardness, color and internal quality. 【Conclusion】The optimum harvest time of ‘Fuping-jianshi’ persimmon is between 5 and 10 days after frost fall. ‘Fuping-jianshi’ persimmon fruits harvested in this period of time has to good color, higher soluble solids content, moderate hardness, lower respiratory intensity and astringent taste and good commodity index, which is conducive to later transportation, storage and processing operations.

**Key words:** ‘Fuping-jianshi’ persimmon; Harvest date; Physiological and biochemical indexes; Physiological characteristics; Commodity of persimmon fruit

柿子(*Diospyros kaki* L.f)是柿属植物的果实,又名朱果、猴枣、红嘟嘟,原产于我国长江黄河流域,主产于我国温带地区及东南亚部分国家,是我国的特色水果之一,也是我国第五大水果<sup>[1]</sup>。柿子栽培在我国已有3 000 多年历史,我国柿子产量位居世界首位<sup>[2]</sup>。柿果富含蔗糖、葡萄糖、果糖、蛋白质、胡萝卜素、维生素C、瓜氨酸、碘、钙、磷、铁、锌等营养元素,营养丰富<sup>[3]</sup>,具有清热、润肺、止渴、止泻、止血<sup>[4]</sup>、涩肠、抗氧化<sup>[5-6]</sup>、抗病毒<sup>[7]</sup>等保健功能<sup>[8-9]</sup>。其果实可加工成柿饼、柿干、柿片、柿子酒、柿子醋等系列产品。与此同时,柿子含丰富单宁,具有涩味,不能鲜食,易软化,难贮藏,不易运输成为限制柿子产业发展的主要问题。

‘富平尖柿’是我国优良的涩柿品种,盛花期一般在5月中旬,果实成熟期在10月下旬,果实成熟后呈橙黄色,肉质致密,纤维少,汁液多,味极甜,无核或少核,果形整齐,是制作柿饼的上乘品种,主要分布于陕西省富平县及其周边地区<sup>[10]</sup>。‘富平尖柿’采收期集中,采收后会快速软化、腐烂,保鲜期很短<sup>[11-12]</sup>,极大地影响了其商品价值,严重挫伤了柿农的积极性,制约了‘富平尖柿’的快速发展。近年来随着富平柿饼加工产业的快速发展,‘富平尖柿’发展迅猛,同时也急需解决柿子的采收问题,延长柿饼的加工期。但目前有关‘富平尖柿’的详细研究资料较为缺乏,对‘富平尖柿’果实的生长发育规律特性研究甚少,因此探究‘富平尖柿’果实成熟衰老的生理变化规律,寻找安全、有效的贮藏保鲜技术,延长柿果的贮藏品质,减少浪费,提高商品价值,对促进‘富平尖柿’产业发展具有极为重要的意义。笔者为探索‘富平尖柿’最佳采收期,研究了不同采收期对‘富平尖柿’的生理生化变化规律,为‘富平尖柿’的实际生产提供一定的理论支持。

## 1 材料和方法

### 1.1 材料

‘富平尖柿’2017年10—11月采集于富平县杜村十队柿子园。首先请柿子专家赵锁牢研究员进行了品种鉴定,之后按一定间隔以随机标记鉴定后的5株柿子树作为供试树,同一株树在东、西、南、北、中五个方位随机采摘2颗柿子作为每株树的试验样本,每次每株树上采收10颗柿子,5株树共采收50颗柿子作为一批样品。采收期以霜降日10月23日

为中心点,向前推10 d,向后推10 d,每隔5 d采收1次。第1次采收时间为10月13日,之后每间隔5 d采收1次,连续采收5批次用于研究采收期对柿子理化及生化品质的影响。每次采收在上午10时完成,采收后的柿果在1 h内运回实验室及时进行色泽、硬度、呼吸强度、水分、可溶性固形物含量测定,测定完呼吸强度后的柿子于-80 ℃进行速冻贮藏,用于单宁、果胶、乙醇、乙醛含量及果胶酶、乙醇脱氢酶、多酚氧化酶(PPO)活性测定。

### 1.2 仪器与设备

试验仪器:GT-1000-H泵吸式复合气体检测仪,上海何亦仪器仪表有限公司;HX-PB915多功能料理机,奥克斯;GY-4果蔬硬度测定仪,浙江托普仪器有限公司;WYT-4型手持糖量计,泉州中友光学仪器有限公司;HE-53/02食品快速水分测定仪,梅特勒-托利多仪器(上海)有限公司;PHS-3C型pH计,上海精密科学仪器有限公司;H-1850高速冷冻离心机,北京迪马科技有限公司;DK-98-II恒温水浴锅,天津市泰斯特仪器有限公司;UV-1240紫外分光光度计,日本岛津公司;DH360电热恒温培养箱,北京科伟永兴仪器有限公司。

试剂:植物乙醇检测试剂盒、植物乙醛检测试剂盒,果胶酶检测试剂盒、乙醇脱氢酶检测试剂盒、多酚氧化酶检测试剂盒,均购买于Megazyme公司

### 1.3 方法

1.3.1 采收期对柿子生理生化品质影响试验 以上述不同采收时间的柿子为试验样品,测定柿子的色泽、单果质量、硬度、呼吸强度、水分、可溶性固形物、单宁、果胶、乙醇、乙醛含量及果胶酶、乙醇脱氢酶、多酚氧化酶(PPO)活性,以研究不同采收期对柿子的理化及生化指标的影响规律。

1.3.2 样品处理方法 采收的样品首先进行单果质量、硬度、水分、可溶性固形物及呼吸强度测定,测定完呼吸强度的柿子经-80℃冷冻保存,用于单宁、果胶、乙醇、乙醛含量及果胶酶、乙醇脱氢酶、多酚氧化酶(PPO)活性测定,在测定前先将冷冻保存的柿子室温自然解冻,然后进行打浆,按四分法取样进行测定,每一个样品的同一指标平行测定3次,取平均值作为样品的测定指标值。单果质量以10个单果质量的平均值作为样品平均值,测定完单果质量的果实用于硬度测定。硬度测定是在每个单果赤道位平均取4个点进行硬度测定,取10个单果的硬度测定

平均值作为一个批次样品的硬度值。测定完硬度的柿果经多功能料理机打浆,采用四分法取样用于水分和可溶性固形物含量测定,平行测定3次,取平均值作为样品的水分与可溶性固形物含量测定值。呼吸强度测定是取10个果实按动态法于室温进行代谢二氧化碳浓度测定,并统一折算成每公斤柿子果实的二氧化碳代谢浓度,作为每批次柿子的呼吸强度值。

**1.3.3 测定方法** 果实硬度测定:通过GY-4数显果蔬硬度测定仪,用直径为6 mm探头采用刺穿法沿每个柿子赤道位置测量4次,计算10个柿子硬度的平均值作为最终柿子硬度;

水分含量测定:采用梅特勒HE-53型食品水分快速测定仪测定,测定温度为105 °C。

可溶性固形物含量测定:采用手持阿贝折光计于室温测定,测定前用校正液进行零点校正。

呼吸强度测定:采用动态法于室温(25 °C)测定1 kg果实呼吸产生的CO<sub>2</sub>浓度,以CO<sub>2</sub>浓度衡量果实的呼吸强度。具体参照胡小松等<sup>[13]</sup>的方法并略有改动。

单宁含量测定:参照NY/T 1600-2008<sup>[13]</sup>方法并稍作改动。单宁提取参照吴如健等<sup>[14-15]</sup>的方法进行。

原果胶、可溶性果胶含量测定:原果胶含量与可溶性果胶含量的检测方法参照NYT 2016-2011方法并稍作改动<sup>[16-17]</sup>。

乙醇含量测定:按乙醇检测试剂盒(Megazyme)

操作说明进行乙醇含量测定。

乙醛含量测定:按乙醛检测试剂盒(Megazyme)操作说明进行乙醛含量测定。

乙醇脱氢酶(ADH)活性测定:柿果乙醇脱氢酶粗酶液的提取参照Bošković等<sup>[18]</sup>的方法提取,提取的柿果粗酶液的活性按乙醇脱氢酶检测试剂盒(Megazyme)操作说明测定。

果胶酶活性测定:按果胶酶检测试剂盒(Megazyme)PE-2-G(可见分光光度法)操作说明进行果胶酶活性测定。果胶酶粗酶液的提取参照李丹如<sup>[19]</sup>等的方法进行。

多酚氧化酶(PPO)活性测定:按多酚氧化酶检测试剂盒(Megazyme)操作说明进行PPO活性测定。

**1.3.4 数据处理方法** 所有实验指标均进行3次重复测定,测定结果用(平均值±标准偏差)表示,利用SPSS Statistics 20软件对数据进行ANOVA差异显著性分析,*p*<0.05为显著性差异。采用Origin 8.5进行图表处理。

## 2 结果与分析

### 2.1 采收期对柿子色泽和单果重影响

不同采收期对柿子色泽影响试验结果见图1。随着采收期的不断延迟,柿子的色泽由青绿色逐步转变为纯黄色,在霜降日前,柿子带有部分绿色,但从霜降日之后,柿子的青绿色快速褪去,转为黄色,伴随着采收时间的延迟,柿子的黄色更加纯正并趋



图1 采收期对柿子色泽的影响

Fig. 1 The influence of harvest time on persimmon color

于稳定。说明柿子在霜降日之后快速成熟,并导致颜色变黄。

不同采收期对柿子单果质量影响见图2,随着采收期的延迟,柿子单果质量缓慢增加。在霜降日前,柿子单果质量随采收时间的延迟增加较大,如10月13日至10月23日,单果质量增加28.3 g,平均每天增加2.83 g;而过了霜降日后,随着采收时间的

延迟,柿子单果质量增加缓慢,在10月23日至11月2日,单果质量仅增加8.7 g,平均每天增加0.87 g,单果质量趋于稳定,说明‘富平尖柿’在霜降日前还处于果实膨大期,柿子果实不断增大,但过了霜降日后,柿子果实的膨大期结束,柿子不再长大,柿子已成熟。从柿子的色泽和单果质量分析,‘富平尖柿’成熟期处于霜降之后5~10 d,此时柿果色泽好,单果

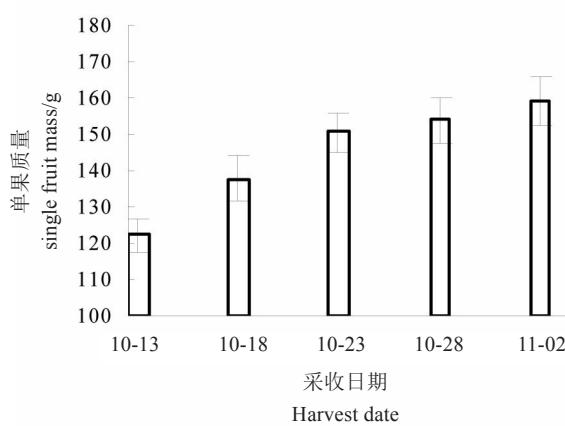


图 2 采收期对柿子单果质量的影响

Fig. 2 The influence of harvest time on persimmon weight

质量大。

## 2.2 采收期对柿子硬度的影响

不同采收期柿子的硬度试验结果见图 3。随着柿子采收期的延迟，柿果硬度逐步降低。在霜降前，柿子的硬度减幅较小，但是在霜降后，柿子硬度迅速减少，硬度变化明显。即柿子在霜降后，柿果随采收时间的推迟，柿子会很快变软，但在霜降后 10 d 尚能保持良好的硬度，硬度保持在  $65 \text{ N} \cdot \text{cm}^{-2}$  以上，有较好的商品硬度。

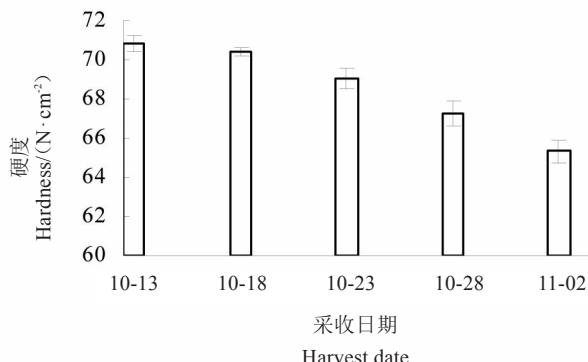


图 3 采收期对柿子硬度的影响

Fig. 3 The influence of harvest time on persimmon hardness

## 2.3 采收期对柿子水分含量影响

采收期对柿子水分含量影响试验结果见图 4。10月23日之前采收的柿果平均水分含量为78.295%，水分含量几乎不随采收时间的延迟而发生变化，10月23日至11月2日采收的柿果水分含量由79.19%增加至80.19%，较之霜降前水分含量明显增加，这可能是柿子在后期膨大时吸收了更多的水分所致，导致柿果水分含量增加。

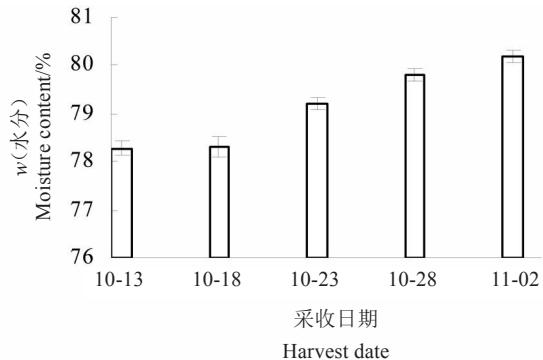


图 4 采收期对柿子水分含量的影响

Fig. 4 The influence of harvest time on persimmon moisture content

## 2.4 采收期对柿子可溶性固形物含量影响

采收期对柿子可溶性固形物含量影响试验结果见图 5。随着采收期的延迟，柿果的可溶性固形物含量不断增加。在霜降日之后，柿果的糖分含量增加明显。从图分析可知，柿子采收的越晚，柿子的含糖量越高，因此柿果在霜降后 5~10 d 采收，其可溶性固形物含量较高，柿子的口感较甜。

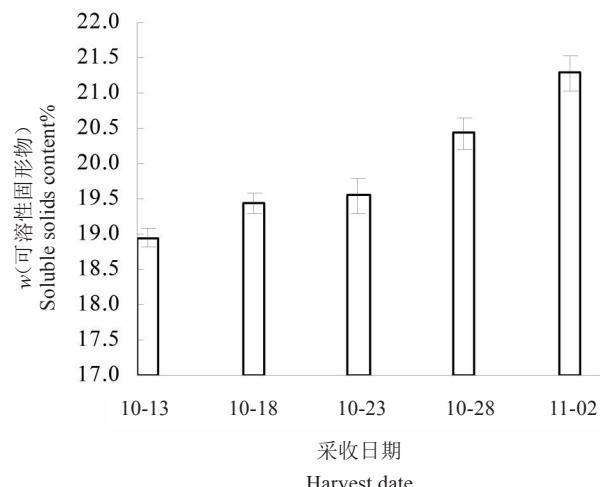


图 5 采收期对柿子可溶性固形物含量的影响

Fig. 5 The influence of harvest time on persimmon soluble solidscontent

## 2.5 采收期对柿子呼吸强度的影响

采收期对柿子呼吸强度的影响试验结果见图 6。在试验期内，随着采收期的延迟，柿子在室温下的呼吸强度有所下降，且呼吸强度峰值的出现时间明显延后。果实的呼吸强度是衡量果实代谢速度快慢的一个重要指标，呼吸强度越大，说明柿果实的代谢速度越快，其消耗果实的营养成分越快。从呼吸强度分析可知，在适宜的采收期内，柿子采收的越

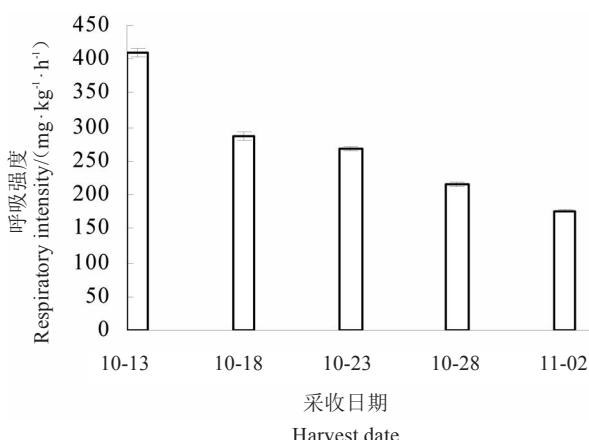


图6 采收期对柿子呼吸强度的影响

Fig. 6 The influence of harvest time on persimmon respiration intensity

晚,呼吸强度越低,糖酵解的速度越慢,贮藏时消耗的自身营养越少,越利于柿子的保存。

## 2.6 采收期对柿子单宁含量的影响

采收期对柿子总单宁、可溶性单宁、聚合单宁的影响试验结果见图7。随着采收期的延后,柿果中的总单宁含量基本保持不变,但可溶性单宁含量在下降,聚合单宁含量在上升。由于柿子中可溶性单宁的含量与柿子的涩味有关,柿子的可溶性单宁含量越高,涩味越重,当柿子的可溶性单宁降低,变为聚合单宁,柿子的涩味变淡。即随着采收时间的延迟,柿子的涩味变淡,甜味增加。因此在霜降后5~10 d采收,柿子的涩味较淡,脱涩也较为容易,有利于改善柿子的风味和口感。

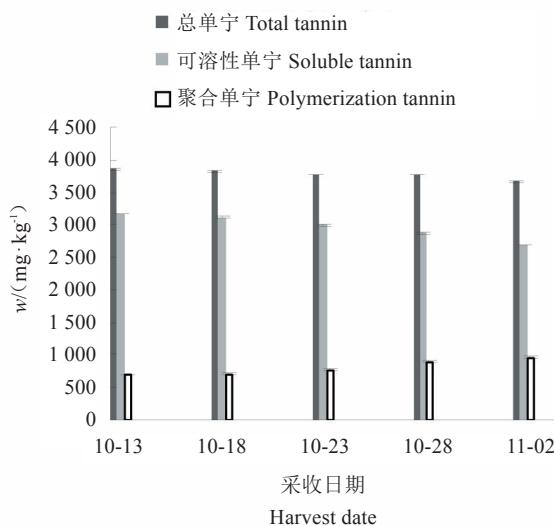


图7 采收期对柿子总单宁、可溶性单宁、聚合单宁含量的影响

Fig. 7 The influence of harvest time on persimmon total tannin, soluble tannin and polymerization tannin content

## 2.7 采收期对柿子总果胶、原果胶、可溶性果胶含量的影响

采收期对柿子总果胶、原果胶、可溶性果胶的影响试验结果见图8。随着采收期的延迟,柿果中的总果胶含量基本保持不变,但原果胶含量随采收时间延迟不断下降,可溶性果胶含量增加。由于柿子中原果胶含量、可溶性果胶含量与柿子硬度有关,原果胶含量越高,柿子的硬度越大,反之可溶性果胶含量越高,柿子的硬度就会降低,柿子变软。因此随着柿子采收时间的延迟,柿子原果胶减少,可溶性果胶增加,柿子硬度降低,直至柿子软化。为了保持良好的柿果商品性,柿子采收需要保持一定的硬度,便于运输储存及加工。因此采收的柿果需要保持一定的原果胶含量,保持柿子的硬度。

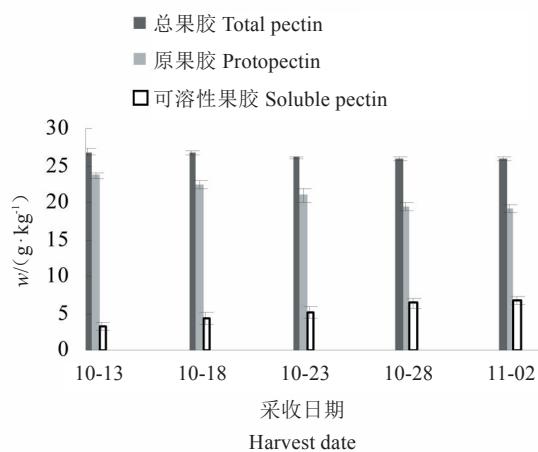


图8 采收期对柿子总果胶、可溶性果胶、原果胶含量的影响

Fig. 8 The influence of harvest time on persimmon total pectin, soluble pectin and propectin content

## 2.8 采收期对柿子乙醇、乙醛含量的影响

采收期对柿子乙醇、乙醛含量的影响试验结果见图9。随着采收期的延后,柿果中的乙醇、乙醛含量先升高后降低,以霜降日为分界点。柿果中乙醇来源于柿果的无氧呼吸,柿果中的糖分在无氧呼吸时酵解转化成乙醇,然后乙醇在乙醇脱氢酶的作用下脱氢变为乙醛,乙醛与柿子中的可溶性单宁反应形成聚合单宁,使柿子脱去涩味<sup>[21]</sup>。从图9分析可知,柿子在霜降前,随着采收期的延迟,柿子的无氧呼吸在增强,柿子的乙醇含量上升,导致乙醛含量也上升,当霜降日后,由于温度和气候的影响,柿子的无氧呼吸减慢,乙醇转化为乙醛,乙醛又与可溶性单宁结合,导致乙醇、乙醛含量降低,柿子涩味变淡,这

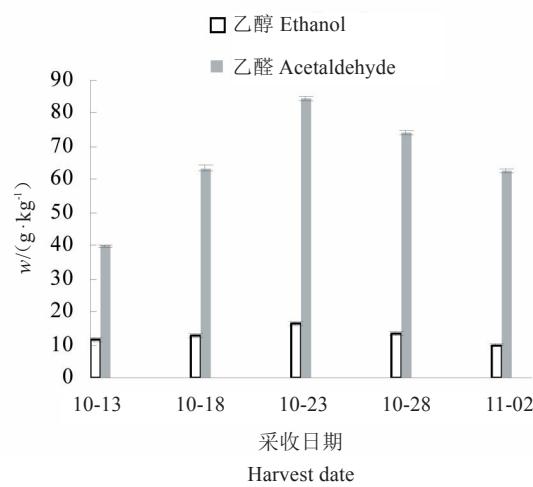


图 9 采收期对柿子乙醇、乙醛含量的影响

Fig. 9 The influence of harvest time on persimmon ethanol and acetaldehyde content

与实际情况相符。所以,霜降后5~10 d采收柿子,涩味淡,利于柿子脱涩。

### 2.9 采收期对柿子果胶酶、乙醇脱氢酶、多酚氧化酶(PPO)活性的影响

采收期对柿子果胶酶、乙醇脱氢酶、多酚氧化酶活性的影响试验结果见图10。随着柿子采收期的延迟,柿子中的果胶酶、多酚氧化酶活性先增加后降低,而乙醇脱氢酶活性基本保持不变。柿子果胶酶活性与柿子中原果胶的降解有关,其活性越强,柿子中原果胶转化为可溶性果胶的速度越快,柿子的软化速度也就越快。乙醇脱氢酶活性与柿子的脱涩速

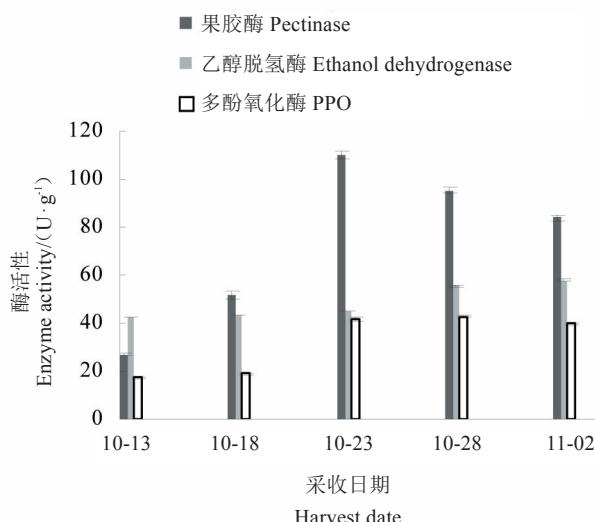


图 10 采收期对柿子果胶酶、乙醇脱氢酶、多酚氧化酶(PPO)活性的影响

Fig. 10 The influence of harvest time on persimmon pectinase, alcohol dehydrogenase and polyphenol oxidase (PPO) activity

度有关,其活性越强,柿子的脱涩速度越快。多酚氧化酶活性与柿子褐变的速度相关,其活性越强,柿子褐变的速度越快。这个试验结果说明柿子在霜降日之后,软化速度加快,涩味变淡,褐变减缓<sup>[20-24]</sup>,柿果充分成熟。因此适时的采收是保持柿果商品性的必要条件,从这些酶活性的变化分析,霜降前采收,柿子成熟度不够,果胶酶、乙醇脱氢酶活性低,不利于柿子后期的软化脱涩,同时多酚氧化酶活性较高,还容易引起柿果变色。因此在霜降后5~10 d进行柿子采收是较为适宜的时间段。

### 3 讨 论

柿子成熟期的生理生化变化非常复杂,不仅涉及果实的色泽、大小、硬度等物理性指标变化,也涉及到果实的糖、单宁、果胶、乙醇、乙醛等化学指标变化,以及果实的多种酶代谢过程。这些化学变化和代谢过程相互交织,互相促进。因此研究柿子的采收品质变化是一个复杂的过程,不仅要考虑柿子的采收期,同时要考虑柿子的内在品质和风味口感,还要考虑柿子后期的贮藏与加工过程中对柿子硬度和生理变化的影响,抑制柿子快速软化和褐变发生,促进柿子的脱涩;要满足这一过程,那么在柿子采收后要抑制柿子果胶酶和PPO的活性,又要促进柿子乙醇脱氢酶的活性,才能提高柿子的质量品质。通过对柿子采收期生理生化指标变化规律的研究,说明柿子的采收期对于柿子的商品品质影响很大,因此严格的柿子采收期对柿子的商品品质提高具有相当大的贡献。适宜采收期是保证果实优质的前提之一,采收过早,果实色泽发绿,果实小,无法形成品种固有的品质,降低产量,采收过晚,柿子变软,硬度不足,不利于运输,不耐贮藏,不利于加工。因此适宜的采收期对保持果实良好的风味物质形成及商品性具有十分重要的意义<sup>[25]</sup>。此外,柿果采收期也与其品种、产地、气候、作物方式等因素相关,因此对于同一品种同一产地,柿子的适宜采收期不是一个固定的时期,但适宜的采收期的是提高柿果采后品质重要手段之一,因此可以通过研究不同采收期柿果果实生理生化指标的综合变化规律来确定柿果的最适采收期。

### 4 结 论

采收期对‘富平尖柿’的色泽、硬度、水分、固形物含量、呼吸强度、单宁、果胶、乙醇、乙醛含量及果

胶酶、乙醇脱氢酶、多酚氧化酶(PPO)活性均有不同程度的影响。在富平县,‘富平尖柿’的最佳采收期处于霜降后5~10 d,在这个时间段采收的柿子成熟度适中,果实色泽好,糖分含量高,原果胶含量大,硬度大,柿子的各项品质指标较优,利于‘富平尖柿’的运输、贮藏与加工,并且能保证柿饼制作的品质。

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