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Consumer Evaluations of 'Delicious' Apple Strains

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Abstract

Nine strains of 'Delicious' apples from three sites were evaluated by consumers one week after harvest and 67 days later for flavor, crispness and overall acceptability. 'Starkrimson' and 'Starkspsur Ultrared' were ranked significantly lower in overall acceptance in comparison to 'Starking,' 'Topred,' and 'Oregon Spur II' one week after harvest. Seventy-four days after harvest 'Redchief' (Campbell), 'Ace' and 'Starkspur Ultrared' were ranked significantly lower in overall acceptance than 'Starkrimson,' 'Oregon Spur II," and 'Silverspur.' Consumers ranked 'Nured Royal' higher in color evaluations than seven other strains ten days after harvest.

Introduction

With over 100 different strains, the 'Delicious' apple cultivar provides a wide selection of genotypes to commercial growers (6). In selecting new strains of 'Delicious' important traits have been intensity or earliness to color and growth habit. Studies have characterized strains based on firmness, acidity or sugar content (5, 9, 13), primarily in an attempt to determine maturity differences. Little attention has been paid to the flavor or color acceptance by consumers. Smith and Frye (12), however, showed that color influenced purchase by consumers at retail outlets. With instrumentation, color can be quantified (3, 7, 8); however, colorimeter values may not always coincide with consumer preference (3). The purpose of this study was to determine if there were diferences in consumer preferences for strains based on flavor, crispness or color.

Materials and Methods

Fruit of selected strains were harvested at 145 to 150 days after full bloom in 1987. The criteria for choosing strains was based solely on availability of sufficient quantities of fruit. Samples were collected from commercial orchards in Pennsylvania and the West Virginia Experiment Farm at Kearneysville, WV. Fruit were collected from the periphery of 3 to 4 trees of each strain in all four quadrants of the tree. Fruit fully exposed to sunlight was chosen to eliminate any effects of pruning or shading. PA fruit samples were from mature trees while those from WV were from trees planted in 1981-1982.

Consumer testing involved three separate groups of participants and test dates. Nine strains of 'Delicious' apples were evaluated for flavor, crispness, and overall acceptability by 271 participants using a nine-point scale ranging from 1 for "dislike extremely to 9 for "like extremely." The apples were cored and cut into eight sections. Each person sampled one section from each of three of the nine strains using a balanced incomplete block design (2). The initial evaluation of the nine strains was conducted approximately one week after harvest followed by a subsequent evaluation 67 days later. Flesh firmness at harvest ranged from 50.1 to 58.2 N and soluble solids ranged from 11.3% to 12.8%, all within the acceptable range of maturity (10). The aples were stored in a refrigerated storage main-

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tained at approximately 0°C. The strains 'Nured Royal' and 'Starking,' in the initial evaluation were replaced by 'Millerspur' and 'Redchief (Campbell)' in the 67 day evaluation.

Fifteen strains of 'Delicious' were evaluated for external color preferences by 275 participants using the nine-point hedonic scale as previously described. Apples were buffed and placed on white paper. Participants were instructed to evaluate only the color. Each person evaluated five of the fifteen strains using a balanced incomplete block design (2). Tests were conducted under normal fluorescent lights to represent conditions under which consumers would purchase fruit.

Panelists for both the flavor and color evaluations were untrained consumers from the Pennsylvania State University. Data were analyzed using analysis of variance (11), with means separated using Duncan's New Multiple Range Test ($p < 0.05$).

Results and Discussion

One week after harvest panelists ranked 'Starkspur Ultrared' and 'Starkrimson' significantly lower in overall acceptance than 3 other strains and lower in flavor than 2 strains (Table 1). 'Starking' was judged to be crispier than 5 of the strains. 'Starkspur Ultrared,' although having a relatively high rating for crispness was rated among the poorer tasting in both flavor and overall acceptance.

There appeared to be less differences between strains after 67 days of storage (Table 2). 'Starkrimson,' 'Silverspur' and 'Oregon Spur II' had higher overall acceptance rankings than 'Starkspur Ultrared,' 'Ace' or 'Redchief (Campbell).' 'Starkspur Ultrared' and 'Redchief (Campbell)' had significantly lower flavor ratings than four other strains. 'Starkspur Supreme' had the highest crispness rating and ranked significantly better than 'Silverspur,' 'Topred,' 'Starkspur Ultrared,' 'Ace' and 'Redchief (Campbell).'

In color evaluations, 'Nured Royal' ranked the highest although similar to eight other strains (Table 3). In looking at strains from the WV site 'Silverspur' was judged significantly lower in color than the other three strains. 'Starking' and 'Starkrimson' in Bedford County were ranked lower than 'Topred' or 'Redchief' at the same site. There were no significant differences in color rankings between strains collected from either Adams or Berks counties.

Bartram (1) found that spur strains at a given date were more highly colored. Fruit collected from Bedford

Table 1. Sensory evaluation of flavor and crispness and overall quality of nine strains of 'Delicious' one week after harvest.

Strain	Location	Hedonic score[z]		
		Overall Acceptability	Flavor	Crispness
Starking (Jack)	Bedford Co., PA	6.7 a[y]	6.4 a	7.0 a
Topred (Hutchison)	Bedford Co., PA	6.3 ab	6.1 abc	6.4 abc
Oregon Spur II	WV	6.2 ab	6.1 abc	6.3 bc
Nured Royal	WV	6.1 abc	6.3 ab	6.2 bc
Silverspur	WV	6.1 abc	6.0 abc	6.7 ab
Ace	WV	6.0 bcd	6.0 abc	6.0 c
Starkspur Supreme® (Paganelli)	Berks Co., PA	6.0 bcd	5.8 bcd	6.2 bc
Starkrimson®	Bedford Co., PA	5.6 cd	5.5 cd	6.2 bc
Starkspur Ultrared® (Flanagan)	Berks Co., PA	5.5 d	5.3 d	6.5 abc

[z]Nine point hedonic score was used; 1 = dislike extremely and 9 = like extremely.
[y]Means within columns followed by the same letter are not significantly different ($P > 0.05$).

Table 2. Sensory evaluation of overall acceptability, flavor and crispness of nine strains of 'Delicious' 74 days after harvest.

Strain	Location	Hedonic score[z]		
		Overall Acceptability	Flavor	Crispness
Oregon Spur II	WV	6.1 a	6.1 a	5.8 abc
Starkrimson®	Bedford Co., PA	6.1 a[y]	6.1 a	5.7 abc
Silverspur	WV	6.0 a	6.0 ab	5.5 bc
Topred (Hutchison)	Bedford Co., PA	5.7 ab	5.9 ab	5.5 bc
Millerspur	Bedford Co., PA	5.7 ab	5.4 bc	6.1 ab
Starkspur Supreme® (Paganelli)	Berks Co., PA	5.7 ab	5.4 bc	6.3 a
Starkspur Ultrared® (Flanagan)	Berks Co., PA	5.4 bc	5.1 c	5.6 bc
Ace	WV	5.3 bc	5.6 abc	5.2 c
Redchief (Campbell)	Berks Co., PA	5.0 c	5.0 c	4.3 d

[z]Nine point hedonic score was used; 1 = dislike extremely and 9 = like extremely.
[y]Means within columns followed by the same letter are not significantly different ($P > 0.05$).

County however, did not support this observation. Comparisons of two spur and two nonspur strains showed that 'Topred' (nonspur) and 'Redchief (Campbell)' were perceived similarly as was 'Starking' (nonspur) and 'Starkrimson.' Since the fruit chosen in this study was all from the periphery of the trees, inadequate color at any one site was not due to shading. Differences in color between sites however existed as evidenced by comparing rankings of 'Redchief (Campbell)' between Berks and Bedford Counties.

'Starking' ranked very high in sensory evaluation but very low in appearance. This supports previous work that apples with good flavor may not necessarily rate good in appearance (12); and that flavor may be of secondary consideration in consumer decisions. Westwood (14) found that spur types tended to mature one week later in Oregon than standard 'Starking.' While Dozier *et al.* (4) found no differences in maturity between nonspur strains. This may account for ranking 'Starking' high in sensory attributes compared to

Table 3. Visual evaluation of color preference rated 10 days after harvest of fifteen strains of 'Delicious.'

Strain	Location	Hedonic score[z]
Nured Royal	WV	6.8 a[y]
Starkrimson® (with Alar)	Adams Co., PA	6.5 ab
Oregon Spur II	WV	6.4 ab
Redchief (Campbell)	Bedford Co., PA	6.3 abc
Ace	WV	6.3 abc
Topred (Hutchison)	Bedford Co., PA	6.3 abc
Redchief (Mercier)	Adams Co., PA	6.0 abcd
Earlibrite	Adams Co., PA	6.0 abcd
Starkspur Supreme® (Paganelli)	Berks Co., PA	5.8 bcd
Redspur	Berks Co., PA	5.6 cde
Starkspur Ultrared® (Flanagan)	Berks Co., PA	5.5 cde
Redchief (Campbell)	Berks Co., PA	5.3 de
Silverspur	WV	4.9 ef
Starking 'Jack'	Bedford Co., PA	4.9 ef
Starkrimson® (without Alar)	Bedford Co., PA	4.3 f

[z]Nine point hedonic score was used; 1 = dislike extremely and 9 = like extremely.
[y]Means within columns followed by the same letter are not significantly different ($P > 0.05$).

some spur type strains. However, older later coloring strains like 'Starking' are typically picked last to allow for greater color development regardless of maturity status. It is possible that had the fruit been left until sufficient color developed that consumer sensory preference ratings may have been affected. It should be noted that all fruit samples were harvested at a predetermined time and that additional days on the tree may have altered the sensory qualities of some strains.

Although coloring characteristics are important, in selecting 'Delicious' strains, consumer acceptance of sensory characteristics must not be overlooked particularly in respect to repeat sales. Based on results of this study, however, consumers could not detect strong differences in sensory attributes between strains. As with grower selection, color seems to be a much stronger determinant in consumer preference based on this and previous work (3, 12). Site and harvest date may also influence color development and subsequent consumer perception. Since most consumers rarely have the opportunity to compare flavor, color will likely continue to be a major consideration in strain selection.

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Book Reviews

Compendiums on strawberry, grape and citrus diseases have been published by the American Phytopathological Society as a guide for disease identification and description. They will be useful to growers, farm advisors, extension specialists, researchers, teachers and students worldwide in providing an understanding and knowledge about diseases affecting the crop. The material was prepared by authorities from around the world, and have been compiled by the editors in a readable and logical style. Each text is supported with over 145 colored plates, selected references, an index, and a glossary. Compendiums are available from APS Press, 3340 Pilot Knob Road, St. Paul, MN 55121. Each costs $20.00 in the U.S. and $25.00 elsewhere.

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