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Chemical and Physical Characteristics of Four Strawberry Cultivar

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Fruit pomological characteristics of different strawberry varieties grown in Adana province, Mediterranean region of Turkey were evaluated in this study. Camarosa, sweet charlie, california giant 4 and carmine cultivars were characterized. The varieties were compared for berry weight, total soluble solids, fruit acidity, total soluble solids/fruit acidity, pH, vitamin C, colour, individual sugars. The highest fruit weight average was obtained from camarosa and california giant 4 whereas they had the lowest total soluble solids. Vitamin C amount was higher in camarosa, sweet charlie and california giant 4 than carmine. Individual sugar contents of 4 varieties were very similar. All strawberry varieties that were analyzed for chemical and physical fruit characteristics had satisfactory results. Therefore, these cultivars can be grown in Adana province commercially.

Key Words: Strawberry, Camarosa, Sweet charlie, California giant 4, Carmine, Pomological characteristic.

INTRODUCTION

Strawberry (*Fragaria xananassa*) is an economically important crop worldwide that production continues to increase through the world. It is among one of the most popular and red fruits consumed either fresh or as a conserved or manufactured product[1]. Strawberries are unique with highly desirable taste, flavour, excellent dietary sources of ascorbic acid, potassium, fiber and simple sugar sources of energy[2-4]. Consumers prefer sweet strawberries and sweetness is positively correlated with soluble solid concentration, total soluble sugars and fructose[5]. Ripeness, maturation, cultivar irrigation and fertilization are major factors that can affect the taste and quality of a product.

During the last decay strawberry production has spread throughout almost all parts of Turkey. Although strawberry has been grown in almost all parts of Turkey, the leading strawberry production region is Mediterranean region with 62 % of total production[6,7].

In the Mediterranean region of Turkey, there has been few studies comparing the fruit quality characteristics of commercially grown varieties. In this study, 4 different varieties grown in Adana province in the Mediterranean region of Turkey were characterized for their fruit characteristics and yield. This type of studies can be beneficial guide for both scientist to evaluate the quality parameters and farmers for choosing the right cultivar with high market value.

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EXPERIMENTAL

Four strawberry genotypes used in this study were: camarosa, sweet charlie, california giant 4 and carmine. The planting was established in a completely randomized design with 4 replicates and each replicate contained 120 plants. Plants were cultivated on raised beds, black plastics mulch and drip irrigation was used during growing period. The fruits were harvested once in growing period depending maturation and analyses were performing the same day of harvest in the laboratory of the Cukurova University Horticulture Department Postharvest Laboratory. The fruits were characterized for fruit weight, percentage of total soluble solids, pH, fruit colour, individual sugars, percentage of fruit titrable acidity, total soluble solids/ titrable acidity ratio and vitamin C. All harvested fruits divided to 4 replicate and used directly for fruit analysis.

Average fruits weights were calculated as a mean of weighted samples (g/fruit). total soluble solids (%) were determined by hand held refractometer (ATAGO-Japan), using 2 drops of homogenized fruits in replicates. Homogenized juice pH was measured by a digital pH meter (CG 840 Schott, Germany). Fruit juice (1 mL) titrated to end point of pH 8.10 with 0.1 NaOH to obtain the total titrable acidity. Total acidity were determined as citric acid equivalents and presented as the mean of all analyses. Surface colour of berries measured on 2 sides on each 20 fruits using a tristimulus colorimeter (CR300, Minolta, Ramsey, N.J.). Colour was measured with a tri-stimulus colour difference meter determining L* (luminance), a* (+red, -green) and b* (+yellow, -blue) and with L* C* h* colorimetric space, were L* is the luminance, C* measure chroma index and h°* is the hue angle[8], which starts by a*+. Dilution with the ultra pure water (18.2 MΩ cm, Millipore Corp., Bedford, MA) and filtration (Whatmann nylon syringe filters, 0.45 µm, 13 mm, diameter) were performed for the individual sugars determination. The individual sugars of fruits were determined by a high-performance liquid chromatographic apparatus (Shimadzu LC 10A Kyoto, Japan) consisted of a in-line degasser, pump, manual injection (20 µ injection volume) interfaced to a PC running Class VP chromatography manager software (Shimadzu-Japan). Vitamin C (mg/100 g) amount determinations were done by spectrophotometer measurement[9].

All data obtained from the trial were analyzed using ANOVA and means were compared using the least significance differences (LSD, $p = 0.05$).

RESULTS AND DISCUSSION

The average fruits weights, total soluble solids, pH, titrable acidity, fruit colour, total soluble solids/titrable acidity, vitamin C are given in Table-1. The heaviest fruit weights were obtained from camarosa whereas carmine fruits had the lowest average. There are a lot of different effects on fruit weight such as, soil, environmental differences, growing season and genotype[10,11]. All genotypes are found to be in average range of weight.

Appearance, colour, size, vitamin C and flavour (soluble solids, titrable acidity) are very important quality characteristics for consumers[10]. Sweet charlie had the

highest average of total soluble solids with 8.54 % average value while california giant 4 had the lowest with 6.12 %. Titrable acidity average also varied depending on genotype. The highest average of titrable acidity was determined in carmine, california giant 4, sweet charlie and camarosa, respectively had lower titrable acidity average. The ratio of total soluble solids to acidity is very good indicator of fruit quality. Sweet charlie had the maximum average ratio. Others had nearly average total soluble solids/titrable acidity ratios. The differences in pH were not significant between genotypes. The data ranged between 1.94 (carmine) and 2.13 (camarosa). The total L-ascorbic varied among cultivars. Sweet charlie had the highest vitamin C level; this was followed by california giant 4, camarosa and carmine.

TABLE-1
FRUIT CHARACTERISTICS OF FOUR STRAWBERRY GENOTYPES

Genotype	Berry weight (g/fruit)	TSS (%)	TA (%)	TSS/TA	pH	Vitamin C (mg/100 g)
Camarosa	13.66 a	6.61 bc	1.48 b	4.47	2.11	38.91 a
Sweet charlie	10.98 b	8.54 a	1.48 b	5.77	2.13	47.76 a
California giant 4	13.50 a	6.12 c	1.52 b	4.02	2.01	40.88 a
Carmine	10.38 b	7.22 b	1.66 a	4.40	1.94	26.51 b

*Means with same letter are not significantly different by Turkey's LSD at the p = 0.05 level.
TSS = Total soluble solids; TA = Titrable acidity.

The harvest date is determined based on berry surface colour. All berries should be harvested near full ripe (>¾ red colour), as eating quality does not improve after harvest. Therefore it is important issue for a cultivar to have a good colour and maintain it during whole market life. The colour changes of fruits also were differed among cultivars. The highest L value obtained from sweet charlie while carmine had the lowest mean value. Also it had higher b and C mean values than others. Moreover both sweet charlie and california giant 4 got the higher Hue angle (H^o) values than others (Table-2).

TABLE-2
TRISTIMULUS COLORIMETRIC MEASUREMENTS OF STRAWBERRY CULTIVARS

Genotype	L	a	b	C	Hue angel (H^o)
Camarosa	38.65 bc	36.28	65.64 bc	75.39 bc	60.53 b
Sweet charlie	44.19 a	33.55 a	75.24 a	82.77 a	65.50 a
California giant 4	43.29 ab	33.66 a	73.68 a	81.25 ab	65.23 a
Carmine	35.62 c	35.96 a	60.47 c	70.57 e	59.05 b

*Means with same letter are not significantly different by Turkey's LSD at the p = 0.05 level.

Individual sugars have long been an important nutritional component of strawberry. Sucrose, fructose, glucose amounts varied depending to the cultivars. Carmine had higher levels of total sugars than other varieties. The main sugars determined were fructose and glucose. The sucrose amounts of all varieties were lower than other sugars (Table-3).

TABLE-3
SUGAR LEVELS OF DIFFERENT STRAWBERRY VARIETIES (%)

Genotype	Sucrose	Fructose	Glucose
Camarosa	0.42 c	2.54 b	2.96 b
Sweet charlie	0.47 ab	3.22 a	3.97 a
California giant 4	0.44 bc	2.09 d	2.59 c
Carmine	0.49 a	2.47 c	2.95 b

*Means with same letter are not significantly different by Turkey's LSD at the p = 0.05 level

From a marketing perspective, the critical features of strawberry quality are appearance and taste of the berry[12]. The total soluble solids, titrable acidity and vitamin C content of all varieties were in an acceptable range comparing their different ecological data's[13]. Visual appearance of strawberries also had a satisfactory mean values.

In summary, the results of this study indicate that all varieties can be commercially grown in Adana province of Turkey. Although all varieties had good pomological results camarosa and sweet charlie are advisable varieties to Adana province for some farming reasons.

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