EFFECTS OF GA_3 TREATMENTS ON SOME CHEMICAL PROPERTIES OF "AMIGA" AND "FESTIVAL" STRAWBERRY CULTIVARS

Mehmet POLAT[1], Volkan OKATAN[2], Sultan Filiz GÜÇLÜ[3], Ayşen Melda ÇOLAK[4], Nazan KORKMAZ[5], Mehmet Atilla AŞKIN[1]

e-mail: mehmetpolat@sdu.edu.tr

Abstract

In the last years, interest in research on polyphenol-rich fruit species has increased due to the potential health benefits of these species, mainly attributed to their high anthocyanin content. This study was conducted to determination of GA_3 treatment effects on some chemical properties of "Amiga" and "Festival" Strawberry cultivars. In this research 25, 50 and 75 ppm GA_3 were applied. Strawberry fruits were harvested at the same maturity stage during the same growing season and the total phenolic, total anthocyanin and ascorbic acid content were determined. It (25, 50 and 75 ppm GA_3 treatments) was compared according to their total phenolic (Folin-Ciocalteu method) and total anthocyanin (pH differential method) and ascorbic acid contents. Total phenolic of "Amiga" strawberry cultivar was varied between 474.97 (mg GAE 100g-1 FW) to 1028.38 (mg GAE 100g-1 FW). Total anthocyanin of "Amiga" strawberry cultivar and ascorbic acid were varied between 105.58 (µg/g) to 219.29 (µg/g) and 17.97 (mg/100 g) to 134.54 (mg/100 g) respectively. Total phenolic of "Festival" strawberry cultivar was varied between 896.85 (mg GAE 100g-1 FW) to 1194.82 (mg GAE 100g-1 FW). And total anthocyanin of "Festival" strawberry cultivar was varied between 37.41 (µg/g) to 113.39. (µg/g). Ascorbic acid contents were determined about 118.88 (mg/100 g) to 172.05 (mg/100 g) in festival strawberry cultivar. Highest value of total anthocyanin and ascorbic acid were obtained from 50 ppm treatment for two varieties. According to results "50 ppm GA_3" treatment was suggested.

Key words: phenolic, anthocyanin, ascorbic acid, strawberry

Strawberries are an important source of phenolic, anthocyanin and ascorbic acid. Therefore, consumed in abundance by consumers it will be beneficial to health. Some researchers have expressed that rather high antioxidant activity of strawberry (Cordenunsi *et al*, 2002; Wang, Cao, &Prior, 1996, Beatriz *et al,* 2005). However, because the shelf life is short, it has been stated that the fresh consumption is important. (Beatriz *et al,* 2005).

Phenolic, anthocyanin and ascorbic acid that health-promoting compounds are strongly affected by genetic, environmental factors, ripeness at harvest, and storage conditions (Pradas *et al*, 2015). Hence, this study was conducted to see the effects of GA_3 application on some chemical properties (Total phenolic, total anthocyanin and ascorbic acid).

MATERIAL AND METHOD

Amiga and Festival strawberry varieties that we use in our research are widely consumed in the world.

'Amiga', was selected in 1998 from the offspring of a cross between 'Camarosa' and 'selection 3-79' and was tested as 'selection 2-269' over the following years. 'Camarosa', a University of California cultivar (Voth *et al*, 1994; U.S. Plant Patent no. 8708)

'Amiga' is a short-day strawberry cultivar developed by the Spanish public breeding program. 'Amiga' has a very high fruit firmness, high production, long fruit shape, and good appearance. An agronomic and sensory characterization of this new cultivar, in comparison with the well-adapted cultivars Camarosa, Carisma, Marina and Medina, was undertaken during the 2000 and 2001 crop seasons (Voth *et al*, 1994).

'Strawberry Festival' originated from a 1995 cross between 'Rosa Linda' (Chandler *et al,* 1997) and 'Oso Grande' (U.S. plant patent no. 6578).

[1] Süleyman Demirel University, Faculty of Agriculture, Isparta/Turkey
[2] Uşak University, Sivaslı Vocational School, Uşak/Turkey
[3] Süleyman Demirel University, Atabey Vocational School, Isparta/Turkey
[4] Uşak University, Faculty of Agriculture and Natural Sciences, Uşak/Turkey
[5] Muğla Sıtkı Koçman University, Muğla/Turkey

'Strawberry Festival' is a short-day cultivar. Festival' has a mean fruit weight similar to that of 'Sweet Charlie' (Chandler *et al,* 1997). Fruit of 'Strawberry Festival' have a very firm texture and excellent flavor. 'Strawberry Festival' is susceptible to anthracnose fruit rot, Colletotrichum crown rot, and angular leaf spot (Chandler *et al,* 1997).

In this research 25, 50 and 75 ppm GA_3 were applied. Strawberry fruits were harvested at the same maturity stage during the same growing season and the total phenolic, total anthocyanin and ascorbic acid content were determined. It (25, 50 and 75 ppm GA_3 treatments) was compared according to their total phenolic (Folin-Ciocalteu method) and total anthocyanin (pH differential method) and ascorbic acid contents.

Total phenols were determined according to the method of Singleton and Rossi (1965), using the Folin–Ciocalteau reagent. Results were expressed as mg GAE 100g-1 FW.

Total anthocyanin was determined according to the pH differential spectroscopic method (Cheng and Breen 1991).

Ascorbic acid was determined according to the method of spectrophotometrically at 525 nm according to the procedure of Hodges et al (2001).

Statistical analysis was done by using the Minitab 17 software package version (Minitab 17 Statistical Software 2010). Differences between means were first analyzed by ANOVA test and Tukey test was applied ($P < 0.05$).

RESULTS AND DISCUSSIONS

In this research, the total phenolic, anthocyanin and ascorbic acid contents of "Amiga" and "Festival" strawberry varieties with three different doses treated GA_3 were determined (Table 1, Table 2).

The total phenolic content was found to vary from 494.97 to 1028.38 mg/100 g FW according to the treatments for Amiga cultivar. It is ranged from 896.85 to 1194.82 mg/100 g FW in "Festival" cultivar. "Festival" cultivar has a higher total phenolic content from "Amiga" cultivar. If we look at the application, the highest value was determined at the 25 ppm GA_3 doses for these cultivars (*table 1, table 2*). In all analyzed phenolic high statistically significant differences between treatments in both cultivars were determined.

The total amounts of phenolic in different varieties of strawberry have reported as 308 to 353 mg/100 g FW by Cordenunsi *et al* (2005) during storage at different temperatures (6, 16 and 25 C°). The results that obtained in our research are higher than the reported value by Cordenunsi *et al* (2005). This was occurred because we have analyzed the fresh sample. However, the values (426.5 to 1014.99 µg GAE/g) that reported by Rekika *et al* (2005) are qualitatively similar with our data.

When we look at the total amount of anthocyanin for "Amiga" cultivar, we see that the highest value was determined at "50 ppm GA_3" application (219.29µg/g). Same case has been to the "Festival" cultivar (113.43 µg/g). However, there are not statistically significant differences between "50 ppm GA_3" and 75 ppm GA_3" treatments. The lowest values were determined in control application for two cultivars.

The data obtained in our research is lower than the values of Tonutare *et al* (2014) that determined by HPLC (27.79-60.05 mg/100g). Also, Rekika *et al* (2005) and Wang and Lin (2000) as reported by the values (190.5-841.26 µg/g and 38.9 mg/100g respectively) is higher than the value we obtained in our research. However, the total anthocyanin in strawberries was reported as 20.07 mg/100g by Zhang *et al* (2007) in fresh fruit. Our findings are consistent with these values. Gill *et al* (1997) reported that when the analyses delayed after the harvest, the total anthocyanin (113.7-153.5 µg/g) was affected. Also, it is reported that the different harvest stages on the total amount of anthocyanin is effective. (Voca *et al* 2014).

Higher ascorbic acid was determined in "Festival" cultivar (171.92 mg/100g) according to "Amiga" cultivar (134.58 mg/100g) in our research. If we look at the application in both varieties, "50 ppm GA_3" treatments have higher ascorbic acid content from other treatments. While "50 ppm GA3" treatment (134.58 mg/100g) was followed by "25 ppm GA_3" treatment (119.38 mg/100g) in "Amiga" cultivar. "75 ppm GA_3" treatment (139.26 mg/100g) was followed in "Festival" cultivar. Amount of ascorbic acid has been reported by Lester *et al* (2012) as 114-182 mg/100g in fresh strawberry fruit. Our findings are consistent with these values.

Various researchers have reported the ascorbic acid amount as 27.1-32.6 mg/100g, 39.9-44.5 mg/100g and 44-60 mg/100g in fresh strawberry fruit. (Asami *et al* (2003), Van de Velde *et al* (2013) and Tonutare *et al* (2009) respectively). Our findings are higher than these values. Although, different growing conditions and genotypes differences are effective we believe that this situation is stemmed from GA_3 treatments.

Table 1

Some chemical characteristics of Amiga

Treatments	Total Phenolic (mg/100 g FW)	Total Anthocyanin (µg/g)	Ascorbic Acid (mg/100g)
25 ppm GA_3	1028.38 a*	161.24 c	119.38 b
50 ppm GA_3	915.34 c	219.29 a	134.58 a
75 ppm GA_3	997.95 b	168.80 b	17.97 d
Control	474.97 d	105.58 d	94.10 c

*The differences between the numbers shown in the same column with different letters are statistically significant (P<0.05)

Table 2

Some chemical characteristics of Festival

Treatments	Total Phenolic (mg/100 g FW)	Total Anthocyanin (µg/g)	Ascorbic Acid (mg/100g)
25 ppm GA_3	1194.82 a*	74.83 b	131.53 c
50 ppm GA_3	936.88 c	113.43 a	171.92 a
75 ppm GA_3	1126.26 b	112.99 a	139.26 b
Control	896.85 d	37.41 c	118.87 d

*The differences between the numbers shown in the same column with different letters are statistically significant (P<0.05)

CONCLUSIONS

Strawberries have positive effect on human health. This fruits are delicious and contain rich phenolic substances, anthocyanin and ascorbic acid. In this research which was conducted to increase of these components with some treatments, we determined that GA_3 treatments have positive effect according to control plot. "50 ppm GA_3" applications have the most effective results for anthocyanin and ascorbic acid. But for highest total phenolic contents most effective results were determined from "25 ppm GA_3" treatments. These treatments can be recommended for growers and researchers.

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