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Antioxidant Capacity and Phenolic Composition of Newly Developed June Bearing Strawberry Lines From BC and QC

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Abstract

The phenolic composition (TPC) and total antioxidant capacity (TAC) of fifteen strawberry genotypes from the Agriculture and Agrifood Canada breeding program were evaluated. This evaluation was use as a first step in establishing a correlation with the shelf-life and the disease susceptibility of these new lines and their TPC and TAC. The methods used were high-performance liquid chromatography (HPLC), Folin-Ciocalteu (FC) and ferric reducing/antioxidant power (FRAP). Several groups of phenolic compounds including anthocyanins, flavonols, hydroxycinnamic, ellagic, and benzoic acids were identified and quantified by HPLC analysis. Anthocyanins were the most predominant group and contributed to 79.2% of the total phenolic content (TPC). A significant variationin TPC was observed among the genotypes. BC2-72-17 had the highest content of total anthocyanins and was significantly different from other genotypes (P<0.05). Although the highest TPC (2123.8 μg g^{-1}) was found in BC2-72-17, this genotype did not have the highest antioxidant capacity. The highest TAC (2259.0 μg g^{-1}) was found in BC2-90-43 which indicated that other phenolics may have contributed to the high TAC, rather than anthocyanins. These results are indicative of the importance of genotypes having high phenolic monomer activities to screen for advanced lines of parents having high TAC, for their potential use in a breeding program.

Introduction

Phenolics, are reputed as the major components responsible for TAC in fruit. They constitute one of the most numerous and widely distributed group of substances in the plant kingdom. Some of the beneficial effects in consumption of fruits are that they reduce and prevent diseases induced by oxidative stresses, such as cardiovascular diseases, cancers and inflammations. These effects may be attributed, in part, to phenolics and various antioxidants contained in fruits (Guo *et al*., 2003, Sun *et al*., 2002; Bushway *et al*., 2002). Strawberry is a good source of natural antioxidants (Khanizadeh *et al*., 2007; Wang and Lin, 2000). Recent study indicated that the antioxidant properties of strawberries have been demonstrated to be mainly due to high content of phenolic compounds rather than to vitamin C (Eberhardt *et al*., 2000; Tsao and Yang, 2003). As antioxidant content is becoming an important parameter, with respect to fruit quality and shelf-life, the antioxidant profile of strawberries should be considered in breeding programs in relation to environmental conditions and cultural practices (Asami *et al.*, 2003; Wang *et al.,* 2002). The purpose of this study was to examine phenolic composition (TPC) and TAC (total antioxidant capacity) of different strawberry genotypes and their relationship, as well as to provide theoretical data for breeding program.

Materials and methods

Fruit samples from 15 strawberry genotypes (*Fragaria xananasa* Deuch.) were obtained randomly from four replicates established in AAFC experimental farm at L'Acadie (longitude 73.35 W; latitude 45.32 N), Quebec. Previous methods used by Tsao *et al*. (2003) and Wang *et al*. (2002) were used to detect their TPC and TAC.

Results and Discussion

HPLC analysis revealed that anthocyanins were the most predominant phenolic group in strawberry extracts (79.2% of the total phenolics). Total anthocyanins varied from 191.0 to 1049.0 μg g^{-1} in the different strawberry genotypes. The highest content of total anthocyanins was found in 'BC2-72-17', 'LL9819-14', 'Chambly' and 'BC2-90-43' respectively, while the lowest content was found in 'SJ9332-7'. However, the content of anthocyanins in 'BC2-72-17' was significantly higher compared to all other genotypes. Flavonols, hydroxycinnamic, benzoic and ellagic acids constituted the lowest portion of the total phenolics, accounting for 6.7%, 6.2%, 5.4% and 2.5% of the composition, respectively.

The highest TAC was observed in 'BC2-90-43' and 'Yamaska' respectively, while the lowest was detected in 'Kent' and 'LL9819-14'. Other genotypes were intermediate.

Results and Discussion (cont'd)

TPC determined by FC method are shown in Table 1. Significant differences were found among the tested genotypes (P<0.05). TPC varied from 649.3 to 2123.8 μg g^{-1}. The highest TPC was found in 'BC2-72-17', 'Kent', 'BC2-90-43' and 'LL9819-14', respectively (2123.8, 1706.8, 1696.8 and 1396.4 μg g^{-1}), whereas the lowest was found in 'LL0220-10' (649.3 μg g^{-1}). The remaining genotypes were intermediate.

In all the genotypes studied, anthocyanins predominate as phenolics, as stated in previous reports on selected genotypes (Bakker *et al*., 1994; Wang *et al*., 2002). However, no correlation was observed between anthocyanins and TAC, as reported by Meyers *et al.* (2003).

Table 1. TPC and TAC of fifteen advanced strawberry lines and cultivars

	TPC[a]	TAC[b]
Genotype	**(ugGAE/g)**	**(ugAAE/g)**
APF937-1	1016.8 efg	1301.0 bc
APF939-71	1026.5 efg	1412.0 bc
BC2-72-17	2123.8 a	1400.7 bc
BC2-90-43	1696.8 bc	2259.0 a
BC96-33-4	1035.6 efg	1401.0 bc
BC98-49-34	1214.5 efg	1690.7 bc
CHAMBLY	920.4 fgh	1512.6 bc
KENT	1706.8 bc	1183.4 c
LL981-24	1127.4 def	1435.7 bc
LL9819-14	1396.4 cd	1224.0 c
LL982-14	750.7 gh	1356.7 bc
LL0220-10	649.3 h	1318.7 bc
SJ9332-7	1351.7 cde	1583.5 bc
VEESTAR	1311.5 de	1526.3 bc
YAMASKA	1950.7 ab	1795.3 ab
MEAN	1285.26	1493.4
$LSD_{0.05}$	358.9	515.5

FRAP and FC analysis were performed in triplicates.
[a] TPC is expressed as μg gallic acid equivalent (GAE) per gram, fresh-frozen weight.
[b] TAC is expressed as μg ascorbic acid equivalent (AAE) per gram, fresh-frozen weight.
LSD 0.05: Least significant difference at 0.05 level.

Conclusions

Regarding their composition and distribution, phenolic compounds and TAC varied among all tested cultivars. The genotypes having the highest TPC did not necessary have the highest TAC. This is probably due to other unquantified phenolics, major phenolics affecting correlation between them and TAC, or synergism among these compounds, which needs more investigation.

The variability of TAC among different genotypes shows the potential value of certain newly developed lines and its possible use in breeding program to select new cultivars having high TAC.

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