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Full Length Research Paper

Relationship between total anthocyanin level and colour of natural cherry laurel (*Prunus laurocerasus* L.) fruits

Rezzan Kasım*, Melekber Sülüşoğlu and M. Ufuk Kasım

Kocaeli University, Vocational School of Arslanbey, 41285 Kartepe/Kocaeli/Turkey.

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The total anthocyanins level and fruit colour were investigated in twelve naturel cherry laurel (*Prunus laurocerasus* L.) genotypes. Anthocyanins are well-noted as healty compounds due to their antioxidant properties. Fruit samples of cherry laurel were examined for their total anthocyanin content by using a spectrophotometric differential pH method. Cherry laurel genotypes showed differences in their total anthocyanins levels which ranged from 67.52 to 260.81 mg kg^{-1}. Total anthocyanin content was the highest in KG 11 (260.81 mg kg^{-1}) and followed by KG 8 (235.99 mg kg^{-1}) and KG 6 (228.60 mg kg-1) and colour a* value (redness) of these genotypes were lower compared to other eight genotypes (5.63, 7.41 and 5.34, respectively). The total anthocyanins were strongly correlated with chromatic parameters (a* and b* value, chroma, hue angle) except for L* value. These results showed that antioxidant level of fully coloured fruits were lower so increasing total anthocyanins level alone was not effective on coloring of fruit of cherry laurel.

Key words: Cherry laurel (*Prunus laurocerasus* L.), anthocyanin, colour.

INTRODUCTION

Cherry laurel (*Prunus laurocerasus* L.) is a member of Rosaceae family, native to the west Asia (Çolak et al., 2005) and is a popular fruit (dark purple or black when mature) mainly distributed in the coast of the Black Sea region of Turkey and is locally called “Taflan” or “Karayemiş” (Alasalvar et al., 2005). It is mostly consumed as fresh fruit in local markets but may also be dried, pickled and put into pekmez, jam, marmalade and fruit juice products (Liyana-Pathirana et al., 2006). Besides its use for food, both fruit and seeds of cherry laurel are well known as traditional medicine in Turkey and have been used for many years for the treatment of stomach ulcer, digestive system ilness, bronchitis (seeds), eczemas and haemorrhoids and as a diuretic (fruits) in folk medicine in Turkey (Baytop, 1999). High fruit and vegetable consumption is associated with a reduced risk of several chronic diseases such as cancer, cardio vascular disease, coronary heart disease and atherosclerosis. The compounds believed to be responsible for the protective effects of a fruit-rich and vegetable-rich diet include carotenoids and antioxidants vitamin. In this regard, attention has been focused on the significance of phenolics such as phenolic acids, flavonoids and in particular anthocyanins (Shadidi and Naczk, 2004).

Anthocyanins, one of the major group of pigments, are responsible for orange, red and blue colours in fruits, vegetables, flowers and other storage tissues in plants (Chandra et al., 1992). Colour is the most important indicator of maturity and quality in many fruit species (Drake et al., 1982) and is mainly influenced by the concentration and distribution of various anthocyanins in the skin (Gao and Mazza, 1995), as well as by other factors such as light, temperature, ethylene and cultural practices (Lancester et al., 1997). Anthocyanins are scavenger activity of radical species (Wang et al., 1997) and contributors to antioxidant activity (Rapisarda et al., 1999), thus constituting useful markers to enable recognition and evaluation of quality of fresh fruits. The influence of ripeness on accumulation of anthocyanins and on the evolution of colour has been analysed in sweet cherries (Gonçalves et al., 2007), grapes

*Corresponding author. E-mail: rkasim@kocaeli.edu.tr.

Table 1. Total anthocyanins content and colour parameters (L*, a*, b*), chroma (C*) and hue angle (h).

Genotypes	Total anthocyanin (mg/kg FW)		L*		a*		b*		C*		h	
1	129.88	cde	21.15	d	11.69	cd	1.22	bcd	10.75	def	6.00	cdef
2	167.41	cd	21.80	cd	10.46	cde	1.25	bcd	10.54	def	6.35	cde
3	181.49	bc	21.14	d	8.14	def	0.68	cd	8.17	efg	4.60	defg
4	118.64	def	22.90	b	15.89	ab	3.31	a	16.24	abc	11.37	ab
5	155.85	cd	21.76	cd	12.51	bc	1.85	bc	12.67	bcd	7.51	cd
6	228.60	ab	21.33	cd	5.34	f	0.22	d	5.35	g	2.09	g
7	91.35	ef	23.07	b	17.72	a	3.87	a	18.15	a	12.08	a
8	235.99	ab	21.29	cd	7.41	ef	0.49	d	7.43	fg	3.69	efg
9	157.62	cd	21.62	cd	12.15	bcd	2.04	b	12.34	cde	9.00	bc
10	126.66	cdef	22.40	bc	16.80	a	3.66	a	17.22	a	11.33	ab
11	260.81	a	22.37	bc	5.63	f	0.42	d	5.65	g	3.13	fg
12	67.52	f	24.21	a	16.27	ab	3.97	a	16.77	ab	13.41	a

Values are means of three replicates (n = 3). Different letters indicate significantly different values at $p<0.05$.

(Ryan and Revilla, 2003) and plum (Usenik et al., 2009). The chromatic parameters L*, a*, b*, chroma and hue angle correlated negatively with total anthocyanin levels in sweet cherry (Gonçalves et al., 2007) and weakly correlated in plums (Usenik et al., 2009).

Cherry laurel has become more popular in recent years in Turkey. There has been pomological traits, physiological (Nardini, 2002), physico-mechanic properties (Çalişır and Aydin, 2004), chemical composition of fruits and leaves (Kolayli et al., 2003; Çolak et al., 2005), medicinal effects (Pieroni, 2000). According to the searched literature there have been studies on the chemical composition of cherry laurel (Alasalvar et al., 2005; Liyana-Pathirana et al., 2006; Halilova and Ercişli, 2010). But no research has been conducted on relationship anthocyanin level and colour of cherry laurel fruits. The aim of this study is to investigate the correlation between total anthocyanin level and colour parameters of naturel cherry laurel fruits.

MATERIALS AND METHODS

Plant material

Twelve cherry laurel genotypes were sampled from Kocaeli in Marmara reğion in Turkey. About 1 kg of fruit per genotype was harvested when fully ripe state and named KG1, KG2, KG3, KG4, KG5, KG5, KG7, KG8, KG9, KG10, KG11 and KG 12. For each genotype nine samples of fruit were randomly selected at nearly same colour for the total anthocyanin level and colour measurements. After colour determination, total anthocyanins were analysed from the whole edible part of fruits. For each genotype, three replicates were measured (n = 3); each with three fruits.

Total anthocyanin analysis

Total anthocyanin content was measured using a spectrophotometric differential pH method, according to Rapisarda et al. (2000) and Lo Scalzo et al. (2007). Two samples of 1 g were treated with 10 ml of buffer solution, pH:1.0 (125 ml of 0.2 M KCl and 375 ml of 0.2 M HCl) and 10 ml of buffer solution, pH: 4.5 (400 ml of 1 M sodium acetate, 240 ml of 1 M HCl and 360 ml of water), respectively. The mixture was homogenised and centrifuged twice at 4°C at 5000 g for 15 min. The supernatant was collected and its absorbance was read at 510 nm. Total anthocyanin amount was determined by the following equation:

$$C(\text{mg kg}^{-1}\text{ FW}) = (\text{ABSpH: }1.0 - \text{ABSpH }4.5) \times 484.82 \times 1000/24825 \times DF$$

Where the term in parentheses is the difference of absorbance at 510 nm between pH 1.0 and 4.5 solution; 484.82 is the molecular mass of cyanidin-3-glucoside chloride; 24825 is its molar absorptivity (ε) at 510 nm in the pH: 1.0 solution and DF is the dilution factor.

Colour analysis

The skin colour variables were measured on three fruit samples immediately after picking. The CIELAB colour system (Comission Internationale de l'Eclairage, 1986) is extensively used to evaluate food colour. Colour of cherry laurel fruits was measured on the cheek area of nine fruits with Konica Minolta CR-400 (Osaka, Japan). Value L*, a*, b*, chroma (C*) and hue angle (h) were measured to describe the colour of cherry laurel fruits.

Statistical analysis

Statistical analysis was conducted with the programme Minitab 11. One-way ANOVA was used for analysis of the anthocyanin content and colour parameters. Differences between genotypes were estimated with Duncan test ($p<0.05$). Linear regression was performed between total anthocyanin concentration and colour parameters. The relationships were tested at $p\leq0.05$.

RESULTS AND DISCUSSIONS

Total anthocyanins content

Total anthocyanins content of twelve cherry laurel fruits are shown in Table 1. The total anthocyanins content was

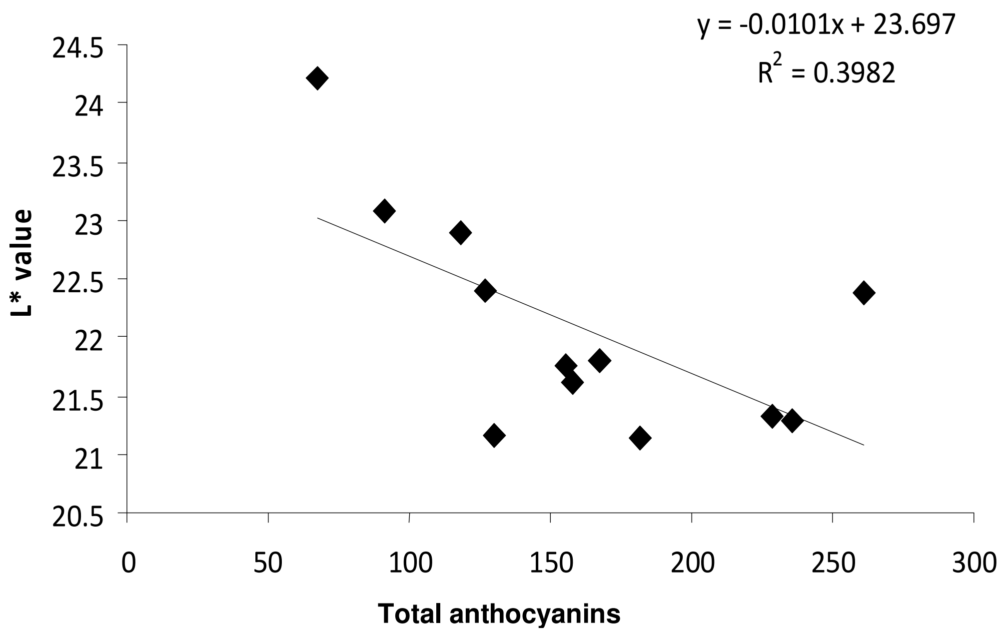

Figure 1. Variation of L* value with total anthocyanins content of twelve different cherry laurel genotype.

highest in KG 11 (260.81 mg kg^{-1}); it was followed by KG 8 (235.99 mg kg^{-1}) and KG 6 (228.60 mg/kg^{-1}), and also differences between these three genotypes and the other genotypes were important statistically ($p<0.05$). Also great variability existed among the examined cherry laurel fruit samples, regarding their anthocyanin content. Similar results were obtained by Halilova and Ercişli (2010). The genotypes with the significantly lowest concentration of total anthocyanins were KG 12 and KG 7 (67.52 and 91.35 mg kg^{-1}, respectively). The highest content of total anthocyanins was measured in Genotype 11 at 260.81 mg kg^{-1}, extracted from the whole edible part of fruits. Alasalvar et al. (2005) reported that the content of total anthocyanins measured two cherry laurel cultivar ranged from 123.8 to 174.3 mg 100 g^{-1} FW, ant total anthocyanin content of eight cherry laurel genotype was changed from 164.4 to 206.4 mg 100 g^{-1} FW found by Halilova and Ercişli (2010). In the present study total anthocyanins content of twelve cherry laurel genotypes ranged from 67.52 to 260.81 mg/kg. These data are in agreement with those reported by Alasalvar et al. (2005) and Halilova and Ercişli (2010).

The total anthocyanin content of dark-coloured sweet cherries was 82 to 298 mg 100 g^{-1} FW. In red grape cultivars it was estimated to 6.9 to 15.1 mg of cyanidin 3-rutinose equivalents of 100 g^{-1} FW and in 30 genotypes of blueberries as 34 to 515 mg of cyanidin 3-glucoside equivalents 100 g^{-1} FW (Moyer et al., 2002). Our results were within these ranges and it can be concluded that cherry laurel genotypes were found to be good sources of anthocyanins among fruit species.

Correlation of total anthocyanins amount and colour parameters

Anthocyanins are a group of widespread naturel phenolic compounds in plants. There are mainly distributed among flowers, fruits (particularly in berries) and vegetables and responsible for their bright colours such as orange, red, violet and blue (Hou, 2002). There were significant differences in colour parameters L*, a*, b*, C* and h between twelve cherry laurel genotypes. The chromatic characteristic of fruits are shown in Table 1. In genotypes that have higher anthocyanin content; chroma and hue angle were always lower than those in genotypes that have lower anthocyanin level. The different correlation coefficients between total anthocyanins and colour parameters was obtained for genotypes of cherry laurel. The variation in the anthocyanin level in genotypes induces variation in the degree of correlation between total anthocyanins and colour parameter (Gonçalves et al., 2007). Our results confirm the findings of McGuire (1992) and Gonçalves et al. (2007) that better correlation could be obtained when anthocyanin levels were compared directly with the values of L*, a* and b* (Figures 1, 2 and 3, respectively). In all cherry laurel genotypes, total anthocyanins level was negatively correlated with chromatic parameters (a*, b*, hue angle (h) and chroma (C*)) and total anthocyanins and this correlation was statistically significant ($p \leq 0.05$). In KG 11, concentration of total anthocyanins were also highest, resulting in the lowest value in the parameter a* (Figure 2) that indicates lower red colour of fruits ($R^2 = 0.86$). So,

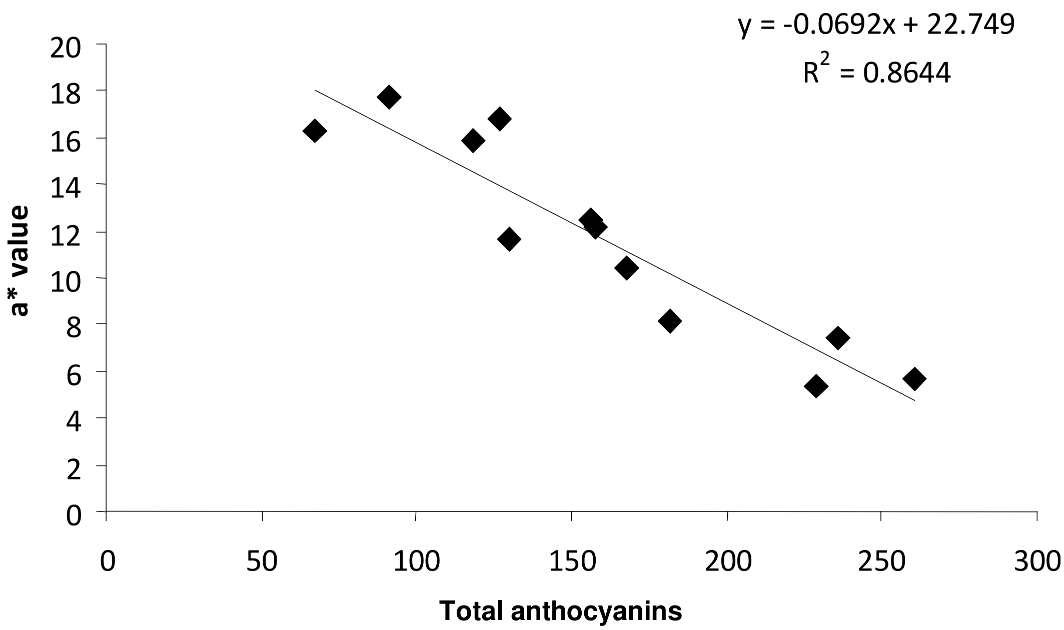

Figure 2. Variation of a* value with total anthocyanins content of twelve different cherry laurel genotype.

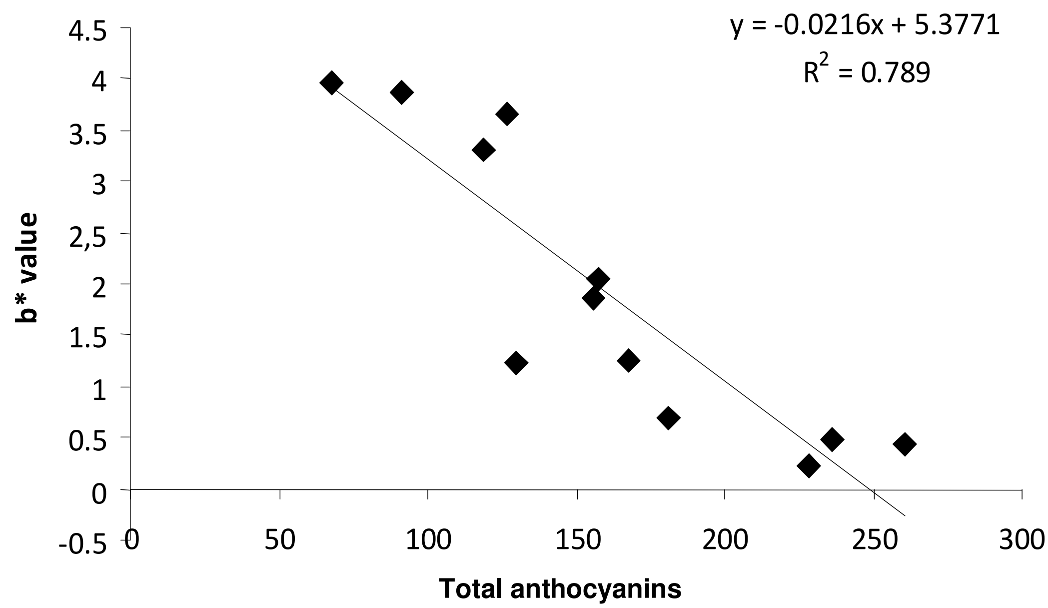

Figure 3. Variation of b* value with total anthocyanins content of twelve different cherry laurel genotype.

this means that the highly coloured fruits have lower anthocyanin content. Also, total anthocyanins content was strongly negatively correlated within all chromatic parameters. We can not say, however, anthocyanins are responsible for the typical colour of cherry laurel genotypes because in genotypes highly coloured the total anthocyanins content was lower.

Similarly a* values; b* value (Figure 3), hue angle (Figure 4), chroma (Figure 5) and total anthocyanins content of fruits strongly negatively correlated (R^2 = 0.78, R^2 = 0.83 and R^2 = 0.84, respectively). In sweet cherry Gonçalves et al. (2007) determined the strongest negatively correlation between chromatic parameters; L*, a*, b*, chroma and hue angle and total anthocyanins

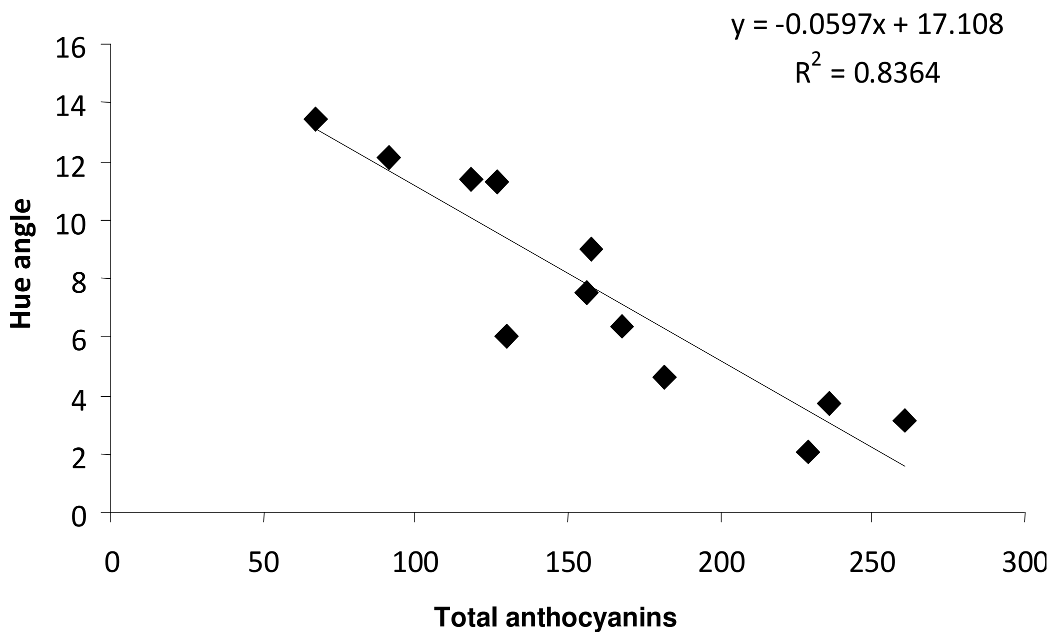

Figure 4. Variation of hue angle (h) with total anthocyanins content of twelve different cherry laurel genotype.

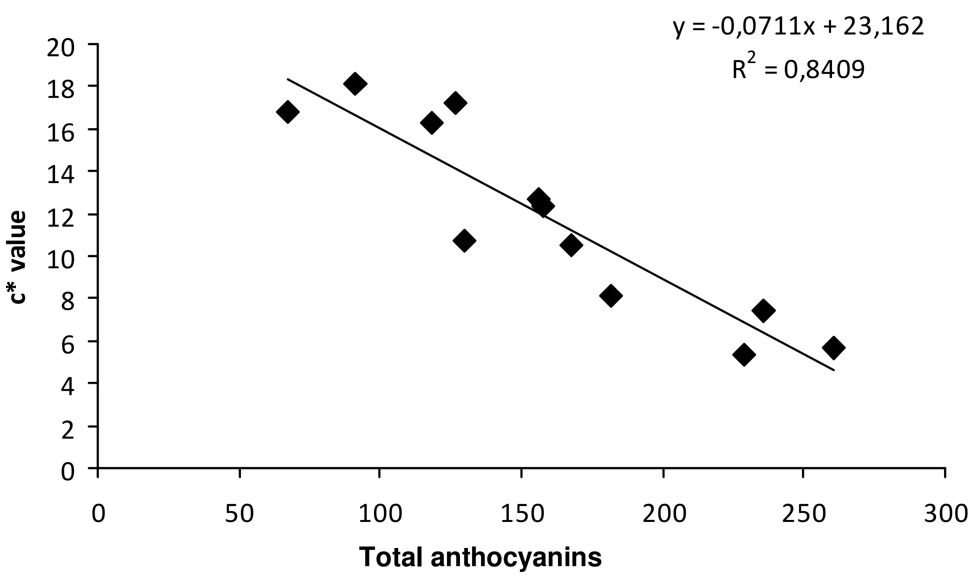

Figure 5. Variation of chroma (C*) with total anthocyanins content of twelve different cherry laurel genotype.

level in sweet cherry. In the present work, the same results were obtained except for L* value (Figure 1). L* value and total anthocyanin level of cherry laurel fruits were not strongly correlated in our study (R^2 = 0.39). Usenik et al. (2007) found weakly correlation between chromatic parameters and total anthocyanin level in four plum cultivars.

Conclusion

There is a wide range of variability between cherry laurel genotypes in their concentrations of total anthocyanins and chromatic parameters. The red colour of cherry laurel fruits which have high anthocyanin content was low. Furthermore, with cherry laurel genotypes, the level of anthocyanins were strongly negatively correlated (mainly statically significant) with colour parameters. Only L* value of fruits weakly correlated with total anthocyanins level. The present study revealed that cherry laurel fruits are a significant source of anthocyanins. And also suggest that anthocyanins, alone, can not be responsible for the coloration of fruits of cherry laurel.

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