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Changes in Qualitative Components of two Melon Cultivars during Maturation

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Fruit quality of two netted melon (*Cucumis melo* L. reticulatus group) cultivars, -Green Wave and Natsukei 6 gou were examined at 35, 40, 45, and 50 days after pollination (DAP) as well as fruit stored for 5 days after the harvest of 50 DAP. It was observed that fruit size, weight, brix and sugar content increased with the maturity but had no significant increase due to storing. For acid content, there was in general a declining pattern with the maturity but significant reduction at the final stage of maturity was observed. The total amino acid including monoamino carboxylic and sweet and sour amino acids increased significantly with the advancement of maturity but found to be decreased at storing. Difference for almost all the qualitative components were observed for two cultivars. In general, fruit of the cv. Green wave were sweeter and of more juicy nature because of higher sucrose and amino acid contents than that of the cv. Natsukei 6 gou.

INTRODUCTION

Wide variations of melon (*Cucumis melo L.*) cultivars exist in respect of fruit characteristics including qualitative aspects. The most popular group among the melon is designated as netted melons (C. *melo* L. reticulatus group). A number of netted melon cultivars have been developed with variable fruit quality. It has been observed that the sugar accumulation as well as acid content contribute the commercial quality of melon fruit. In addition amino acid also makes important contribution to the taste quality. There are quite a few reports on the accumulation of sugar in melon fruit (Eguchi and Fujieda, 1970 ; Mizuno *et al.*, 1971 and Yoshida *et al.*, 1989) but reports on the changes of amino acids and other organic acids are meagre. The present study, therefore, examines the change of acid, sugar and amino acid content in relation to the maturity of fruit aiming at determining the proper harvesting stage.

MATERIALS AND METHODS

Seeds of netted melon (C. *melo* L. reticulatus group) cvs. Green Wave and Natsukei 6 gou were sown on sand on May 8, 1989 and at cotyledonary leaf stage seedlings were transferred into plastic pots. At two true leaves expanding stage seedlings were transplanted into the sandy soil bed under plastic film greenhouse

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maintaining 35 ± 3°C to 25 ± 3°C during day and night, respectively. Single-stem training method was followed for all the plants. Perfect flowers on lateral branches of 11 to 15th node were pollinated and as the fruit started developing, the top of the branch was pinched after 22nd node. Only one fruit was finally kept per plant. Fruit were harvested for qualitative analysis at 35, 40, 45 and 50 days after pollination (DAP). Another treatment consisted of fruits stored for 5 days after the last harvest of 50 DAP. For every harvesting stage fruit size, weight and brix of fruit juice were recorded.

For chemical analysis, 100g of flesh tissue were ground with quartz sand and after maceration the samples were centrifuged to 10,000 rpm for 15 minutes at 0°C. The final volume was then made upto 500ml. However, the calculations were corrected on the basis of 100g.

Sugar content was measured by the Bertrand method. Total acidity was determined by titration against 0.1N NaOH after passing the extract through a cationexchange colum (Amberlite CG-120) and acidity was expressed as % citric acid (g/100g). Free acidity was determined by titration against 0.1N NaOH and was also expressed as % citric acid.

Preparation and determination of amino acid content were performed by the ion exchange column chromatography.

RESULTS AND DISCUSSION

Fruit characteristics :

For both the cultivars fruit weight and size increased progressively with the advancement of maturity (Table 1). However, the fruit growth was rapid upto 45 DAP in cv. Green Wave and in cv. Natsukei 6 gou the growth continued upto 50th days. The rind appeared to be reducing at maturation. Initially cv. Green Wave had thick rind (at 35 & 40 DAP) but was found to be thinned at ripening. In case of cv. Natsukei 6 gou the medium size rind gradually became slim and finally rind size appeared to be slightly thicker than that of cv. Green Wave. Both cultivars had attractive greenish ash color at final maturity. Flesh color was greenish white for

Table 1. Fruit characteristics of two cultivars of melon at various stages of maturity.

Cultivars	Days after pollination	Length (cm)	Maximum diameter (cm)	Rind thickness (cm)	Weight (g)
Green Wave	35	15.7	13.4	1.10	1628
	40	16.3	13.9	0.81	1748
	45	17.2	14.4	0.52	1843
	50	17.5	14.7	0.43	1862
	50+5 days storing	17.5	14.7	0.38	1862
Natsukei 6 gou	35	12.1	13.2	0.71	1282
	40	13.0	13.8	0.50	1445
	45	13.5	14.3	0.45	1605
	50	14.0	14.6	0.45	1671
	50+5 days storing	14.0	14.5	0.43	1669

both the cultivars. The crispiness decreased with the maturity and particularly for cv. Green Wave, when the fruit were harvested at 45 DAP the flesh was found to be quite soft whereas similar stage was observed in cv. Natsukei 6 gou at 50 DAP. For both cultivars fruit stored for *5* days after harvesting at *50* DAP became soft and juicy with cv. Green Wave having more juicy nature. Mizuno et *al.* (1971) reported increased fruit size and weight with the maturity.

Brix :

Brix percent found to be advanced with the maturity of fruit. For both cultivars there was dramatic shift of brix percent from 35 to *40* days and then advanced gradually upto 50 DAP. No significant increase in this respect was observed after 5 days of storing. The cv. Green Wave had the higher brix for the corresponding harvesting stages than those of cv. Natsukei 6 gou. The cv. Green Wave reached 17.8 % brix as compared to 13.7 % of cv. Natsukei 6 gou. Mizuno et *al.*(1971) and Yoshida et al. (1989) also reported brix of 15.0 or more for different cultivars of netted melons.

Total and reducing sugar :

The total sugar content also showed similar pattern of increase as the brix. Whereas the reducing sugar seemed to be decreased with the maturity (Table 2). However, total sugar content was comparatively higher for cv. Green Wave than cv. Natsukei 6 gou. The reducing sugar content did not differ between the cultivars. Regarding the sugar content there was two significant shift of sucrose accumulation in cv. Green Wave - one from 35 to 40 days and the other from 45 to 50 DAP. Whereas for cv. Natsukei 6 gou the progression in accumulation of sucrose was higher from 35 to 40 days and then there was steady accumulation. Fruit of cv. Green Wave accumulated 12.5 % sucrose as compared to 8.6 % of cv. Natsukei 6 gou at the end of observation. Mizuno *et al.* (1971) also reported similar increasing tendency of sugar accumulation in melon and recorded 10.4 % sucrose for fruit after 50 days of flower-

Table 2. Brix, total sugar, reducing sugar and sucrose content of two cultivars of melon at various stages of maturity.

Cultivars	DAP	Brix (%)	Total sugar (g.)*	Reducing sugar (g.)*	Sucrose (g.)*
Green Wave	35	12.2	10.43	6.73	3.70
	40	15.4	11.76	3.76	8.00
	45	16.6	12.27	3.18	9.09
	50	17.5	15.07	3.04	12.03
	50 + 5 days storing	17.8	15.50	2.97	12.53
Natsukei 6 gou	35	9.7	8.27	5.73	2.54
	40	11.6	10.13	4.00	6.13
	45	12.6	10.35	3.89	6.46
	50	13.7	10.89	3.74	7.15
	50 +5 days storing	13.7	11.63	3.02	8.61

*Per 100g basis ; DAP-days after pollination

Table 3. Acid contents of two cultivars of melon during maturation

Cultivars	DAP	Total acidity (g)*	Free acidity (g)*
Green Wave	35	0.829	0.179
	40	0.605	0.084
	45	0.532	0.077
	50	0.525	0.058
	50+5 days storing	0.275	0.048
Natsukei 6 gou	35	0.564	0.118
	40	0.544	0.090
	45	0.544	0.067
	50	0.535	0.058
	50+5 days storing	0.352	0.045

*Per 100g basis; DAP-days after pollination

ing.

Total and free acid :

Both the total and free acid seemed to be decreased with the maturity. However, there was sharp decline in this regard for fruit stored for 5 days after harvesting at 50 DAP (Table 3). Similar phenomenon was recorded for both cultivars. The decrease of total acid for cv. Green Wave was sharp at the begining of maturity (35 to 45 DAP) and then was rather steady upto 50 days, and after 5 days storing it declined sharply. For cv. Natsukei 6 gou, the decrease was rather slow until 50 DAP and then similar to that of cv. Green Wave it dropped quickly at storing. Both the cultivars had almost similar pattern of decrease in free acid content with cv. Green Wave having higher initial content. The decrease of acid contents with maturity is common phenomenon in many fleshy fruits.

Amino acid content :

Table 4 presents the contents of individual amino acid, total amino acid and groups of amino acids on the basis of chemical construction and organoleptic assessment.

In terms of total amino acid content, both the cultivars showed increasing pattern upto the final stage of harvent (50 DAP) and then after 5 days of storing the amount decreased. At 50 DAP total content of amino acid was found to be almost similar for cv. Green Wave and cv. Natsukei 6 gou with 7858 and 7691 μM/100g, respectively. However, for cv. Green Wave the total content started to rise after 40 days. Whereas for cv. Natsukei 6 gou it started from the initial stage of harvest (35 DAP). In general, cv. Green Wave had little higher contents of amino acids as compared to corresponding harvesting stages of cv. Natsukei 6 gou.

The most abundant amino acids observed in both cultivars were threonine, alanine and glutamic acid which constituted 70 % of the total amino acid contents. Besides these major amino acids, serine, glycine, aspartic acid, lysine and valine also constituted 20 % of the total content of free amino acids. Cystine was found only at the later

Table 4. Free amino acid contents (μM/100g fresh tissue) of two melon cultivars during maturation

Free amino acids	Green Wave (DAP)*					Natsukei 6 gou (DAP)*				
	35	40	45	50	50+5 days storing	35	40	45	50	50+5 days storing
Aspartic acid	486.5	135.5	5.5	310.0	11.5	145.5	474.0	274.0	282.0	230.5
	(9.1)	(2.4)	(0.1)	(3.8)	(0.2)	(4.1)	(9.7)	(4.5)	(3.8)	(3.7)
Threonine	189X.5	2529.5	2430.0	2380.0	1643.0	1808.5	1991.5	2286.0	2605.5	1727.0
	(31.9)	(45.6)	(38.7)	(30.3)	(25.6)	(52.8)	(38.8)	(37.8)	(34.0)	(27.7)
Serine	402.0	31.0	345.0	443.0	419.0	156.5	250.5	12.0	427.0	340.0
	(7.6)	(0.6)	(5.5)	(5.6)	(6.5)	(4.6)	(4.8)	(0.3)	(5.6)	(5.5)
Glutamic acid	626.5	759.0	1558.0	1724.0	1429.5	271.5	679.0	1332.0	1791.0	1044.0
	(12.0)	(22.8)	(24.8)	(22.0)	(22.2)	(7.9)	(13.4)	(22.0)	(23.1)	(16.8)
Glycine	233.0	183.0	248.0	337.0	363.0	98.0	176.5	227.0	302.5	246.5
	(4.5)	(3.3)	(4.0)	(4.3)	(5.6)	(2.9)	(3.5)	(3.7)	(4.0)	(4.0)
Alanine	435.5	316.0	757.5	1327.5	1401.0	124.0	471.5	576.0	965.0	1470.5
	(8.0)	(5.71	(12.0)	(17.0)	(21.8)	(3.6)	(9.0)	(9.2)	(12.6)	(23.6)
Cystine	0.0	0.0	0.0	352.0	182.0	0.0	0.0	250.5	130.5	239.5
				(4.5)	(2.8)			(4.8)	(1.6)	(3.8)
Valine	314.0	141.9	263.5	203.0	181.0	198.0	249.5	240.0	304.0	168.0
	(5.9)	(4.5)	(4.2)	(2.6)	(2.8)	(5.8)	(5.0)	(3.9)	(4.0)	(2.7)
Methionine	203.0	149.0	148.5	137.0	108.0	129.5	132.0	173.0	197.5	75.5
	(3.9)	(2.7)	(2.4)	(1.8)	(1.7)	(3.9)	(2.7)	(2.9)	(2.6)	(1.2)
Isoleucine	143.0	76.5	52.5	52.0	53.5	64.0	66.5	77.0	81.5	64.5
	(2.7)	(1.4)	(0.8)	(0.7)	(0.8)	(1.9)	(1.4)	(1.3)	(1.1)	(1.0)
Leucine	136.5	90.5	63.0	76.0	101.5	75.5	77.0	83.5	93.0	90.5
	(2.6)	(1.6)	(1.0)	(1.0)	(1.6)	(2.2)	(1.6)	(1.4)	(1.2)	(1.3)
Tyrosine	39.5	35.0	34.5	47.5	152.0	28.5	27.5	44.5	38.0	36.0
	(0.7)	(0.6)	(0.6)	(0.7)	(2.4)	(0.8)	(0.6)	(0.7)	(0.5)	(0.6)
Phenylalanine	106.0	142.0	100.0	76.0	93.5	65.0	110.5	137.0	153.0	50.0
	(2.0)	(2.6)	(1.6)	(1.0)	(1.5)	(1.9)	(2.0)	(2.3)	(2.0)	(0.8)
Histidine	79.0	66.5	66.0	87.5	34.0	76.0	72.0	101.5	81.5	72.5
	(1.4)	(1.2)	(1.1)	(1.1)	(0.5)	(2.2)	(1.5)	(1.7)	(1.1)	(1.2)
Lysine	216.0	129.5	118.0	182.0	119.0	120.0	204.0	156.5	90.5	260.5
	(4.0)	(2.3)	(1.9)	(2.4)	(1.9)	(3.3)	(4.1)	(2.7)	(1.2)	(4.2)
Arginine	200.0	147.5	111.0	126.0	138.5	84.5	116.0	88.5	150.0	108.5
	(3.8)	(2.7)	(1.8)	(1.6)	(2.2)	(2.2)	(2.1)	(1.5)	(1.9)	(1.7)
Monoamino mono-carboxylic acid (MM)	3922.5	3801.5	4440.0	5429.0	4697.0	2747.5	3552.0	4105.0	5297.0	4508.0
Polyamino mono-carboxylic acid (PM)	495.0	343.5	295.0	395.0	291.5	281.0	392.0	346.0	321.5	431.5
Monoamino di-carboxylic acid (MD)	1113.0	1400.5	1563.5	2033.5	1440.5	417.5	1153.0	1606.0	2073.0	1274.5
Imino carboxylic acid (IMI)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sweet amino acid**	3235.0	3224.0	3930.0	5067.5	4278.5	2335.5	3121.5	3551.5	4558.0	4320.0
Sour amino acid**	1113.0	1400.5	1563.5	2033.5	1440.1	417.5	1153.0	1606.0	2073.0	1274.5
Bitter amino acid**	1182.0	921.0	804.0	756.5	709.5	692.5	822.5	900.0	1060.5	629.5
Total amino acid	5530.0	5545.0	6300.0	7857.5	6428.5	3445.5	5097.0	6057.0	7690.5	6224.0

Figures in the parantheses represents the % of total amino acids.

* DAP- days after pollination ; ** Sweet amino acids- threonine, serine, glycine, alanine, cystine, tyrosine and lysine ; Sour amino acids- aspartic and glutamic acid ; Bitter amino acids (accompanied by slight sweetness)- valine, methionine, isoleucine, leucine, phenylalanine, histidine and arginine.

stages of maturity. Arginine, methionine, isoleucine, leucine, tyrosine, phenylalanine and histidine were also present in small quantities. High concentraion of monoamino carboxylic acid (MM) seemed to contribute for the high content of total amino acids for both the cultivars. Next to this group, monoamino dicarboxylic acid (MD) also had quite good contribution while polyamino monocarboxylic acid (PM) had very little contribution. No iminocarboxylic acid (IMI) was present in any of the melon cultivars. Mizuno et al. (1971) also observed similar accumulation pattern of amino acid content as well as the accumulation of cystine at maturity.

In respect to organoleptic contribution, amino acids are classified into three groups (Kirimura et al., 1969). Threonine, serine, proline, glycine, alanine, cystine, tyrosine and lysine are the important contributors of sweet taste. Aspartic- and glutamic acids contribute sour taste ; whereas, valine, methionine, isoleucine, leucine, phenylalanine, histidine, and arginine have a bitter taste accompanied by slight sweetness. Considering the cumulative organoleptic assessment of the two cultivars, there was indication of higher sweetness, lower sourness and bitterness for cv. Green Wave when compared to those of Natsukei 6 gou (Table 4). But after 5 days of storing there was not much difference in this respect indicating post harvest loss of variable amino acid contents. However, it was observed that the taste index for sweetness improved with the advancement of maturity. For sourness in both the cultivars, the taste index advanced with the maturity. Because of lower content of bitter amino acid in cv. Green Wave it might had superior sweetness taste compared to cv. Natsukei 6 gou which had higher content of bitter amino acid as maturity advances.

The above results indicated that accumulation of sucrose and sweet amino acid was relatively earlier in cv. Green Wave when compared to cv. Natsukei 6 gou. Fruit of cv. Green Wave seems to achieve edible sweetness at 45 days (DAP) with quite a high content of sucrose and sweet amino acid with high brix. For cv. Natsukei 6 gou fruit of similar stage had relatively lower brix and lower content of sucrose and sweet amino acid. But the content of sour and bitter amino acid was quite similar for the corresponding stage. Because of the higher percent of sweet amino acid as compared to sour and bitter amino acids and higher sucrose fruit of cv. Green Wave were more sweeter than the fruit of cv. Natsukei 6 gou at the corresponding stage of maturity. At 50 days DAP fruit of cv. Natsukei 6 gou contained higher sucrose and brix but not to the level of the fruit of cv. Green Wave at 45 DAP. Sweet amino acid also increased but was relatively low in the fruit of cv. Green Wave of that stage. Considering the above aspects it may be concluded that fruit of cv. Green Wave and cv. Natsukei 6 gou can be suitably harvested for optimum quality at 45 and 50 DAP, respectively. However, more postharvest stages should be studied for better conclusion on postharvest keeping quality.

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