EURASIAN JOURNAL OF FOOD SCIENCE AND TECHNOLOGY

Physicochemical and Nutritional Properties of Bitter Melon at Four Maturation Stages

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Abstract

The purpose of the present study was to investigate the physicochemical characteristics of bitter melon fruit at four maturation stages. Results showed that during the maturation period, ascorbic acid, carotene, total phenolic content and antioxidant capacity of the bitter melons were changed between 5.16±0.03-7.26±0.03 mg/g dry weight, 78.91±0.86-190.28±2.23 µg/g dry weight, 5.62 ±0.2-8.25 ±0.1 mg gallic acid equivalent/g dry weight and 653.84±20.53-822.81±19.75 mg ascorbic acid equivalent /g dry weight respectively. Moreover, the values of Ca, Cu, Fe, K and Mg ranged between 172.33±7.2-196.82±5.1, 14.33±0.1-16.32±0.2, 11.38±41.8-16.58±16.3, 1670.38±84.4-1922.67±95.3 and 106.79±16.0-145.41±28.1 mg/100 g dry weight respectively. Results indicated that maturation stages highly affected nutritional and functional value of bitter melon.

Keywords: Antioxidant activity; nutrient; total phenol

INTRODUCTION

The bitter melon or bitter gourd (*Momordica charantia*) belongs to the family of Cacurbitaceae. This plant is widely cultivated in many tropical and subtropical regions. Bitter melon fruit is widely used for medicinal purposes in developing countries Myojin et al. (2008) and Ullah et al. (2011). Physicochemical properties of the fresh bitter melon are able to affect the sensory and nutritional properties of cooked food or food derivatives produced by bitter melon. However, no reports have been found about the detailed physicochemical properties of bitter melon fruit during the maturation period in the literature. The purpose of the present work was to determine the physicochemical properties of bitter melon fruit at green, yellow, orange and late orange maturation stages.

MATERIALS and METHODS

Bitter melon fruits grown in greenhouse at Yalova/Turkey were harvested at 4 different maturation stages which were yellow, orange and late orange (when the fruit was opened from end point). Fruits had 15.61±0.4 cm length, 6.4±0.2 cm diameter and 135.4±13 g weight. Before the analysis, seeds and pithy white membranes of the fruit were scooped out. Color values were measured with color meter (Minolta, Japan). pH was measured with a pH meter (Consort P514, Belgium).

Titratable acidity was determined according to AOAC (1975). Moisture, oil and mineral element were determined according to official method of AOAC (1990). Sugar

content was determined by the Lane and Eynon method (Cemeroglu, 2007). Ascorbic acid content was determined by the indophenol method Freed (1966). Carotene content was determined with spectrophotometric method (Cemeroglu, 2007). Total phenolic content was determined by the Folin–Ciocalteu method according to Singleton and Rossi (1965). Total antioxidant capacity was determined according to Dasgupta and De (2004). Analysis of variance using the LSD test of multiple comparisons of the means ($p \leq 0.05$) was used to determine the presence of significant differences among the samples.

RESULTS and DISCUSSION

Color values, pH and titratable acidity of bitter melon fruit were demonstrated in Table 1. The highest L value was detected at yellow maturation stage while the lowest value was detected at green maturation stage. In contrast, Aminah and Anna (2011) reported the highest L value at the late orange maturation stage.

Table 1. Color values, pH and titratable acidity of bitter melon fruit

Ripeness	Color parameters			pH	Titratable acidity (%)
	L	a	b		
Green	41.49±2.90c	4.46±0.1a	0.11c	4.46±0.1a	0.11c
Yellow	51.97±1.32a	4.10±0.06c	0.13b	4.10±0.06c	0.13b
Orange	50.84±2.16a	4.25±0.08b	0.16a	4.25±0.08b	0.16a
Late orange	48.15±0.91b	4.38±0.06a	0.16a	4.38±0.06a	0.16a

Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$)

There was a small fluctuation of pH values and an increase of titratable acidity. pH and titratable acidity of bitter ground were determined between 4.10-4.46 and 0.11-0.16% respectively. The highest titratable acidity was detected at orange and late orange stages but the lowest pH value was detected at yellow maturation stage. These results are similar with that found by Aminah and Anna (2011) and Kulkarni et al. (2005). Chemical characters of bitter melon flesh were presented in Table 2.

Table 2. Chemical characters of bitter melon flesh

Ripeness	Moisture content (%)	Fat content (%)	Reduced sugar content (%)	Ascorbic acid (mg/g dry weight)	Carotene (µg/g dry weight)	Total phenolic content (mg gallic acid /g dry weight)	Antioxidant capacity (mg ascorbic acid /g dry weight)
Green	94.60±0.94a	0.14±0.02a	1.04±0.1c	7.26±0,03a	78.91±0.86d	5.62 ±0.2c	822.81±19.75a
Yellow	94.48±1.12a	0.12±0.01b	1.22±0.05b	5.21±0,04bc	123,64±1.47c	8.25 ±0.1a	775.06±18.62b
Orange	93.73±0.77b	0.09±0.01c	1.37±0.1a	5.48±0,04b	190.28±2.23a	8.22 ±0.3a	719.92±19.78c
Late orange	91.25±1.18c	0.08±0.01c	1.35±0.1a	5.16±0,03c	167.65±2.45b	7.53±0.3b	653.84±20.53d

Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$)

As it is shown moisture and oil content of fruit were slightly decreased whereas the value of reduced sugar content was increased. There is no statistical difference between moisture content of green and yellow maturation stages. Although the highest fat content was determined at green maturation, however the highest reduced sugar content was determined at orange and late orange maturation stages. The findings of the present study showed higher

values of moisture content and lower values of reduced sugar content at all maturation stages compared to that found by Kulkarni et al. (2005). In agreement with the values of moisture content detected in this study are the results found by Yuwai et al. (1991) and Donya et al. (2007).

Fat content of bitter melon was changed between 0.08-0.14% during maturation. This result was similar with that found by Yuwai et al. (1991), but lower than that found by Horax et al. (2005) and Donya et al. (2007). During maturation fat content was increased until orange maturation stage in contrast, Horax et al. (2005) stated that there was no change in the fat content of bitter melon during maturation. Ascorbic acid content was determined between 5.16-7.26 mg/g dry weight. Although in literature there was no report relevant to the change in the ascorbic content of bitter melon during the maturation period however, ascorbic acid content of mature bitter melon fruit was reported by Gopalan et al. (1993), Myojin et al. (2008) and Ullah et al. (2011) as 0.8mg/g fresh fruit, 0.96 mg/ g fresh flesh and 9.41-16.20mg/100g fresh respectively.

Carotene content increased from 78.91±0.86 to 290.28±2.23 between green and orange maturation stages. These values were significantly higher than that found by Gopalan et al. (1993) and Stephen and Duke (1994). The increase in carotene content was able to affect the color of the fruit. The values of the carotene content were the lowest at green maturation stage, showing an increase at yellow maturation stage and reaching its peak at orange maturation stage. Bitter melon has higher total phenolic content at yellow and orange maturation stage than at green and late orange maturation stages whereas Kubola and Siriamornpun (2008) found higher total phenolic content at green bitter melon fruit than that of ripe bitter melon. These results were similar with that found by Kubola and Siriamornpun (2008) but lower than that stated by Myojin et al. (2008). Also similar results were found by Horax et al. (2010). Antioxidant capacity showed a decrease during the maturation period. Similar results were found by reference Kubola and Siriamornpun (2008). The amounts of Ca, Cu, Fe, K and Mg content of bitter melon flesh were given in Table 3. The Mg, Fe, Na and Cu contents were decreased during maturation whereas K content was increased while Ca content was not changed significantly ($p<0.05$).

Table 3. Antioxidant capacity and total phenolic, Ca, Cu, Fe, K and Mg contents of bitter melon flesh (mg/100 g dry weight)

Maturation stages	Ca	Cu	Fe	K	Mg
Green	185.07±3.2bc	16.32±0.2a	16.58±16.3a	1670.38±84.4c	145.41±28.1a
Yellow	196.82±5.1ab	15.17±0.2bc	14.67±16.3b	1835.83±148.9b	129.83±35.5b
Orange	172.33±7.2c	16.28±0.1ab	14.43±25.3b	1922.67±95.3a	106.79±16.0c
Late orange	184.15±6.3bc	14.33±0.1c	11.38±41.8c	1826.33±15.6bb	108.84±24.9c

Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$)

These mineral contents were much lower than that found by references Soomro and Ansari (2005) and Ullah et al. (2011). Moreover, although the results regarding Ca and Fe contents are in agreement with that found by Gopalan et al. (1993), Stephen and Duke (19947) and Horax et al. (2010).

CONCLUSION

According to the results of the present study, the maturation stages cause significant changes on the characteristics of the bitter melon. In particular, bitter melon had the highest

pH value, fat, ascorbic acid, Fe and Mg content and total antioxidant capacity at green maturation stage whereas the highest reduced sugar, carotene and total phenolic content were determined at orange and late orange maturation stages. These changes relevant to chemical content of bitter melon determine not only the changes of aroma and other nutrient content of bitter melon when it is used as a food stuff but also affect other changes concerning its phytochemicals content which are important for medicinal uses. Thus, it is obvious that the appropriate maturation stage should be selected according to the use of this fruit. In some countries fat of bitter melon was used in folk medicine.

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