African Journal of Biotechnology Vol. 9(25), pp. 3901-3903, 21 June, 2010
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2010 Academic Journals

Short Communication

Effect of ripening period on composition of pepino (*Solanum muricatum*) fruit grown in Turkey

Hasan Yalçin

Erciyes University, Engineering Faculty, Food Engineering Department, 38039, Kayseri, Turkey.
E-mail: hsnyalcin@hotmail.com. Tel: (90 352) 4374901/32731. Fax: (90 352) 4375784.

Accepted 5 May, 2010

Pepino is a new crop for Turkey. Raw and mature pepino fruits which were grown in greenhouse in Antalya, Mediterranean region of Turkey, were used for compositional analysis. Moisture, protein, ash, oil, sugar, NDF (Neutral detergent fiber) and ADF (Acid detergent fiber) analysis were done at two stages. Moisture was determined as the main component of the fruit by 93.80 and 91.45% for raw and mature fruit respectively. Pepino fruits have fewer amounts of protein, ash and oil at two stages of raw and mature fruits (0.93, 0.78, 0.46, 0.47, 0.05 and 0.09%, respectively). Sugar is the main component of dry matter especially in mature fruit (7.03%). Also, free sugar contents were determined. The contents of glucose and fructose declined during ripening, whereas sucrose showed an increase in concentration as ripening progressed.

Key words: Pepino, *Solanum muricatum*, ripening period.

INTRODUCTION

Pepino (*Solanum muricatum*) which is also called pepino dulce or pear melon is a horticultural crop from the tropical and subtropical Andes grown for its edible fruits (Ruiz-Bevia et al., 2002). Despite its high yield potential, it has not achieved the success of other New World Solanaceae like tomato, potato, tobacco and pepper (Prohens et al., 1999). It has been a neglected crop for a long time, until recently when its crop attracted increased interest in the exotic fruit markets of Europe, Japan and USA (Gonzales et al., 2000). This has lead to an increase in the areas devoted to pepino cultivation in several countries like Chile, Peru, Ecuador, Colombia and New Zealand (P´erez-Benlloch et al., 2001).

The variation of fruit size, shape, colour and flavour among pepino clones is striking. However, in most of the commercial cultivars the fruits weigh between 100 to 300 g; are round, ovate or elongate in shape, yellow-skinned with purple stripes, juicy, aromatic and with a flavour resembling muskmelon (Ruiz and Nuez, 1997). Pepino is a very versatile fruit which can be consumed in different ways depending on its maturity stage. When ripe, it is consumed as a refreshing dessert fruit, or as an ingredient of fruit salads. When it is in an earlier ripening stage (green), it can be used as a vegetable in stews (Gonzales et al., 2000). Also, pepino is harvested at an early stage of ripening for shipping purposes (Huyskens-Keil et al., 2006).

As ripe pepino fruits are sensitive to bruising during handling and transport, pepino production areas should be located near the consumption countries. This offers interesting possibilities for this crop in Mediterranean climate areas from Europe (Prohens et al., 1999). There is increasing production and commercialization in European fruit markets (Martınez-Romero et al., 2003).

Because of the increasing demand of pepino fruits, several attempts have been made to introduce this crop in several regions of Mediterranean climate (Prohens et al., 2005) such as Turkey. This fruit was not known by Turkish people until recently; it is very new product for Turkish people. It was not grown in commercial scale in Turkey. In recent years, it has been grown in some greenhouse in Mediterranean Region of Turkey in a small scale. This production has been carried out as a trial aim

Abbreviation: NDF, Neutral detergent fiber; **ADF,** acid detergent fiber; **HPLC,** high performance liquid chromatography; **LSD,** least significant difference.

Table 1. Proximate composition of the raw and mature pepino fruits.

Parameters	Raw	Mature
Moisture (%)	93.80 ± 0.11 [a]	91.45 ± 0.12 [b]
Protein (%)	0.93 ± 0.027 [a]	0.78 ± 0.015 [b]
Ash (%)	0.46 ± 0.012 [a]	0.47 ± 0.019 [a]
Oil (%)	0.05 ± 0.01 [a]	0.09 ± 0.03 [b]
Sugar (%)	4.48 ± 0.22 [a]	7.03 ± 0.28 [b]
NDF ($g.kg^{-1}$)	6.27 ± 0.17 [a]	2.28 ± 0.11 [b]
ADF ($g.kg^{-1}$)	5.12 ± 0.38 [a]	1.48 ± 0.08 [b]

All values are means of three replicates ± SD. Different letters within the same line show significant differences at $p<0.05$.
NDF, Neutral detergent fiber; ADF, acid detergent fiber; SD, standard deviation.

for the present.

There are a lot of agricultural investigation on the pepino and also pepino mosaic virus but there is very little study on the composition of this fruit. Especially, there is no literature on the compositional analysis of pepino fruit grown in Turkey. This work is aimed to determine the some chemical characteristics of the pepino fruits at two different maturity stages (ripe and green) grown in Turkey.

MATERIALS AND METHODS

Pepino fruits were harvested at two ripening stage (raw and mature) from greenhouse in Antalya which is located in the Mediterranean Region of Turkey. Raw pepino fruits had completely green skin and mature fruits had a yellow skin covered with regular purple stripes when they were harvested. Raw and mature fruits were harvested 30 and 70 days after flowering, respectively. Raw and mature fruits were harvested in August and November, respectively.

The edible portion of the fruits is considered to be the whole fruit except for the peel and seeds. The fruit was homogenized and pulps were used for analysis. Moisture content was determined by desiccation in an oven at 105°C until constant weight (Anon, 1980). Total oil content was obtained by the soxhlet extraction method using n-hexane as described by IUPAC Method (Anon, 1979). Protein content was determined by the standard Kjeldahl method (Anon, 1980). Ash content was determined by the method of AOAC (Anon, 1980). For total sugar analysis Lane-Eynon Method described by Schneider (Schneider, 1979) was used.

Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined by the method of Van Soest et al. (1991). The mono and disaccharides (glucose, fructose and sucrose) were determined with method of Sanchez et al. (2000). A HPLC (HP Agilent 1100 Model, USA) equipped with a RI detector was used for carbohydrate analysis. The column used was a Waters µ-Bondapak/carbohydrate analysis column. The mobile phase was acetonitrile/water (80:20). Operating conditions were a flow rate of 0.9 ml/min and ambient temperature.

For statistical analysis, data were subjected to ANOVA test. Multiple comparison of the means was performed by least significant difference (LSD) test at $p<0.05$.

RESULTS AND DISCUSSION

Moisture content is high in two ripening stages of fruit but raw pepino has a higher content than the mature fruit (Table 1). There is a significant difference ($p<0.05$) between these two values. Sanchez et al. (2000) determined the moisture content of the green and mature fruits as 93.7 and 91.8%, respectively. Our moisture values are in accordance with this literature. They also reported that moisture content of early ripening pepino fruits were always higher than those from the late crops. This clearly indicates that the ripening period has a main effect on the moisture content of pepino fruits. Gonzales et al. (2000) examined the moisture content of the different varieties of the fruit and reported that all moisture values were comprised between 89.2 and 91.6%. Pepino has high moisture content; this means that it is a fruit with low caloric content, therefore supporting the refreshing and diuretic character of this fruit (Gonzales et al., 2000).

Values for the protein contents are low in both raw and mature fruits, 0.93 and 0.78%, respectively, but there is a statistically significant difference ($p<0.05$) between protein contents of both stages. Protein content of the raw fruits is higher than the mature fruits in our study. It could be claimed that ripening period has an effect on protein content of pepino. Sanchez et al. (2000), found a decrease in protein content of raw and mature fruits as 0.95 and 0.86%, respectively. But they did not find an important decrease in protein content among ripening stages of another varieties of pepino in another study.

Raw and mature pepino fruits have very low ash content values (0.46 and 0.47%, respectively). These values were very similar and there is no important differences ($p<0.05$) among them. Oil is the lowest component in weight of pepino. Although it is the lowest content of the fruits, there is a significant increase in oil content of the mature fruits. There is no literature on the ash and oil content of the pepino fruit for comparison.

Since pepino fruits have low amounts of protein, ash and oil, it is mostly composed of water. On the other hand sugar is the main component of dry matter. While there is a significant decrease in moisture and protein content during ripening, there is a significant increase in sugar content in the same period. These results indicate that ripening stage has an important influence ($p<0.05$) on the evolution of sugar content in pepino. The free sugar profile shows that the main free sugar in pepino at the raw stage was fructose (Table 2). The content of glucose and fructose declined during ripening, whereas sucrose showed an increase ($p<0.05$) as ripening progressed (Table 2). Sanchez et al. (2000), Lopez et al. (2000) and Prono-Widayat et al. (2003) found a decrease in glucose and fructose, with an increase in sucrose, as ripening progresses. Their results are consistent with the present results. But Huyskens-Keil et al. (2006) reported that raw pepino fruit contained lower contents of sucrose, glucose

Table 2. Free sugar contents of pepino fruits (% of total free sugars).

Parameters	Raw	Mature
Glucose	34.6±0.98 [a]	20.2±0.41 [b]
Fructose	43.2±0.87 [a]	27.9±0.27 [b]
Sucrose	22.2±0.76 [a]	55.7±0.69 [b]

All values are means of three replicates ± SD. Different letters within the same line show significant differences at $p<0.05$.

and fructose. Lopez et al. (2000) reported that pepino could be classified as a sucrose accumulator such as sweet melon or citrus, showing a reduction in starch and reducing sugar and an increase in sucrose during ripening. It is assumed that the increase in sucrose content is caused by a reduction in acid invertase activity associated with normal levels of sucrose synthesis. Moreover, it is assumed that monosaccharides in young pepino fruits, mainly glucose, might have been already used as primary respiration substrates. Therefore, the ratio of disaccharides to monosaccharides might be a good indicator of physiological processes during ripening (Prono-Widayat et al., 2003).

NDF and ADF values decreased during ripening period. NDF is called cell wall and contains polymeric carbohydrate such as hemicelluloses, cellulose, etc. ADF contains these carbohydrates except hemicellulose. O'Donoghue et al. (1997) reported that cellulose content decreased markedly when pepino fruit reach the fully ripe stage, hemicellulose were maintained during early ripening but began to decrease as pepino fruit entered the late ripening stage. These values indicated that the ripening period has a decreasing effect on the polimeric carbohydrates especially cellulose and hemicellulose. The breakdown of polymeric carbohydrates, especially hemicellulose, results in weakening of cell walls. The degree of fruit softening is directly related to the rate of degradation of these substances (Bartley and Knee, 1982).

Ripening process of pepino is characterized by a depolymerization of complex carbohydrates (insoluble fiber) with an increase in the total sugar content and an exceptional accumulation of sucrose. High sucrose content is responsible for its sweet taste and justifies its use as a dessert fruit, in contrast to the unripe fruits which are more suitable for use in salads as a vegetable.

This study was the first to determine some chemical composition of the raw and ripe pepino fruits grown in Turkey. It indicates the need for further studies about other compositions of the fruit.

ACKNOWLEDGEMENTS

This research was supported by the Konya Exchange of Commerce. Thanks to this institution for their technical support.

REFERENCES

Anon (1979). Standard methods for the analysis of oils, fats and derivatives (IUPAC). 6th Ed. Pergamon Press, Oxford,

Anon (1980). Official method of analysis. Association of official analytical chemists (AOAC), Washington DC.

Bartley IM, Knee M (1982). The chemistry of textural changes in fruit during storage. Food Chem. 9: 47-58.

Gonzales M, Camara M, Prohens J, Ruiz JJ, Torija E, Nuez F (2000). Colour and composition of improved pepino cultivars at three ripening stages. Gartenbauwissenschaft. 65: 83-87.

Huyskens-Keil S, Prono-Widayat H, Ludders P, Schreiner M (2006). Postharvest quality of pepino (*Solanum muricatum Ait.*) fruit in controlled atmosphere storage. J. Food Eng. 77: 628-634.

Lopez S, Maroto JV, San Bautista A, Pascual B, Alagarda J (2000). Qualitative changes in pepino fruits following preharvest applications of ethephon. Scientia Horticult. 83: 157-164.

Martınez-Romero D, Serrano M, Valero D (2003). Physiological changes in pepino (*Solanum muricatum Ait.*) fruit stored at chilling and non-chilling temperatures. Postharvest Biol. Technol. 30: 177-186.

O'Donoghue EM, Somerüeld SD, Vre LA, Heyes JA (1997) Developmental and Ripening-Related Effects on the Cell Wall of Pepino (*Solanum muricatum*) Fruit. J. Sci. Food Agric. 73: 455-463.

P´erez-Benlloch L, Prohens J, Soler S, Nuez F (2001). Yield and fruit quality losses caused by ToMV in pepino (*Solanum muricatum L.*) and search for sources of resistance. Euphytica, 120: 247-256.

Prohens J, Rodriguez-Burruezo A, Nuez F (2005). Utilization of genetic resources for the introduction and adaptation of exotic vegetable crops: The case of pepino (*Solanum muricatum*). Euphytica, 146: 133-142

Prohens J, Ruiz JJ, Nuez F (1999). Yield, earliness and fruit quality of pepino clones and their hybrids in the autumn-winter cycle. J. Sci. Food Agric. 79: 340-346.

Prono-Widayat H, Schreiner M, Huyskens-Keil S, Lüdders P (2003). Effect of ripening stage and storage temperature on postharvest quality of pepino (*Solanum muricatum Ait.*) Food, Agric. Environ. 1: 35-41.

Ruiz JJ, Nuez F (1997). The pepino (*Solanum muricatum Ait.*), an alternative crop for areas affected by moderate salinity. Hortsci. 32: 649-652.

Ruiz-Bevia F, Font A, Garcia AN, Blasco P, Ruiz JJ (2002). Quantitative analysis of the volatile aroma components of pepino fruit by purge-and-trap and gas chromatography. J. Sci. Food Agric. 82: 1182-1188.

Sanchez M, Camara M, Prohens J, Ruiz JJ, Torija E, Nuez F (2000). Variation in carbohydrate content during ripening in two clones of pepino. J. Sci. Food Agric. 80: 1985-1991.

Schneider F (1979). Sugar Analysis, Official and tentative methods recommended by the International Commission for Uniform Methods of Sugar Analysis, Peterborough. pp. 41-73.

Van Soest PJ, Robertson JD, Lewis BA (1991). Methods for dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal Nutrition. J. Dairy Sci. 74: 3583-3597.