

STUDY ON THE VARIATIONS OF THE FATTY ACIDS AND AMINO ACIDS OF GREEN PEEL AVOCADO IN SON LA PROVINCE AT DIFFERENT HARVESTING MATURITY

Nguyen Van Loi

Faculty of Environmental Sciences, University of Science, Vietnam National University

Abstract. Green peel avocado is a fruit with high nutritional value, rich in lipids, proteins, sugars, vitamins, and minerals. The aim of this study was to determine the change in fatty acid and amino acid content of green peel avocados harvested at 200, 210 and 220 days in order to select the appropriate harvest time, serving for efficient preservation and processing. The results of the study showed that 9 fatty acids were identified at the time of harvesting at 200 days, 10 fatty acids at the time of harvesting at 210, and 220 days of green peel avocado. Compared with two harvest times as 210, and 220 days since fruiting, the fatty acid content of green peel avocado did not differ so much. By using the HPLC method, 13 amino acids, 14 amino acids, and 15 amino acids were identified at 200, 210, and 220 days after fruiting, respectively. Glycine, alanine, lysine, and phenylalanine were intended to increase in the developmental stages of green peel avocado, whereas the other amino acids did not change much. Therefore, based on the change in fatty acid and amino acid content, green peel avocado farmers in Son La province should choose the time of harvest from 210 to 220 days from fruiting to be suitable for preservation and processing. If harvesting green peels avocados at more than 220 days after fruiting, it will make the dried fruit and spongy, and affect flowering, fruit set, and yield in the next fruit crop.

Keywords: amino acid, fatty acid, green peel avocado, harvesting.

1. Introduction

Avocado trees are grown a lot in Vietnam, including Son La province. Son La province has favorable natural conditions for avocado tree development, in which green peel avocado varieties account for a large proportion of the province's fruit tree structure. Green peel avocado is a fruit with high nutritional value, rich in lipids, proteins, sugars, vitamins, and minerals [1, 2]. Green peel avocado has a fast ripening time, the chemical composition of the fruit also changes with age and maturity. Therefore, if it is not harvested in time and has effective preservation measures, it will affect the quality of the fruit [1, 2]. In Son La province in particular and our country in general, the harvesting of green peel avocados is mainly based on sensory evaluation.

Received August 12, 2021. Revised October 22, 2021. Accepted October 29, 2021.

Contact Nguyen Van Loi, e-mail address: nguyenvanloi@hus.edu.vn

Relying on sensory evaluation to determine the time of harvest still lacks a scientific basis. Besides, studies on the change of chemical compositions of green peel avocado at different harvest times in Vietnam have received little attention and research. Therefore, together with the agronomic criteria, it is very important to analyze and determine the chemical composition of green peel avocados to determine and verify the optimal harvest time. The aim of this study was to determine the change in fatty acid and amino acid content of green peel avocados harvested at 200, 210, and 220 days in order to select the suitable harvest time serving for efficient preservation and processing.

2. Content

2.1. Material, equipment, and methods

*** *Materials***

The raw materials used are green peel avocado purchased at 3 VietGap-standard avocado farms in Chieng Son commune, Moc Chau district, Son La province at the time of harvest 200 days, 210 days, and 220 days from since fruiting. Avocados must be intact, free from pests, and diseases, green peel, yellow flesh and ensure food safety. Avocados are stored in perforated styrofoam boxes and transported to the laboratory, stored in a refrigerator at a temperature of 4 - 6 °C to conduct experiments.

*** *Equipment***

Gas chromatography and mass spectrometry system GC6890-MS 5898, manufactured by Agilent Technologies (USA). By using Detector PAD 2996, fluorescence 2475, and Water model automatic pump of Water company (USA). The chromatographic column was Symmetry RP18 amino acid (150 mm × 4.6 mm × 3.5 pm) and Symmetry Shield RP18 column (150 mm × 4.6 mm × 5 pm) by Water.

*** *Methods***

- Method for determination of fatty acid content

Fatty acids in green peel avocado oil were determined by gas chromatograph GC6890-MS5898, capillary column HT-5MS: The injection sample volume is μL . Column temperature from 80 to 180 °C, the temperature of temperature increase every 3°C/min, keep at this temperature threshold for 5 minutes; the column temperature ranges from 180 to 220 °C, the rate of temperature increase every 8 °C/min, keep at this threshold for 5 minutes. MS conditions: ionize the sample at an ionization potential of 70 EV, maintain the temperature at 250 °C, a carrier gas is helium, have a transport rate of 1.0 ml/min, and a flow rate of 1:50 [3].

- Method for determination of amino acid content

Amino acid contents in the flesh of green peel avocado were determined by HPLC method by using Detector PAD 2996, fluorescence 2475, and Water model automatic pump of Water company (USA). The chromatographic column was Symmetry RP18 amino acid (150 mm × 4.6 mm × 3.5 pm) and Symmetry Shield RP18 column (150 mm × 4.6 mm × 5 pm) by Water. The mobile phase was a buffer solution of borates, acetonitrile, MiliQ water; The flow rate was 1 ml/min and the column temperature was 35 °C. Amino acids were quantified by a fluorescence detector with excitation and emission wavelengths of 340 nm and 450 nm, respectively [4].

2.2. Results and discussion

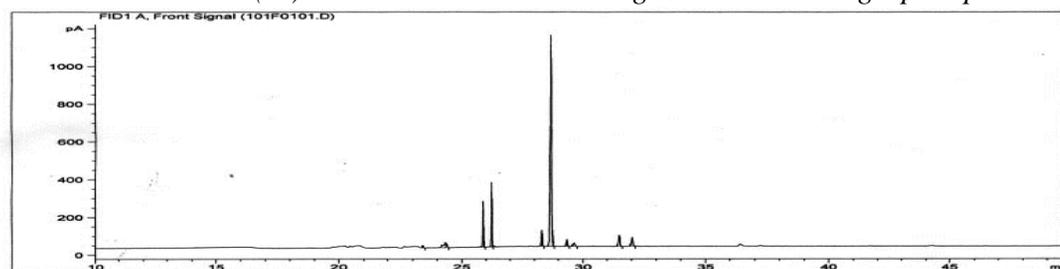
2.2.1. The change of fatty acid content in the flesh of green peel avocado harvested at different maturity

During the growth and development of green peel avocado, the content of nutritional components in general and fatty acids, in particular, are always changing. Determination of fatty acid composition in green peel avocado is an important criterion for evaluating the quality of this fruit. The results of determining the content of fatty acids in green peel avocado at different harvesting stages are shown in Table 1, Figures 1, 2, and 3.

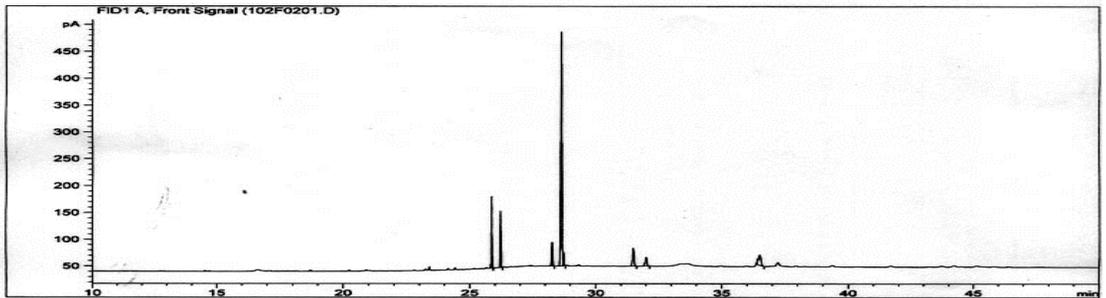
Table 1. The fatty acid composition of the green peel avocado at different maturity

No.	Fatty acids (%)	Content of fatty acids content by harvest date (%)		
		200 days	210 days	220 days
1	Myristic acid (C14: 0)	0.35	0.38	0.41
2	Pentadecanoic acid (C15: 0)	3.26	3.13	3.09
3	Palmitic acid (C16: 0)	7.92	7.91	8.02
4	Palmitoleic acid (C16: 1)	11.07	11.09	11.13
5	Stearic acid (C18: 0)	3.73	3.68	3.65
6	Oleic acid (C18: 1)	63.18	64.06	64.19
7	Linoleic acid (C18: 2 n6)	2.83	2.87	2.91
8	Linolenic acid (C18: 2 n3)	3.34	3.36	3.45
9	Eicosenoic acid (C20: 1)	2.79	2.83	2.76
10	Behenic acid (C22: 0)	No detectable	0.02	0.02
Total saturated fatty acids		15.26	15.12	15.19
Total unsaturated monounsaturated fatty acids		77.04	77.96	78.08
Total polyunsaturated fatty acids		6.17	6.23	6.36
Total		98.47	99.31	99.63

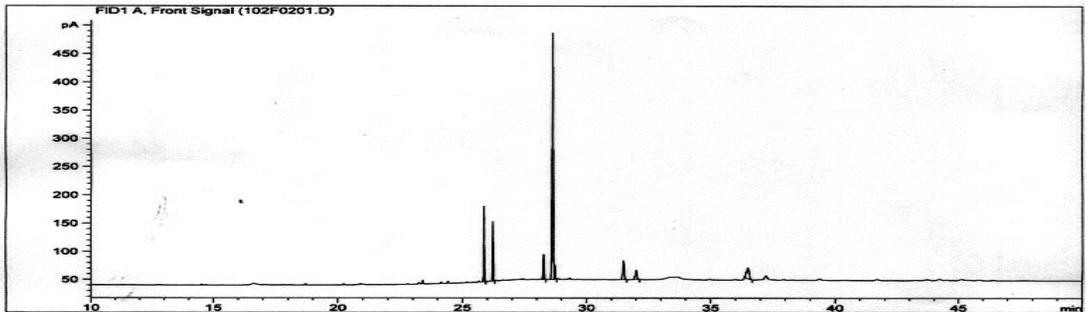
Note. The ratios (%) were calculated according to the chromatographic peak areas



Figures 1. Chromatogram of the fatty acid of green peel avocado at 200 days from fruiting



Figures 2. Chromatogram of the fatty acid of green peel avocado at 210 days from fruiting



Figures 3. Chromatogram of the fatty acid of green peel avocado at 220 days from fruiting

Table 1, Figures 1, 2, and 3 show that at the time of harvest of 200 days, 9 fatty acids were identified in green peel avocado. Three unsaturated fatty acids are containing one double-bonded 77.04%, some fatty acids account for a high proportion, such as oleic acid (C18: 1) accounting for 63.18%, palmitoleic acid (C16: 1) accounts for the proportion of 11.07% rate. Also, there is an unsaturated fatty acid-containing two double bonds and four unsaturated fatty acids, which account for 21.43%. At harvest 210 and 220 days from fruiting obtained 10 fatty acids, of which three unsaturated fatty acids contain one double bond, two fatty acids contain two double bonds and five saturated fatty acids. Of the 10 fatty acids, oleic acid (C18: 1) and palmitoleic acid (C16: 1) are fatty acids that account for a high proportion in green peel avocado. Comparing the two harvest periods 210 and 220 days since fruiting, the results showed that at these two stages, there was not much difference in the fatty acid content of green peel avocado. This result is also consistent with the research results of Requejo T.L.C *et al.* [5], Yoshio K *et al.* [6]. Therefore, based on the change in fatty acid content, the time to harvest green peel avocados in Son La province is from 210 to 220 days from the date of fruit set.

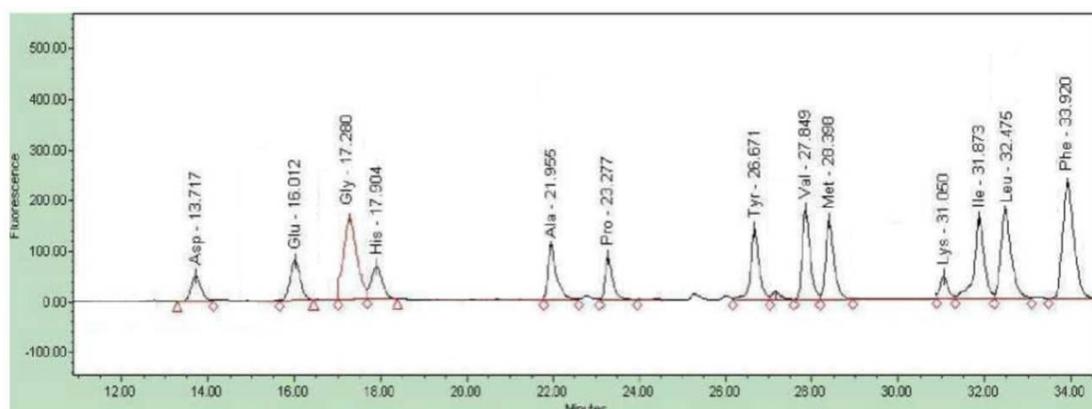
2.2.2. The change of amino acid content in the flesh of green peel avocado harvested at different maturity

In addition to the changes in size, and ratios of the structure of green peel avocado harvested at different maturity, there were also changes in the contents of amino acids in these periods Table 2.

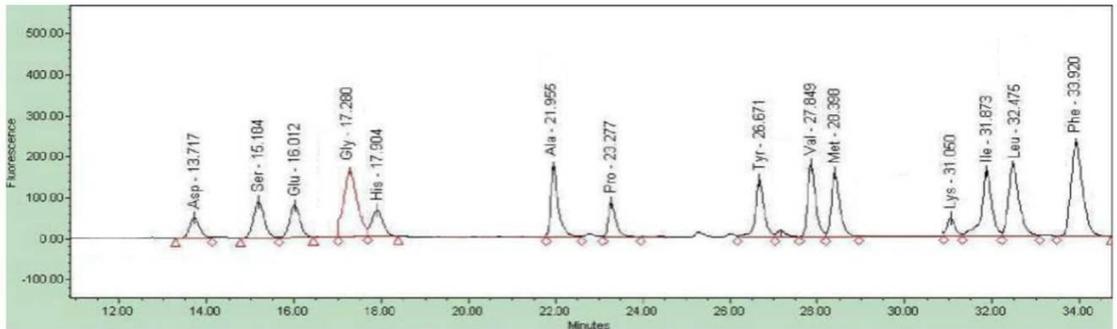
Table 2. The change of amino acid content in the flesh of green peel avocado harvested at different maturity

No.	Amino acids	Content of amino acids content by harvest date (%)		
		200 days	210 days	220 days
1	Aspartic	4.84	3.97	3.05
2	Serine	No detectable	4.31	3.49
3	Glutamic	4.61	4.06	3.54
4	Glycine	9.07	9.12	13.16
5	Histidine	5.59	5.13	3.17
6	Alanine	9.13	9.19	12.08
7	Proline	6.71	6.17	3.76
8	Tyrosine	8.16	7.98	6.03
9	Cysteine	No detectable	No detectable	1.84
10	Valine	9.27	9.06	6.18
11	Methionine	8.74	8.21	6.05
12	Lysine	3.72	3.78	3.81
13	Isoleucine	8.16	7.94	6.08
14	Leucine	9.39	9.02	12.67
15	Phenylalanine	10.48	10.47	13.95
Total		97.87	98.41	98.86

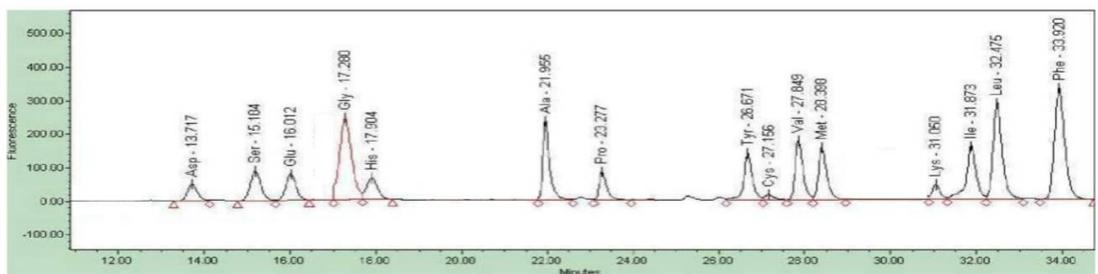
Note: The ratios (%) were calculated according to the chromatographic peak areas



Figures 4. Chromatogram of the amino acid of green peel avocado at 200 days from fruiting



Figures 5. Chromatogram of the amino acid of green peel avocado at 210 days from fruiting



Figures 6. Chromatogram of the amino acid of green peel avocado at 220 days from fruiting

At these stages (200 days, 210 days, and 220 days after fruiting) 13 amino acids, 14 amino acids, and 15 amino acids were identified, respectively. Among those, there were 7 non-substituting amino acids, including histidine, valine, methionine, lysine, isoleucine, leucine and phenylalanine. Serine and Cysteine only appeared 210 and 220 days after fruiting. Moreover, glycine, alanine, lysine, and phenylalanine intended to increase in the developmental stages of green peel avocado, whereas the other amino acids did not change much. Therefore, based on the change in amino acid content, the time to harvest green peel avocados in Son La province is from 210 to 220 days from the date of fruit set.

3. Conclusions

After 200 days, 210, and 220 days of harvest, 9 to 10 types of fatty acids were identified. Comparing two harvest times 210 and 220 days since fruiting, the fatty acid content of green peel avocado did not differ much. By using the HPLC method, 13 amino acids, 14 amino acids, and 15 amino acids were identified 200, 210, and 220 days after fruiting, respectively. Moreover, glycine, alanine, lysine, and phenylalanine tended to increase in the developmental stages of green peel avocado, whereas the other amino acids did not change much. Therefore, based on the change in fatty acid and amino acid content, green peel avocado farmers in Son La province should choose the time of harvest from 210 to 220 days from fruiting to be suitable compositions for preservation and processing.

REFERENCES

- [1] Eaks I, 1990. Change in the fatty acid composition of avocados fruit during ontogeny, cold storage and ripening. *Tropical Fruit in International Trade, Acta Horticulturae*, 269, pp.141-151.
- [2] Lucia P, Concepcian, Senchez M, Soniade, Pascual T, Begona D.A, Pilarcano, 2009. Fatty Acids, Sterols, and Antioxidant Activity in Minimally Processed Avocados during Refrigerated Storage. *Agricultural and Food Chemistry*, 57, pp. 3204-3209.
- [3] Trang, P.T.K, Dung, N.X, Hai, L.T, 1998. Capillary gas chromatography is used to determine the composition of fatty acids in vegetable oils. *Journal of Analytical Chemistry, Physics and Biology*, 3(2), pp. 6-11.
- [4] Hao, L.T.H, Dung, N.T, 2005. Determination of some amino acids in soybean and processed products by high-performance liquid chromatography technique. *Journal of Nutrition and Food, Vietnam Nutrition Association*, 3(4), pp. 68-77.
- [5] Requejo T.L.C, Woolf A.B, Roughan G, Schroeder R, Young H, White A, 1999. Seasonal changes in lipid content and fatty acid composition of Hass avocados. *Avocado Postharvest Research*, 99, pp. 1-27.
- [6] Yoshio K, Louis C, Erickson, 1968. Seasonal changes of avocado lipids during fruit development and storage. *California Avocado Society, Yearbook* 52, p. 102-108.