



Bioactive Compounds In Watermelon Flesh And Rind

Sensus Technical Note (SEN-TN-0021)

03/20/2009

Youngmok Kim, Ph.D. and Kevin L. Goodner, Ph.D.

ABSTRACT

The effect of enzyme treatment on carotenoid and volatile content in watermelon was investigated. Enzyme treatment was desirable for watermelon flesh processing for higher carotenoid content. For rind processing, enzyme treatment is essential due to significantly low yield rate of watermelon juice without enzyme treatment.

INTRODUCTION

Watermelon (*Citrullus Lanatus*) is an emerging source of carotenoids which is known as natural antioxidant colorant. According to recent study conducted by South Central Agricultural Research Laboratory (SCARL) in Lane, Oklahoma, watermelon has significantly more (about 40%) lycopene (most prevalent carotenoid in both crops) than raw tomatoes (Bauer 2002). During watermelon processing and handling, there is a significant loss of carotenoids due to heat treatment and clarification processing by enzyme treatment. In the present study, retention of carotenoids, polyphenolics, and flavour during clarification processing using various enzymes and temperatures were determined. Also, total carotenoid concentration in Sensus watermelon base was also determined to provide precise information to customers.

MATERIALS AND METHODS

Material:

Watermelon flesh and rind were thoroughly ground with a mill. For the flesh treatment, 200 ppm of pectinase was added to three samples and held at 4, 25, and 45°C for 90 min while one sample was remained untreated (no enzyme). For the rind, pectinase (200 ppm), cellulase (200 ppm), pectinase+cellulase (100ppm each) were added to ground rind while no enzyme was added to control. All four samples were incubated at 45°C for 90 min.

Methods:

1. Total Phenolics (TP) (also known as total soluble Phenolics) was determined using Folin-Ciocalteu assay as early described by Swain and Hillis (1959) and expressed as gallic acid equivalent.
2. Individual carotenoids were analyzed using Agilent 1200 series HPLC.

3. Total carotenoid in Sensus watermelon product was determined using spectrometric analysis. 10g of watermelon product was extracted using known volume of 50:50 acetone:ethanol solvent mixture until the residue became colorless. Carotenoid concentration was determined by scanning 2 mL of watermelon extract on a spectrophotometer between 350 nm and 550 nm and recording absorbance values at 425 nm, 447 nm, and 470 nm. These wavelengths correspond to predominant carotenoids present in mango, for example β -carotene (429, 452, 478), antheraxanthin (422, 445, 472), and violaxanthin (420, 443, 470). Concentration was calculated using 2500 as an average extinction coefficient for all carotenoids and reported in parts per million using Eq. 1.

$$\text{Eq. 1. Total carotenoid (mg/L)} = \frac{A_{470} \times \text{extraction} \cdot \text{volume}}{\text{sample} \cdot \text{weight} \times 100 \times \text{extraction} \cdot \text{coefficient}}$$

4. A Gerstel MultiPurposeSampler (MPS-2) (Baltimore, MD) was used with a 2-cm 3-phase (divinylbenene, Carboxen, Polydimethylsiloxane) for sample preparation. A 10-min incubation followed by a 40-min exposure was used to capture the volatiles on the fiber for injection into the GC. The sample was stirred using a 3x12mm stirbar in the 20mL vial. The fiber was desorbed for 5-min in the GC injector for 5 min. An Agilent 7890A gas chromatograph (Palo Alto, CA) was used for the analysis. Analysis was performed in the splitless mode with a helium flow rate of 1.25mL/min through a 60m x 0.25mm x 0.25 μ m RTX-5ms column. The initial oven temperature was 50°C immediately followed by a 4°C/min temperature ramp to 170°C which was followed by a 100°C/min ramp to 250°C and held for 5min in order to ensure no sample to sample contamination. The transfer line to the Leco TruTOF MS (St. Joseph, MN) was held at 240°C. Data was collected for 30-250 m/z at an acquisition rate of 10 spectra per sec. Identification was based on a combination of MS library matching along with reported retention indices. The samples were then prepared for analysis by pipetting 50 μ L into 4.9mL of water along with 50 μ L of internal standard (phenol-D6, 100 ppm).

RESULTS AND DISCUSSION

Total phenolic content determined by Folin-Ciocalteu assay in watermelon flesh and rind at different extraction method was illustrated in Table 1. In watermelon pulp, no significant difference was observed for enzyme (pectinase) treatment and the temperature (45°C is optimal for pectinase activity) was not a factor on the concentration of polyphenolic. Pectinase and pectinase+cellulase showed higher extraction yields of polyphenolics in watermelon rind. By breaking the cell wall structure of watermelon flesh, polyphenolics may have been dissolved.

Total carotenoids were higher when watermelon flesh was incubated at the optimal temperature for pectinase activity (45°C) (Figure 1(1)). All the enzyme treatments lowered carotenoid content in watermelon rind (Figure 1(2)). However, using pectinase is still required for watermelon rind processing because significantly lower juice yield was observed when no enzyme or cellulase only were added to rind.

A GC chromatogram (overall) was illustrated in figure 2. Figures 3-6 are sections of the chromatogram to show detail. Peaks are numbered and shown in Table 2. Peaks with melon in aroma descriptor are bolded. Of particular note is #15 (3-Hexen-1-ol) described as melon rind. There is a large peak in the rind sample and almost none in pulp sample. Compounds 24-29 (C-9 compounds) are all described as melon. As expected, the rind has little of these peaks, and the pulp has large amounts.

Copyright by SENSUS, LLC.

2

Total carotenoid concentration in Sensus watermelon base was 224.8 mg/L. Enzyme treatment is desirable for watermelon flesh processing for higher carotenoid retention while non-enzyme treated showed higher carotenoid content. However, when rind is not treated with pectinase, the yield rate of watermelon juice was significantly low.

Figure 1. Relative amount of carotenoid in watermelon flesh (1) and rind (2) (no enzyme = 1).

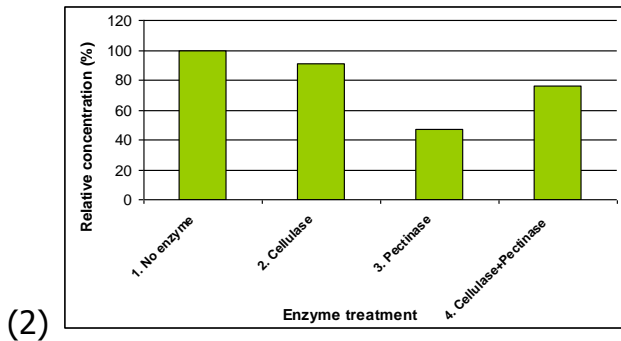
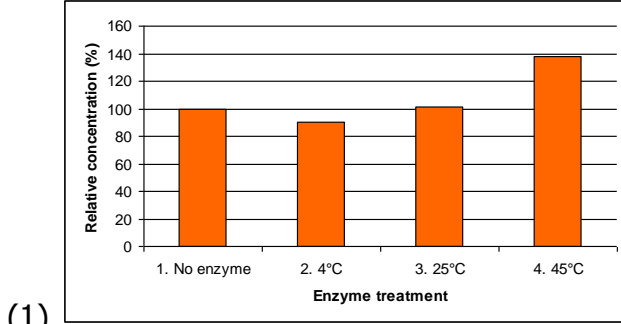


Figure 2. Chromatograms of watermelon flesh and rind by GC-MS.

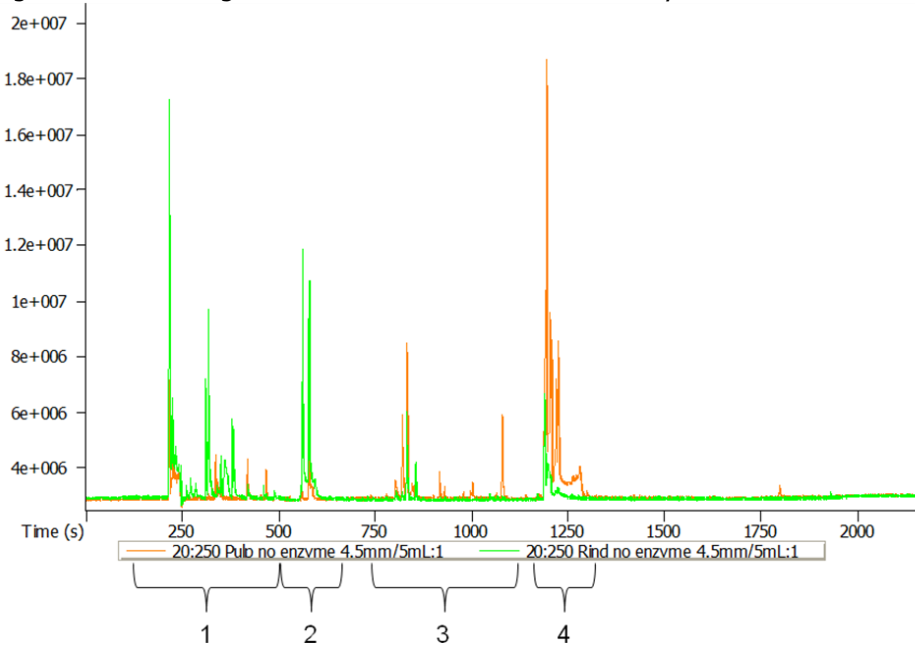


Figure 3. Section (1) from Figure 2.

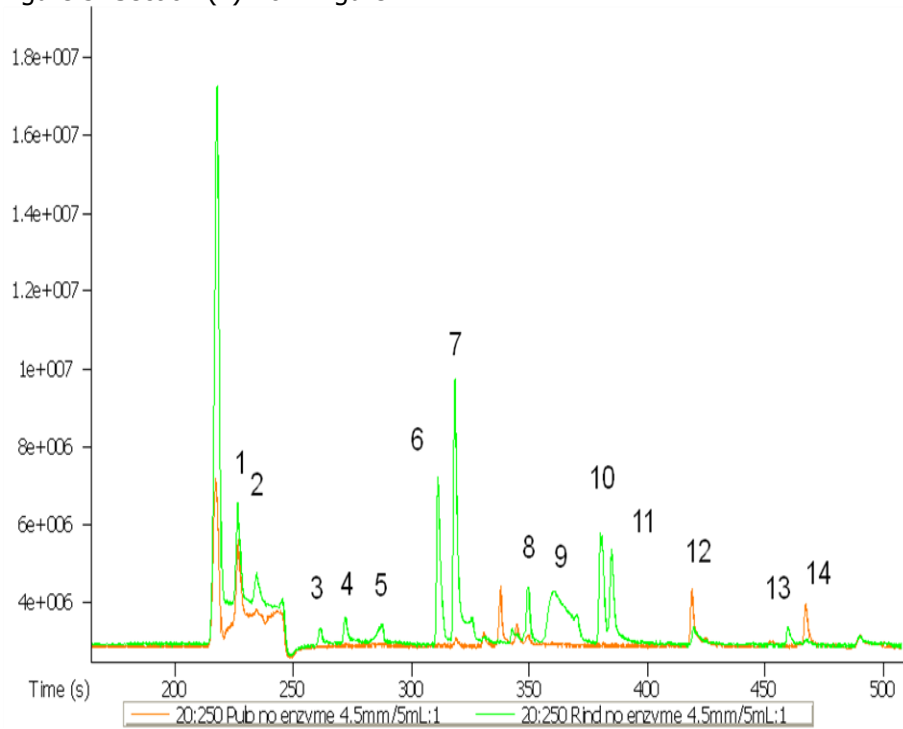


Figure 4. Section (2) from Figure 2.

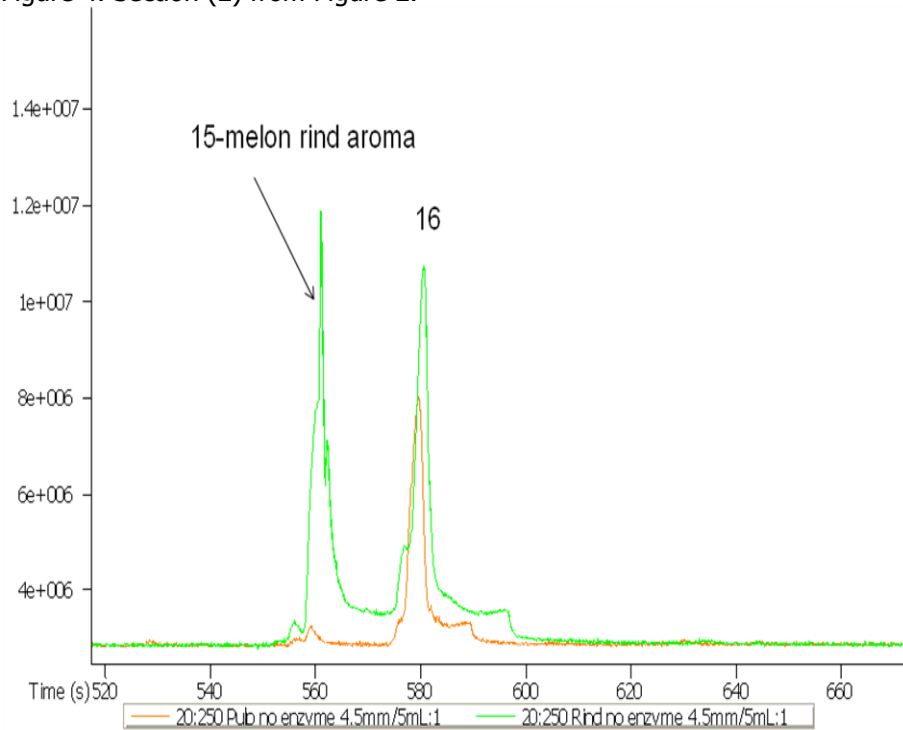


Figure 5. Section (3) from Figure 2.

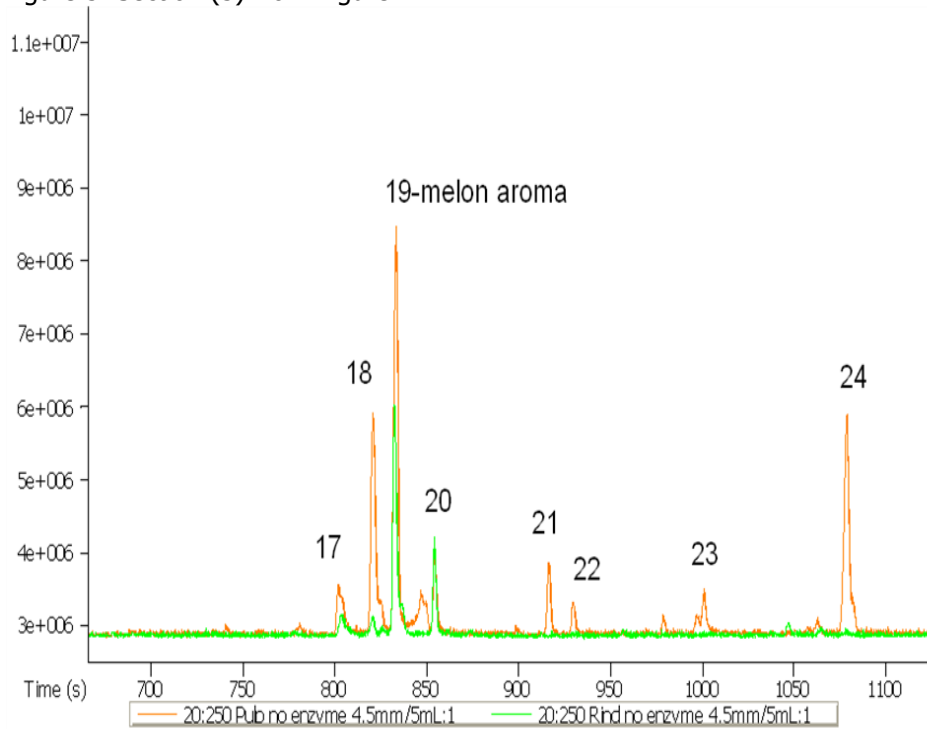


Figure 6. Section (4) from Figure 2.

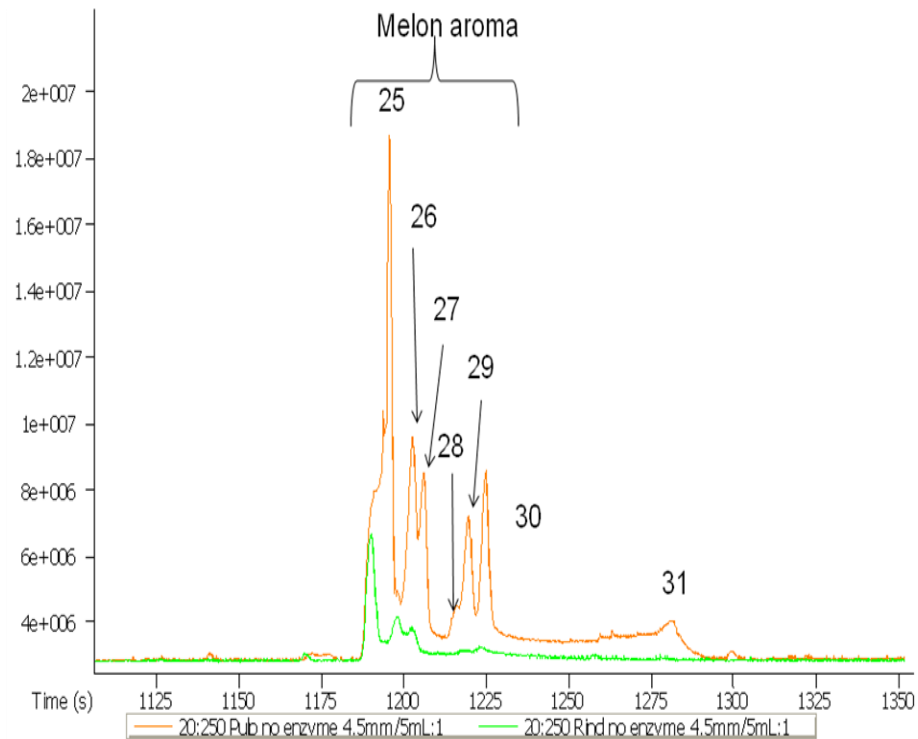


Table 1. Total phenolic content in pulp and rind by different clarification methods (mg/kg).
Copyright by SENSUS, LLC.

	No enzyme	4°C	25°C	45°C
Pulp	105.00	102.86	104.11	110.71
	No enzyme	Cellulase	Pectinase	Cellulase+Pectinase
Rind	266.79	248.75	296.25	304.11

Table 2. Peak identifications and aroma descriptor.

Peak #	Name	Retention Index	Aroma descriptor
1	Acetaldehyde	521	Pungent, winey
2	Ethyl alcohol	532	alcohol
3	Propanal, 2-methyl-	571	ripe fruit
4	2,3-Butanedione	586	buttery
5	Acetic acid	609	vinegar, sour
6	Butanal, 3-methyl-	643	fruity, sour, peach
7	Butanal, 2-methyl-	652	cocoa, coffee, fruity
8	Furan, 2-ethyl-	698	
9	2-Butanone, 3-hydroxy-	708	buttery, creamy, yogurt
10	1-Butanol, 3-methyl-	724	whiskey, alcoholic
11	1-Butanol, 2-methyl-	728	
12	1-Pentanol	756	fusel oil, chemical, sweet
13	2,3-Butanediol, [R-(R*,R*)]-	790	
14	Hexanal	796	green, grassy
15	3-Hexen-1-ol	850	green, grassy, melon rind
16	1-Hexanol	862	green, sweet
17	Phenol-d6-Internal Standard	975	
18	5-Hepten-2-one, 6-methyl-	983	green, herbaceous
19	Furan, 2-pentyl-	989	melon, vegetable
20	trans-2-(2-Pentenyl)furan	999	
21	Unknown	1028	
22	Unknown	1034	
23	1-Octanol	1066	citrus, floral
24	Nonanal	1101	citrus, orange, floral, melon
25	3-Nonen-1-ol, (Z)-	1155	Green, melon
26	3,6-Nonadien-1-ol, (E,Z)-	1156	Cucumber, melon
27	2-Nonenal, (E)-	1159	Green, vegetable, melon
28	trans,cis-2,6-Nonadien-1-ol	1165	melon, cucumber, guava, green
29	2-Nonen-1-ol, (E)-	1166	melon, oily
30	1-Nonanol	1169	citrus, rosy
31	1-Octanol, 2,7-dimethyl-	1195	

REFERENCES CITED

Bauer, S. Watermelon packs a powerful lycopene punch. Agricultural Research Magazine. 2002, 50, 11-13. Electric copy available here.
<http://www.ars.usda.gov/is/AR/archive/jun02/lyco0602.pdf>