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Separation and Processing Effects on Aromatic Components of Saskatoon Berries (*Amelanchier alnifolia* Nutt.)[1]

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Abstract. **Aroma essences of reproducible composition were separated from saskatoon berries by concentration of the headspace. Gas chromatography revealed 12 components in the aroma essences. The quantitative composition of the essences differed significantly among fresh berries, juice and jelly, and among fruit from 2 locations.**

Saskatoon, a rosaceous fruit, is found throughout the Canadian Prairies, southern Yukon and Northwest Territories, and the northern prairie states of the United States. Other species of *Amelanchier* are found elsewhere in North America and in parts of Europe and Asia where they are better known as serviceberry, shadbush, or juneberry (1).

Saskatoons have been used by the American Indians for centuries in pemmican, and were a major source of fruit for the early settlers of the North American prairies. The fruit is usually purple and ranges in diameter from 0.6 to 1.0 cm in the wild, and up to 1.6 cm under cultivation. Within the past decade considerable interest has been shown in bringing this fruit under cultivation, and in Alberta several orchards of saskatoons have come into production. This development, together with increased research activities in the areas of propagation, harvesting, plant development and processing (1, 2, 3) prompted the initiation of an investigation aimed at the identification of the major volatile components of saskatoons. This was thought important in the light of observations made when processing this fruit into jelly and juice that significant amounts of saskatoon flavor were lost during even mild heat treatment. Literature concerned with volatiles of saskatoons is non-existent and that for non-volatile constituents of the fruit is limited. Tuba et al., (6) indicated that saskatoons might be a useful source of Vitamin C. These workers, using the classical 2,6-dichlorophenolindophenol titration for Vitamin C estimation, reported 5-38 mg/100 g of ascorbic acid in fresh fruit. The method they used has limitations since saskatoons contain purple coloring pigments which obscure the endpoint of the titration. Subsequently, Panther & Wolfe (5) reported that saskatoons had a negligible ascorbic acid content and that ascorbic acid added to saskatoon juice was rapidly degraded. The predominant acid of ripening saskatoons is malic, while the major sugars are fructose and glucose (7).

Firm-ripe 'Smoky' saskatoon berries hand-harvested on August 1, 1978, were used for this study. Fruit was cleaned and frozen immediately in 0.5 kg lots and stored at -29°C for 3 weeks before the volatile analyses were initiated. The thawed fruit had the following characteristics: 21.5% total solids, 15.9% soluble solids, and 4.2 pH.

The juice used for the analyses and for the preparation of the jelly was extracted using an enzyme-assisted process (2) in which 0.8 parts of 0.5% Spark-L (Miles Laboratory, Rexdale, Ontario) solution to 1 part of fruit were mixed before heating for 30 min at 60°C, screening, pressing and filtering. This process produced a juice with a mild but distinctive flavor which was highly suitable for making jelly.

Jelly was made from juice, extracted as described above, using a 11.4 liter electric kettle (Alloy and Steel Fabricators Ltd., Scarborough, Ontairo) for the boiling operation, and a refractometer (Bausch and Lomb, Rochester, New York) for determining the finishing point. White sugar, citric acid and rapid set, 150 grade pectin (Bowes Co. Ltd., Montreal, Quebec) were used in the formulation. Citric acid and commercial pectin were used to adjust the pH to 3.2, and to reinforce the pectin content of the juices, respectively. The amount of sugar used in the formula was 49.0% of the total weight. The soluble solids content of the jelly, as determined with a refractometer, was 65%. The texture was smooth and firm, and the color was that of the fruit.

The volatile compounds of thawed saskatoons and saskatoon products were separated by a gas chromatographic (GC) procedure developed previously for dehydrated onion (3). Fifty grams of thawed, whole saskatoons, or an equivalent amount of processed product were mixed with 50 ml of pre-boiled distilled water in a 300 cm^3 stainless steel jar, fitted with a blending blade and a 2-port screw-cap connected to a nitrogen supply and to a 6-way, heated-type gas sampling valve (Varian Aerograph, Walnut Creek, California). The gas valve was on the exterior of a Hewlett-Packard Model 5710A gas chromatograph, connected to the gas chromatograph column and the injector. It was fitted with a 16 × 0.32 cm O.D. stainless steel trap containing approximately 12 cm of a porous polymer, Tenax-GC (Enka, The Netherlands) between glass wool plugs. The fruit-water mixture (inside the sealed jar) was blended for 30 sec, placed in a water bath at 40°C and swept with purified nitrogen, at 50 mg/min, to the Tenax-GC trap. During sampling, the trap was held near 0°, by placing a block of ice in an aluminum dish on its surface. After 15 min, the trap containing the saskatoon volatiles was backflushed by redirecting the GC nitrogen carrier gas through the trap and into the column. Immediately after activating the gas valve (injection) the Tenax trap was heated to 225° and kept at this temperature for the entire length of the gas chromatographic program, i.e., 1.0 hr. The heating of the trap was accomplished by replacing the block of ice with a block of brass held at 225° by means of a heating tape.

Volatiles were separated using 2.44 m × 3.175 mm O.D. dual stainless steel columns packed with Chromosorb 101, 80/100 mesh. The oven was held at 50°C for 4 min after injection, then programmed at 4°/min to 190° with a final period of 24 min at 190°. Gas

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valve temperature was 100° and that of the flame ionization detector was 250°. Nitrogen carrier gas flow rate was 30 ml/min. Hydrogen flow rate was 25 ml/min and air flow rate 275 ml/min. Peak area was measured with a Hewlett-Packard 3380A electronic integrator. The individual components were not identified.

The means of at least 3 replicates of the areas under the peaks obtained from the analyses of saskatoon berries, juice and jelly are given in Table 1. The percentage change in total peak area which reflects the volatile loss due to processing into juice and jelly is also given in the same table.

Table 1. GC headspace peak areas of saskatoon berries, juice and jelly.

Peak with retention time (min)	Peak area[z] (cm^2)		
	Fruit	Juice	Jelly
12.05	1.3	0.6	0.0
15.55	9.4	5.9	–
16.77	494.9	239.9	27.7
20.58	2.9	2.8	4.0
21.58	2,035.2	736.7	71.5
26.00	–	–	19.2
28.15	7.7	3.2	0.5
30.46	3.7	1.4	–
32.51	8.0	4.5	10.5
35.45	15.4	5.9	2.3
38.91	30.3	4.2	6.1
46.16	185.4	185.6	18.7
Total	2,794.2	1,190.9	160.5
Change from fruit (%)		57.4	94.3
Change from juice (%)			86.5

[z]The peak area figures are means of 3 or more replicates; coefficient of variation was ≤ 5%.

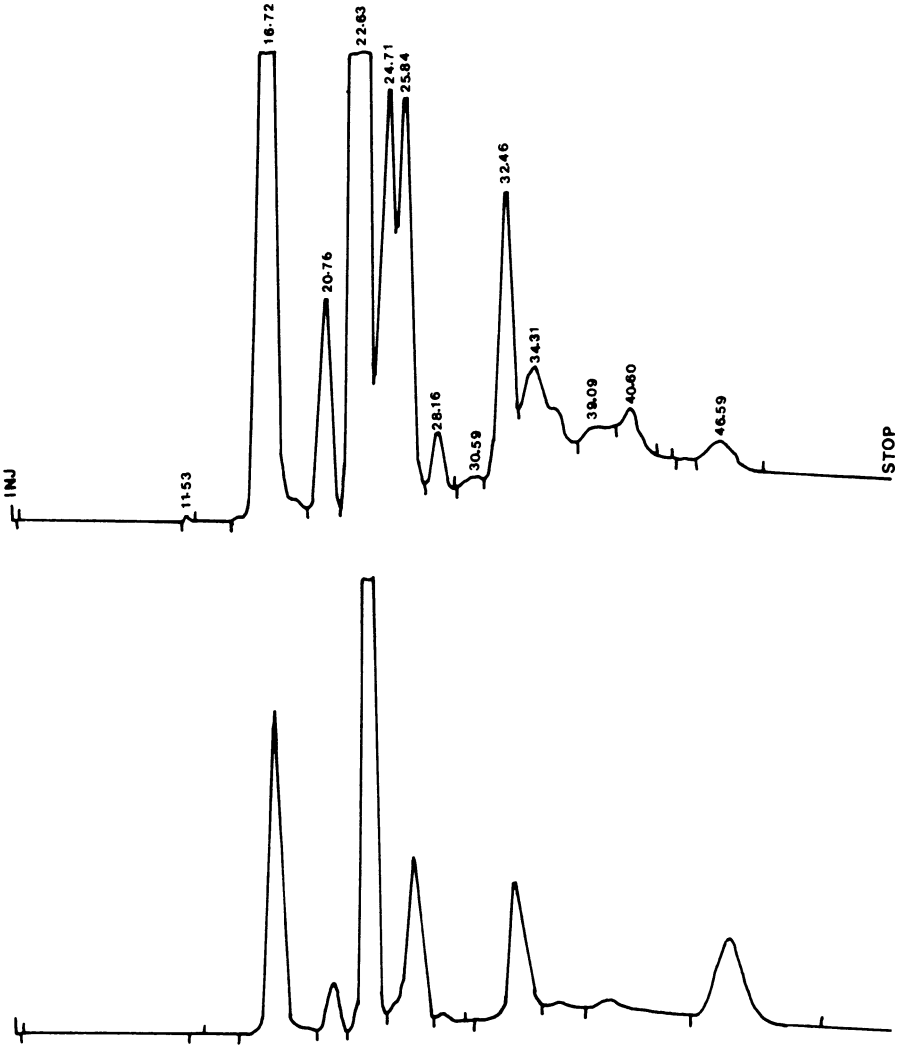

Fig. 1. Gas chromatograms of headspace volatiles developed from saskatoon jelly made from fruit grown in northern (top) and southern (bottom) Alberta.

Processing of the saskatoon berries into juice reduced all peaks, except the last one which remained unchanged. The total area under the 11 peaks decreased by 45.4%. Processing the juice into jelly resulted in a total peak area decrease of 86.5%. The total decrease from fruit to jelly was 94.3%. This indicates that nearly all the volatile compounds, including those which probably contribute to the odor sensation, were lost during processing of the saskatoon berries into jelly.

The chromatograms of headspace volatiles from saskatoon jelly made from berries obtained from the Agriculture Canada Research Station in Beaverlodge, Alberta, and from berries obtained from the Alberta Horticultural Research Center plots at Brooks, indicate more volatiles from the northern location (Beaverlodge). This is in agreement with observations made over the years by individuals who have had the opportunity to taste the fruit from these 2 locations.

The fact that the last compound separated did not decrease with processing is not surprising because, generally, the last compound on a chromatogram is the compound with the highest molecular weight and boiling point, hence can be retained more easily. The lower amount of volatile loss observed in processing fruit into juice, as compared to processing the juice into jelly, can be explained by the lower temperature (60°C) used in the former process. The difference in flavor intensity between the fruit grown at the 2 locations investigated, has generally been attributed to a difference in dry matter content which we found to be 5% higher in the fruit from Beaverlodge. The identity of the saskatoon volatiles has not been established, hence we cannot, at this time, use their physico-chemical properties to explain the observed loss.

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