

## CHEMICAL COMPOSITION OF THE JUICE OF THE FRUIT OF *Citrus unshiu*

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UDC 634.322:543.7/8

We have investigated the chemical composition of the juice of the mandarin *Citrus unshiu* Marc, family Rutaceae, cultivated in the Khelvachaur, Kobuleti, Makharadze, and Sukhumi regions of Georgia. Comparative biochemical analysis has shown that the compositions of the mandarin juice from the fruit of different regions of growth differ little from one another. The proportion by weight of soluble dry matter in it is 10%, the proportion by weight of titratable acids ranges between 1.0 and 1.8%, the ash content is 0.22-0.27%, and the concentration by weight of total nitrogen is 0.7-0.8 g/dm<sup>3</sup>.

We have studied the composition of the amino acids, organic acids, carbohydrates, flavonoids, and microelements in more detail.

Amino acids were determined with the aid of an amino acid analyzer (Hitachi model 835). For this purpose, 5 cm<sup>3</sup> of mandarin juice was mixed with 5 cm<sup>3</sup> of a solution of sulfo-salicylic acid. The protein that deposited was separated off by centrifugation (5 min, 3000 rpm, 20 min [sic]). The supernatant liquid was transferred to a 25-cm<sup>3</sup> measuring flask and its volume was up to the mark with the aid of citrate buffer.

As the definitive result we took the arithmetic mean of three parallel determinations the difference between which did not exceed 20% of the absolute value (Table 1).

The number of amino acids detected in the juice was 18, cystine and aspartic acid being in the form of traces and seven being essential amino acids. Their sum ranged from 229 to 350 mg/dm<sup>3</sup>. In the quantitative respect, threonine predominated. Proline was present in the juice in the largest amount (up to 550 mg/dm<sup>3</sup>). In a comparison of the amino acid compositions of the juice from the fruit of different growth sites, attention was attracted by the fact that the amounts of a number of amino acids - namely, glycine, methionine, isoleucine, and histidine - differed little, while for proline, alanine, and  $\alpha$ -aminobutyric acid the variations were considerable.

Sugars and organic acids were determined by gas-liquid chromatography after the conversion of these compounds into trimethylsilyl derivatives [1]. For this purpose, the moisture was eliminated from 0.1-0.2 cm<sup>3</sup> of a solution of 25 mg of hydroxylamine chloride and 2.5 mg of inositol (internal standard) in pyridine, and the mixture was kept in a thermostat at 70°C for 30 min and was then cooled to room temperature, after which 1 cm<sup>3</sup> of hexamethyl-disilazane and 0.1 cm<sup>3</sup> of trifluoroacetic acid were added. After 30 min, 0.5  $\mu$ l of the supernatant liquid was injected into the evaporator of a Perkin-Elmer chromatograph.

The carbohydrate in the juice consisted predominantly of fructose, glucose, and sucrose in amounts of 2.24, 2.07, and 1.97%, respectively, i.e., in a ratio of approximately 1:1:1. The proportion by weight of total sugars was 6.27%. The predominating organic acids were malic (0.4%) and citric (1.36%). When the acidity was high, a partial inversion of the sucrose was observed and the ratio of sugars changed. The growth site had no appreciable influence.

Spectral analysis showed the presence in the juice of the following macro- and microelements: K, Na, Ca, P, Cu, Mn, Fe, Ni, Cl, and V. The mineral composition is shown in Table 2. Of the main microelements, potassium was present in the largest proportion.

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Pyatigorsk Pharmaceutical Institute All-Union Scientific-Research and Experimental-Design Institute for the Storage and Processing of Subtropical Fruit, Batumi. Translated from Khimiya Prirodnikh Soedinenii, No. 3, pp. 415-417, May-June, 1990. Original article submitted July 12, 1989.

TABLE 1. Amino Acid Compositions of the Juice from *Citrus unshiu* Fruit Growing in Various Regions of Georgia, mg/dm<sup>3</sup>

Amino acid	Region of growth			
	Khelvachaur	Kobuleti	Makharadze	Sukhumi
	Traces			
Aspartic acid	136	159	173	223
Threonine	109	144	166	156
Glutamic acid	202	550	370	386
Proline	7	9	10	9
Glycine	78	46	122	122
	Traces			
Alanine	17	24	28	24
Cystine	5	6	5	8
Valine	3	6	4	4
Methionine	17	29	33	32
Isoleucine	15	2	22	16
Leucine	36	35	34	38
Tyrosine	131	208	185	159
Phenylalanine	15	20	25	21
$\alpha$ -Aminobutyric acid	165	221	257	230
Lysine	Traces	5	9	3
Serine	48	54	46	50
Histidine	229	279	317	350
Ammonia				
Sum of the essential amino acid				

TABLE 2. Micro- and Macroelements in the Juice from *Citrus unshiu* Fruit, mg/100 g

Element	In the juice	In the ash*
K	8.82	30.0
Na	$2.82 \cdot 10^{-1}$	9.6
Ca	$8.82 \cdot 10^{-1}$	3.0
P	$1.30 \cdot 10^{-1}$	3.82
Cu	$2.35 \cdot 10^{-3}$	8.0
Mn	$1.47 \cdot 10^{-2}$	5.0
Fe	$1.47 \cdot 10^{-2}$	5.0
Ni	$1.76 \cdot 10^{-3}$	6.0
Cl	$1.13 \cdot 10^{-3}$	4.0
V	Traces	Traces

\*Total amount of ash 0.34%.

The juice also contained flavonoid compounds. Of these, hesperidin predominated, but didymin, naringin, and narirutin were also present, as we have reported previously [2, 3].

#### LITERATURE CITED

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3. V. A. Bandyukova and G. M. Fishman, *Khim. Prir. Soedin.*, 405 (1979).