ECOLOGICAL AND TECHNOLOGICAL PARAMETERS OF APPLES

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Key words: *provisions, apples, juices, ecology, technology*

Abstract: *The aim of the study is to investigate the most cultivated traditional varieties of apples from farmers in the Kyustendil region, Bulgaria which to be compared with the new varieties and hybrids grown by the Institute of Agriculture in Kyustendil for their main environmental and technological parameters, in view of their safety for the population and the possibilities for their use as a raw material in the food industry by the enterprises in the region. The study found that the apples are environmentally friendly. The highest yields (over 70%) have apples from the varieties Granny Smith and Hybrid 2/14. The most delicious juices of fresh fruit are separated from the varieties Florina, Golden Delicious, Granny Smith, and Pinova × Fuji. Juices with the best color of fresh fruit (not brown) produce Florina, Golden Delicious, Granny Smith, Hybrid 1/3, Hybrid 2/14, Hybrid 9, Hybrid 8/35, and Pinova × Fuji.*

ЕКОЛОГИЧНИ И ТЕХНОЛОГИЧНИ ПАРАМЕТРИ НА ЯБЪЛКИ

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Ключови думи: *продовоствия, ябълки, сокове, екология, технология*

Резюме: *Целта на това изследване е да бъдат проучени най-отглежданите традиционни сортове ябълки от земеделските производители в Кюстендилски регион, които да бъдат сравнени с новите сортове и хибриди, отглеждани в Институт по земеделие в гр. Кюстендил за техните основни екологични и технологични параметри, с оглед на тяхната безопасност за населението и за възможностите за използването им като суровина в хранително-вкусовата промишленост от предприятията в региона. Изследването установи, че ябълките са екологично чисти. С най-висок рандеман (над 70% сок отделят ябълките от сортовете Грени Смит и Хибрид 2/14. Най-вкусни сокове, с вкус на пресни плодове дават сортовете Златна превъзходна, Грени Смит, Ренора и Пинова × Фуджи. Сокове с най-добър цвят дават Флорина, Златна превъзходна, Грени Смит, Хибрид 1/3, Хибрид 2/14, Хибрид 9, Хибрид 8/35 и Пинова × Фуджи.*

Introduction

In connection with the security of the food provision of our country, the apples are the main food resource in the fruit category. Apples are durable fruits for raw consumption with a rich and useful nutritional composition. They produce turbid juices and nectars, clear juices, syrups, wine, vinegar, cider. They can be used for cooking, puree, dried apples, fruit flour, apple acid, marmalades, compotes, and etc. Apples are used for all types food and canning industry. Bulgaria, and particularly

Kyustendil region is a traditional apple producer with high quality of the fruits. For this reason, the creation and study of new hybrids and varieties of apples is mandatory.

The topic is not very common in the scientific literature, but there are studies related to the protection of apples from radiation during storage as an example [1,2,3] as well as information about possible sources of radioactive contamination, influence of the common radiation background, the radioactivity of soils, waters and air, published by [4,5,6]. Data about the environmental situation of the Kyustendil region is published by [7,8,9]. Data about different apple varieties in the region is published by [10,11].

The aim of the study is to obtain information about the environmental and technological characteristics of some of the new raw materials for the food industry and in particular of fruits – apple hybrides from the proved fruit-growing Kyustendil region, Bulgaria.

Materials and Methods

This study presents investigation of 7 apple varieties and 13 hybrids, produced by the Institute of Agriculture, town of Kyustendil, Bulgaria, designed for the food canning (juice) industry. Classical apple varieties as Granny Smith, Golden Delicious and some others were analyzed for comparison of the hybrids with them.

Turbid juice was obtained by cold pressing with a single-shaft juicer Star Light SJB-150 R.

Through portable digital instruments MA871 Brix Refractometer and “Waterproof IP57“ tester their main technological parameters were studied for total sugars in juice (Brix %), total acidity (pH), electro-conductivity (µS), TDS-total dissolved solids (ppm), total salt content (ppm). Yield juice content (%) was measured and calculated through analitical laboratory scale and also the main sensor parameters as taste, aroma, color and turbidity were analysed.

The total radiation background, the radioactivity of the fruit and the juice obtained from them were measured with a Geiger counter "Radex" RD1503 in the microsievert per hour (µSv/h). For each variety of apples and their juices, 4 consecutive measurements were performed, followed by averaging of the value, which were performed automatically. The measurements of the total radioactivity of the fruits were performed without dividing the individual types of radiation. Glucose content is measured with an instrument CodeFree, with range 0.6–33.3 mmol/l.

For measurements of the moisture and drying of the apples an electro-thermal incubator PJPX (0–100°C) series and a moisture measurement instrument KWB were used.

Nitrate and nitrite content in the juice were measured by using test strips with a range of 0–10–25–50–100–250–500 mg/l. Arsenic content was measured by the usage of test strips with a range of 0.005–0.0010–0.0025–0.05–0.1–0.25–0.5 mg/l. Zink content was measured by the usage of test strips with a range of 0–4–10–20–50 mg/l. Lead content was measured by the usage of test strips with a range of 20–40–100–200–500 mg/l. Manganese content in the juice was measured by the usage of test strips with a range of 2–5–20–50–100 mg/ l. Sulfate and sulfite content were measured by using test strips with a range of 200–400–800–1200–1600 mg/l for SO_4 and 10–40–80–180–400 mg/l for SO_3.

Results

The results of the performed measurements are presented in Tables 1 and 2.

Table 1. Measured ecological parameters of the apples

№	**Parameters measured** / **Apple varieties**	**Radiation background, µSv/h**	**Radioactivity of the apples, µSv/h**	**Juice Radioactivity, µSv/h**	**Juice Sulfate (SO4 2-), mg/l**	**Juice Sulfite (SO3 2-), mg/l**	**Juice Nitrate (NO3 -), mg/l**	**Juice Nitrite (NO2 -), mg/l**	**Juice Mn, mg/l**	**Juice Zn, mg/l**	**Juice Pb, mg/l**	**Juice As, mg/l**
1	**COOP 10**	0.16	0.17	0.16	300	0	0	0	2	1	0	0
2	**Florina**	0.16	0.12	0.13	300	0	0	0	2	1	0	0

3	**Golden Delicious**	0.16	0.14	0.12	300	0	0	0	2	1	0	0
4	**Golden Resistance**	0.14	0.12	0.14	300	0	0	0	2	1	0	0
5	**Granny Smith**	0.15	0.13	0.10	300	0	0	0	2	1	0	0
6	**Pinova × Fuji**	0.15	0.14	0.12	300	0	0	0	2	1	0	0
7	**Prima**	0.12	0.13	0.13	300	0	0	0	2	1	0	0
8	**Hybrid 1/3**	0.16	0.15	0.12	300	0	0	0	2	1	0	0
9	**Hybrid 1/37**	0.16	0.17	0.15	300	0	0	0	2	1	0	0
10	**Hybrid 2/14**	0.18	0.14	0.14	300	0	0	0	2	1	0	0
11	**Hybrid 2/28**	0.16	0.17	0.17	300	0	0	0	2	1	0	0
12	**Hybrid 2/30**	0.15	0.12	0.12	300	0	0	0	2	1	0	0
13	**Hybrid 2/4**	0.16	0.16	0.16	300	0	0	0	2	1	0	0
14	**Hybrid 2/8**	0.16	0.17	0.16	300	0	0	0	2	1	0	0
15	**Hybrid 6**	0.16	0.19	0.16	300	0	0	0	2	1	0	0
16	**Hybrid 7**	0.18	0.18	0.16	300	0	0	0	2	1	0	0
17	**Hybrid 8/22**	0.18	0.16	0.17	300	0	0	0	2	1	0	0
18	**Hybrid 8/35**	0.16	0.16	0.15	300	0	0	0	2	1	0	0
19	**Hybrid 9**	0.16	0.15	0.15	300	0	0	0	2	1	0	0
20	**Hybrid 9/36**	0.13	0.16	0.12	300	0	0	0	2	1	0	0

Table 2. Measured technological parameters of the apples

№	**Para-meters measured** **Apple varieties**	**Juice Yield, %**	**Juice Brix-total sugar, %**	**Juice Glucose, mmol/l**	**Juice PH-acidity**	**Juice Conductivity, µS**	**Juice TDS-total dissolved solids, ppm**	**Juice Salt, ppm**	**Juice Colour**	**Juice Turbidity**	**Juice Aroma**	**Juice Taste**	**Taste of the Dried Apple**	**Misture separated, %**
1	**COOP 10**	3.00	9.90	>33.3	3.66	763	509	371	yellow	puree	unidentified	tasteless	sweet	85.2
2	**Florina**	61.61	11.70	26.9	2.9	1391	935	699	yellow brown	high	fresh fruit	sweet-acid	sweet-acid	83.9
3	**Golden Delicious**	66.51	11.30	>33.3	3.26	1799	1204	908	yellow	high	fresh fruit	sweet-acid	sweet-acid	82.5
4	**Golden Resistance**	43.60	13.10	>33.3	2.88	738	495	357	brown	puree	dried fruit	sweet-acid	sweet-acid	86.4

5	**Granny Smith**	72.50	11.50	>33.3	2.94	1250	685	374	yellow-green	high	fresh fruit	acid-sweet	sweet-acid	84.2
6	**Pinova × Fuji**	49.50	14.00	>33.3	3.97	1914	1282	971	yellow	high	fresh fruit	sweet-acid	sweet-acid	82.1
7	**Prima**	<30	10.50	>33.3	3.1	727	664	478	brown	puree	dried fruit	sweet-acid	sweet	85.2
8	**Hybrid 1/3**	51.76	15.90	>33.3	4.02	1413	942	702	yellow-brown	high	dried fruit	sweet-acid	sweet	85.9
9	**Hybrid 1/37**	54.67	10.90	>33.3	3.87	1972	1321	1003	brown	high	dried fruit	sweet	sweet-acid	86.9
10	**Hybrid 2/14**	70.00	11.60	>33.3	2.72	1992	1323	1004	yellow-brown	high	fresh fruit	sweet-acid	sweet-acid	86.3
11	**Hybrid 2/28**	7.26	11.10	26.7	3.00	1908	1277	969	yellow-brown	puree	dried fruit	sweet-acid	sweet-acid	84.2
12	**Hybrid 2/30**	23.00	13.00	27.1	3.81	507	765	370	brown	high	dried fruit	sweet-acid	sweet	83.2
13	**Hybrid 2/4**	42.00	13.00	>33.3	3.00	3760	2520	2020	brown	puree	dried fruit	sweet-acid	sweet	86.4
14	**Hybrid 2/8**	<30	11.70	>33.3	3.15	1459	979	724	brown	puree	dried fruit	sweet-acid	sweet-acid	85.6
15	**Hybrid 6**	34.17	12.00	>33.3	3.70	3820	2560	2040	brown	puree	dried fruit	sweet-acid	sweet	84.2
16	**Hybrid 7**	21.28	10.30	>33.3	2.97	1911	1281	971	yellow-brown	puree	dried fruit	sweet-acid	sweet-acid	87
17	**Hybrid 8/22**	18.93	13.10	>33.3	3.11	1901	1276	968	brown	puree	dried fruit	sweet-acid	sweet-acid	83.9
18	**Hybrid 8/35**	61.99	13.80	>33.3	2.84	1460	982	730	yellow-brown	high	fresh fruit	sweet-acid	sweet-acid	86.5
19	**Hybrid 9**	19.82	14.10	>33.3	3.30	1833	1226	925	brown	puree	dried fruit	sweet-acid	sweet-acid	83.4
20	**Hybrid 9/36**	42.98	12.50	25.3	3.47	3770	2520	2010	brown	high	dried fruit	sweet-acid	sweet	82.7

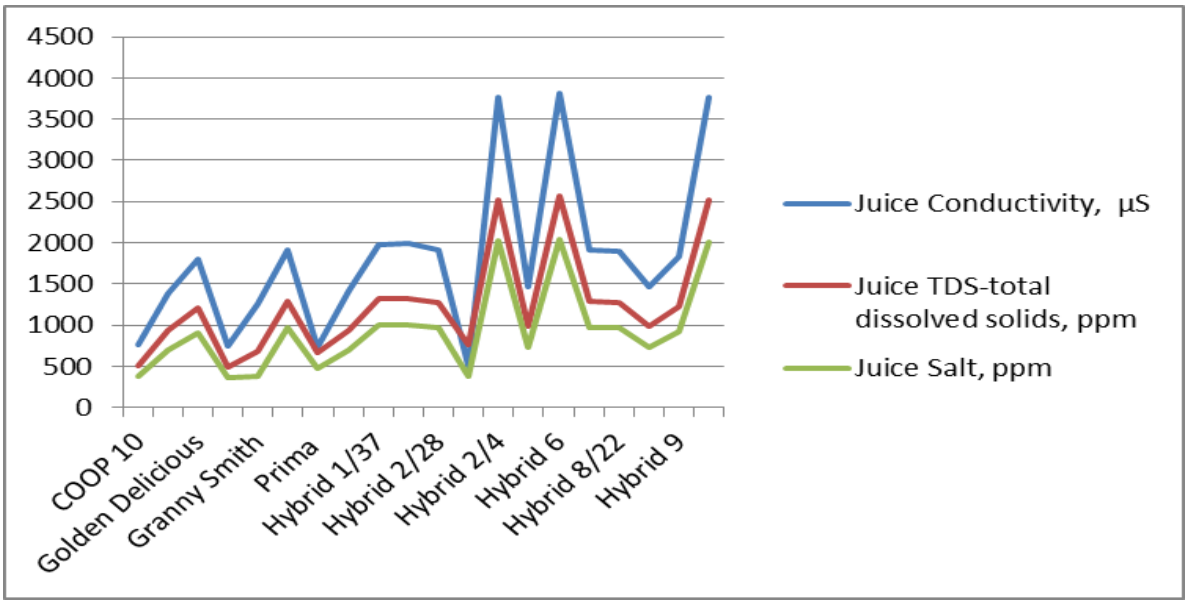

Fig. 1. Mutual depending of some technical parameters of the juice

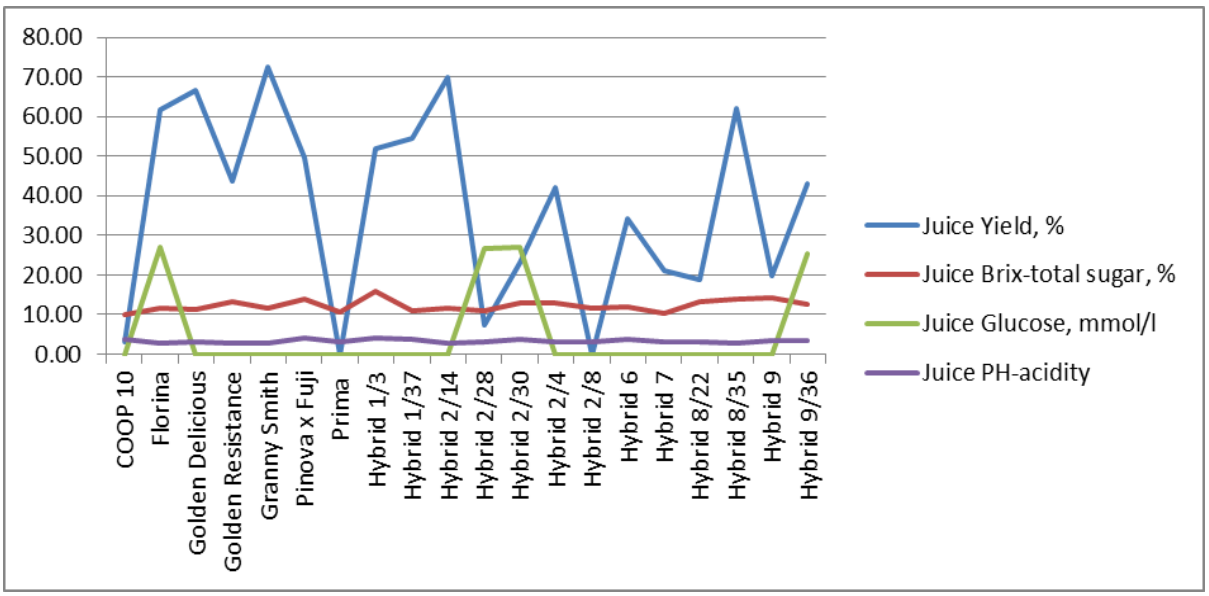

Fig. 2. Juice is the most variable parameter of the apples

Conclusion

All tested varieties and hybrids of apples and their juices have low radioactivity in accordance with regulations. The natural radiation background of the Kyustendil region is 0.16 μSv/h (as there is a fluctuation from 0.10 to 0.20 μSv/h), and less often it is outside these norms. With few exceptions, the radioactivity of the juice directly depends on the radioactivity of the fruit, with a slight decrease of the radiation values in the juice, probably part of it remains in the pressed fruit mass.

There are not established content of lead, arsenic, nitrate, nitrite and sulfite's content. The content of the sulfates is constant for all studied apple varieties and hybrids about 300 mg/l. They are probably a part of the amino-acids in the organic matter in the fruits.

The analyses of the technological parameters show that almost half of the hybrids can't produce juice, but they are good for producing of puree and dried apples and the most tasteless apple variety has excellent taste of the dried fruit.

The highest juice yields (over 70%) have apples from the varieties Granny Smith and Hybrid 2/14. The most delicious juices of fresh fruit are separated from the varieties Florina, Golden Delicious, Granny Smith, and Pinova × Fuji. Juices with the best color of fresh fruit (not brown) produce Florina, Golden Delicious, Granny Smith, Hybrid 1/3, Hybrid 2/14, Hybrid 9, Hybrid 8/35, and Pinova × Fuji.

Acknowledgements

The research and publication were supported by the Bulgarian Ministry of Education and Science (Fund "Scientific Research") – Project "Breeding and application on new yellow-green crisp apple varieties in Bulgaria and China" – Contract: № КП -06-China /4 from 20.12.2018.

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