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DEVELOPMENT OF FRUIT PRODUCTION AND PROCESSING IN THE REPUBLIC OF SERBIA

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Summary

Although Serbia is characterized by favourable natural conditions for growing most of the continental fruit species, the full potential of their exploitation has not been reached yet. The main indicators of this underutilisation are values of main parameters of fruit production during longer periods of time. Due to its mostly extensive feature, the fruit production in Serbia has been ground to a halt for a considerable period of time, and has even shown the signs of reduction. In the period from 1981 to 2011, orchard areas in Serbia covered 252,364 ha on average, with the annual reduction rate of -0.40%.

During the analysed period (2001-2010), the highest production volume of processed fruit products (semi-processed and finished products) was recorded in fruit juices (155,012 t) and frozen fruits (24,602 t). Fruit juices and frozen fruits account for 93% of the total processed fruit products in Serbia. The processed fruit production during the analysed period increased at the average annual rate of change of 14.82%.

Key words: *orchard areas, fruit production, semi-processed fruit products, finished fruit products*

JEL: *Q15, L66*

Introduction

Considering all favourable natural conditions for fruit growing, the production of fresh and processed fruits in Serbia is rather insufficient. It can be freely stated that orchard areas in Serbia surpass the demand for fruits. Intensive fruit production in smaller orchard areas could provide significantly larger quantities of high-quality fruits (by increasing the yield per unit area). Therefore, provided the yield is increased to 15 t/ha, plum production

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(which is the most prevalent and cost-effective fruit production in Serbia) could achieve the current volume of production on 35,000-40,000 ha in contrast with over 100,000 ha of the present plum plantations in Serbia (Obradović, 2001, Milić et al., 2005).

Observed as a whole, the fruit growing in Serbia is in a rather poor condition. Small areas of fruit plantations impede the application of high-capacity machinery for cultural practices. The high prevalence of obsolete (antiquated) varieties and great diversity of varieties cause considerable hardships in the supply of high-quality fruits on the market. Moreover, other unresolved issues (such as the production of high-quality planting material, the required funding for fruit growing and production, etc.) also pose a great hindrance to the improvement of fruit production.

Although the need for integrated fruit production and processing is often emphasised, the generally accepted solution of their vertical relationship has not been found yet. However, intensive fruit production cannot be established without modern high-technology processing capacities. The modernisation of fruit processing capacities simultaneously enhances fruit production. Therefore, fruit processing capacities should be closely connected to raw materials due to high safety requirements in continuous raw material supply.

Research aims, data resources and work methods

The principal aim of this research is a review of general tendencies in the fruit production and processing in Serbia. The analysis of production volume change was conducted in several major fruit species during 1981-2011, as well as major semi-processed and finished fruit products during 2001-2010.

The analysis of parameter values and tendencies in fruit production and processing was conducted based on the published and internal data of the Statistical Office of the Republic of Serbia and the Federal Statistical Office of Yugoslavia (the Bulletin of Crop Science, the Bulletin of Fruit Science and Viticulture, and the Bulletin of the Industry of Serbia) for the analysed period.

The aim of the research and available data resources were expressed by means of descriptive statistics: the arithmetic mean, the interval of variation, and the coefficient of variation. The assessment of parameter value changes was done by means of the average annual rate of change based on the exponential trend:

In the exponential trend: $\hat{Y}$ is the value of the dependent variable, x is the independent variable, a and b are the parameters of the exponential trend.

Research results

Fruit production capacity

In the period from 1981 to 2011, the total orchard area in Serbia covered 252,364 ha on average, with the variations ranging from 237,640 ha in 2006 to 265,817 ha in 1983 (Table 1). The orchard areas in the analysed period reduced at the average annual rate of change of -0.40%.

The status and importance of fruit production in the Serbian agriculture is evident from the share of orchard area in the total arable land. In the analysed period (1981-2011), the share of orchard area in the total arable land was 5.61%.

Table 1. The share of orchard area in the total arable land in the period 1981-2011

Indicators	Arable land (ha)	Orchard area (ha)	Orchard area share in the total arable land (%)
Average: 1981-2011	4,502,812	252,364	5.61
Minimum	4,211,377	237,640	5.44
Maximum	4,742,683	265,817	5.78
Annual Rate of Change (%)	-0.51	-0.40	0.11
Coefficient of Variation (%)	5.11	3.79	1.87

Source: The calculation was based on the data obtained from the Statistical Office of the Republic of Serbia and the Federal Statistical Office of Yugoslavia

Although Serbia is characterized by favourable natural conditions for growing most of the continental fruit species, the share of orchard area in the total arable land has been slightly increasing (at the rate of change of 0.11%) due primarily to larger reduction of the arable land in comparison with the reduction of orchard area.

The analysis of structural changes in fruit growing according to fruit species can only be conducted based on the number of productive fruit trees (the number is recorded by the official statistical office). Therefore, the analysis of the number of productive fruit trees can show the structural tendencies in fruit production, considering the fact that the number of fruit trees is one of the indicators of fruit production capacity and that the variations of growth habits change the number of trees per unit area.

Table 2. The number of productive fruit trees in Serbia in the period 1981-2011

Fruits species	Average number of productive fruit trees (1000)	Interval of variation		Annual rate of change (%)	Coefficient of variation (%)	Structure (%)
		Min.	Max.			
Apple	13,727	11,151	16,042	0.95	8.94	16.78
Pear	5,906	4,404	7,198	-1.45	15.57	7.22
Plum	44,710	40,822	50,438	-0.67	6.30	54.67
Cherry	1,868	1,804	1,933	-0.12	1.56	2.28
Sour cherry	8,528	6,022	9,527	0.15	7.91	10.43
Peach	3,846	3,563	4,800	0.57	8.29	4.70
Apricot	1,549	1,376	1,781	0.53	5.81	1.90
Walnut	1,654	1,424	1,757	0.55	5.51	2.02
Total	81,788	78,912	85,921	-0.25	2.81	100.00

Source: The calculation was based on the data obtained from the Statistical Office of the Republic of Serbia and the Federal Statistical Office of Yugoslavia

The number of productive fruit trees increased in most of the analysed fruit species (Table 2). In the analysed period (1981-2011), the largest increase of the number of productive fruit trees was recorded in apple production, in which the number of productive fruit trees increased at the average annual rate of change of 0.95%. The number of productive fruit trees in all the other analysed fruit species increased ranging from the average annual rate of 0.15% in cherry production to 0.57% in peach production.

The total number of the analysed productive fruit trees was 81.8 million. With 44.7 million productive trees on average, plum trees account for 54.67% of the total productive fruit tree number in Serbia, followed by apple trees (16.78%), sour cherry trees (10.43%), and pear trees (7.22%). The productive tree number of the other analysed fruit species (such as peach, cherry, walnut, and apricot trees) was below 4.70% of the total productive fruit tree number in Serbia. Therefore, plums are traditionally most extensively grown fruit species in the Serbian fruit production. The vast majority of farmers in Serbia grow plums due to traditional plum brandy production (*Slivovitz*) and minimal requirements of this fruit species in terms of natural conditions and cultural practices.

In the period 1981-2011, the average fruit production in Serbia was 1,025,411 t, with the variations ranging from 585,866 t in 2002 to 1.4 million t in 1996. High fruit production variations over the years were confirmed by the difference between the minimal and the maximal interval of variation which equals to 817,304 tonnes in the analysed period (Table 3). The total fruit production increased at the average annual rate of change of 0.37%.

Table 3. The fruit production in Serbia in the period 1981-2011

Fruits species[2]	Average production (t)	Interval of variation		Annual rate of change (%)	Coefficient of variation (%)	Structure (%)
		Min.	Max.			
Apple	213,712	95,584	306,950	-0.17	21.57	20.84
Pear	68,172	33,645	96,400	-1.55	20.80	6.65
Plum	459,712	197,486	680,566	0.35	28.59	44.83
Cherry	25,288	15,726	30,823	-0.18	15.78	2.47
Sour cherry	80,691	48,919	112,326	-0.07	19.88	7.87
Peach	50,246	36,873	77,230	1.32	21.50	4.90
Apricot	20,630	5,592	40,754	1.11	40.28	2.01
Walnut	19,018	10,238	25,172	1.58	22.90	1.85
Strawberry	30,336	20,004	39,707	0.80	16.76	2.96
Raspberry	57,606	17,432	93,982	5.00	41.36	5.62
Total	1,025,411	585,866	1,403,170	0.37	19.86	100.00

Source: The calculation was based on the data obtained from the Statistical Office of the Republic of Serbia and the Federal Statistical Office of Yugoslavia

2 Fruit species with the published data by the Statistical Office of the Republic of Serbia were included (only quince production was not included due to its irrelevance with the share of 0.8% in the total Serbian fruit production).

The largest increase in production volume was recorded in raspberry production (at the 5.00% rate of change) and walnut production (at the 1.58% rate of change). The total raspberry production increased from 17,432 tonnes in 1981 to 93,982 tonnes in 2011 due primarily to the increased demand for this fruit species on the international market. The 41.36% coefficient of variation indicates the precariousness of this production. The increase in production volumes of other analysed fruit species was recorded ranging from the average annual rate of change of 0.35% in plum production to the average annual rate of change of 1.58% in walnut production.

The tendencies of orchard area decrease and production volume increase indicate the intensification of fruit production in Serbia, especially during the final years of the analysed period.

Plum and apple production account for the greatest share of the total fruit production in Serbia (65.67%), followed by sour cherry (7.87%), pear (6.65%), and raspberry production (5.62%). The share of the other analysed fruit species ranged from 1.85% (walnut) to 4.90% (peach). Therefore, plums, apples and sour cherries are the most prevalent fruit species in the Serbian fruit production according to both the number of productive trees and the volume of production.

Table 4. Production of major fruit species in Serbia

Period	Fruits species				
	Apple	Pear	Plum	Sour cherry	Raspberry
1981-1990					
Average production (t)	234,660	81,191	471,962	84,709	34,341
Annual Rate of Change (%)	-1.71	1.59	-3.35	3.45	14.46
Coefficient of Variation (%)	16.15	11.35	25.20	15.42	44.85
1991-2000					
Average production (t)	191,113	68,960	404,946	74,740	51,417
Annual Rate of Change (%)	0.97	-1.53	0.96	-4.42	4.98
Coefficient of Variation (%)	16.35	11.52	24.83	18.29	19.22
2001-2011					
Average production (t)	215,212	55,621	498,361	82,450	84,381
Annual Rate of Change (%)	7.71	3.46	6.84	3.33	0.26
Coefficient of Variation (%)	26.48	20.23	31.86	24.13	6.81

Source: The calculation was based on the data obtained from the Statistical Office of the Republic of Serbia and the Federal Statistical Office of Yugoslavia

The Serbian share in the total European production of the analysed fruit species accounts for 3.71%. In the total European plum production (Table 5), Serbia participates with 426,846 tonnes (15.41%) and immediately follows Romania, which is the leading plum producer in Europe with the annual plum production of 624,884 t. Furthermore, Serbia also significantly participates in the total European production of raspberries (21.43%), sour cherries (9.08%), and walnuts (6.54%). The Serbian share in the European production of the other analysed fruit species is below 2.92%.

Table 5. The Serbian share in the total European fruit production in 2010

Fruit species	Production (t)		Serbian share in the European fruit production (%)	Serbia's rank in Europe
	Republic of Serbia	Europe		
Apples	239,945	13,715,674	1.75	14
Pears	47,501	2,874,697	1.65	13
Plums and sloes	426,846	2,770,496	15.41	2
Cherries	22,201	759,419	2.92	13
Sour cherries	66,224	729,179	9.08	4
Peaches and nectarines	68,636	4,017,093	1.71	5
Apricots	22,936	795,759	2.88	9
Walnuts	21,419	327,641	6.54	5
Strawberries	32,973	1,432,945	2.30	11
Raspberries	83,870	391,455	21.43	3
Total	1,032,551	27,814,358	3.71	10

Source: The calculation was based on FAO

Fruit processing

Nowadays, Serbia possesses considerable capacities of fruit processing and cooling. However, for the last decade of its development, this industry has been facing the issues of facility underutilisation (because the increased capacity demands the increased volumes of raw material for a wide array of high-quality processed fruit products). Approximately 10% of the total fruit yield is processed, which is rather low in comparison with the USA where approximately 45% of produced apples and 70% of produced plums are processed (Jovanović et al., 1996). This is undoubtedly a consequence of the discrepancy between the fruit production and the fruit processing industry (Milić, Radojević, 2003). The current utilisation of processing capacities is far below its potentials and amounts to approximately 30% (Lukač Bulatović, 2004). According to different production lines, the capacity utilisation ranges from 3.1% (in the concentrated fruit juice production line) to 38% (in the frozen fruit production line). The reason of this capacity underutilisation is also the low marketability of processed fruit products. Processed fruit products in Serbia are still mostly produced by national resources as a consequence of the consumers' low standard of living, and the low quality and array of products.

Fruit processing is mostly located in the region of Central Serbia. In the total fruit processing industry of Serbia, Vojvodina participates with the share of 28.3% in semi-processed fruit products and 19.0% in finished fruit products. In contrast with the fruit processing industry of Central Serbia (which offers a wide assortment of semi-processed fruit products), the fruit processing industry of Vojvodina offers only frozen fruits, fruit pulp, and fruit puree (Lukač Bulatović, 2010). In order to enrich the assortment of processed fruit products, minimize the seasonal feature of fruit processing and increase the utilization of equipment and infrastructure, fruit processing technology ought to (especially fruit drying technology which is still mostly related to plum drying) include other fruit species such as apricots, peaches, grapes (Gvozdenović et al., 1997).

Considering that fruits of many species are not favourable raw materials for obtaining high-quality processed fruit products (especially for the international market), the production of industrial fruits (the fruits which is exclusively used for processing) should be enhanced. The high-quality raw materials, with high technological value and standardised quality, ensure the uniformity of processed fruit products. Consequently, the fruit processing industry is constantly supplied by high-quality raw materials at acceptable prices. Certain industrial peach cultivars (such as clingstone peaches *Pavia*) are mostly used in the processing industry. The largest quantity of these fruits is preserved (approximately 40%), 1-2% is dried, 5-6% is marketed as frozen, and 2-3% is processed into jams, jellies, brandies and juices (Ognjanov, 2003, 2004). The supply of fruits for processing is rather poor and unvaried in Serbia. The processed fruits are usually fresh fruits with certain flaws, mechanical damages or signs of rot and mouldiness. However, plums (*Prunus domestica*), apricots and small fruits are very favourable for high-quality processing.

Table 6. The processed fruit production in Serbia in the period 2001-2010

Type of processed fruit	Average 2001-2010	Interval of variation		Annual rate of change (%)	Coefficient of variation (%)	Structure (%)
		Min	Max			
Fruit pulp and puree - frozen	2,285	14	4,778	-42.45	85.55	1.18
Concentrated fruit juice	5,032	53	11,172	45.10	83.21	2.60
Frozen fruit	24,602	18,375	42,709	3.48	28.86	12.73
Semi-processed fruit products	31,919	24,772	51,949	5.14	25.89	16.51
Fruit juice	155,012	49,947	251,057	19.08	46.61	80.18
Fruit syrup	1,044	266	1,706	-13.43	42.32	0.54
Preserved fruit	576	27	1,505	-28.23	94.59	0.30
Jam	4,449	3,038	6,193	-4.78	23.60	2.30
Dried fruit	329	16	1,145	22.04	106.28	0.17
Finished fruit products	161,410	53,346	257,084	17.40	44.03	83.49
Total	193,329	84,118	284,463	14.82	39.18	100.00

Source: The calculation was based on the data obtained from the Statistical Office of the Republic of Serbia

In the period 2001-2010, the total production volume of processed fruit products in Serbia amounted to 193,329 tonnes ranging from 84,118 tonnes in 2001 to 284,463 tonnes in 2008 (Table 6). The highest production volume was recorded in fruit juices (155,012 t) and frozen fruits (24,602 t). These processed fruit products account for 92.91% of the total analysed processed fruit products in Serbia. The production volumes of the other analysed processed fruit products ranged from 329 tonnes (dried fruits) to 5,032 tonnes (concentrated fruit juices).

In the analysed period, the total processed fruit production increased at the average annual rate of change of 14.82%. The highest production volume increase was recorded in concentrated fruit juices (the 45.10% rate of change) and dried fruits (the 22.04% rate of change). The

calculated coefficients indicate high variations of the production volumes, especially in dried fruits (CV=106.28%) and compotes (CV=94.59%).

Table 7. Production of major processed fruit products in Serbia per year (2001-2010)

Years	Production (t)		
	Concentrated fruit juice	Frozen fruit	Fruit juice (clear, cloudy and pulpy)
2001	1,155	21,064	49,947
2002	734	25,426	65,967
2003	1,838	19,591	76,665
2004	53	25,543	124,673
2005	2,950	20,533	164,546
2006	6,029	18,375	170,247
2007	9,900	26,946	219,912
2008	7,265	19,738	251,057
2009	9,226	42,709	226,520
2010	11,172	26,092	200,583

Source: Statistical Office of the Republic of Serbia

According to the analysed production lines in Serbia in 2010, the capacity utilisation amounts to 54.4% in the dried fruit production line, 45.8% in the fruit juice production line, 45.5% in the frozen fruit production line, 33.9% in the fruit concentrate production line and 30.8% in the jam production line (Table 8). The capacity utilization of the other analysed production lines was lower than 9.2%.

Table 8. The capacity utilisation in fruit processing lines in 2010

Processed fruit products	Potential production volume (t)	Realised production volume (t)	Capacity utilisation (%)
Fruit pulp and puree	2,600	99	3.81
Concentrated fruit juice	33,000	11,172	33.85
Frozen fruit	57,313	26,092	45.53
Fruit juice (clear, cloudy and pulpy)	438,384	200,583	45.76
Fruit syrup	30,725	535	1.74
Preserved fruit	850	78	9.18
Jam	15,591	4,799	30.78
Dried fruit	1,354	737	54.43

Source: The annual report of the Statistical Office of the Republic of Serbia (Published tables for 2010)

Conclusion

The fruit processing and cooling industry in Serbia is facing the increasing problem of capacity underutilisation. The increase in processing capacity has not been accompanied with the increase in the quality and assortment of raw materials due to the uneven development of primary fruit production and processing. It should be especially highlighted that optimal conditions for the development of fruit production in the private sector have not been created yet. Moreover, it has not been generally accepted that the

development of industrial processing capacities is not paralleled with the development of primary fruit production.

In the period 1981-2011, fruit production covering 252,364 ha on average had the share of 5.61% in the total Serbian arable land. This share has been increasing due to the fact that the arable land in Serbia is decreasing more rapidly than orchard area.

The highest production volume was recorded in plum (459,712 t) and apple production (213,712 t), and these fruit species account for 66% of the total fruit production in Serbia. The total production volume of the analysed fruit species shows the increasing tendency (with the 0.37% rate of change). The highest increase in the production volume was recorded in raspberry production (with the 5.00% rate of change).

In the period 2001-2010, the highest production volume on average was recorded in fruit juices (155,012 t) and frozen fruits (24,602 t), and these processed fruit products account for 93% of the total analysed processed fruit production in Serbia. The realised production volume of all other analysed processed fruit products ranged from 329 tonnes (dried fruits) to 5,032 tonnes (concentrated fruit juice).

The total production of processed fruit products increased at the average rate of change of 14.82%. The most significant increase in production volume was recorded in concentrated fruit juices (the rate of change of 45.10%) and dried fruits (the rate of change of 22.04%). The calculated coefficients indicate high variations of the production volume, especially in dried fruits (CV=106.28%). The highest capacity utilisation was recorded in dried fruit production (54.4%) and fruit juice production (45.8%). The lowest capacity utilisation was recorded in fruit syrup production (1.7%) and compote production (9.2%).

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RAZVOJ PROIZVODNJE I PRERADE VOĆA U REPUBLICI SRBIJI

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Rezime

Iako u Srbiji postoje veoma povoljni prirodni uslovi za uzgoj većine kontinentalnih voćnih vrsta, mogući nivo iskorišćenosti ovih uslova još nije postignut, što potvrđuje i kretanje najvažnijih kapaciteta voćarske proizvodnje u dužem vremenskom periodu. Zbog pretežno ekstenzivnog karaktera, voćarska proizvodnja u Srbiji već duže vremena stagnira ili se čak i smanjuje. U proseku za period 1981-2011. godine površine voćnjaka u Srbiji su iznosile 252.364 ha, sa tendencijom opadanja po prosečnoj godišnjoj stopi promene od -0,40%.

U proseku za ispitivani period (2001-2010) najveći obim proizvodnje prerađevina od voća (polupreradevine i gotovi proizvodi) je utvrđen kod voćnih sokova (155.012 t) i smrznutog voća (24.602 t). Spomenute prerađevine od voća učestvuju sa 93% u ukupnoj proizvodnji analiziranih prerađevina Srbije. Proizvodnja prerađevina od voća u posmatranom periodu se povećava po prosečnoj godišnjoj stopi promene od 14,82%.

Ključne reči: *površine voćnjaka, proizvodnja voća, polupreradevine od voća, gotovi proizvodi od voća*

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