The European Journal of Plant Science and Biotechnology ©2007 Global Science Books

Serbian Dried Fruit Research

Dobrivoje Ogašanović[1*] • Slobodan Milenković[1] • Olga Mitrović[1] • Miodrag Kandić[1] • Branislav Zlatković[2] • Ljiljana Babić[3]

[1] Fruit Research Institute, 9, Kralja Petra I st., Čačak, Serbia
[2] The Faculty of Agriculture, 6, Nemanjina st, Belgrade, Serbia
[3] The Faculty of Agriculture, 8, Trg Dositeja Obradovića, Novi Sad, Serbia

Corresponding author: * **mitrovico@tfc.kg.ac.yu**

ABSTRACT

Serbia has a very long tradition of plum drying, and it used to be a recognized prune exporter on both a European and global scale. Investigations in the field of fruit drying have not always been in accordance with production and export of dried fruits, prunes in particular. In times of the largest production and export, no adequate attention was devoted to the development and advancement in the respective field, i.e. application of the results of the study, which accordingly resulted in a decrease in production and export in the ensuing period. Research aimed at advancing the technology and suitability of particular cultivars for drying as well as quality of prune have been pursued ever since the 1960s. Convective drying is the most common method of fruit drying, especially plum drying, and is the major drying method in Serbia. The latest investigations include current research in the field of kinetics of convective drying, study of newly developed and/or combined methods of fruit drying (osmotic, vacuum, lyophilization, etc.) as well as procedures applicable to finishing of dried fruits.

Keywords: cultivars, dried fruits, drying methods, kinetics, prune, technology

CONTENTS

INTRODUCTION

Conserving fruits by drying has been known for ages. In Serbia, it used to be one of the most common ways of conserving fruits aimed at better preservation and out-of-season usage. At first, fruits were sun dried, and it was plum fruits that were mostly dried. Autochthonous pear cultivars with small fruits as well as sliced apple fruits were also dried. Plum fruits free of stone were used for preparation of particular fruit cakes that were also dried in the sun. Afterwards, different kinds of dryers were developed. In the initial phases, solid fuels (mostly firewood) were used, whereas other energy resources followed (Marković 1986).

Favourable natural environment and tradition have made way for plum to be the most widespread dried fruit variety in Serbia. It has been grown for centuries in hilly-mountainous regions at altitudes of 200-800 m. Prune (dried plum) is not only a dessert fruit. Besides fresh plum, prunes are not the only significant source of energy but also a high nutritive food with emphasized dietary, physiological, protective, and therapeutic properties (Zlatković 2000).

Dried fruits, plums in particular (as the most important fruit produce), are of great economic importance, and a highly respected fruit variety in Serbia. Besides being used as food it has always represented a major Serbian export product.

BRIEF HISTORY OF FRUIT DRYING

Prune is the most common dried fruit in Serbia, hence the development and advancement of the technology of plum drying has been continuously pursued.

Sun-dried plum was mostly used for private household purposes. More intensive sale of dried plum on the market as well as easily available firewood (a cheap source of energy) marked the beginning of drying in dryers for local purposes. At first, primitive hot houses made of brushwood flakes or thin slats were used for plum drying. In these 'dryers', fruits were heated, i.e. were disposed to the very source of heat (Marković 1986).

Over the last two decades of the XIX century, fruit drying for private household purposes was transformed into massive production of prunes intended for export into European countries and the USA. Dryers were being constantly improved, and at the close of the XIX and in the early XX centuries first industrial, discontinuous, convective dryers were constructed (made by Glavinić, Havelka and Stojković) (Marković 2000). Concurrent pulling of air over fruits and elimination of vapourized air in the dryer were adding up to better quality of dried fruits and reduction of drying

Received: 23 February, 2007. Accepted: 10 April, 2007.

Invited Mini-Review

time. Special procedures in processing (etivation) and packaging, which extended shelf life of dried fruits, were introduced.

The establishment of first industrial tunnel-type dryers in 1958, and especially the introduction of the 'CER'-type tunnel dryer in the second half of the past century, laid the foundations of modern industrial drying of plum culture. In the beginning, the tunnel dryers were of a counter-flow, direct effect type, i.e. combustion products were used for direct drying of plums. Oil was then the most common fuel used for drying. Within the ensuing period, some indirect effect dryers that used the air heated through a heat exchanger, which ensured dried fruits free from combustion smoke, were constructed. As the source of energy, gas fuel was subsequently introduced. Discontinuous, indirect-type tunnel dryers were succeeded by continuous, indirect stripe convective dryers. For low-scale production, indirect firewood-driven dryers were constructed.

In modern times, substantial efforts are being made to improve the quality of prunes by introduction of the same course flow drying method. Special attention has been devoted to finishing and packaging, fruit containers, production of dried plums free of stone as well as to processing of dried plums for obtaining other final products.

Conserving of other dried fruits by drying has been performed from the time immemorial with the aim of extending their shelf life when out of fresh fruit season. Autochthonous small-fruit pear cultivars were dried along with the thin-sliced apple cultivars. Initially, fruits were sun-dried, to be succeeded by household dryers later on (Marković 1986). In more recent times, the drying of fruits (sour cherry, apricot, pear, and apple) has been industrialized.

PRODUCTION AND EXPORT OF DRIED FRUITS

In Serbia, plum ranks first as a growing fruit culture in both number of trees and fruit production. Therefore, it is considered a national fruit variety. Dried plums were the principle export product as early in the second half of the XIXth century and all through to the 1980s. Subject to weather conditions and social and political circumstances, the production and export of prunes underwent considerable fluctuations. Hence, to be more precise in delivering the report, we have presented them through tables covering several periods of time.

The first period refers to the time of the Kingdom of Serbia. More intensive export of prunes was recorded over 1868-1874 (**Table 1**), with an average annual export amounting to 2,200 tons. The 'golden age' of prune production and export covers two-decade period at the close of the XIXth century (1881-1900) (**Table 2**). The average export recorded over the period reached some 26,200 t, wheres in 1887 the registered export record summed some 41,296 tons. Political circumstances in the early XXth century resulted in a plateau, with subsequent decline in production and export of prunes. The First World War paralized completely all economic activities.

The second period covers the period of existence of the Kingdom of Yugoslavia, namely, the time between the two World Wars. Although the period (1921-1939) was characterized by the absulute record in export of prunes (66,390 t) (**Table 3**), 25,900 t of exported prunes was the average amount recorded in the whole of Yugoslavia, which is almost identical to the prune export recorded during the 'golden age' in Serbia, at the close of the XIXth century.

The third period refers to the period from 1946 to 1988 (over a 40-year–period), i.e. from the post-war time and thereon up to the breakup of Yugoslavia at the close of the XXth century. The period reveals considerable fluctuations in production and export of prunes. Serbia accounted for more than two thirds of the total prune production in Yugoslavia. The average global export of dried plum during the period (**Table 4**) was about 13,800 t, whereas the record export was made in 1963 (33,300 t). The minimal export reached down to 450 t in 1950. Major quantities were exported to the Soviet Union, and markedly fewer quantities were placed on the West European and other convertible markets. The decrease in export was due to new market requirements and newly set up standards of quality which Yugoslavia could not meet – inappropriate and outdated drying technologies, price difference on the market, etc. (Zlatković 2000). In addition, changes in the plum assortment occured at the time. Due to the incidence of Sharka virus, cv. 'Požegača' ceased to be the major cultivar in the assortment, and was succeeded by some other cultivars unsuitable for drying. Cv. 'Stanley' succeeded superior cv. 'Požegača'.

Eventually, the final period refers to 1990 and thereon, when due to the Civil war in other republics of Yugoslavia and economic blockade and bomb attacks on Serbia a sharp downward movement in plum production occurred, coupled with an abrupt cessation of export. The average production over 1990-2005 (16-year-period) was only 3,900 t (**Table 5**). From 2000 and thereon the production of plums and prunes has been on the rise (although the number of trees does not follow the pattern). Export of prunes is once more recorded

Table 1 Export of prunes in the Principality of Serbia over 1868–1874.

Year	Quantity (tons)
1868	1,188
1869	538
1870	1,193
1871	1,841
1872	3,527
1873	2,639
1874	4,500
Average	**2,200**

Table 2 Export of prunes in the Kingdom of Serbia over 1881–1900.

Year	Quantity (tons)
1881	13,520
1882	24,420
1883	24,520
1884	20,065
1885	23,226
1886	35,783
1887	41,296
1888	31,999
1889	31,089
1890	17,654
1891	9,684
1892	17,534
1893	21,459
1894	22,508
1895	28,804
1896	17,354
1897	37,468
1898	40,131
1899	40,530
1900	27,163
Average	**26,210**

Table 3 Export of prunes in Yugoslavia over 1921– 1939.

Year	Quantity (tons)
1921	38,370
1922	44,044
1923	66,390
1924	19,940
1925	34,540
1926	37,180
1927	32,880
1928	24,370
1929	13,140
1930	7,640
1931	8,240
1932	22,260
1933	26,530
1934	22,310
1935	12,540
1936	27,470
1937	8,990
1938	6,830
1939	37,800
Average	**25,870**

Table 4 Export of prunes in Yugoslavia over 1946–1988.

Year	Quantity (tons)
1946	7,240
1947	8,300
1948	12,640
1949	3,100
1950	450
1951	9,620
1952	8,860
1953	7,920
1954	18,800
1955	29,400
1958	20,970
1959	15,480
1960	19,640
1961	15,240
1962	14,590
1963	33,300
1964	17,560
1965	13,040
1966	4,900
1967	7,280
1968	14,402
1969	4,635
1970	20,599
1971	22,949
1972	13,589
1973	8,445
1974	8,849
1975	14,868
1976	4,626
1977	13,331
1978	10,178
1979	6,991
1980	11,394
1981	18,336
1982	21,306
1983	19,648
1984	24,975
1985	26,421
1986	13,403
1987	8,838
1988	10,427
Average	**13,820**

Table 5 Production of prunes in Serbia over 1990–2005.

Year	Quantity (tons)
1990	3,735
1991	2,126
1992	5,709
1993	5,509
1994	3,674
1995	2,751
1996	5,541
1997	4,275
1998	3,728
1999	3,060
2000	4,087
2001	3,269
2002	1,489
2003	4,881
2004	5,674
2005	2,524
Average	**3,880**

today, at the beginning of the XXIth century, when an average annual export amounts to 2,000 t, which is identical to the export recorded in fifties of the XIXth century.

As compared to the prune production, the production of dried fruits other than plum has been as low (500 t/year averagely) that has been hardly evidenced by the official statistics. When presented, these are expressed collectively, and indirectly through the difference between the total prune production (Statistical Almanacs of Serbia).

SELECTING CULTIVARS FOR DRYING

When choosing cultivars for drying, a special attention has to be devoted to their technological properties in order to obtain high quality prunes. Prunes should be of good appearance, appropriate colour, consistency, and appealing flavour. Picked fruits intended for drying ought to have high dry matter content, i.e. to be large, abundant in sugar, with a small stone. Fruits should not break at drying, and capacity of easy and fast drying is preferred.

Cv. 'Požegača' is our oldest cultivar that has traditionally been used for drying all over Serbia and Yugoslavia, and has prevailed to date. Even today, when we say 'prune' we actually mean 'prune of Požegača', primarily for its unsurpassed harmonious, sweet-acid flavour. However, small fruits of cv. 'Požegača' and its susceptibility to Sharka virus necessitated development of new cultivars for drying aimed at replacement of the cultivar.

Upon evaluating drying suitability of 12 plum cultivars over a three-year period, Janda (1967) concluded that cvs. 'Požegača' and 'Agen 707' performed best. Cvs. 'Stanley', 'Agen 303', 'Imperial Epineuse', 'Italian Prune' and 'Kohlstokzwetsche' proved to be less suitable. As for production, Janda's choice falls on large-fruited cv. 'Požegača' and cv. 'Stanley', regardless of unfavourable flesh and stone ratio of the latter, as compared to the large-fruited cv. 'Požegača'.

Aimed at development of larger plum fruits suitable for drying, the work on hybridization and selection of plum was initiated in 1949 at the Fruit Research Institute in Čačak, and has been continuously pursued up to the present day. Over the period some 11 plum cultivars have been developed, 6 cultivars out of which are suitable for production of dried fruits.

According to the investigations of Janda *et al*. (1984), cv. 'Požegača' is the commonest cultivar for drying, cv. 'Čačanska Rodna' follows (in overbearing years it produces small, low quality prunes), and finally, cv. 'Čačanski Šećer', with small stone and large, high quality dried fruits. Cvs. 'Italian Prune', 'Požegača', 'Čačanska Rodna', and hybrids 1/4 ('Jelica') and 1/6 ('Valjevka') are very suitable for drying owing to their high content of dry matter and sugar. These cultivars differ in the total acids content and in taste accordingly, which leaves space for a number of available cultivars, subject to the taste of consumers (Janda *et al*. 1986.). Cv. 'Valjevka' is self-fertile, tolerant of Sharka virus and ripens in late August. Fruits are medium large, oval, firm. The flesh is yellow and the stone is medium to large, free, and produces high quality prunes (Ogašanović 1990).

Evaluation of drying capacity of cvs. 'Požegača', 'Stanley', 'Valjevka' and 'Čačanska Rodna' by Mitrović *et al*. (2000a) suggested that prunes of cv. 'Požegača' are the most harmonious in taste (sensor analysis), the flavour of fruit of cv. 'Stanley' is rather unharmonious and the impression is even more unfavourable with regard to a rather large stone. As for cv. 'Valjevka', 90% of fruits are well dried, the very drying process is easy and fast, and its drying ratio is favourable. Intense deep, dark colour is one of its advantages as well.

Cv. 'Čačanska Rodna' is productive under diverse agro-ecological conditions, thus being one of the leading plum cultivars. If fresh fruits are large, blue, with optimal dry matter content, prunes are of premium quality, not lagging behind fruits of cv. 'Požegača' that are considered a standard in Serbian prune production (Mitrović *et al*. 2000b). However, due to the abundant cropping, fruits of cv. 'Čačanska Rodna'' often remain small, with low dry matter content. Aiming at management of yields and obtainment of fruits that will provide high quality prunes, Mitrović *et al*. (2001) applied a number of pruning methods. Severe pruning (removal of 1/4 or 1/3 of fruiting wood) resulted in large fruits with higher dry matter content, and good quality prunes accordingly. Intensity of pruning should be adjusted to the cropping potential of a tree to obtain an optimal fruit quality.

Large prunes of cv. 'Čačanska Lepotica' are of good quality, but unfavourable dry matter content affects the drying ratio nevertheless (Mitrović *et al*. 2006).

When developing cultivars for drying, primary objective of the selection is obtainment of genotypes with high soluble solids content (high drying matter content) that are resis-

tant to Sharka virus (Ogašanović 2000). As the result of the approach, cv. 'Mildora' (hybrid G-12), named and released in early 2004, was developed at the Fruit Research Institute-Čačak. It is highly tolerant of Sharka virus. Fruits are roundish, medium large, sweetish, and of very good flavour. Its soluble solids content exceeds 25%, and prune is of high quality (Ogašanović *et al*. 2005). The evaluation of drying capacity of plum cultivars developed at Fruit Research Institute conducted by Mitrović *et al*. (2006) describe amber coloured fruits of cv. 'Mildora' as appealing, with high drying ratio, and excellent consistency. Relatively small fruits are considered a disadvantage. This cultivar differs from others in its skin colour and specific sweetness, which recommends it for processing by drying as supplementary in the prune assortment.

The prune assortment has been further expanded by another plum cultivar. It is cv. 'Krina' which is tolerant of Sharka virus (named and released in 2005). Fruits are medium large, oval. The stone is small, free. It produces prunes of good quality (Ogašanović *et al*. 2006).

ADVANCEMENT OF THE TECHNOLOGY OF FRUIT DRYING

The quality of dried fruits is governed by the selection of factors and parameters both before and after drying process. First detailed investigations of plum drying were performed by Glavinić (close of XIXth century) and Stojković (early XXth century) who constructed plum dryers by application of convective drying principles.

Investigations aimed at advancement of the technology of fruit drying, plum drying in particular, improvement of fruit quality and drying suitability have been continuously performed since the 1960s. The investigations included several issues: definition of the assortment, technological drying procedure (all operations before, during and after drying), finishing and packaging of dried fruits. Major scientific-research institutions in Serbia (Fruit Research Institute, Čačak, Faculty of Agriculture, Beograd, Faculty of Agriculture, Novi Sad, Institute of Nuclear Science, Vinča – laboratory for thermotechnics and energetics) have studied these aspects.

Investigation of the preparational procedures for drying and combined drying procedures

This group includes investigation of procedures and operations for preparation of fruits for drying as well as investigation of both preparation and drying of fruits. Dipping is one of the technological procedures for preparation of fruits for drying and may be conducted by dipping in either boiling water or boiling NaOH. Janda (1969) found that the former influenced favourably the fruit quality, which recommends it for a wider application in the production process. In comparison with untreated fruits, the quality of fruits dipped in boiling NaOH (at diferent concentrations) was greatly affected due to strong perforation and deformation of the fruit skin.

Pavasović *et al*. (1981) studied drying of plum by combining osmotic dehydration and convective drying in a prototype industrial instalation. The process included several operations: preparation of the raw material, osmotic dehydration, processing of osmotic-dehydrated fruits, and convective drying. The results suggested that duration of drying is markedly shorter than usual. The data on precise energy costs were not recorded, but the initial data inferred 15-25% less energy utilization for evaporation of 1 kg of water, as compared to the convective drying in a tunnel dryer. Prunes produced by this method have higher sugar and moisture content. The colour, flavour and aroma of fresh fruits are preserved, and their shelf life is very good.

Investigations conducted by Bardić *et al*. (1983) suggested that cv. 'Stanley' belongs to a group of cultivars with larger sized fruits that should be blanched in a sugar syrup prior to drying, to harmonize sugars and acids ratio.

Ćirić *et al*. (1989) dipped halves of cvs. 'Požegača and Stanley', and chips of apple cv. 'Idared' and pear cv 'Beurre Bosc' in a sucrose syrup, and subsequently dryed them for 4-6 hours at temperature not higher than 80°C. Thus, they shortened the time of drying and obtained fruits of higher quality. Dried fruits were attractive, with very pleasant flavour and aroma. They proposed that drying should be applied not only to plum but other fruit cultures as well (apple, pear, apricot, peach, sour cherry, etc.).

Laboratory tests with apricot halves (Babić *et al*. 2002) included preparation of fruits by sulphuration (3 g of sulphur per kg of fresh apricot halves were burnt for 4 hours), and subsequent drying in the osmotic dryer for two hours. The temperature and concentration of the solution at osmosis were selected as major factors. During the osmotic dehydration, migration of moisture from the halves through micro- and macro-pores into the surroundings occurs in the liquid phase causing minor contraction of volume of the sample. The studies were further pursued by application of combined procedures of osmotic and convective dehydration, which included further drying of fruits in the convective dryer with temperature ranging from 40°C and up to 65°C (Babić *et al*. 2003, 2006a). The authors emphasize that the moisture balance value of fruits dried by combined technology was higher than that obtained by classical procedure, thus providing safe storage of samples. Aiming at preventing the occurrence of enzyme-caused tarnishing of apricots during convective drying Babić *et al*. (2006b) studied the influence of factors like selection of cultivar (4 cultivars: cvs. 'Ananasnii', 'Ambrozija', 'Novosadska rodna' and 'Kecskemeti rozsa'), temperature (45^{o}C and 55^{o}C), and solution concentration (70% and 85%) on the osmotic drying. By the application of the statistical method of dispersion analysis, the influence of the abovementioned factors on the osmotic drying of apricot halves was confirmed.

Investigation of the convective drying procedures

The second group of investigations refers to the study of methods of convective drying. Investigation of the process of drying in commercial industrial dryers and/or in some types of laboratory dryers may provide results that may lead to optimizing of drying technology and advancement of solutions in the field of construction of fruit dryers.

First detailed investigations of convective drying of plums in industrial tunnel dryers were performed over 1975-1980 at the Institute of Vinča. This thermo-technical approach of investigation included the study of the processes in the drying agent that causes a fruit to dry, but it neglected the processes of migration of weight and heat within the fruit itself.

According to the results of drying of cvs. 'Požegača' and 'Stanley' in a laboratory, forced air circulation dryer, in a tunnel-type dryer ('Cer', Čačak) (fruits dried indirectly by a fan heater), and in a tunnel-type dryer (fruits dried by air flow combined with fuel combustion products), Bardić *et al*. (1983) concluded that the highest quality fruits were obtained by the second method, thus recommending sole utilization of indirect heat dryers.

Živković *et al*. (1997, 2006) studied drying of apricot and plum in a laboratory, prototype industrial dryer aiming at rationalization of fuel and energy costs. The results have suggested that neither of the theoretical approaches may as yet be fully applied to plant materials such as fruits of fruit cultures. Practical and theoretical discoveries in the field of stone fruits drying have been focused on costs and quality of obtained fruits. Conditions and duration of drying have a direct impact on both energy costs and quality of dried fruits. The heat exchange process should be conducted by forced flow of air over the heat exchanger. The manner of preparation of fruits for drying reflects on energy costs and fruit quality as well.

By studying the influence of different temperature levels, 70°C and 90°C, on drying of cvs. 'Požegača', 'Čačanska Rodna', 'Valjevka', and 'Stanley' in a convective experi-

mental dryer, Mitrović *et al*. (1997) concluded that the latter is more suitable in the first phase of drying during which some 50-60% of water evaporate (3-5 hours), whereas the former temperature of inflowing air should be applied in the final phase, to avoid fruits to overheat, caramelize and overdry.

Methodology of study of fruit drying process includes investigations of parameters of drying agents, and kinetics of drying and heating during the drying process (Kandić *et al*. 2001). On the basis of investigation of kinetics of plum drying on a convective fruit drying device Kandić *et al*. (2006) established a vertical flowing system of convective fruit drying. The system includes a chamber dryer with trays, whereas the process of plum drying is performed discontinuously. Flowing air, the drying agent of adequate properties (temperature, flow, moisture) is pulled over the stack of trays with fruits for drying. Vertical flow alternates within precisely defined time intervals. It has been suggested that the drying in such a manner is uniform, which further induces that the flowing system is optimal for defining parameters of convective drying. This model may be applied in studying both counter-flow and the same course flow methods of drying, as well as for investigation of continuous drying, therefore may represent simulation of drying in real convective dryers.

With regard to the preliminary laboratory investigation of convective drying of raspberry, Paunović *et al*. (2006) found that moisture migrates more slowly at 70°C only if humidity ranges between 50% and 70%, whereas at humidity rates below 50% and above 70% moisture evaporates quickly, so that a somewhat higher temperature might be applied. Convective-dried raspberry may be of satisfactory quality and well preserved colour.

Investigation of other procedures for drying and finishing of dried fruits

The third group of studies refers to finishing procedures, along with studies of other non-conventional procedures of drying.

With regard to the importance of storage of dried fruits, Zlatković (1987) studied the hygroscopic properties of prunes of cv. Požegača. The influence of both initial moisture of dried fruits and dipping of fresh fruits on the sorption kinetics was studied. Water is one of limiting factors as regards enzymic activity. Zlatković *et al*. (1998) emphasize the importance of the fact that the water activity depends on dry weight concentration in dried apples. He suggests that dried apples may be considered conserved only with 18% of dry matter content, as it is only then that the water activity is below 0.6.

Aiming at surface protection of prunes upon rehydration (prior to packing), Marković (1987) studied the influence of different concentrations of potassium sorbate. The objective of these studies was successful conservation with as low a concentration as possible. The obtained results suggested that sufficient quantity of potassium sorbate is obtained by soaking fruits in the 0.6% preserver solution.

Lyophilization (freeze-drying) is a method that results in the production of whole, small fruits without much change in appearance and nutritive value (Janković 1992). The very drying process much depends on heat, physical properties of fruits, applied freezing regimes, sublimation, and desorbtion. Sublimation and desorbtion values functioning as temperature have been established, as well as those of heater in the lyophilizator chamber for strawberries, raspberries and blackberries. Studies were pursued in ensuing years, this time on sour cherry, apricot and apple. Mašović *et al*. (1998) compared changes in the quality of apricot conserved by various drying methods: convective, dehydrofreezing and lyophilization. It has been emphasized that the best results were obtained by application of lyophilization which gave fruits with best preserved vitamin C, although this method presupposes the highest cost requirements.

Study of fruit drying under vacuum conditions aimed at constructing an industrial vacuum condensing dryer were initiated at the close of the XXth century, and are still in progress. To obtain high quality dried fruits (especially those prone to oxidation) is a major objective of these investigations (Zlatković 2004).

CONCLUSION

Serbia has a very long tradition of plum drying, and it used to be one of the top exporters of dried plum in Europe and the world. Despite continuity, investigations in the respective field, investigation of plum drying in particular, have not always kept pace with the production and export of dried fruits. Development and advancement in the respective field were neglected at the time of the most intensive production and export of dried fruits, whereas at present, with only 2,000 t of exported prunes annually, the studies are being intensified.

REFERENCES

Babić Lj, Babić M, Karadžić B, Stanivuković B (2002) Sušenje kajsije. *Časopis za procesnu tehniku i energetiku u poljoprivredi* **6**, 1-4

Babić Lj, Babić M, Pavkov I (2003) Coupled osmotic and convective drying of apricot. *Časopis za procesnu tehniku i energetiku u poljoprivredi* **7**, 1-4

Babić Lj, Babić M, Pavkov I (2006a) Novel concept of fruits drying. *Časopis za procesnu tehniku i energetiku u poljoprivredi* **10**, 9-15

Babić Lj, Babić M, Pavkov I (2006b) Sušenje kajsije novom tehnologijom. *Voćarstvo* **40**, 245-253

Bardić Ž, Ćirić D (1983) Uticaj sorte i postupka sušenja na kvalitet osušenih šljiva. *Tehnologija Voća i Povrća* **16**, 15-19

Ćirić D, Vračar Lj (1989) Unapređenje tehnologije sušenja voća. *Jugoslovensko Voćarstvo* **23**, 647-651

Janda Lj (1967) A study on the suitability of some plum varieties for dehydration. *Journal for Scientific and Agricultural Research* **68**, 62-72

Janda Lj (1969) Uticaj tretmana svežih šljiva na kvalitet suvih plodova. *Jugoslovensko Voćarstvo* **8**, 303-308

Janda Lj, Gavrilović J (1984) Komparativna proučavanja vrednosti ploda u novih sorti šljiva. *Jugoslovensko Voćarstvo* **18**, 59-64

Janda Lj, Šoškić M (1986) Pogodnost ploda u nekih sorti i elitnih hibrida šljiva za sušenje. *Jugoslovensko Voćarstvo* **20**, 683-688

Janković M (1992) The Influence of the heater temperature on the intensity of sublimation and desorption of berrylike fruits. *Review of Research Work at the Faculty of Agriculture University of Belgrade* **37**, 135-140

Kandić M, Mitrović O, Gavrilović-Damnjanović J, Mitrović V (2006) Prostrujni model za ispitivanje procesa sušenja voća. *Voćarstvo* **40**, 379-388

Kandić M, Mitrović O, Mitrović V (2001) Metodologija ispitivanja procesa sušenja šljive. In: Mišić P, Milenković S, Mitrović M, Belij S, Grković J (Eds) *Tematski zbornik radova 3. Jugoslovensko savetovanje Proizvodnja, prerada i plasman šljive i proizvoda od šljive*, Institut za istraživanja u poljoprivredi "Srbija", Koštunići, pp 151-159

Marković V (1986) Suva šljiva. Šabac 3-172

Marković V, Puretić M, Kakučka K (1987) Upotreba kalijum sorbata u preradi suvih šljiva. *Tehnologija Voća i Povrća* **20**, 51-58

Marković V (2000) Iistorija sušenja šljiva u našoj zemlji. In: Mišić P, Ševarlić M, Todorović M (Eds) *Tematski zbornik radova I Međunarodni naučni simpozijum Proizvodnja, prerada i plasman šljive i proizvoda od šljive*, Institut za istraživanja u poljoprivredi "Srbija", Koštunići, pp 259-264

Mašović S, Janković M, Kostić S, Radulović E (1998) Ispitivanje promena kvaliteta kajsije konzervisane sušenjem, sušenjem-smrzavanjem i liofilizacijom. Poljoprivredni fakultet Univerziteta u Beogradu, Institut za prehrambenu tehnologiju i biohemiju (Ed), *Zbornik radova III jugoslovenskog simpozijuma prehrambene tehnologije*, Mladost biro, Beograd, pp 68-73

Mitrović O, Mitrović V, Gavrilović-Damnjanović J, Kandić M (1997) Uticaj temperature vazduha na proces sušenja šljive. *Jugoslovensko Voćarstvo* **31**, 359-366

Mitrović O, Mitrović V, Gavrilović-Damnjanović J, Kandić M (2000a) Uporedna ispitivanja sušenja šljive Požegače i Čačanske rodne. In: Protić R (Ed), *Zbornik naučnih radova XV savetovanja agronoma, veterinara i tehnologa*, *PKB INI Agroekonomik,* Aranđelovac, pp 341-345

Mitrović O, Mitrović V, Gavrilović-Damnjanović J, Popović B, Kandić M (2000b) Problematika sušenja šljive. In: Mišić P, Ševarlić M, Todorović M (Eds) *Tematski zbornik radova I Međunarodni naučni simpozijum Proizvodnja, prerada i plasman šljive i proizvoda od šljive*, Institut za istraživanja u poljoprivredi "Srbija", Koštunići, pp 253-258

Mitrović O, Mitrović V, Stanojević V, Mićić N, Kandić M (2001) Uticaj različitih intenziteta rezidbe na kvalitet suve šljive Čačanske rodne. *Jugoslovensko Voćarstvo* **35**, 97-104

Mitrović O, Gavrilović-Damnjanović J, Popović B, Kandić M (2006) Karakteristike čačanskih sorti šljive pogodnih za sušenje. *Voćarstvo* **40**, 255-261

Ogašanović D (1990) Valjevka – nova sorta šljive za sušenje. *Jugoslovensko*

Voćarstvo **24**, 13-16

Ogašanović D (2000) Selekcija šljive na visok sadržaj rastvorljivih suvih materija. *Jugoslovensko Voćarstvo* **34**, 55-61

Ogašanović D, Ranković M, Paunović S, Mitrović O, Stamenković S (2005) Mildora – nova sorta šljive za sušenje. *Jugoslovensko Voćarstvo* **39**, 251-256

Paunović D, Zlatković B, Janković M, Mašović S (2006) Kinetika sušenja maline u laboratorijskim uslovima. *Voćarstvo* **40**, 389-396

Pavasović V, Stefanović M, Urošević M, Mirilović R (1981) Proizvodnja suve šljive kombinovanjem procesa osmotske dehidracije i konvektivnog sušenja. *Jugoslovensko Voćarstvo* **15**, 541-550

Zlatković B (1987) Higroskopna svojstva sušenih plodova šljive Požegače. *Tehnologija Voća i Povrća* **20**, 43-49

Zlatković B, Bukvić B, Vukosavljević P (1998) Aktivnost vode kao mera njenog sadržaja u proizvodu. Poljoprivredni fakultet Univerziteta u Beogradu, Institut za prehrambenu tehnologiju i biohemiju (Ed), *Zbornik radova III jugoslovenskog simpozijuma prehrambene tehnologije*, Mladost biro, Beograd, pp 57-62

Zlatković B (2000) Uloga tehnologije prerade na plsman šljive. In: Mišić P, Ševarlić M, Todorović M (Eds) *Tematski zbornik radova I Međunarodni naučni simpozijum Proizvodnja, prerada i plasman šljive i proizvoda od šljive*, Institut za istraživanja u poljoprivredi "Srbija", Koštunići, pp 245-252

Zlatković B, Vulić T (2004) From a smokehouse to a vacuum dehydrator. *Journal of the Agricultural Sciences of the University of Belgrade* **49**, 131-139

Živković M, Radojević R, Raičević D, Ercegović Đ, Kosi F, Vukić Đ (1997) Nove tehnologije niskotemperaturskog sušenja koštičavog voća. *Jugoslovensko Voćarstvo* **31**, 367-374

Živković M, Kosi F, Radojević R, Komnenić V (2006) Potrošnja toplotne enrgije i kvalitet sušenja koštičavog voća. *Voćarstvo* **40**, 273-285