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ECONOMIC EFFECTS OF DRIED SOUR CHERRY PRODUCTION IN SERBIA

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Abstract

The fruit processing in the Republic of Serbia is primarily focused on the production of juices, alcoholic beverages, compotes, aromas, jams and marmalades. The potential for dried fruit production is enormous, but minimally exploited. The sole exception is dried plum production, which is very important. Considering a constant increase in dried fruit consumption in the world, it is necessary to seriously take into account the possibilities for dried fruit production in Serbia.

In this paper, various aspects of the cost-effectiveness of dried sour cherry production are analysed. It is about combination of fruit drying technology (osmotic and convective). The research was conducted on a “smaller” dryer with the capacity of 450 kg of raw material per day, which is suitable for the production on family farms.

The raw material, i.e. fresh sour cherry (60.2%), poses a dominant factor in the cost structure. The labour costs were also significant (22.7%), whereas the energy share was surprisingly low (3.5%). The obtained retail price of 792 RSD (7.07 €/kg) is more competitive on the domestic market. This level of selling prices enables the profit of 1,406 € during 15 days of sour cherry production.

Previous research, which included a greater number of fruit species, indicate that the total profit during 135 days of effective dryer operation was approximately 15,200 €. The total investments, which are not high (approximately 30,900 €), are repaid in 1.82 years, which is very acceptable. Considering other success indicators (the efficiency ratio of 1.35 and the production accumulation rate of 26.0%), it is evident that this is a highly cost-effective business.

Key words: sour cherry drying, combined technology, profitability, comparative analysis

Introduction

A sour cherry is one of the oldest fruit species that man has used since the ancient time. The origin of the sour cherry is the area from the Caspian Sea to Istanbul. As a adaptive fruit species, it can be cultivated up to 1,000 meters above the sea level, but its most appropriate fields are from 400 to 800 meters above the sea level. For centuries people had been breeding sour cherry varieties the most adaptable for the agroecological conditions in Serbia. By the grafting way of production, many native ecotypes of sour cherry have been introduced (the most popular is Oblačinska variety).

Sour cherry is a perspective fruit species whose production is continuously increasing in the world as well as in our country. Distribution area of sour cherry is wide because this kind of fruit does not have specific requirements in terms of environmental conditions. However, despite the modest requirements in terms of natural conditions for production results, sour cherry market is scarce not only in Europe, but also in the whole world. Furthermore, important issue is providing a sufficient number of workers for the harvest. The world largest sour cherry producers are: USA, Russia, Iran, Poland and Germany. Production of sour cherry in Republic of Serbia in a few last years was on average 28-30 thousand tons and it represents

an important export product (Statistical Yearbook, 2010). Due to its quality, sour cherry from our country is very reputable on the European market.

Sour cherry as a fruit species has a great economic importance for the country by the high utility value of fruits, both as for fresh consumption and for further processing. Sour cherry production is not particularly demanding in terms of cultural practices and does not require high investment per unit area. In fact, compared to the most of other fruit species, it does not require more extensive pruning, it is relatively good resistant to pests and diseases, it becomes very early productive and fruitful regularly.

The Republic of Serbia has very favorable natural and climatic conditions for growing sour cherry. Sour cherry is a significant and promising fruit our country, especially from the point of export to the international market. It belongs to a group of high dainty fruit and has also significant nutritional, medicinal, dietary and technological values (Cerovic et al., 2005).

Sour cherry fruit has a high biological value due to the content of solids, pectin, proteins, tannins, carbohydrates, organic acids, minerals, vitamins and other beneficial substances. Besides fresh consumption, sour cherry is very suitable as a raw material for the manufacture of various products: syrup, juice, jam, marmalade, compote and for other variety of desserts. Sour cherry can be used for drying and deep freezing. It is also used for the production of liqueurs and cherry brandy, followed by using in confectionery industry for filling chocolates.

Processing of sour cherry by drying is not so much spread in our country. Research at the Faculty of Agriculture in Novi Sad has shown that sour cherry can be successfully dried by the mixed fruit drying technology. It remains to consider the economic viability of the drying sour cherry in the local conditions, which represents the main objective of the present study.

Material and methods

Processing of sour cherry by drying can be applied only through the conventional procedure (conventional drying), which represents the most common way of drying. The sour cherry fruits can be also exposed to combined drying method, which consists of osmotic and convective drying. Osmotic drying is performing in sweet dilution of saccharose or of some other sugars. Unlikely to candying process, which is performing in saccharic dilutions and lasts up to several days, process of osmotic drying ends in several hours.

After osmotic drying, fruits is further drying by convective procedure until achieving required humidity. Applying osmotic drying method instead of candying has positive effects on conservation of fruit aromas and flavor. By the candying method, dominant product flavor comes from molasses.

The paper is based on profitability analysis of drying sour cherry by the application of the combined fruit drying method. Technological stages of drying, packaging and distribution are taken in consideration, but not production of fresh sour cherry. The combined fruit drying technology is based on original constructed devices in the Laboratory for Bio-systemic Engineering of the Agricultural Faculty in Novi Sad. The conducted laboratory research shows that this technology has positive effect on conservation of mechanical, visual and nutritional characteristics of the products, mass balance is favorable and rational energy consumption is accompanied by the possible usage of solar and biomass energy.

In the focus of the research are costs, achieved financial results and other productive-financial indicators of production of dried sour cherry. However, it is not possible to separately observe profitability of drying process of only one fruit species. By the fact that it is seasonal production and that during the whole year many different fruit species are used in drying process, it is important to take in consideration the profitability of total production, validity of investment project of construction and use of mini-plant for drying fruits respectively. Research is related to a "smaller" dryer with capacity of about 450 kg of raw

material per day, which is suitable for the family farms' production.

Aiming at the more detailed analysis and the clear presentation of achieved costs and financial results, calculation by technical activities (raw material preparation, osmotic drying, convective drying, packaging and selling) has been specially emphasized in the paper. Additional success indicators have been also introduced: margin coverage, income, pay-back time of invested funds, cost-effectiveness ratio and profitability ratio, sensitive analysis.

Results and discussion

Considering profitability of future business activities, it is necessary to evaluate the total market potential and the amount of invested funds.

There are no precise data of sour cherry consumption in Republic of Serbia, but it is definitely on the modest level. Production and market demand for sour cherry are also on very law level in our country thanks to lack of habit of local consumers for this product. By the following increase of local consumption, it is obligatory to invest in marketing in order to create higher market demand. Higher possibilities of selling dried sour cherry would be firstly as a mixture with other fruit species and then as a stand-alone product. Undoubtedly, there is high potential for the growth and development of the domestic market, especially because of expected increase in living standard and by the fact of changing consumers' habits. Additionally, there are also significant opportunities for export.

Construction of small plant for drying fruit on family farm requires investments in purchasing dryer and equipment, building of new objects or reconstruction existing objects, building of cooling object, purchasing boilers for thermal energy needed for drying and the construction of the boiler room. There are also investments in infrastructure (roads, gas network, electricity), which occur to a greater or lesser extent. The total investment value of plant for drying fruits with capacity of 500 kg fresh fruit amounts 30,900 €. If there is suitable building in the commercial yard of the family farm, construction costs of the facility are reduced enough to carry out renovation (*Vukoje and Milic*, 2011).

Calculations are based on the following most important technical-technological and production-economic presuppositions:

- real daily capacity of dryer is 450 kg of fresh sour cherry, the plant is used effectively for 135 days per year, out of which 15 days are used for drying sour cherry (6,750 kg of fresh, i.e. 1,156 kg of dried sour cherry), while the rest of the days are used for drying other sorts of fruit (apricot, nectarine, peach, plum and apples), working in three shifts, it requires 5 workers;
- energy for osmotic drying is generated from electric energy, while for the convective drying it is generated from wheat straw, substitution of wheat straw by natural gas is also taken in consideration;
- investments in purchasing equipment and object, including cooling object, amount 30,900 €, half of which is financed from credits, working capital is entirely financed from own resources;
- calculations are based on realistic market prices of inputs and final products in the period VI-XII 2012, all the prices are without VAT, free delivered (1€ = 112 RSD) ;
- calculations are based on the laboratory determined expenditures of materials, labor and energy, and on the following mass balance:

Table 1. *The mass balance of drying cherries*

Name	**%**	**kg**
Dry halves	13.12%	59.0
Dry cubes	4.00%	18.0
Dried core	0.78%	3.5
Husk	3.14%	14.1
Usable waste*	3.66%	16.5
Unusable waste	1.97%	8.9
Evaporated water	73.33%	330.0
Sum:	**100%**	**450.0**

* whole fruit that can be used for brandy etc.

Precise calculation requires cost monitoring by the technological production stages (preparation of raw materials, osmotic drying, convective drying and finalization). Direct costs are primarily calculated daily, then, on the basis of the established RSD exchange rate, calculations for 15-day sour cherry production are made *(tab. 2; graph. 1)*. For calculating the general costs the procedure is inverted: the costs are determined on a yearly basis, and then divided by 135 days of planned effective operating of the dryer, to reach a daily amount.

Table 2. *Production calculation of dried* cherry *(1€ = 112 RSD)*

No	TECHNOLOGICAL OPERATION	Unit	Quantity	Price RSD/Unit	RSD/ 1day	€ / 15 days
1	Fresh cherry	kg	450	40.0	18000	2411
2	Sulphur	kg			0	0
3	Water	l	950	0.113	107	14
4	Labour costs	h	19.2	170	3264	437
I	**Preparation of material for drying**				**21371**	**2862**
5	Electrical energy	kwh	49.6	6.97	346	46
6	Sugar	kg	7.6	74.0	562	75
7	Water	l	50.0	0.11	5.7	0.8
8	Labour costs	h	4.8	170	816	109
II	**Osmotic drying**				**1730**	**232**
9	Electrical energy	kwh	12.0	6.97	84	11
10	Heat energy (straw)	kg	168.0	3.70	622	83
11	Labour costs	h	8.0	170	1360	182
III	**Convective drying**				**2066**	**277**
12	Package				732	98
13	Labour costs	h	8.0	170	1360	182
IV	**Finalisation**				**2092**	**280**
A)	VARIABLE COSTS (1 to 13)				**27259**	**3651**
14	Depreciation and maintenance				1686	226
15	Overhead costs and interest				945	127
B)	**TOTAL COSTS (1 do 15)**				**29890**	**4003**

	ACHIVED RESULTS	Unit	Quantity	Selling price	RSD/ 1day	COST PRICE RSD/kg	COST PRICE € / kg
16	Dry halves	kg	59.0	550	32472	**388.0**	**3.46**
17	Dry cubes	kg	18.0	440	7920		
C)	**PRODUCTION VALUE (16 to 17)**				**40392**	5410	
D)	**PROFIT (C - B)**				**10502**	**1406**	

Production of sour cherry requires daily costs of 29,890 RSD, which amounts 448,356 RSD (4,003 €) in the 15-day period. Regarding the overall costs, as expected, the costs of fresh sour cherry as the basic raw material are dominant with 60.2% (Fig. 1). Labor costs are also very important item (22.7%), primarily due to the relatively low level of automatization process. Fixed costs account for 8.8% of the overall production costs (depreciation and maintenance, general expenses and interest). General expenses include a proportionate share of overheads of family farm (telephone, fuel and travel expenses, insurance, fees and taxes for property, administrative services, potential sales costs, etc.)

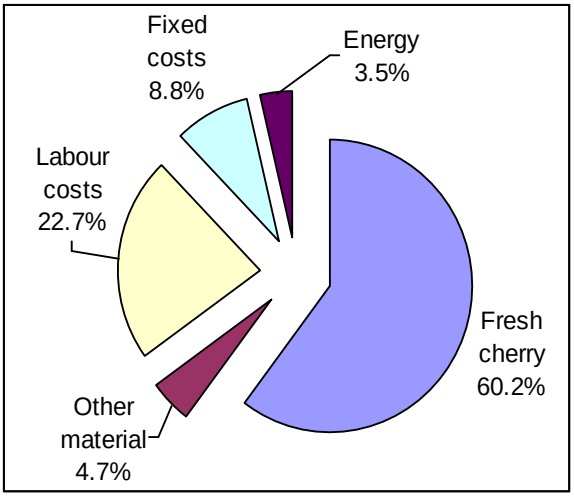

Fig. 1. *Costs structure of dried cherry (%)*

The share of energy costs is very low (3.6%), which is mainly caused by using biomass (wheat straw) for convective drying. However, it is also very important to emphasize the relatively low cost of electricity (about 7.2 € cents / kWh). Logically, there is the issue of substitution of straw by natural gas, which is from the technological and organizational viewpoint considerably more suitable fuel. The equivalent amount of natural gas is about 67 m^3/day, which, for the price of 40 RSD/m^3, amounts 2,680 RSD/day. This increases energy cost for 277 €/15 –day period, 2,490 €/135-day period respectively. Beside that fact, their share remains acceptable with 6.7%. The cost of the dry half and dice is the same and amounts 388 RSD/kg (3.43 €/kg). When we calculate 20% trade margin and 20% VAT to the wholesale price of dried quarters of 550 RSD/kg, we get the retail price of 792 RSD/kg (7.07 €/ kg). This could be considered as competitive price for the domestic market.

The expected level of sales price ensures the profit of 1,406 € for the planned 15-day production of 1,156 kg of dried sour cherry. A farm can have significant additional benefit if employing two members of the family (40% of total manpower). In this case, the profit can be expressed by the income of the farm in amount of 1,771 €/15-day period, whereas additional benefit amounts about 3,279 € per year (tab. 3). Cost-effectiveness coefficient (1.35) and profitability rate of dried sour cherry production (26.0%) also have very good values.

Table 3. *Additional indicators of success*

No	TYPE OF INDICATOR	€/ 15 days
1	Gross margin (C - A)*	1759
2	Farm income (D+ 40% of labour costs)**	1771
3	Financial Flow- average annual	16942
4	Time of investment return	1.82
5	Production efficiency (C / B)	1.35
6	Production accumulation (D / C)	26.0%

* Marks refer to the data given in Table 2

** It is assumed that 40% of the workforce are members of the family

Since throughout a year some other fruit sorts are dried and since they have different levels of profitability, by the indicators of dried sour cherry production is not possible to make accurate projections of success on the annual level. Taking into account average profit of the most important fruit productions (apricot, pear, peach, quince and sour cherry) for which it has been calculated on average in amount of 15,209 €/year, by adding average annual depreciation (1,733 €/year), average financial flow amounts 16,942 €/year (Vukoje et al, 2010, 2011, 2012). By this assumption, the total investment is repaid for around 1.82 years, which is a highly acceptable period *(tab. 2)*. The subsidizing of "smaller" construction for drying fruits from the state directly contributes to the shortening of this period.

Conclusion

The analysis of economic parameters shows that dried sour cherry production is very profitable (profitability rate is 26.0%, cost efficiency 1.35). Moderate price fluctuations of fresh sour cherries and/or energy can not threaten the conclusion. The whole business project of building a mini plant for drying fruit on the family farm is also profitable. The relatively modest initial investment of around 30,900 € repays by about 1.82 years. The present national program of subsidizing the construction of new capacity in agriculture significantly cheapens the amount of investments. By the employment of family members, it possible to achieve an additional benefit in the form of salaries of about 3,280 €/ year.

Republic of Serbia possesses not only natural, but also considerable market potential for production of dried fruits. Beside the fact that imported dried fruits dominate on the domestic market, there are also significant opportunities for the export. The construction of small plants for drying fruits can be a good way for increasing income of family farms, reduction of unemployment and overall development of the countryside. Serious subsidy programs for building mini dryer as well as support for export products would significantly contribute to the development of this business.

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Literature

Babic, M., Babic, Ljiljana, Pavkov, I. (2005), *The energy and mass balance of dried fruit*, PTEP, 9(3-4), pp 54-56.

Cerovic, R., Misic, D.P., Milutinovic, M. (2005): *Present and future of fruit growing in Serbia*, Cacak, Vocarstvo, Vol. 39. br. 150(2), pp 93-112.

Milic, D., Radojevic, V. (2003): *Production, economic and usability of fruit and grapes*, Authors, Novi Sad.

Milic, D., Sredojevic, Zorica, Jelocnik, M. (2008): *Determination of upper limit for investment in cherry plantation establishment*, DAES, Institute of Agricultural Economics, Belgrade, Economics of Agriculture, pp 339-432.

Milic, D., Lukac, Mirjana, Kukic, D. (2007), *Economics justification of dried fruits production on familiar farm*, PTEP, 11(1-2), pp 14-16.

Pavkov, I., Babic, Ljiljana, Babic, M., Radojcin, M., *Kinetics of the combined drying technology of pear slice*, PTEP, 13(2009) 2, pp 111-116.

Vlahovic, B. (2003): *The market of agricultural and food products*, Faculty of Agriculture, Novi Sad.

Vukoje, V., Pavkov, I. (2010): *Analysis of economic justification of drying of apricots by combined tehnology*, PTEP, Vol 14, No 1, pp 36-39

Vukoje, V., Milic, D. (2011): *The analysis of the economic viability of the dried fruit production in Serbia*, Agroznanje, Vol 12, br. 1, Faculty of Agriculture, Banja Luka, pp 5-14.

Neskovic, M. (2011): *Economic effects of dried fruit production on the family farms*, masret rad, Faculty of Agriculture Novi Sad, 2011.

Zivković, M., Zaric, V., Radojevic, R. (2006): *Cost-benefit analysis of fruits drying using different technical alternatives*, PTEP, 10(1-2), pp 26-28.

Statistical yearbooks and other publications, Statistical Office of the Republic of Serbia, Available at www.stat.gov.rs