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PROFITABILITY OF DRIED APPLE PRODUCTION IN SERBIA*

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Summary: The primary objective of the paper is to determine the level of profitability of the production of dried apples in our country. It was analyzed and evaluated the most important economic indicators drying apples with combined technology (osmotic and convective drying). The calculations are based on real technical and technological norms for consumption and the current market prices of inputs and final products. In the structure of total costs, dominated by fresh apples (62.1%) and labor costs (20.5%), while energy costs are not particularly significant (3.6%). The results show that it is a very profitable production (profit 3558 €/22 days, production efficiency 1.60; production accumulation 37.4%). Investments in the construction of mini facility for drying fruits are not large (about 30,900 €) and are repaid for about 2 years, which is very acceptable period for this type of production. With the proper state subsidies, building mini facility for drying fruit can significantly contribute to improving the economic situation of agricultural holdings, reducing unemployment and overall development of the village.

Keywords: apple drying, combined technologies, profitability, comparative analysis.

INTRODUCTION

Apple is the most important fruit species in the world. Together with orange and banana, dominates global markets as one of the most popular types of fruit, which are used throughout the year (Bound, 2005). Given the virtually continuous season of consumption, this kind of fruit is very important, both in the human diet, and also from economical aspects (Milic et al., 2011). The world's largest producer is China, then the USA, Turkey, Poland, Italy and France. Apple fruit is rich in nutrients, depending on the cultivar, cropping, storage, packaging and processing possible. Apple fruit contains very useful carbohydrates, vitamins, minerals, fiber, and even the fat contained in the seeds.

Apples are grown in Serbia for centuries and, after plums, is the most important fruit species in our country. Its production varies with the increasing trend in recent years, so has reached a level of about 330 thousand tons (<http://webzs.stat.gov.rs>). Serbia has excellent natural conditions for the production of apples, which are not enough utilized. Lately, raises an increasing number of high-quality apple orchards, with the application of modern technology, which give high yield and better economic results. They are high quality varieties of apples (Granny Smith, Gala, Braeburn, Golden Delicious, Jonagold, Modi, Fuji), which besides drinking in the fresh state, are suitable for various types of processing, including drying.

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Apple is primarily used in the fresh state, as stone fruits. Apple fruit can be processed into more than twenty very tasty and valuable products. In our country, apples are commonly processed into concentrate, and there are other products: juice, syrup, brandy, vinegar, jam, dried apples, malic acid, jam, pectin. Processing of apples with drying is underrepresented, although lately dried apples are increasingly present in the domestic market.

Drying is one of the oldest methods of food preservation, whereas it is important to produce hygienic and healthy product, with preserved quality and extended shelf life of products. Domestic demand for dried fruit are settled mainly with the imports, while a significant part of the domestic primary products is wasted due to lack of processing capacity (Blagojevic et al., 2014). Drying removes water from the fruit which enables a much higher concentration of nutrients and natural flavors. The biggest advantage of dried fruit is that it can be used all year round. Dried fruit has a high energy value, and one pouch of 100 grams can replace more than 2 kg of fresh fruit. A significant advantage of dried fruit is that it takes up far less space than fresh or frozen fruit.

In the domestic market is dominated of dried fruit from imports, which is often more expensive, while lower quality than domestic. Production of dried fruit is underdeveloped in our country, especially when we take into account the large export opportunities. The basic prerequisite for the production of quality dried fruit is high quality raw material and modern technology for drying fruit. Our country has a very high-quality fresh fruit, possess the necessary knowledge and products and different equipment for drying fruit.

Production of dried apples in our country is relatively little represented, particularly in relation to the production of fresh apples, as well as other kinds of apple products. Dried apples can be found on sale in the form of crunchy leaves - chips, which due to its high price is not interesting customers in Serbia. Research at the Faculty of Agriculture in Novi Sad have shown, that apples can be dried successfully with combined technology of fruit drying. Dried fruit with this technology has a favorable mass balance of raw materials - the finished product, while for chips apple is not the case. Changes in physical properties of dried apples with combined technology are favorable in comparison to conventional drying technology (Pavkov et al., 2008). It remains to determine the level of profitability of this production in local conditions, which is also the objective of research in this paper.

MATERIAL AND METHODS

Apple may be dried by using a variety of technologies, using a variety of technical solutions of drying device. In addition to conventional drying process (ie, convective drying) that are commonly applied in apple fruits, can be also used and combined drying technology (combination of osmotic and convective drying). First, the osmotic dehydration of fruits is done in a sweet sucrose or other sugars, and then fruits are dried by convective process till the humidity storage. This paper examines the economic effects of drying apples with the combination of osmotic and convective drying.

It is the combined technology of fruit drying (osmotic and convective), which is based on original constructed devices in the laboratory of Biosystems Engineering of the Faculty of Agriculture in Novi Sad. Performed laboratory studies have shown that drying fruit with combined technology has many advantages compared to conventional drying technology. Benefits originate primarily from the osmotic drying, and are reflected in the preservation of the quality of dried fruit (natural color, smell, flavor, taste), prolonged storage period with higher humidity, with the possibility of using solar energy and biomass (Khoy et al., 2007, Kingsly et al 2007, Ratti et al., 2005 M. Babic et al., 2005, Pavkov et al., 2009, Pavkov, 2012, Guine, 2006).

The study refers to the facility of the medium capacity that is perfect for the production on family farms. The technological stages of drying, packaging and distribution are considered but not the production of fresh apples. Calculation and analysis are based on the following most important production-technological and economic assumptions:

- real daily capacity of dryer is 500 kg of fresh apples, facility is effectively used 135 days a year, of which 22 days for apples (a total of 11,000 kg of fresh or dried apples 2,468 kg), and the remainder for other dry fruits (cherries, nectarines, peach, apricot, quince, plums and pears);
- investment in the purchase of equipment and facilities, including refrigerators, amounted to € 30,900; half is financed from loans, working capital is wholly financed from own resources (Vukoje and Milic, 2011);
- thermal energy for osmotic drying is obtained from electricity, and for convective drying primarily from wheat straw, it is also analyzed and replacement straw with natural gas;
- work in three shifts, need for five employees, of whom one knows drying technology;

RESULTS

All calculations of costs and results based on the real market prices of inputs and finished products. It uses the prices without VAT, fco farm. The most important results of the study are presented in euros, in order to obtain a clearer picture and more easily comparable data. Use the average euro exchange rate from the period in which the study relates (1 € = 119 RSD). The starting point for determining the costs and results are laboratory established consumptions of materials, labor and energy. Table 1 shows the mass balance of drying apples, based on previously conducted laboratory studies.

Table 1. The mass balance of drying apples

	%	kg
Dry slices	19,10%	95,5
Dry cubes	3,50%	17,5
Usable waste*	5,00%	25,0
Leftovers**	1,00%	5,0
The evaporated water	71,40%	357,0
Total:	100%	500,0

* Whole fruit unsuitable for drying.

** The seeds lodge of apples.

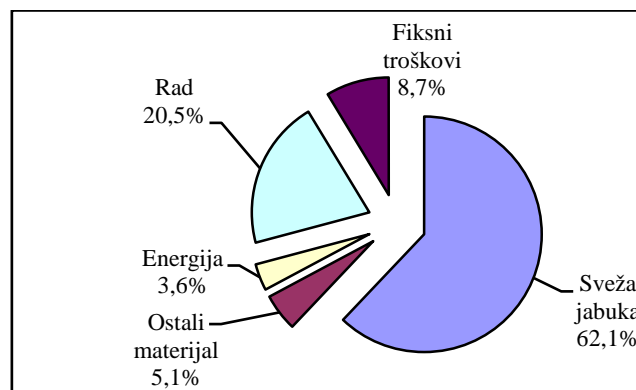
It is used primarily form of calculations according technological operations (preparation of materials, osmotic drying, convective drying and finishing). It provides detailed apportion of costs, and thus their accurate calculation, as well as more opportunities for cost analysis and results. More reliable estimates of the cost-effectiveness of production are determined by additional absolute and relative indicators of success. The most important indicators of success are compared with the results in the production of dried apricots, quinces, cherries and pears.

Direct costs are primarily calculated for daily production, and then, based on the average exchange rate of the euro, perform calculations for the 22-day production of dried apples (Table 2). The overall costs are determined on an annual basis, and then dividing by 135 days of effective work of dryer, gets their daily amount. Daily costs in the production of dried apples amounted to 32.221 RSD, or 5.957 €/ for 22 days of the drying apples.

Table 2. Production calculation of dried apples (1€= 119 RSD)

Dryer capacity: 500 kg of fresh apples per day, i.e.1100 kg for 22 daYS							
No	TECHNLOGICAL OPERATIONS	Unit	Quant ity	Price RSD/ Unit	RSD / 1 day	€/22 days	
1	Fresh apple	kg	500	40,0	20000	3697	
2	Sulphur	kg	0,0	0,0	0	0	
3	Water	l	1000	0,13	130	24	
4	Labour costs	h	19,2	165	3168	586	
I)	Preparation of material for drying				23298	4307	
5	Electrical energy	kwh	49,6	6,97	346	64	
6	Sugar	kg	7,6	58,0	441	81	
7	Water	l	50,0	0,13	6,5	1,2	
8	Labour costs	h	4,8	165	792	146	
II	Osmotic drying				1585	293	
9	Electrical energy	kwh	12,0	6,97	84	15	
10	Heat energy (straw)	kg	168,0	4,44	747	138	
11	Labour costs	h	8,0	165	1320	244	
III	Convective drying				2150	398	
12	Package				1074	198	
13	Labour costs	h	8,0	165	1320	244	
IV	Finalisation				2394	442	
A)	VARIABLE COSTS (1 to 13)				29427	5440	
14	Depreciation and maintenance				1792	331	
15	Overhead costs and interest				1002	185	
B)	TOTAL COSTS (1 to 15)				32221	5957	
	ACHIEVED RESULTS	Unit	Quant ity	Sellin g price	RSD/1 day	COST PRICE	
						RSD/kg	€/ kg
16	Dry slices	kg	95,5	470	44885	285,1	2,40
17	Dry cubes	kg	17,5	376	6580		
C)	PRODUCTION VALUE (16 to 17)				51465	9515	
D)	PROFIT (C - B)				19244	3558	

In the structure of the total production costs, dominate the costs of fresh apples, as the basic raw material with 62.1% (Figure 1). Using fresh apples from own production, would significantly reduce costs, since the calculation would make at cost price, which is much lower than the market price. The relatively high share of labor costs (20.5%), may primarily be explained by the low degree of automatisisation facilities.



Graph. 1. Structure of the cost production of dried apples (%)

Fixed costs make significant 8.7% of the total cost of production of dried apples. Of these, depreciation and maintenance are 5.6% and general costs holdings and interest of 3.1%. General costs include a proportionate part (for 22 days) of mainly overheads on the farms (insurance, fees, taxes and contributions of property, telephone, fuel and travel costs, administrative services, the eventual cost of sales, etc.).

Table 3. Additional indicators of success

No	TYPE OF INDICATOR	€/ 22 days
1	Gross margin (C - A)*	4074
2	Farm income (D+ 40% earning)**	4001
3	Production efficiency (C / B)	1,60
4	Production accumulation (D / C)	37,4%

* Marks refer to the data from Table 2.

** It is assumed that 40% of the workforce is composed of members of the family, ie. 2 of 5 people.

The coefficient of cost-efficiency (1.60) shows that for each RSD incurred costs, achieved 1.6 RSD worth of production and the rate of accumulation -that 100 production value retained 37.4 RSD of profit. It is a very good values of these indicators, especially for this type of production.

DISCUSSION

The need for thermal energy for drying fruits depend on the physical and thermo-physical properties and characteristics of fruits and drying facilities. By applying a combined drying, the total heat energy consumption is lower. If as an energy source for convective drying used wheat straw, average lower heating value of Hd = 13,000 kJ / kg, required mass of 176 kg / day (Vukoje et al., 2010). The relatively low share of energy costs (3.6%) can be explained using a straw for the purposes of convective drying or low cost electricity in the country. Costs or prices of the main raw material (fresh fruit) are, therefore, critical to the profitability of the production of dried fruit, and not the cost of energy, as is commonly thought. This does not mean that energy costs are not important to raise the profitability of production of dried fruit, but only that, in the specific market conditions, primarily due to low energy prices do not constitute a key element of the cost price.

In these circumstances, the logical question arises, cost-effectiveness and use of other types of energy for drying. It is, above all, the question of replacing straw with natural gas, as well as much more convenient and more comfortable to use fuel. In the present example, the equivalent amount of natural gas is 71.2 m³ / day (lower heating value of Hd = 32,000 kJ / kg), which at a price of 49 RSD / m³ is 3.489 RSD / day. This increases the cost of energy in the production of dried apples 507 €/ 22 days, but their participation remains at an acceptable level of 11.2%. This measure reduces profits for about 2.700 €/ for 22 days, but it still does not question the viability of production. Certainly, this substitution deserves serious consideration in the present conditions of production.

Power consumption is small in the process of drying fruit with combined technology. There is no significant increase in the price of energy, which in the future can realistically be expected, and should not affect significantly on the costs of this production. When electricity price is 12 euro cents / kwh, the share of total energy costs are increased from 3.6% to 4.5%, which decrease profit for only 310 €/ for 22 days.

The costs of dry-quarter and dice are the same, and it is 318,4 RSD / kg (3,53 €/ kg). When on the wholesale price of dried quarter of 470 RSD / kg, added a 20% trade margins and 20% VAT, then obtained retail price is 676.8 RSD / kg (5.69 €/ kg). With this price, dried apple is very competitive in the domestic market, especially regarding relationship between price and quality.

For the planned 22-day production of 2.486 kg of dried apples, is achieved a very significant amount of profit from 3.558 €/ 22 days (Table 2). If the drying operations employ two members of the household, (which accounts for 40% of the required five workers), wages can be expressed with the income of households, which amounts to 4.001 €/ 22 days (Table 3). In addition, supplementary benefit per annum (for 135 days effective work) is about 2.700 € Gross margin (the difference between the value of output and variable costs) is a very useful indicator of success, especially from the aspect of short-term decision-making. Given that fixed costs are unchangeable in the short term, gross margin shows clearer than profits the contribution of individual production to the overall success of the enterprise.

Previously published research results (Vukoje and Milic, 2011; Vukoje et al., 2010; 2011; 2013) allow comparison of the level of profitability of drying apples with other fruits. At the same time, it is best to use relative indicators, i.e. coefficient of cost-efficiency. The results show that the most cost-effective production is of dried apples with a coefficient of 1.6. Approximate cost-effectiveness ratio has only the production of dried pears (1.56), while considerably less coefficients recorded by dried apricots (1.42), cherry (1.35) and quince (1.30). The value of such comparisons should, however, be interpreted with caution, given the significant fluctuations in input prices, finished products, as well as the euro exchange rate, in some years.

All previous calculations are related to the 22 daily production of dried apples, which is only part of a total of 135 days of effective work of the dryer. Remaining time are used for drought for other types of fruit (cherry, peach, apricot, pear, plum, etc.), with different degrees of profitability. Reliable estimates of the profitability of this business can be done, however, on the basis of overall cost-benefit analysis of construction and use of facilities for drying fruit, i.e. annually. Previously conducted studies that were related to a higher number of fruit species (Vukoje et al., 2012) indicate that it is a profitable production, which show coefficient of cost-efficiency 1.43 and the period of return of investment of 2.02 years. To the similar results comes Nešković (2011), who, with a slightly different structure of production and slightly bigger investments (about 36.000 €), came to the coefficient of cost-efficiency 1.42 and payback period of 2.36 years.

CONCLUSION

The most important economic parameters indicate that the production of dried apples is highly profitable (profit 3.558 € for 22 days, accumulation of production 37.4%, cost-efficiency 1.60). Even more significant rise in prices of basic inputs can not bring into question this conclusion. There is no doubt that the whole business venture construction of mini facility for drying fruits, with combined technology on the family farm is also a profitable business, which confirms earlier conducted researches. The employment of family members, may generate additional benefits for households of around 3.280 €/ year.

The Republic of Serbia has respectable natural, technical, technological and market potentials for the development of the production of dried fruit, including significant export opportunities. It is necessary to make an organized effort to raise this production to a much higher level in quantitative and qualitative terms.

The construction of small facility for drying fruits can be a good way to improve the economic status of family farms, reducing unemployment and overall development of the village. They did not negligible direct and indirect benefits from the use of straw and other crop residues in the drying process. Programs of subsidizing for the construction of mini kilns, some of which are now available, as well as government assistance in exporting dried fruits, can significantly contribute to the development of this business in our country.

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ISPLATIVOST PROIZVODNJE SUŠENE JABUKE U SRBIJI

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Izvod: Primarni cilj rada je da se utvrdi nivo isplativosti proizvodnje sušene jabuke u našoj zemlji. Analiziraju se i ocenjuju najvažniji ekonomski pokazatelji sušenja jabuke kombinovanom tehnologijom (osmotsko i konvektivno sušenje). Obračuni se zasnivaju na realnim tehničko-tehnološkim normativima utrošaka i aktuelnim tržišnim cenama inputa i gotovih proizvoda. U strukturi ukupnih troškova dominiraju sveža jabuka (62,1%) i troškovi rada (20,5%), dok troškovi energije nisu posebno značajni (3,6%). Rezultati istraživanja pokazuju da se radi o vrlo isplativoj proizvodnji (dobit 3.558 €/ za 22 dana, ekonomičnost 1,60; akumulativnost proizvodnje 34,4%). Investiciona ulaganja u izgradnju mini pogona za sušenje voća nisu velika (oko 30.900 €) i otplaćuju se za oko 2 godine, što je vrlo prihvatljiv period za ovu vrstu proizvodnje. Uz odgovarajuće subvencije države, izgradnja mini pogona za sušenje voća može značajno doprineti poboljšanju ekonomskog položaja poljoprivrednih gazdinstava, smanjenju nezaposlenosti i ukupnom razvoju sela.

Ključne reči: sušenje jabuke, kombinovana tehnologija, profitabilnost, uporedna analiza.

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