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ECONOMIC EFFECTS OF DRIED PEAR PRODUCTION USING COMBINED TECHNOLOGY[1]

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Abstract

This paper analyses the expenses and results of dried pear production using combined technology. The research refers to a dryer of the capacity 450 kg of raw material per day, which is suitable for production on family farms. Drying of pears lasts for 20 days, while the period for drying all fruit lasts 135 days per year in total. Cost price of dried pear, in packages of 100-500g, is 376.8 RSD/kg. (3.59 €/kg). In the cost price structure the expenses of dried pear (56.7%) are the highest, while energy costs are low (2.8%). Substitution of wheat straw by natural gas in the process of convective drying increases energy costs to the still acceptable amount of 6.9%, so it can be an alternative in the present production conditions. The wholesale price of 590 RSD/kg (5.62 €/kg) makes the profit of 3,376 €/20 days in dried pear production.
Key words: *pear drying, combined technology, costs, profitability.*

Introduction

Pear is one of fruit sorts of the greatest quality and it is highly profitable in moderately continental climate. Apart from being consumed in the fresh state, pear is also suitable as a raw material for processing. There is a demand for the majority of processed products from pear on the domestic market, while it also presents an important item for export.

Fresh fruit processing in Serbia is generally restricted to production of alcoholic drinks, soft drinks, stewed fruit, marmalade and jams. There are no precise data on domestic production and consumption of dried pear, but it seems to be very low and insufficient. Domestic market is not sufficiently supplied with dried pear. In retail

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dried pears are available only in well-supplied health food stores and supermarkets. Therefore, there is great potential for further growth of domestic market for this product, having in mind the expected improvement of life standard and, thus, gradual changes in consumers' habits.

Continual supply of high quality raw materials is a prerequisite for the development of dried pear production. In spite of the constant decrease of the number of fruitful trees, the pear production Serbia is growing. In 2008, 61,886 tons of fresh pears were produced with around 4,400 trees. The territory of Vojvodina accounts for 17.4% of the production (Statistical Yearbook, 2009). High-quality cultivars are present to a sufficient degree, predominantly the cultivar "William", which is generally used for drying.

The quality indicators of dried pear (colour, shape, texture, flavour and aroma of dried fruit) currently available in retail are not outstanding. The main deficiency is inadequate drying technology. The question that arises is whether applying of combined technology, which provides better quality of dried fruits, would contribute to achieving corresponding economic effects, as well.

Material and methods

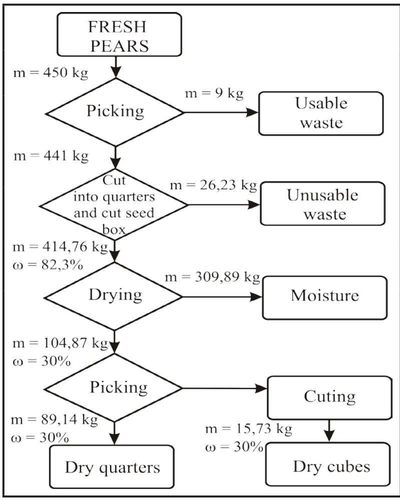
Pear can be dried by applying different technological procedures, and by using various technical solutions for drying devices. The paper examines economic effects of pear drying by combined technology combination of osmotic and convective drying, (Babić Ljiljna et al., 2003). It is a relatively small capacity plant, suitable for production on family farms.There are a number of advantages if combined technology is used in drying fruits compared with classical drying technologies. These advantages refer to preserving the quality of dried fruit (natural colour, aroma and flavour), to the extended period of storing with higher moisture content and it is more rational in terms of energy consumption (Kil et al., 2002, Babić M. et al., 2005, Pavkov et al., 2009, Guine, 2006).

In a Laboratory of Bio-systematic Engineering of the Faculty of Agriculture in Novi Sad, original devices for drying fruit with combined technology were designed. Previous laboratory research showed that this technology is suitable for drying various sorts of fruit, including a pear cultivar "William". The products are of good quality, mass balance is favourable, energy consumption rational, while there is also the possibility of using solar and biomass energy.

The research is supposed to test whether drying of pears using combined technology can be cost-effective on family farms. Calculations are based on the following most important technical-technological and production-economic presuppositions:

- Production is performed on a registered commercial farm, which is included in VAT system and has the status of an entrepreneur;
- Realistic daily capacity of the dryer is 450 kg of fresh pear, pre-calculation of costs and results is based in the following mass balance (Fig. 1):

Fig. 1. Diagram of technological procedure for pear processing by drying with mass balance; [m – mass (kg), ω - moisture content (%)]



	%	kg
Dry quarters	19.81%	89.1
Dry cubes	3.50%	15.7
Usable waste	2.00%	9.0
Unusable waste	5.83%	26.2
Moisture	68.86%	309.9
Sum:	100.0%	450.0

- Continual supply of raw material is provided from the area within 60 km, cold storage is not necessary;
- The plant is used effectively for 135 days per year, out of which 20 days are used for drying pears (9,000 kg of fresh, i.e. 2.097 kg of dried pear), while the rest of the days are used for drying other sorts of fruit (sour cherry, nectarine, peach, apricot, quince, plum and apples);
- Thermal energy for osmotic drying is generated from electric energy, while for the convective drying it is generated from wheat straw;
- Work is in organised in three shifts, requiring five workers, one of whom is required to be well qualified for drying technology;
- Calculations are based on realistic market prices of input and final products, all the prices are without VAT, free delivered (1€ = 105 RSD);
- Investment in procurement of equipment and tools as well as facility construction (30 m^2) amounts 17,500 €, half of which is financed from credits with the interest rate of 5% and repayment period of 4 years, while the working capital is entirely financed from own resources.

The analysis is primarily based on analytic calculation of production costs for dried pear. The emphasis is placed on the calculation of technological operations (preparation of material, osmotic drying, convective drying and finalisation). This form of calculation system enables detailed itemisation of costs, and, therefore, more precise cost calculation, and provides more possibilities for costs and results analyses.

Aiming at a more reliable evaluation of cost-effectiveness, certain additional absolute and relative success indicators were determined. The most important economic indicators are compared with production results of dried apricot produced using the same technology.

Results and discussion

Direct costs are primarily calculated for a dryer of daily capacity of 450 kg of fresh pear; then, on the basis of the established RSD exchange rate, calculations for 20-day pear production are made (Table 1).

Table 1. Production calculation of dried pear (1€ = 105 RSD)

Dryer capacity: **450** kg of fresh pear per day, i.e. 9000 kg for 20 days						
No	TECHNOLOGICAL OPERATION	Unit	Quantity	Price RSD/Unit	RSD/ 1day	€ / 20 days
1	Fresh pear	kg	450	50.0	22500	4286
2	Sulphur	kg	0.40	154.4	62	12
3	Water	l	950	0.113	108	20
4	Labour costs	h	19.2	170	3264	622
I	**Preparation of material for drying**				**25933**	**4940**
5	Electrical energy	kwh	49.9	6.97	348	66
6	Sugar	kg	7.1	46.7	332	63
7	Water	l	50.0	0.11	5.7	1.1
8	Labour costs	h	4.8	170	816	155
II	**Osmotic drying**				**1501**	**286**
9	Electrical energy	kwh	14.4	6.97	100	19
10	Heat energy (straw)	kg	176.0	3.70	652	124
11	Labour costs	h	8.0	170	1360	259
III	**Convective drying**				**2112**	**402**
12	Package				6825	1300
13	Labour costs	h	8.0	170	1360	259
IV	**Finalisation**				**8185**	**1559**
A)	VARIABLE COSTS (1 to 13)				**37732**	**7187**
14	Depreciation and maintenance				1180	225
15	Overhead costs and interest				778	148
B)	**TOTAL COSTS (1 do 15)**				**39690**	**7560**

	ACHIVED RESULTS	Unit	Quantity	Selling price	RSD/ 1day	COST PRICE RSD/kg	COST PRICE € / kg
16	Dry slices	kg	89.1	590	52593	**376.8**	**3.59**
17	Dry cubes	kg	15.7	295	4640		
18	Usable waste	kg	9.0	20	180	**20.0**	**0.19**
C)	**PRODUCTION VALUE (16 to 18)**				**57413**		**10936**
D)	**PROFIT (C - B)**				**17723**		**3376**

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.

Technological operations include a number of working activities (e.g. "preparation of material": receiving fruit, washing, selection, cut into quarters and sulphuring). Material and energy consumption are based on the results of previously performed laboratory research (Babić, M. et al, 2004). Most of the costs arise during the very first operation (65.3%), which is expectable, as it includes the values of fresh pears and requires a lot of manpower.

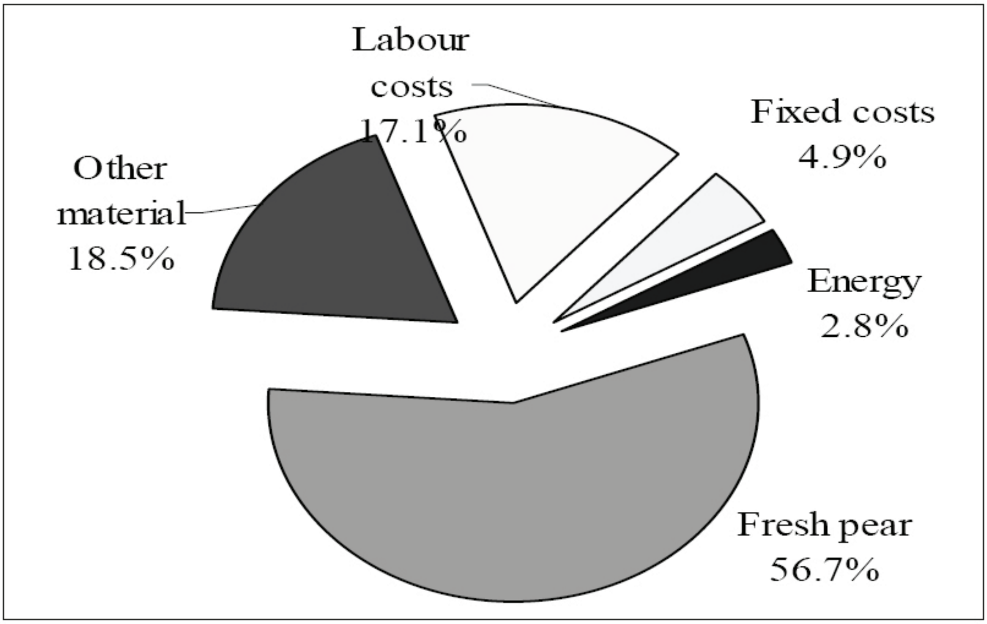
Regarding the overall costs, as expected, the costs of fresh apricot as the basic raw material are dominant with 56.7% (Fig. 2). Significant share of manpower (17.1%) can be explained by a low level of plant automation.

The demands for thermal energy in fruit drying depend on physical and thermo-physical properties of fruit to be dried and the dryer. By applying combined drying, the overall consumption of thermal energy is decreased. If wheat straw is used as fuel for convective drying, with the mean values of lower thermal power Hd = 13,000 kJ/kg, the mass 176 kg/day is required.

The share of energy costs is very low (2.8%), which is partially due to using biomass (wheat straw) for convective drying. This fact questions the common opinion that energy costs are crucial for cost-effectiveness or ineffectiveness of dried fruit production. Apart from the already mentioned automation of the process, this can be attributed also to the current low price of electric energy.

Logically, there is the issue of substitution of straw by natural gas, which is from the technological and organisational viewpoint considerably more suitable fuel. The equivalent amount of natural gas is

Fig. 2. Costs structure of dried pear (%)



71.5 m3/day (lower thermal power Hd = 32.000 kJ/kg), which, for the price of 33.78 RSD/m3, amounts 2,415 RSD/day. This increases the costs of energy in dried pear production for 336€ /20 days, but their share remains acceptable with 6.9%. This does not jeopardise considerably the cost-effectiveness and it is certainly justifiable to consider it seriously in the current production conditions.

Fixed costs account for 4.9% of the overall production costs. Depreciation and maintenance are dominant costs, while interest in investment credits is not significantly high (0.7%, i.e. 358€ on the annual basis). Cost price of dried slices and cubes is the same, and it amounts to 376.8 RSD/kg (3.59 €/kg). Since the cost price of by-products (usable waste) equals the selling price, the success of the whole production depends on the main products.

When we calculate 20% trade margin and 18% VAT to the wholesale price of dried quarters of 590 RSD/kg, we get the retail price of 835.4 RSD/kg (7.96 €/ kg). That price is significantly lower than the average price of packed pear which can be found in our shops. Furthermore, dried pear produced with combined technology has important competitive advantages in terms of quality.

The expected level of sales price ensures the profit of 3,376 € for the planned 20-day production of 2,097 kg of dried pear (Table 1). This is around 2.3 time better result than in dried apricot production using the same technology, which makes the profit of 1,482€ /20 days (Vukoje and Pavkov, 2010).

Since throughout the year some other fruit sorts are dried, as well (sour cherry, nectarine, peach, apricot, quince, plum and apple), and since they have different levels of profitability, it is not possible to make accurate projections of success indicators on the annual level, based only on the data on dried pear production. However, having the assumption that dried pear production reflects the average level of cost-effectiveness on the annual level it is possible to draw a number of useful indicators of cost-effectiveness of using dryers. In this case, the total profit for 135 days of effective dryer functioning can be assessed for about 10,000€.

Since the fixed costs mostly do not change during a short period of time, the cost-effectiveness of certain production can be discussed more appropriately on the basis of the gross margin than on the profit basis.

A farm can have significant additional benefit if employing two members of the family (40% of manpower). In this case the profit can be expressed by the income of the farm (3,894€). The additional benefit amounts 518 € from the process of pear production, i.e. about 3,497 € per 135 of work days.

Table 2. Additional indicators of success

No	TYPE OF INDICATOR	€/ 20 days
1	Gross margin (C – A)*	3749
2	Farm income (D+40% Earning)**	3894
3	Production efficiency (C / B)	1.45
4	Production accumulation (D / C)	30.9%
5	Economic flow (average profit + depreciation) **	1662
6	Time of investment return	1.56

* Marks refer to the data given in Table 1
** The amounts in No. 5 and 6 are calculated on the basis of the assumed "average profit" of 1.482€ /20 days, which correspond to dried apricot production.

Cost-effectiveness coefficient (1.45) and profitability rate of production (30.9%) also have very good values, considerably better than in dried apricot production (1.31 cost-effectiveness, i.e. 23.9% of accumulation; Vukoje and Pavkov, 2010). The total investment is repaid for around 1.56 years, which is a highly acceptable period.

Conclusion

The analysis of technological and economic parameters show that dried pear production using combined technology on family farms can be very profitable (profitability rate is 30.9%), even if the price of fresh pear substantially increases. Regarding the costs structure, the costs of fresh pears are the highest (56.7%), while the energy costs are quite low (2.8%).

The observed scope of processing (9,000 of fresh pear, for 20 days) makes the profit of 3,376 €. Significant additional profit in the form of earnings can be made in the amount of about 3,497 € per year, if employing family members.

No large investment is necessary to start the production (up to 18,000 €). The existing specific-purpose funds and credit lines in Serbia enable people to take loans under relatively favourable conditions. The investment is to be paid back in about 1.56 years, which is a very short period of time. Evidently, there is not only natural but also market potential for development of such business in Serbia.

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