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ECONOMIC ANALYSIS OF DRIED PLUM FRUITS

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Abstract

Fruits are beneficial to humans in many ways. They are an essential part of a varied, healthful diet as well as a crucial one. As we know, fruits are seasonal food, and to guarantee longer-term storage and consumption throughout the year, they should be treated differently. The study evaluates economic indicators of three plum cultivars: Stanley, Top Taste, and Top 2000. They were dried using four different methods: in sun, in shade, in dehydrator, in lyophilizer. The study's methodological framework includes: a theoretical overview of plum drying methods, and an analysis of the economic indicators of prune fruits, such as gross production, net income, and profitability rate. The results show that freeze-dried plums have better indicators than the other three drying methods. However, if the freeze-drying method is excluded because the production price is ten times higher than that of sun-dried, shade-dried, and dried-in dehydrator plums, then in that case, the dehydration method shows better economic indicators than the remaining three drying methods at the three cultivars.

Key words**:** *drying plum methods, prune, gross output, rate of return, net income*

INTRODUCTION

In Bulgaria, the Common Agricultural Policy aids farm growth, revitalises the agricultural sector and enhances rural infrastructure [7]. Also, other research indicates high expectations for income stabilization and support in bigger farms, while some variations and negative trends were found in smaller holdings [1].

According to some research, traditional foods represent a particular category of products with an inherent worth in preserving and advancing local and national traditions [15]. Producers, especially small farmers, need help increasing the production of this food category. For this reason, the authors have chosen a case study to identify the leading economic operators of Romania's fruit-growing areas, which research unique food and processing qualities.

In other point, fruits are a healthy element of varied nutrition. Due to the high moisture content in fruits, the growth of bacteria, and the occurrence of enzymatic reactions that cause a deterioration in their quality, fresh fruits might present specific storage difficult. While, dried fruits have preserved carbohydrates, vitamins, and salts. Also, identifying their organoleptic properties is one of the primary advantages of drying fruits [9].

Dried fruits have long shelf lives and concentrated nutrient content. Other research shows that fruits can become infected with different toxic fungal species at different points in their life cycle, such as during cultivation, harvesting, processing, drying, and storage. As a result, there's a chance that these goods have elevated mycotoxin levels [6]. According to the authors, several variables, such as fruit variety, geographic location, climate, harvesting techniques, and storage management procedures, influence the development of mycotoxin.

Plums (*Prunus domestica*) have a complex biological makeup [12]. Other research has found that indicators like air, light, temperature, and moisture cause the development of microorganisms in fruits, which leads to the deterioration of their taste, smell, colour, and vitamins [2]. As a result, many techniques for drying plums have been explored in order to increase their shelf life. Plum fruit quality can be determined in part by

measuring the dry matter content of the fruit [13].

One of drying method is in sun, which is the most popular. In some research, an alternative energy source like the author's model solar dryer is utilized. In the method drying temperature is adjusted based on the daily temperatures [4].

Second drying method is dehydration by heat pump. Additionally, a comparison was conducted between the alternative energy source and heat pump drying the fruit at 45°C [3]. It was found that sun-drying has advantages. Since the fruits are dried in shade without direct solar heating, sun-drying is a cost-effective method that guarantees the preservation of biologically active chemicals [5].

Next drying method is lyophilization. The physicochemical, biochemical, and structural-mechanical characteristics of dried fruits influence the length of drying when using lyophilization. The lyophilization includes the subsequent technological phases [11]: 1) primary drying, which under high vacuum, ice crystals in fruits created during freezing sublimate when subjected to pressure that is first intense and then moderate; 2) secondary drying, which is defined as the desorption of remaining moisture at higher vacuum and positive temperature circumstances; 3) process ends, when the product reaches a specified level of residual moisture, and the sublimation chamber's vacuum is broken with dry, inert gas, then the product is left for storage.

The conditions at which the fruits are frozen before drying have a significant impact on their quality when dried [11]. In the study was found that freeze-dried fruits exhibit low moisture content (2-5%), a high concentration of carbohydrates, vitamins, and mineral salts. Also, the authors conclude that freeze-dried fruits have a maximally conserved enzyme system, and superior organoleptic indicators.

In other research, it was applied four different drying methods: hot-air-drying, vacuum-drying, ultra sound-assisted vacuum-drying, and freeze-drying, which were used to obtain dried plums [16]. Also, it was shown morphology of fresh plum, including the four drying methods, 2,000x magnification on the outer surface, and 1,500x cross-section of the dried samples.

MATERIALS AND METHODS

The aim of the study is to analyse economic indicators of three plum cultivars dried by four methods, tested under the conditions of the Kyustendil region.

The study's methodological framework includes:

1) a theoretical overview of plum drying methods;

2) an analysis of the economic indicators of plum-dried fruits, such as gross production, net income, and profitability rate.

The study evaluates economic indicators of three plum cultivars, which are grown in the experimental plantations at the Institute of agriculture – Kyustendil:

1) Stanley;

2) Top Taste;

3) Top 2000.

In 2023, plum fruits were dried using four different ways: in sun, in shade, in fruit dehydrator, in lyophilizer. The first three methods were applied in pilot plantations at the Institute of Agriculture – Kyustendil. The fourth method was applied at the Institute of Cryobiology and Food Technologies – Sofia (Photo 1 and Photo 2).

Photo 1. Drying methods – in sun and shade
Source: Own elaboration.

In processes before drying the plums were washed, cleaned, weighed, and cut in half and cleaned of stones. Plum pieces are not treated with acid before drying. Plums were dried on nets from the first to second drying method, which were raised at 30 cm. The day and night temperatures throughout the studied period

determine the drying temperature in sun and shade.

Photo 2. Drying methods – in dehydrator and lyophilizer
Source: Own elaboration.

Third method was provided on a "Klarstein Master Jerky 16" fruit dehydrator with a heat output of 1,500 W and even heat distribution. Temperature on drying was 70°C, and the drying time varies depending on each cultivar. Fourth method was provided on a "Hochvakuum-TG - 16.50" lyophilizer. Freeze-drying includes three phases:
1) first phase – freezing on plums at -25 ℃;
2) second phase – sublimation, removal water of fruits at -25 ℃/-35 ℃ under deep vacuum;
3) third phase – desorption, by heating under deep vacuum, at +25 ℃/+35 ℃.
The economic evaluation includes the analysis on gross output (BGN/da), production costs (BGN/da), net income (BGN/da) and rate of return (%).
Studies on agriculture's economic efficiency have focused on: effectiveness of dairy cattle farms [8], evaluation of economic aspects of urban agriculture [14], dried apple pomace [10], optimized orchard systems [17] and others.

RESULTS AND DISCUSSIONS

After processing plum production data, an economic analysis of some indicators was made. The first indicator is gross output (BGN/da), which is calculated as the average yield per decare of plums at the price per unit production (Figure 1).
Freeze-dried plums stand out from the other three drying methods. In this variant, cultivar Top Taste has results that are less than those of Stanley and Top 2000, and the reason is minimal harvest per tree. Also, in general, freeze-dried fruits have a significant increase in price than others. Based on market research, it was established that the price for drying in sun and shade is 16 BGN/kg, and in dehydrator is 20 BGN/kg. The lyophilized plum price stands out by a difference between 8 and 10 times higher than other prices. At this point, the cost price for freeze-dried plums is ten times higher than that of other fruit-dried methods. In summary, the cultivar Stanley performs better than Top 2000 and Top Taste in all drying methods for this indicator.

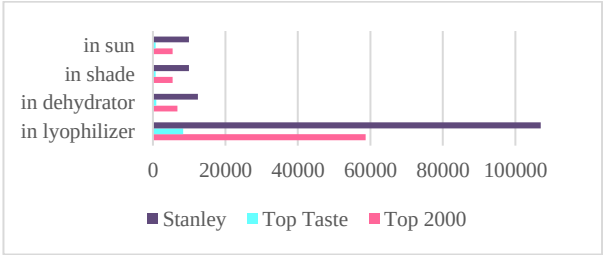

Fig. 1. Gross output (BGN, da) by four drying methods
Source: Own elaboration.

The second indicator, production costs (BGN/da), was calculated and displayed the labour and material costs associated with the production (Figure 2). The average plum production significantly influences this indicator. There is no difference between the two drying techniques, sun and shade, for cultivar Top Taste, and no extra electrical expenses were charged in these two cases.

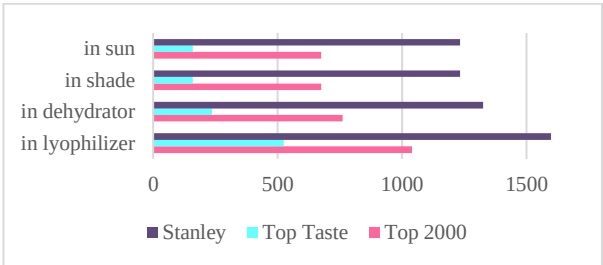

Fig. 2. Production costs (BGN, da) by four drying methods
Source: Own elaboration.

The third indicator, net income (BGN/da), was calculated as the difference between income and costs to produce prunes (Figure 3). The freeze-dried fruit price affected this indicator, 173 BGN/kg. Stanley is again the leading

cultivar, followed by Top 2000 in all drying methods.

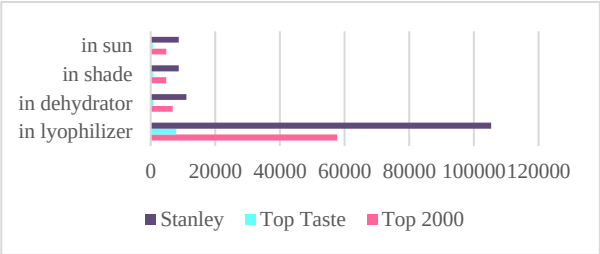

Fig. 3. Net income (BGN,d a) by four drying methods
Source: Own elaboration.

The fourth indicator, rate of return (%), reflected the percentage ratio between net income and production costs (Figure 4). This is where the pattern is repeated.

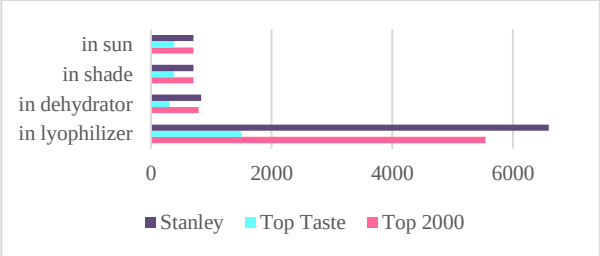

Fig. 4. Rate of return (BGN, da) by four drying methods
Source: Own elaboration.

Suppose we exclude the last drying method, which is the most expensive. We need to find out to what extent consumers are willing to pay the price in other study. In that case, it can be concluded that the dehydration method gives better economic indicators of sun-dried and shade-dried methods in the three cultivars.

CONCLUSIONS

The leading cultivar in the research is Stanley, followed by Top 2000, and in the end, Top Taste with minimal yield.
The study also showed the results of the economic analysis of gross output, production cost, net income, and rate of return indicators.
It was found that freeze-dried plums stand out from the other three drying methods with better indicators. The price for that production stands out by a difference between 8 and 10 times higher than prices in sun-dried, shade-dried, and dried-in dehydrator plums. This concludes that the cost price for freeze-dried plums is ten times higher than other fruit-dried methods.
The production costs were influenced by the average plum yield. The net income was influenced by the higher price for lyophilization fruit production, which is ten times higher than others. The ratio of net income to production costs was shown in the rate return, which repeats the findings of the preceding economic indicators.
Also, it was found that if the freeze-drying method is excluded, the dehydration method gives better economic indicators than sun-dried and shade-dried methods in the three cultivars.

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