

## THE VARIABILITY OF FRUIT CHARACTERISTICS OF TRADITIONAL PEAR KARAMANKA IN DIFFERENT ECOLOGICAL CONDITIONS

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### Abstract

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In this paper, we present the results of the phenological characteristics (flowering and ripening time), fruit characteristics (fruit mass, fruit length, fruit width, fruit hardness, length of fruit stalk and number of seeds in fruit) and chemical characteristics of fruits (soluble dry matter, total sugar and total acids) of a traditional pear variety ‘Karamanka’. For this study, a survey was undertaken in different ecological regions of Macedonia i.e. Skopje, Kumanovo, Kratovo, Kriva Palanka and Resen. The ‘Karamanka’ pear flowers in the first half of April. The period of fruit ripening starts in the second half of August and lasts until the first half of September. The earliest time of flowering and ripening was found to be in the regions of Skopje and Kumanovo. The pear ‘Karamanka’ has medium-sized fruits and the largest fruits were detected in the regions of Kumanovo and Resen. These differences in reference to the fruit mass were statistically significant. It was found that fruits contained 14.2% of soluble dry matter, 13.5% of total sugar and 0.13% of total acids. The highest values of soluble dry matter and total sugar were found in the fruits from the Kriva Palanka region. These values were statistically significant. The fruits from the regions of Skopje and Kratovo were characterized with poor quality and with the highest amount of stone cells.

*Key words:* different ecological conditions, fruit characteristics, Karamanka pear, traditional variety

### Introduction

Aiming for maximum achievements, implementation of new industrial varieties, by substitution of local varieties with those from abroad, puts the genetic variations on very low range. With intensive agricultural production and implementation of new pear varieties, new diseases also came along, that destroyed the local gene fond as well as the gene fond brought from abroad. The presence of fire blight bacteria (*Erwinia amylovora* Burr.) and the pest (*Psylla pyri* L.) in 90's years of 20<sup>th</sup> Century, highly damaged the pear production in Republic of Macedonia, and worldwide. So today, pear became deficient fruit variety in Macedonia, as well as worldwide.

Traditional pear varieties that were grown in the past are: Karamanka, Letna kajkushka, Zimska kajkushka, Tiranka,

Zimorka, Tatlija, Erebasma, Shalganka etc. (Avramovski et al., 2005). Their main characteristics were vitality and long lasting, reaching age of 100-150 year, according to the local citizens. They were very well adapted to the local conditions and naturally resistant to some diseases, therefore using chemicals was not necessary.

Nowadays traditional varieties are very rare. They are found sporadically in some yards. Some pear trees can be found in hilly and mountainous areas where extensive agriculture is practiced.

Such a situation required necessary preserving of the traditional pear gene-fond in Macedonia. Through our investigations, we make effort the pear in Macedonia to be revitalized. This research was part of the applicative project ‘Autochthonous Gene-fond Pears in Republic of Macedonia

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## Materials and Methods

The object of the research was the traditional pear variety Karamanka, one of the most present varieties in these places. For a selection of varieties, appropriate to certain soil and climate conditions, it is necessary to know the genetic, phenological and fruit characteristics of the varieties, their response to different soil and climate conditions, their sensitivity and resistance to abiotic and biotic factors, conditions for keeping and transport etc. Starting from this, the aim of this study was the determination of: flowering and ripening time, fruit characteristics (fruit mass - g, dimensions of fruit -mm, fruit hardness - g/cm<sup>2</sup>, length of fruit stalk - mm, number of seeds in fruit) and chemical characteristics of the fruit (soluble dry matter - %, total sugar - %, total acids -%). A description of the variety was made by an IBPGR descriptor. The fruits were classified according to the Rubcov classification (Mratinic, 2000). The mass of each fruit was weighed on the laboratory scales. The seeds were manually extracted from the fruits and the number of filled (healthy) seeds per fruit was counted. The total sugar and the soluble dry matter were measured by a refractometer. The total acids were determined by the standard method of titration (NaOH). Comparative investigations were made by Fisher's multiple comparative test.

The research activities took place in several different regions in Republic of Macedonia i.e. Skopje, Kumanovo, Kratovo, Kriva Palanka and Resen.

The regions of Skopje and Kumanovo belong to a continental-submediterranean climate-vegetation-soil region (Filipovski et al., 1996), where the influences of sub-mediterranean and east-continental climate are combined. These regions have an average year temperature in range 11.8°C - 13.6°C (average 12.7°C). The rain quantity is 460-583 mm per year (average 507 mm). The average year drought index is 22.6, and it is especially high in July, August and September. According to these data, Kumanovo has semi-arid climate, while Skopje has dry climate.

The regions of Kriva Palanka and Kratovo belong to hot continental climate-vegetation-soil region. The average air temperature per year is in the range of 9.6°C to 11.8°C (average 10.9°C). The Kriva Palanka valley has lower middle-day temperatures (9.6-10.1°C) than the Kratovo valley (11.6-11.8°C). The average year falls is 700 mm. According to the presented data, the regions of Kratovo and Kriva Palanka have semi-arid climate.

The region of Resen belongs to cold continental climate-vegetation-soil region, situated on 900-1100 m altitude. As a

result of the high altitude, in this region, the cold continental climate is dominant, with a certain influence of the mountain climate. The relief is mountainous. The average air temperature in the Resen region is 9.6°C and the rain quantity is 800-900 mm per year. The climate is humid. Depending on the active air temperature sum under 10°C, the region of Resen belongs to moderate hot regions (Filipovski et al., 1996).

## Results

According to the obtained results, the pear Karamanka exists in hilly to hilly-mountainous conditions at 300-500-950 m altitude. Wild pear trees were found on natural meadow, on soils with low quality. They were found sporadically in the yards, gardens etc. According to the morphological characteristic, this pear variety forms middle-vigorous to vigorous tree, with horizontal branches curved down. Also, its crown gets an extraordinary look. These pear trees are characterized as vital and long-lasting. They are very productive, more than 300 kg per tree. The fruits are mainly used by the local people and only small quantity is sold at the local markets.

The pear Karamanka is characterized as an early-flowering variety. The fruits ripen in the third decade of August, in the time of the orthodox holiday Golema Bogorodica, and also, it is characterized as late-summer pear variety. The fruits have asymmetrical pear-shape (1.3-1.4). The fruit peel is smooth, green-yellow with red blush on the sunny side and it rarely has small spots. At the time of full maturity the fruit gets yellow color like straw, with green small spots all over the fruit surface.

The pear Karamanka forms medium-sized fruits. The fruit mesocarp is very juicy, white-yellow, semisolid, with sweet-sour flavor and excellent taste and aroma. The fruit has middle fine to fine texture and small to middle amount of stone cells. A mature fruit has rotten mesocarp. The season of their consummation lasts up to 30 days, which is not characteristic to the other summer pear varieties. The fruit stalk is semi thick, long, very often curved, superficially located just aside of the apex. There are a small number of filled (healthy) seeds in the fruit. Fruits contain big amount of soluble dry matter and total sugar (Table 1).

## Discussion

Karamanka is one of the oldest pear varieties on the Balkan (Figure 1). It was brought by the Turks, who were spreading sweet tasting varieties during their trips. In addition, it can be found under several synonyms: Blagun, Begram, Bozdunka, Bozdogan, Bozdoganka, Mariovka, Grglash, Kashi-ja, Kashnjak, Beljak, Medenica, Mlechnica. In the neighbor-

hood, in Metohia it is known as Turkish pear or Medunk', in Bosnia as Batvacha. In other countries it could be found under other names like Gradska, Prasad etc. (Selamovska et al., 2012).

The pear Karamanka is a high quality variety and its fruits are highly valued in the Balkan. Today, this variety has advantages, when compared to the other late-ripening summer varieties. In the past, Karamanka was consumed with bread (Avramovski et al., 2005). It is a very vigorous variety (crown is over 40 m<sup>2</sup> according to Stancevic, 1983), and a high-yield variety (25-30.000 kg / ha or 150 kg per tree, with possibility for altering the fruit yield) (Stancevic, 1983; Mratinic, 2000; Avramovski et al., 2005).

Depending on the climatic conditions, Karamanka has different flowering times. The earliest time of flowering (first decade of April) is characteristic for pear trees in the Skopje and Kumanovo regions and the latest time of flowering (middle of April) in the region of Resen. Also, the fruits in the Skopje and Kumanovo region ripen the earliest (from the second half of August and until the end of August) and in the other regions in the beginning, or in the first half of September. The reason for the earliest time of fruit ripening in the Skopje and Kumanovo regions is the higher air temperature, lower altitude and smaller quantity of rain during the year, compared with the other ecological regions.

According to Gjurgjevic and Shoshkic (1968), pear Karamanka belongs to early-flowering varieties and according to the ripening time it is classified as a late-summer variety (Avramovski et al., 2005; Selamovska and Nikolic, 2012).

Karamanka pears form medium-sized fruits, with average fruit mass of 183.6 g, average fruit length of 80.1 mm and average fruit width of 70.2 mm. The biggest fruits were found in the Kumanovo and Resen region (over 250 g.) and the smallest fruits were found in the Kratovo and Skopje region (about 100 g.). These differences were statistically significant. No statistically significant difference was found in

the fruit mass, fruit length and fruit width in the regions of Kumanovo and Resen, as well as in the regions of Skopje and Kratovo. Because of the excellent climate and soil conditions for growing pears, the biggest fruits were expected in the Resen region. This region has the optimum amount of rain per year, and high relative air humidity, which is not the case in the other regions with less rain and low relative air humidity. The influence of the climate conditions is also shown in the taste and presence of stone cells in the fruits, as well as in its solidness. In dry years and dry regions it gives smaller fruits, the mesocarp has sour taste and the contents more stone cells. The smallest fruit, with the worst taste, biggest amount of stone cells and most solid fruits (over 2000 g cm<sup>-2</sup>) give pear trees in the Kratovo and Skopje regions, which was significantly different.

According to literature data, fruits of Karamanka were found to be medium-small fruits, with average mass of 87.55



Fig. 1. Pear "Karamanka"

**Table 1**  
**Fruit characteristics of pear Karamanka in different ecological regions of Macedonia**

Region	Fruit characteristics						Chemical content		
	Fruit mass, g	Fruit length, mm	Fruit width, mm	Length of stalk, mm	Number of seeds in fruit	Fruit hardness, g/cm	Soluble dry matter, %	Total acids, %	Total sugar, %
Skopje	113.9c	64.3c	61.2c	50.5a	2.2ab	2203a	14.5	0.06	14
Kumanovo	276.7a	95.6a	81.3a	54.3a	0.7b	1317b	14.8	0.11	13
Kratovo	113.5c	70.3c	62.0c	49.5ab	3.1a	2182a	11.2	0.23	11
Kriva Palanka	155.3b	77.4b	67.8b	49.6ab	1.6ab	1403b	16.4	0.15	16
Resen	258.7a	93.0a	78.5a	45.5ab	1.0ab	1285b	14.3	0.13	13.5
Average	183.6	80.1	70.2	49.9	1.7	1678	14.2	0.13	13.5

g (Mratinic, 2000) to medium-large in size (Niketic, 1951; Milutinovich et al., 1998; Milutinovich et al., 2005; Avramovski et al., 2005). Under dry conditions, its yield is altering, giving smaller fruits with low quality, poor taste and higher amount of stone cells.

The long fruit stalk allows a good connection between the fruit and the branches that is very important for hilly-mountainous regions. The longest fruit stalk was found in the Skopje and Kumanovo regions, which was significantly different. Not statistically significant difference was found for the fruits of the regions of Kratovo, Kriva Palanka and Resen, where the length of the fruit stalk is almost identical. This characteristic of pear 'Karamanka' is important for its growing in windy regions (Dimitrovski, 1974).

The lower number of seeds in a fruit (average 1.7) is due to the triploidy of the variety. This was confirmed by Mratinic (2000) and Avramovski et al. (2005). The biggest seed number is found in fruits from the Kratovo region, for which, statistically significant differences were found. There was no statistically significant difference in other regions.

The quantity of the chemical components of the fruit alters, depending on the region where it is grown. Fruits contain about 14.2% of soluble dry matter, 13.5% total sugar and 0.13% total acids. The highest amount of soluble dry matter and total sugar was measured in fruits from the Kriva Palanka region and fruits from the Kratovo region had the smallest amounts. The pear fruits from Kriva Palanka region are used for preparing rakija because they contain high amount of sugar.

Fruits are used not only for fresh consummation, but also as dry fruits, for preparing compote etc. According to Mratinic (2000) Karamanka fruits contain 19.5% of soluble dry matter, 17.9% of total sugar and 0.17% of total acids.

## Conclusions

Depending on different climate conditions, the pear Karamanka has different time for flowering and ripening. The earliest flowering was detected in the Skopje and Kumanovo region (first decade of April) and the latest in the Resen region (middle of April). Karamanka is classified as an early-flowering variety. According to the ripening time it is characterized as late-summer pear variety. The fruits

ripen from the second half to the end of August (region of Skopje and Kumanovo) to the first half of September in the other ecological regions. It forms medium-sized fruits with fruit mass of 183.6 g, fruit length of 80.1 mm and fruit width of 70.2 mm. The biggest fruits were found in the Kumanovo and Resen regions (over 250 g) and the smallest were found in the regions of Skopje and Kratovo (around 100 g). The fruit stalk is semi thick, long, with average length of 49.9 mm. The average number of seeds in the fruit was 1.7. The fruits contain high quantity of soluble dry matter and total sugar, found in the region of Kriva Palanka, and the lowest amounts of these components were found in the fruits from the Kratovo region.

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