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## RASPBERRY AS A POTENTIAL COMMODITY EXCHANGE MATERIAL IN THE REPUBLIC OF SERBIA

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### ABSTRACT

Commodity exchange has a very long tradition and in a modern business conditions. Serbia ranks among the world's largest producers of raspberries, exporting more than 90% of total production of this fruit. Considering that Serbia is among global leaders in the export of frozen raspberries and that the process of standardization of the quality and quantity of this type of fruit is relatively simple, the starting hypothesis is that Serbian raspberry can be traded at commodity exchange. The main objective of our research is to analyze the necessary conditions for formation and sustainable functioning of the raspberry commodity exchange, with the emphasis on testing the proposed model of the commodity exchange method of communication between primary raspberry producers (vendors), intermediaries (purchasers, raspberry dealers or exporters of raspberries) and end customers who buy raspberries. We surveyed 100 persons representing the key actors of the Serbian raspberry producers and proposed the model of raspberry trading through commodity exchange.

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## Introduction

Raspberries represent a highly sought after commodity in the world market. Apart from being a delicious fruit that can be consumed without any further processing, raspberries are an essential input when it comes to the production of juices, jams, extracts and similar food and beverages. They are also very popular for their properties connected to health benefits. Numerous empirical studies confirm that raspberries can help control blood glucose for people who have high risk of diabetes (Schell et al., 2019; Di Xiao et al., 2019; Moreno, 2019). This medicinal property of raspberries is of great importance given that more and more adults in the world are facing this problem. For example, in the US, about 84.1 million of Americans over the age of 18 have diabetes, which is approximately 33.9% of its total adult population (National Diabetes Statistics Report, 2017). Additionally, it has been proven that some raspberry extracts can protect the skin against damage caused by UVB rays, by its anti-oxidant and anti-inflammatory properties (Pei-Wen Wang et al., 2019). Extracts of raspberry leaves and fruit has been proven to have an anti-oxidative and also anticancer effect, which has been proven on the example of Serbian wild raspberry (Veljković et al., 2018). The aforementioned benefits of consuming raspberries certainly add to the demand for these fruits in the global market. On the other hand, Serbia is one of the world's largest raspberry producers, so it is of great importance to consider the possibility of including Serbian raspberries in the stock exchange trading process.

Instability of prices of the goods and high transaction costs provide a strong theoretical background for establishment of commodity exchanges in all parts of the world (Nicholas, Jayne, 2012). In accordance with the level of development of the country, commodity exchanges can have a number of significant functions, the most important of which are the following functions: market risk management, reducing the risk of not fulfilling the obligations of the other party, increasing price transparency, reducing the risks related to collateral value, standardization of the quality of goods and providing direct access to the capital market through repo-transactions (Belozertsev et al., 2011).

Goods and commodities which are used for trading on commodity exchanges can be of various kinds with four categories of commodities generally distinguished in practice: energy (crude oil, gas, natural gas), metals (gold, silver, platinum and copper), livestock and meat (pork, beef, offal, etc.) and agricultural products (corn, soybeans, wheat, rice, cocoa, coffee, cotton and sugar) (Faruk, 2015). However, when it comes to trading of these commodities, authorized warehouses play a very important role, especially in the field of agricultural production (which is of particular importance in our case). In the warehouses, the evaluation of the quality and quantity of the commodities is being performed, after which farmers can obtain certificates. Storage certificates (merchandise records or warehouses receipts) are papers or electronic documents indicating the type of goods, quality, location and ownership of the goods deposited in the warehouse. Unlike private warehouses that only issue a certificate of receipt, record of goods (warehouse receipt) can be issued only by public (authorized) warehouses. Warehouse receipts allow depositors of agricultural products to have full

disposal of stored goods without physical contact with the goods. The easiest way to utilize a warehouse receipt for farmers is to give some kind of security or pledge over stored goods to get a favorable short-term loan. A warehouse receipt for banks is a much safer means of collateral security than other types of physical securities.

Commodity exchanges were created a long time ago, but in modern business conditions, their development is generally tied only to developed industrial countries. However, with the liberalization of the market and the development of information technology, they are also being introduced in developing countries (Rashid et al., 2010). The most important conditions for the development of the commodity exchanges are usually the following ones (Belozertsev et al., 2011):

- Supply and demand for goods must be large enough, i.e. there must be a large number of potential participants;
- Traded goods must be subject to standardization;
- Determining the price of goods should be left to the market, without monopolistic influence and state interference;
- The stock market should support major commercial interests;
- Leading commodity exchange participants should join their efforts towards establishing a functioning and reliable clearing system that would guarantee commodity exchange in a regulated market (stock exchange);
- Stock exchange services must be functional and accessible, with the necessary infrastructure facilities (accessible roads, adequate freight bridges, availability of transport companies, quality control services, efficient administration, storage and communication, etc.);
- Adequate support of the state is required, along with defining appropriate regulation and supervision of stock market trading.

It can be noticed that for the formation and efficient functioning of commodity exchanges, it is necessary to fulfill the conditions that come from the broader economic and political environment, which primarily include: physical, legal and regulatory infrastructure, macroeconomic stability, development of the commercial and financial sector and political support as well (Rashid et al., 2010). Also, the development of commodity exchanges requires fulfillment of specific conditions, such as: continuous production and adequate storage of products, homogeneity of products, large and active spot market and large price variability in the spot market.

All of the aforementioned conditions indicate that the development of commodity exchanges is a very complex and demanding process. In this regard, some countries have experienced certain restrictions during their process of development. The most common restrictions of their more intensive development are: lack of knowledge when it comes to stock market operations and risk management systems, low level of

development of agricultural production, low level of development of the agricultural and financial sector and inadequate agricultural policy (Belozertsev et al., 2011). If the volume of agricultural production is low, the potential exchange through the commodity market is also low, which indicates its financial unsustainability. In addition to that, when agricultural production is poorly organized, i.e. when farmers, intermediaries and traders are poorly educated, the chances of the successful establishment of a commodity exchange are very low. On the other hand, when the agricultural sector is very well organized but it consists of several large and vertically integrated companies, then those companies generally do not show interest in increasing market transparency (Maxwell, 2015). The highest level of market transparency is achieved when there is a lot of competition in the sector, that is, when goods are sold through auctions or commodity exchanges.

### **Regulatory Framework of Commodity Exchanges' Operations in Serbia**

The unique mission of commodity exchange is to provide conditions for commodity market, as well as to monitor supply and demand and to form a balanced level of the price of goods. Regarding this, in most cases, commodity exchanges have significant government support and precisely-defined regulations, since they provide security in trading strategically important products. However, in Europe, the area of functioning of commodity exchanges is not regulated by some specific EU directives, so the regulatory framework of their functioning is different from country to country. In Serbia, commodities and commodity securities were treated differently over time in the past years. The Law on Commodity Exchanges, Commodity Exchange Operations and Stock Brokers (applicable from 1994 to 2002) defined goods as stock market material and commodity exchange as an institution that organizes trading of these materials. On the other hand, the Law on the Market for Securities and Other Financial Instruments (applicable from 2002 to 2011) completely neglected the goods and all market materials that derive from the goods. However, the Capital Market Act, which came into force at the end of 2011, provides the opportunity to develop a modern commodity exchange. This law defines transferable securities as all types of securities that can be traded on the capital market, except for payment instruments (Vlatković, Jovanović, 2016). In addition to this, the Law on Trade (Article 22) defines a commodity exchange market as a separate market institution that organizes interaction of buyers and sellers of standardized goods and goods which can be exchanged. In accordance with the same law, it is stipulated that the commodity exchange and stock exchange operations are regulated by a separate law. Regarding this, the Law on Commodity Exchanges was adopted in Serbia in 2019, which should contribute to a significant development of the commodity market in the observed area. The main objective of this law is to regulate and organize a fair, transparent and efficient market for standardized market material and protect the integrity of the market (Law on Commodity Exchanges, Art. 3).

## The analysis of quantity and quality of the raspberries produced in Serbia

The most important conditions for including some commodities (in this case raspberries) in the commodity exchange trading process are: sufficient amount of commodities and the possibility of standardizing their quality (Belozertsev et al., 2011). In this regard, the following two parts of the paper will analyze the volume of raspberry production in Serbia and the current standardization of the quality of those raspberries.

### The analysis of the quantity of raspberry production in Serbia

The total area where raspberries are planted and total raspberry production worldwide is analyzed based on the data published by The Food and Agriculture Organization - FAO (Table 1).

**Table 1.** The total area where raspberries are planted and total raspberry production worldwide

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
h (000)	96.9	106.3	106.8	102.2	92.5	93.3	101.1	114.3	118.2	124.9
t (000)	553.5	522.0	599.4	569.2	588.0	629.9	676.4	824.1	797.3	870.2

*Source:* FAOSTAT

It can be concluded that, on the global level, raspberry plantations have increased by about 25% in the last ten years. Regarding this, in the observed period, there was an increase in the production of this fruit. In the ten-year period which was observed, raspberry production increased by about 60%. Observed by regions, Europe is by far the largest producer of raspberries (Table 2).

**Table 2.** Production of raspberries by regions, total 2009-2018

Europe	70,50%
America	27,10%
Asia	2,10%
Africa	0,10%
Oceania	0,10%

*Source:* FAOSTAT

Out of the total raspberry production globally in 2009-2018, 70.5% were produced in Europe. The largest world producer of raspberries is the Russian Federation, which produced an average of 141,350 tons of raspberries annually, while Serbia ranks fourth with an average annual production of 90,802 tons in the last ten years (Table 3). However, although it is the largest producer, the Russian Federation does not cultivate many crops of raspberries per hectare. This is probably because they do not use state-of-the-art raspberry cultivation technology. The Netherlands, Italy, Switzerland and the USA have the highest raspberry crop yields per hectare (Sarić et al., 2009).

**Table 3.** The world's largest raspberry producers (average annual production in the period of 2009-2018)

Russian Federation	141 350 tons
Poland	109 564 tons
USA	94 459 tons
Serbia	90 802 tons

*Source:* FAOSTAT

According to the data referring to 2018 only, Serbia ranks third with a total production of 127,010 tons of raspberries (Table 4).

**Table 4.** The world's largest raspberry producers in 2018

Russian Federation	165 800 tons
Mexico	130 187 tons
Serbia	127 010 tons
Poland	115 613 tons
USA	99 215 tons

*Source:* FAOSTAT

Raspberry production in Serbia is getting more and more popular, which is also confirmed by the significant increase in its production over the last three years. The majority of raspberry production is intended for export, while only a small portion of production stays on the domestic market. Raspberries are mainly exported in frozen form, making Serbia the world leader in this type of export (Djurkovic, 2012). In 2017, the export of frozen raspberries from Serbia amounted to approximately 94,000 tons, which makes for about 29.9% of the world's total export of frozen raspberries (Serbia Food Industry). About half of raspberries produced in Serbia are exported to Germany, while about a quarter of produced raspberries is exported to France (Djurkovic, 2012; Nikolic, 2018). On the other hand, there is also an increase in raspberry imports from other countries into Serbia. It is estimated that in the period from 2010-2015 between 5,000 and 3,000 tons of raspberries were imported into Serbia in 2016, and around 5,000 tons were imported in 2016 alone. In 2017, raspberry imports to Serbia amounted to about 11,000 tons, an increase of more than 100% compared to 2016 (Nikolic, 2018).

At the end of 2017, raspberry crops in Serbia occupied an area of 21,861 hectares, which is approximately 12.5% of the total area under fruit in the observed area (SORS). Ten years ago, raspberries in Serbia were cultivated on an area of between 14 and 15 thousand hectares (Saric, Subic & Roljevic, 2009). In the region of Sumadija and Western Serbia, raspberries are grown on an area of 18,175 ha, which represents more than 80% of the total area under raspberries in Serbia. They are mostly produced on the territory of the municipalities of Ivanjica and Arilje, where approximately a quarter of the total raspberries planted in Serbia are located (Nikolic, 2016).

Raspberry production in Serbia is very profitable, which is confirmed by one empirical research conducted in Serbia (Kljajić et al., 2017; Wróblewska et al., 2019). For the formation and cultivation of raspberries, alongside irrigation, on the area of one

hectare, it is necessary to invest about 12,140 EUR. The earnings from the first year can be approximately EUR 9,300. It can be observed that the accumulation rate is about 77%, which means that the return on invested capital is already achieved in the second year (Kljajić et al., 2017). However, the buying up price of raspberries changes every year, which causes uncertainty and often dissatisfaction with the producers of this fruit. Independent appearance of individual producers on the foreign market mainly damages the reputation of Serbian raspberries, with financial effects well below the real level. Regarding this, the mutual competition among individual raspberry producers (purchasers) in the foreign market may be one of the important reasons for the lower price of this product (Sarić et al., 2009). One empirical research conducted in the region of Šumadija and Western Serbia points out that the mining sector has great potential for a successful and sustainable development of clusters, which can only be established by removing the existing limitations and constraints. For the development of clusters in the raspberry sector, it is important to meet the following important prerequisites: better organization of marketing channels through horizontal and vertical integration of all actors in the sector, strengthening cooperatives specialized in raspberry production, application of innovation and scientific knowledge in the production, processing and distribution of raspberries (Paraušić, Simeunovic, 2016). In addition to that, the development of cluster initiatives requires the joint work of agricultural producers, people who work in the area of processing, refrigerator business, traders, government, regional development agencies, research institutions and other institutions and organizations (Paraušić, Simeunović, 2016). In this regard, farmers are generally willing to pay for additional services in order to integrate the input and output markets more efficiently. They are interested in services of sorting out the goods, of storage, transport, short-term loans (such as, loans for transport to the market), preparation of documents, mobile service providers and other electronic services such as email. However, providing such services requires the existence of local entrepreneurs with the necessary knowledge and capacity to develop and provide these services in the remote rural areas where most farmers live (Mukhebi, Kundu, 2014).

### **Standardization of the quality of raspberries in Serbia**

The industrialization of agricultural production, the use of agents such as additives, hormones, pesticides, antibiotics, etc., has imposed the need for an effective and internationally acknowledged system for controlling their use. In Serbia, raspberry quality is standardized according to GLOBALGAP standards (GAP – Good Agricultural Practice). GLOBALGAP is based on principles for safe and sustainable agriculture and on partnerships between farmers and traders. This standard applies to the production of primary agricultural products, but also to the activities that follow. Regarding this, in the process of raspberry production, a very important role is played by harvesting fruits, so it is of great importance that it is properly implemented. Also the activities following the harvest are of great importance. Integral food safety system includes food production, processing, packing, distribution/transportation, storage and preparation (Abdulah et al., 2011).

The raspberry fruits are classified into three categories, according to their quality: extra quality fruits, class I fruits and class II fruits. Since the raspberry fruit is sensitive, keeping it fresh is difficult and short-term. Fresh raspberry fruit can be stored for 10-14 days in the refrigerator at -0.6 to 0 degrees and at a relative humidity of 85-90%. Today, raspberries are mostly frozen and stored until used. This procedure consists of (<http://www.agroTV.net/berba-cuvanije-klasiranje-plodova-maline/>):

1 – previous cooling of the fruit to 0 °C

2 – deep freezing at -35 to -45 °C

3 – storing fruits at -18 to -20 °C.

Deep-frozen raspberry fruits can be stored for a very long time. They are divided into four categories: roland, bruh, grits and block. Roland raspberry is of equal color and ripeness without buds and foreign matter, of vegetative and mineral origin. These are single frozen fruits of good quality. Bruh raspberry is a mixture of whole, broken fruits and bites. Grits is a ground raspberry, and block is a third class of raspberries used for hot processing (jams, juices, etc.).

In order to apply quality standards in the raspberry sector in a more efficient way, it is necessary to introduce to Serbia appropriate technological innovations which are increasingly applied in the food sector. Applying new technologies, like IoT (Internet of Things), nowadays it is possible to connect food producers, transportation and hospitality/retail companies (Maksimovic et al., 2015). Technology innovation and the IoT move the packaging market from conventional packaging to interactive, aware, and intelligent. Smart packaging utilises chemical sensor or biosensor to monitor the food quality and safety from the farm to the costumers. This technology can result in a variety of sensor designs that are suitable for monitoring of raspberry quality and safety (freshness, pathogens, leakage, carbon dioxide, oxygen, pH, time or temperature) (Abdulah et al., 2011). With the development of nanotechnology, the use of nanosensors could enable production, processing, and transportation of raspberry products more secure (Wesley et al., 2014). For example, frozen raspberry casings and bags can be labeled with a gsm chip and a temperature sensor, so that it can be seen at any time via the wifi connection if the raspberries have been properly stored and in what way they were transported.

### **Methodology**

In order to collect primary data, we used the survey method. The survey was conducted based on personal contacts with raspberry producers. Raspberry producers were contacted at the place of purchase and asked to participate in survey which would be used solely for research purposes. We also emphasized that the survey was anonymous. Interviews were scheduled with manufacturers who agreed to participate in the survey so that they could have time to think and give objective and representative answers.

The questionnaire had a total of 17 questions divided into three groups. The first group of questions was intended to determine the basic characteristics of individual raspberry

producers, while the second group of questions was defined with the aim of determining the real need for establishing a raspberry market exchange, that is, examining the satisfaction of raspberry producers with the current way of buying up raspberries. The third group of questions was aimed at testing the proposed model of the commodity exchange for raspberry trading. At the end of the questionnaire, we left some space for the respondents to make their suggestions regarding the improvement of the current way of buying up (trading) raspberries.

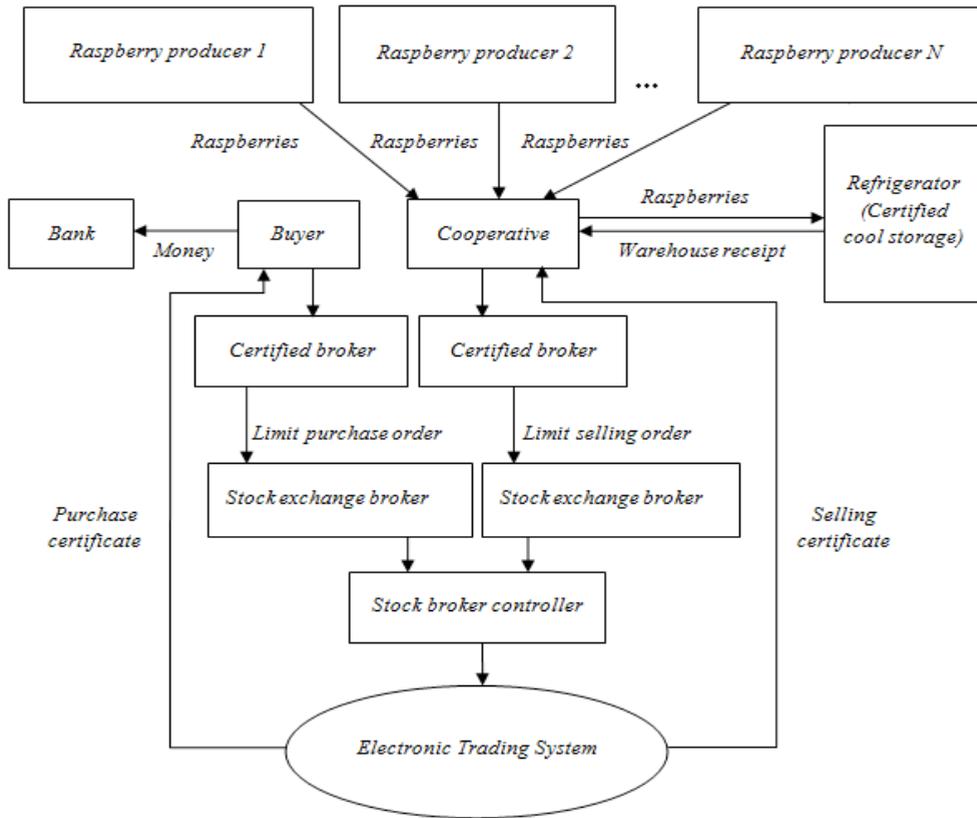
### Results and discussion

According to the proposed model for trading raspberries through commodity exchange, trading would be conducted in the trading hall by placing limit orders for buying and selling into an electronic trading system. In order to prevent possible abuses, only limit orders would be traded, i.e. there would be no market orders on the market. Market orders do not contain the stated price, but the purchases and sales are carried out according to market prices, that is, at the prices established during the trading day. A limit sale / purchase order can be defined as a stock exchange order to buy or sell raspberries within the defined limit. The stated price limit in the sales order represents the minimum price at which the potential seller is ready to sell the raspberries, while the price limit in the purchase order represents the maximum price that the potential raspberry buyer is willing to pay.

The basic elements of limit orders for trading are: the date of issue and receipt of the order; order number; name and surname of the stockbroker who the order was addressed to; complete information about the client; a type of raspberry with a defined quality; raspberry price; quantity of raspberries; place of loading (pickup) of raspberries; delivery time for raspberries; terms of payment; "total amount or nothing" element; validity period of the order and the defined commodity exchange fee, as well as penalties and fees for negligent execution of the work, which the principal accepts with his verification of the order.

Trading process: Purchase and sale orders are issued to stockbrokers who further check them. After checking the orders, the brokers forward the orders to the stockbroker controller who inputs them into the electronic trading system, after which they become visible on the monitor in the trading hall. Also, members of the commodity exchange can be informed about quotations online, on the commodity exchange's website. After pairing orders that match, the stock exchange prepares invoices, that is, receipts that will be submitted to the buyer and vendor. After the purchase and sale confirmations are received, the realization of the work starts. Commodity exchange trading means that buyers and vendors do not know each other until they receive confirmation. In accordance with the above described process of trading on commodity exchanges, a possible model of raspberry trading in Serbia is shown schematically (Figure 1). The raspberry trading model presented here can be further developed and adapted to the standardized graphical notation of business process modeling, BPMN (Aagesen and Krogstie, 2010).

**Figure 1.** A proposed model of raspberry trading through commodity exchange



Source: Authors research

Fig. 1 shows that the process of raspberry trading through the commodity exchange implies that individual raspberry producers must be registered members of the cooperative. In this regard, they would have to sign a representation agreement with the cooperative. In addition to providing small farmers with the opportunity to trade their products through the commodity exchange, cooperatives are also useful from the perspective of educating farmers and improving efficiency of the production (Faruk, 2015). Therefore, the proposed model of the commodity exchange for raspberry trading implies that the cooperative (association of raspberry producers) represents and acts on behalf of individual producers and through the authorized brokers, hence issuing the limit of the sales order. On the other hand, after depositing the required amount of money in a dedicated trading account, potential raspberry buyers place a limit on the purchase order through authorized brokers.

The survey was conducted in 2019 on the territory of Ivanjica municipality, which is the largest raspberry producer in Serbia alongside the municipality of Arilje. In total, 100 completely filled questionnaires were collected and processed. Partially filled questionnaires (20 of them) were not included in the data analysis. The results of the survey are presented in Tables 5, 6 and 7.

**Table 5.** Determination of basic characteristics of raspberry production

I have been producing raspberries	less than 5 years	from 5 to 15 years	more than 15 years
	18%	32%	50%
I produce (process) raspberries every year.	YES		NO
	86%		14%
Raspberry production is my main source of income.	YES		NO
	23%		77%
The raspberry plantation area is:	up to 50 ares	from 50 ares to 1 acres	over 1 acre
	73%	25%	2%
Average annual crops of raspberries:	up to 5 tons	from 5 tons to 1 wagon	over 1 wagon
	65%	33%	2%
The female population's participation in raspberry production is:	up to 25%	from 25 to 50%	over 50%
	9%	48%	43%

Source: Authors research

**Table 6.** An analysis of the current way of buying up raspberries

Raspberry buyers do not agree among themselves on the purchase price.	YES	NO	Not sure
	15%	46%	39%
The price of raspberries is realistic / determined by the supply-demand ratio).	YES	NO	Not sure
	2%	71%	27%
Raspberry dealers (refrigeration facilities) are fully fulfilling their obligations.	YES	NO	Not sure
	39%	33%	28%
Communication with raspberry dealers (refrigeration facilities) is good.	YES	NO	Not sure
	46%	22%	32%
There is a possibility of credit financing by the buyer (refrigeration facilities) ("borrowing at the expense of raspberries")	YES	NO	Not sure
	70%	8%	22%
Classification of the raspberries is done in the right way.	YES	NO	Not sure
	22%	43%	35%

Source: Authors research

**Table 7.** Testing of the proposed model of the commodity exchange for raspberry trading

Do you have a registered agricultural holding?	YES		NO
	71%		29%
Are you a member of an agricultural cooperative?	YES		NO
	1%		99%
Would you sell raspberries through commodity exchange (a public market visible to the world)?	YES	NO	Maybe
	53%	7%	40%
Would you agree for a cooperative, as an authorized stock exchange seller, to sell raspberries on your behalf?	YES	NO	Maybe
	52%	9%	39%
In order to maximize the purchase price of raspberries, would you apply standards related to raspberry quality in a more effective manner (weight of full casks, the humidity of raspberries, fruit size, and method of storage and transport of raspberries to the refrigerator facility, etc.)?	YES	NO	Maybe
	77%	3%	20%

Source: Authors research

Based on the conducted empirical research, we can conclude the following important information, regarding the determination of the basic characteristics of raspberry production, the analysis of the current method of buying up raspberries and the testing of the proposed model of the commodity exchange for raspberry trading:

Raspberry production in Serbia is longstanding and continuous. Half of the respondents have been part of this production for more than 15 years, and about one third of respondents have been engaged in raspberry cultivation for the period between 5 and 15 years. Also, 86% of respondents stated that they process (produce) raspberries every year. This statement is of great importance for the establishment of the raspberry commodity exchange, as continuous production is necessary and it is a precondition for the inclusion of some commodities in the commodity exchange trading process).

However, raspberry production in Serbia is very fragmented and is not a major source of income for most of the respondents. The survey found that 73% of respondents cultivate raspberries on an area of less than 50 acres, with 65% of respondents achieving an overall amount of crops of less than 5 tons. The fragmentation of the raspberry production process is a potential barrier to the development of the raspberry commodity exchange, having in mind that the commodity exchange trading method involves the trading of large quantities of a standardized product. Also, for 77% of respondents, raspberry production is not a main source of income, which can also be one of the obstacles for the development of the raspberry commodity exchange. When raspberry production does not constitute a primary source of income, these producers are less likely to be willing to make some extra effort and invest the extra time which is required to move to an alternative way of selling (selling through the commodity exchange market).

Female population is dominant in the raspberry production process. In 43% of respondents, the female population makes up the majority of employees in the raspberry production process, while in 48% of respondents their participation ranges between 25 and 50%. The majority participation of the female population in the process of raspberry production in Serbia may indicate that raspberry production contributes to the improvement of financial position and greater independence of women in rural areas.

15% of respondents believe that raspberry buyers do not agree among themselves on the purchase price of raspberries. Also, 71% of the surveyed producers believe that the purchase price of raspberries is not realistic. In this regard, only 2% of respondents believe that the price of raspberries is determined by the relationship between supply and demand. The attitude of the respondents regarding the fact that the purchase price of raspberries is not realistic and that it is mainly the result of mutual agreement among buyers (raspberry dealers) represents a real chance for the development of the raspberry commodity exchange (a transparent market in which the real price of goods is determined on the basis of supply and demand).

70% of the respondents found that the current way of buying raspberries offers the possibility of credit financing, or borrowing based on the future crops of raspberries. The fact that raspberry producers can carry out the entire production process without

significantly investing their resources can be an obstacle to switching to alternative ways of production and sale (e.g. raspberry commodity exchange). However, 22% of surveyed raspberry producers believe that communication with purchasers is not good, and 33% of producers believe that purchasers do not completely fulfill their obligations, which may be beneficial for the development of the raspberry commodity exchange. Also, only 22% of respondents believe that the current way of classifying raspberries by the purchasers is being implemented in the right way. In contrast, the auction trading method, i.e. commodity exchange, implies clearly defined product quality standards, which would probably contribute to the elimination of this problem by the manufacturers (Handschuch et al., 2013).

Our evaluation of the proposed commodity exchange model for raspberry trading revealed that 29% of raspberry producers do not have a registered agricultural household, and that almost all raspberry producers (99%) are not members of the producers cooperative. This fact is an obstacle for the eventual development of the raspberry market, which implies that all raspberry producers must have registered agricultural households and be associated amongst themselves.

However, the raspberry producers who were surveyed expressed great confidence in the cooperatives, as only 9% of producers expressed the attitude that they would not agree to be represented by the cooperatives on the commodity exchange and also would not agree for the cooperatives to sell raspberries on their behalf. In addition, as many as 77% of respondents expressed their willingness to apply the quality standards more efficiently in order to attain a higher purchase price for raspberries (weight of full casks, humidity of raspberries, fruit size, storage method and transport of raspberries to the refrigerator, etc.). Implementing raspberry quality and safety standards is decisive in increasing farm income (Jara-Rojas et al., 2018).

The major suggestion of the respondents related to the possible improvement of the raspberry market, was the establishment of the free market, along with the better regulation of the production, sale and distribution process. It was pointed out that currently established system is a cooperative oligopsony, with only a small number of existing large buyers.

## Conclusions

Based on the conducted empirical research, it can be concluded that including raspberries in the commodity exchange trading process in Serbia would be possible for several reasons. First of all, Serbia is one of the largest raspberry producers in the world and it is a global leader in the export of frozen fruits. Annual production of raspberries of more than 100 thousand tons would be more than sufficient to cover all commissions and compensation of participants in the stock exchange trading process. The analysis also found that the processes of standardization of the quality of this fruit and its storage are not too demanding and complicated. In addition, it has been established that the production of this fruit in Serbia is long-standing and

continuous, which is also one of the important preconditions for the development of the commodity exchange. On the other hand, the analysis revealed dissatisfaction of raspberry producers with the current way of buying up raspberries, which may indicate a real need to switch to alternative trading methods. This dissatisfaction is reflected in the fact that the majority of the respondents expressed the opinion that the purchasers and raspberry dealers agree among themselves on the amount of the purchase price, which results in a low purchase price. Also, only a small number of respondents believe that the current way of classifying raspberries is implemented in an adequate way. Raspberry producers, on the other hand, have expressed their willingness to sell their products through the commodity exchange. In this regard, most respondents would make additional efforts to raise and maintain the quality of these fruits in order to achieve a higher raspberry selling price.

However, the research also identified some limitations that are an obstacle to the possible development of the raspberry commodity exchange. Raspberry production is generally a family-run business and is characterized by a large fragmentation of production, while further efforts are needed to bring them together in associations. It was found that for most of the respondents, raspberry production is not the main source of income, which can be an obstacle for their additional engagement and education, which are necessary factors for the initial stages of the development of commodity exchanges. Also, the current way of buying up raspberries offers different forms of crediting, that is, the borrowing of producers at the expense of the future crops of raspberries, which can be an obstacle to switch to alternative ways of production and sale. The next limitation was established when we tested the proposed commodity exchange trading model. Approximately one third of raspberry producers do not have a registered agricultural holding, while almost all producers who were surveyed were not members of the cooperative. Without well-organized cooperatives and associations of raspberry producers, selling raspberries through the commodity exchange market is impossible. In Serbia, the process of registration of agricultural holdings is quite simple, which indicates how easy it is to solve this problem. However, the problem of underdevelopment of cooperatives in the observed area is much more complex and more difficult to solve. In relation to this, unless more intensive development of cooperatives in the sector of raspberry production occurs in the future, it is impossible to think about the inclusion of raspberries in the commodity exchange trading process. Also, this process involves the development of a network of authorized warehouses that would perform the tasks of standardizing the quality and quantity of raspberries. We also concluded that application of internet of things in packaging and transport would be good support in establishment of efficient commodity market.

### **Conflict of interests**

The authors declare no conflict of interest.

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