

SUSTAINABLE DEVELOPMENT OF THE FRESH AGRI-FOOD SUPPLY CHAIN – Case study about fruit and vegetables market from Romania

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Abstract

Fruits and vegetables have a high importance from two points of view: for the consumer it represents a healthy and nutritious food and for the national economy it represents a key sector that gives added value to the agricultural sector. The importance of the paper comes from the dominant position of the fruit and vegetable in agriculture, but also their need to be consumed daily, so a comprehensive statistical analysis was performed to identify the evolution and main qualitative aspects that describe the state of this market. The purpose of the paper is to determine the level of the fruit and vegetable market, both in quantitative and value terms. The study focuses on the available quantities that address to human consumption, to which are added the imports necessary to cover the constant needs of consumers throughout the year, considering the seasonal aspect of Romanian agriculture. The applicative part of the paper involves a statistical analysis to determine the evolution and size of fruit and vegetable categories on the Romanian and international agricultural trade. The main conclusions aim that the sector is characterized by volatility, production and price fluctuate, and supply stability is achieved through imports that have increased annually.

Keywords: *supply chain, sustainability, trade, consumption*

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Introduction

Fruits and vegetables represent an important sector of Romanian agriculture, with a high added value for both fresh and processed products, being a source of healthy food with very good nutritional properties for human consumption. The purpose of the paper is to determine the level of the fruit and vegetable market, both in quantitative and value terms, being performed a statistical analysis that surprises the evolution of the two categories of products. The study focuses on the available quantities that address human consumption, to which are added the imports necessary to cover the constant needs of consumers throughout the year, the Romanian production being a seasonal one. Also, the price of the products is analyzed, being an important economic component and which is characterized by volatility.

For fresh agri-food products, the supply chain is more dynamic, but also with a higher attention considering their high perishability, so special conditions and specific actions are needed to maintain freshness, the importance of this work consists in the need for the sustainable development of food supply chains in the context of adopting innovations, technology and trends in both production and consumption, to ensure food safety and security for population.

The supply chain with fresh fruits and vegetables is a dynamic one, in Romania being characterized by two types, both a short chain through direct trade between producer and consumer that takes place in urban markets and specialized fairs, and a complex chain in which trade dominates. modern, especially retail.

The offer of products is made by small producers who practice agriculture for generations, representing a semi-subsistence agriculture and their main income, at the opposite pole there are currently 23 producer organizations specializing in fruits and vegetables (MADR, 2020) which provide an added value to the sector through a high-level activity. The cold season determines an important volume of imported products given the fact that the Romanian production, especially the fruit is low, in terms of vegetables the quantities are higher because it is still produced in heated protected areas, such as plastic solariums, and the products they are more resistant and suitable for storage in appropriate conditions.

The demand for fruits and vegetables, both fresh and processed, continues to increase, but with a significant difference between the two categories, with vegetables having a consumption of about 50% higher compared to fruits.

1. Literature review

To maintain health, it is recommended daily consumption of at least five servings of fruits and vegetables (Fernandez et al, 2015) and Food Agriculture Organization (FAO) together with the World Health Organization (WHO) recommends at least 400 grams of fruits and vegetables per day. The growing interest in a healthy lifestyle gives potential for the development of fruit and vegetable consumption (Majerska et al., 2019), various researchers supporting the importance of fruits and vegetables in the human diet (Borrelli, 2016) and the supply must adapt to consumer requirements and preferences. The increase in the number of inhabitants will determine an increase in the demand for food, as well as for fruits and vegetables, so it is necessary to resort to technologies to guarantee food safety and security (Kondo, 2010) but also providing information on the traceability of products sold and consumed. (Guyon et al., 2020)

Consumption of fruits and vegetables is the influence of various factors characteristic of the final consumer, such as cultural, socioeconomic, knowledge of nutrients, psychological, age ((Landais et al., 2014), (Obayelu et al., 2019), (Wang et al., 2016), (Mullie et al., 2009)) consumer behaviour can be directed to fruits and vegetables through active and educational communication.

2. Methodology

The methodology includes statistical data from 2010 until now, regarding the import and export value of Romania for two categories of food products, Edible vegetables and certain roots and tubers and Edible fruit and nuts, peel of citrus fruit or melons, data being available on International Trade Centre database (ITC). It analyses both the results registered regarding the Romanian international trade at annual and quarterly level to compare the first two quarters of 2020 which are under the incidence of the global pandemic with the afferent periods from the previous years to determine the impact brought by the pandemic on the Romanian fruits and vegetables market. Also, the food balances from 2014-2018 and monthly indicators of the prices offered by National Institute of Statistic from Romania (NIS) were studied. The applicative part of the paper involves a statistical analysis to determine the evolution and size of fruit and vegetable categories on the Romanian and international agricultural trade.

3. Romanian fruit and vegetable market

Romania has a tradition in the production of fruits and vegetables, most households practicing a subsistence agriculture by growing fruits and vegetables. The main reference indicators for determining the volume of production and the quantity available for human consumption were analyzed, according to the categories of indicators in the food balances on the NIS from

2014-2018. The analyzed indicators are expressed in tons and according to the NIS methodology, the quantities are calculated as the equivalent of fresh products and Available for consumption includes the quantities available for human consumption to which are added the imports made during the year and the exports are decreased.

3.1 Production and availability of fruits and vegetables

Intermediate consumption is represented by the consumption of seeds and fodder for the category of vegetables and by the industrial processing for fruit products, for vegetables lacking the data regarding the processing.

Table 1. The evolution of the main indicators regarding the quantities of fruits and vegetables in Romania

Unit: tonnes

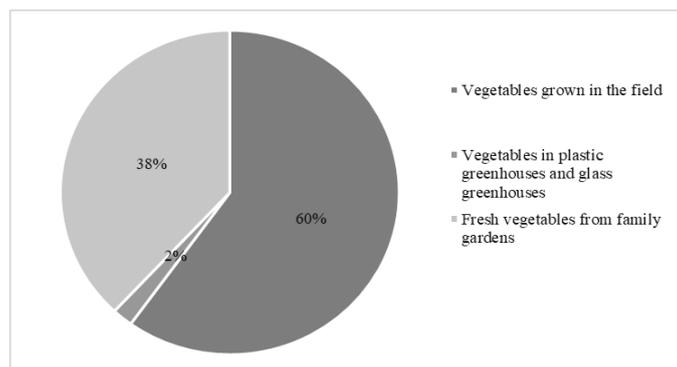
Indicators	VEGETABLES AND VEGETABLE PRODUCTS					FRUIT AND FRUIT PRODUCTS				
	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018
Usable production	3,271,817	3,123,575	2,880,833	3,084,932	3,213,561	2,085,118	1,994,433	1,978,478	2,125,614	2,957,785
Intern availability consumption	3,699,851	3,649,532	3,506,357	3,696,477	3,923,548	2,849,443	2,928,851	3,114,620	3,288,064	4,126,238
Intermediate consumption + losses	450,942	431,810	398,066	421,598	447,990	1,234,895	1,228,557	1,209,340	1,450,691	1,867,674
Available for consumption	3,146,511	3,140,786	3,071,002	3,175,780	3,378,510	1,597,312	1,740,736	1,892,951	1,881,457	2,157,835

Source: NIS, 2020

Table 1 shows fluctuations for the production used and that available for human consumption, both for vegetables and fruits. The production of Romanian vegetables and products obtained from vegetables is higher compared to that of fruits, in the period 2014-2017 the difference being at least 40%, in 2018 the gap being only 9% due to a considerable increase in the production of fruits 39% in 2018 versus 2017, being also the highest volume obtained of fruit production in the analyzed period. Intermediate consumption is more pronounced in terms of fruits, especially in terms of high volumes for processing, which in 2018 reached the value of 1,746,940 tons, being the highest value recorded, while much of the intermediate consumption of vegetables is on feed consumption. In terms of losses, they are higher for vegetables considering the higher volume produced compared to that of fruits, but fruits have a higher perishability due to the higher sugar content.

Romania's vegetable area fluctuated between 2010-2019, reaching a decrease of 13.3% in 2019 versus 2010, with a decrease by 9% of area in households that was transferred to vegetables grown in glass greenhouses and plastic greenhouses registering an increase of 72.6%, reaching 4,394 hectares.

Figure 1. The share of types of areas cultivated with vegetables in Romania in 2019

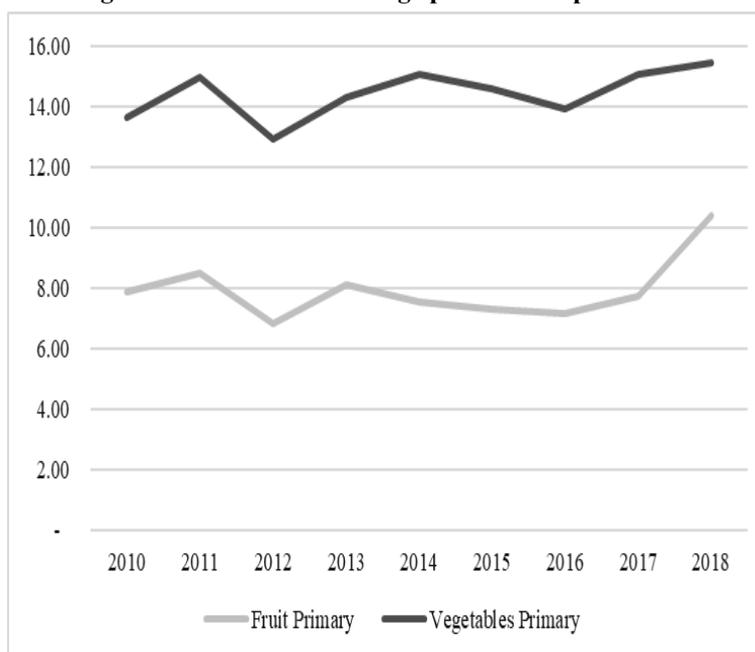


Source: NIS, 2020

Regarding the areas cultivated with fruits, vineyards and orchards have a share of approximately 3% of the total agricultural areas in Romania. Figure 1 shows a high share of cultivated areas in open spaces, predominantly in the field, followed by family crops, while greenhouses hold only 2%. Currently, more and more farmers are moving to protected areas, especially to hydroponic greenhouses.

Regarding the average production obtained, there are higher yields for vegetables. Figure 2 shows the evolution of average yields per hectare expressed in tons / hectare in the period 2010-2019.

Figure 2. Evolution of average productions per hectare



Source: NIS, 2020

According to figure 2, both fruits and vegetables had a fluctuation in yields but were increasing compared to 2010. With a low productivity of fruit production and with smaller cultivated areas than vegetables, the fruit sector must develop by calling for innovations and technological solutions adapted to crops and able to offer high yields.

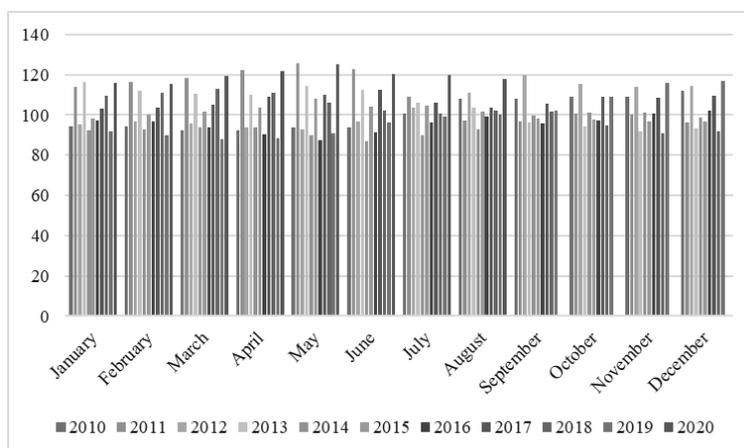
3.2 Price evolution

Price is an important component of the market, being the link vector in demand and supply with a high influence on the behaviour of the final consumer. The agri-food market is volatile due to dependence on various factors, especially natural ones that are unpredictable and difficult to manage in agriculture and that influence the yields obtained, but also the quality of products, so the price is fluctuating for fresh products.

The seasonal character of Romanian fruits and vegetables, the diminished degree of crops made in protected areas, the reduced number of storage spaces to allow the staggering of the product offer on the market and for a longer time natural factors lead to fluctuations in prices from month to month.

The graphs below show the monthly evolution of the price index for fruits and vegetables, the index relating to the corresponding month of the previous year.

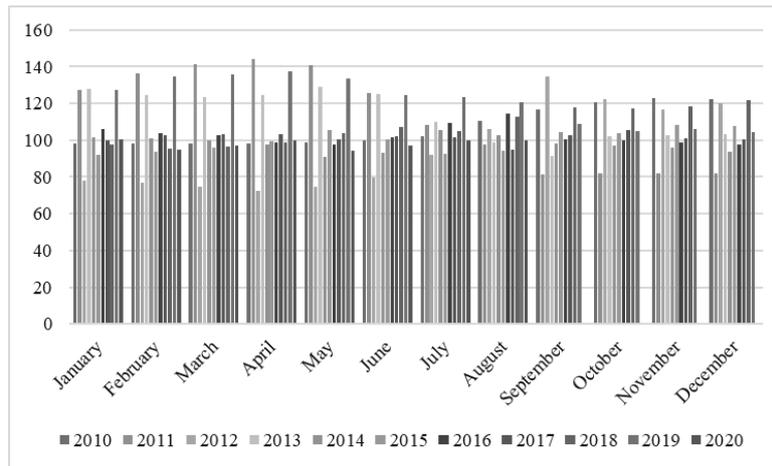
Figure 3. Evolution of the price index for fruits in Romania



Source: NIS, 2020

Both fruits and vegetables had the highest values of the index analyzed in January-June 2011 in 2013, the maximum being reached in May 2011 when fruits increased by 125.69 versus May 2010, while vegetables recorded in April 2011 an increase of 144.22 compared to April 2019.

Figure 4. Evolution of the price index for vegetables in Romania



Source: NIS, 2020

On the other hand, the first half of 2019 had the lowest fruit indices, in March 2019 being a decrease of the index to 87.86 compared to March 2018, this value coming after two years in which March brought increases. Regarding vegetables, the first half of 2012 had values of the indicator below 80, in April it was 72.28, the lowest in the entire period studied. The value registered by the vegetable prices in April 2012 comes after in April 2011 the highest value of all months was registered.

Table 2 focuses on the evolution of the indicator between January and August 2020 versus 2019 to include the period corresponding to the pandemic to perform an analysis to determine its impact on the price of fruits and vegetables. The fruits had in 2019 a descendant for the studied indicator, 2020 bringing major increases, while the vegetables registered the opposite.

Table 2. Evolution of the price index for vegetables in Romania in 2020 versus 2019

Category	Year	January	February	March	April	May	June	July	August
Fruit	2019	92.14	90.06	87.86	88.53	90.87	96.17	99.2	100.37
	2020	115.73	115.62	119.34	121.64	125.05	120.42	119.72	118.02
Vegetables	2019	127.21	134.69	135.51	137.3	133.32	124.6	123.15	120.46
	2020	100.33	94.74	97.13	99.81	94.44	97.14	99.76	99.87

Source: NIS, 2020

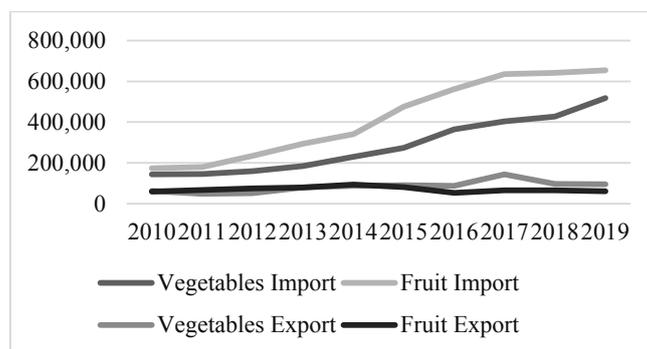
The prices of agricultural products present instability on the market, the main factor being the yield obtained, but there are a series of specific factors that bring a high contribution in the formation of prices.

4. Foreign trade

In order to perform a detailed analysis on the evolution and value of imports and exports of fruits and vegetables, the data provided by ITC for the two categories studied were analyzed,

according to their nomenclature they are Edible vegetables and certain roots and tubers and Edible fruit and nuts, peel of citrus fruit or melons.

Figure 5. The Evolution of Romania values of foreign trade with fruit and vegetables
Unit: thousand euro



Source: ITC, 2020

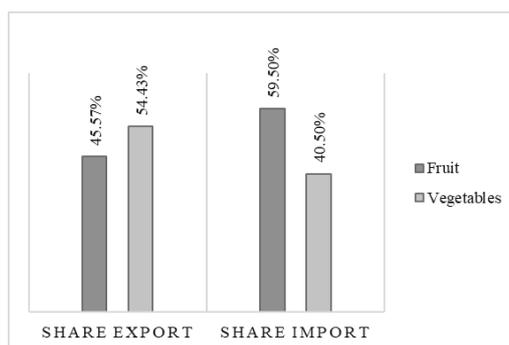
During the period 2010-2019, the import of fruits had an ascending trend reaching in 2019 to be 277% higher compared to the base year 2010, the value of imports made by Romania being higher than that of vegetables, this fact being due to high consumption of exotic and citrus fruits, products that are exclusively imported. Vegetables registered an annual increase in imports, their value being 259% higher than in 2010.

Regarding exports, of the two categories analyzed, vegetables were the products with a higher value, the fruits being half of the value achieved by vegetables. If imports had an upward trend, exports fluctuated, the highest values being in 2017 with vegetable exports worth 143.306 thousand euros, while in 2014 fruit exports had the highest value, respectively 93.818 thousand euros. Fruit exports were on an upward trend in the period 2010-2014, when it managed to increase by 60%, but then began to decline following fluctuations, reaching in 2019 an increase of only 3.19% compared to 2010. Perishability higher yields of fruits compared to vegetables, mainly due to the high level of sugars, prevents the achievement of specific export activity because in Romania there are not enough modern spaces to allow long-term storage in optimal conditions that best preserve the characteristics and appearance of fruits fresh. Also, the low level of Romanian exports is due to the lack of processing infrastructure, Romania exporting mostly fresh produce.

Throughout the analyzed period, imports were significantly higher than exports, thus registering a deficient trade balance annually, the largest gap being in 2019 due to the increase in the value of imports by 21% for vegetables and 2% for fruits, over time that exports decreased by 1% in the case of vegetables, fruits registering a more drastic decrease of 8% compared to 2018.

Figure 6 shows the share of fruits and vegetables in the trade carried out by Romania in the 2010-2019 cumulus, fruits having a higher share in imports by 19 percentage points higher than vegetables, while exports are dominated by vegetables with an advance of 8.85 percentage points compared to fruit.

Figure 6. Share of imports and exports values during 2010-2019



Source: ITC, 2020

For a detailed analysis of the situation of imports and exports of fruits and vegetables from Romania, in the period 2010-2020, the values were divided into quarters to determine the periods with higher activity of international trade, the emphasis being on the first two semesters of 2020 which coincides with the onset of the pandemic.

Table no. 3 shows the share of each quarter in terms of the value recorded by imports and exports of fruits and vegetables, where imports dominate in quarters 1, 2 and 4 representing over 80% of the annual value for both categories analyzed. Exports of fruits and vegetables are higher in the last two quarters with a share of over 65%, the main reason being the concentration of Romanian production starting with the summer months, in the third quarter.

Table 3. Quarterly share of imports and exports values of fruits and vegetables during 2010-2019

Period	Share export		Share import	
	Fruit	Vegetables	Fruit	Vegetables
Q1	18.58%	9.70%	28.92%	37.28%
Q2	16.02%	17.56%	27.41%	30.86%
Q3	30.03%	46.03%	18.04%	10.50%
Q4	35.38%	26.70%	25.62%	21.35%

Source: ITC, 2020

Table No. 4 includes the quarterly analysis from 2010-2020 which shows two periods in which Romania's trade balance was positive for trade in vegetables, respectively Q3 of 2011, 2013, 2014, 2015, 2016, 2017 when domestic vegetable production is in high season and vegetable imports are lower while the balance of fruit trade was constantly negative.

Table 4. The quarterly evolution of the value of imports and exports of fruits and vegetables in 2010-2020

Unit: thousand euro

Category	Vegetables			Fruit		
	Year	Import	Export	Trade balance	Import	Export
2010-Q1	52,282	4,951	-47,331	56,049	8,186	-47,863
2010-Q2	50,205	11,434	-38,771	45,915	7,282	-38,633
2010-Q3	13,816	29,237	15,421	26,682	17,552	-9,130
2010-Q4	33,115	19,588	-13,527	49,502	28,772	-20,730
2011-Q1	59,853	7,202	-52,651	56,788	8,122	-48,666
2011-Q2	52,580	12,673	-39,907	48,484	10,081	-38,403
2011-Q3	14,841	22,938	8,097	31,860	24,809	-7,051
2011-Q4	25,423	10,281	-15,142	48,444	27,094	-21,350
2012-Q1	45,867	6,285	-39,582	45,925	11,648	-34,277
2012-Q2	45,657	11,018	-34,639	57,437	11,429	-46,008
2012-Q3	22,874	17,917	-4,957	53,646	24,464	-29,182
2012-Q4	44,419	16,692	-27,727	77,913	27,213	-50,700
2013-Q1	66,917	7,804	-59,113	81,301	10,786	-70,515
2013-Q2	56,278	17,775	-38,503	74,506	9,652	-64,854
2013-Q3	18,390	31,852	13,462	52,933	21,445	-31,488
2013-Q4	44,476	22,562	-21,914	85,591	37,502	-48,089
2014-Q1	82,607	7,560	-75,047	89,321	20,688	-68,633
2014-Q2	69,182	14,160	-55,022	86,035	14,923	-71,112
2014-Q3	26,200	44,721	18,521	65,367	23,143	-42,224
2014-Q4	49,638	21,822	-27,816	101,207	36,736	-64,471

Category	Vegetables			Fruit		
	Year	Import	Export	Trade balance	Import	Export
2015-Q1	86,205	9,123	-77,082	117,230	21,665	-95,565
2015-Q2	77,335	15,445	-61,890	114,080	12,835	-101,245
2015-Q3	32,484	37,170	4,686	102,656	17,790	-84,866
2015-Q4	77,470	28,928	-48,542	142,493	29,611	-112,882
2016-Q1	128,136	6,667	-121,469	144,027	10,235	-133,792
2016-Q2	110,431	12,646	-97,785	144,563	9,168	-135,395
2016-Q3	40,076	46,770	6,694	119,013	17,315	-101,698
2016-Q4	86,373	20,490	-65,883	155,548	17,313	-138,235
2017-Q1	149,975	5,821	-144,154	160,890	11,178	-149,712
2017-Q2	120,509	11,783	-108,726	172,913	11,450	-161,463
2017-Q3	49,516	86,269	36,753	125,468	22,932	-102,536
2017-Q4	89,589	35,601	-53,988	179,384	19,804	-159,580
2018-Q1	139,541	9,823	-129,718	195,911	10,751	-185,160
2018-Q2	120,413	16,863	-103,550	165,188	10,515	-154,673
2018-Q3	53,848	41,974	-11,874	120,457	26,420	-94,037
2018-Q4	111,214	28,407	-82,807	157,721	18,624	-139,097
2019-Q1	184,183	10,643	-173,540	176,412	8,306	-168,106
2019-Q2	154,099	15,746	-138,353	166,368	10,339	-156,029
2019-Q3	61,314	41,465	-19,849	131,092	24,854	-106,238
2019-Q4	116,105	27,829	-88,276	179,638	17,351	-162,287
2020-Q1	187,781	8,513	-179,268	205,336	14,974	-190,362
2020-Q2	122,945	13,179	-109,766	184,145	10,053	-174,092

Source: ITC, 2020

Starting with 2015 for fruits and 2016 for vegetables, the trade balance deviates considerably from the values obtained until then, exceeding the threshold of -100,000 thousand euros. The first quarter of 2020 corresponds to the largest deficit of the trade balance in Romania, reaching -179,268 thousand euros in the vegetable trade, with an increase of 3.3% compared to the same quarter of 2019 and -190,362 thousand euros for fruits representing 13.2% versus Q1 from 2019.

Conclusions

In this paper a comprehensive statistical analysis was performed to identify the evolution and main qualitative aspects that describe the state of this market, the results obtained show an improvement of the yields currently obtained compared to the base year, 2010 and a development of vegetables grown in protected areas that brings a safety against natural factors. Characterized by volatility, production and price fluctuate, and supply stability is achieved through imports that have increased annually. The first half of 2020 recorded maximum values for fruit imports throughout the period under review, even though prices had marked monthly increases. Vegetables registered in the first half of 2020 the highest values of imports, but in terms of prices there is a decrease in the indicator.

The fruits and vegetables supply chain are constantly evolving and must have a high capacity for adaptability to changes in the market, as well as to the effects of globalization, but also of unexpected events like pandemic. Following the study, several characteristics were identified for fresh agri-food products, supply chain is more dynamic, but also with a higher attention considering their high perishability, so special conditions and specific actions are needed to maintain freshness, the importance of this work consists in the need for the

sustainable development of food supply chains in the context of adopting innovations, technology and trends in both production and consumption, to ensure food safety and security for population.

The limits of the research were the lack of accurate data regarding the COVID-19 pandemic to identify the impact of this pandemic on the fresh fruit and vegetable sector and the related supply chain, future research will include an analysis of the impact of the pandemic on the supply chain, in accordance with the principles sustainability.

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