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# COMPETITIVENESS OF SAUERKRAUT PRODUCTION <sup>1</sup>

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## Abstract

Vegetable production represents important segment of the Serbian agricultural output. Within the structure of produced vegetable, cabbage has significant share. Cabbage conservation, primarily for the winter period, in a form of sauerkraut (for preparation of salads and hot dishes) has long tradition both at national and international level. Sauerkraut production is usually in function of value added products generation at the farms oriented to vegetable production that boosts their long-term sustainability. The main goal of this article is to compare contribution margin gained at the farm involved in sauerkraut production made from conventionally or organically produced cabbage. One production year is observed (gained data refers to 2018). It could be concluded that pickling of organic cabbage allows creation of higher farm's income and contribution margin.

**Key words:** conventional and organic cabbage, sauerkraut production, contribution margin.

**JEL<sup>5</sup>:** Q12, Q19

## Introduction

Cabbage (*Brassica oleracea* var. *capitata*) is perennial, cultivated, herbaceous plant gained through the selection of wild cabbage over a very long period (into the human nutrition and medicine was introduced during the ancient Greece in the 4<sup>th</sup> century BC). Cabbage has a pronounced nutritional and medicinal value, as well as low calorie value. It is contained in the availability of certain useful phytochemicals,

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such as indole-3-carbinol (I3C), sulforaphane, phenolic compounds, carotenoids or glucosinolates (antioxidants desirable for detoxification), as well as the most of vitamins (primarily C, or A, B1, B2, PP, B6, B12, P, K and U), minerals (Ca, K, S, etc.) and carbohydrates (mostly free sugars, starch, cellulose and hemicellulose), (Cvetković, 2014).

Cabbage significantly appears within the structure of vegetable production in Serbia. After potatoes, it occupies the largest production areas (Červenski, Medić Pap, 2018). It is most commonly used in human nutrition, as fresh or processed (usually as sauerkraut), for the preparation of various salads and meals. In the diet are used the head, leaf or juice of cabbage.

Cabbage is mainly cultivated at the small family farms, which dispose with at maximum 5 ha of production area. Production is dominantly turned to direct or natural consumption and industrial processing. On the other side, in the total volume of produced vegetables, cabbage is generally positioned around the 10<sup>th</sup> place, where, as with other vegetables, annual production is insufficient to cover domestic demand (GRS, 2019).

The SORS collects and presents summarized production data for all brassica plants (cabbage and kale). From the data presented in the Table 1., it could be noticed that during the last 7 years (2012-2018), there has been a negative trend in the total harvested areas under the brassica plants. Oscillations related to yields and total production is primarily caused by the climatic factor (increase in deficit or bad spatial and temporal dispersion of rainfalls, or increase in average temperatures within the growing season), as cabbage production requires significant volume of water and frequent watering.

**Table 1.** Harvested surfaces, total production and average yields of cabbage and kale at national level (period 2012-2018)

Year	Harvested area (in ha)	Total production (in t)	Yield (in t/ha)
2012.	11,890	303,893	25.6
2013.	11,246	303,893	27.0
2014.	11,116	261,240	23.5
2015.	11,039	288,698	26.2
2016.	10,804	290,001	26.8
2017.	10,213	262,545	25.7
2018.	8,251	209,353	25.4
<b>Average</b>	10,651	274,232	25.7

Source: SORS, 2019.

Although surfaces under organic production are still limited (less than 0.5% of utilized agricultural area), their growth has positive trend at national level. They cover around 9,550 ha (Milić et al., 2018), where within the sowing structure are dominant cereals and fruit, while vegetables are present at small areas, up to couple hundred hectares (Sojić, 2017). Besides, some estimations show that organically produced cabbage covers just several hectares.

On the other hand, traditionally sauerkraut has played a significant role in the dietary habits of the European population, especially during the winter. It is estimated that in certain countries it involves more than 70% of total fresh cabbage production, as well as consumption per capita of around 4 kg (in Eastern Europe region). Besides production, in Serbia the most of fresh cabbage is processed (fermented) at small family farms and households. Within the volume of market-oriented sauerkraut, 50% ends up in retail, while the rest is realized through the green market or direct sales at the farm gate (Simović, 2010).

Usually, sustainable agriculture is turned to the ability of agricultural systems to handle the high crop or animal productivity over the long period, while they are flexible enough to adapt to expecting changes. In essence, sustainable agriculture is mainly characterized by maintaining of environmental quality, stable crop or animal productivity and social acceptability (Đokić, 2019).

Besides, there is a need for reconsideration of long-term farm sustainability, as well as certain factors that affect it (D'souza et al., 1993; Baccar et al., 2019): farms' size and economic strength; production orientation; level of specialization; age and number of farm members; availability of natural and production resources; level of farmers' education and readiness for tech-tech transfer, knowledge and skills improvement, or added value creation; level of awareness linked to environmental issues; etc.

In function of strengthening the farm sustainability is also the availability of specific agricultural and/or food products, or services that carry within themselves certain level of added value, and that can be successfully realized at the local or regional market. They can be the result of either production specialization or diversification of farm activities.

During the previous decades, farmers seriously fight to find the right way to increase their income throughout the process of "adding value" to raw agricultural products they produce. There are a number of methods for that, such are: cleaning, cooling, packaging, labelling, processing, distributing, churning, grinding, hulling, extracting, drying, smoking, handcrafting, etc. So contemporary farm business recognizes the adding value as "selling the sizzle, not the steak", where the sizzle is the product of information, education, entertainment, image, and other intangible attributes (Born, Bachmann, 2006).



In support of previously mentioned is the business philosophy of “niche marketing”, which refers to the realization of a specific product at the relatively small but well-defined market segment, such are certain geographical territory, specialized sector of industry, or certain ethnic, religious, age, gender or some other consumers’ group. As example could be noted local traditionally produced products or products with geographical origin, organic products, or foodstuff intended for vegetarians or sportsmen (Anzaku, Salau, 2017).

From the farmer’s perspective, value added represents a portfolio of agricultural activities and practices by which they want to maximally adjust their agro-food products and services with the preferences of end-consumers. Value-added is available to farmers who are improving their position within the supply chain, moving closer to the end-consumers, or making changes or advancements within the existing production process in order to change, point up or preserve certain characteristics of their products (Coltrain et al., 2000).

### **Used methodology and data sources**

All necessary data used for analytical calculations are obtained from family farm traditionally oriented to vegetable production and vegetable processing, located in South-Banat District. It has to be noted that farm is involved in conventional vegetable production and further processing, while large share in produced vegetable has cabbage production. Collected data refers to production year 2018. Besides, it’s also used the secondary data of SORS, scientific and professional literature oriented to the researched field of production and processing.

Main research goal is comparison of economic effects (incomes and variable costs) gained in sauerkraut production during one year based on the use of conventionally and organically produced cabbage. Economic effects are reconsidered and compared throughout the preparation of analytical calculations based on variable costs (contribution margin).

Calculation of contribution margin linked to the production of certain crop culture (including vegetables) or food product (food processing) considers subtracting of variable costs from incomes generated within the observed production line (Nastić et al., 2018). Character of variable costs in food (vegetable) processing mainly have used inputs and services, such are fresh vegetable, salt or certain additives, water, energy, external services and engaged labour, etc.

Better comparison is enabled by the tabular presentation of all data and economic results (in RSD) for the total volume of sauerkraut production (volume of processed cabbage at the farm is unified and limited by the capacity of production space and used equipment).

## Results with discussion

The analysis of economic justification of sauerkraut production is based on the data obtained from a registered family farm that has been active in the vegetable sector for many years. The farm is located in the South-Banat District, at the territory of the Pančevo city. Production is dominantly turned to ecologically oriented growing (in line to strict use of the GAP principles) of cucumbers and tomatoes in greenhouse, as well as production of cabbage and other Brassicaceae plants in the open field. The most of the produced vegetables is selling as fresh throughout the local green market or at farm gate. Besides, certain volume of vegetables is transformed through the processing into the higher value products (such as sauerkraut, pasteurized tomato juice, pickles, hot ketchup, torshi, etc.). They are selling throughout the local retail, green market, or at farm gate.

In the focus of this paper is a comparative analysis of the economic justification of processing (pickling) of cabbage produced within the conventional or organic system of production. Since the farm has many years of experience in cabbage processing (sauerkraut production), according the fact that processing of cabbage produced in any production system requires the same equipment, technological approach and norms of used inputs, it would be interesting to consider economic effects initiated by changing of the basic input (cabbage) within the process of sauerkraut production.

Starting the process of cabbage processing at the farm in the volume of around 16 t of fresh cabbage per year (split into the two cycles), requires certain level of investments in infrastructure equipment of processing facility (electrification, access to fresh water and drainage of technical water, thermal insulation, lining the ceramic tiles, etc.), as well as purchase of required equipment. Total sum needed for that purpose is almost 2,115,000 RSD, or approximately 18,000 EUR (1 EUR = 117,5 RSD).

Organizing the cabbage processing at the farm involves a production facility of approximately 65 m<sup>2</sup> consisted from at least three separate rooms (with space for pickling, for manipulation under the inputs and final product, and for cold storing of the packed final product).

Required equipment includes: 15 barrels (from industrial plastic, with the capacity of 1,000 l); worktable (acid-resistant); vacuum machine (two-chambers); cabbage cutting machines (with working parts of stainless steel); set of knives; 30 plastic water weights (5 kg each); 5 plastic containers (with the capacity of up to 20 kg); 2 digital weighing scales (up to 40 kg); 4 fine polished wooden pallets for sauerkraut squeezing; cart; etc. (Subić, Tomić, 2019).

Short description of used technology in the sauerkraut production, as well as incomes, costs and contribution margin gained throughout the pickling of organically and conventionally produced cabbage, are given in the following table (Table 2.).

**Table 2.** Contribution margin in sauerkraut production

Element	U.M.	Sauerkraut from conventionally produced cabbage			Sauerkraut from organically produced cabbage		
		Quantity	Price/UM (in RSD)	Total (in RSD)	Quantity	Price/UM (in RSD)	Total (in RSD)
I Incomes							
Sauerkraut	kg	12,000	70	840,000	12,000	160	1,920,000
Subsidies	pack.	-			-		
Value of production (total I)				840,000			1,920,000
II Variable costs							
Cabbage	kg	15,750	17.5	275,625	15,750	75	1,181,250
Salt	kg	600	140	84,000	600	140	84,000
Foil	pcs	30	275	8,250	30	275	8,250
Vacuum bag	pcs	6,000	7.5	45,000	6,000	8,5	51,000
Transport box	pcs	400	55	22,000	400	55	22,000
Labour	h	408	270	110,160	408	270	110,160
Energy	-	-	-	27,000	-	-	27,000
Water	-	-	-	1,800	-	-	1,800
Dez & Der	-	-	-	9,500	-	-	9,500
Quality control	-	-	-	8,500	-	-	10,500
Certification	-	-	-	-	-	-	118,000
Taxes	-	-	-	6,750	-	-	6,750
Other costs	-	-	-	6,250	-	-	6,250
Sum of variable costs (total II)				604,835			1,636,460
III Contribution margin (I-II)				235,165			283,540

Source: IAE, 2019.

Hereinafter, it will be given certain clarifications regarding the data shown in previous table (Table 2.). The season of production and sale of sauerkraut is framed by the period September - January. Technological process of sauerkraut production lasts for 20-25 days. As was previously mentioned, farm has on disposal 15 barrels, where each barrel is used twice during the season of sauerkraut production (annual production is technically limited to 30 barrels).

For processing is used self-produced or from local vegetable growers purchased first class fresh cabbage. It's shown the average wholesale price of fresh cabbage



(conventionally and organically produced) that includes its delivery to farm. One season of cabbage pickling requires the purchase of 15,750 kg of fresh cabbage.

After the purchase, fresh cabbage is mechanically cleaned (stripping the outer leaves), and preparing for pickling (cutting the root or chopping the heads into the small pieces). With this activity, the volume of fresh cabbage that enters the pickling process is reduced for 5%. Each barrel could receive 500 kg of fresh cabbage, where during the pickling process volume of cabbage is additionally reduced for 20%. So after the draining around 12,000 kg of final product could be packaged (in vacuum bags and shipping boxes) and sold usually to local retailer.

In addition to fresh cabbage, a solution of water and table salt is adding into the barrel. Then, the barrel is tucked in well by the foil and additionally loaded with plastic water weights. Share of salt within the structure of production mass is about 2%, i.e. each barrel contains 20 kg of salt. Salt is buying in bulk in 5 kg bags. As was previously mentioned, the process of pickling requires the use of a foil for the barrel sealing, in order to preserve necessary conditions for cabbage fermentation (new foil is placed during the each filling of the barrel).

Sauerkraut is delivering at the market in vacuum bags (with printed data about the producer and products' declaration) in volume of 1-2 kg/bag. Vacuum bags are additionally packaged in plasticized cardboard boxes (15 bags/box).

Labour costs consider the occasional engagement of two persons for the realization of several processing activities. Although the labour costs (the most often only costs of external labour are used (Subic, Jelocnik, 2019)) may or may not burden the analytical calculation of contribution margin, in order to better perceive the effects that arise from cabbage processing, they are fully shown within the structure of variable costs. Working staff is represented by a farmer and external worker, where the gross wage per working hour accounts around 270 RSD.

The process of filling the barrels with fresh cabbage (cleaning, cutting, chopping and stacking of the cabbage, pouring the brine and sealing the barrels) requires in total the fund of 168 working hours. Taking out the sauerkraut from the barrels and its stacking at the wooden pallets for further draining (before packing the sauerkraut is pyramidally stacked at the pallets and left to drain for next 24 hours) requires in total the 120 working hours. Packing (vacuuming) of sauerkraut and its transfer to cold storage requires additional 120 working hours. So, the total labour (for the whole season) requires the fund of 408 working hours.

Production of sauerkraut is additionally burdened with the costs of electricity (for lighting, heating of the working facility, for operation of the cold storage

and used equipment, etc.), water costs (for the use of fresh water and disposal of wastewater), costs of disinfection and pest control within the facility, costs of final product quality control (verification of the product declaration), costs of taxes and fees, and other costs.

In order to mark the final product of processing with the tag representing it as a organic, production of sauerkraut based on organic cabbage has to be previously certified (certification of technological process, i.e. used facility and equipment) by authorized certification body. Besides, processor has to proof that the input he uses in pickling is produced in organic system.

So, within the processing of organic products are used just certified inputs. If parallel with the processing of conventional inputs, processing line of organic inputs wants to be established, the entire technological process must be separated in time or space. Also, before the beginning of organic products processing, all equipment must be pre-cleaned with allowed cleanser. In addition, mixing of organically and conventionally produced inputs and final products of processing is not allowed. It can be used only by the regulative on organic production allowed additives, excipients, minerals, etc. Domestic processed certified organic products may be labelled with the national organic product sign and logo of the inspection body that previously certified the primary product (input) if the final product of processing contains minimum 95% of ingredients of agricultural origin produced in line to principles of organic production (Serbia Organica, 2019).

According to previously mentioned next could be concluded:

- In both processing lines are gained positive contribution margin.
- Under the same processing capacity, the contribution margin achieved in processing of organically produced cabbage is for more than 20% higher than achieved one in processing of conventionally produced cabbage.
- Initiation of processing of organically produced cabbage needs much higher amount of financial assets (2.7 times higher). Besides, achieved incomes are 2.3 times higher.
- In both lines, in the structure of variable costs dominate the costs of fresh cabbage (in processing of organically produced cabbage even 72%).

## **Conclusion**

Cabbage production has long tradition at the territory of Serbia. As primary product gained from cabbage processing, sauerkraut is unavoidable food product, especially

during the winter time. On the other hand, areas under organically produced vegetable, specifically cabbage, currently are below production capabilities and market demand.

In paper were tested and compared contribution margins gained in sauerkraut production based on the use of organically or conventionally produced cabbage, as mentioned productions require identical production process and equipment. Obtained results show that for certain farm, processing of organic cabbage could be for 20% more profitable, although starting of its conduction (purchasing of inputs) requires much higher amount of financial assets.

This could be such important information given the assumption that the needs at national niche market for organic sauerkraut are much greater than currently possible production. This is crucial for two reasons. Firstly, mentioned can pull organic cabbage producers to expand their production areas and offer fresh cabbage to farms that are already active in cabbage processing. By this processors could additionally engaged their available processing capacity to maximal level, reaching at that way the higher grade of profitability and economic sustainability. Secondly, producers of organic cabbage can divers their production activity with introduction of cabbage processing at the farm. By that they could contribute to maintaining and increase of farm income, especially in years with low sales price of fresh organic cabbage. Thirdly, any farm active only in the segment of cabbage processing (whether organic or conventional cabbage), with presented capacities cannot provide its own, primarily financial sustainability (gained incomes and contribution margins are too low for maintaining of decent life for farm members). In line to the volume of produced final product, required work engagement and possible incomes, cabbage processing could be just in function of secondary (additional) activity at the farm.

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