SUPERMARKET VS. FARMERS MARKET: A COMPARATIVE ANALYSIS

SUPERMARKET VS. PIAȚĂ AGROALIMENTARĂ: O ANALIZĂ COMPARATIVĂ

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Abstract.
Vegetable products are part of a balanced diet regardless of the consumer's age. Their diversity and the options offered for marketing multiply the factors considered when purchasing them. Through the present study we analyzed three vegetable products widely distributed and consumed by all population groups (potatoes, tomatoes and spinach). Supermarket products and similar products from a farmers market were selected, and the indicators analyzed were pH, acidity and the content of nitrite, phosphate, iron and copper ions. Differences were observed between the two categories of products, in the sense that those purchased from the farmers market had a higher content of dry matter, but also high values for the analyzed ions, which denotes the application of fertilization and foliar treatments to increase production. The highest values, compared to data from the literature, of the phosphate content were recorded in farmers market potatoes (20.62 mg P/100 g), for nitrite, in farmers market spinach (7.23 mg/100 g), and as for iron and copper ions, all products exceeded the values provided in the literature.
Key words: potatoes, tomatoes, spinach, quality indices

Rezumat.
Produsele vegetale fac parte dintr-o dietă echilibrată indiferent de vârsta consumatorului. Diversitatea acestora și opțiunile oferite pentru comercializare multiplică factorii luați în considerare la achiziția lor. Prin intermediul prezentului studiu am analizat trei produse vegetale distribuite pe scară largă și consumate de către toate grupele de populație (cartofi, tomate și spanac). Au fost selectate produse din supermarket și produse similare dintr-o piață agroalimentară, iar indicatorii analizați au vizat pH-ul, aciditatea și conținutul în ionii azotit, fosfat, fier și cupru. Au fost observate diferențe între cele două categorii de produse, în sensul că cele achiziționate din piață au avut un conținut mai mare de substanță uscată, dar și valori ridicate pentru ionii analizați, ceea ce denotă aplicarea fertilizării și a tratamentelor foliare pentru creșterea producției. Cele mai mari valori, comparativ cu datele din literatură, ale conținutului de fosfați s-au înregistrat la cartofii din piață (20.62 mg P/100 g), pentru azotiți, la spanacul din piață (7.23 mg/100 g), iar în ceea ce privește ionii de fier și cupru, toate produsele au depășit valorile prevăzute în literatură.

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Cuvinte cheie: cartofi, tomate, spanac, indici de calitate

INTRODUCTION

In modern society, the consumption of vegetables has become more and more important in a healthy and balanced diet. When thinking about shopping for vegetables, two of the most popular options are supermarkets and traditional markets. Both places offer a wide range of fresh and delicious vegetables, but there are significant differences between them.

One of the important aspects to consider is the quality of the products. In general, vegetables found in markets are considered to be of better quality, as they are often fresh and sourced directly from local producers [Rahman *et al*., 2021]. They are picked at optimal maturity and may be less subject to chemical treatments or preservatives. Many producers practice organic farming methods, which means that the vegetables are grown without the use of pesticides or chemical fertilizers [Parris, 2011].

On the other hand, supermarkets offer a wider range of vegetables available throughout the season, regardless of the season. This is because supermarkets can import vegetables from other countries or use preservation techniques to keep them fresh for longer. However, this can come at a cost, as imported vegetables may be of lower quality or may be treated with preservatives to extend shelf life.

Similarly, market vegetables are often grown traditionally, without using intensive farming techniques or genetically modified organisms (GMOs). Instead, many supermarkets sell vegetables that come from large factory farms, where these practices are used to achieve higher yields. The applied treatments may involve the use of chemical fertilizers and pesticides that may have a negative impact on the environment [Havugimana *et al*., 2017].

However, it is important to note that there are exceptions to both cases. Some markets may be located near industrial areas or have access to polluted water and soil [Bell *et al*., 2011; Kumar *et al*., 2021]. There are also supermarkets that offer organic or locally sourced products that meet ecological standards and reduce the use of toxic substances.

Therefore, when comparing vegetables from the market to those from the supermarket, it is important to consider the main factors determining the quality of the products so that we can make the right choice.

MATERIAL AND METHOD

In this study, the following vegetable products from an agro-food market and a supermarket, both very frequented, were subjected to laboratory analysis: white potatoes (*Solanum tuberosum*) – P 1 supermarket, P 2 farmers market, tomatoes (*Solanum lycopersicum*) - P 3 supermarket, P 4 farmers market and spinach (*Spinacia oleracea*) - P 5 supermarket, P 6 farmers market. Characteristic methods were used to determine some quality physico-chemical parameters: the content of dry matter and moisture by oven drying at 105^0C, the pH by the potentiometric method, with a Hanna Instruments device, the acidity by titration with NaOH solution of factor known and expressed in mg citric acid/100 g, the content of nitrites was determined with a Spekol

1100 spectrophotometer, by the Griess method, the content of phosphates by the colorimetric method using sulfomolybdenic solution, the content of Fe^{3+} ions (by colorimetric method, with the help of sulfosalicylic acid) and Cu^{2+} (by colorimetric method, based on the formation of the ammonia complex).

RESULTS AND DISCUSSIONS

The plant product purchased from the farmers market refers to the products obtained from plant raw materials that have not been treated with pesticides or chemical fertilizers, that do not come from genetically modified organisms, and in the process of processing these products, the use of radiation or food additives is avoided [https://health.clevelandclinic.org/diet-food-fitness/nutrition].

For these reasons, consumers are inclined to pay a higher price for products from the farmers market to the detriment of those from large stores.

At the same time, in order to obtain profitable productions, in addition to irrigation, fertilization with different doses of N, P and K is applied, according to the requirements of the culture, as well as treatments against diseases and pests, or the application of preservatives to maintain the fresh appearance of the harvested fruits or vegetables.

The analyzed products show different stages of development until they reach consumption maturity, as follows:

- potatoes - dormancy, sprouting, vegetative growth, tubering, maturation;
- tomato - seedling, spacing, transplanting, green, mature green, color breaker, half ripe, ripe, red ripe, full ripe;
- spinach - germination, spacing, thinning.

In the different development phases presented above, there is the possibility of applying some chemical substances, that is why comparative determinations were made for the three types of products, the results being detailed below.

The moisture and dry matter of the analyzed samples were determined using a Biobase hot air oven at 105ºC, their values being presented by comparison with the data from literature in Figure 1.

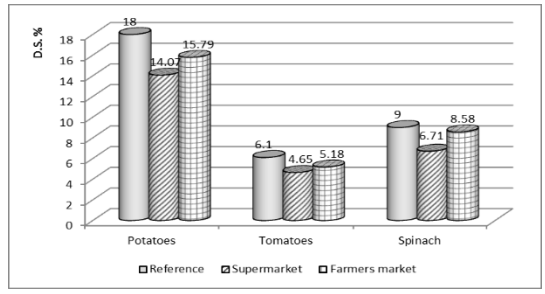

Fig. 1. Dry matter values for the analyzed samples

The products in the farmers market have a higher dry matter content compared to those in the supermarket. This can be explained by the agricultural

system applied, the use of synthetic chemicals that can affect the accumulation of nutrients and the early harvesting of plant products, before maturity is achieved, either for consumption in natural form or for industrial processing.The pH values were determined in the samples' extracts, at room temperature, as seen in Figure 2. Acidity was expressed in g citric acid/100 g of fresh product and the obtained values are presented in Figure 3. After analyzing the results graphically represented above, we can see that there are no big differences in pH within the three groups of products. We can mention that the products in the market tend to be slightly more acidic than those in the supermarket.

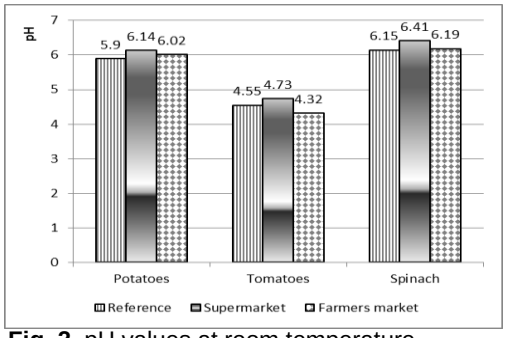

Fig. 2. pH values at room temperature

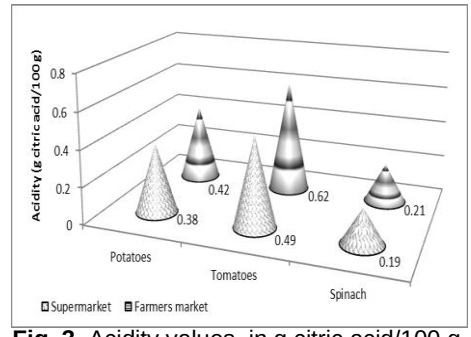

Fig. 3. Acidity values, in g citric acid/100 g

According to Griess method, we prepared a series of standard solutions and drew a calibration curve, based on which we determined the nitrite content of the samples, as presented in Figure 4.

Regarding the nitrites content for the tomatoes subjected to the determinations, there are no significant differences for this parameter. On the other hand, for potatoes and spinach, the samples from the farmers market show a higher nitrite concentration than those from the supermarket, almost double for potatoes and about five times higher in the case of spinach.

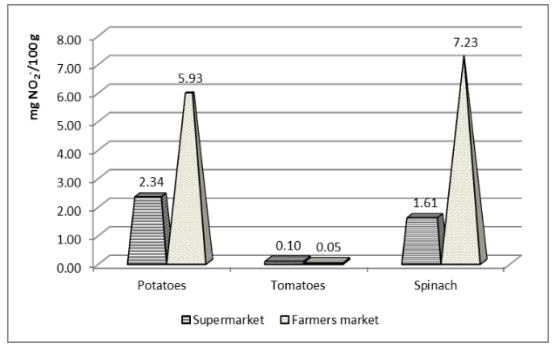

Fig. 4. Nitrite contents of samples in mg NO_2^-/ L

Among the factors affecting the nitrate and nitrite contents in vegetables, food processing (washing and boiling, peeling the skin) is found to lower the nitrate

content. Chopping or mashing of vegetables releases enzymes in the plant cells that convert nitrates into nitrites, therefore, it is advisable to cook vegetables soon after these processing, especially when preparing baby food. If necessary, storage below 4°C is appropriate if they are not cooked immediately, to inhibit the activities of enzymes and bacteria [Salehzadeh *et al*., 2020].

Following the results obtained when analysing the phosphate content (Figure 5), it was found that vegetable products purchased from the farmers market have higher values compared to similar products from the supermarket, but no product reaches the level provided by the literature. The content of phosphate ions is higher in vegetable products from the farmers market because the probability of applying phosphorus-based chemical fertilizers during the vegetative and ripening period is higher.

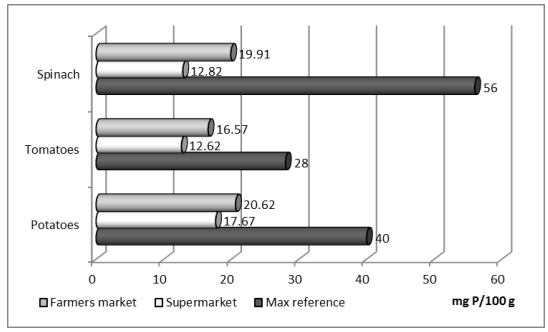

Fig. 5. Phosphate contents for the analyzed samples

Iron-rich vegetables include broccoli, string beans, dark leafy greens (dandelion, collard, kale, spinach), potatoes, cabbage, Brussels sprouts, and tomato paste [Welk et al., 2023]. Iron content in the analyzed species was similar to literature values, with slight variations, but notably higher in potatoes and tomatoes. Iron-based fertilizers are used to address soil deficiencies and improve plant weight, chlorophyll, protein, and enzyme activity [Reda et al., 2019]. Copper levels in potatoes and tomatoes should be low, and 0.174 mg per 100 g in spinach. However, the analyzed samples showed higher copper concentrations, particularly in potatoes, with spinach from the market having over twice the concentration compared to supermarket samples and literature values (Figure 7).

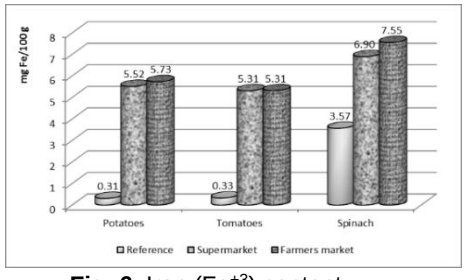

Fig. 6. Iron (Fe^{+3}) content

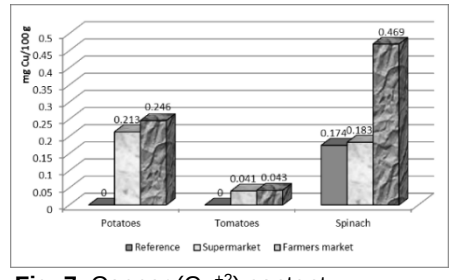

Fig. 7. Copper (Cu^{+2}) content

The treatments applied with copper-based products can cause an increased concentration in the commercialized products, especially in spinach or other species where the leaves are consumed, considering the foliar application of the treatments and the more intense absorption from this level.

CONCLUSIONS

The farmers' market products had a higher content of dry matter, which shows that the harvest was carried out at the ripeness for consumption. Also, the products purchased from the market had a more appetizing appearance.

The content of iron, nitrites and phosphate ions was higher in these products, indicating the application of fertilization in different phases of vegetation.

The presence of an increased level of copper ions in the vegetables purchased from the farmers market also shows that treatments were applied to the crops from which the analyzed samples came.

It is up to each consumer to choose the place of purchase for vegetable products, and the factors include, in addition to the quality of the products, the appearance, the price, proximity and personal experience.

REFERENCES

1. **Bell J.N.B., Power S.A., Jarraud N., Agrawal M., Davies C., 2011** - *The effects of air pollution on urban ecosystems and agriculture*. International Journal of Sustainable Development and World Ecology, vol. 18, no. 3, p. 226-235. doi:10.1080/13504509.2011.570803.
2. **Havugimana E., Bhople B., Kumar A., Byiringiro E., Mugabo J.P., Kumar A., 2017** - *Soil pollution - Major sources and types of soil pollutants.* Environmental Sci. & Eng., vol. 11, p. 53-84.
3. **Kumar N., Kumar A., Marwein B.M., Kumar Verna D., Jayanalan I., Kumar A., Duraisamy R., 2021** - *Agricultural activities causing water pollution and its mitigation – a review***.** International Journal of Modern Agriculture, vol. 10, no.1, p. 591-599.
4. **Parris K., 2011** - *Impact of agriculture on water pollution in OECD countries: recent trends and future prospects***,** International Journal of Water Resources Development, vol. 27, no. 1, p. 33-52.
5. **Rahman S.M.E., Mele M.A., Lee Y.T., Islam M.Z., 2021** - *Consumer preference, quality, and safety of organic and conventional fresh fruits, vegetables, and cereals.* Foods, vol. 10, no. 1, p. 105. doi: 10.3390/foods10010105.
6. **Reda M. A., Abdelhameed R., Hedaya A. K., 2019** - *Iron-based metal-organic-frameworks as fertilizers for hydroponically grown Phaseolus vulgaris.* Materials Letters, vol. 237, p. 72-79. doi: 10.1016/j.matlet.2018.11.072.
7. **Salehzadeh H., Maleki A., Rezaee R., Shahmprado B., Ponnet K., 2020** - *The nitrate content of fresh and cooked vegetables and their health-related risks.* PLoS One, vol. 15, no. 1. doi: 10.1371/journal.pone.0227551.
8. **Welk A.-K.,Mehlhose C., Daum D., Enneking U., 2023** - *Vegetables with enhanced iron bioavailability - German consumers' perceptions of a new approach to improve dietary iron supply***.** Nutrients, vol. 15, no. 10, p. 2291. doi: 10.3390/nu15102291.
9. *****,** https://health.clevelandclinic.org/diet-food-fitness/nutrition.