
PhD THESIS

Research on the evaluation of bioactive compounds in sweet potatoes (*Ipomoea Batatas*)

(SUMMARY OF THE PhD THESIS)

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INTRODUCTION

Herbal medicine is a popular, emerging field. If you follow the research in this field, you will notice that most of the work focuses on different fibrous plants and "herbs" as medicinal plants. However, many vegetables and fruits, their juices and extracts, have medicinal properties and have been used as such since ancient times. Due to the fact that bioactive substances from different plants are natural, they can also be used in cosmetics or pharmaceuticals, having many benefits for the human body. (URSO, 2016). Lately, medicine has developed a lot and focused on herbal therapy, and thus limited the excessive use of synthetic drugs. (AZIZ, 2016). Given that the action of bioactive substances in different plants used in phytotherapy do not result in various adverse effects (DELFIN, 2014, NASEER, 2020), it is recommended to use them, even if the beneficial effects are felt by patients after a period longer course of natural treatment compared to the action of synthetic drugs.

Sweet potato (*Ipomoea batatas*) is one of the main foods in many countries. Although considered a staple food, people have noticed its beneficial and medicinal properties. Bioactive components, such as anthocyanins, polyphenolic compounds, coumarins, calistegins and triterpenes, have been shown to stimulate immune function, reduce oxidative stress and free radical damage, reduce the risk of cardiovascular disease, suppress the growth of cancer cells and prevent cancer cells. Diabetes and hypoglycemia, suppressing HIV symptoms, act as hepatoprotectors while being part of a nutritious food together.

Therefore, a diet with sweet potatoes can supplement them for any of the conditions mentioned above.

STRUCTURE OF THE THESIS

The present paper establishes to review the benefits and medicinal properties of sweet potato, following the bioactive substances from different varieties of sweet potato cultivated both in Romania and in Egypt.

The samples of *Ipomoea Batatas* tubers were taken from Oltenia, Dăbuleni locality, Dolj county within the Research - Development Station for Plant Culture on Dăbuleni Sands, and the other part of the samples was taken on *Ipomoea Batatas* cultivated in Cairo, Egypt.

The result is to list the main components and medical benefits observed, highlighting the potential uses of *Ipomoea Batatas* in the field of natural medicine.

The analyzes were performed in the laboratories of the University of Agricultural Sciences and Veterinary Medicine in Cluj-Napoca and in the Research Institute for Analytical Instrumentation Cluj-Napoca, thus benefiting from high performance equipment and special analytical techniques. We also worked in a pleasant environment, benefiting from the experience of groups of researchers with a high degree of professional integrity.

The first part "Current state of knowledge" consists of 3 chapters and extends over 30 pages, this part containing the general elements on medicinal plants, the nutritional composition of *Ipomoea Batatas* and sweet potato products on the market. The most important characteristics of the plant, the nutritional value and importance and the use of sweet potatoes in the food industry are listed.

The second part of the thesis, "Personal Contributions" extends over 44 pages and is made up of 8 chapters. In the second turned out order, the objectives of the work, materials them and methods they used , the results obtained from analyzes and discussions based on them. We also compared the data obtained, the results with the information in the literature.

In **Chapter 4** turned out the aims, scope and design the experimental study. In **chapter 5** have described the features of the natural environment such as climate, topography, from which samples were taken: that Dăbuleni, Dolj and Cairo, Egypt. In **chapter 6** were rated material other biological it, sampling and analytical methodologies used for the matrix under investigation.

In the **chapter 7**, held interpretation of results and discussions with methods using statistical -matematice.

In **chapter 8** we interpreted the results of research on e laboration comparative bioactive compounds in *Ipomoea batatas*. The concentration of essential heavy metals, toxic heavy metals, ascorbic acid, beta-carotene content, phenolic compounds, and carbohydrates in the studied biological material were determined. In **chapter 9** have highlighted the conclusions and recommendations covered in this research. In **chapter 10** were described thesis originality and innovative contributions, will then, **chapter 11** contain future research prospects.

RESULTS OF THE RESEARCH

Physico-chemical analyzes for determining the raw material and benefits of bioactive substances were performed at the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca and in the laboratories INCDO-INOE 2000, Branch of the Research Institute for Analytical Instrumentation, ICIA, Cluj - Napoca. There are four types of samples analyzed, tubers of *Ipomoea batatas*, three samples were picked up in Romania and a sample originating in Egypt. Among the essential minerals, analyzing the sweet potato tuber, potassium is in the highest concentration with values between 4267-9489 mg / kg. The highest concentration of potassium is found in sweet potatoes in Cairo, Egypt, (9489 mg / kg), taken in 2020.

The essential mineral potassium is an important micronutrient helping the cardiovascular system by maintaining the balance of fluids and electrolytes in the body. The second essential mineral is calcium, which is found in the sweet potato tuber in all the samples studied, in a considerable amount, being between 714.4-2552 mg / kg. The highest value is in the Yulmi soil, the tuber transported from Dăbuleni, Dolj County, Romania.

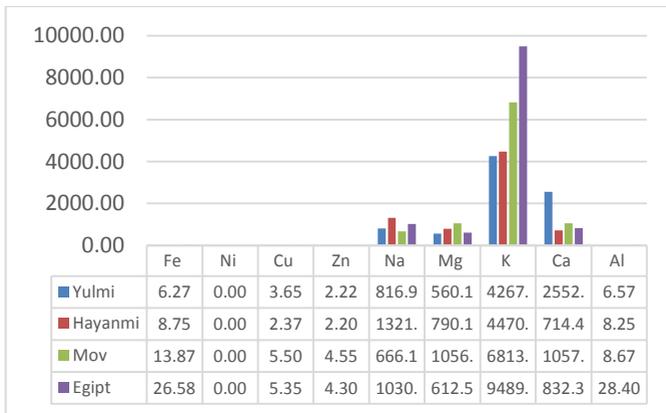


Fig. 1. Comparison of the content of essential metals in the tuber

The highest concentration of toxic metals in the studied sweet potato tubers is strontium, with the highest concentration in Yulmi sweet potatoes in Dăbuleni, Dolj County, namely 9.05 mg / kg, followed by potato

tubers in Cairo, Egypt having a concentration of 5.90 mg / kg. Manganese is also in a high concentration in the type of Hayanmi sweet potato from

Dăbuleni, Dolj County, namely 5.62 mg / kg. It is essential to note that all concentrations of toxic metals studied on sweet potato tubers did not exceed the values of the allowed daily dose.

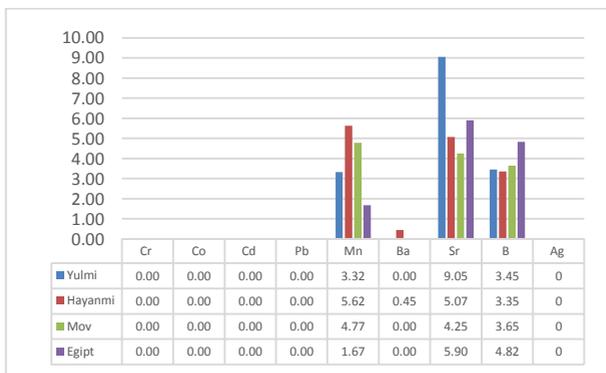


Fig. 2. Comparison of toxic metals from studied Ipomoea Batatas tubers

The recommended daily doses for minerals are 2000 mg / kg for potassium, 14 mg / kg for iron, 800 mg / kg for calcium, 1 mg / kg for copper, 375 mg / kg for magnesium, and for zinc 10 mg / kg, according to the 2008 Directive. / 100 / EC of 28 October 2008. Compared to these data in the literature, the concentrations of minerals we have acquired may indicate that this increased content of minerals such as potassium, calcium, magnesium and iron, sweet potatoes they are recommended both for daily consumption and in phytotherapy, having bioactive substances with healing potential. The analyzes performed to determine the ascorbic acid from the different varieties of sweet potatoes studied show that each type of Ipomoea Batatas has this antioxidant in its composition. The highest concentration of vitamin C 673.53 mg / kg is represented in the purple potato grown in Dăbuleni, Dolj County, compared to the lowest value of ascorbic acid of 15.86 mg / kg found in the variety Hayanmi , potato grown in Dăbuleni.

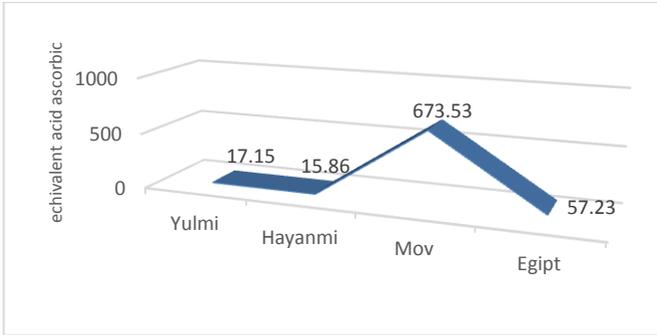


Fig. 3. Ascorbic acid content of the sweet potato samples studied

In the case of beta-carotene analysis, it was found that the samples grown in Cairo, Egypt, the orange potato, has the highest concentration of beta-carotene 101.8 mg / kg, compared to the variety in the sweet potato Hayamni which has a concentration of 0.17 mg / kg. Comparing the concentration of beta-carotene and ascorbic acid, represented in the graph below, a high concentration of ascorbic acid 673.53 mg / kg was obtained for the sweet potato Mov from Dăbuleni, Dolj county and an increased concentration of beta-carotene in the case of sweet potato from Cairo, Egypt. The lowest concentration of ascorbic acid is found in Hayanmi tuber 15.86 mg / kg compared to the variety of the Cairo sample, which has a concentration of 101.8 mg / kg.

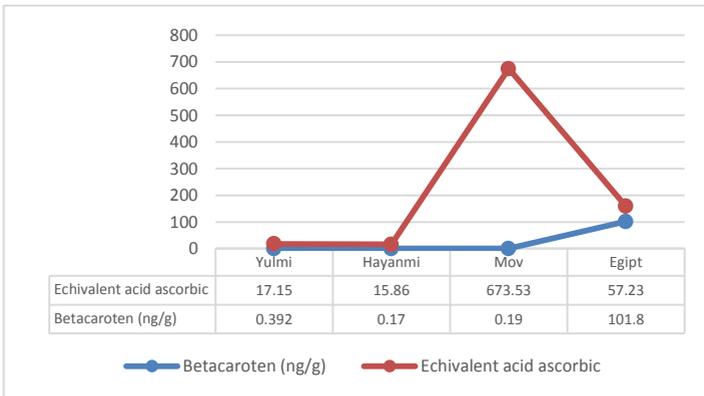


Fig. 4 . Comparative situation of beta-carotene and ascorbic acid in the potato samples analyzed

In the case of the determination of phenolic compounds, the analyzes performed showed a directly proportional increase of these parameters. The sampling period (November 2020) indicates high values especially for the type of orange sweet potato in Cairo, Egypt, which recorded high values. The results obtained for the amount of phenols in each type of sweet potato variety studied are shown in Figure 5.

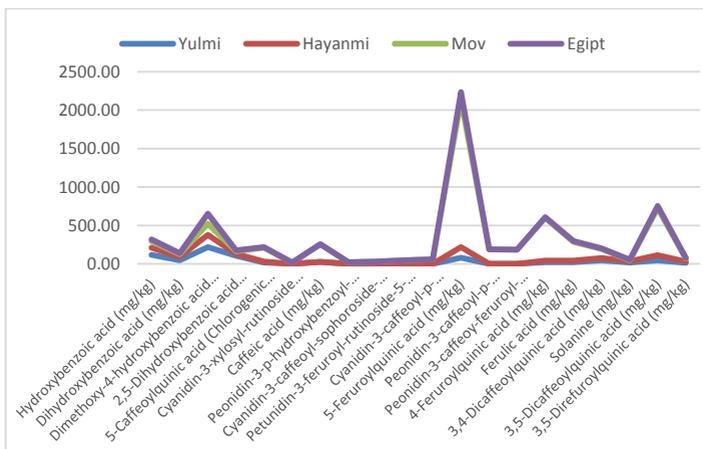


Fig. 5. The content of phenolic compounds in the studied sweet potato samples

It can be seen that ferulic acid has the highest values recorded in all samples analyzed, the highest value being obtained for the Egyptian variety (1916 mg / kg). Caffeic acid is the next phenolic compound with significant values, the highest value being recorded also for the potato samples analyzed in the area of Egypt (610 mg / kg).

In the case of determining the carbohydrate compounds in *Ipomoea Batatas*, three types of carbohydrates were studied, such as fructose, glucose and sucrose, for each type of sweet potato, respectively the three varieties grown in Romania: Yulmi, Hayanmi and purple plus potato samples. sweet orange, grown in Egypt. Of all the three types of carbohydrates, *Ipomoea Batatas* has the highest concentration of sucrose, followed by glucose and fructose. The highest amount of sucrose 7.76 mg / kg is found in the sweet orange potato, from Cairo, Egypt compared to the purple variety grown in Dăbuleni, Dolj County, which has a concentration of 4.51 mg / kg.

On the glucose side, the highest concentration is represented by the sweet potato Yulmi from Romania with a value of 1.34 mg / kg compared to the orange variety grown in Egypt, which has a concentration of 0.17 mg /kg.

The last part of the carbohydrates with the lowest values is fructose. The lowest concentration of fructose is found in Cairo sweet potatoes with a value of 0.15 mg / kg compared to the highest concentration of fructose 1.04 mg / kg found in the Yulmi variety.

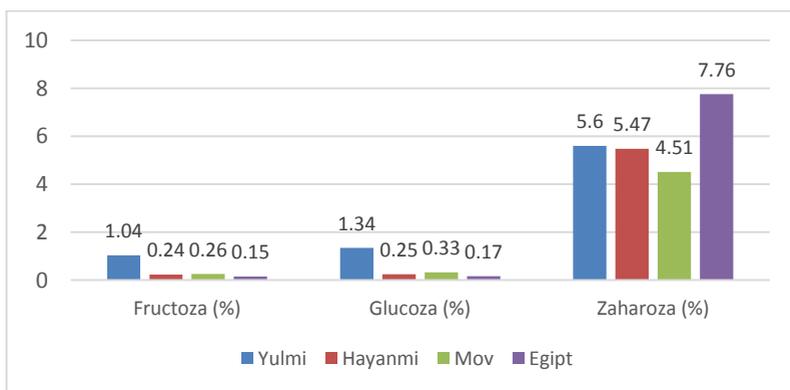


Fig. 6 . Concentration of carbohydrate compounds in the analyzed sweet potato samples

GENERAL CONCLUSIONS

Analyzes performed on the tubers of *Ipomoea Batatas* showed that through the special substances they possess they have the ability to prevent and even treat various health problems. They can also be used in different fields:

- *Ipomoea Batatas* contain a large amount of vitamins and minerals essential for the human body, with an impressive concentration of nutrients, higher amount compared to the recommended daily dose.
- Performing chemical analyzes showed that the tubers also contain a significant amount of phenols, polyphenols, sugars and carotenoids. The tubers also have an increased value of antioxidant capacity, which shows that *Ipomoea Batatas* consumed regularly fights free radicals, having beneficial effects in cancer prevention.
- Experiments with research have shown that an elevated temperature can better preserve the nutrients in tubers, and the most significant

values of essential vitamins and minerals are found in tubers grown in Egypt.

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- Analyzes obtained from four types of *Ipomoea batatas* shows that each variety of sweet potato, whether we refer to those grown in Dăbuleni, Dolj, whether discussing those cultivated in Cairo Egypt contain many bioactive substances, cherish quality that they are indispensable to prevent and even treat various diseases.
- Given the analyzes performed on *Ipomoea Batatas* in the laboratories within the University of Agricultural Sciences and Veterinary Medicine and within the Research Institute for Analytical Instrumentation Cluj-Napoca, it was found high concentrations of beta-carotene, calcium salts, magnesium and sugars, which indicates that tubers should be included in the daily menu of people who are healthy or have various medical conditions or who are obese, thus helping to control satiety and weight loss.
- The analyzed samples, which include different varieties of sweet potatoes, both from Romania and from Egypt demonstrated properties with known health benefits. The two fundamental minerals for the human body calcium and potassium are in high quantities, with the most representative in the Yulmi variety in Dăbuleni, Dolj County and the orange variety in Cairo, Egypt.
- Potassium is the highest concentration in the sweet orange potato in Egypt, with a value of 9489 mg / kg, and calcium is with a significant value in the Yulmi variety in Dăbuleni, with a concentration of 2552 mg/kg.
- Strontium and manganese, among the toxic minerals performed, are the most abundant, with a maximum concentration of 9.05 mg / kg of strontium in the Yulmi variety, and for manganese a maximum value of 5.62 mg / kg was found in the Hayanmi variety, both types of *Ipomoea Batatas* grown in Romania.
- When comparing the values of essential minerals with the recommended daily dose for these samples, significantly higher values were identified for the compared minerals, especially potassium, with the recommended daily dose of 2000 mg / day, and the maximum value in the potato tuber. sweet from Egypt is 9489 mg / kg. This confirms that *Ipomoea Batatas* are a fundamental source of essential minerals for the human body.
- The analysis of the ascorbic acid content in the sweet potato tubers shows that the purple variety from Dăbuleni has a high content of

vitamin C, respectively 673.53 mg / kg, followed by the Cairo tuber with the value of 57.23 mg / kg. The maximum value of ascorbic acid found in the samples is 673.53 and indicates that *Ipomoea Batatas* are important sources of vitamin C, essential for the human body.

- The study conducted for the determination of beta-carotene in *Ipomoea Batatas* tubers showed that the orange variety exported from Cairo has a maximum concentration of 101.8 mg / kg of beta - carotene, especially important for its qualities as a precursor of provitamin A, being a carotenoid that supports the system immune system, eye health, reduces oxidative stress and chronic inflammation.
- Analysis of the phenol content of the tubers indicates that there is a directly proportional increase in these parameters. The sampling period (November 2020) indicates high values especially for the type of orange sweet potato in Cairo, Egypt, which recorded high values.
- The determination of carbohydrates consisted in the study of several tubers to find out the content of sucrose, glucose and fructose. From the analyzes performed, the maximum quantities found in the samples were those of sucrose in the orange tuber of Cairo, 7.76 mg / kg, followed by glucose with a value of 1.34 mg / kg in the Yulmi variety and 1.04 mg / kg fructose in the same type of *Ipomoea Batatas*.
- The results obtained, in their entirety, have shown that *Ipomoea Batatas* are rich in minerals and vitamins so they can be a valuable source of nutrients, being recommended in the prevention and treatment of various diseases, but it is very important the variety and place they belong, these two factors influencing the quality of their healing properties.

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