第 49 卷 第 1 期
2022 年 1 月

湖南大学学报（自然科学版）
Journal of Hunan University（Natural Sciences）

Vol. 49 No. 1
January 2022

Open Access Article https://doi.org/10.55463/issn.1674-2974.49.1.16

Comparative Evaluation of Nutritional Values in Different Food Prepared Traditional Methods from Iraqi Cuisine of Beta Vulgaris Roots

Wathiq A. Al-Hachami*, Ali R. Albakaa, Nehad K. Abed, Ahmed M. Ahmed, Nouran A. Abdulredha, Alliya M. Hameed

Department of Pharmaceutical Chemistry, College of Pharmacy, Mustansiriyah University, Baghdad, Iraq

Abstract: This study aims to assess the nutritional values of Iraqi Beta vulgaris roots, prepared with different traditional methods. A juice of beta vulgaris roots is considered a good and vital dietary source of Fe, NO_3^-, Mg, K, vitamin C, and folic acid. We show for the first time the difference in amounts of some metal ions, vitamins, and nutritional values in the prepared beta vulgaris roots depending on its cooking method in Iraqi cuisine using atomic absorption spectroscopy, high-performance liquid chromatography, and ion selective electrode to determine the nitrate ions. The way of preparation of beta vulgaris juice influences the concentration of these six major elements. Four different ways of preparing beta vulgaris roots were carried out and subjected to elemental analysis. In general, it is found that K has a high value of concentration, while folic acid was found in low concentrations. A juice sample prepared with cooled deionized water has higher values of concentration of Fe than other procedures, while the salted samples prepared with NaCl were rich in NO_3^-. Also, elemental analysis of these samples showed that the acidified samples with acetic acid have higher values of concentration of Mg, K, vitamin C, and folic acid than other juice samples. Thus, it can be concluded that the concentrations of elements in the juice samples of Beta vulgaris roots are influenced by polarity and temperature.

Keywords: beta vulgaris roots, comparative evaluation, ion selective electrode, high-performance liquid chromatography.

伊拉克菜中不同食物傳統方法製備的甜菜根的營養價值比較評價

摘要：本研究旨在評估用不同傳統方法製備的伊拉克甜菜根的營養價值。β寻常的根汁被認為是鐵、不 3-、鎂、鉀、維生素 C 和葉酸的良好且重要的膳食來源。我們首次使用原子吸收光譜法、高效液相色譜法和離子選擇電極展示了根據伊拉克菜烹飪方法製備的普通白菜根中一些金屬離子、維生素和營養價值的差異，以確定硝酸根離子。甜菜汁的製備方式會影響這六種主要元素的濃度。進行了四種不同的製備普通甜菜根的方法並進行了元素分析。一般來說，K 的濃度值較高，而葉酸的濃度值較低。用冷卻的去離子水製備的果汁樣品比其他方法具有更高的铁濃度值，而用氯化钠製備的鹽漬樣品富含不 3-。此外，這些樣品的元素分析表明，與其他果汁樣品相比，用乙酸酸化的樣品具有更高的镁、K、維生素 C 和葉酸濃度值。因此，可以得出結論，甜菜根汁樣品中元素的濃度受極性和溫度的影響。

关键词：甜菜根，比較評價，離子選擇電極，高效液相色譜。

1. Introduction

In human generations, there is a close link between nutrition and health. Beliefs in the great benefits that food has provided over simply supplying energy and the medicinal properties have been described in many early writings [1].

Beta vulgaris vegetable (BVR) (also known as red beet, table beet, garden beet, or just beet) of the

Received: October 23, 2021 / Reviewed: November 22, 2021 / Accepted: December 24, 2021 / Published: January 28, 2022

About the authors: Wathiq A. Al-Hachami, Ali R. Albakaa, Nehad K. Abed, Ahmed M. Ahmed, Nouran A. Abdulredha, Alliya M. Hameed, Department of Pharmaceutical Chemistry, College of Pharmacy, Mustansiriyah University, Baghdad, Iraq

Corresponding author Wathiq A. Al-Hachami, wathiq_al_hachami@uomustansiriyah.edu.iq

Chenopodiaceae family is widely consumed in traditional cooking [2]. These vegetables represent a highly renewable and cheap source of nutrients, and they can be cultivated in soils with scarce organic material and little light and water [3].

Beta vulgaris (Red beetroot), which is considered to be a naturally occurring root vegetable and a rich source of bioactive compounds and phytochemicals, is well-known for its health-promotional properties in the improvement of several clinical and pathologic outcomes such as treatment for various metabolic disorders, including hypertension, diabetes, insulin resistance and kidney dysfunction [4].

BVR is a great source of many essential vitamins, minerals, and fibers. Folate (vitamin B9) is important for normal tissue growth and cell function, it is particularly necessary for women during pregnancy, and vitamin C is important for immune function and skin health. On the other hand, essential trace elements like selenium, zinc, and magnesium are found in small amounts in whole beetroots, while potassium can be found in high amounts. A high dietary system with potassium can reduce blood pressure levels and any positive effects on the heart. Furthermore, iron amounts, which have many important functions, can be found in red blood cells to transport oxygen. Enriching BVR may be a suitable vehicle to increase intakes of cardio-protective positive effects on heart health. BVR in the diet may provide new therapeutic perspectives in managing hypertension [5].

BVR mainly consists of water (87%), carbs (8%), and fiber (2–3%). Raw or cooked beetroot offers about 8 to 10% carb, while simple sugars such as glucose and fructose make up 70% and 80% of the carbohydrate in raw and cooked beetroots, respectively [6].

Also, it can be considered as a source of fructans (short-chain carbs), which is classified as "fermentable oligo-, di-, monosaccharides and polyols" FODMAPs. Some people cannot digest FODMAPs, causing unpleasant digestive symptoms [7]. Beetroots are high in fiber, which provides about (2–3 g) in each (3/4 cup) (100g) raw serving. Dietary fiber is important as part of a healthy diet and linked to a reduced risk of various diseases [8].

According to Food data central, each 100g of beta vulgaris contains: Energy (43cal), carbohydrate (9.56 g), protein (1.61 g), total fat (0.17 g), cholesterol (0), dietary fiber (2.80 g), folates (109 µg), niacin (0.334g), pantothenic acid (0.155 g), pyridoxine (0.067 mg), riboflavin (0.057mg), thiamin (0.031 mg), vitamin A (33 I.U.), vitamin C (4.9 mg), calcium (16 mg), copper (0.057 mg), iron (0.80 mg), magnesium (23 mg), Zinc (0.35 mg), phosphorus (17 mg), potassium (144 mg), sodium (198 mg), and selenium (0.5µg) [8-9].

BVR and beetroot juice are exceptionally high in nitrates and turn into nitric oxide in the human body, which improves running performance in healthy adults. Since whole vegetables have been shown to have health benefits, it would be wise for individuals seeking performance benefits to getting the nitrates from whole vegetables, such as beetroots or beetroot juice [10], and has many nutrition benefits come particularly from fiber, vitamins, minerals, and unique beets root-derived antioxidants [9].

From the above, BVR has many nutritional values as they are a good source of minerals, vitamins, folates, and nitrates that are important and necessary for a healthy human life, and changes in their concentrations depend on the cooking method.

Detection of minerals in food and herbs has been considered by many researchers using different kinds of spectrophotometric techniques [11-15]. Therefore, BVR quantitative estimation to distinguish between traditional methods of preparation in Iraqi cuisine is considered. For this reason, this research aims to determine the concentration of metal ions (K, Mg, and Fe), vitamin C, folate, and nitrate in the prepared BVR according to its cooking method in Iraqi cuisine.

2. Materials and Methods

2.1. Apparatus and Experimental Conditions

Atomic-absorption spectrophotometry (AAS) measurements were performed with a Phoenix-986 AA (UK) spectrophotometer equipped with a hydride generator graphite furnace for flameless analysis. Trace amounts of Fe, Mg, and K ion contents were determined at operative conditions where Fe, Mg, and K were at 248.3, 285.2, and 766.5 nm, respectively. An Ohaus adventurer Pro AV264 analytical balance (Switzerland) weighed the collected samples. Ion-selective or membrane electrodes techniques are membranes that produce an electrical potential by converting the activity of dissolved ions in a solution. It was used for quantitative analysis of nitrate ions in each sample solution.

High-performance liquid chromatography (HPLC) Shimadzu DGU-20As (LC-20AD, SPO-20A) was done by the directorate of material research labs for quantitative analysis of (folic acid and vitamin C) in each sample solution.

2.2. Samples Collection

Fresh BVR were collected from local Markets (Iraq). A total of samples of BVR (20 completely and healthy) were collected. The samples were washed several times with water then deionized water.

2.3. Preparation of Stock Solutions

Stock solutions of Fe, Mg, and K were prepared by diluting a volume of 1000 mg/L standard solution of the abovementioned ions with deionized water to

obtain 1-10 mg/L of Fe and 10-100 mg/L of Mg and K. The injected volumes of standard solutions were adjusted gradually by using an autosampler to generate clear standard curves.

For calibration curve of folic acid and vitamin C in HPLC, standard stock solution 1000ppm was prepared by dissolving 100 mg of folic acid in 1.0 mL of 10% ammonium hydroxide for every 100 mL of stock solution, and standard stock solution of 500 ppm was prepared by dissolving 50 mg of vitamin C in mobile phase [16].

2.4. Preparation of Sample Solutions

Four solutions were prepared in each beaker, (25 g) of Iraqi BVR cylindrical shape were cut and weighted, as follow:

– In a first beaker, the beets were put and filled with (200mL) deionized water, then put at cooling (under 20℃) for two weeks.

– A second beaker solution is made by boiling beets in (200mL) of deionized water for (15) minutes, then put at cooling (under 20 ℃) for two weeks.

– A third beaker solution is made by adding (10 g) of coarse crystals of sodium chloride (NaCl) with beets and filled with deionized water to (200 mL) mixed using a stirrer, then put at cooling (under 20℃) for two weeks.

– A fourth beaker solution is made by adding (200mL) of acetic acid (W=5%) with beets, then put at cooling (under 20℃) for two weeks. These four samples are filtered, then completed the extracted solution to 200mL with deionized water in a volumetric flask.

3. Results

The concentration of the selected metals in Beta vulgaris beets extracted solution (juice) is estimated according to the abovementioned procedures 1, 2, 3, and 4 and shown in Table.1.

Also, quantification of nitrate using ion-selective electrodes technique in each sample (except in acetic acid sample (Fourth) which has high acid concentration) can be measured, and HPLC technique is used to quantify vitamin C and folic acid in each mixture of four samples as presented in Table 2.

Table 1 Concentrations of Fe, Mg, K, vitamin C & folate (mg/200mL) in Beta vulgaris beets juice samples

No.	Procedure	Fe (mg)	Mg (mg)	K (mg)	NO_3^- (mg)	Vit.C (mg)	Folate (mg)
1	First	0.75	12.4	32	17.4	0.698	0.194
2	Second	0.25	48	528	142.6	1.17	0.2624
3	Third	0.50	32	172	616.2	4.124	0.8098
4	Fourth	0.45	54	552	--------	2.668	5.736

Table 2 Concentrations of Fe, Mg, K, vitamin C & folic acid (ppm) in 200 mL in Beta vulgaris beets juice samples

No.	Procedure	Mass of beta vulgaris beets (gm) **	Fe (ppm)	Mg (ppm)	K (ppm)	NO_3^- (ppm)	Vitamin C (ppm)	Folate (ppm)
1	First	25.0012	3.75	62	160	87	3.49	0.97
2	Second	24.9988	1.25	240	2640	713	5.86	1.312
3	Third	25.0024	2.50	160	860	3081	20.62	4.049
4	Fourth	25.0008	2.25	270	2760	-----	13.34	28.68

* Concentration mean of metals for six extracted sample solutions

** Six sample solutions average the mass of beta vulgaris beets (gm)

4. Discussion

Iron, magnesium, and potassium were successfully determined by the flameless atomic absorption spectrophotometry technique. Quantification of nitrate in each sample using ion-selective electrodes technique was performed, except in acetic acid samples (Fourth), which cannot be measured due to high acid concentration, and HPLC was used for determination of vitamin C and folate. The obtained concentrations of the elements in juice samples from the fourth procedure were relatively higher than in other procedures with a significant difference in potassium and nitrate concentrations in all the prepared samples from 32 mg in first to 552 mg in fourth of K and from 17.4 mg in first to (616.2 mg) in third, as shown in Fig. 1 and 2.

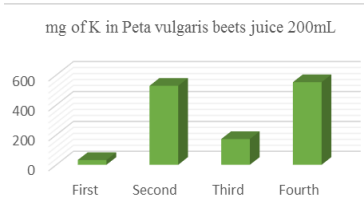

Fig. 1 Amounts of potassium (mg) in Beta vulgaris juice (200 mL)

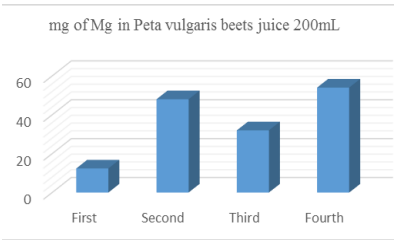

Fig. 2 Amounts of magnesium (mg) in Beta vulgaris juice (200 mL)

Furthermore, variation in magnesium concentration was noticed in all of the procedures starting from (12 mg) in the first procedure ending with (54 mg) in the fourth one, as shown in Fig. 3.

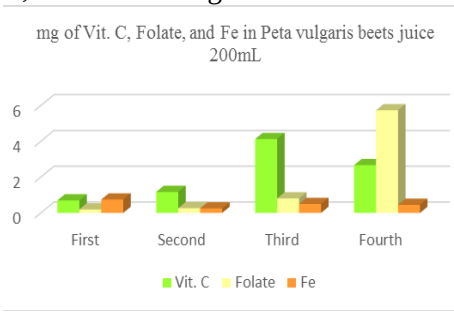

Fig. 3 Amounts (mg) of vitamin C, folate, and Fe in Beta vulgaris juice (200 mL)

Vitamin C and folate vary in their contents from procedure to other. It was found that the prepared sample with NaCl gives the highest concentration of vitamin C, and a folate concentration was detected at the high level when the sample was treated with acetic acid while the amount of Fe remains almost fixed (0.25-0.75 mg). The study results referred to the importance of each preparation method as the concentrations of nutritional components differed between four sample juices depending on the preparation method. Hence advice can be given about which cooking or eating method is more beneficial than others for each condition. For patients with iron deficiency anemia, macerating the BVR with deionized or distilled water only overnight is sufficient to obtain a good amount of iron.

Also, a high amount of folic acid in acetic acid solution was obtained. It is so important for pregnant women to grow the spinal cord and the brain of the fetus and prevent neural tube defects; furthermore, those with folate deficiency anemia get high benefits by eating it.

Vitamin C and its antioxidant activity were obtained in higher amounts with salt and water solution. As it is known that nitrate is very important for patients with high blood pressure and angina as it is converted in the body to nitric oxide, which is a vasodilator, and nitrate has an anti-microbial activity which helps against infections, a higher amount of nitrate was found in salt and water solution and relatively close to the other samples as well. Magnesium is a cofactor in more than 300 enzyme systems that regulate diverse biochemical reactions in the body, including protein synthesis, muscle and nerve function, blood glucose control, and blood pressure regulation, trace amount is only needed for the human body, and it is found in acetic acid solution.

The last one is that potassium helps to reduce high blood pressure, stroke, anxiety, and stress and enhance muscle strength and water balance in the body. K was detected in close quantities in acetic acid and hot water solutions.

As a result, the conclusions of this comparative study of nutritional values in BVR regarding the four popular methods of taking this plant is that the most appropriate method used for the dietary supplement which is taken from BVR would be the acetic acid method, as with this method we have many advantages. It has a very good amount of each component studied; it is stable, not easily contaminated, and can last for several weeks at room temperature, acceptable to the people depending on using the food.

5. Conclusion

Four kinds of BVR juice are consumed in Iraq and some neighboring countries. Due to its high nutritional and medicinal value, it is known as a health booster, disease prevention, and treatment for some of them. Therefore, it is used as a functional food source against many diseases such as diabetes, cancer, cardiovascular disease, and other chronic diseases.

BVR juice is one of the richest plant foods products, as it contains many essential ingredients, including vitamins, minerals, phenols, carotenoids, nitrates, ascorbic acid, folate, and betanin. The effect of these phytochemicals depends on the biological accessibility of these nutrients during gastrointestinal digestion.

BVR juice shows high stability and antioxidant activity. Therefore, it can be a potential material for developing functional and innovative foods. BVR juice can have synergy with other food products and increase its nutritional value when used in this way. BVR juice can be used by itself or as a preservative to replace nitrates in food products.

By comparing the results of chemical analysis between the different types of beta vulgaris juice prepared in the Iraqi kitchen, we recommend the use of juice prepared using acetic acid 5% solution (the fourth method). It is necessary for a healthy human life, stable, not easily contaminated, and can last for several weeks at room temperature (antibacterial, anticancer, antioxidant, and source of potassium, magnesium, iron, nitrate, folate, and vitamin C). It is acceptable to people depending on its consumption with food in the form of natural juice.

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