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A comparative study on the effect of soaking and heat treatment on cooking period Faba bean

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Abstract

Anabasis articulata is commonly found in the Iraqi desert, belonging to the Amaranthaceae (formerly Chenopodiaceae) family. Chemical composition was determined, showing that the percentage of moisture, ash, protein, fat, and carbohydrate content in the plant on a dry weight basis was 9.8, 20.23, 10.08, 7.15, and 52.74%, respectively. The concentrations of mineral elements represented by phosphorus, potassium, sodium, and calcium were 0.26, 1.7, 11.20, and 3.82 ppm, respectively. The analysis of the Anabasis aqueous extract showed that it contained active compounds represented by carbohydrates, saponins, tannins, flavonoids, alkaloids, phenols, and glycosides, all of which gave a positive examination. It was used to cook faba bean using different treatments: A: without soaking; B: soaking in distilled water; C: soaking in anabasis solution (4 g) and sodium bicarbonate; D: 1 g and E: 2 g; F: 3 g and G: 4 g, respectively. Treatments C and D were approximately in cooking time. while the lowest and highest the cooking time at G and B treatment. Testing different concentrations of Anabasis aqueous extract showed that it has antimicrobial properties, with the most effective concentration of 0.5%% against *Bacillus subtilis, Escherichia coli,* and *Staphylococcus aureus*, with diameters of 2.5, 2, and 2 mm, respectively.

Keyword: *Anabasis articulata*, Faba bean, Soaking , heat treatment.

Introduction

The genus Anabasis is a member of the family Amaranthaceae (former name: Chenopodiaceae) and includes approximately 102 genera and 1400 species. The genus Anabasis is one of the most significant families in salt marshes, semi deserts, and other harsh environments. [1, 2].

Anabasis articulata is frequently encountered in the desert of Iraq. It is a desert plant found in Iraq. It is commonly utilized in traditional medicine to help control high blood sugar, reduce fevers, treat skin inflammation, and combat certain kidney infections.

Anabasis is a multi-branch perennial tree in the Chenopodiaceae family. Its succulent needle-like leaves are silvery green, and its smooth white branches are white. Numerous species lack leaves [3]. Their seeds can sprout in a broad range of temperature variations. It may also sprout and survive in very salty concentrations [4]. *Anabasis articulata* has flavones, alkaloids, tannins, saponins, and resins [5]. The fruits of Anabasis include a class of compounds called alkaloids. Its concentration is 2-3%, of which the most significant are the volatile, very poisonous alkaloid anabasine and other crystalline alkaloids like lupine, aphylline, and aphyllidine [6, 7]. Several research studies have proven that plants possess antioxidant properties due to their phenolic compounds [8]. The diverse pharmacological effects of compounds like anti-inflammatory, anti-allergic, antimicrobial, antiviral, anti-cancer, cardioprotective, and vasodilatory contribute significantly to human health [9,10]. Anabasis can be found in Iran, Turkey, Syria, Jordan, Palestine, and Kuwait [6]. It is widely distributed throughout Iraq, including the Abu Dibs Marsh, Ain Tamr, the Al-Akhdir Fort area in Karbala, the Al-Nukhaib desert in Samawah, Al-Zubair, and Umm Qasr in Basra [11]. It has long been used as fodder because salty plants have a relatively good nutritional value when combined with other pasture plants [3].

Commercial antimicrobial medications that are frequently used to treat infectious diseases have been used indiscriminately in recent years, leading to the development of diverse resistances in human pathogenic microorganisms. Due to this circumstance and the unfavorable side

effects of some antibiotics and the rise in formerly rare illnesses [12], Scientists are now searching for novel antimicrobial compounds from a variety of sources, including medicinal plants like Anabasis. When we view extracted A. articulata as a beneficial option for reducing oxidative stress and health issues linked to diabetes, we also see its potential as an antimicrobial agent, effectively halting the growth of specific bacterial strains. The extracts significantly inhibited the α-amylase and α-glycosidase enzymes, indicating that this plant could be a source of effective antidiuretic medications [13]. Faba bean (*Vicia faba* L.) is a significant legume crop in Egypt and numerous other regions worldwide. It is commonly utilized in the Mediterranean area as a protein source in human diets. Nevertheless, it is necessary to enhance its nutritional aspects to make it more appealing to other nations. One method for getting rid of soluble nutritional components could be soaking, as they can be removed along with the soaking solution. During soaking, certain metabolic reactions occur simultaneously, impacting the level of soluble carbohydrates present. Furthermore, soaking aids in softening the seed coat and reduces the cooking time needed [14].

The faba bean, also known as horse or field bean, is a cool seasonal crop in the Fabaceae family, commonly grown for food and animal feed [15]. It has 20–35% protein, 1-2% fat, 55–65% carbohydrate, and 10-15% fiber, plus vitamins and minerals like iron, zinc, calcium, potassium, and magnesium [16-18]. It has been proposed that the inclusion of phytochemicals in faba bean components offers various health advantages, including antioxidant effects and the prevention of enzyme activity in carbohydrate breakdown [19,20]. Given the widespread use and easy availability of Anabasis, the study aimed to determine the chemical composition, mineral elements, and bioactive compounds of Anabasis and the effect of soaking in Anabasis solution, water and bicarbonate on the cooking time of local beans.

Figure 1. ***Anabasis articulata***

Materials and Methods

Materials

The herb Anabasis and Faba bean seeds were purchased at the Basrah local market. Anabasis was grinding by using an electric grinder made in France called Moulinex and kept in a bottle at room temperature until the study was conducted. The reagents that were utilized were the Wagner-Meyer reagent, 5N KOH and H2SO4, Mulch's, Marcus's, aqueous mercuric chloride 5%, aqueous lead acetate 1%, alcoholic potassium hydroxide 5N, ferric chloride 1%, and ninhydrin nitric acid.

Analysis methods

1-Estimation of the chemical composition

Determination of the Anabasis plant's chemical composition: the amount of fat was estimated using the Soxhlet device [21], the moisture, protein, and ash content was estimated chemically [22], and the proportion of carbohydrates was determined by calculating the difference between the aforementioned components, as indicated in [23].

2-Estimation of mineral elements

Mineral element estimation After adding 5 milliliters of concentrated sulfuric acid to the sample and letting it sit for 24 hours, the Anabasis plant was heated to 400°C for two hours while the acid mixture (H_2SO_4 + $HClO_4$) was present. Once a clear solution was reached, the phosphorus content was determined using a spectrophotometer, as per the instructions in [24]. An atomic absorption device was utilized to estimate calcium and magnesium, while a flame photometer was employed to measure sodium and potassium [25].

3-**Preparing the Anabasis aqueous extract**

The Anabasis aqueous extract was produced following method [26] by soaking 20 grams of ground plant powder in 100 ml of water for 24 hours at room temperature, removing suspended matter by centrifugation, concentrating the extract with a rotary evaporator, drying it, and using it for further experiments.

4-Qualitative analyses of the Anabasis aqueous extract

Preliminary tests were conducted on the aqueous extract of Anabasis to determine the active chemical components in this extract.

4-1- Carbohydrates test

The carbohydrate test was conducted as found [27].

4-2-Saponins test

The saponins test was conducted according to the following method [28].

4-3- Tannins test

The Tannins test was conducted using two methods, which are

A. Lead acetate test method 1% according to the followed method [29].

B: Ferric chloride test method 1% as found in [30].

4-4- Flavonoids test

The flavonoids test was conducted using an alcoholic potassium hydroxide (5N) reagent according to the following method [31].

4-5- Alkaloids test

The alkaloids test was conducted using Marcus reagent as stated in the method [32].

4-6-Glycosides test

Glycosides were detected using Benedict reagent according to method [33].

5- Antibacterial Activity:

Bacterial strains *Escherichia coli, Staphylococcus aureus,* and *Bacillus subtilis* were collected from the Department of Food Science, College of Agriculture, University of Basrah.

Conduct a study on the stimulating effect of the Anabasis by testing different concentrations (0.1, 0.2, and 0.5%) using the co-etching method detailed in [34] research. Use the classic McFarland solutions with a turbidity level of 0.5 and a cell integrity of 1.5×10^8 cells. I utilized a spectrophotometer device. The reference is timed at 600 hues [35]. The antibacterial activity level was evaluated. Making a hole with a diameter of 6 mm on the surface of the Mueller-Hinton medium. Adding a 50µ l to every concentration. Distilled water was utilized in the treatment. The dishes were placed in an incubator at a temperature of 37 °C for a period of 24 hours. The diaphoresis diameter measurement was recorded in millimeters.

6- Faba bean treatment

Soaking 250 g of Faba beans in variety treatments, including: A: without soaking; B: soaking in distilled water; C: 4 g of anabasis solution and sodium bicarbonate D: 1 g and E: 2 g; F: 3 g and G: 4 g, respectively. The soaking solutions were made with 2 liters, and the soaking period

was 8 hours for each treatment. Following that, the cooking process was carried out, and when it achieved maturity (tenderness), the cooking period was calculated.

7-Statistical analysis:

Analyze the results statistically using a complete randomized design (CRD) with the Genesta program (2011) and test the factors with the least significant difference at the 0.05 level.

8- Results and discussion

8-1 Chemical content of *Anabasis articulata*

The chemical content of *Anabasis articulata* shown in Table (1), which was represented by moisture, protein, fat, ash, and carbohydrates on a dry weight basis. The protein percentage reached 10.08%, which is higher than what was mentioned [33]. The fat percentage reached 7.15%, which is higher than what was found by [3]. The ash content of the leaves reached 20.23. Ash is an indication of the plant containing mineral elements, as the higher the ash percentage, the higher the percentage of mineral elements, such as sodium and potassium salts, which are basic salts that play a role in the cooking process.

Table 1. The Chemical Content of *Anabasis articulata*

Contents%				
Moisture	Protein	Fat	Ash	Carbohydrates
9.8	10.08	7.15	20.23	52.74

8-2 Mineral elements:

Table 2. shows the concentrations of some mineral elements in the Anabasis plan, represented by phosphorus, potassium, sodium, and calcium, as the concentrations of calcium and phosphorus were 3.82 and 0.26 ppm respectively, which is higher than the concentration of calcium and phosphorus in the Iranian Anabasis plant, which was 1.23 and 0.20 ppm [36], as calcium enters into the composition of plant cell walls in the form of calcium pectate, which provides mechanical support for them. As for the phosphorus element, it is found in very low concentrations in the soil solution, while the concentrations of potassium and sodium reached 1.7 and 11.20 ppm respectively. It is noted that these alkaline elements play an important role in the soaking process, which is less than the percentage of potassium and sodium in the Iranian Anabasis [36].

Table 2. *Anabasis articulata* content of mineral elements

Mineral	Concentration (ppm)
P	**0.26**
K	**1.7**
Na	**11.20**
Ca	**3.82**

Qualitative analysis of the Anabasis aqueous extract:

8-3 Qualitative detection

Table 3. shows the results of the qualitative detection of the active ingredients of the Anabasis aqueous extract, where it was noted that it contained flavonoids, which are phenolic substances similar to tannins, but they are simpler in structure and more widespread. The presence of saponins was noted because they dissolve in water and give soap foam. The Anabasis aqueous

extract contained tannins, which are phenolic compounds dissolved in water and are characterized by their ability to precipitate alkaloids, gelatin, and protein. The presence of glycosides, carbohydrates, alkaloids, and phenols was noted, all of which gave a positive detection.

Table 3. The qualitative detection of the bioactive compounds in the Anabasis aqueous extract

Reagents	Anabasis Aqueous extract	Effective groups
Mulch's reagent	+	**Indication of the presence of carbohydrates**
5%mercuric chloride	+	**Indication of the presence of saponins**
1% lead acetate reagent and 1% ferric chloride reagent	+	**Indication of the presence of tannins**

5N (KOH) and concentrated H_2SO_4 reagent	+	**Indication of the presence of flavonoids**
Wackner-Meyer reagent and Marcus reagent	+	**Indication of the presence of alkaloids**
ferric chloride solution1%	+	**Indication of the presence of phenols**
Benedict's reagent	+	**Indication of the presence of glycosides**

The sign (+) indicates the presence of the bioactive compound

8-4 The antimicrobial activities of *Anabasis articulata*

The Table 4. displays the Anabasis 's ability to stimulate activity against three different bacteria strains. The Anabasis Aqueous extract had varying stimulating effects depending on the bacteria type, with a significant difference ($p \leq 0.05$) observed and the largest halo diameters of 2.5, 2, and 2 mm observed with concentrations of 0.5% for *Bacillus subtilis*, *Escherichia coli*, and *Staphylococcus aureus*, respectively, in pigeons. A concentration of 0.2% resulted in a minimum areola diameter of 0.5 mm. Found [37] that an aqueous Moringa leaf extract strongly inhibited *B. cereus* and weakly inhibited *S. aureus* and *E coli*.

Table 4. Antibacterial activity of the Anabasis at different concentrations

inhibitory zone (mm) microorganisms*	**Concentration%**

Staphylococcus aureus	*Escherichia coli*	*Bacillus subtilis*	
0.5	1	1.5	0.2
1	1.5	2	0.3
2	2	2.5	0.5
-	-	-	0

* Values are the mean of tree replicates
(-) Indicates there is no inhibition

8-5 Treatment of faba bean sample

Table 5. shows the results of the cooking time of faba beans, as significant differences appeared ($p \leq 0.05$) between the treatments, with treatment A having the longest cooking time at seven hours, followed by treatment B, which had a cooking time of 5 hours, and treatment G having the shortest time at two hours. Treatment C and D were close in cooking time, as did treatment samples E and F, and this difference in cooking time is related to the soaking method, confirming the importance of soaking prior to cooking, as it speeds up the cooking process and reduces the time required for that, as this herb contains active substances that speed up the cooking process and reduce the time [38]. Because of their tough seed coat, beans need to be cooked for a longer period of time, causing an increase in cooking expenses and a decrease in their nutritional value [39]. Sodium bicarbonate primarily changes the pH of the soaking liquid and cooking water, leading to a softer outer shell, shorter cooking times, and potential changes in nutrients, flavor, and texture of cooked beans [40,41]. The amount of time spent cooking beans is crucial for calculating the energy used and assessing their overall cooking quality. Extended cooking periods diminish the nutritional content of legumes when compared to brief preparation [42].

Table 5. Cooking time for soaked fava beans with different treatments for 8 hours

Sample	Treatment	Cooking time/ hour
A	without soaking,	**7**
B	soaking in distilled water	**5**
C	anabasis solution 4g	**4**
D	sodium bicarbonate 1g	**3:30**
E	sodium bicarbonate 2g	**3**
F	sodium bicarbonate 3g	**2:30**
G	sodium bicarbonate 4g	**2**

Conclusions:

When cooking faba beans without soaking, it takes longer to cook, and when adding anabasis, the cooking time is reduced because it contains bioactive compounds that help the faba beans tenderness Adding sodium bicarbonate (soda) reduces the cooking time to almost the same as anabasis.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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