

Determination of Metal Content and Biological Activities of Radish Plant Consumed as Turnip by Public in Siirt Region

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Abstract - This study was carried out on turnip (avtutu) obtained from a radish ecotype grown in Eruh region of Siirt. Antioxidant capacities, total phenolic and flavonoid amounts of DPPH (free radical scavenging), Ferric ion reducing antioxidant power (FRAP) analyses were performed in extracts obtained from radish with different solvents. In addition, the metal content of the samples and the elemental analysis of the soil samples taken in the area where they were collected were made. In this study, the content of total phenolic, total flavonoid, DPPH highest % inhibition values and the highest values of the ferric ion reducing antioxidant power (FRAP) were 71.97 ± 14.54 mg / mL Gallic acid equivalents, 298.17 ± 12.81 mg / mL routine equivalent, 66.88% and 3.29 ± 0.01 mg / mL FeSO₄ equivalents were detected in the above-ground fractions methanol extract, respectively. Samples of the turnip beverage traditionally produced by the people from the Eruh region of Siirt were randomly obtained from eleven families. Some physicochemical tests such as pH, water activity, Oxidation-Reduction (O / R; Eh) Potential Value, colour analysis, dry matter content and % salt ratio and microbiological tests such as TMAB, yeast, mould, Staphylococcus species, Lactobacillus spp., coliform group bacteria and E. coli were applied to these avtutu samples.

Keywords: Antioxidant, radish, microbiological quality, DPPH, FRAP, Siirt

Siirt Yöresinde Halk Tarafından Şalgam Olarak Tüketilen Turp Bitkisinin Metal İçeriği Ve Biyolojik Aktivitelerinin Belirlenmesi

Öz - Bu çalışma, Siirt'in Eruh bölgesinde yetiştirilen bir turp ekotipinden elde edilen şalgam (avtutu) üzerine yapılmıştır. Turptan farklı çözümler ile elde edilen ekstraktlarda antioksidan kapasiteleri, toplam fenolik ve flavonoid miktarları DPPH (serbest radikal süpürme), Ferrik iyon indirgeyici antioksidan gücü (FRAP) analizleri yapılmıştır. Ayrıca örneklerin metal içeriği ve toplandığı alanda alınan toprak numunelerinin element analizi yapılmıştır. Çalışma sonucunda toplam fenolik madde miktarı en yüksek değer $71,97 \pm 14,54$ mg/mL Gallik asit eşdeğeri ile toprak üstü kısımların metanol ekstraktında tespit edilmiştir. Toplam flavonoid en yüksek değer $298,17 \pm 128,13$ mg/mL rutin eşdeğeri ile toprak üstü kısımlarına ait metanol ekstraktında tespit edilmiştir. DPPH en yüksek % inhibisyon değeri %66,88 ile turp örneklerinin torak üstü kısmında metanol ekstraktında tespit edilmiştir. Ferrik iyon indirgeyici antioksidan gücü (FRAP) en yüksek değer $3,29 \pm 0,01$ mg/mL FeSO₄ eşdeğeri olarak toprak üstü kısımlara ait metanol ekstraktında tespit edilmiştir. Element içeriği Kalsiyum, Potasyum ve Sodyum gibi besin açısından önemli olan elementler açısından zengin bulunmuştur. Toprak Analizi bakımından bakıldığında organik madde oranı iyi, alınabilir fosfor çok fazla ve alınabilir potasyum iyi olarak tespit edilmiştir.

Anahtar kelimeler: Antioksidant, turp, DPPH, FRAP, Siirt



1. Introduction

Radish (*Raphanus sativus* L.) belongs to the Brassicaceae (Cruciferae) family and has a wide variation, spreading area and production especially in China, Japan, Korea and South Asia, and it is a rich nutrient-rich vegetable that has an important place in meeting the fresh vegetable needs of people. Many plants, both naturally grown and cultivated in Turkey, are used by the public against many diseases due to their functional structure.

Most of the radish production in our country is carried out in Kadirli district of Osmaniye province. The most grown types are black (bayır), red, white, Chinese and Japanese radish. The public against many diseases due to their functional structure uses many plants, both naturally grown and cultivated in Turkey. One of the plants that be considered as a functional food is radish.

It is known that the production of fermented foods is as old as human history and they are generally produced traditionally [1]. Fermented foods are among the most consumed products in daily life. It is known that fermented foods such as yoghurt, cheese and pickles are longer lasting and more beneficial than the raw materials used [2].

In addition to the prolongation of the storage period of the obtained products, new products can be obtained and various vitamins and organic acids can also be obtained [3].

Microorganisms involved in fermentation include lactic acid bacteria, propionic acid bacteria, some alcohol-producing yeasts and moulds. Acetic acid bacteria are encountered in products produced under aerobic conditions [2].

Considering the activities of microorganisms involved in fermentation, fermentation microbiology is becoming increasingly important today. Microorganisms that show some functional properties that play a role in fermentation also have important positive effects on health [4],[6]. Although pickle, wine, vinegar and olives are the leading vegetable-origin fermented products, there are also various herbal fermented products known as soy sauce, tempeh, miso, ogi and gari in different regions of the world.

Avtitu is one of the products used in our city as a vegetable origin. For the fermentation of avtitu, the tuber of the plant, sourdough and salt are used as additives. It is obtained by the traditional method, depending on the amount of yeast used in fermentation at about 25 ° C, by maturing from a few days to a few weeks. The production technique of this avtitu is similar to that of turnip production. Bulgur flour (setik), water, black carrot, salt, sourdough and turnip radish are used in turnip production. In the first stage of turnip making; by adding bulgur flour, sourdough and salt, kneading is done with water and left to fermentation at 25 ° C for 3-5 days. Towards the end of the fermentation period, the mixture swells up and cracks begin to form on it. When this formation is observed, fermentation is ended, 4 times more water is added to the dough and mixed for 5-10 minutes. When the insoluble sediment sets to the bottom, filtering is done. In the second stage of turnip production; in the fermented liquid, salt, as well as previously sliced carrot and turnip radish are added. The mixture is left to ferment again at 25 ° C for about 7 days. After fermentation, turnips are kept in a cold place and consumed [7].

It is believed that the tubers of the plant known as avtitu in the province of Siirt have positive effects in terms of health by fermentation and thus it is consumed with love. This study was conducted to determine the microbiological and some physicochemical properties of avtitu drink, which is frequently consumed in Siirt province, and to determine whether its consumption would pose a public health hazard. In this way, it is aimed for the first time in the region that this study will be a reference for future studies and to raise awareness of producers and consumers about food safety practices that may put public health at risk. It is aimed to encourage the production of this product in more hygienic and modern conditions and to obtain products with high economic added value.

2. Materials and Methods

2.1. Chemicals and Instruments

The element analysis of the Radish plant samples was performed using a Perkin Elmer, Inc., Shelton, CT, USA, Model Optima TM 7000 DV ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometer). Digesting of the samples was done with a Speedwave MWS-3 Berghof brand microwave oven. Salt determination of the samples was made with a salinometer. Chemicals used in this study such as HNO₃ and H₂O₂, 2,2-diphenyl-1-picrylhydrazyl (DPPH[•]), Folin-Ciocalteu's phenol reagent, Gallic acid and ascorbic acid were provided from Sigma Chemical Co.

2.2. Preparation of Plant Specimens for Analysis

The herbal material used in this study was obtained from Siirt-Eruh center and villages in October 2020. Radish specimens were identified by Dr Mehmet Fidan.

Plant samples dried in the shade and separated into different parts were shredded with a laboratory grinder and stored in suitable containers at +4 °C until extraction steps.

The plant samples were prepared in different ways for extraction and elemental analysis. 5 g of the ground plant samples were taken and 50 mL of distilled water, ethanol (80%) and 80% methanol were added to them. The samples were physically homogenized in a laboratory grinder for 5 minutes, then mechanically in a tissue shredder (sonicator) for 5 minutes. The samples were covered with foil and after being shaken at room temperature for 12 hours, they were centrifuged at 7500 rpm. The supernatants obtained at the end of the centrifuge were collected and the solvents were evaporated with the aid of an evaporator. By calculating the weight values of the crude extracts obtained, all samples were diluted with their solvents as 10 mg / mL. Total phenolic, total flavonoid, DPPH and FRAP analyzes of the extractions obtained in the study were performed.

2.3. Determination of total phenolic compounds

1 ml of FCR (Folin-Ciocalteu) reagent was added on plant extract and incubated for 3 minutes at room temperature. Later, 1 mL of saturated Na₂CO₃ (7%) will be added and foaming and green colour formation were expected at this stage. Then, it was incubated in the dark at room temperature for 90 minutes and absorbance at 725 nm wavelength was measured [8], [9]. Total phenolic was calculated as gallic acid equivalents ($y = 0.0823x + 0.0342$ and $R^2=0.990$).

2.4. Determination total flavonoid content

Flavonoid content is based on the study done by reading the reaction of the extracts with NaNO₂ and AlCl₃ at a wavelength of 510 nm (Park ve ark. 2008). After adding 400 µL of 80% methanol to 1 mL of extract (separate for each concentration prepared), 30 µL of 5% NaNO₂ was added and kept for 6 minutes. The resulting pinkish colour absorbance was read at 510 nm wavelength. The total flavonoid content was made according to the different concentrations of Rutin (0.1-1 mg / mL) and the calculation was made according to the formula $y = 0.0081 + 0.0168$ and $R^2=0.9962$, which was constructed by the rutin standard.

2.5. DPPH radical scavenging activity

DPPH solution generates a deep purple colour with maximum absorbance at 517 nm. When a solution containing antioxidant substance or substances is added to this DPPH solution, this dark purple colour starts to lose its colour over time. Colour change is accepted as the colourimetric indicator of antioxidant substances to suppress DPPH radical. The change is expressed as a percentage (%). For each concentration prepared, 1 mL of plant extracts were placed in separate tubes and 4 ml of DPPH (0.001 M DPPH, dissolved in pure methanol) solution was added and mixed thoroughly [10]. Then it was left to incubate for 30 minutes and its absorbance was measured at 517 nm in a spectrophotometer.

$$\% \text{ Inhibition} = \frac{A_{\text{control}} - A_{\text{sample}}}{A_{\text{sample}}} \times 100$$

Where,

$A_{control}$: The initial concentration of the DPPH

A_{sample} : The absorbance of the remaining concentration of DPPH* in the extracts or positive controls [11].

2.6. Elemental analysis of samples

For the elemental analysis of the samples, 0.6-1.0 g of the samples weighed and solubilized with the help of a microwave. For this, the weighed samples were transferred to pressure-resistant polytetrafluoroethylene (PTFE) containers and after adding $\text{HNO}_3 / \text{H}_2\text{O}_2$ (10.0/2.0) acid mixture, the digesting process was carried out in the Speedwave MWS-3 Berghof brand microwave oven under the conditions specified by Uyan (2017) [13], [14]. After the necessary procedures, elemental analysis was performed with Model Optima™ 7000 DV ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometer) (Perkin Elmer, Inc., Shelton, CT, USA).

2.7. Analysis of soil

Soil samples taken from different locations were analyzed according to the method given in Table 1.

Table 1. The analysis method Soil.

Analysis method	Method	Unit
pH	Determination of pH in 1:2 Soil-Water Mixture [15]	
EC	Determination of EC in 1:5 Soil-Water Mixture	dS/m
Lime	TS EN ISO 10693 (Calcimeter Method)	%
Texture	Bouyoucos Hydrometer Method	%
Organic matter	Modified Walkley Black Age Burning Method	%
phosphorus available	TS ISO11263 [16] (Olsen ve ark., 1954) (Sodium Bicarbonate Method)	Kg/da
Potassium available	Ammonium Acetate Method	Kg/da
Calcium available	Ammonium Acetate Method	Kg/da
Magnesium available	Ammonium Acetate Method	Kg/da
Zinc	DTPA Solution Extraction Method	ppm
Manganese	DTPA Solution Extraction Method	ppm
Iron	DTPA Solution Extraction Method	ppm
Copper	DTPA Solution Extraction Method	ppm

2.8. Microbiological Analyses of Turnip Samples

In this study, avtutu samples obtained from 11 different people, approximately one liter each, from a traditionally produced radish-turnip juice (avtutu) sample in Eruh district of Siirt. Microbiological analyses were carried out to determine whether the procured avtutu samples contain potential hazards for public health.

2.9. Preparation of Dilutions

10 mL sample taken under aseptic conditions was weighed in stomacher bags in 90 mL of buffered peptone water and homogenized for 2 minutes in the stomacher device, and sterile decimal dilutions were prepared from the homogenate with sterile peptone water up to 10^{-8} [17].

To determine the yeast-mould count; PDA (Potato Dextrose Agar, Oxoid CM139) was planted with the spreading method from these dilutions instead of solid media, and then incubated at 25°C under aerobic conditions for 72-120 hours. All colonies formed on the medium as a result of incubation were counted as yeast mould [17], [18].

Similarly, using these dilutions for TMAB number, PCA (Plate Count Agar, Oxoid CM463) was inoculated on solid media by the spread plate method and the colonies formed in incubation at 30°C under aerobic conditions for 24-48 hours were counted [17], [19].

In determining the number of *Staphylococcus* spp.; Potassium tellurite (Potassium tellurite, Sigma-Aldrich, Merck) and Baird-Parker (Baird-Parker agar base, Merck) agar with microfiltration

sterilized egg yolk were added and seeded at appropriate dilutions by the smear plate method. Then, it was incubated under aerobic conditions for 18-24 hours at 35-37 °C.

In determining the number of *Staphylococcus* spp.; Potassium tellurite (Potassium tellurite, Sigma-Aldrich, Merck) and Baird-Parker (Baird-Parker agar base, Merck) agar with the addition of sterilized egg yolk sterilized by microfiltration were planted with appropriate dilutions by the spreading plate method. Afterwards, incubation was carried out at 35-37 °C for 18-24 hours under aerobic conditions. At the end of the incubation, convex colonies of 1.5-2.5 mm in diameter, black and surrounded by a transparent zone, formed on Baird-Parker agar medium, were evaluated as *Staphylococcus* species (by tests such as Gram staining, microscopic examination, fermentation of glucose under anaerobic-aerobic conditions) [20].

In the investigation of lactic acid bacteria, MRS (de Man, Rogosa and Sharpe broth, Merck) agar was inoculated with the smear plate method. In the next step, incubation was carried out at 37 °C for 24 hours under anaerobic conditions. At the end of the incubation, off-white, white and opaque colonies with a diameter of 2.5 mm growing on MRS agar were counted as *Lactobacillus* spp. [21], [22].

To determine the number of coliform bacteria, EMB agar was incubated for 24 hours at 37°C after inoculation with the smear plate method. Typical colonies formed at the end of incubation were evaluated as coliform bacteria, and metallic green colonies were evaluated as faecal coliform *E. coli*. In addition, to determine the number of *E. coli*, TBX Medium (Tryptone Bile X-Glucuronide, Oxoid, CM0945) was inoculated with the smear plate method and the Petri dishes were incubated aerobically at 44°C for 18-24 hours. At the end of incubation, turquoise-coloured colonies were evaluated as *E. coli* [17], [18].

2.10. Physicochemical analysis of turnip samples

2.10.1. Determination of water activity

In the determination of water activity, it was performed with a device branded Novasina LabTouch®-a_w, [Lachen, Switzerland] [23]. After three repeated measurements were made for each sample, their averages were taken.

2.10.2. Determination of pH, oxidation-reduction (O / R; Eh) potential value

In the determination of these analysis values, Mettler Toledo Seven Compact™ S220 [China] branded device was used with the method suggested by [24]. After three repeated measurements for each sample, their averages were taken.

2.10.3. Determination of Colour Analysis of Turnip Samples

Pen Color Art 1 L model Artoxy MSM, Istanbul, Turkey branded device was used to determine the colour analysis. L, a and b values were determined by taking the averages with 4 repeated measurements [25]–[27].

2.10.4. Determination of dry matter of Turnip Samples

For the determination of dry matter values, it was made with a Hanna® HI 96801 (Romania) digital refractometer device using the method suggested by Cemeroğlu [24].

2.11. Statistical Evaluation

SPSS-22 (Statistical Package For Social Sciences) program was used for the statistical evaluation of whether there is a difference and correlation between the samples by using Duncan test [28].

3. Results and Discussions

Vegetables and fruits contain many antioxidant compounds. These antioxidant compounds are abundant in seeds, leaves, flowers, roots, and bark [29]. Studies have reported that as a result of the consumption of large quantities of vegetables and fruits, the risk of developing diseases decreases, there is a significant decrease in cardiovascular diseases, cancer cases and mortality rates [30].

Preparing extracts from plants and using them as medicine. It dates back to 2700 BC. As in other countries of the world, many plants found by trial and error in our country, known as medicinal plants, are used in the treatment of diseases.

The first written record of the use of plants in food was found in excavations in Ancient Egypt. BC in Egypt. It is known that various herbs, especially mint, were used in the mummification of corpses in the year 2500. In mummification, corpses were treated with extracts obtained from the plants in question, and it was possible to keep them intact for centuries with other methods. In addition, plants are mentioned both as a source of healing and power in many scriptures [31]. The number of studies investigating the use of herbs and spices as natural antioxidant sources is increasing day by day [32], [33].

In our study, elemental analysis and extraction of water, 80% methanol and 80% ethanol solvents were made of different parts of the Siirt ecotype (whole tuber, tuber shell part, peeled form of tuber and above-ground green parts) of the *Raphanus sativus* species used for food in different ways by the public. Total phenolic, total flavonoid, DPPH, FRAP analyzes of these extracts were made. In addition, the analysis of the soils where the plant is grown has been made. In addition, samples of traditional fermented avtitu drink produced in Eruh district of Siirt province were taken randomly from 11 families and some physicochemical and microbiological tests were applied.

3.1. Statistical Evaluation

In the study conducted [34], it was found that in extractable fractions, according to radish types, Chinese radish is equivalent to 312.10 mg GAE / 100 Gallic acid, and Bayır radish is equivalent to 187.41 mg GAE / 100 g Gallic acid. The radish type with the lowest total phenolic content was found in hazelnut radish with 71.90 mg/ 100 g Gallic acid equivalent.

When Table 2 is examined, as a result of analysing extracts belonging to different solvents and parts of radish, the highest total phenolic substance amount was determined in the aboveground part of radish prepared with 80% methanol.

In the phenolic substance content analysis performed, it was determined that the highest phenolic substance content belonged to methanol surface extract with a value of 71.97 ± 14.54 mg / mL Gallic acid equivalent.

Table 2 Total phenolic matter analysis results.

Sample	Solvent	mg/mL Gallic acid equivalent.
Root without bark	Pure water	11.21 \pm 1.42
bark	Pure water	12.54 \pm 2.44
Root shell	Pure water	9.29 \pm 1.67
Above-ground part	Pure water	11.52 \pm 1.38
Root without bark	Methanol (80%)	7.18 \pm 1.10
bark	Methanol (80%)	10.39 \pm 0.41
Root shell	Methanol (80%)	25.35 \pm 3.34
Above-ground part	Methanol (80%)	71.97 \pm 14.54
Root without bark	Ethanol (%80)	14.84 \pm 0.79
bark	Ethanol (%80)	17.77 \pm 3.38
Root shell	Ethanol (%80)	16.91 \pm 6.51
Above-ground part	Ethanol (%80)	20.10 \pm 1.29

3.2. Total flavonoid content analysis

When Table 3 is examined, it has been determined that the total flavonoid content is similar to the phenolic substance content in the total flavonoid analysis. The total flavonoid substance amounts of extracts prepared with water and ethanol were reported as 280.58 mg / mL and 503.82 mg / mL routine equivalent, respectively [35]. In our study, the highest total flavonoid value was detected in the methanol extract of the above-ground parts of radish with 298.17 ± 128.13 mg / mL routine equivalent.

Table 3. Total flavonoid substance analysis results.

Sample	Solvent	mg/mL Routine equivalent.
Root without bark	Pure water	41.07±10.53
bark	Pure water	37.43±2.49
Root shell	Pure water	34.31±10.4
Above-ground part	Pure water	56.68±7.22
Root without bark	Methanol (80%)	25.62±4.2
bark	Methanol (80%)	44.4±11.17
Root shell	Methanol (80%)	183.37±85.66
Above-ground part	Methanol (80%)	298.17±128.13
Root without bark	Ethanol (%80)	66.09±4.21
bark	Ethanol (%80)	109.42±23.56
Root shell	Ethanol (%80)	53.61±2.48
Above-ground part	Ethanol (%80)	105.05±12.87

3.3. DPPH free radical scavenging activity

DPPH activity is a general test used to determine the antioxidant properties of plant extracts. According to the results of DPPH analysis, methanol extract belonging to the above-ground parts showed the highest value.

Teucrium polium L. subsp. DPPH% values of the extracts of polyum taxa prepared with water and ethanol were determined as 81.13±19.17-92.76±29.51, respectively [36]. Fidan et al. [35] reported that as a result of the analysis of the extracts prepared with water and ethanol of *Origanum acutidens* (Hand.-Mazz.) Ietsw. plant, water extract showed 77.53% inhibition and ethanol extract showed 90.69% inhibition. According to the results of this study, the highest % inhibition value was found in the methanol extract of the above-ground parts of the radish samples with 66.88%.

Table 4. Analysis results of DPPH %.

Sample	Solvent	DPPH %
Root without bark	Pure water	14.45
bark	Pure water	18.95
Root shell	Pure water	9.15
Above-ground part	Pure water	12.87
Root without bark	Methanol (80%)	9.91
bark	Methanol (80%)	13.58
Root shell	Methanol (80%)	38.22
Above-ground part	Methanol (80%)	66.88
Root without bark	Ethanol (%80)	14.94
bark	Ethanol (%80)	21.82
Root shell	Ethanol (%80)	9.69
Above-ground part	Ethanol (%80)	24.94

3.4. FRAP analysis

DPPH activity is a general test used to determine the antioxidant properties of plant extracts. According to the results of DPPH analysis, methanol extract belonging to the above-ground parts showed the highest value.

Table 5. The results of FRAP

Sample	Solvent	mg/mL FeSO ₄ equivalent.
Root without bark	Pure water	1.89 ±0.03
bark	Pure water	1.98 ±0.02
Root shell	Pure water	1.59 ±0.03
Above-ground part	Pure water	2.22 ±0.04
Root without bark	Methanol (80%)	1.24 ±0.03
bark	Methanol (80%)	1.88 ±0.04
Root shell	Methanol (80%)	2.95 ±0.13
Above-ground part	Methanol (80%)	3.29 ±0.01
Root without bark	Ethanol (%80)	1.58 ±0.06
bark	Ethanol (%80)	2.52 ±0.06
Root shell	Ethanol (%80)	1.17 ±0.01
Above-ground part	Ethanol (%80)	2.4 ±0.1

When the values obtained in this study are examined, it is seen that the highest value is in the methanol extracts of the above-ground parts of radish as 3.29 ± 0.01 FeSO₄ equivalent. [37], as a result of the analysis of the extracts of the radish plant, reported that there is a ferric ion-reducing antioxidant potential in the equivalent of $3.56 \mu\text{g} / \text{mL}$ Gallic acid.

3.5. Elemental analysis of different parts of the radish sample

Some of the healing properties of plants come from the trace elements found in their structures [35], [38]. Excessive amounts of micronutrients or heavy metals may cause some basic problems to occur. Therefore, the determination of the properties of the chemical ingredients of the plants and their use accordingly is an important element [35], [39].

Elemental analysis of the samples were performed with the ICP-OES device. As can be seen from Table 6 the heavy metal contents of the samples are among acceptable values. Radish is rich in nutritionally important elements such as Calcium, Potassium and Sodium.

Table 6. Elemental analysis of different parts of the radish sample by ICP-OES

Element	Sample inner part (ppm)		Sample shell part (ppm)		All sample (Shell + inner) (ppm)	
	Mean	sd	Mean	sd	Mean	sd
B	14.23	0.05	16.12	0.06	20.17	0.07
Ba	14.58	0.06	15.19	0.05	14.16	0.06
Bi	3.97	0.15	4.11	0.21	3.53	0.06
Cd	0.71	0.01	0.70	0.01	0.60	0.01
Co	1.35	0.02	1.73	0.02	1.08	0.02
Cr	0.14	0.00	1.24	0.00	0.25	0.01
Cu	3.69	0.03	5.19	0.01	3.69	0.06
Fe	20.79	0.22	288.70	4.36	77.15	0.89
Li	2.15	0.02	2.82	0.02	2.00	0.01
Mn	13.62	0.21	26.56	0.35	13.91	0.10
Ni	0.99	0.01	2.59	0.07	1.54	0.04
Pb	4.69	0.12	5.02	0.30	2.82	0.07
Sr	59.98	0.19	62.96	0.48	57.33	0.05
Zn	34.24	0.13	64.11	0.06	33.50	0.01

Element	Sample inner part (mg/g)		Sample shell part (mg/g)		All sample (Shell + inner) (mg/g)	
	Mean	sd	Mean	sd	Mean	sd
Ca	9.96	0.02	10.54	0.07	10.56	0.00
K	51.22	0.33	51.47	0.25	45.33	0.19
Mg	2.29	0.00	2.39	0.00	1.57	0.02
Na	2.83	0.01	1.66	0.02	0.28	0.01

When Table 6 is examined, it has been found that Ca, K, Mg and Na values are at the level of mg, especially the amount of Fe in the shell is above 200 ppm. It has been observed that other metals accumulate more in the shell, as in Fe. The fact that the Pb amount is slightly excessive corresponds to the region where the radish sample was taken, probably where the mineral formations were located. When Sadık (2019) compared with the elemental analysis of *Eremurus spectabilis* Bieb plant, it was seen that the element values of Fe, Na, Mg, K and Ca were mg/g, whereas, in this study, the values of Ca, K, Mg and Na were at the level of mg [40].

As can be understood from this study, Ca, K, Mg and Na values were found to be much higher. Although Zn, Co and Fe (value in the crust) values are higher than Sadık (2019) values, Cu values were found to be close to each other. When compared with the oregano element analysis found in the study of Kara (2012)[41], Ca, Cd, Co, Cr (value in the crust), Sr and Zn values were lower than this study, and Ba, Cu, Fe and Mn values were found to be higher. Mg and Ni values were found close to each other.

Calcium is an imperative mineral for the ordinary working of the human body and plays a key part within the electrophysiology of cardiac tissue [42]. K takes an interest effectively within the upkeep of cardiac cadence [43].

3.6. Soil analysis

Soil samples were taken from the localities where the samples that made up the study material were grown, using appropriate methods, and subjected to different analysis methods. The results obtained are given in Table 7. According to the results of the analysis, the soils from which the study samples were taken were determined to be neutral in pH, salt-free in terms of electrical conductivity, very calcareous in terms of lime, clay in the body, good organic matter, high amount of absorbable phosphorus and good potassium.

Table 7. The results of soil analysis.

Analysis	Method	Unit	Analysis results	Evaluation result
pH	Determination of pH in 1:2 Soil-Water Mixture [15]		6.95	Neutral
EC	Determination of EC in 1:5 Soil-Water Mixture	dS/m	0.18	Saltless
Lime	TS EN ISO 10693 (Calcimeter Method)	%	38.95	Very limy Clayey
Texture	Bouyoucos Hydrometer Method	%	Clay: 46.5 Silt: 31.6 Sand: 21.9	Clayey
Organic matter	Modified Walkley Black Age Burning Method	%	3.74	Good
phosphorus available	TS ISO11263 [16] (Olsen ve ark., 1954) (Sodium Bicarbonate Method)	Kg/da	29.75	Too much
Potassium available	Ammonium Acetate Method	Kg/da	107.99	Good
Calcium available	Ammonium Acetate Method	Kg/da	445.86	
Magnesium available	Ammonium Acetate Method	Kg/da	27.87	
Zinc	DTPA Solution Extraction Method	ppm	1.01	
Manganese	DTPA Solution Extraction Method	ppm	23.43	
Iron	DTPA Solution Extraction Method	ppm	12.64	
Copper	DTPA Solution Extraction Method	ppm	2.23	

3.7. Some physicochemical and microbiological analysis results of Avtutu samples

Some physicochemical and microbiological tests of the traditional fermented avtutu beverage produced in Eruh district of Siirt province were applied. Physicochemical analysis results and microbiological analysis results of these samples are given in Table 8 and Table 9.

Table 8. Physicochemical results of avtutu samples analysed.

Sample	pH	Dry matter	Water activity	Salt %	Colour L	Colour a	Colour b	Croma
1	4.15	2.3	0.973	2.5	27.24	0.38	-1.69	1.652
2	4.16	0.1	0.974	2.0	29.12	0.31	-1.55	1.581
3	4.02	0.1	0.956	2.0	22.51	0.46	-1.63	1.694
4	4.02	0.1	0.957	2.5	23.07	0.38	-0.94	1.014
5	3.75	0.6	0.96	3.0	27.19	0.30	-1.2	1.237
6	3.84	0.3	0.964	1.25	28.10	0.38	-1.64	1.683
7	3.98	0.1	0.963	2.5	27.24	0.34	-1.45	1.489
8	3.91	0.1	0.966	1.0	27.63	0.55	-1.68	1.768
9	3.98	1.5	0.973	2.5	28.61	0.75	-2.15	2.277
10	4.37	0.1	0.962	2.0	25.63	0.28	-1.25	1.281
11	3.97	0.1	0.960	2.0	24.74	0.32	-1.11	1.155

In terms of pH, moulds and yeasts have a wider reproductive pH range than bacteria. While bacteria generally grow in the range of 4.5-9.0 pH, it is known that some pathogens (such as *Salmonella* spp., *Staphylococcus* spp., *Listeria* spp.) do not grow at pH values below 4 [44]. In this study, pH ranging from 3.75 to 4.37 was determined at an average level of 4.01. However, in this study, it was revealed that only pH was not effective (As a matter of fact, *Staphylococcus* spp. should not have been reproduced at pH like 3.84). On the other hand, control of pathogens may be impacted depending on nutrient content, water activity, temperature and the presence of inhibitor substances [20], [44]. It was seen that the increase of O / R potential in decreasing pH value is quite important ($p < 0.01$). It was also revealed that the samples analysed statistically showed a significant difference ($p < 0.01$) in terms of pH.

When examined in terms of water activity, according to these findings, conditions were provided for bacteria to easily reproduce in an environment where yeasts and moulds could easily reproduce. The water activity value ranges from 0 to 1. As this value approaches zero, the shelf life of the food extends due to the slowdown of microorganism activities, and the closer to one, the food spoils quickly as a result of the increase in microbial activity [44].

In this study, water activity, which is between 0.956-0.974, was determined at the average level of 0.964. This value is among the values that bacteria, yeast, and moulds can easily reproduce. Therefore, it indicates that the avtutu samples analyzed may be spoiled quickly. It was determined that the increase in water activity was effective between the increase in the amount of dry matter ($p < 0.05$), the increase in the colour L value (lightening the colour) $p < 0.01$ and the decrease in the colour b value (the lightening of the blue tone) at the level of $p < 0.05$. It was determined that the analyzed samples showed significant differences ($p < 0.01$) in terms of water activity.

Dry matter in foods refers to compounds other than water, such as minerals, vitamins, protein and carbohydrates [24]. Dry matter, which is closely related to its nutritional value, is one of the most important factors for the activities of microorganisms that play a role in fermentation technology. Fermentation conditions are expected to be earlier or effective if the dry matter or nutrient content is sufficient [7]. In this study, the dry matter varying between 0.1-2.3% was found at the average level of 0.49%. Due to the low dry matter here, the desired pH as a result of fermentation suggests that other organic compounds that may be formed are not sufficiently formed. It was observed that the increase in the amount of dry matter showed a significant correlation with the increase in water activity ($p < 0.05$), on the other hand, the analyzed samples did not show a significant difference in terms of dry matter content ($p > 0.05$).

Although salt is generally used in flavouring and fermentation (around 1%) to support the growth of microorganisms, it has a protective effect on prolonging the preservation of some fermented products, as well as a lethal effect on some pathogens [45]. One of the issues to be considered in the use of salt is the use of the product according to the typical feature of the product (such as 4-10% as in pickles). The salt ratio varied between 1-3% in this study, the average level was found to be 2.11%.

In this case, it has been observed that many salt-resistant microorganisms (such as *Micrococcus*, *Staphylococcus* spp.) survive under these conditions. It was determined that the analyzed samples showed a significant difference ($p < 0.01$) in terms of the amount of salt.

The oxidation-reduction potential (O / R) value gives an idea about the aerobic-anaerobic spoilage of foods. This is one of the internal factors affecting microbial activity. While food spoilage is positive in aerobic conditions (oxidation), it is negative in anaerobic conditions (reduction) [20], [44]. In this study, this value, which ranges from +165 to +209, has an average value of 189.73. Therefore, it suggests that this product is oxidized and that the microorganisms responsible for spoilage are microorganisms of aerobic origin. Statistically, the increase in the O / R potential value showed that the decrease in the pH value was a very significant ($p < 0.01$) relationship, on the other hand, there was a very significant difference ($p < 0.01$) in terms of the O / R potential of the analyzed samples.

Colour, one of the physical properties, is one of the important quality parameters. It is one of the first physical elements perceived by consumers. It is known that the pigment substances in the food, other components used as additives to the product, as well as the compounds that are reduced by microorganisms in fermentation are effective in the formation of colour [46], [47]. Among the colour values, L (darkness-lightness; takes values between 0-100), a (greenness-redness; takes values between -175 and +175), b (blueness-yellowness; takes values between -175 and +175), chroma is found by calculating the colour saturation with the formula $((a^2+b^2)^{1/2})$. The average values of L, a, b and chroma of the samples analyzed in this study were determined as 26.458, 0.405, -1.481 and 1.530, respectively. There is a significant correlation between the increase in the colour L value and the increase in the water activity and the increase in the colour L value (lightening of the colour) $p < 0.01$, the increase in the colour b value, the decrease in the water activity, and the increase in the chroma increase in the water activity ($p < 0.05$) was determined. It was determined that the analyzed samples showed a significant difference ($p < 0.01$) in terms of colour L, a, b and chroma values, respectively.

It is thought that the amount of dry matter used and the fermentation conditions (microorganism type-number, temperature, time) may be effective in revealing the differences in terms of colour among the samples. Microbiological analysis results of the samples are given in Table 9.

Table 9. Microbiological analysis results of avtutu samples (log₁₀ CFU/mL).

Sample	TMAB	Yeast	Mould	Staphylococcus spp.	Lactobacillus spp.	Coliform group bacteria	E. coli
1	6.30	7.20	-	-	6.54	5.30	-
2	6.70	6.15	-	-	5.40	5.60	-
3	6.48	5.30	-	-	6.04	4.30	-
4	7.70	5.48	5	-	5.78	5.00	-
5	6.00	5.48	-	-	4.00	4.48	-
6	6.78	6.18	-	2.30	6.40	5.00	-
7	7.08	6.34	-	-	6.30	4.30	-
8	7.48	6.78	-	-	7.00	6.90	-
9	7.30	5.90	-	-	6.20	5.84	-
10	7.30	5.70	-	-	6.84	6.30	-
11	6.30	4.00	-	-	4.00	4.00	-

The total number of aerobic bacteria of the samples analyzed in terms of microbiological quality was determined as 6-7.70, average 6.85 log₁₀ CFU/mL. For the expected benefit in fermented products, the number of probiotic microorganisms (the number of Lactobacillus species responsible for lactic fermentation) should be at least 7 log₁₀ CFU/mL [2], [48]. According to the turnip notification [49], it has been reported that there should be at most 5 log₁₀ CFU/mL TMAB count. For this reason, it has been determined that the analyzed samples do not comply with the standards. Fermentation was achieved with the effect of the *Saccharomyces* type yeast, which is included in the

sourdough used in the production of Avtitu fermented beverage. The number of yeast detected was 4-7.20, with an average of 5.86 log₁₀ CFU/mL yeast cells. However, it was stated that there should be no mould in fermented beverages or a maximum of 20 log₁₀ CFU/mL in turnips. There should be no residue (the mass settling to the bottom of the residue as yeast) at the bottom of the avtitu beverage obtained. There is a moderate correlation between the TMAB number and the increase in *Lactobacillus* species numbers ($p < 0.05$). A significant correlation was determined between yeast and water activity and lactobacilli ($p < 0.05$). There was a correlation between *Lactobacillus* spp. and TMAB, yeast, coliform group bacteria ($p < 0.05$), and a correlation ($p < 0.05$) between coliform group bacteria and *Lactobacillus* species. There was no significant difference in the presence of mould and *Staphylococcus* spp. in the analyzed samples ($p > 0.05$), but; a significant difference ($p < 0.01$) was found in terms of TMAB, yeast, *Lactobacillus* spp. and coliform group bacteria.

The presence of *Staphylococcus* species (such as *S. aureus*, *S. epidermidis*) among pathogenic microorganisms indicates that the necessary hygienic conditions cannot be provided for product production. Considering that this number may increase, it should not be forgotten that it may cause infection or intoxication [50].

The number of Lactic acid bacteria has an important effect on fermentation [51]. In this study, it varied between 4-6.84 log₁₀ CFU/mL and was determined at the average level of 5.86 log₁₀ CFU/mL. Although this value is acceptable for fermented products, considering the number of Coliform bacteria in the final product, this value was found to be quite high (1100 units / mL) according to the literature [49]. On the other hand, the total number of coliform group bacteria was found between 4-6.90, with an average of 5.18 log₁₀ CFU/mL. This value was again found higher than the turnip juice notification. *E. coli*, which is microbiologically an indicator of faecal pollution, was not encountered in any of the samples analysed in this study. Correlation analysis of Avtitu samples is given in Table 10.

Table 10. Correlation analysis of Avtutu samples.

	Sample	pH	Dry matter	Water activity	O/R	Salt amount	Colour L	Colour a	Colour b	Croma	TMAB	Yeast	Mould	Staphylococcus spp	Lactobacillus spp.	Coliform group bacteria	E. coli
Samples	1.00																
pH	-0.03	1.00															
Dry matter	-0.30	0.07	1.00														
Water activity	-0.19	0.24	0.609*	1.00													
O/R	0.06	-0.985**	-0.03	-0.17	1.00												
Salt amount	-0.23	0.01	0.39	-0.04	-0.04	1.00											
Colour L	0.02	-0.13	0.33	0.815**	0.21	-0.12	1.00										
Colour a	0.18	-0.22	0.37	0.34	0.22	-0.14	0.19	1.00									
Colour b	0.07	0.05	-0.52	-0.674*	-0.14	0.23	-0.55	-0.762**	1.00								
Croma	-0.02	-0.08	0.46	0.632*	0.16	-0.24	0.53	0.818**	-0.994**	1.00							
TMAB	0.30	0.26	-0.26	0.01	-0.35	-0.29	-0.04	0.39	-0.06	0.12	1.00						
Yeast	-0.45	0.12	0.46	0.608*	-0.11	-0.16	0.56	0.21	-0.52	0.47	0.23	1.00					
Mould	-0.20	0.01	-0.18	-0.38	-0.18	0.22	-0.51	-0.06	0.53	-0.49	0.51	-0.15	1.00				
Staphylococcus spp	0.00	-0.34	-0.09	-0.02	0.36	-0.49	0.25	-0.06	-0.16	0.14	-0.05	0.12	-0.10	1.00			
Lactobacillus spp.	-0.05	0.41	0.15	0.28	-0.41	-0.45	0.14	0.36	-0.49	0.48	0.624*	0.712*	-0.03	0.17	1.00		
Coliform group bacteria	0.15	0.37	0.12	0.50	-0.36	-0.46	0.42	0.38	-0.38	0.39	0.59	0.55	-0.07	-0.07	0.646*	1.00	
<i>E. coli</i>	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a

** . Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Cannot be computed because at least one of the variables is constant.

4. Conclusions

As primary health care, the number of people using alternative medicine accounts for almost 80% of the world's population. For this reason, analysis of materials used in alternative medicine based on different parameters becomes more and more important every day. The results obtained in the analyzes give us the opportunity to determine which components of these herbal products affect the disease factor. According to the analysis results of the radish samples used in this study. It has been determined that the above-ground green parts of the plant have the most antioxidant effect. However, only the underground part of this plant is used by the people in turnip production. It was concluded that it would be more beneficial to include the above-ground parts of the plant in turnip production. Therefore, the study results will be shared with the people of the region and it will be suggested to include the green parts of the plant in turnip production.

According to the Turkish Standards Institute's turnip juice standards no. TS 11149, in terms of TMAB, not all analysed avititu samples meet the standards. 90.90% of the samples in terms of yeast and 9.09% in terms of mould and *Staphylococcus* species do not comply with the standards. pH and 45.45% in terms of salt were not found suitable. In terms of TMAB, it was observed that 90.90% of the samples in terms of yeast number (according to 10^4 CFU/mL) and 9.09% of the samples in terms of mould and *Staphylococcus* were not produced under the standards.

Looking at the elemental analysis results, it was found that the highest value was at K with 51.22 ± 0.33 mg / g. In the study conducted by Kaymak in 2006 [52], the highest value was found to be 288.42 mg / 100g in parallel with our K value. This parallel situation increases the accuracy of the results obtained in the study.

As a result, it was concluded that this beverage does not meet the microbiological criteria in terms of human health and that a sample contains high levels of mould and *Staphylococcus* spp. One sample may pose a health risk by consuming avititu. When evaluated from a technological point of view, a standard production was not made due to the traditional production of the added additives other than standard productions. Therefore, the typical desired properties could not be achieved.

To eliminate such negative situations especially in terms of human health it is necessary to use raw materials with high microbiological quality, this product should be standardized and more modern and technological productions should be encouraged. Thus, especially small family businesses should be informed about the subject. In this way, both family businesses and regional economic contributions should be made.

Although it is believed to be beneficial among the public, it has been revealed that this fermented beverage is not produced under the standards. As seen in the microbiological findings obtained, the presence of pathogenic bacteria and mould as well as the high total number of bacteria suggest that serious health problems may occur if these products are consumed.

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