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Evaluating the effect of solvents and extraction methods on extraction yield, determining the amount of minerals and antibacterial activity of Cyperus Rotundus L flower extract

Asana Ahmadi*[1], Reza Naghiha[2], Abolfazl Ahmadi[3]

1-Master of Phytochemistry, Yasouj University.

2- Ph.D in Microbiology, Shahid Chamran University of Ahvaz .

3- Chemical Engineering, Mahshahr Azad University.

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*Corresponding Author E-

asana.ahmadi1399@gmail.com

ABSTRACT

Cyperus Rotundus L plant is a monocotyledonous weed from the Cyperaceae family. Cyperus Rotundus L of tuber is a home remedy for indigestion, vomiting, diarrhea, bitter, astringent, sedative, carminative, diuretic, anthelmintic, menstruate and nerve tonic. In this study, for the first time, the flower of the Cyperus Rotundus L plant was extracted by two methods of maceration and ultrasound with distilled water and ethanol solvents at times of 15 and 30 minutes. Also, the antibacterial activity was evaluated by determining the diameter of the growth inhibition zone, the minimum inhibitory concentration (MIC), the minimum bactericidal concentration (MBC) and the amount of minerals in the flower extract. The results reported that the difference between the extraction yield of both methods is insignificant, but the ultrasonic method is more optimal than maceration due to the reduction of the extraction time. Among the amounts of minerals, the highest amount was obtained for potassium and the lowest amount for copper, molybdenum and selenium. The results of investigating the antibacterial properties of flower extract compared to antibiotics show that the inhibitory effect of antibiotics on Escherichia coli and Staphylococcus aureus bacteria is greater.

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1-Introduction

The use of traditional medicine for the prevention and treatment of diseases has been approved by the World Health Organization for many years ago. In 1978, a statement was issued by the World Health Organization in the field of traditional medicine, which was changed in 2002, “traditional medicine is a general term that refers to traditional medicine systems such as Chinese traditional medicine, Indian Ayurveda, Greek-Arabic traditional medicine, and various native forms”. Traditional medicine treatments include drug therapy (use of medicinal plants, animal and mineral components) and non-drug methods (such as acupuncture, massage, and psychological treatments) [1,2]. Cyperus Rotundus is a member of the Cyperaceae family and is a monocotyledonous weed. One of the essential medicinal plants is Cyperus Rotundus, usually called Nagar Motha or Musta in India, and it is known globally as Suad Kufi or Nutsedge and belongs to the Cyperaceae family [3,4,5]. The parts consumed are tubers or bulbous roots. Cyperus Rotundus tuber is a home remedy for indigestion, vomiting, diarrhea, and other intestinal problems in children, light, bitter, astringent, carminative, diuretic, anthelmintic, Bringing sweat, and increases milk. Cyperus Rotundus tuber decoction or soup is beneficial for diarrhea, dysentery, indigestion, vomiting, cholera, and fever[6]. Solvents are an important part of the environmental performance of processes in the chemical industry. To reduce pollution in the environment, reduce waste resulting from chemical reactions and toxic, dangerous and flammable solvents, the idea of green solvents by minimizing the environmental effects caused by the use of solvents and replacing organic solvents in the production of chemicals is considered. In general, the problems caused by the separation of solvents from products, the complete recycling of these solvents, and environmental hazards are among the factors that direct researchers' attention to the use of green solvents. The results show that simple alcohols (methanol, ethanol) or alkanes (heptane and hexane) are compatible with the environment [7]. Maceration is widely used in medicinal plant research. This method is based on breaking the cell wall and separating the phytochemical compounds of the plant. Considering that the phytochemical compounds of some plants are sensitive to heat, this extraction method is a suitable option for such cases [8]. Extraction with the help of ultrasonic waves is one of the most important methods of extracting valuable compounds from plant sources, which can be applied on a large and small scale. Ultrasound is a mechanical wave that needs an elastic medium and sounds with different wave frequencies to disperse. Sounds are at the frequency of human hearing (20 Hz to 20 KHz), while ultrasound has frequencies higher than the range of human hearing [9]. The science of nutrition is one of the basic sciences in human life, in such a way that with the knowledge of this not-so-difficult science, a fundamental step can be taken towards having a healthy life, preventing many diseases and also treating them. Minerals, like other food, affect life, health and healing of some diseases. This group is in the category of micronutrients, the body contains a small amount of them and needs a small amount of them and it is necessary to reach the body through food [10,11]. ICP has many advantages over other sources for mass spectrometry of minerals, one of which is the rapid resolution of samples. The most important advantage of this coupling is the increase in sensitivity in analysis, which was known as ICP_MS the most important analytical method in the

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21st century. The most important device development required to launch this method is the adequate and suitable coupling of the ICP at atmospheric pressure with the mass spectrometer [12]. Staphylococcus belong to the Micrococcaceae family and they are non-motile, non-spore-forming, aerobic and facultatively anaerobic [13]. Staphylococcus aureus is a gram-positive bacterium and an important pathogen for humans that colonizes the skin and about 25% to 30% of healthy people carry this organism [14,15]. Escherichia coli is a gram-negative bacillus and one of the most important bacteria of the Enterobacteriaceae family and is a member of the natural intestinal flora [14,16]. Determining MIC or the lowest concentration required to inhibit the growth of microorganisms is a fundamental method to measure the intrinsic activity of antimicrobial substances [17]. The bactericidal endpoint (MBC) is defined as the determination of the minimum bactericidal concentration or the lowest concentration at which 99.9% of the bacteria are killed [11]. In this study, the effect of water and ethanol solvents and extraction methods on the extraction yield, the amount of minerals in the flower extract and the antibacterial activity of the extract were evaluated by the method of determining the diameter of the growth inhibition zone (mm), MIC and MBC.

2- Materials and methods

Staphylococcus aureus bacteria with the code PTCC25923 and Escherichia coli with the code PTCC25922 were prepared from the National Center for Genetic and Biological Resources of Iran, Mullerhinton Agar and Mullerhinton Broth was prepared from Merck (Germany), antibiotic disks of trimethoprim (TMP), ciprofloxacin (CP), gentamicin (GM) and penicillin (P) was prepared from the Iranian Antibody Teb company and ciprofloxacin antibiotic powder was prepared from the Canadian Bio-basics company.

2-1- Plant Sample Preparation

In October, Cyperus Rotundus flowers were collected from Khuzestan Province, Iran. They were identified and confirmed by the Khuzestan Province Agriculture and Natural Resources Research and Education Center with herbarium code 11127. The flowers were dried in the shade and away from sunlight, and then they were micro-powdered with an electric grinder model 1048 and 05 or 500 MESH.

2-2- Preparation of aqueous and alcoholic maceration extract

To prepare the extract by maceration method, 25 gr of flower powder was mixed in 250 ml of distilled water solvent and 25 gr of flower powder was mixed in 250 ml of ethanol solvent and placed on a shaker in an environment away from light for 48 hours. Then, the resulting extracts were passed through Whatman No. 1 filter paper using a Buchner funnel. To remove the solvents, the extracts containing the solvent were poured on the surface of the glass plates, transferred to the oven at a temperature of 50°C for 3 days, and finally the weight of the dry extracts was measured with a digital scale and placed in a dark container in the refrigerator at a temperature of 4°C.

2-3- Preparation of aqueous and alcoholic ultrasonic extract

To prepare the extract by ultrasound method, direct ultrasonic waves (ultrasonic probe) were used with a frequency of 20 KHz and a temperature of 25 °C. Four extracts were prepared, respectively, 25 gr in distilled water solvent for 15 minutes, 25 gr in ethanol solvent for 15 minutes, 25 gr in distilled water solvent for 30 minutes,

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and 25 gr in ethanol solvent for 30 minutes. Then, the resulting extracts were passed through Whatman No. 1 filter paper using a Buchner funnel. To remove the solvents, the extracts containing the solvent were poured on the surface of the glass plates, transferred to the oven at a temperature of 50°C for 3 days, and finally the weight of the dry extracts was measured with a digital scale and placed in a dark container in the refrigerator at a temperature of 4°C.

2-4- Measurement of extraction yield

The extraction yield of two methods of maceration and ultrasound with water and ethanol solvents was calculated through the following equation [12].

Extraction yield (%)== $M_2/M_1 \times 100$

where M1 is the weight of the powdered sample used for extraction and M2 is the weight of the extracted dry extract.

2-5- Measuring the amount of minerals

From the extract prepared by the maceration method, 25 gr of flower powder in 250 ml of distilled water solvent and ICP-MS model ELAN6100 DRC-e manufactured by Perkin Elmer company were used to analyze the amount of minerals by inductively coupled plasma-mass spectrometry method. In the prepared extract, the amount of potassium, calcium, magnesium, sulfur, phosphorus, iron, boron, manganese, zinc, copper, molybdenum and selenium were evaluated.

2-5-1- Preparation of Cyperus Rotundus plant extract

Preparation of plant extract powder was done by solid sample digestion method. For this reason, 0.25 gr of extract powder was weighed in microwave containers and nitric acid and hydrogen peroxide were added to it in the ratio (3:1). Then, according to the program, the device was heated in microwave containers and the resulting solution was brought to volume in volumetric balloons. Due to the closure of the microwave system, volatile elements such as arsenic and mercury could not escape, so the findings were reported with confidence.

2-6- Antibacterial activity

2-6-1- Agar well diffusion assay

Concentrations of 25, 50, 150 and 200 mg/ml were prepared from the maceration aqueous extract. To measure the sensitivity of bacteria to different concentrations of the extract by the agar well diffusion method, a suspension equivalent to half of McFarland (1.5×10^8) was prepared from the studied bacteria in a tube containing physiological serum, then it was cultured on a Mullerhinton agar plate. Using a sterile punch device, wells with a diameter of 6 mm and a volume of 100 µl were created on the surface of the agar, and 100 µl of the prepared concentrations were poured into the wells. Then the plates were incubated for 24 hours at a temperature of 37°C and after this period, the diameter of the growth inhibition zone was measured and recorded in millimeters using a caliper ruler. It should be noted that if the diameter of the growth inhibition zone has not been observed, the size was shown with the number 6 equivalent to the volume of the wells in the table.

2-6-2- Agar disk – diffusion assay

The sensitivity of bacteria to antibiotic discs was measured by the agar disc diffusion method. For this purpose, a suspension equivalent to half McFarland (1.5×10^8) was prepared from the studied bacteria in a tube containing physiological serum, then cultured on Mueller-Hinton agar plate and discs were placed on the agar surface. At the end, the plate was incubated at 37°C for 24 hours and after this period,

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the diameter of the growth inhibition zone was measured and recorded in millimeters using a caliper ruler. It should be noted that the antibiotic gentamicin was not used for Staphylococcus aureus and penicillin was not used for Escherichia coli.

2-6-3- Microdilution Broth assay

MIC was determined by broth microdilution method and using 96 well plates. At the beginning of the experiment, 100 µl of Mullerhinton broth was added to all the wells of the plate. Different concentrations (200 to 0.09 mg/ml) of the extract and the antibiotic ciprofloxacin (CP) (128 to 0.0039 µg/ml) were prepared in the wells by serial dilution method. At the end, 100 µl of bacterial suspension with a concentration of 10^6 was added to the wells. To ensure the accuracy of the test, positive control wells (culture medium and solvent) and negative control (culture medium, solvent and bacteria) were considered and the plate was incubated for 24 hours at 37°C. After this period, the wells were examined for bacterial growth. The lowest concentration of the substance that inhibited the growth of the microorganism was reported as the MIC concentration. To determine MBC, after observing the wells of the plate to check the MIC concentration, 100 µl of the wells in which the bacteria did not grow were transferred to the plates containing Mullerhinton agar culture medium and incubated for 24 hours at 37°C. After this period, the lowest concentration in which bacteria were killed was reported as MBC concentration.

3- Results

3-1- Extraction yield in maceration method

In the maceration method, extraction was done at a temperature of 25 °C with two solvents, distilled water and ethanol, and the comparison of the percentage of extraction yield between these two extracts showed that the difference between the two groups was insignificant and negligible (Table 1).

Table 1 Extraction result with distilled water and ethanol solvent by Maceration method

Types of extracts		Amount of powder(gr)	Extraction yield(%)
Maceration	Water extract	25	2/960 ± 0.008
	Ethanol extract	25	2/956 ± 0.008

3-2- Extraction yield in the ultrasonic wave method

In the ultrasound method, extraction at a temperature of 25°C with two solvents, distilled water and ethanol, and at two times of 15 and 30 minutes, in terms of the percentage of extraction yield, showed that the difference between the extraction yield of the extracts was insignificant and negligible (Table 2).

Table 2 The result of extracting with distilled water and ethanol solvent by ultrasonic method

Types of extracts	Amount of powder(gr)	Extraction yield(%)

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Prop Ultrasonic (ultrasound)	Water extract (15 minutes)	25	2/957 ± 0.008
	Ethanol extract (15 minutes)	25	2/958 ± 0.008
	Water extract (30 minutes)	25	2/959 ± 0.008
	Ethanol extract (30 minutes)	25	2/960 ± 0.008

3-3- The amount of minerals

In the results of measuring the amount of minerals in the aqueous extract obtained by the maceration method, the highest amount was potassium (>100000) and the lowest amount was copper, molybdenum and selenium (< 0.1) (Table 3).

Table 3 The result of the analysis of the amount of minerals with the ICP-MS device

minerals	The amount of minerals (ppm)
Potassium	> 100000
Calcium	28631/07
Magnesium	16121/36
Sulfur	15885/44
Phosphorus	8348/84
Iron	499/22
Boron	353/88

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Manganese	186/01
Zinc	135/43
Copper, Molybdenum, Selenium	$< 0/1$

3-4- Antibacterial activity

3-4-1- Agar well diffusion assay

The results obtained from the Agar well diffusion assay of Cyperus Rotundus plant flower extract on bacteria showed that the extract in different concentrations had no growth inhibition zone and no antibacterial effect (Table 4).

Table 4 The results of measuring the diameter of the growth inhibition zone in different concentrations of the extract

diameter of growth inhibition zone (mm)				
Bacteria	25 ($\frac{mg}{ml}$)	50 ($\frac{mg}{ml}$)	150 ($\frac{mg}{ml}$)	200 ($\frac{mg}{ml}$)
Staphylococcus aureus	6	6	6	6
E. coli	6	6	6	6

3-4-2- Agar disk – diffusion assay

The results of the investigation of antibacterial effects of antibiotic discs using the Agar disk – diffusion method on Gram-positive (Staphylococcus aureus) and Gram-negative (Escherichia coli) bacteria showed that antibiotics with a diameter of growth inhibition zone between 25-44 have an Significant inhibitory effect (Table 5).

Table 5 The results of measuring the diameter of the growth inhibition zone in different antibiotic discs

diameter of growth inhibition zone (mm)				
Bacteria	Ciprofloxacin (5µg)	Trimethoprim (5µg)	Penicillin (10µg)	Gentamicin (10µg)

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Staphylococcus aureus	25	26	44	—
E. coli	35	27	—	25

3-4-3- Microdilution Broth assay

The results of the investigation effect of the extract compared to the control antibiotic ciprofloxacin (CP) in determining the minimum inhibitory concentration (MIC) and determining the minimum bactericidal concentration (MBC) showed that the antibiotic had a greater inhibitory and lethal effect than the extract on gram-positive Staphylococcus aureus and gram-negative Escherichia coli bacteria (Table 6).

Table 6 Antibacterial activity of extract by MIC and MBC determination method

Bacteria	MIC		MBC	
	Extract	Ciprofloxacin	Extract	Ciprofloxacin
Staphylococcus aureus	25 ($\frac{mg}{ml}$)	0/5 ($\frac{ug}{ml}$)	> 200 ($\frac{mg}{ml}$)	1 ($\frac{ug}{ml}$)
E. coli	100 ($\frac{mg}{ml}$)	0/0039 ($\frac{ug}{ml}$)	> 200 ($\frac{mg}{ml}$)	0/125 ($\frac{ug}{ml}$)

4- Discussion

In the ultrasonic probe, the plant sample is constantly in direct contact with the probe and is directly affected by the ultrasonic waves, which reduces the extraction time compared to the ultrasonic bath method, and the extraction time with this method is less [18]. The ultrasound extraction method is considered an environmentally friendly extraction method due to the reduction of solvent use, energy consumption and carbon dioxide (CO_2) emissions to the atmosphere on a laboratory and industrial scale [19]. In a study, the effects of different solvents on the extraction yield of extracts obtained from the tubers of the Cyperus Rotundus plant were evaluated and the result was presented as follows in the extracts obtained by the ultrasonic bath extraction method and different solvents, respectively, 70% ethanol extract, 50% ethanol extract, Acetone extract, dichloromethane extract, 95% ethanol extract, and aqueous extract have the highest to lowest percentage of extraction yield [20]. In the comparison between the two old methods of maceration and the new ultrasonic method, according to the highest extraction yield in both of them, which respectively correspond to the maceration water extract (2.960 ± 0.008%) and the 30-minute ethanol extract (2.960 ± 0.008). In the comparison between the two methods of maceration and ultrasonic, the difference in the percentage of extraction yields was insignificant and can be ignored. But because time is an important factor in extraction, a result of reducing the extraction time from 48 hours in the maceration method to 30 minutes in the

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ultrasound method with almost similar results, shows that the new ultrasound method with the ultrasonic probe device compared to the old maceration method is more optimal. So far, no research study has been conducted on the extract of the flower of Cyperus Rotundus plant in the field of extraction, and in the mentioned study on the extract of the tuber of Cyperus Rotundus plant, extraction with ultrasound method and ethanol solvent a higher extraction yield than the aqueous solvent, but in the present study also in the ultrasonic extraction section, there was a very small difference between the extraction yields of the two solvents. In a study, the mineral content of Cyperus Rotundus plant leaf extract was evaluated by wet digestion extraction method, and the result was presented as follows: sodium 6.4, potassium 561.5, calcium 22.78, magnesium 102.7, iron 10. 12, zinc 1.22, copper 0.46, phosphorus 234.6 mg in 100 gr [21]. Calcium plays a role in the growth and development of bones and teeth, normal body muscle activity, heartbeat regulation, blood coagulation process, effective use of phosphorus, reducing insomnia, helping iron metabolism in the body, and treating depression [10,22]. Potassium plays a key role in the proper functioning of all cells, tissues and organs of the body, heart function, skeletal and smooth muscle contraction, normal digestive function, protein synthesis from amino acids, carbohydrate metabolism, nervous system function and regulation of body water balance [11,23]. Magnesium in the treatment of depression and proper functioning of nerves, keeping blood arteries and teeth healthy, preventing heart diseases, better digestion of food, preventing calcium deposition in the kidney and cholecyst, synthesis of protein and nucleic acid, absorption of calcium, vitamin C, sodium, potassium, vitamin E and group B vitamins and cell skeleton integrity [10,11,24]. Phosphorus plays a role in all chemical reactions in the body, absorption of nisin, regulation of heart function, normal kidney activity, bone growth, fat and starch metabolism, reduction of bone pain, making lecithin and cephalin, and cellular metabolism for energy [10,22,25]. Sulfur plays a role in curing skin diseases, inhibiting free radicals, regulating gene expression, protein synthesis, tissue integrity and protection, lipid metabolism, detoxification in the liver, and the function of tendons and ligaments depends on it. Sulfur is also a part of glutathione, vitamin B1, biotin and pantothenic acid [10,26,27,28]. Iron plays a role in transporting oxygen to tissues by red blood cell hemoglobin, mediating the transfer of electrons in cells, part of enzyme systems in various tissues, synthesis of deoxyribonucleic acid, body growth, relieving fatigue and resistance to diseases [22,29,30]. Zinc is involved in oxidative reactions as an antioxidant, muscle growth, normal growth in children, cell division, synthesis of deoxyribonucleic acid, protein synthesis, carbohydrate metabolism and depression treatment [11,31,32]. Manganese plays a role in growth, digestion, reproduction, antioxidant defense, immune response, regulating nerve activity, relieving fatigue, preventing osteoporosis, enhancing memory, ossification, thyroxine production, and treating depression [22,33]. Boron plays a role in antioxidant defense, preventing arteriosclerosis, growth of plants, animals and humans, anti-inflammatory effect, improving the function of the central nervous system and improving bone density [34,35,36]. Copper, molybdenum and selenium have important roles in the body, but in the present study, their amount was insignificant. The required amount of potassium in the body is from 0.9 to 5.5 gr,

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calcium 400 to 600 mg, magnesium 150 to 350 mg, sulfur 140 to 850 mg, phosphorus 440 to 800 mg, iron 26 to 40 mg, boron is 2 mg, manganese is 1.6 to 3 mg, and zinc is 3 to 15 mg [10]. Taking into account the required amounts and the key and vital roles of minerals in the body, it is believed that the flower of Cyperus Rotundus plant and medicinal plants can be considered as a supplement for supplying minerals, but more research is needed to check their absorption by the body. In a study of the antimicrobial effects of different concentrations of the methanolic extract of the rhizomes of Cyperus Rotundus plant by disk diffusion method on the mentioned bacteria, it showed that different concentrations of the extract had no antibacterial effect on Salmonella, Escherichia coli, Aspergillus niger and Cladosporium herbarum and only on Staphylococcus aureus bacteria and Micrococcus luteus is effective [37]. In a study, the antimicrobial effects of the aqueous and ethanolic extracts of the leaves and tuber of the Cyperus Rotundus plant native to Nigeria were investigated and the result was reported that the extracts of this plant were effective against gram-positive Staphylococcus aureus and gram-negative Escherichia coli bacteria with the diameter of growth inhibition zone respectively (10, 13 mm) and (12, 14 mm) had an antibacterial effect. In this experiment, it was also proved that ciprofloxacin with the diameter of the growth inhibition zone of 17 and 23 mm, respectively, had a greater antibacterial effect than the aqueous and ethanolic extracts of leaves and tubers [38]. In a study, the antibacterial effects of the extracts and different methods of Cyperus Rotundus tuber were investigated and the result was reported that the minimum inhibitory concentration (MIC) of the extracts on Staphylococcus aureus bacteria with concentrations of 0.5, 5 and more than 5 mg/ml, on Salmonella typhimurium bacteria with concentrations of 1, 5 and more than 5 mg/ml, on Salmonella enteritidis bacteria with concentrations of 0.5, 2.5 and 5 mg/ml, on Escherichia coli bacteria with concentrations of 5 and more than 5, on Enterococcus faecalis bacteria with concentrations of 0.5, 2.5 and 5 and the control antibiotic is ampicillin, which showed a growth inhibitory effect on the target bacteria with a concentration between 0.0015 to 0.006 mg/ml. In the comparison between the extracts and the antibiotic, it was found that the antibiotic had a growth-inhibitory effect on the bacteria in much lower concentrations than the extracts [39]. So far, no research has been done on the flower extract of the Cyperus Rotundus plant in terms of antibacterial activity. The comparison between the mentioned studies and the present study showed that the extract of the leaves and rhizomes of the Cyperus Rotundus plant had more antibacterial effect than the flower of the plant. In the investigation of the antibacterial properties on the target bacteria, taking into account the measurement of the diameter of the growth inhibition zone, the minimum inhibitory concentration (MIC) and the minimum bactericidal concentration (MBC), it was found that the flower extract of Cyperus Rotundus plant had no significant an antibacterial effect on bacteria compared to antibiotics.

5- Conclusion

Considering that the Cyperus Rotundus L plant is one of the weeds and resistant to the methods of destroying weeds in agriculture, therefore there is no need to study the cultivation of this plant and it is available in abundance. Therefore, research on the medicinal properties of this plant is worth investing. Many analyses have been done on different parts of the Cyperus Rotundus

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plant from different chemical, biological and medicinal aspects, and also the flower of the Cyperus Rotundus plant was evaluated in other studies in terms of antioxidant and anticancer properties. Considering the properties mentioned for the first time, this research was conducted on the quality and quantity of the flower extraction method with two old and new methods to find a more economical method and analyze the amount of minerals in the extract to compensate for the lack of nutrients needed by the body.

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ارزیابی اثر حلال‌ها و روش‌های استخراج بر بازده‌ی استخراج، تعیین مقدار مواد معدنی و فعالیت آنتی باکتری عصاره‌ی گل گیاه اویار سلام (Cyperus Rotundus L.)

آسانا احمدی *[۱]، رضا نقی ها[۲]، ابوالفضل احمدی[۳]

۱- کارشناسی ارشد فیتوشیمی دانشگاه یاسوج

۲- دکتری تخصصی میکروب شناسی دانشگاه شهید چمران اهواز.

۳ - مهندسی شیمی دانشگاه آزاد ماهشهر.

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* مسئول مکاتبات:

asana.ahmadi1399@gmail.com

چکیده

گیاه اویارسلام (Cyperus Rotundus L.) از تیره‌ی جگن (Cyperaceae) و یک علف هرز تک لپه‌ای می‌باشد. غده گیاه اویارسلام دارویی خانگی برای سوء هاضمه، استفراغ، اسهال، تلخ، قابض، آرام بخش، بادشکن، مدر، کرم کش، قاعده‌آور و مقوی اعصاب است. در این مطالعه برای اولین بار از گل گیاه اویار سلام به دو روش ماسراسیون و فراصوت با حلال‌های آب مقطر و اتانول و در زمان‌های ۱۵ و ۳۰ دقیقه عصاره گیری شد. هم چنین فعالیت آنتی باکتری با روش تعیین قطر هاله‌ی‌عدم رشد، حداقل غلظت بازدارندگی رشد (MIC) و حداقل غلظت باکتری کشی (MBC) و مقدار مواد معدنی موجود در عصاره‌ی گل مورد ارزیابی قرار گرفت. نتایج بدین صورت گزارش شد که تفاوت بین بازده‌ی استخرج هر دو روش ناچیز است ولی روش فراصوت به دلیل کاهش بازه‌ی زمانی عصاره گیری نسبت به ماسراسیون بهینه‌تر می‌باشد. در بین مقادیر مواد معدنی بیش‌ترین مقدار برای پتاسیم و کم‌ترین مقدار برای مس، مولیبدن و سلنیوم حاصل شد. نتایج حاصل از بررسی خاصیّت آنتی باکتری عصاره‌ی گل نسبت به آنتی بیوتیک نشان دهنده‌ی این است که اثر مهارکنندگی آنتی بیوتیک‌ها روی باکتری اشریشیاکلی و استافیلوکوکوس اورئوس بیش‌تر است.

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