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Evaluation of chlorophyll content, antioxidant activity and antimicrobial effect of Dandelion leaves extract

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Abstract

In this research, the chlorophyll content, total flavonoid content (TFC), total phenolic content (TPC) and antioxidant activity of aqueous extract of Dandelion was determined. In addition, the effect of aqueous extract of Dandelion, obtained by maceration, was tested on various food borne and food spoilage microorganisms. Antimicrobial activity of leaf extract of Dandelion was investigated using disk agar diffusion, well agar diffusion, minimum inhibitory concentration and minimum bactericidal/fungicidal concentration methods. The values obtained for TFC, TPC, chlorophyll a and b were 22.82 (µg/mL), 116.89 (mg/mL), 0.081 (mg/l) and, 0.063 (mg/l), respectively. The result of the radical scavenging activity was IC_{50}= 68.81µl/mL. The results showed that MIC of leaf extract of Dandelion on *Aspergillus niger*, *Salmonella typhimurium*, *Bacillus subtilis* and *Staphylococcus epidermidis* was 512, 256, 256 and 64 mg/ml respectively. MBC for *Aspergillus niger* was more than 512, for *Salmonella typhimurium*, and *Bacillus subtilis* was 512, and for *Staphylococcus epidermidis* was 128 mg/ml. In addition, the diameter of inhibitory growth zone in well diffusion method was more than disk diffusion. Generally, it can be stated that the aqueous leaf extract of Dandelion on Gram-positive bacteria showed more antimicrobial activity than Gram-negative bacteria, while there is no significant inhibition on mold. Based on the results of this study, Dandelion aqueous extract might be used as a natural agent to prevent the growth of food borne microorganisms, particularly, that cause food poisoning that leading to the reduction of gastroenteritis risk.

Keywords: Antimicrobial activity, Antioxidant activity, Dandelion, Pathogenic microorganisms.

Introduction

Dandelion is originally from Western Europe and Northern Asia; it is widely distributed through Europe, Asia, and America. It blossoms almost the whole year and grows in the autumn and is found in fields, gardens, wild lands and by the roadsides, at altitudes ranging from sea level to two thousand meters (Escudero *et al*., 2003). Dandelion, is a member of the Asteraceae/ Compositae family. It is a perennial herb, native throughout the Northern hemisphere. Traditionally, Dandelion has been used for centuries as a remedy for various ailments due to its antidiabetic, choleretic and diuretic properties (Sigstedt *et al*., 2008; You *et al*., 2010). The variety of health benefits associated with the use of Dandelions has been attributed to specific *Taraxacum* species as extracts of the whole plants or specific plant parts (Cragg., 2007). Dandelions play a pivotal role in traditional medicine for treatment of breast, uterine and lung tumors as well as hepatitis and digestive diseases, kidney disease, liver and spleen disorders, eye problems and diarrhea (Schütz., *et al*. 2006; Sigstedt., *et al*. 2008). The young leaves and flowers are very appreciated in salads, while roasted roots are used as coffee substitutes (Dias *et al*., 2014).

Identification of plant products or alternative medicines which could limit reactive oxygen species (ROSs) is necessary to help protect the liver from possible damage. ROSs, such as singlet oxygen, superoxide ion, hydroxyl ion and hydrogen peroxide, are highly reactive,

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toxic molecules, which are generated normally in cells during metabolism. (Baba and Malik., 2015). Antioxidants are substances that delay or prevent the oxidation of inter- or intra-cellular oxidizable substrates from oxidative stress. Some bioactive compounds, which are generally found in plants, have been determined to protect cells from oxidative stress by preventing the formation or detoxifying free radicals, resulting in prohibition variety of pathophysiological problems (You., *et al.* 2010).

Free radicals have been implicated in the development of a number of disorders, including cancer, neurodegeneration and inflammation, giving rise to studies of antioxidants for the prevention of diseases. The presence of antioxidants such as phenolics, flavonoids, tannins and proanthocyanidins in plants may provide protection against a number of diseases; for example, ingestion of natural antioxidants has been inversely associated with morbidity and mortality from degenerative disorders (Baba and Malik., 2015; Mohsenipour., 2015).

In the other hand, the growing bacterial resistance to antibiotics has become a major concern worldwide which prompting a resurgence in research of the antimicrobial role of herbs against resistant strains. A lot of plants have been recognized as valuable resources of natural antimicrobial compounds. Plant extracts offer considerable potential for the development of the new agents against infections currently difficult to treat (Wendakoon., *et al*. 2012).

Therefore a renewed interest in natural substances has focused attention on plants rich in bioactive compounds well known for their antimicrobial and antioxidant properties being investigated for their antioxidant properties, and the demand for natural antioxidants and food preservatives is increasing (Baba and Malik, 2015; Mohsenipour, 2015).

The objectives of this research were to measure the chlorophyll content (CC), total flavonoid content (FC), total phenolic content (TPC) and the antioxidant activity (AA) of Dandelion leaves extract in addition to its free radical scavenging activity. The other aim of this study was to investigate the antibacterial and antifungal effects of Dandelion leaves on various food borne microorganisms "*in vitro"*.

Materials and methods

Extract preparation

Fresh plant Dandelion was collected in spring locally in April, 2017 from the green area of Ferdowsi University of Mashhad (Mashhad, Khorasan Razavi), Iran. The taxonomical identification of the plant was confirmed by Ferdowsi University of Mashhad, Institute of Plant Sciences. Plants were extracted as described by Sigstedt *el al.*, (2008) with some modifications. Freshly collected leaf of Dandelion were rinsed with running water, shade- dried and then powdered using an electrical blender (Bosch Limited, Germany). For successive extraction, 50 gram of plant powder was macerated in 250 ml of water. Extracts was prepared using the maceration process for 72 h under constant shaking and filtered with Whatman No. 1 filter paper. The extract was evaporated to dryness under reduced pressure using a rotary evaporator and then was incubated at 37°C to complete evaporation of solvent. Percentage yield of the extract (w/w) is calculated as follows: Percentage yield of the extract (w/w) $= \frac{W1}{W2} * 100$, W_1= Weight of plant powder was macerated (g) and W_2= Weight of extract obtained (g)

Chlorophyll content

In a 15 ml volumetric flask, 100 mg of aqueous extract was dissolved in 10 ml of 80% acetone. The volumetric flask was kept in ice and dark environment for 30 minutes. The sample was centrifuged at 3000 rpm (Sigma, Germany) for 10 min at 4°C. Immediately after centrifugation, the falcon was transferred to ice before rapid measurement with spectrophotometer. The absorbance of the solution was read at three wavelengths including 663.2, 646.8 and 470 nm (Roshanak *et al.*, 2015). Chlorophyll concentrations were

calculated in mg/l of acetone according to the following formula:

Ca (mg/l)= (12.25*D66302)– (2.79*D646.8)

Cb (mg/l)= (21.50*D646.8)– (5.10*D663.2)

Ca: Chlorophyll a
Cb: Chlorophyll b

Total flavonoid content

Total flavonoid content was determined spectrophotometrically using a method based on the formation of a complex flavonoid–aluminum, according to Chang *et al.*, (2002) with some modifications. Quercetin was used to make the calibration curve. Ten mg of quercetin was dissolved in 80% ethanol and then diluted to 25, 50 and 100 µg/mL. The diluted standard solutions (0.5 mL) were separately mixed with 1.5 mL of 95% ethanol, 0.1 mL of 10% aluminum chloride, 0.1 mL of 1 M potassium acetate and 2.8 mL of distilled water. After incubation at room temperature for 15 min, the absorbance of the reaction mixture was measured at 510 nm. The amount of 10% aluminum chloride was substituted by the same amount of distilled water to give blank. Similarly, 0.5 mL of extract was reacted with aluminum chloride for determination of flavonoid content as described above (Chang *et al.*, 2002).

The calibration equation for quercetin was obtained as y=0.0107x+ 0.135 (R^2= 0.994), where x is the absorbance and y is the concentration of quercetin in mg/l.

Total phenolic content

Briefly, 2.5 g of the finely dried extract powder was mixed with 50 ml methanol 80% in falcon and was shacked in 240 rpm for 24 h. The sample was filtered twice with Whatman 0.2µm. TPC was determined using Folin-Ciocalteu method. Then, 500 µl of diluted extract, 2.5 ml Folin- Ciocalteu reagent and 2 ml of 7.5% sodium carbonate were also mixed. After heating at 45°C for 15 min, the absorbance was measured at 765 nm against methanol 80% as blank. TPC was expressed as Gallic acid equivalent/g dry weight of sample. The calibration equation for Gallic acid was obtained as y=17.422x+0.0872 (R^2=0.998), where x is the absorbance and y is the concentration of Gallic acid in mg/l (Capannesi *et al.*, 2000).

Antioxidant properties

The antioxidant activity of the extract was determined by the 1,1-diphenyl-2-picryl-hydrazyl (DPPH) assay. Briefly, 200 µL of extract (150- 200- 250 µg/mL) was mixed with 3.8 mL DPPH solution and incubated in the dark at room temperature for 1 h. The absorbance of the mixture was then measured at 517 nm. The control sample contained all the reagents except the extract. The percentage inhibition was calculated using the following equation:

% inhibition=100× (A of control−A of sample)/A of control (Baba and Malik., 2015; Roshanak *et al.*, 2015).

Reducing power

2.5 mL of extract and Butylated hydroxytoluene (BHT) were mixed with 2.5 mL of 1% potassium ferricyanide and 2.5 mL of 200 mM sodium phosphate buffer (pH 6.6) and were incubated at 50°C for 20 min. Then, 2.5 mL of 10% trichloroacetic acid was added, and the mixture was centrifuged at 200 g for 10 min. 2.5 mL of the supernatant was mixed with 2.5 ml of deionized water and 0.5 ml of 0.1% ferric chloride. The absorbance at 700 nm was measured against distillated water as a blank. The increased absorbance of the reaction mixture correlates with greater reducing power (Ardestani and Yazdanparast, 2007)

Microorganisms and culture conditions

Aspergillus niger (PTCC 5010), *Salmonella typhimurium* (PTCC 13311), *Bacillus subtilis* (PTCC 1023), and *Staphylococcus epidermidis* (PTCC 1435), were procured from microbial collection, Department of Food Science and Technology, Faculty of Agriculture, Ferdowsi University of Mashhad. Microbial strains were incubated 24 hours for bacteria and 72 hours for fungal strains before the antimicrobial tests were performed. 0.5 McFarland standard was

used for preparation of microbial suspension, which was equivalent to 1.5×10^8 CFU/ml of microorganism (Amin Mir *et al.*, 2016).

Minimum inhibitory concentration (MIC) and Minimum bactericidal/ fungicidal concentration (MBC/ MFC)

MICs were determined by the broth microdilution method. Serial dilutions of the aqueous extract of Dandelion (512, 256, 128, 64, 32, 16, 8, 4, 2 and 1 mg/mL) in broth medium were prepared on a microtiter plate, and microbial suspensions were added to the micro wells at 1.5×10^8 CFU/ ml. It is worth to mention that Mueller Hinton Broth (MHB) (Sigma-Aldrich) was used for bacterial strains and Potato Dextrose Broth (PDB) (Sigma-Aldrich) was used for fungal strain. The microtiter plates were then incubated at 37°C for 24 h for bacterial strains and 25°C for 72 h for fungal strain. Activity was recorded as red coloration in the wells after addition of Triphenyltetrazolium Chloride (concentration of 5 mg/ mL) and incubation for 30 minutes. MICs were determined as the lowest concentration that prevented visible growth (Baba and Malik, 2015). 100 µL of the culture from each well in which the red color was not observed, was streaked on Mueller Hinton Agar (MHA) (Sigma-Aldrich) for bacterial strains and Potato Dextrose Agar (PDA) (Sigma-Aldrich) for fungal strains. The plates were incubated at 37°C for 18-24 h for bacterial strains or 25°C for 72 h for fungal strains and the lowest dilution that yielded complete inhibition of growth was taken as MBC or MFC (Wendakoon *et al*., 2012).

Well diffusion agar (WDA) method

20 ml of sterile MHA for bacterial strains and PDA for fungal strain was poured into plates and allowed to set. The plates were then seeded with 100 µL of a 24-hour old culture using a sterile glass rod to spread the culture, and then the plates were kept for drying. Wells were made on the plates with sterile whole puncture (6 mm diameter). 60 µL of the plant extract (100, 200, 300 and 400 mg/ml) was poured in each respective well. The plates were then incubated at 37°C for 18-24 h for bacterial strains or 25°C for 72 h for fungal strain. The antimicrobial activity of the plant extract was assessed by an inhibition zone surrounding the well and inhibition zone diameter (IZD) was measured and expressed in millimeter (Sohail *et al.*, 2014).

Disc diffusion agar (DDA) method

10 µL of MHA for bacterial strains and PDA for fungal strain were prepared and fresh inoculum was spread over the surface of the media. The sterile filter paper discs of size 6 mm were dipped into the extract solution of different concentrations (100, 200, 300 and 400 mg/ml). Then the disc was placed over the center of medium surface and the plates were incubated at 37°C for 18-24 h for bacterial strains or 25°C for 72 h for fungal strain. Inhibition zone diameter was reported in millimeters (Espinel-Ingroff *et al*., 2002; Awoyinka *et al.*, 2007).

Statistical analysis

All the assays were carried out in triplicate. The results were expressed as mean values and standard deviation (SD). The results were analyzed using one-way analysis of variance (ANOVA) followed by Fisher Test with $\alpha = 0.05$. This analysis was carried out using Minitab v. 18.0.

Results and discussion

The type and level of biological activity exhibited by any plant material depends on many factors, including the plant part, geographical location, soil conditions, harvest time, moisture content, drying method, storage conditions, and post- harvest processing. For example, the relatively high temperatures that can be generated during tissue grinding can denature chemical constituents. Also, the extraction solvent, time period, and temperature can affect the level and composition of secondary metabolites extracted from plant tissues. Many solvents are used for extraction including water, methanol, ethanol and acetone separately or mixed with water. In this study water was chosen as extraction solvent because it is quite safe for human consumption as

compared with other organic solvents (Wendakoon *et al.*, 2012).

The results of MIC and MBC/MFC tests showed that *Staphylococcus epidermidis* was the most susceptible and *Aspergillus niger* was more resistant to the aqueous extract of Dandelion leaves respectively. According to Kuete (2010), Kuete and Efferth (2010), the antibacterial activity of a plant extract is considered significant when MIC values are below 100 µg/ mL, moderate when 100≤ MIC ≤ 625 µg/mL and weak when MIC> 625 µg/mL (Voukeng *et al.* 2017). Consequently, the antimicrobial activity observed with Dandelion (64≤ MIC≤ 512 mg/mL) can classified as weak for bacterial and fungal strain. In our previous research we also found that MIC of leaf extract of Dandelion (*Taraxacum pseudocalocephalum*) on *Candida albicans*, *Staphylococcus aureus*, *Bacillus cereus*, *Listeria innocua*, *Escherichia coli*, *Salmonella typhi* and *Pseudomonas aeruginosa* was 128, 128, 256, 256, 256, 256 and 512 respectively (Shahidi *et al*., 2019).

The results of the antimicrobial activity of the aqueous extract of Dandelion leaves according to well diffusion agar and disk diffusion agar methods are depicted in Table 2.

Table 1- MIC and MBC/MFC of Dandelion leaves extract on some pathogenic bacteria and fungi

Microorganisms	MIC (mg/mL)	MBC or MFC (mg/mL)
Aspergillus niger	512	512<
Salmonella typhimurium	256	512
Bacillus subtilis	256	512
Staphylococcus epidermidis	64	128

Table 2- Average inhibition zone (mm) of Dandelion leaves extract concentrations on some pathogenic microorganisms thorough DDA and WDA antimicrobial methods

Microorganisms	Zone of inhibition (mm)							
	Well diffusion agar				Disk diffusion agar			
	Concentrations (mg/mL)				Concentrations (mg/mL)			
	100	200	300	400	100	200	300	400
Aspergillus niger	8.20±0.22	10.20±0.36	12.10±0.22	14.00±0.42	7.10±0.55	8.00±0.37	10.70±0.22	11.00±0.55
Salmonella typhimurium	9.60±0.43	11.40±0.15	14.00±0.44	17.40±0.36	9.40±0.37	10.10±0.42	12.60±0.36	15.20±0.42
Bacillus subtilis	8.12±0.27	12.50±0.34	17.00±0.30	20.60±0.22	8.20±0.29	10.10±0.57	12.50±0.48	16.00±0.35
Staphylococcus epidermidis	10.00±0.41	14.30±0.29	16.20±0.21	18.30±0.35	8.00±0.16	10.30±0.55	12.50±0.22	17.10±0.52

The results showed that by increasing the concentration of extract from 100 mg/mL to 400 mg/mL, the IZD increased significantly. The maximum and minimum effects of the aqueous extract of plant leaves were observed on *Staphylococcus epidermidis* and *Aspergillus niger*respectively. As a result, Gram-positive bacteria were generally more susceptible than Gram-negative bacteria to aqueous extract of Dandelion. Possibly because of the presence of outer membrane that serves as an effective barrier in Gram- negative species (Al-Marzoqi *et al.*, 2015). Mean IZD by well agar method was higher than disk agar method. Also the strains showed a smaller IZD at lower concentrations. Perhaps higher IZD in well agar diffusion is related to the direct contact of the aqueous extract of Dandelion with the microbial strains. In addition, in the disk agar diffusion method, the antimicrobial agent from the disk should be transferred to the surface of the medium.In this case factors such as

Temperature and time can be effective in releasing antimicrobial agent (Klančnik *et al.*, 2010).

Polyphenolic substances, tannins, catechins and polyphenolic acids are abundantly found in about 20% of the plants with high antimicrobial properties. It is known that polyphenols can form heavy soluble complexes with proteins. Polyphenols may adhesive to bacterial and causing disrupt for accessing to cell surface receptors (Brantner and Grein, 1994). For example, flavonoids are polyphenolic heterocyclic compounds and an integral constituent of food, fodder and a prominent antioxidative compounds. The antioxidant ability of flavonoids resides mainly in their tendency to donate hydrogen atoms and thereby scavenge the free radicals generated during lipid peroxidation (Agarwal and Verma., 2011).

Although a pro-oxidant activity of chlorophylls under light, which could be understood as a transfer of the energy of singlet-excited chlorophyll to oxygen that would form reactive oxygen species, has been studied. However, many studies also reported that chlorophylls and pheophytins provide protection by preventing autoxidation of vegetable edible oils stored in the dark and suggested a hydrogen donating mechanism breaking the radical chain reactions (Lanfer-Marquez *et al.*, 2005).

Table 3 showed phytochemicalcompounds of Dandelion. The ability of aqueous extract of the Dandelion leaf to quench DPPH free radical was measured. The extracts and BHT demonstrated a dose-dependent scavenging activity by reducing DPPH radical (Fig. 1). By plotting the graph of extract concentrations against the scavenging activity, a specific concentration of the sample that needed to provide 50 % inhibition (IC_{50}) was calculated. IC_{50} for aqueous extract of the Dandelion was 68.81 µl/ml.

Table 3- Average mean of total phenolic content, total flavonoid content and chlorophyll content of aqueous leaf extract of Dandelion

Chemical test of aqueous extract of Dandelion	result
Total phenolic content (µg/mL)	22.82± 97
Total flavonoid content (mg/mL)	116.89± 2
Chlorophyll content (mg/L)	Ca:0.081±0.0 Cb:0.063±0.002

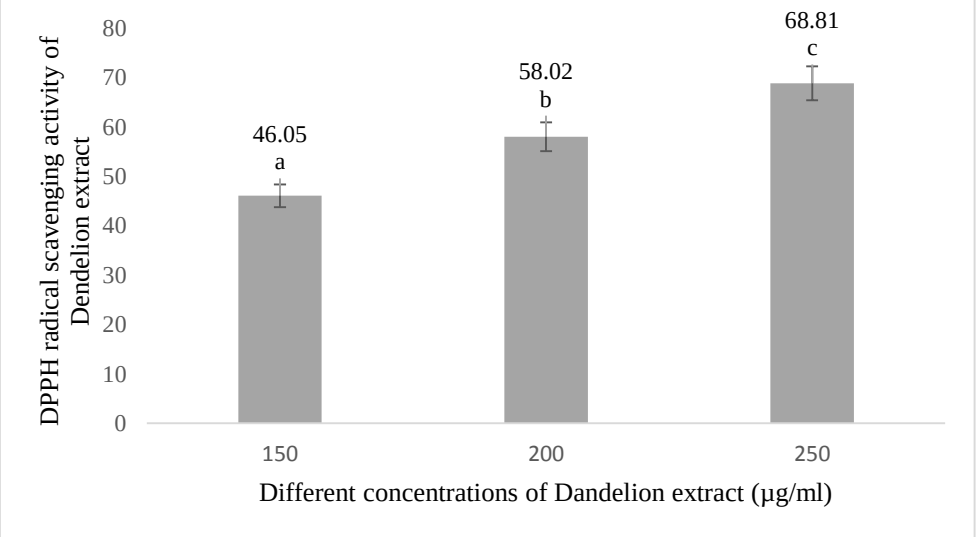

Fig. 1. DPPH radical scavenging activity of aqueous leaf extract of *Taraxacum pseudocalocephalum*. Bars with different letters are significantly different.

In a study by Ali *et al.*, (2016) antimicrobial Activity of dichloromethane, ethylacetate, methanol and water extracts of stem, root and flower of *Taraxacum officinale*, against *Streptococcus mutans, Streptococcus pyogenes, Streptococcus pneumonia, Streptococcus aureus* and *Pseudomonas aeruginosa* was evaluated. They addressed that among all types of plant extracts, the methanolic extracts were found to bear the highest antimicrobial potential against all examined bacterial strains, followed by the ethylacetate, the dichloromethane and the water extracts of the plant respectively. Among the plant parts observed, roots were observed to be more effective in inhibiting the growth of microorganisms followed by flower extracts. The stem extracts have a little effect on the growth of microorganisms (Amin Mir *et al.*, 2016).

Baba and Malik (2015) evaluated the antioxidant and antimicrobial activity of a methanolic extract of the roots of *Arisaema jacquemontii* and showed this extract prevented the growth of both Gram-positive and Gram-negative bacteria, at an MIC of 0.24– 0.41 mg/mL. They reported that antimicrobial and antioxidant activities of the extracts were positively associated with the total phenolic and flavonoid contents of the extract.

Antibacterial activity of the plant *Taraxacum officinale* leaves extracts including methanol, chloroform, and distilled water was investigated by Sohail et al. (2014). The results of this study showed that methanol and chloroform extracts of *Taraxacum officinale* were found to be effective against all tested pathogenic bacteria (*P. aeruginosa, E. coli, S. aureus, Bacillus Subtilis* and *Micrococcus luteus*), while water extracts showed no activity. MIC of the extracts against these bacterial strains was in the range of 0.30 mg/ml. They reported that phytochemical analysis result indicates the presence of secondary metabolites like Alkaloids, Tannins, and Flavonoids which may be responsible for antibacterial activity and the extracts of *Taraxacum officinale* have potential against growth of all tested pathogenic strains.

Xue et al. (2017) evaluated compounds extracted from different parts of Dandelion. Their study showed Dandelion leaf had the highest, while root had the lowest level of total phenolic and flavonoid contents. Among eleven phenolic acids and flavonoids which were identified, chicoric acid was the main component in all parts of Dandelion. Consistent with the total content of phenolics and flavonoids, leaf extract had the highest total antioxidant and DPPH scavenging activity.

Antibacterial activity of water-soluble polysaccharides from the *Taraxacum officinale* was investigated by Wang (2014). The result of this study showed that polysaccharides extracted from Dandelion (PD) displayed high antibacterial activity at a concentration of 100 mg/mL against *Escherichia coli*, *Bacillus subtilis* and *Staphylococcus aureus* and PD may be a viable option for use as a food preservative (Wang, 2014).

Sangeetha and Ezhilarasan. (2016) evaluated the antimicrobial effect of Dandelion against oral pathogens by the minimum inhibitory concentration and minimum bactericidal concentration. They reported that Dandelion shows high sensitivity against cariogenic microbes such as *Enterococcus faecalis* and *Streptococcus salivarius* and *Taraxacum officinale* suggested as a useful herb in order to control dental caries and endodontic infections.

Qian et al. (2014) prepared oligosaccharides from Dandelion (*Taraxacum officinale*) by hydrolysis with hydrogen peroxide and investigated their antibacterial activity. They reported that the oligosaccharides showed high antibacterial activity against *Escherichia coli*, *Bacillus subtilis* and *Staphylococcus aureus*, indicating that Dandelion-derived oligosaccharides have the potential to be used as antibacterial agents.

Conclusion

Although, many solvents are used for extraction, in this study water was chosen as extraction solvent because it is quite safe for human consumption as compared with other organic solvents. Generally, it can be stated that the aqueous leaf extract of Dandelion on Gram-

positive bacteria showed more antimicrobial activity than Gram-negative bacteria, while there is no significant inhibition on mold. The results of MIC and MBC/ MFC tests showed that *Staphylococcus epidermidis* was the most susceptible and *Aspergillus niger* was the most resistant strains to the aqueous extract of Dandelion leaves respectivel. As previously mentioned, polyphenolic substances are abundantly found in plants with high antimicrobial properties. The results of this study also showed that the content of phenolic compounds and especially the flavonoids of dandelion is in considerable quantities. According to our knowledge, Dandelion aqueous extract might be used as a natural agent to prevent the growth of food borne microorganisms, particularly, the cause of food poisoning that leading to the reduction of gastroenteritis risk.

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ارزیابی میزان کلروفیل، فعالیت ضداکسایشی و اثر ضدمیکروبی عصاره برگ قاصدک

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چکیده

در این پژوهش محتوای کلروفیل، محتوای فلاونوئیدی کل، محتوای فنل کل و فعالیت ضداکسایشی عصاره آبی قاصدک مورد بررسی قرار گرفت. همچنین، تأثیر عصاره آبی خبررسانک به‌دست آمده به روش خیساندن، بر برخی میکروارگانیسم‌های عامل فساد و مسمومیت ناشی از مواد غذایی آزمایش شد. فعالیت ضدمیکروبی عصاره برگ قاصدک با استفاده از روش‌های انتشار دیسک و چاهک، حداقل غلظت بازدارندگی و حداقل غلظت کشندگی مورد بررسی قرار گرفت. مقادیر به‌دست آمده برای TFC، TPC ، کلروفیل a و b به‌ترتیب ۲۲/۸۲ (میکروگرم بر میلی‌لیتر)، ۱۱۶/۸۹ (میلی‌گرم بر میلی‌لیتر)، ۰/۸۱ (میلی‌گرم بر لیتر) و ۰/۰۶۳ (میلی‌گرم در لیتر) بود. فعالیت به دام‌اندازی رادیکال‌های آزاد، بر حسب IC_{50} برابر با ۶۸/۸۱ میکروگرم بر میلی‌لیتر بود. نتایج نشان داد که MIC عصاره برگ قاصدک بر *Aspergillus niger*، *Salmonella typhimurium*، *Bacillus subtilis* و *Staphylococcus epidermidis* به‌ترتیب ۵۱۲، ۲۵۶، ۲۵۶ و ۶۴ میلی‌گرم بر میلی‌لیتر بود. MBC عصاره برگ قاصدک بر *Aspergillus niger*، *Salmonella typhimurium*، *Bacillus subtilis* و *Staphylococcus epidermidis* به‌ترتیب بیش از ۵۱۲، ۲۵۶، ۲۵۶ و ۱۲۸ میلی‌گرم بر میلی‌لیتر به‌دست آمد. نتایج نشان داد که قطر هاله بازدارندگی در روش چاهک آگار بیشتر از روش دیسک دیفیوژن بوده و سویه‌ها در غلظت بالاتر قطر هاله بازدارندگی بیشتری نشان دادند. به‌طور کلی می‌توان اظهار داشت که عصاره آبی گیاه قاصدک روی باکتری‌های گرم مثبت فعالیت ضدمیکروبی بیشتری نسبت به باکتری‌های گرم منفی داشت، در حالیکه اثر بازدارندگی چشمگیری بر کپک‌ها نداشت. بر اساس یافته‌های این پژوهش، عصاره آبی قاصدک می‌تواند به‌عنوان یک ماده طبیعی برای جلوگیری از رشد میکروارگانیسم‌های عامل فساد مواد غذایی و به‌ویژه عامل مسمومیت غذایی و با هدف کاهش خطر ابتلا به بیماری‌های گوارشی، مورد استفاده قرار گیرد.

واژه‌های کلیدی: قاصدک، فعالیت ضدمیکروبی، فعالیت ضداکسایشی، میکروارگانیسم‌های بیماری‌زا.

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