MANSOURA JOURNAL OF BIOLOGY
Official Journal of Faculty of Science, Mansoura University, Egypt
E-mail: scimag@mans.edu.eg ISSN: 2974-492X

Chemical Composition of *Launaea spinosa* Methanolic Extract and Its Potential Antioxidant and Antimicrobial

Basma S. El-Nabawy [1,] *, Hoda M. Soliman [1] and Yasser A. El-Amier [1]

[1]*Botany Department, Faculty of Science, Mansoura University, Mansoura - 35516, Egypt*

**** Correspondence to:** yasran@mans.edu.eg; Tel. +201017229120*

Received:30/1/2024
Accepted: 16/3/2024

Abstract:*Launaea* plants, which are members of the Asteraceae family, are used in ethnomedicine to address various health conditions. The medicinal properties of *Launaea spinosa* are used for the treatment of various ailments. The study aimed to conduct preliminary phytochemical screening of crude extracts of *L. spinosa* and evaluate its antioxidant and antibacterial potential. Above-ground parts of *L. spinosa* were collected from Wadi Hagoul in the Eastern desert of Egypt. Phenolic, flavonoids, alkaloids, saponins and tannins were estimated in the extract. Antioxidant activity was evaluated using DPPH assay. The extract showed antioxidant activity ranging from 13.08% at 100 mg/mL to 72.05% at 1000 mg/mL with IC_{50} value of 59.66 mg/mL. Antibacterial activity was tested against Gram negative and positive bacteria. The extract showed antibacterial activity against most of the tested bacterial isolates. The study concluded that *L. spinosa* extract contains bioactive compounds and has potential as a natural antioxidant and antibacterial.

keywords: *Launaea*, Asteraceae, DPPH, Antimicrobial, Phytochemical.

1. Introduction

Asteraceae (Compositae) is a large family of flowering plants that is widely distributed worldwide, particularly in the semi-arid areas of the tropics and subtropics. It has around 1600 genera and 25000 species globally. The flora of Egypt has a significant number of representatives from the Asteraceae family, with 98 genera and 228 species [1]. The majority of species of this family consist of evergreen shrubs, subshrubs, or perennial rhizomatous herbs. However, biennial and annual herbs are also commonly found [2]. *Launaea* Cass. is the most extensive genus globally, consisting of around 40 species [3]. At least five species of the genus *Launaea* are found in the Southwestern region of the Mediterranean Basin. The mentioned species are pioneering plants in dry vegetation or in shrub areas that have been modified [4-6]. The genus *Launaea* comprises smooth, herbaceous plants that may be either annual or perennial, with occasional shrubs that have few or no spines. This genus consists of around 40 species, mostly found in the Saharo-Sindian, Mediterranean, and Irano-Turanian regions. They may also be found in Tropical and South Africa, as well as in India [7]. The genus *Launaea* is found in Egypt and consists of around 11 species according to El-Hadidi and Fayed [8], or 9 species according to Boulos [1].

Medicinal applications have been observed in some cultures for different components of the plant. The leaves, specifically, are said to provide possible therapeutic advantages in traditional medicine. *Launaea spinosa* does play a role in local ecosystems. It provides habitat and food sources for various insects and small animals. In some cultures, *Launaea spinosa* has been traditionally used for medicinal purposes. Conservation efforts often focus on controlling the spread of invasive species to protect the biodiversity of native flora and fauna.[9]

Novel sustainable approaches are necessary to mitigate the proliferation of harmful germs and extend the longevity of food items, without relying on synthetic preservatives. In recent times, several researchers have explored the potential use of some plant extracts as efficient natural preservatives [10-12]. Historically, the

unrefined extracts derived from various components of medicinal plants, such as the root, stem, flower, fruit, and twigs, were extensively used for the treatment of certain human ailments [13]. Medicinal plants include several phytochemicals, including flavonoids, alkaloids, tannins, and terpenoids, which have antibacterial and antioxidant activities.[14]

Chronic diseases are often caused by oxidative stress. Asthma, inflammatory arthropathies, diabetes, Parkinson's and Alzheimer's diseases, cancers, and atherosclerosis are linked to free radicals and other reactive oxygen species. Human aging is linked to reactive oxygen species [15, 16]. Antioxidants delay or prevent molecular oxidative damage [17]. Free radical trapping is an antioxidant's main function. Antioxidants such phenolic acids, polyphenols, and flavonoids eliminate peroxide, hydroperoxide, and lipid peroxyl. They suppress oxidative processes that produce degenerative illnesses [18]. Since ancient times, herbs have been antioxidants.

Plants have long been used as a source of nourishment and medicinal products. Plants include a wide range of bioactive chemical compounds and have been often used either in traditional remedies or as pure active ingredients. Utilizing indigenous plant species, whether cultivated or in their natural state, as alternatives to manufactured preparations is a sensible approach. The efficacy of traditional herbal remedies has been proven by several researchers. The use of herbal remedies as a form of complementary and alternative medicine has seen a significant surge over the last two to two and a half decades [19]. The present study aimed to a preliminary phytochemical screening of the crude extracts of *Launaea spinosa* and evaluate the antioxidant and antibacterial potential of its extract.

2. Materials and Methods

2.1. Plant samples collection and preparation

The above-ground parts of *Launaea spinosa* were gathered from Wadi Hagoul, located in the Eastern desert of Egypt (30°01′32.64″N 32°44′78.6″E), in the spring of 2023. The specimens were verified based on the authentication methods described by Tackholm [20] and Boulos [2]. The specimens were gathered in separate plastic pouches and promptly transported to the laboratory. The specimens were desiccated in a shady location at ambient temperature (25 ± 3 °C) for a duration of 7 days, pulverized using a grinder to achieve a particle size of 3.0 mm, and thereafter enclosed in paper bags.

2.2. Phytochemical Constituents

Total phenolic, flavonoids, and alkaloids were estimated according to the assays described by Stankovic [21], Chlopicka et al. [22], and Joshi et al. [23], respectively. Saponins' content was determined using the method described by Obadoni and Ochuko [24], while tannins according to Van Burden and Robinson [25].

2.4. Antioxidant activities

The assessment of antioxidant activity was conducted by using the free radical DPPH (1,1-diphenyl-2 picrylhydrazyl) [26]. A volume of 1 mL of a DPPH solution with a concentration of 0.15×10^{-3} M was combined with 1 mL of *L. spinosa* extract that were generated at various concentrations (100, 200, 400, 600, 800, and 1000 mg/mL). A control was made by combining one milliliter of DPPH with one milliliter of the solvent. The mixture was subjected to light exclusion and incubated at room temperature for a duration of thirty minutes. Subsequently, the absorbance was quantified at a wavelength of 517 nm [27]. The IC_{50} values were calculated using graphical methods, and the antioxidant activity was represented as:

%RSA = [1-A_sample/A_control]*100

2.4. Antibacterial Activity Assay

The antimicrobial activity of the samples was assessed using a modified Kirby-Bauer disc diffusion technique, as described by Bauer [28]. The filter paper discs, which had a diameter of five milliliters and had been sterilized, were soaked in the plant extracts that had been prepared in advance. These discs were then placed on top of the nutrient agar medium that had been inoculated with the pathogenic microorganisms being tested for the antibacterial experiment [29]. As a negative control, filter discs soaked in 10 µl of solvent (DMSO) were used. The Petri plates were

placed in an incubator set at a temperature of 37 °C for a duration of 24 hours. Subsequently, the diameter (in millimeters) of the zone of inhibition was measured. The *L. spinosa* extract was tested against three-gram negative bacteria: *Pseudomonas aeruginosa*, *Escherichia coli*, and *Salmonella typhi*, and two-gram positive bacteria; *Staphylococcus aureus*, and *Bacillus cereus.*

3. Results and Discussion

3.1. Phytochemical Constituents

Many consider phytochemistry to be an early branch of organic chemistry as it deals with the chemical make-up of plants and all the many components they contain. It is of utmost significance to characterize and find medicinally active chemicals produced from plants [30]. The distinct characteristics of the studied plant and the varied array of phytoconstituents that showed variation between plant samples were uncovered by a thorough examination of the analytical data relating to *L. spinosa*. Also, the tested plant has a lot of alkaloids, flavonoids, phenols, tannins, and saponins, according to the analysis (Figure 1). Many chemical classes have been recognized for their pharmacological actions against various disorders. These classes include alkaloids, saponins, tannins, anthraquinones, and flavonoids. Hassan et al. [31] and Usman and Osuji [32] conducted research that demonstrated the historical use of these compounds for the treatment of various medical disorders.

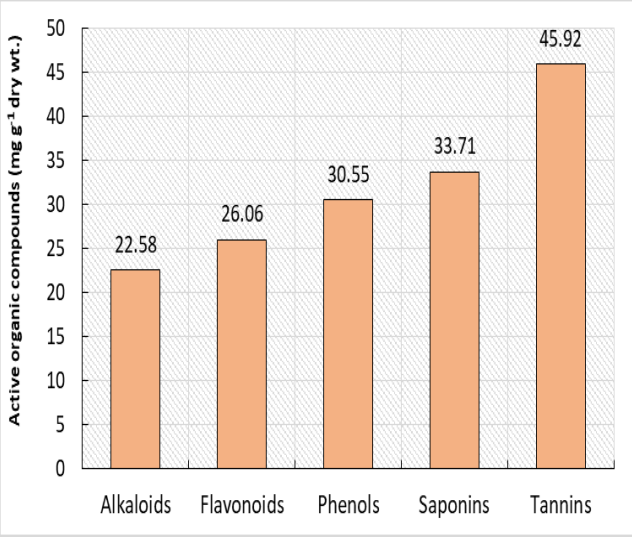

Figure 1. Active organic compounds (mg g^{-1} dry wt.) of *L. spinosa* collected from the inland desert.

3.2. Antioxidant assay

Antioxidants have a crucial role in safeguarding human cells from oxidative stress, hence diminishing the likelihood of developing cancer [33]. The antioxidant activity of the MeOH-extract of L. spinosa was evaluated using the free radicals 2,2-diphenyl-1-picrylhydrazyl (DPPH). The amount of antioxidant needed to lower the initial concentration of DPPH by 50% (IC_{50}) was determined as a measure of antioxidant activity. There is a relationship between the IC_{50} and antioxidant power that is directed in the opposite direction: as the IC50 drops, the antioxidant activity rises. Catechol was used as a benchmark compound in this investigation. The research findings indicate that the methanolic extract of the plant under investigation had antioxidant activity that varied depending on the dosage ($P < 0.05$). This activity was similar to that of catechol, which was used as a reference standard (Table 1). The extract of *L. spinosa* exhibited a scavenging activity of 72.05% at a concentration of 1000 mg/ml. Nevertheless, the antioxidant activity is at its lowest level when the concentration is at its minimum (100 mg/ml) (Table 1). Based on the IC_{50} findings, the IC_{50} values of plant extract were determined to be 59.66 mg/ml, in comparison to catechol with an IC_{50} value of 15.41 mg/ml. In accordance with the findings of the current investigation of *L. spinosa*, the findings of Abd-ElGawad et al. [33], Corenara et al. [34], and Leointi [35] are consistent.

Several studies have shown that the antioxidant activities of plants are controlled by the quantity of bioactive compounds, namely phenolic elements such as flavonoids, phenolic acids, ascorbic acid, and carotenoids [36]. Our study results suggest that this particular plant has nonvolatile chemicals, such as tannins, flavonoids, and phenolic substances.

3.3. Antibacterial Activity

The antimicrobial potential of methanolic extract of *L. spinosa* shows various inhibitory spectrum activities against bacteria with different degrees as illustrated by assessing the diameters of clear zone created by the extracts (Table 2). The findings indicated that most of the extracts had significantly superior antibacterial activity compared to the

conventional antibiotics tested against a range of bacterial isolates, except for S. typhimurium (Table 2). The assessed antibacterial activity of the *L. spinosa* extract could be attributed to its contents of alkaloids, phenolics and tannins, particularly the flavonoids compounds that have been reported to possess antimicrobial activity .[37]

Polyphenols, as demonstrated by Laouini and Ouahrani [38] and Kumar and Goel [39], can act as antibacterial, antioxidant, and antitumor agents, as well as against a number of pathogenic microorganisms. Alkaloids' antimicrobial and anti-inflammatory effects are well known [40.41]. Górniak et al. [42] assert that plants synthesize flavonoids as a reaction to microbial infection

Table 1. Scavenging activity percentage of DPPH and the IC_{50} values by *L. spinosa* MeOH extract and catechol as standard.

Plant species	Concentration (mg/ml)	Scavenging activity (%)	IC_{50} (mg/ml)
L. spinosa	1000	72.05±1.24	**59.66**
	800	69.33±2.31	
	600	51.27±1.76	
	400	36.95±0.81	
	200	24.57±1.05	
	100	13.08±0.62	
	$LSD_{0.05}$	2.52	
Catechol	500	84.35±2.36	**15.41**
	400	71.67±1.07	
	300	65.00±1.43	
	200	56.33±0.98	
	100	32.47±0.88	
	$LSD_{0.05}$	3.76	

Table 2. The antibacterial activities represented by the inhibition zone diameter (mm) of the extracted MeOH from *L. spinosa* and standard antibiotics.

Organism	*L. spinosa*	Standard antibiotic (10 mg L^{-1})		
		Ampicillin	Cefotaxime	Tetracycline
Gram-negative bacteria				
Escherichia coli	25	22	12	22
Pseudomonas aeruginosa	18	9	-	8
Salmonella typhi	0	15	12	-
Gram-positive bacteria				
Bacillus cereus	25	22	27	25
Staphylococcus aureus	14	-	22	20

4. Conclusion

In conclusion, *Launaea spinosa* exhibits biological activity that spans ecological, medicinal, and cultural dimensions. As a plant species, it plays a role in local ecosystems by providing habitat and food for various organisms, contributing to soil stabilization, and showcasing adaptability to challenging environmental conditions. Culturally, it holds traditional significance in certain regions, with its leaves being utilized for medicinal and culinary purposes. Current research demonstrates that the plant has a high concentration of active secondary chemicals, which function as natural antioxidants and antimicrobials. It is common practice for conservation efforts to place a higher priority on the control of invasive species in order to preserve the diverse array of native plants and animals.

4. References

1. Boulos, L. (2009); Flora of Egypt; Al Hadara Publishing: Cairo, Egypt, Vol. **2**.
2. Boulos, L. (2002); Flora of Egypt; Al Hadara Publishing: Cairo, Egypt, Vol. **3**.
3. El-Hadidi, M.N. and Fayed, A.A. (1995). Materials for Excursion Flora of Egypt (EFE). Cairo Univ. Herbarium, Giza, Egypt, Taeckholima, **15**:74 -75.
4. Feinbrun-Dothan, N. (1978). Flora Palaestina. Parts 3. The Israel Academy of Sciences and Humanities, Jerusalem.

5. Schütz, W. and Milberg, P. (1997). Seed Germination in Launaea arborescens: A Continuously Flowering Semi-Desert Shrub. *Journal of Arid Environments*, **36**: 113–122.
6. El-Bassuony, A.A. and Abdel-Hamid, N.M. (2006). Antibacterial Coumarins Isolated from Launaea resedifolia. Chemistry of Plant Raw Materials, **1**: 65-68.
7. Boulos, L. (1976). Sonchus L. In: Flora Europaea. Volume **4**. Cambridge, England: Cambridge Univ. Press: 327-328.
8. Kilian, N. (1997). Revision of Launaea Cass. (Compositae, Lactuceae, Sonchinae). Englera, **17:** 1- 478.
9. Asif, M., Mahrukh, Saadullah, M., Yaseen, H.S., Saleem, M., Yousaf, H.M., Khan, I.U., Yaseen, M. and Shams, M.U., (2020). Evaluation of in vivo anti-inflammatory and anti-angiogenic attributes of methanolic extract of Launaea spinosa. Inflammopharmacology, **28**, pp.993-1008.
10. Fernández-López, J., Zhi, N., Aleson-Carbonell, L., Pérez-Alvarez, J. A., and Kuri, V. (2005). Antioxidant and antibacterial activities of natural extracts: application in beef meatballs. Meat Sci. **69**, 371–380.
11. Suppakul, P., Thanathammathorn, T., Samerasut, O., and Khankaew, S. (2016). Shelf life extension of “fios de ovos”, an intermediate-moisture egg-based dessert, by active and modified atmosphere packaging. Food Control **70**, 58–63 .
12. Clarke, D., Tyuftin, A. A., Cruz-Romero, M. C., Bolton, D., Fanning, S., Pankaj, S. K., et al. (2017). Surface attachment of active antimicrobial coatings onto conventional plastic-based laminates and performance assessment of these materials on the storage life of vacuum-packaged beef sub-primals. Food Microbiol. **62**, 196–201
13. Khan, U. A., Rahman, H., Niaz, Z., Qasim, M., Khan, J., Tayyaba, et al. (2013). Antibacterial activity of some medicinal plants against selected human pathogenic bacteria. Eur. *J. Microbiol. Immunol*. **3**, 272–274 .
14. Talib, W. H., and Mahasneh, A. M. (2010). Antimicrobial, cytotoxicity and phytochemical screening of Jordanian plants used in traditional medicine. Molecules **15**, 1811–1824 .
15. Kanwar JR, Kanwar RK, Burrow H, Baratchi S. (2009) Recent advances on the roles of NO in cancer and chronic inflammatory disorders. Curr Med Chem.; **16**: 2373–2394 .
16. Chiavaroli V, Giannini C, De Marco S, Chiarelli F, Mohn A. (2011) Unbalanced oxidant-antioxidant status and its effects in pediatric diseases. Redox Rep.; **16**: 101–107.
17. Yamagishi S, Matsui T. Nitric (2011) oxide, a Janus -faced therapeutic target for diabetic microangiopathy-Friend or foe? Pharmacol Res.; **64**: 187–194 .
18. Wu YY, Li W, Xu Y, Jin EH, Tu YY (2011). Evaluation of the antioxidant effects of four main theaflavin derivatives through chemiluminescence and DNA damage analyses. *J Zhejiang Univ Sci B*.; **12:** 744–751 .
19. Tackholm, V. (1974) Students’ Flora of Egypt, 2nd ed.; Cairo University Press. Cairo, Egypt,.
20. Stankovic, M.S. (2011). Total phenolic content, flavonoid concentration and antioxidant activity of Marrubium peregrinum L. extracts. Kragujevac *Journal of Science*, **33:** 63-7.
21. Chlopicka, J.; Pasko, P.; Gorinstein, S.; Jedryas, A. and Zagrodzki, P. (2012). Total phenolic and total flavonoid content, antioxidant activity and sensory evaluation of pseudocereal breads. LWT-Food Science and Technology, **46(2)**: 548-555.
22. Joshi, N.; Sah, G. and Mishra, D. (2013). GC-MS analysis and antimicrobial activity of essential oil of Senecio pedunculatus. *IOSR Journal of Applied Chemistry*, 6: 61
23. Obadoni, B. and Ochuko, P. (2001). Phytochemical composition, spoilage and shelflife extension. studies and Comparative efficacy of the crude extracts of some homeostatic plants in Edo and Delta States of Nigeria. Global *Journal of Pure and Applied Science*, **8**: 203-208.

24. Van Buren, J.P. and Robinson, W.B. (1969). Formation of complexes between protein and tannic acid. *Journal of Agricultural and Food Chemistry*, **17(4):** 772-777 .
25. Miguel, M.G. (2010). Antioxidant activity of medicinal and aromatic plants. A review. *Flavour and Fragrance Journal*, **25(5):** 291-312.
26. Dawidar, A.M.; Ghani, A.; Alshamy, M. M.; Tawfik, E. H. and Abdel-Mogib, M. (2015). Fatty Acid Pattern and alkaloids of Echium rauwolfii. *International Journal of Science and Engineering Applications*, **4(4)**: 208-213.
27. Bauer, A.W. (1966). Antibiotic susceptibility testing by a standardized single disc method. *American Journal of Clinical Pathology*, **45**: 149-158 .
28. Cappuccino, J. and Sherman, N. (1992). Microbiology: A Laboratory Manual, 3rd Edn. New York: Benjamin/Cummings Pub, **134**: 125-179 .
29. Oszahin AD, Kirecci OA. (2016) Antioxidant properties, characterization of nutrients, and phytochemistry of seven medicinal plants. Chemistry of Natural Compounds.; **52(6)**:1081-1083
30. Hassan MM, Oyewale AO, Amupitan JO, Abduallahi MS, Okonkwo EM. (2004) Preliminary Phytochemical and antibacterial investigation of crude extracts of the root bark of Detarium microcarpum. *J Chem Soc Nigeria*.; **29**: 26–29 .
31. Usman H, Osuji JC. (2007) Phytochemical and in vitro antimicrobial assay of the leaf extract of Newbouldia leavis. *Afr J Trad CAM.*; **4(4):** 476–480.
32. Abd-ElGawad, A.M.; El-Amier, Y.A.; Assaeed, A.M.; Al-Rowaily, S.L., (2020) Interspecific variations in the habitats of Reichardia tingitana (L.) Roth leading to changes in its bioactive constituents and allelopathic activity Saudi *Journal of Biological Sciences*, **27**, 489-499.
33. Cornara, L.; La Rocca, A.; Marsili, S.; Mariotti, M., (2009) Traditional uses of plants in the Eastern Riviera (Liguria, Italy) *Journal of Ethnopharmacology*, **125**, 16-30
34. Leonti, M. (2006). Local Mediterranean food as a source of novel nutraceuticals. in In Pharmaceutical Soc Great Britain. Pharmaceutical Press-Royal Pharmaceutical Soc Great Britian.
35. Sytařová, I.; Orsavová, J.; Snopek, L.; Mlček, J.; Byczyński, Ł.; Mišurcová, L., (2020) Impact of phenolic compounds and vitamins C and E on antioxidant activity of sea buckthorn (Hippophaë rhamnoides L.) berries and leaves of diverse ripening times Food chemistry, **310**, 125784 .
36. Salehi, B.; Krochmal-Marczak, B.; Skiba, D.; Patra, J.K.; Das, S.K.; Das, G.; Popović-Djordjević, J.B.; Kostić, A.Ž.; Anil Kumar, N.V.; Tripathi, A.; et al. (2020) Convolvulus plant-A comprehensive review from phytochemical composition to pharmacy. Phytotherapy Research, **34**, 315-328.
37. Laouini, S.E. and Ouahrani, M.R. (2017). Phytochemical screening, In vitro antioxidant and antibacterial activity of Rumex vesicarius L. extract. Scientific Study and Research. Chemistry and Chemical Engineering, Biotechnology, Food Industry, **18**: 367-376.
38. Kumar, N. and Goel, N. (2019). Phenolic acids: Natural versatile molecules with promising therapeutic applications. Biotechnology Reports, **24**: e00370.
39. Singh, B. and Sharma, R. A. (2013). Anti-inflammatory and antimicrobial properties of pyrroloquinazoline alkaloids from Adhatoda vasica Nees. Phytomedicine, **20(5)**: 441-445.
40. Wangchuk, P.; Sastraruji, T.; Taweechotipatr, M.; Keller, P.A. and Pyne, S.G. (2016). Anti-inflammatory, anti-bacterial and anti-acetylcholinesterase activities of two isoquinoline alkaloids–Scoulerine and Cheilanthifoline. Natural Product Communications, **11(12)**: 1934578X1601101207 .
41. Górniak, I.; Bartoszewski, R. and Króliczewski, J. (2019). Comprehensive review of antimicrobial activities of plant flavonoids. Phytochemistry Reviews, **18**: 241-272.