The Biological Effect of Forssk (*Achillea fragrantissima*) Aqueous Extract on the Immune System of Experimental Rats

Alaa A. Sayed, Omnia G. Refaat and Hany G. EL-Masry
Nutrition and Food Science Department, Faculty of Home Economics, Helwan University, Cairo, Egypt

Abstract

The present study aimed to investigate the biological effect of Forssk (Achillea fragrantissima) aqueous extract on the immune system of experimental rats. Thirty-five adult male rats (Sprague Dawley strain) were randomly divided into five equal groups (n=7). Group 1 was the control negative group, whereas the other 4 groups were injected with cisplatin (3.5 mg/kg) once every 3 days for 2 consecutive weeks. Group 2 was kept as the immunotoxic control group (+ve group). Group 3 was orally administered 1 ml/day of Forssk (Achillea fragrantissima) aqueous extract at a concentration of 5%, while Group 4 received 1 ml/day of Forssk (Achillea fragrantissima) aqueous extract at a concentration of 7.5%. Group 5 was orally administered 1 ml/day of Forssk (Achillea fragrantissima) aqueous extract at a concentration of 10% for 8 weeks. Results showed that intraperitoneal injection of cisplatin in rats caused a significant ($P<0.05$) reduction in body weight, spleen weight, serum immunoglobulins (IgG, IgM, and IL-1B), total protein, albumin, globulin, leukocytes, and neutrophils, whereas lymphocytes and monocytes significantly increased in the positive control group compared to the negative control group. On the other hand, oral administration of Forssk (Achillea fragrantissima) aqueous extract attenuated these adverse effects and markedly ameliorated biochemical and functional alterations in the spleen caused by cisplatin injection. In conclusion, Forssk (Achillea fragrantissima) aqueous extract stimulates the immune system of rats with cisplatin-induced suppressed immunity. This study recommends increasing the consumption of Forssk (Achillea fragrantissima) in the diet, as it may raise the immune response in patients with immune disorders.

Keywords: Forssk, Achillea fragrantissima, Immune System, Cisplatin, Rats.

INTRODUCTION

The immune system plays the most effective role in preventing invasion of pathogens through immune response in order to maintain the physiological balance. However, several factors may affect or even destroy the immune response, and cause immune disorder further, such as malnutrition, application chemotherapy and stressors **(Huang *et al*., 2016)**. The damaged immune system can lead to inflammatory diseases, autoimmune diseases, and even cancer **(McComb *et al*., 2019)**. Immunotoxicity could be the result of direct or indirect action of a chemical on the immune system, causing a suppression or activation of the immune response. Compromised immune response can result in suppression of host resistance to infectious agents as well as tumor cells **(Khalaf *et al*., 2019)**.

Cisplatin (also known as cisplatinum is a platinum-containing compound which inhibits synthesis of RNA, DNA and protein in cells. Cisplatin is one of the most effective anticancer drugs used for the treatment of various oncologic diseases. Despite its effective anticancer efficacy, cisplatin exerts many undesirable adverse effects, including +hepatotoxicity, nephrotoxicity, spermiotoxicity, and immunotoxicity toxic effects of cisplatin are attributed to several factors, such as peroxidation of the cell membrane, DNA damage, mitochondrial dysfunction, inhibition of protein synthesis, and ability to affect host immune response **(Khalaf *et al*., 2019)**.

Herbs are traditionally used in many therapeutic practices, if not as the main, then as the accompanying therapy in combination with medications, aimed at boosting immunity for prevention.

Phytotherapy has repeatedly proven its effectiveness, including its ability to cope with infectious diseases **(Babich *et al*., 2020)**.

Forssk *(Achillea fragrantissima)* Sch. Bip. (*A. fragrantissima*) is related to the Asteraceae family in Arabic called ‘’Qaysoom’’. Traditionally, it is used as a medical plant in Arabian countries for the treatment of dysfunction of the liver and kidneys, gastrointestinal tract, as well as wound healing due to its antiseptic properties **(Eissa *et al*., 2018)**. *Achillea fragrantissima* is used in the treatment of common health problems such as respiratory disease, eye infections, smallpox, fever, diabetes, dysmenorrhea, headache, or fatigue **(Awad *et al*., 2017)**. It has antioxidant and anti-inflammatory effects **(Patocka and Navratilova., 2019)**. A. fragrantissima may be useful as an alternative remedy for prophylaxis for some fatal diseases such as COVID-19 before infection and restore and modulate the immune response in vivo **(Alhomaid *et al*., 2022)**.

MATERIALS AND METHODS

A. Materials

1. **Plants:** Forssk were obtained from Agriculture Research Center, Egypt.
2. **Chemicals:** Cisplatin, casein, cellulose, choline chloride, D-L methionine, vitamin and mineral constituents were purchased from El-Gomhoriya Pharmaceutical Company, Cairo, Egypt. Starch, corn oil, and sucrose were obtained from the Egyptian local market .
3. **Experimental animals:** Thirty-five adult male rats **(**Sprague Dawley strain), weighing about (180±10) g b.wt. were obtained from the Laboratory Animal Colony, Helwan, Egypt.

B. Methods

1. Preparation Forssk *(Achillea fragrantissima*) Extract:

The crude water extract was prepared by boiling 100 grams of dry powder with 300 ml of distilled water for 10 to 15 minutes, then sieve and then the crude extract is evaporated until a paste is obtained and then dried. The solid crude extracts were weighed and then 10 g were dissolved in 100 ml of distilled water according to **Chaplins'ka and Golovkin (1962).**

2. Induction of Immune Diseases:

Cisplatin-induced immune deficiency diseases in rats. Intraperitoneal injection of male albino rats with cisplatin (3.5 mg/kg) once every 3 days for consecutive 2 weeks **(Wang *et al*., 2013)**.

3. Preparation of Basal Diet:

The basal diet consisted of protein (14%), corn oil (5%), mineral mixture (3.5%), vitamin mixture (1%), fiber (5%), sucrose (10%), choline chloride (0.25%) and the remainder was Corn starch up to 100%. These constituents were thoroughly mixed together and formulated according to **Reeves *et al*., (1993)**.

4. Experimental Design:

The experiment and biochemical determination were conducted at Graduate Research Labs, Nutrition and Food Science Dept., Faculty of Home Economics, Helwan University. Rats were kept in standard cages at room temperature (25±3°C) with a 12 h dark/light cycle. They were left for seven days as an adaptation period and they were allowed to feed standard laboratory food and water.

After the adaptation period, rats were divided into two main groups, as follows: -

- **First group:** Negative control group, rats (n=7) were fed only on basal diet during the experimental period.
- **Second group:** Immunotoxic rats (n=28), after cisplatin injection, rats were divided as follow:

Subgroup (1): Rats (served as positive control group) were fed on basal diet only

Subgroup (2): Rats were fed on basal diet and orally given 1 ml/day of Forssk aqueous extract at concentration of 5%

Subgroup (3): Rats were fed on basal diet and orally given 1 ml/day of Forssk aqueous extract at concentration of 7.5%.

Subgroup (4): Rats were fed on basal diet and orally given 1 ml/day of Forssk aqueous extract at concentration of 10%.

5. Biological Evaluation:

Feed intake was recorded daily, and animals were weighed at the beginning and twice a week throughout the experimental period. Body weight gain and feed efficiency ratio were calculated at the end of the experiment according to the method of **Chapman *et al*., (1959)**.

6. Blood Collection and Serum Separation:

At the end of the experimental period (8 weeks), rats were fasted overnight before scarifying and blood samples were collected from each rat and were centrifuged at 3000 rpm for 15 min to obtain the serum for biochemical analysis.

7. Biochemical Analysis:

Biochemical analyses were conducted in the National Research Center. Collected serum were used for determination of:

- Immunoglobulins (IgM and IgG) were measured according to **Ziva and Pannall, (1984)**.
- Concentration of total protein was determined according to **Burtis and Ashwood (1999)**. Albumin and globulin were determined according to **Young, (1995)**.
- Levels of leukocytes, neutrophil, lymphocyte, monocytes, eosinophil and basophil were estimated according to **Ochei and Kolharktar, (2008)**.
- The plasma level of malondialdehyde (MDA) was calculated to measure lipid peroxidation and determined according to **Draper and Hadley (1990)**. Glutathione peroxidase (GP_X) was measured methods by **Aebi, (1984), Moin, (1986),** respectively.
- Concentrations of pro-inflammatory cytokines (interleukin (IL)-1β, were determined using a commercial kit according to manufacturer's instruction.

8. Statistical Analysis:

All data obtained were analyzed using Statistical Package for the Social Sciences (SPSS) for Windows, version 20 (SPSS Inc., Chicago, IL, USA). Collected data were presented as mean± standard deviation (SD). Analysis of Variance (ANOVA) test were used for determining the significances among different groups according to **(Armitage and Berry, 1987)**. All differences were considering significant if P-values were ($P< 0.05$).

Results and Discussion

The results in **Table 1** showed that intraperitoneal injection of cisplatin to rats caused a decrease in feed intake and a significant ($P<0.05$) reduction in body weight gain (BWG%), feed efficiency ratio (FER) and spleen relative weight % when compared to the negative control group. Oral administration of Achillea fragrantissima aqueous extract to rats inflicted with immune deficiency diseases (IDD) caused increasing in feed intake and a significant ($P<0.05$) increases in FER, body weight and spleen weight as compared to the positive control group.

Lin *et al*., (2018) demonstrated that cisplatin administration resulted in significantly decrease in feed intake, body weight and feed efficiency, as found in the present study. Immunotoxicity may parallel alterations in the weight of lymphoid organs (spleen) **(Pearse *et al*., 2009)**. Results of the present study were in the same line with **Alhejaily *et al*., (2023)** who found that rats fed on diets supplemented with Achillea fragrantissima extract (AFE) The weight gains and percentage changes in weight gain were significantly increased in G3 (AFE + ethanol), versus G2 (positive control). Moreover, **Al-Sarraf *et al*., (2020)** reported that there was significant increase in the spleen weight ($P<0.01$), in the 3 studies-groups(peritoneal injection of Achillea fragrantissima oil extract at 10, 20 and 40 mg/kg of body-weight,(2/day for 10 days), respectively compared with controlling-group.

Results presented in **Table 2**, revealed that rats inflicted with immune deficiency diseases by cisplatin had significant ($P<0.05$) reduction in serum immunogolobulin G (IgG) ,immunogolobulin M (IgM) and IL-1B antibodies levels when compared with the negative

control (-ve) group. Administration withAchillea fragrantissima aqueous extracton to IDD rats resulted in significant (P<0.05) increases in serum IgG, IgM and IL-1B as compared to the positive control group. it was also observed that rats administrated with 1 ml with concentration 10% of Achillea fragrantissima aqueous extract onrecorded the best results for increasing IgM, IgG and IL-1B.

Results in **Table 2** were confirmed by **Nassef *et al*., (2018)** who reported that cisplatin injection to rats caused a significant reduction is serum immunoglobulin (IgG, IgM). Administration of A. fragrantissima succeeded in rising IgM titer for the first dose of SRBC and IgG for the second dose of SRBC significantly. The present results agree with **Mathivanan and Kalaiarasi (2007)** who concluded that medicinal plants increased antibody titer against SRBC more than virginiamycin. In the same line of the present study, **Alhomaid *et al*., (2022)**, showed that The groups that received 500 mg/kg A. fragrantissim showed a substantial (P<0.05) increase in total Igs.

Results illustrated in **Table 3** showed that rats injected intraperitoneally with cisplatin had significant decreases in the serum levels of total protein, albumin and globulin when compared with the negative control group. Oral administration of Achillea fragrantissima aqueous extract to IDD rats significantly normalized (P < 0.05) the levels of total protein, albumin and globulin in the serum. In this study, exposure of rats to cisplatin resulted in significant decrease in total protein, globulin and albumin concentration. These results were confirmed by **Parameshappa *et al*., (2012); Abd El Azeem *et al*., (2019)** and **Khalaf *et al*., (2019)**. Results also, in agreement with that of **Mandour *et al*., (2013)**, showed that the plant extract of Achillea fragrantissima induced a

significant increase in total proteins and globulins in rats , yet it did not ex-ceed the normal reference range in all animals.

Results in **Table 4** showed that positive control group had a significant decrease (P<0.05) in leukocytes, Neutrophil and basophil and significant increase (P<0.05) in levels of lymphocyte, monocytes and eosinophil when compared to the negative control group. On the other hand, rats that administrated orally different levels of Achillea fragrantissima aqueous extracts showed a significant(P<0.05) elevation in leukocytes, Neutrophil and basophil and significant reduction in lymphocyte, monocytes and eosinophil compared to the positive control group. The highest improvement was recorded in group that treated with the high level (1 ml with concentration 10%) of Achillea fragrantissima aqueous extract.

The present study issupported by the finding of **(Aboraya *et al*., 2022)** and **Kassem *et al* ., 2022)** ,cisplatin induced a significant decrease in WBCs, lymphocyte,phagocytic killing % and an insignificant decrease in basophil besides insignificant increase in neutrophil, monocyte and eosinophil in rabbits.Cisplatin induced a decrease in WBCs, lymphocytes, phagocytosis %, killing % and increase in neutrophil may be due to damage in bone marrow by cisplatin **(Abd El Azeem *et al*., 2019)**.on the other hand,The antioxidants of the A.fragrantissima protect the white blood cells responsible for immunity (neutrophils and lymphocytes) from oxidative stress, preventing their apoptosis. The beneficial effect of A. fragrantissima on immune responses recorded in this study may be attributed to its antioxidant properties and phytochemical constituents (Camphor, 1,8-Cineole, Artemisia ketone, Thujone, and Cyclohexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene) **(Alhomaid**

***et al*., 2022)**. and in a study conducted by **Al-Sarraf *et al*., (2020)** to assess the effect of the A. Fragrantissima plant on measuring and evaluating the extent of the immune response.The results showed, through analyzing results, that the extraction had apparent effects. A. fragrantissima at a high dose succed to modulate the immunosuppressive. This finding coincided with a recent study, which concluded that A. fragrantissima extract has an immunostimulant effect concerning humoral and cell-mediated immunity **(Alhomaid *et al*., 2022)**. Studies have repeatedly demonstrated the anti-inflammatory and immunomodulatory properties of A. fragrantissima extract **(Hijazi *et al*.,2019)**.

Results in **Table 5** showed that positive control group had a significant decrease (P<0.05) Glutathione peroxidase (GPx) and Superoxide dismutase enzyme (SOD), and significant increase (P<0.05) in levels of Malondialdehyde (MDA) when compared to the negative control group. On the other hand, rats that administrated orally different levels of Achillea fragrantissima aqueous extracts showed a significant(P<0.05) elevation in Glutathione peroxidase (GPx) and Superoxide dismutase enzyme (SOD) and significant reduction inMalondialdehyde (MDA) compared to the positive control group. The best result has been recorded in group that treated with the high level (1 ml with concentration 10%) of Achillea fragrantissima aqueous extract.

In the same line of the present study**, Alhomaid *et al*., (2022)** , showed that serum MDA exhibited significant (P<0.05) improvement by 500 mg/kg A. fragrantissima extract supplementations. Serum MDA did not affect by a low dose of A. fragrantissima ((300 mg/kg). on the other hand,A. fragrantissima extracts in both doses (300 and 500) mg/kg showed significant

(P<0.05) elevation in SOD. The antioxidants of A. fragrantissima seem to protect the white blood cells responsible for immunity (neutrophils and lymphocytes) from oxidative stress, preventing their apoptosis. The essential oil of A. fragrantissima can be used safely as an antioxidant.

Conclusion

The findings of this study demonstrated that Forssk (Achillea fragrantissima) aqueous extract is a promising immunomodulatory agent with a potent therapeutic value in stimulating the suppressed immune response.

Table 1: The Biological Effect of Achillea fragrantissima Aqueous Extract on Feed Intake (FI), Body Weight Gain (BWG) , Feed Efficiency Ratio (FER) and spleen relative weight of Rats with Immune Deficiency Diseases

Parameters / Groups	IBW g	FBW g	FI g/d/rat	BWG G	BWG %	FER	Spleen g
Control (-Ve)	185.60±1.28a	254.80±1.59a	26	69.20±0.73a	37.29±0.42a	0.0476±0.0005a	.91±0.014
Control (+Ve)	186.20±1.20a	216.20±1.24d	17	30.00±0.70e	16.11±0.41e	0.0316±0.0009d	0.45±0.011
1ml/day -5%	186.80±1.73a	224.10±1.48c	19	37.40±0.50d	20.01±0.33d	0.0354±0.0005c	0.63±0.009
1ml/day -7.5%	185.80±1.15a	230.40±1.12b	21	44.60±0.50c	24.01±0.35c	0.0378±0.0003c	0.75±0.008
1ml/day -10%	185.40±1.82a	235.80±1.24b	22	50.40±0.60b	27.19±0.42b	0.0408±0.0003b	0.82±0.005

*Mean values are expressed as means ± SE.
*Mean values at the same column with the same superscript letters are not statistically significant at P<0.05.

Table 2: The Biological Effect of Achillea fragrantissima Aqueous Extract on Serum Immunogolobulin G (IgG), Immunogolobulin M (IgM) and Interleukin-1 Beta (IL-1β) of Rats with Immune Deficiency Diseases

Parameters / Groups	IgM (g/L)	IgG (mg/L)	IL-1ß pg/mL
Control (-Ve)	13.17±0.57a	163.20±2.51a	7.07±0.11a
Control (+Ve)	5.65±0.13d	95.38±0.71e	3.42±0.15e
1ml/day -5%	6.59±0.24d	105.91±0.73d	4.69±0.08d
1ml/day -7.5%	8.71±0.23c	122.47±1.12c	5.33±0.09c
1ml/day -10%	10.38±0.21b	141.99±0.91b	6.02±0.07b

*Mean values are expressed as means ± SE.

*Mean values at the same column with the same superscript letters are not statistically significant at P<0.05.

Table 3: The Biological Effect of Achillea fragrantissima Aqueous Extract on Serum Total Protein, Albumin and Globulin of Rats with Immune Deficiency Diseases

Parameters / Groups	**Total Protein** mg/dL	**Albumin** mg/dL	**Globulin** mg/ dL
Control (-Ve)	6.80±0.24a	3.84±0.21a	3.33±0.9a
Control (+Ve)	3.38±0.14d	2.10±0.14d	1.52±0.10d
1ml/day -5%	4.01±060d	2.42±0.08cd	1.92±0.02c
1ml/day -7.5%	5.12±0.61c	2.84±0.05bc	2.51±0.10b
1ml/day -10%	5.98±0.50b	3.18±0.06b	3.05±0.06a

*Mean values are expressed as means ± SE.

*Mean values at the same column with the same superscript letters are not statistically significant at P<0.05.

Table 4: The Biological Effect of Achillea fragrantissima Aqueous Extract on Leukocytes, Neutrophil, Lymphocyte, Monocytes, Eosinophil, and Basophil Count of Rats with Immune Deficiency Diseases

Parameters / Groups	Leukocytes x10^3/ul	Neutrophil x10^3/ul	Lymphocyte x10^3/ul	Monocytes x10^3/ul	Eosinophil x10^3/ul	Basophil x10^3/ul
Control (-Ve)	12.05±0.31a	5.42±0.22a	1.21±0.06e	1.55±0.06e	0.47±0.01e	1.46±0.07a
Control (+Ve)	5.73±0.24e	1.96±0.11e	5.11±0.51a	3.45±0.05a	0.90±0.02a	0.17±0.01e
1ml/day -5%	6.90±0.17d	2.75±0.08d	4.25±0.04b	3.00±0.02b	0.82±0.01b	0.26±0.02d
1ml/day -7.5%	8.47±0.13c	3.66±0.07c	3.71±0.06c	2.41±0.07c	0.75±0.03c	0.47±0.04c
1ml/day -10%	9.91±0.15b	4.76±0.09b	2.42±0.07d	1.90±0.06d	0.63±0.01d	0.87±0.01b

*Mean values are expressed as means ± SE.

*Mean values at the same column with the same superscript letters are not statistically significant at P<0.05.

Table 5: The Biological Effect of Achillea fragrantissima Aqueous Extract on serum enzyme activities, Glutathione peroxidase (GPx), Superoxide dismutase enzyme (SOD) and malondialdehyde(MDA) of Rats with Immune Deficiency Diseases

Parameters / Groups	MDA ng/mL	GPx U/mL	SOD U/mL
Control (-Ve)	118.78±1.52d	136.62±1.70a	2.83±0.15a
Control (+Ve) HCD	402.25±3.68a	83.32±0.41e	0.81±0.17c
1ml/day -5%	383.81±1.89a	94.76±1.35d	1.07±0.11bc
1ml/day -7.5%	332.41±1.55b	102.11±1.63c	1.53±0.18bc
1ml/day -10%	287.34±1.71c	121.18±1.36b	2.03±0.13ab

*Mean values are expressed as means ± SE.

*Mean values at the same column with the same superscript letters are not statistically significant at P<0.05.

REFERENCES

Abd El Azeem, A., Amr, R. and Anupam, B. (2019): Protective effect of Echinacea pur-purea against cisplatin-induced immunotoxicity in rats. DARU J Pharm Sci., 30: 325-332.

Aboraya, D., El Baz, A., Risha, E. and Abdelhamid, F. (2022): Hesperidin ameliorates cisplatin induced hepatotoxicity and attenuates oxidative damage, cell apoptosis, and inflammation in rats. Saudi Journal of Biological Sciences, 29: 3157-3166.

Aebi, H. (1984). Catalase in vitro. Methods Enzymol., 105:121–126.

Alhejaily, T. B., Alamri, Z. Z., ALaryani, F. S., & Shareef, S. H. (2023): The Potential Gastro-Protective Effect of Qaysum (Achillea fragrantissima) Against Ethanol-Induced Gastric Ulcer in Wistar Albino Rats. Cureus, 15(10).

Alhomaid, R. M., Alharbi, Y. M., Algheshairy, R. M., Almujaydil, M. S., Alharbi, H. F., & Ali, H. (2022). In Vivo Immune Study of Achillea fragrantissima Extract Versus Echinaid and Endoxan in Wistar Rats. *Current Research in Nutrition and Food Science Journal*, *10*(2), 733-748.

Al-Sarraf, A., Hussien, Y., Yahiya, Y., & Al-Aubaidy, H. (2020): The protective effects of Achillea fragrantissima on immune response in mice model: A pilot study.

Armitage, G.Y. and Berry, W.G. (1987): Statistical methods 7th Ed. Ames., Iowa State University. Press.39-63.

Awad B.M., Habib E.S., Ibrahim A.K., Wanas A.S., Radwan M.M., Helal M.A., ElSohly M.A. and Ahmed S.A. (2017): Cytotoxic activity evaluation and molecular docking study of phenolic derivatives from *Achillea fragrantissima* (Forssk.) growing in Egypt. *Med Chem Res*. Sep;26(9):2065-2073.

Babich, O., Sukhikh, S., Prosekov, A., Asyakina, L., & Ivanova, S. (2020): Medicinal Plants to Strengthen Immunity during a Pandemic. Pharmaceuticals (Basel, Switzerland), 13(10), 313.

Burtis, C. and Ashwood, E. (1999): Tietz textbook of clinical chemistry. 3rd ed. Philadelphia: W.B. Saunders, 1999: 1840, 1841, 1844, 1845; 1799; 1834-5 Textbook of Clinical Chemistry, 3rd ed AACC.

Chaplins'ka MG, Golovkin VA (1962). Antimicrobial action of some extracts . Farma Tsevt. Zh. 18(2): 56-60.

Chapman D. G. and Gastilla R. and Campbell J. A. (1959): Evaluation of protein in foods: 1- A Method for the determination of protein efficiency ratio. Can. J. Biochem. Phys; 37:679- 686.

Draper, H. and Hadley, M. (1990). Malondialdehyde determination as index of lipid per-oxidation. Methods Enzymol,186: 421-431

Eissa T.F., Gonzalez-Burgos E., Carretero M.E. and Gomez-Serranillos M.P. (2018): Chemical characterization of polyphenols of Egyptian *Achillea fragrantissima* with *in vitro* antioxidant study. *Chiang Mai J Sci*. 1;45(2):897-904.

Hijazi, M. A., Jambi, H. A., Aljehany, B. M., & Althaiban, M. A. (2019): Potential Protective Effect of Achillea fragrantissima against Adriamycin-Induced Cardiotoxicity in Rats via an Antioxidant and Anti-Inflammatory Pathway. *BioMed Research International*, *2019*(1), 5269074.

Huang, S., Chen, X., Zhong, X., Li, M., Ao, K., Huang, J. and Li, X. (2016): Plant TRAF proteins regulate NLR immune receptor turnover. Cell Host Microbe, 19: 204–215.

Kassem, M., Atwa, S., El-Zoghby, S. H. and Kamoura, N. A. (2022): Protective role of aqueous moringa olifera leaves extract against adverse effect of cisplatin on hematoimmunobiochemical parameters in rabbits. Assiut Veterinary Medical Journal, 68(175), 39-48.

Khalaf, A., Hussein, S., Tohamy, A., Marouf, S., Yassa, H., Zaki, A. and Bishayee, A. (2019): Protective effect of Echinacea purpurea (Immulant) against cisplatin-induced immunotoxicity in rats. Daru: journal of Faculty of Pharmacy, Tehran University of Medical Sciences, 27(1): 233–241.

Lin, M., Ko, J., Liu, T., Chao, P., and Chu-Chyn Ou, C. (2018): Protective Effect of D-Methionine on Body Weight Loss, Anorexia, and Nephrotoxicity in Cisplatin-Induced Chronic Toxicity in Rats. Integr Cancer Ther., 17: 813–824.

Mandour, M. A., Al-Shami, S. A., Al-Eknah, M. M., Hussein, Y. A., & El-Ashmawy, I. M. (2013): The acute and long-term safety evaluation of aqueous,

methanolic and ethanolic extracts of Achillea fragrantissima. Afr. J. Pharm. Pharmacol, 7, 2282-2290.

Mathivanan R. and Kalaiarasi K. (2007): Panchagavya and *Andrographis paniculata* as alternatives to antibiotic growth promoters on haematological, serum biochemical parameters and immune status of broilers. *J Poult Sci.* ;44(2):198-204. doi: 10.2141/jpsa.44.198.

McComb, S., Thiriot, A., Akache, B., Krishnan, L. and Stark, F. (2019): Introduction to the Immune System. Methods in molecular biology, 2024: 1-24.

Nassef, N., El-Melegy, M., Beshay, E., Al-Sharaky, D. and Al- Attar, T. (2018): Trypanocidal effects of cisplatin alone and in combination with *Nigella sativa* oil on experimentally infected mice with *Trypanosoma evansi*. Iran J Parasitol., 13: 89–99.

Ochei, J. and Kolhatkar, A. (2008): Medical Laboratory Sciences; Theory and Practice. Tata McGraw-Hill Publishing Co. Ltd. New Delhi; 321-324.

Parameshappa, B., Basha, M., Sen, S., Chakraborty, R., Kumar, G., Sagar, G., Sowmya, L., Raju, K., Sesh, K. and Lakshmi, A. (2012): Acetaminophen induced nephrotoxicity in rats: protective role of Cardiospermum halicacabum. Pharm Biol; 50:247–253.

Patocka, J. and Navratilova, Z. (2019): Achillea fragrantissima: Pharmacology Review. Clinics in Oncology, 4: 1-5.

Pearse, G., Pietersma, A., Cunliffe, J., Foster, J., Turton, J., Reeves, P. Nielsen, F. and Fahmy, G. (1993): AIN-93. Purified diets for laboratory rodents: Final reports of the American Institute of Nutrition adhoe writing committee of reformulation of the AIN-76 A Rodent Diet. J. Nutr., 123: 1939-1951.

Reeves, P.G.; Nielsen, F.H. and Fahey, G.C., (1993): AIN-93 purified diets for laboratory rodents: final report of the American Institute of Nutrition ad hoc writing committee on the reformulation of the AIN-76A rodent diet." J. Nutr. 123:1939-51.

Wang, Y., Chen, L., Huang, G., He, D., He, J. and Xu, W. (2013): Klotho sensitizes human lung Cancer cell line to cisplatin via PI3k/Akt pathway. PLoS One, 8: 573–591.

Young, D. (1995): Effect of drugs on clinical lab Tests, 4 th ed AACC press.

Ziva, J. and Pannall, P. (1984): Clinical chemistry in diagnosis and treatment. Publ. L.loyd-Luke (Medical books), Londo, 348- 352.

The Biological Effect of Forssk (*Achillea fragrantissima*) Aqueous Extract on the Immune System of Experimental Rats

ألاء علي سيد أمنية، جلال رفعت، هاني جابر المصري
قسم التغذية وعلوم الأطعمة - كلية الاقتصاد المنزلى - جامعة حلوان

المستخلص العربي

هدفت الدراسة الحالية إلى التحقق من التأثير البيولوجي لمستخلص القيصوم المائي على الجهاز المناعي للفئران. تم تقسيم خمسة وثلاثين فأرًا ذكرًا بالغًا سلالة (Sprague Dawley) عشوائيًا إلى ٥ مجموعات متساوية (٧ في كل مجموعة). كانت المجموعة الأولى هي المجموعة السلبية الضابطة، في حين تم حقن المجموعات الأربع الأخرى بالسيسبلاتين (٣,٥ مجم/كجم) مرة واحدة كل ٣ أيام لمدة أسبوعين متتاليين. تم الاحتفاظ بالمجموعة الثانية كمجموعة ضابطة ذات خلل مناعي كمجموعة موجبة .تم إعطاء المجموعة الثالثة عن طريق الفم ١ مل / يوم من مستخلص القيصوم المائي بتركيز ٥٪، بينما تم إعطاء ١ مل/يوم من مستخلص القيصوم المائي بتركيز ٧,٥٪ عن طريق الفم للمجموعة الرابعة .المجموعة ٥ تم إعطاؤها عن طريق الفم ١ مل/يوم من مستخلص القيصوم المائي بتركيز ١٠٪ لمدة ثمانية أسابيع .أظهرت النتائج أن الحقن بالسيسبلاتين للفئران تسبب في انخفاض كبير معنوي عند مستوي ثقة ($P < 0.05$) في وزن الجسم ووزن الطحال والغلوبولينات المناعية في المصل (IgG و IgM وIL-1B) والبروتين الكلي والألبومين والجلوبولين وكريات الدم البيضاء، في حين زادت الخلايا الليمفاوية بشكل كبير عند الحقن السيسبلاتين في المجموعة الضابطة الإيجابية مقارنة بالمجموعة الضابطة السلبية .من ناحية أخرى، أدى الإعطاء عن طريق الفم لمستخلص القيصوم المائي إلى التخفيف من هذه الآثار الضارة وتحسين التغيرات الكيميائية الحيوية والوظيفية في الطحال الناتجة عن حقن السيسبلاتين بشكل ملحوظ .وفي الختام، فإن المستخلص المائي لنبات القيصوم يحفز الجهاز المناعي للفئران التي تعاني من ضعف المناعة الناجم عن السيسبلاتين .وقد أوصت هذه الدراسة بزيادة استهلاك نبات القيصوم في النظام الغذائي، وهذا قد يرفع من الاستجابة المناعية لدى المرضى الذين يعانون من اضطرابات المناعة.

الكلمات المفتاحية: نبات القيصوم، الجهاز المناعي، مادة السيسبلاتين، الفئران.