

Article

Mechanism Activity and Spesific Chemical Compound of Purslane (*Portulaca oleracea* L.) in Managing Obesity: A Systematic Literature Review

Article Info

Article history :

Received July 28, 2026
Revised October 23, 2026
Accepted October 27, 2026
Published October 30, 2026

Keywords :

Obesity,
Portulaca oleracea,
Purslane,
Literature review

Rizqi Nur Azizah^{1,2}, Fadlina Chany Saputri^{1*}, Meidi Utami Puteri¹, Aktsar Roskiana Ahmad³

¹Department of Pharmacology-Toxicology, Faculty of Pharmacy, Universitas Indonesia, Depok, Indonesia

²Laboratory of Pharmacology and Biopharmacy, Faculty of Pharmacy, Universitas Muslim Indonesia, Makassar, Indonesia

³Laboratory of Pharmacognosy and Phytochemistry, Faculty of Pharmacy, Universitas Muslim Indonesia, Makassar, Indonesia

Abstract. Obesity is global health problem characterized by an increase in body fat, leading to adverse metabolic, biomechanical, and psychosocial health consequences. Herbal supplementation have become increasingly popular due with fewer adverse effects and lower cost Previous study showed that *Portulaca oleracea* L. (PO) are one of the plants that can treating obesity. This review demonstrates that PO exhibits potential as an alternative therapeutic agent in the management of obesity through multiple pharmacological mechanisms, including reduced weight gain & body fat, improved insulin sensitivity, reduced LDL-C, triglycerides, Improved weight, BMI, liver function with multiple mechanisms that can help manage obesity, primarily through its antioxidant, anti-inflammatory, and lipid & glucose methabolism regulation. These effects are associated with the synergistic action of its bioactive constituents, including homoisoflavonoids, oleracein E and oleracein L, omega-3 Fatty Acids (ALA), quercetin, rutin, and polyphenolic compound. The dose effective in animal studies is between 5%-10% extract PO for 12 weeks and 500-700 mg for 4-8 weeks in clinical trial. This eviiew articles suggest a need for further, advanced-phase clinical trials in humans to establish an optimal and safe dosage for long-term use.

This is an open acces article under the [CC-BY](#) license.



This is an open access article distributed under the Creative Commons 4.0 Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. ©2026 by author.

Corresponding Author :

Fadlina Chany Saputri

Department of Pharmacology-Toxicology, Faculty of Pharmacy, Universitas Indonesia,
Depok, IndonesiaEmail : fadlina.chany@farmasi.ui.ac.id**1. Introduction**

Obesity is a globally health problem characterized by excessive body fat accumulation in the adipose tissue caused by high-calorie diets, sedentary lifestyles, genetic factors, psychological diseases, and endocrine disorders [1-2]. It is associated with health complications, including diabetes, cardiovascular disease, stroke, cancer, lung disease, thrombophlebitis, arthritis, reproductive difficulties, and discrimination against obesity, which impair the quality of life and increase mortality [3-12]. In 2022 WHO reported that 43% of adults aged 18 years and over (43% of men and 44% of women) being overweight; an increase from 1990, when 25% of adults aged 18 and over were overweight [13]. Nowadays, lifestyle modification and pharmacological or herbal intervention are being used as alternative therapy in managing obesity. Herbal supplementation have become increasingly popular due with fewer adverse effects and lower cost compare to manufactured medication.

Plant that is known to be efficacious as herbal medicine is Purslane (*Portulaca oleracea* L.). *Portulaca oleracea* L. (PO) is a type of wild plant that grows anywhere, especially in sandy areas and soil. This plant is an annual herbaceous plant that lives in tropical climates and has the characteristics of fleshy purplish green stems with blunt leaf tips, has yellow flowers and has small seeds that are black when ripe and reddish brown when immature. Purslane, which comes from the Portulacace family [14-15]. It has been traditionally used to treat many diseases such as as a medicine for burns, headaches, rheumatoid arthritis, antiobesity, antidiabetes, and coughs [16-18]. The most active purslane compounds include omega-3, tocopherol, carotene, amino acids, thiamine, ascorbic acid, niacin, and phenolic compounds. Purslane is also known to contain a high amount of fatty acids, namely 189.16 ± 25.52 mg/100 g dry weight, especially alpha-linolenic acid (ALA) compared to other green leafy vegetables and has better nutritional quality. The phenolic content of purslane is 2.00 ± 0.03 mg GAE/g dry weight and the carotenoid content is 132 ± 1.06 mg BCE/g dry weight.

The pharmacological potential of purslane has been extensively investigated through in vitro and in vivo study and also clinical study in human. Previous in vivo study shown that a group of mice that were given a high-fat diet and 10% purslane extract were significantly able to reduce weight gain by 34% compared to other mice that were only given a high-fat diet. Another study was also conducted show that ethanol extract of purslane herb had good activity in reducing body weight in obese mice at a dose of 200 mg/kgBW with a reduction percentage of 21.868% [19-21].

Research on the effect of administering ethanol extract of purslane herb (*Portulaca oleracea* L.) on reducing body weight in rats (*Rattus norvegicus*) with a model of obesity is an interesting topic in the field of experimental research. The research on the effect of administering purslane herb ethanol extract on reducing body weight in animal model of obesity is still very limited, so it is hoped that this review can provides new information about the potential use of purslane plants as an alternative medicine for managing obesity.

The purpose of the review article is to determine the potential of PO as an antiobesity. The subject of this review is articles which discuss the antiobesity ability of PO based on study type and model methods, mechanisms of action of PO in managing obesity, and specific chemical compounds in contributing to antiobesity effects.

2. Experimental Section

2.1. Materials

Literature search were performed using multiple electronic database, including PubMed, Scopus, Google Scholar, ScienceDirect, dan Cochrane Library and key words as follows : ("Portulaca oleracea" OR "purslane" OR "krokot") AND ("obesity" OR "obesitas" OR "anti-obesity" OR "body weight"). The inclusion criteria comprised original research articles involving in vitro, in vivo, and clinical studies investigating the antiobesity effect. Article not available in full text, review papers, conference abstracts, editorials, and studies unrelated to obesity management were excluded from the analysis. International and national articles are indexed on the site SJR (Scimago Journal Ranking).

2.2. Methods

A systematic literature review was conducted to determine ability of PO in managing obesity based on study type and model methods, mechanisms of action of *Portulaca oleracea* in managing obesity, and specific chemical compounds in contributing to antiobesity effects, published between 2011 and 2026. The article selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines and consisted of four sequential stages: identification, screening, eligibility assessment, and final inclusion. This research is a Review Journal. The subject of this review is international articles indexed nationally and internationally in the last 10 years which discuss the antiobesity Search for articles based on the keywords antiobesity, purslane, *Portulaca oleracea* L.

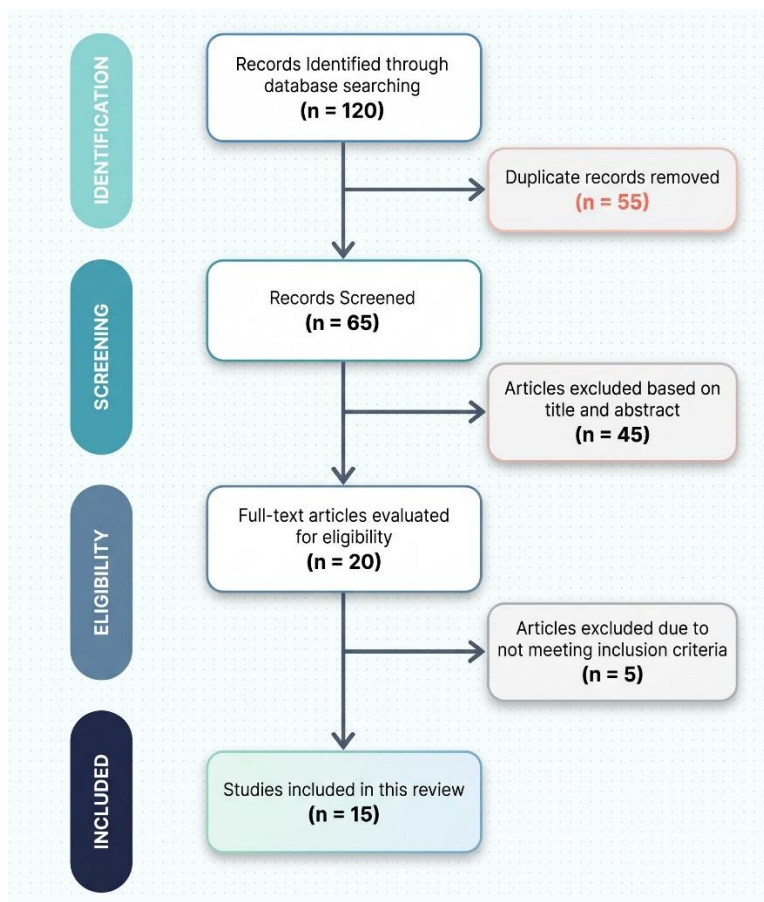


Figure 1. PRISMA Flow Diagram of the study

3. Results and Discussion

Portulaca oleracea L. (PO) is a plant from the Portulacaceae family which has more than 120 different species. This plant is generally used in society as a vegetable, spice and also medicine. The characteristics of the PO herb plant are that it has a round stem that grows partially or completely upright without producing roots and is located above the ground. It has single, thick, green leaves with reddish stems.



Figure 2. Plant of *Portulaca oleracea* L.

The purslane herb is a plant that can be cultivated easily by having its seeds fall to the surface of the ground as they dry out, then the seeds grow by themselves. Purslane herb is also a plant with flavonoids, phenols, saponins, alkaloids and glycosides. PO based on their taxonomic structure are classified as follows:

Kingdom	: Plantae
Sub Kingdom	: Tracheobionta
Division	: Magnoliophyta
Class	: Magnoliopsida
Sub Class	: Caryophyllidae
Ordo	: Caryophyllales
Family	: Portulacaceae
Genus	: Portulaca
Species	: <i>Portulaca oleracea</i> L.

Several studies show that the purslane plant has properties as a diuretic, anti-oxidant, anti-inflammatory, hypolipidemic, anticonvulsant, antimicrobial, etc. which are related to the chemical compounds contained in this plant such as flavonoids, alkaloids, omega-3 fatty acids, 3 and phenolic acids. Apart from that, traditionally purslane has been used by people throughout the world to cure various diseases such as skin diseases, fever, dysentery, diarrhea, bleeding, coughs, shortness of breath, kidney and liver diseases, and asthma [22-36].

In an animal model of obesity induced by high-Fat Diet (HFD), mice were divided into groups receiving different concentrations of PO powder (5% and 10%) for 12 weeks show that significant reduction in weight gain, body fat, and improved insulin sensitivity. Protein expression levels of PPAR- α , GLUT4, and PPAR- γ were upregulated, while TNF- α levels were reduced. PO can suppress of weight gain, reduction in body fat, and improvement in blood glucose levels through modulation of lipid metabolism and insulin sensitivity pathways [16].

Table 1. Classification of antiobesity based on Study type and model methods

Study Type	Model	Outcome	Mechanism	Reference
Animal Study	HFD Mice	Reduced weight gain, body fat, improved insulin sensitivity	Modulation of lipid metabolism and insulin sensitivity pathways	[16]
Animal Study	CC Mice	Reduced body weight, improved glucose levels	Genetic background influence, glucose tolerance improvement	[37]
Animal Study	Hyperlipidemia Rats	Decreased body weight, improved liver status	Regulation of blood lipid levels, antioxidant activity	[38]
Clinical Trial	Obese Adolescents	Reduced LDL-C, triglycerides	Polyphenolic and antioxidant compounds	[35]
Clinical Trial	NAFLD Patients	Improved weight, BMI, liver function	Anti-inflammatory, antioxidant effects	[36]
Review Article	Metabolic Syndrome	Reduced lipids, blood sugar, body weight	Anti-metabolic syndrome potential	[39]

In a different study, genetically diverse collaborative cross (CC) mouse model, 221 mice from 13 different CC lines were fed a high-fat diet and treated with PO via intraperitoneal injection, show that significant reduction in body weight and glucose levels, with male mice showing more sensitivity to the treatment, improvement in glucose tolerance and stabilization of body weight, potentially influenced by genetic background [37]. In hyperlipidemia Rat, Rats were fed a high-fat diet and treated with different doses of PO polyunsaturated fatty acids (PUFAs). Study show that decreased body weight, serum lipid levels, and improved liver tissue status. PO regulate of blood lipid levels and enhancement of antioxidant enzyme activities [38]. The contradictory evidence could partially be attributed to the differences in the dose and duration of PO supplementation and the type of used animals.

Human Clinical trial with study design Triple-blinded, randomized, placebo-controlled trial with obese adolescents taking PO seed capsules 500 mg twice daily for one month. Significant reduction in LDL-C and triglycerides, indicating positive effects on serum lipid profiles, Atributed to the polyphenolic and antioxidant compounds in PO [35]. Non-alcoholic Fatty Liver Disease (NAFLD) patient, Double-blind, randomized clinical trial with NAFLD patients receiving 700 mg PO supplement for eight weeks. Study show that significant improvements in weight, BMI, fat mass index, waist circumference, blood sugar, lipid profile, and liver function. PO has anti-inflammatory and antioxidant effects leading to improved liver steatosis and fibrosis [36]. Review of scientific publications on the use of PO for metabolic syndrome, show that PO acts on pathways reducing lipids, blood sugar, body weight, and total cholesterol and have potential use as an anti-metabolic syndrome agent due to its broad pharmacological activities [39].

Table 2. Mechanisms of Action of *Portulaca oleracea* in Managing Obesity

Mechanism of Action	Description	Reference
Reduction of Lipids and Body Weight	Lowers total cholesterol, lipid levels, and body fat content	[23],[37]
Improvement of Insulin Sensitivity	Enhances HOMA-IR, QUICKI, and stimulates PI3K/Akt and AMPK pathways	[35],[40]
Anti-inflammatory and Antioxidant	Reduces oxidative stress and inflammation, activates AMPK/eNOS signaling	[40],[41]
Regulation of Lipid Metabolism	Upregulates PPAR- α , PPAR- γ , GLUT4, and reduces TNF- α expression	[42]
Reduction of Blood Glucose Levels	Lowers blood glucose and HbA1c levels, improves glucose tolerance	[43]
Potential in treating metabolic syndrome	Multifaceted actions beneficial for metabolic syndrome management	[39]

PO has been found to reduce body weight, total cholesterol, and lipid levels, which are crucial in managing obesity and metabolic syndrome [23],[37]. In high-fat diet-induced obese mice, PO treatment significantly reduced weight gain and body fat content, particularly in the perirenal and epididymal regions [35]. PO enhances insulin sensitivity by improving the homeostasis model assessment of insulin resistance (HOMA-IR) and increasing the quantitative insulin sensitivity check index (QUICKI) [40]. It stimulates the phosphorylation of key proteins in the PI3K/Akt and AMPK pathways, which are essential for glucose uptake and metabolism in skeletal muscles [40]. PO exhibits significant anti-inflammatory and antioxidant properties, which help in reducing oxidative stress and inflammation associated with obesity [40-41]. It ameliorates endothelial dysfunction by activating the AMPK/eNOS signaling pathway, thereby protecting vascular function in diabetic obese mice [5].

PO can stimulate AMPK phosphorylation in adipocytes. AMPK acts as a cellular regulator of energy homeostasis. Its activation within adipose tissue stimulates the transition toward brown fat, increases energy expenditure, enhances glucose uptake, promotes adiponectin secretion, and facilitates fatty acid oxidation. Simultaneously, this process suppresses lipogenesis, lipolysis, and the secretion of pro-inflammatory markers. Consequently, the activation of AMPK by PO provides protection against obesity and its associated metabolic dysfunctions. Furthermore, supplementation with purslane (krokot) is linked to increased expression of PPAR- δ in the liver, which is known to suppress adipocyte growth and differentiation while promoting lipolysis and fatty acid oxidation. PO upregulates the expression of proteins involved in lipid metabolism, such as PPAR- α and PPAR- γ , and glucose transporter type 4 (GLUT4), which are crucial for lipid and glucose homeostasis. It also reduces the expression of tumor necrosis factor (TNF)- α , a pro-inflammatory cytokine linked to obesity and insulin resistance [42].

PO significantly lowers blood glucose and glycosylated hemoglobin (HbA1c) levels, indicating its role in improving glycemic control [41]. It enhances glucose tolerance and reduces insulin resistance, which are critical factors in managing obesity-related diabetes [43]. PO multifaceted actions, including lipid reduction, anti-inflammatory effects, and improvement in insulin sensitivity, make it a promising candidate for treating metabolic syndrome, which encompasses obesity, hyperglycemia, and dyslipidemia [39].

Table 3. Specific Chemical Compounds in *Portulaca oleracea* Contributing to Antiobesity Effects

Compound	Effect	Reference
Homoisoflavonoids	Reduce lipid accumulation, down-regulate adipogenic genes	[40]
Quercetin, Kaempferol, rutin	Antioxidant, anti-inflammatory, improve metabolic profiles	[23],[44],[45]
Omega-3 Fatty Acids (ALA)	Improve lipid profiles, reduce inflammation	[26],[46]
Oleracein E and L	Enhance glucose uptake, insulin secretion, hypoglycemic effect	[41]
Polyphenolic Compound	Antioxydant activity, inhibit alpha-glucosidase and pancreatic lipase, reduce carbohydrate absorption	[47]

Homoisoflavonoids isolated from the 85% aqueous methanol fraction of PO, have been shown to significantly reduce lipid accumulation in adipocyte cells. Homoisoflavonoid, in particular, down-regulates adipogenic transcription genes such as PPAR γ and C/EBP α , and adipogenic target genes like FABP4, FATP1, and ACS1, which are crucial in the process of adipogenesis [40]. These compounds typically activate AMPK by inducing mild metabolic stress in the mitochondria (inhibiting respiratory chain complexes). This increases the AMP/ATP or ADP/ATP ratio within the cell. Elevated AMP levels trigger the phosphorylation of the AMPK alpha subunit (at Thr172) by upstream kinases, such as LKB1. Once activated, AMPK suppresses lipogenic transcription factors, including SREBP-1c and FAS. It is rich in flavonoids such as quercetin, kaempferol, and rutin, which exhibit antioxidant and anti-inflammatory properties. These compounds can potentially contribute to antiobesity effects by improving metabolic profiles and reducing oxidative [23],[44-45].

The presence of omega-3 fatty acids, particularly α -linolenic acid (ALA), in PO has been associated with improved lipid profiles and reduced inflammation, which are beneficial in managing obesity [26,46]. ALA triggers AMPK activation via an intracellular calcium influx pathway. ALA can activate the upstream kinase CaMKK β (calcium/calmodulin-dependent protein kinase kinase-beta) as a result of increased cytosolic calcium, which subsequently phosphorylates and activates AMPK without requiring a drastic change in the adenine nucleotide (ATP) ratio. Isoquinoline alkaloids like oleracein E and L have shown potential hypoglycemic effects by enhancing glucose uptake and insulin secretion, which can indirectly support weight management by improving metabolic health [41]. The ethyl acetate fraction of PO, which is rich in polyphenols, has demonstrated significant antioxidant activity and the ability to inhibit enzymes like α -glucosidase and pancreatic lipase. These activities are crucial in managing obesity by reducing carbohydrate absorption and fat accumulation [47].

4. Conclusion

This review demonstrates that PO exhibits potential as an alternative therapeutic agent in the management of obesity through multiple pharmacological mechanisms, including reduced weight gain & body fat, improved insulin sensitivity, reduced LDL-C, triglycerides, Improved weight, BMI, liver function with multiple mechanisms that can help manage obesity, primarily through its antioxidant, anti-inflammatory, and lipid & glucose metabolism regulation. These effects are associated with the synergistic action of its bioactive constituents, including homoisoflavonoids, oleracein E and oleracein L, omega-3 Fatty Acids (ALA), quercetin, rutin, and polyphenolic compound. Although experimental data from animal studies consistently show positive results, review articles suggest a need for further, advanced-phase clinical trials in humans to establish an optimal and safe dosage for long-term use.

References

- [1] Ruddock, J.S., Goswami, G.(2023).Obesity. Handbook of Outpatient Medicine: Second Edition,
- [2] Aydin, M.R.(2022).Obesity. Chronic Disease Follow-Ups for Adults in Primary Care,
- [3] Müller, T. D., & Blüher, M. (2023). Obesity treatment: will pharmacotherapies replace metabolic surgery in the future?. *Innere Medizin (Heidelberg, Germany)*, 1.
- [4] Faucher, P., & Poitou, C. (2016). Physiopathology, causes and complications of obesity. *Soins; la Revue de Reference Infirmiere*, 61(811), 20-25.
- [5] Milewicz, A., & Kubicka, E. (2015). Metabolic Healthy Obesity and Metabolic Obesity with Normal Weight and CVD Risk in Women. In *Frontiers in Gynecological Endocrinology: Volume 3: Ovarian Function and Reproduction-From Needs to Possibilities* (pp. 111-116). Cham: Springer International Publishing.
- [6] Mehrzad, R. (2020). Definition and introduction to epidemiology of obesity. In *Obesity* (pp. 1-6). Elsevier.
- [7] Hauner, H. (2016). Obesity: Influence on Diabetes and Management. In *Type 2 Diabetes* (pp. 409-418). CRC Press.
- [8] Cheskin, L. J., Frutchey, R. A., Bunyard, L., & Glascoe, S. (2015). Obesity management. In *Encyclopedia of Food and Health* (pp. 126-131). Elsevier Inc..
- [9] Kiwanuka, E. (2020). The health impact of obesity. In *Obesity* (pp. 73-83). Elsevier.
- [10] Mazaheri, T., Ansari, S., Nallagonda, M., Kollmann, L., Nickel, F., Seyfried, F., & Miras, A. D. (2023). Pharmacotherapy of obesity-Competition to bariatric surgery or a meaningful supplement?. *Chirurgie (Heidelberg, Germany)*, 94(6), 497-505.
- [11] Kiwanuka, E. (2020). The role of physical activity in the obesity epidemic. In *Obesity* (pp. 109-115). Elsevier.
- [12] Mazzarone, F., Chamma, R. S., & Manente, M. M. (2024). Thoracobrachioplasty. In *Body Contouring: Current Concepts and Best Practices* (pp. 803-808). Cham: Springer International Publishing.
- [13] WHO. (2024). Obesity. Link : <https://www.who.int/health-topics/obesity>.
- [14] Zhou, Y. X., Xin, H. L., Rahman, K., Wang, S. J., Peng, C., & Zhang, H. (2015). Portulaca oleracea L.: a review of phytochemistry and pharmacological effects. *BioMed research international*, 2015(1), 925631.
- [15] Syed, S., Fatima, N., & Kabeer, G. (2016). Portulaca oleracea L.: a mini review on phytochemistry and pharmacology. *International journal of Biology and Biotechnology*, 13(4), 637-641.
- [16] Jung, J. H., Hwang, S. B., Park, H. J., Jin, G. R., & Lee, B. H. (2021). Antiobesity and antidiabetic effects of Portulaca oleracea powder intake in high-fat diet-induced obese C57BL/6 mice. *Evidence-Based Complementary and Alternative Medicine*, 2021(1), 5587848.
- [17] Azizah, R. N. (2019). Antirheumatoid Arthritis Effect of Purslane Herb Extract (portulaca oleracea l.) to Rat (rattus norvegicus) Induced by Complete Freuds Adjuvant. *Journal of Global Pharma Technology*, 11(4), 314-319.
- [18] Asmaliani, I., Putra, B., Emelda, A., & Azizah, R. N. (2024). Histopathological Profile of Rats (Rattus norvegicus) with Collagen-Type II Rheumatoid Arthritis and treated with Purslane Tea (Portulaca oleracea Linn.). *Tropical Journal of Natural Product Research*, 8(6), 7526.
- [19] Nemzer, B., Al-Taher, F., & Abshiru, N. (2020). Phytochemical composition and nutritional value of different plant parts in two cultivated and wild purslane (Portulaca oleracea L.) genotypes. *Food chemistry*, 320, 126621.
- [20] Vajdi, M., Hassanizadeh, S., Shojaei-Zarghani, S., Bagherniya, M., & Askari, G. (2023). The Effects of Purslane Consumption on Obesity Indices: A GRADE-Assessed Systematic Review

-
- and Meta-Analysis of Randomized Controlled Trials. *Journal of Food Biochemistry*, 2023(1), 6655305.
- [21] Azizah, R. N., Emelda, A., Asmaliani, I., Ahmad, I., & Fawwaz, M. (2022). Total phenolic, flavonoids, and carotenoids content and anti-obesity activity of purslane herb (*Portulaca oleracea* L.) ethanol extract. *Pharmacogn J*, 14(1), 8-13.
- [22] Putra, R. P., Aisyah, S. I., & Nurcholis, W. (2023). Benefits of total phenolic and flavonoid content of *Portulaca oleracea* as antioxidant and antidiabetic: a review. *Trop J Nat Prod Res*, 7(2), 2293-2304.
- [23] Zhang, H., Chen, G., Yang, J., Yang, C., & Guo, M. (2022). Screening and characterisation of potential antioxidant, hypoglycemic and hypolipidemic components revealed in *Portulaca oleracea* via multi-target affinity ultrafiltration LC-MS and molecular docking. *Phytochemical Analysis*, 33(2), 272-285.
- [24] Kim, K. H., Park, E. J., Jang, H. J., Lee, S. J., Park, C. S., Yun, B. S., ... & Rho, M. C. (2019). 1-carbomethoxy- β -Carboline, derived from *Portulaca oleracea* L., ameliorates LPS-mediated inflammatory response associated with MAPK signaling and nuclear translocation of NF- κ B. *Molecules*, 24(22), 4042.
- [25] Shafi, S., & Tabassum, N. (2016). Evaluation of antidiabetic and hypolipidemic activities of ethanolic extract of *Portulaca oleracea* (whole plant) in alloxan induced diabetic rats. *Int. J Pharm Sci Rev Res*, 38, 64-69.
- [26] Chen, W. C., Wang, S. W., Li, C. W., Lin, H. R., Yang, C. S., Chu, Y. C., ... & Chen, J. J. (2022). Comparison of various solvent extracts and major bioactive components from *Portulaca oleracea* for antioxidant, anti-tyrosinase, and anti- α -glucosidase activities. *Antioxidants*, 11(2), 398.
- [27] Heras, L. E. G., Mir, V. G., Rubio, O. C., Jaramillo, C. G. J., & Japón, G. E. R. (2017). Composición química y actividad antiinflamatoria de extracto de partes aéreas de *Portulaca oleracea* (verdolaga). *Revista Cubana de Farmacia*, 51(1).
- [28] Iranshahy, M., Javadi, B., Iranshahi, M., Jahanbakhsh, S. P., Mahyari, S., Hassani, F. V., & Karimi, G. (2017). A review of traditional uses, phytochemistry and pharmacology of *Portulaca oleracea* L. *Journal of ethnopharmacology*, 205, 158-172.
- [29] Rahimi, V. B., Ajam, F., Rakhshandeh, H., & Askari, V. R. (2019). A pharmacological review on *Portulaca oleracea* L.: focusing on anti-inflammatory, anti-oxidant, immuno-modulatory and antitumor activities. *Journal of pharmacopuncture*, 22(1), 7.
- [30] El-Sayed, M. I. K. (2011). Effects of *Portulaca oleracea* L. seeds in treatment of type-2 diabetes mellitus patients as adjunctive and alternative therapy. *Journal of ethnopharmacology*, 137(1), 643-651.
- [31] Chan, K., Islam, M. W., Kamil, M. A., Radhakrishnan, R., Zakaria, M. N. M., Habibullah, M., & Attas, A. (2000). The analgesic and anti-inflammatory effects of *Portulaca oleracea* L. subsp. *sativa* (Haw.) Celak. *Journal of ethnopharmacology*, 73(3), 445-451.
- [32] Karimi, G., Hosseinzadeh, H., & Ettehad, N. (2004). Evaluation of the gastric antiulcerogenic effects of *Portulaca oleracea* L. extracts in mice. *Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives*, 18(6), 484-487.
- [33] Iranshahy, M., Javadi, B., Iranshahi, M., Jahanbakhsh, S. P., Mahyari, S., Hassani, F. V., & Karimi, G. (2017). A review of traditional uses, phytochemistry and pharmacology of *Portulaca oleracea* L. *Journal of ethnopharmacology*, 205, 158-172.
- [34] Uddin, M. K., Juraimi, A. S., Hossain, M. S., Nahar, M. A. U., Ali, M. E., & Rahman, M. M. (2014). Purslane weed (*Portulaca oleracea*): A prospective plant source of nutrition, omega-3 fatty acid, and antioxidant attributes. *The Scientific World Journal*, 2014(1), 951019.
-

- [35] Sabzghabae, A. M., Kelishadi, R., Jelokhanian, H., Asgari, S., Ghannadi, A., & Badri, S. (2014). Clinical effects of *Portulaca oleracea* seeds on dyslipidemia in obese adolescents: a triple-blinded randomized controlled trial. *Medical Archives*, 68(3), 195.
- [36] Milkarizi, N., Barghchi, H., Belyani, S., Bahari, H., Rajabzade, F., Ostad, A. N., ... & Askari, V. R. (2024). Effects of *Portulaca oleracea* (purslane) on liver function tests, metabolic profile, oxidative stress and inflammatory biomarkers in patients with non-alcoholic fatty liver disease: a randomized, double-blind clinical trial. *Frontiers in Nutrition*, 11, 1371137.
- [37] Yehia, R., Lone, I. M., Yehia, I., & Iraqi, F. A. (2023). Studying the Pharmagenomic effect of *Portulaca oleracea* extract on anti-diabetic therapy using the Collaborative Cross mice. *Phytomedicine Plus*, 3(1), 100394.
- [38] Wang H., Li G., Yang J., Chen C., Zhang N., Sun J., Qin N., Liu X. (2023). Lipid-Lowering Effect of *Portulaca oleracea* L. Polyunsaturated Fatty Acids on Hyperlipidemia Rats. *Journal of the Chinese Cereals and Oils Association*, 38 (3), pp. 144 – 150
- [39] Aini, N. S., Ansori, A. N. M., Kharisma, V. D., Syadzha, M. F., Widyananda, M. H., Murtdlo, A. A. A., ... & Zainul, R. (2022). Potential roles of purslane (*Portulaca oleracea* L.) as antimetabolic syndrome: A review. *Pharmacognosy Journal*, 14(3), 710-714.
- [40] Lee, J. H., Park, J. E., & Han, J. S. (2020). *Portulaca oleracea* L. extract reduces hyperglycemia via PI3k/Akt and AMPK pathways in the skeletal muscles of C57BL/KsJ-db/db mice. *Journal of Ethnopharmacology*, 260, 112973.
- [41] Karamalakova, Y., Petkova-Parlapanska, K., Hinkov, I., Vetskov, N., Georgieva, E., & Nikolova, G. (2024). The effect of radiation preservation on macromolecule content, antimicrobial activity and radical-scavenging potential of *Portulaca oleracea* L. leaves extract. *Journal of Chemical Technology and Metallurgy*, 59(2), 243-249.
- [42] Oyabambi, A. O., Aindero, B. B., Awolola, A. M., Adebayo, A. Y., Iluromi, I. B., & Olorunniyi, K. S. (2024). *Portulaca oleracea* (purslane) aqueous extract reduced the adverse metabolic outcomes and favored liraglutide activities in streptozotocin-induced cardiometabolic disorders of male Wistar rats. *Endocrine and Metabolic Science*, 16, 100191.
- [43] Tafti, M. A., Moein, M., Babajafari, S., Haem, E., & Zarshenas, M. M. (2024). Efficacy of herbal supplementation of purslane freeze-dried juice for weight loss: An 8-week randomized, double-blind, placebo-controlled clinical trial. *Current Traditional Medicine*, 10(1), 81-90.
- [44] Roozi, H., Bojar, M. N., Eidi, V., & Ali, K. N. R. (2019). Effects of oleracein E and oleracein L from *Portulaca oleracea* on cell survival, antioxidant and antidiabetic efficacy on beta-TC-6 pancreatic cell line. *Indian Journal of Pharmaceutical Sciences*, 81(4), 681-689.
- [45] Alfwuaires, M. A., Algefare, A. I., Afkar, E., Salam, S. A., Abd El-Moaty, H. I., & Badr, G. M. (2021). Immunomodulatory assessment of *Portulaca oleracea* L. extract in a mouse model of colitis. *Biomedicine & Pharmacotherapy*, 143, 112148.
- [46] Shao, G., Liu, Y., Lu, L., Wang, L., Ji, G., & Xu, H. (2024). Therapeutic potential of traditional Chinese medicine in the prevention and treatment of digestive inflammatory cancer transformation: *Portulaca oleracea* L. as a promising drug. *Journal of Ethnopharmacology*, 327, 117999.
- [47] Shanker, N., & Debnath, S. (2015). Impact of dehydration of purslane on retention of bioactive molecules and antioxidant activity. *Journal of food science and technology*, 52(10), 6631-6638.