

**TRADITIONAL USES, PHYTOCHEMISTRY AND
PHARMACOLOGICAL ACTIVITIES OF *Arctium lappa***Surbhi Jangir^{1*}, Ritu Rawat¹, Rohitashv Sharma²¹Department of Pharmacology, Jaipur College of Pharmacy, Jaipur, Rajasthan, India²Department of Pharmaceutical Chemistry, Jaipur College of Pharmacy, Jaipur, Rajasthan,
India**ABSTRACT**

Arctium lappa L., a widely distributed medicinal and edible plant in the Asteraceae family, is rich in phytochemicals. The plant's roots, with cylindrical shapes and brown skin, have been historically used in traditional medicine for various health concerns. Commonly known as Niubang in China, gobo in Japanese, and repejnik in Russia, burdock has been employed for issues ranging from gastrointestinal complaints to skin conditions. Its stem, featuring crimson-violet flower heads, reaches a height of 1 meter, while the root extends up to 45–50 cm in depth. *Arctium lappa* diverse compounds include volatile oils, lignans, sesquiterpene lactones, polyynes, and caffeic acid derivatives. Pharmacologically, *A. lappa* exhibits antibacterial, anti-inflammatory, and anti-fatigue activities. Its extract has proven effective against *Bacillus subtilis* and *Candida albicans*. Additionally, *A. lappa* demonstrates antiviral activity against porcine circovirus type 2. The plant's anti-diabetic potential is evident in glucose tolerance improvement and insulin secretion suppression. It also displays anticancer effects, causing cytotoxic and genotoxic effects on root meristem cells. This comprehensive overview underscores the multifaceted properties of *Arctium lappa*, making it a valuable subject for further exploration in pharmaceutical and therapeutic applications.

Keywords: *Arctium lappa*, Anticancer, Antidiabetic, Traditional uses, Phytochemistry, etc.

Submitted: 23-Oct-2023; Revised: 19-Nov-2023; Accepted: 28-Nov-2023

INTRODUCTION

Arctium lappa L., a medicinal and edible plant belonging to the Asteraceae family, is widely distributed globally, especially in Asia. This shrub typically reaches a height of approximately 1 meter, featuring roots that can extend up to 45–50 cm in depth and 3–6 cm in diameter. The roots have a cylindrical shape, a brown skin, and an inner color ranging from white to yellowish-white, depending on the plant's age [1].

The common names of *A. lappa* vary across different regions. In China, it is known as Niubang, referred to as gobo in Japanese, and identified as repejnik in Russia [2,3]. Throughout history and across diverse cultures, burdock has garnered significant attention in traditional medicine. It has been utilized to enhance overall well-being and address various health concerns such as fever, dizziness, throat pain, infections, diabetes, diuretic properties, anti-inflammatory effects, toothaches, swelling, boils, cuts, wounds, and even hair loss [4].

Traditional Uses

Arctium root preparations have a historical association with addressing gastrointestinal issues, acting as a diaphoretic and diuretic, and contributing to blood purification. Additionally, externally, it found application in treating conditions like ichthyosis, psoriasis, and seborrhea of the scalp. In Chinese traditional medicine, burdock root was employed for the treatment of skin-related problems such as carbuncles, ulcers, and erythema, along with addressing sore throats [5].

Morphological Characteristics

Arctium stem boasts numerous branches, each adorned with numerous crimson-violet flower heads that give rise to the well-known burrs, lending the plant its distinctive name. As a biennial, it reaches a height ranging from three to nine feet. The root is characterized by a robust, tough, brown bark with longitudinal wrinkles and a white interior. Cultivating the plant is easily accomplished from seed in moist, nutrient-rich soil and full sunlight [6].



Figure 1. Morphological features of *Articum Lappa*

Phytochemistry

The plant contains a diverse range of compounds, including volatile oils with small amounts of phenylacetaldehyde, benzaldehyde, and 2-alkyl-3-methoxypyrazines. Lignans such as neoarctiin A and arctigenin, sesquiterpene lactones, polyynes (with trideca-1, 11-dien-3, 5,7,9-tetraen as key components), sulfur derivatives, and caffeic acid derivatives like chlorogenic acid and isochlorogenic acid are present. Polysaccharides in the form of fructose, mucilages like xyloglucans and acidic xylans, and triterpenes including alpha-amyrin, omegataraxasterol, and acetic acid ester are also part of the plant's composition. Phytosterols such as beta-sitosterol, stigmasterol, campesterol, and their esters, along with tannins, contribute to its chemical makeup.

Lignans have been isolated from different plant parts, with arctigenin found in leaves, fruits, seeds, and roots; arctiin in leaves, fruits, and roots; trachelogenin in fruits; lappaol F in fruits and seeds; and diartigenin in fruits, roots, and seeds. Fruits also yield terpenoids like beta-eudesmol, 3 α -hydroxylanosta-5, 15-diene, and 3 α -acetoxy-hop-22(29)-ene. Polyphenols, including caffeic acid from stems, leaves, and root skin, chlorogenic acid from leaves and root skin, and tannins from roots, are part of the chemical profile. Roots contain inulin and sterols.

Furthermore, the plant provides amino acids, essential metal elements such as potassium, calcium, iron, magnesium, manganese, sodium, zinc, and copper. It also offers vitamins C, A, B1, and B2, as well as crude fiber, phosphorus, and carotene [7-11].

Pharmacological Activities

Antimicrobial Activity

A. lappa has demonstrated antibacterial activity against various strains, including Gram-negative bacteria such as *E. coli*, *Shigella flexneri*, and *Shigella sonnei*, as well as Gram-positive bacteria like *Staphylococcus aureus* and *Bacillus subtilis*, along with *Mycobacterium*. Furthermore, the lyophilized extract of *A. lappa* has proven effective against *Bacillus subtilis* and *Candida albicans*. The ethyl acetate fraction of the extract was utilized as intracanal medication for a 5-day period in teeth infected with *Candida albicans*, *E. coli*, *Lactobacillus acidophilus*, *Pseudomonas aeruginosa*, and *Streptococcus mutans*. Impressively, this treatment inhibited microbial growth after a 14-day observation period [12,13].

Anti-inflammatory Activity

Arctium lappa has shown efficacy in reducing edema in a rat-paw model of carageenan-induced inflammation. Its extract demonstrated a significant reduction in the release of inflammatory mediators by inhibiting degranulation and cys-leukotriene release.

In investigating the anti-inflammatory mechanism of arctigenin from *A. lappa*, cultured macrophage RAW 264.7 cells were employed. Arctigenin exhibited a dose-dependent suppression of lipopolysaccharide (LPS)-stimulated nitric oxide (NO) production and secretion of pro-inflammatory cytokines, including TNF- α and IL-6. Furthermore, arctigenin strongly inhibited the expression and enzymatic activity of inducible nitric oxide synthase (iNOS), while the expression and activity of cyclooxygenase-2 (COX-2) were not affected by arctigenin [14].

Anti-fatigue effect

The anti-fatigue effect of *Arctium lappa* L. extract was investigated in male mice using the forced swimming test. Mice treated with 4 and 6 g/kg of the *Arctium lappa* extract exhibited a significantly prolonged swimming time compared to the control group. Additionally, hepatic glycogen storage in groups treated with 2, 4, and 6 g/kg of the extract was significantly increased. Notably, lactic acid clearance in groups treated with 4 and 6 g/kg of *Arctium lappa* extract was significantly accelerated following the swimming activity in mice [15].

Anticancer activity

The cytotoxic and genotoxic effects of *A. lappa* root aqueous extract were investigated on the root meristem cells of *Allium cepa* (onion). Onion bulbs were subjected to concentrations of 12, 62.5, and 125 mg/ml of *A. lappa* extracts. The study revealed cytotoxic effects on cell division in *A. cepa*, with *A. lappa* root extract causing a significant increase in the total number of chromosomal aberrations and micronuclei (MNC) formations in *A. cepa* root tip cells. Two of the tested concentrations exhibited mitodepressive effects on cell division and induced disturbances in mitotic spindle formation in *Allium cepa* [16].

Antidiabetic activity

A. lappa root extract has demonstrated *in vivo* anti-diabetic activity by enhancing glucose tolerance and suppressing insulin secretion [7]. Evaluation of the anti-diabetic effect of *A. lappa* root extract revealed a significant decrease in serum glucose levels and an improvement in insulin levels [18]. Another study found that *A. lappa* root extract contributed to a reduction in body weight and serum glucose levels [19].

The total lignan extracted from *Fructus Arctii*, the dried ripe fruit of *A. lappa*, exhibited anti-diabetic properties in an alloxan-induced diabetic mice model. This was achieved by down-regulating blood glucose levels, enhancing glucose tolerance, and increasing serum insulin

levels [20]. In a study involving Goto-Kakizaki type 2 diabetic mice, Fructus Arctii total lignan displayed significant hypoglycemic potential by promoting glucose tolerance, insulin secretion, and GLP-1 release, while concurrently suppressing the intestinal absorption of glucose [21].

The hypoglycemic activity of arctigenic acid14 (PubChem CID: 141309089) was investigated in Goto-Kakizaki rats, revealing an enhancement in glucose tolerance and insulin secretion, accompanied by a suppression of blood glucose levels and glycosylated hemoglobin.

Antiviral Activity

The antiviral activity of arctigenin4 was assessed in mice challenged with porcine circovirus type 2 (PCV2), revealing a notable inhibition in the proliferation of PCV2 in various organs, including the lungs, inguinal lymph nodes, and spleen [22].

CONCLUSION

Arctium lappa L., commonly known as burdock, emerges as a versatile plant with a rich history of traditional medicinal uses across diverse cultures. The plant, belonging to the Asteraceae family, exhibits a broad spectrum of pharmacological activities, including antibacterial, anti-inflammatory, anti-fatigue, antiviral, anticancer, and anti-diabetic effects. The morphological characteristics of *A. lappa*, such as its crimson-violet flower heads and robust root system, contribute to its distinctive appearance. The phytochemical composition of the plant, encompassing volatile oils, lignans, sesquiterpene lactones, polyynes, and caffeic acid derivatives, underscores its potential therapeutic value. The documented pharmacological activities highlight *A. lappa*'s potential in addressing various health issues, from microbial infections to inflammation, fatigue, and even chronic conditions like diabetes. Additionally, its anti-cancer properties and the ability to modulate glucose metabolism further emphasize its significance in the realm of natural medicine. While the provided information offers valuable insights into the diverse facets of *Arctium lappa*, continued research is warranted to unravel its full therapeutic potential, understand underlying mechanisms, and explore practical applications in modern medicine. As a plant deeply rooted in traditional practices, burdock holds promise as a source of novel compounds for pharmaceutical development and complementary healthcare strategies.

References

1. Nabeshima EH, Moro TMA, Campelo PH, Sant'Ana AS, Clerici MTPS. Tubers and roots as a source of prebiotic fibers. In: da Cruz AG, Prudencio ES, Esmerino EA, da Silva NR,

- editors. Probiotic Prebiotics Foods Challenges, Innov. Adv. Academic Press; 2020. p. 267–293.
2. Shikov AN, Narkevich IA, Flisyuk EV, Luzhanin VG, Pozharitskaya ON. Medicinal plants from the 14th edition of the Russian Pharmacopoeia, recent updates. *J Ethnopharmacol.* 2021;268:113685.
 3. Mi Q-L, Liang M-J, Gao Q, Song C-M, Huang H-T, Xu Y, et al. Arylbenzofuran Lignans from the Seeds of *Arctium lappa* and Their Bioactivity. *Chem Nat Compd.* 2020;56:53–57.
 4. Lal M, Chandraker SK, Shukla R. Antimicrobial properties of selected plants used in traditional Chinese medicine. In: Prakash P, editor. *B.B.T.-F. and P.P. of.* Academic Press; 2020. p. 119–143.
 5. Jeelani S, Khuroo MA. Triterpenoids from *Arctium lappa*. *Nat Prod Res.* 2012;26(7):654–658.
 6. Chan YS, Cheng LN, Wu JH, Chan E, Kwan YW, Lee SMY, et al. A review of the pharmacological effects of *Arctium lappa* (burdock). *Inflammopharmacology.* 2011;19(5):245–254.
 7. Kato Y, Watanabe T. Isolation and characterization of a xyloglucan from gobo (*Arctium lappa* L.). *Biosci Biotechnol Biochem.* 1993;57(9):1591–1592.
 8. Wang HY, Yang JS. Studies on the chemical constituents of *Arctium lappa* L. *Yao xue xue bao Acta pharmaceutica Sinica.* 1992;28(12):911–917.
 9. Park SY, Hong SS, Han XH, Hwang JS, Lee D, Ro JS, et al. Lignans from *Arctium lappa* and their inhibition of LPS-induced nitric oxide production. *Chem Pharm Bull.* 2007;55(1):150–152.
 10. Matsumoto T, Hosono-Nishiyama K, Yamada H. Antiproliferative and apoptotic effects of butyrolactone lignans from *Arctium lappa* on leukemic cells. *Planta Med.* 2006;72(03):276–278.
 11. Maruta Y, Kawabata J, Niki R. Antioxidative caffeoylquinic acid derivatives in the roots of burdock (*Arctium lappa* L.). *J Agric Food Chem.* 1995;43(10):2592–2595.
 12. Perin FM, Franca S, Saquy P, Neto MDS. In vitro antimicrobial evaluation of aqueous herbal extracts for endodontic. *J Dent Res.* 2002;81:B157–B157.
 13. Gentil M, Pereira JV, Sousa YT, Pietro R, Neto MDS, Vansan LP, et al. In vitro evaluation of the antibacterial activity of *Arctium Lappa* as a phytotherapeutic agent used in intracanal dressings. *Phytother Res.* 2006;20(3):184–186.

14. Zhao F, Wang L, Liu K. In vitro anti-inflammatory effects of arctigenin, a lignan from *Arctium lappa* L., through inhibition on iNOS pathway. *J Ethnopharmacol.* 2009;122(3):457–462.
15. Dong W. Study on Anti-fatigue Function of the Extracts from *Arctium Lappa* L. *J Anhui Agric Sci.* 2006;34(13):3171.
16. Fatemeh K, Khosro P. Cytotoxic and genotoxic effects of aqueous root extract of *Arctium lappa* on *Allium cepa* Linn. Root tip cells. *Int J Agronomy Plant Production.* 2012;3(12):630–637.
17. Xu Z, Wang X, Zhou M, Ma L, Deng Y, Zhang H, et al. The antidiabetic activity of total lignan from *Fructus Arctii* against alloxan-induced diabetes in mice and rats. *Phyther Res.* 2008;22:97–101.
18. Xu Z, Ju J, Wang K, Gu C, Feng Y. Evaluation of hypoglycemic activity of total lignans from *Fructus Arctii* in the spontaneously diabetic Goto-Kakizaki rats. *J Ethnopharmacol.* 2014;151:548–555.
19. Xu Z, Gu C, Wang K, Ju J, Wang H, Ruan K, et al. Arctigenic acid, the key substance responsible for the hypoglycemic activity of *Fructus Arctii*. *Phytomedicine.* 2015;22:128–137.
20. Han H, Kee JY, Kim DS, Park J, Jeong MY, Mun JG, et al. Anti-obesity effects of *Arctii Fructus* (*Arctium lappa*) in white/brown adipocytes and high-fat diet-induced obese mice. *Food Funct.* 2016;7:5025–5033.
21. Hou B, Wang W, Gao H, Cai S, Wang C. Effects of aqueous extract of *Arctium lappa* L. roots on serum lipid metabolism. *J Int Med Res.* 2018;46:158–167.
22. Chen J, Li W, Jin E, He Q, Yan W, Yang H, et al. The antiviral activity of arctigenin in traditional Chinese medicine on porcine circovirus type 2. *Res Vet Sci.* 2016;106:159–164.

***Corresponding Author: Surbhi Jangir, Department of Pharmacology, Jaipur College of Pharmacy, Jaipur, Rajasthan, India**