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Review Article

Bio-Medical Importance of Agronomic Weeds: An Overview

Muhammad Fraz Ali[1*], Muhammad Ahsan Jamil[1], Muhammad Adnan[2], Muhammad Sulaman Saeed[3], Fazal ur Rehman[4] and Haroon Ilahi[5]

[1]Department of Agronomy, Faculty of Agriculture, University of Agriculture, Faisalabad

[2]Department of Agronomy, College of Agriculture, University of Sargodha, Punjab, Pakistan

[3]Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan

[4]Department of Plant Pathology, College of Agriculture, University of Sargodha

[5]Department of Agriculture - The University of Swabi, Pakistan

*Corresponding Author E-mail: frazali15@gmail.com

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ABSTRACT

Delivery of substandard medicines in the emerging world is an alarming issue for clinical and public health. These low quality medicines can cause unwanted side effects. Weeds are causing the serious issues for disturbing the environment, reducing the crop productivity with competition for resources with main crops in field but weeds are potentially important because of their multipurpose uses which includes in biomedical industry, synthetic industry and allelopathy. Weeds are used in curing many human problems by its useful form of medicine. In this review we have discussed biomedical importance of many noxious weeds which are disturbing the crop productivities but have many useful impacts for the pharmaceutical industry.

Keywords: *Allelopathy, Clinical and public health, Side effects*

INTRODUCTION

Market is full of synthetic drugs having high prices, severe side effects and affecting the environment. All of these medicines can cause unwanted side effects. For example, some antibiotics can be the cause of allergic reactions in around 5 percent of the world population (Bilal et al., 2016). Skin rashes are very common reaction of low quality medicines (Caudron et al., 2008). It is not an easy task to tell if the reaction is produced by the low quality medicine (Cabello, 2008) or shortage of social and monetary assets within the health sector as a whole bounds the capacity of drug regulatory agencies (Victor et al., 2011), resulting in a suboptimal controlled atmosphere in which substandard drugs are produced without detection and can be regulated easily.

Weeds are major factor reducing agricultural crop productivity (Aziz et al., 2021; Adnan, 2021; Adnan et al., 2021; Hayyat et al., 2020; Aziz et al., 2020). Weeds are using the same nutrients that crop plants are using, mostly in same proportions (McErlich and Boydston, 2014).

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Weeds are also using resources such as water, light, space and air that are necessary for crops (Gaba et al., 2014). The more similar the weed and crop requirements, the more they will compete for those resources. Weeds that compete aggressively with crops reduce their yield.

Weeds are the potential source of useful drugs if they are evolved through complete identification, characterization, and biochemical screening. Medicinal plants and the drugs derived from them are cheaper in cost, have lesser side effects and hence popular among the people. It is reported in a research that around 80% of the world's human population relies over weed and related plants as they are well-known for healing many diseases. Pakistan have biodiversity in climate and in geographical situation and have many useful medicinal plants and weeds in heritage, but its flora is never as it should be explored for medicinal point of view and not for food purpose. Despite of the facts that medicinal weeds are considered to be mostly rich in nutrients. In this review we have discussed biomedical importance of many noxious weeds which are disturbing the crop productivities but have many useful impacts for the pharmaceutical industry.

Gokharu (*Xanthium strumarium* L.)

Gokharu *Xanthium strumarium* L. (Asteraceae) is a common weed and used for its medicinal purposes from thousands of years (Ramírez-Erosa., 2007). Its English name is Burweed and in Pakistan locally known as Gokharu (Gethe et al., 2011). As cultural herbal medicine Gokharu has been used from ages to cure many human diseases, which includes rhinitis, nasal sinusitis, headache, gastric ulcer, urticaria, rheumatism bacterial, fungal infections and arthritis (Fan et al., 2019).

Botany

Gokharu (*Xanthium*) belongs to the Asteraceae. Gokharu is an annual herb plant which have 90 cm height with erect and branched stem (Acharya and Rai, 2011). It is often dotted with purple and white short hairs spread across the surface (Ramírez-Erosa et al., 2007). Leaves of ghokaru are green in color, with cauline, mostly alternate (proximal 2–6 sometimes opposite) with petiole symmetry (Gould et al., 2010), which are 5–20 cm long and 4–16 cm wide; the shape of blades is lanceolate, linear, ovate, orbicular-deltate The achenes are black, fusiform, obovoid, enclosed in the hardened involucre, with two hooked beaks and hooked bristles (Strong et al., 2006). The flowering time ranges from July to August, and fruiting stage lasts from September to October.

Phytochemistry

Phytochemistry of Gokharu (*Xanthium*) reported more than 170 chemicals, which have been isolated and identified from *X. strumarium*, includes sesquiterpenoids (Olivaro et al., 2016), phenylpropenoids (Van Kiem et al., 2020), lignanoids, coumarins, steroids, glycosides, flavonoids, thiazides, anthraquinones, naphthoquinones and other compounds (Jiang et al., 2020). Among them, sesquiterpenes and phenylpropanoids are the most abundant and major bioactive constituents in *X. strumarium*, and are considered as the characteristic constituents of this plant. In addition to the chemical constituents found in fruits, constituents in other parts of *X. strumarium* were also comprehensively reported, including leaves, roots and stems, etc.

Biomedical Importance

Gokharu weed possess comprehensive pharmacological effects which, includes anti-allergic rhinitis effects (Peng et al., 2014), anti-tumor effects (Han et al., 2007), anti-inflammatory and analgesic effects (Kim et al., 2005), insecticide and anti-parasitic effects (Nejad et al., 2018), antioxidant effects, antibacterial and antifungal effects (Kumar et al., 2019), antidiabetic effects, anti-lipidemic effects and antiviral effects (Wang et al., 2011). It is noteworthy that the research areas of modern pharmacy primarily focus on chemical components and extracts, which indicated the promising potential of Gokharu for treating disease.

Khaksi (*Sisymbrium officinale*)

Khaksi or Hedge mustard (Sisymbrium officinale) is known as a conventional weed in South Asia and South Australia (Guarise et al., 2019). It is a common weed of crops, pastures, roadsides, disturbed sites and waste areas. Khaksi with its scientific name Sisymbrium officinale, is also known as Wild mustard (Jangli Sarsoon), Hedge mustard, Oriental mustard, Tumbling mustard, and Indian hedge mustard (Blažević et al., 2010). Khaksi or Hedge mustard is domesticated from Europe and lies in the family Brassicaceae/Cruciferae. This weed plant is widely used for its edible seeds and leaves (Rahman et al., 2018).

Botany

Khaksi is a straight and herbaceous annual weed plant that grows upto 3.5 ft. in height. It has erect stem which have hairs from greenish to purple greenish. Khaksi have egg shaped, oblong to lanceolate leaves which measures about 4-8 inches in length and 1-3 inch in width. The flowers of khaksi have four petals in yellow color and measures ~4 mm in length. The fruit of this plant produced capsules which are 0.5-1.0 inch in length which contains cylindrical and flattened, seeds which are reddish brown and size of 1 mm long (Zorzan et al., 2020).

Phytochemistry

Phytochemical investigation of the Sisymbrium officinale elixir showed that the presence of some relevant constituents which includes putranjivine and proline. Putranjivine is deliberated as the glucosinolate marker of Sisymbrium officinale, whereas a stable existence of proline is typical of the Brassicaceae family. S. officinale is rich in sulfated compounds (particularly glucosinolates, isothiocyanates and sulfated lactones), to which its beneficial properties (Di Sotto et al., 2010)

Biomedical Importance

Khaksi plants have a great biomedical importance It is used as herbal medicine and its plants fresh or dried delivers a medicinal effect to humans. It supports treatment of chest congestion, coughs, asthma and fever (Kayani et al., 2014). Ahmad et al. 2018 reported that khaksi aids in reducing swelling and inflammation, cleansing of spleen and liver, removing piles and wounds. It is superficially used as an agent for gout, arthritis and rheumatic problems. Khaksi also play a significant role in the treatment of anti-inflammatory diseases, with the aim to avoid common undesired side effects of the main synthetic drugs commonly utilized. Herbal remedies and dietary plants used in traditional medicine could be a promising source of new effective drugs. Moreover, shoots and leaves of the wild plant have been traditionally used also as food, in salads.

Jangli Palak *(Rumex dentatus)*

Jangli Palak (*Rumex dentatus*) is a species of flowering plant in the knotweed family known by the common names **toothed dock** and **Aegean dock**. It is native to parts of Eurasia and North Africa, and it is widely known elsewhere as a introduced species. It grows in disturbed habitat, often in moist areas, such as lakeshores and the edges of cultivated fields.

Botany

Jangli palak is an annual or biennial herb producing a slender, erect stem up to 70 or 80 centimeters in maximum height. The leaves are lance-shaped to oval with slightly wavy edges, growing to a maximum length around 12 centimeters. The inflorescence is an interrupted series of clusters of flowers, with 10 to 20 flowers per cluster and each flower hanging on a pedicel. Each flower has usually six petals, the 3 inner of which are edged with spinelike teeth and have tubercles at their centers.

Phytochemistry

Its plants have high levels of oxalic acid, which gives the leaves of many members of this genus an acid-lemon flavour. Perfectly alright in small quantities, the leaves should not be eaten in large amounts since the oxalic acid can lock-up other nutrients in the food, especially calcium, thus causing mineral deficiencies. The oxalic acid content will be reduced if the plant is cooked.

Biomedical Importance

Its tender young leaves are cooked as a vegetable. As for medicinal purpose, its roots are used as an astringent application in the treatment of cutaneous disorders. People with a tendency to rheumatism, arthritis, gout, kidney stones or hyperacidity should take especial caution if including this plant in their diet since it can aggravate their condition

Bathu (*Chenopodium album*)

Bathu (*Chenopodium album*) is rapidly growing annual weed plant, belongs to genus *Chenopodium* (Pandey and Gupta, 2014). It is cultivated in few regions but elsewhere in world it is nominated as weed. This plant tumbles under genus Chenopodium which is distributed globally and have around 250 common species (Sukhorukov and Kushunina, 2014). Kochar et al. 2009 reported that bathu grow naturally as weed with many crops including wheat, barley, mustard and gram. It's used as food and herbal medicine as reported in many countries and literature. The common names for bathu in different countries are as Bathua sag (Hindi), Chandanbetu (Bengali), Parupukkirai (Tamil), Pappukura (Telgu)and Katu ayamoddakam (Malyalam).

Botany

Bathu botanical description is as follow, it tends to grow upright at initial stage and reached the height of 10–150 cm (rarely to 3 m), but characteristically becomes horizontal after flowering due to the weight of the foliage and seeds (Saini and Saini, 2020). The leaves are alternate and varied in appearance and have 3–7 cm length and 3–6 cm width. Its leaves are waxy-coated, unlettable and mealy in appearance, with a whitish coat on the underside. The small flowers are radially symmetrical and grow in small cymes on a dense branched inflorescence 10–40 cm length, the flowers are bisexual and female, with five petals which are mealy on outer surface, and shortly united at the base (Bajwa et al., 2019).

Phytochemistry

Bathu is augmented with phytochemicals like flavonoid, isoflavonoid, polyphenol etc., have gathered prodigious interest for their possible role in the looking after of human health predominantly major reduction in cancer risk. Bathu have been found to have flavonoid as phenolic amide and is hypotensive in activity. It has saponin, cinnamic acid amide, alkaloid chenoalbicin; apocarotenoids, xyloside; phenols and lignans. It also has seven free phenolic acids i.e. gallic acid, protocatechuric acid, protocatechuric aldehyde, vanillic acid, caffeic acid, syringic acid and vanillin. Gallic and protocatechuric acids were found in the fruits of C. album, while vanillin and m-coumaric acid in leaves whereas; vanillic, caffeic and syringic acids were present in both fruits and leaves.

Biomedical Importance

Bathu is used as anthelmintic, cardiotonic, carminative, digestive, diuretic and laxative. It is also useful in peptic ulcer, dyspepsia, flatulence, strangury, pharyngopathy, splenopathy, opthalmopathy and general debility. A fine powder of leaves is dusted to ally irritation and leaf juice is used for treating burns. The powdered plant (25–50 %), when mixed with normal food was reported to suppress oestrus cycle. A decoction of aerial parts mixed with alcohol is rubbed on the body affected by arthritis and rheumatism. The tender shoots are eaten raw in salad or with curd. The leaves are rich in potassium and vitamin C. Its use for the treatment of hepatic disorders, spleen enlargement, intestinal ulcers and burns.

Gajar booti (*Parthenium hysterophorus*)

Gajar booti is a species of flowering plant in the aster family, Asteraceae. Its common names include Santa-Maria, whitetop weed, and famine weed. In sub-continent, it is locally known as carrot grass, congress grass or *Gajar Booti*. The pollen grains of *Parthenium hysterophorus* invades disturbed land, including roadsides. It infests pastures and farmland, causing often disastrous loss of yield, as reflected in common names such as famine weed. In some areas, heavy outbreaks have been ubiquitous, affecting livestock and crop production, and human health. The plant produces allelopathic chemicals that suppress crop and pasture

plants, and allergens that affect humans and livestock. It also frequently causes pollen allergies.

Botany

Gajar booti is a much-branched, short-lived annual weed plant, it is erect, herbaceous plant that forms a basal rosette of leaves during the early stage of growth. It usually grows 0.5-1.5 m tall, but can occasionally reach up to 2 m or more in height. Mature stems are greenish and longitudinally grooved, covered in small stiff hairs (hirsute), and become much branched at maturity. The alternately arranged leaves are simple with stalks (petioles) up to 2 cm long and form a basal rosette during the early stages of growth. Numerous small flower-heads (capitula) are arranged in clusters at the tips of the branches (in terminal panicles). Colour changes to light brown when seeds are mature and about to shed. Flowering can occur at any time of the year, but is most common during the rainy seasons.

Photochemistry

Biochemical exploration of *Gajar booti* has indicated that all its fragments comprising trichomes and pollen encompass contaminants called sesquiterpene lactones (Ashour et al., 2018). Gajar booti contains a bitter glycoside parthenin, a major sesquiterpene lactone. Other phytotoxic compounds or allelochemicals are hysterin, ambrosin, flavonoids such as quercelagetin 3,7-dimethylether, 6-hydroxyl kaempferol 3-0 arabinoglucoside, fumaric acid. P-hydroxy benzoin and vanillic acid, caffeic acid, p courmaric, anisic acid, p-anisic acid, chlorogenic acid, ferulic acid, sitosterol and some unidentified alcohols. Parthenin, hymenin and ambrosin are found to be the culprits behind the menacing role of this weed in provoking health hazards. Gajar booti from different geographical regions exhibited parthenin, hymenin, coronopilin, dihydroisoparthenin, hysterin, hysterophorin and tetraneurin.

Biomedical Importance

Gajar booti have many advantages for human health. The main benefits include as it is a possible solution to cure skin inflammation (Patel, 2011), rheumatic pain, diarrhea (Maishi et al., 1998), urinary tract infections, dysentery, malaria and neuralgia (Fazal et al., 2011).

CONCLUSION

Although weeds are very harmful for our crops in agriculture, but we can't ignore their importance in pharmaceutical industry. They are rich source chemicals that can be used directly for curing many human diseases. There should be need to conserve weeds and to explore their potential roles for pharmaceutical industry.

REFERENCES

Acharya, D., & Rai, M. (2011). Traditional knowledge about Indian antimicrobial herbs: retrospects and prospects. Ethnomedicinal Plants: Revitalizing of Traditional Knowledge of Herbs, 212-237.

Adnan, M. (2021). Herbicide Resistance; A Major Problem in Weed Management. *Acta Sci. Biotec. 2*(3), 4.

Adnan, M., Hayyat, M. S., Mumtaz, Q., Safdar, M. E., ur Rehman, F., Ilahi, H., & Tampubolon, K. Improving the Management of Parthenium hysterophorus to Enhance Okra Production through the Application of Chemicals, Adjuvants and Plant Extract Blends in Pakistan. *Caraka Tani: J. Sust. Agri*. *36*(1), 165-174.

Ahmad, M., Zafar, M., Shahzadi, N., Yaseen, G., Murphey, T. M., & Sultana, S. (2018). Ethnobotanical importance of medicinal plants traded in Herbal markets of Rawalpindi-Pakistan. *J. Herb. Med.* 11, 78-89. https://doi.org/10.1016/j.hermed.2017.10.001

Ashour, M., Wink, M., & Gershenzon, J. (2018). Biochemistry of terpenoids: monoterpenes, sesquiterpenes and diterpenes. *Ann. Plant Rev. 40*, 258-303.

Aziz, A., Akhtar, N., Asif, M., Ashraf, M., Bhatti, M. A., Majeed, M. Z., Adnan, M., Ali, K., Munawar, A. (2020). Phytoregulatory Effects of Foliar

Applied Aqueous Extracts of Three Weed Species on Seedling Growth of Barley, Mustard and Sesame. *J. Environ. Agri. 5*(2), 468-475.

Aziz, A., Asif, M., Munawar, A., Majeed, M. Z., Nadeem, M. A., Akhtar, N., ... & Khan, B. A. (2021). Exploring the herbicidal potential of some weed species by using two distinct extraction methods. *Agr. Bio. Res*. *37*(1), 88-92.

Bajwa, A. A., Zulfiqar, U., Sadia, S., Bhowmik, P., & Chauhan, B. S. (2019). A global perspective on the biology, impact and management of *Chenopodium album* and *Chenopodium murale*: two troublesome agricultural and environmental weeds. *Env. Sci. Pollu. Res. 26*(6), 5357-5371. https://doi.org/10.1007/s11356-018-04104-y

Bilal, M., Haseeb, A., Khan, M. H., Arshad, M. H., Ladak, A. A., Niazi, S. K., Musharraf, M. D., & Manji, A. A. (2016). Self-Medication with Antibiotics among People Dwelling in Rural Areas of Sindh. *J. Clin. Diagnos. Res. 10*(5), 08–13.

Blažević, I., Radonić, A., Mastelić, J., Zekić, M., Skočibušić, M., & Maravić, A. (2010). Hedge mustard (*Sisymbrium officinale*): chemical diversity of volatiles and their antimicrobial activity. *Chem. Biodiv. 7*(8), 2023-2034.

Cabello, F. C. (2006). Heavy use of prophylactic antibiotics in aquaculture: a growing problem for human and animal health and for the environment. *Env. Microbiol. 8*(7) 1137-1144.

Caudron, J. M., Ford, N., Henkens, M., Mace, C., Kiddle-Monroe, R., & Pinel, J. (2008). Substandard medicines in resource-poor settings: a problem that can no longer be ignored. *Trop. Med. Int. Health. 13*(8), 1062-1072.

Di Sotto, A., Vitalone, A., Nicoletti, M., Piccin, A., & Mazzanti, G. (2010). Pharmacological and phytochemical study on a *Sisymbrium officinale* Scop. extract. *J. Ethnopharma. 127*(3), 731-736. https://doi.org/10.1016/j.jep.2009.12.001

Fan, W., Fan, L., Peng, C., Zhang, Q., Wang, L., Li, L., ... & Wu, C. (2019). Traditional uses, botany, phytochemistry, pharmacology, pharmacokinetics and toxicology of *Xanthium strumarium* L.: a review. *Molecules 24*(2):359.

Fazal, H. I. N. A., Ahmad, N., Ullah, I., Inayat, H., Khan, L., & Abbasi, B. H. (2011). Antibacterial potential in *Parthenium hysterophorus*, *Stevia rebaudiana* and *Ginkgo biloba*. *Pak. J. Bot. 43*(2): 1307-1313.

Gaba, S., Fried, G., Kazakou, E., Chauvel, B., & Navas, M. L. (2014). Agroecological weed control using a functional approach: a review of cropping systems diversity. *Agron. Sustain.* Develop. *34*(1): 103-119. https://doi.org/10.1007/s13593-013-0166-5

Gethe, R. M., Dingre, S. K., Pawar, D. D., & Sonawane, S. V. (2011). Effect of Weed Management on Soybean (*Glycine Max*. L. Merrill). *J. Life Sci. 8*(3), 278-279.

Gould, K. S., Dudle, D. A., & Neufeld, H. S. (2010). Why some stems are red: cauline anthocyanins shield photosystem II against high light stress. *J. Exp. Bot. 61*(10), 2707-2717.

Guarise, M., Borgonovo, G., Bassoli, A., & Ferrante, A. (2019). Evaluation of two wild populations of hedge mustard (*Sisymbrium officinale* (L.) Scop.) as a potential leafy vegetable. *Horti. 5*(1), 13-23.

Hayyat, M. S., Adnan, M., Asif, M., Abbas, B., Khan, S., Ullah, S., ... & Toor, M. D. (2020). Allelopathy of waste-land

weeds: A review. *Int. J. Bot. Stu. 5*(3), 97-102.

Jiang, H., Wang, X. J., Yang, L., Zhang, J. X., Hou, A. J., Man, W. J., ... & Kuang, H. X. (2020). The fruits of *Xanthium sibiricum* Patr: A review on phytochemistry, pharmacological activities, and toxicity. *World J. Trad. Chinese Med. 6*(4), 408-422.

Kayani, S., Ahmad, M., Zafar, M., Sultana, S., Khan, M. P. Z., Ashraf, M. A., ... & Yaseen, G. (2014). Ethnobotanical uses of medicinal plants for respiratory disorders among the inhabitants of Gallies–Abbottabad, Northern Pakistan. *J. Ethnopharma. 156*, 47-60.

Kumar, P. V., Kala, S. M. J., & Prakash, K. S. (2019). Green synthesis derived Pt-nanoparticles using *Xanthium strumarium* leaf extract and their biological studies. *J. Env. Chem. Eng. 7*(3), 103146. https://doi.org/10.1016/j.jece.2019.103146

Maishi, A. I., Ali, P. S., Chaghtai, S. A., & Khan, G. (1998). A proving of *Parthenium hysterophorus*, L. *British Homoeo. J. 87*(1), 17-21.

McErlich, A. F., & Boydston, R. A. (2014). Current state of weed management in organic and conventional cropping systems. In Automation: the future of weed control in cropping systems (pp. 11-32). Springer, Dordrecht.

Nejad, A. S. M., Bahmani, M., Shah, N. A., Shah, S. A., & Rafieian-Kopaei, M. (2018). Beliefs of herbal therapies of the community of the Ilam city of Ilam province, *Iran. J. Pharm. Pharmacog. Res. 6*(4), 299-317.

Olivaro, C., Rostan, V., Bandera, D., Moyna, G., & Vazquez, A. (2016). Xanthane sesquiterpenoids from the roots and flowers of *Xanthium cavanillesii*. Natu. *Prod. Res. 30*(19), 2238-2242.

Pandey, S., & Gupta, R. K. (2014). Screening of nutritional, phytochemical, antioxidant and antibacterial activity of *Chenopodium album* (Bathua). *J. Pharmacog. Phytochem. 3*(3), 1-9.

Patel, S. (2011). Harmful and beneficial aspects of *Parthenium hysterophorus*: an update. *Biotech. 1*(1): 1-9.

Peng, W., Ming, Q. L., Han, P., Zhang, Q. Y., Jiang, Y. P., Zheng, C. J., ... & Qin, L. P. (2014). Anti-allergic rhinitis effect of caffeoylxanthiazonoside isolated from fruits of *Xanthium strumarium* L. in rodent animals. *Phytomed. 21*(6), 824-829.

Rahman, M., Khatun, A., Liu, L., & Barkla, B. J. (2018). Brassicaceae mustards: Traditional and agronomic uses in Australia and New Zealand. *Molecules. 23*(1), 231.

Ramírez-Erosa, I., Huang, Y., Hickie, R. A., Sutherland, R. G., & Barl, B. (2007). Xanthatin and xanthinosin from the burs of *Xanthium strumarium* L. as potential anticancer agents. *Canadian J. Physio. Pharma. 85*(11), 1160-1172.

Saini, S., & Saini, K. K. (2020). *Chenopodium album* Linn: An outlook on weed cum nutritional vegetable along with medicinal properties. *Emergent Life Sci. Res. 6*, 28-33.

Strong, M. T. (2006). Taxonomy and distribution of Rhynchospora (Cyperaceae) in the Guianas, South America. Contributions from the United States National Herbarium, *53*, 1-225.

Sukhorukov, A. P., & Kushunina, M. A. (2014). Taxonomic revision of Chenopodiaceae in Nepal. *Phytotaxa. 191*(1), 10-44.

Van Kiem, P., Hoang, N. H., Thu, V. K., Tai, B. H., & Nhiem, N. X. (2020). Diterpene glycosides and phenolic compounds from the fruits of *Xanthium strumarium*. *Vietnam J. Chem. 58*(5), 648-653.

Victora, C. G., Barreto, M. L., do Carmo Leal, M., Monteiro, C. A., Schmidt, M. I., Paim, J., ... & Lancet Brazil Series

Working Group. (2011). Health conditions and health-policy innovations in Brazil: the way forward. *Lancet. 377*, 2042-2053.

Wang, Y., Han, T., Xue, L. M., Han, P., Zhang, Q. Y., Huang, B. K., ... & Qin, L. P. (2011). Hepatotoxicity of kaurene glycosides from *Xanthium strumarium* L. fruits in mice. *Die* Pharmazie-An *Int. J. Pharma. Sci. 66*(6), 445-449.

Zorzan, M., Zucca, P., Collazuol, D., Peddio, S., Rescigno, A., & Pezzani, R. (2020). *Sisymbrium officinale*, the Plant of Singers: A Review of Its Properties and Uses. *Planta Medica. 86*(05), 307-311.