A Critical Review on Effluent impacts on *Withania somnifera* and *Achrynthes aspera Linn.*

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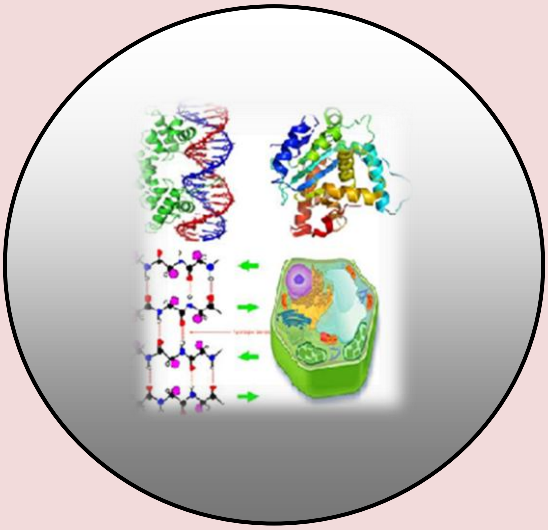
ISSN 2319-3077 Online/Electronic
ISSN 0970-4973 Print

Index Copernicus International Value
IC Value of Journal 82.43 Poland, Europe (2016)
Journal Impact Factor: 4.275
Global Impact factor of Journal: 0.876
Scientific Journals Impact Factor: 3.285
InfoBase Impact Factor: 3.66

J. Biol. Chem. Research
Volume 39 (1), 2022 Pages No. 237-247



Journal of Biological and Chemical Research

An International Peer Reviewed / Referred Journal of Life Sciences and Chemistry

Indexed, Abstracted and Cited in various International and National Scientific Databases

Published by Society for Advancement of Sciences®

J. Biol. Chem. Research. Vol. 39, No. 1, 237-247, 2022
(An International Peer Reviewed / Refereed Journal of Life Sciences and Chemistry)
Ms 39/01/083/2022

ISSN 2319-3077 (Online/Electronic)
ISSN 0970-4973 (Print)

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REVIEW PAPER

Received: 30/03/2022 Revised: 28/06/2022 Accepted: 29/06/2022

A Critical Review on Effluent impacts on *Withania somnifera* and *Achrynthes aspera Linn.*

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ABSTRACT

In Indian Ayurvedic and traditional medicine, Withania somnifera and Achrynthes aspera linn. has long been a key plant. This is especially common in wastelands that get polluted runoff from nearby municipalities and industrial facilities. As the world's population grows, businesses including agro-, food-, paper-, and pulp-making will see an increase in demand. The hazardous waste created by these companies is mostly organic in origin, and it is being discharged or treated in the environment. As a result of these wastes, the creatures and animals that come into touch with them suffer higher death rates, bodily alterations, and morphological changes of various kinds. In spite of its hazardous nature, the created waste has a high concentration of macromolecules and bioactive chemicals, making it an ideal source for the extraction and manufacturing of high-value goods. This article examines the environmental impact of various waste sources on Withania somnifera and Achrynthes aspera linn. Since they are rich in proteins, lipids, carbohydrates, and lignocelluloses they can affect the physiochemial properties of these medicinal plants.
Keywords: Wastes, Withania somnifera, Achrynthes aspera, Traditional Medicine, Medicinal plants

INTRODUCTION

There are many other names for the Ayurvedic herb Ashwagandha, which comes from the Solanaceae family and has been used in India for thousands of years under many names including "Indian winter cherry" and "Indian ginseng." For more than 3,000 years, WS has been used in Ayurveda for stress management, energy elevation, and boosting cognitive health [Farooqui et al. 2018; Pratte M.A. 2014, Singh R.H 2008, Rege N.N 1999] and to decrease inflammation, blood sugar levels, cortisol, anxiety and depression [Montalvan V 2015, Mirjalili M.H. 2009].

Withania somnifera is one of the most significant herbs in Ayurveda. The plant is an upright, greyish, evergreen shrub with long tuberous roots, short stems, oblong and petiolate leaves, greenish axillary blooms, and bisexual stigmas. For therapeutic purposes, the leaves, roots, stems, and flowers have at least 29 known metabolites [Mirjalili M.H. 2009, Rai M 2016] that are generated from leaf and root extracts. Analgesic, renewing, regenerative and growth stimulating activities have been discovered in this medicinal plant as well as anti-epileptic and arthritic benefits. It is also anti-depressive and has anti-coagulant properties. It is also anti-diabetic and has anti-pyretic properties.

Phytochemicals including alkaloids, steroids, terpenoids, and other similar compounds are abundant in plants and have long been used as food and medicine by humans (Saleem S 2018, Muhammad G 2011, Hussain MA 2016, Aye MM 2019). As early as 1911, Power and Salway began studying the phytochemistry of *W. somnifera,* isolating withaniol, somnirol, somnitol and withanic acid from alcoholic extracts of leaves and roots. They also found phytosterol, ipuranol, and alkaloids in these extracts (Power FB 1911). Somiferine, somnine, somniferinine, withamine, withanmine, pseudowithamine, and withanaminine were some of the alkaloids identified in this research (Majumdar DN. 1952). Phytochemicals such as tropine, choline, pseudotropine, dl-isopelletierine, cuscohygrine, anahygrine, and anaferine were found in the plant's alcoholic extract (Leary JD, et al. 1963). Pyrazole alkaloid, withasomnine, was isolated from *W. somnifera's* alcoholic root extract (Schröter HB 1966). In 1980, it was discovered that the methanolic extract of plant leaves included tisopelletierine, 3-tigloyloxtropine, cuscohygrine, 3-tropyltigloate, hygrine, dl-isopelletierine, withasomnine, mesoanaferine, withanine, somniferine, hentriacontane, withananine, visamine, ashwagandhin (Kirson I 1980). To add to this list, the plant's extract included withaniol, reducing sugars (acetysteryl glycosides, ducitol, starch), and amino acids such as aspartic acid (proline), tyrosine (alanine), glutamic acid (cystine), and tryptophan (alanine) (Alam N 2011, Mirjalili MH 2009, Abraham A 1968). By employing Fast Atom Bombardment Mass Spectrometry, 13C and 1H nuclear magnetic resonance (NMR), and UV-Visible spectroscopy methods, seven novel withanosides I-VII were identified (Mirjalili MH 2009).

Effluents

Waste products that are produced by varied human activities from the industries are known as effluents. Production of these wastes is an integral part of industrial activities but unfortunately our inability to anticipate or predict the types and magnitude of undesired consequences of unbridled release of effluents in our environment, coupled with the growth of industrialization have resulted in massive and destructive operations in our ecosystems.

Although industrial processes are desirable, at the same time, the serious and irreversible damage done to the environment through their apparently innocuous discharge of effluents are unquantifiable. Until now, effluents are discharged into rivers, estuaries, lagoons or the sea without treatment by most of the industries. However, despite the treatment being employed by some industries, it is still impossible to remove all undesirable properties from the effluents.

Pollutant discharges have increased dramatically due to a growth in urbanization and industrial activity and the increased exploitation of cultivable land, which has led to a broad range of pollutants. Pollutants that enter rivers and other aquatic habitats.

Arsenic, chromium, and other hazardous metals are dissolved in the water. Dissolved organic matter (lead, mercury, and other metals) PCBs, organochlorine pesticides (OCs), and polyaromatic hydrocarbons (PAHs) are contaminants. There are (PAHs, dioxins, and polychlorinated benzofurans) that pollute water supplies. Consequently, the effluent must meet particular standards depending on the business, monitoring practices might differ significantly legislation pertaining to streams and other bodies of water. Continuous monitoring may be necessary in certain instances prior to being discharged. Other circumstances will need the use of monitoring for a certain length of time quarterly). Monitoring water quality is a difficult task (Mostafaie, A., et al., 2021).

Effluents from food industry

For India, the dairy sector plays a critical role and produces 35% of Asian milk. It is the world's greatest milk producer and consumes practically all of its own milk output. To clean cans, machines, and floors, dairy companies need a lot of water. The liquid waste in a dairy comes from production, utilities, and service. Milk processing, washing, packing, and cleaning of the milk tankers all discharge wastewater known as dairy effluent when clean water is utilized. Processing requires a water-to-milk ratio of 1:10 per liter. Whey proteins, lactose, fat, and minerals [R. Mukhopadhyay 2003] are abundant in dairy effluent, which is also malodorous due to the breakdown of some of the pollutants that lead it to be unusable by the general public. Approximately 0.2–10 liters of effluent per liter of processed milk are generated by the dairy industry [B. Balannec 2005]. Due to the quick conversion of milk sugar to lactic acid, dairy wastes are often neutral or slightly alkaline. Casein may precipitate due to a decreased pH. The smell of butyric acid and thick black flocculated sludge masses define dairy wastes [V.B. Braio 2007]. FOG (fats, oil, and grease) may harm wastewater treatment plants because of its corrosive properties. Hydrocarbons of petroleum origin, animal and vegetable fat, and sulfur compounds and organic colors make up the bulk of oil and grease [W.L. Stuth 1989]. The bulk of the organic load is made up of milk (raw material and dairy products), which reflects an effluent with high levels of COD, BOD, oil and grease, N and P. Further complicating matters is the fact that the CIP (cleaning in situ) automated cleaning system discards rinse liquids with pH values ranging from 1.0 to 13.0.

Effluents from textile industries

Textile industries consume a large amount of chemicals and water for manufacturing. After the product is manufactured, untreated effluent from the textile industries is directly discharged into water streams. Dye constituents in the effluents are highly variable because of the different types of clothes, including different structural varieties of dyes such as acidic, basic, metal complex, azo, diazo and reactive dyes. These effluents are typically highly coloured, usually alkaline, and contain higher amounts of biochemical oxygen demand (BOD) and chemical oxygen demand (COD) and a variety of toxic contaminants such as suspended solids, dyes, acids, bases, salts, surfactants, chlorinated compounds, oxidizing and reducing agents [Mahmoued, E.K., 2010]

Heavy metals are natural components that cannot be eliminated or degraded; they are thus irreversible. Textile effluent has a high concentration of heavy metals, which is a hazard for the environment all over the globe. As a result of leaching, these effluents end up in both surface and ground water, polluting both.

Small amounts of heavy metals including copper, cadmium, chromium and mercury are necessary to keep the human body's metabolism running smoothly on a day-to-day basis (Sarker, B.C 2015). At larger quantities, heavy metals may cause hazardous health consequences to people and other aquatic species; they can enter the human body via drinking water, food and air. The maximum acceptable level of metals in drinking water has been established by the Bureau of Indian Standards and the US Environmental Protection Agency (BIS, 1992; USEPA, 1990).

Textile effluents seem to include a significant amount of suspended particles. An oily scum such as oil, grease, clay, silt and gritty components may combine to produce suspended solids. The amount of suspended particles in wastewater has had a significant impact on the aquatic ecosystem, preventing the transmission of oxygen from the air to the water. Suspended particles in an aquatic environment may impede fish development and increase their susceptibility to illness (Ghaly, A.E 2014). In addition, suspended particles prevent light from penetrating the aquatic environment, reducing the capacity of algae to create food and oxygen. The water temperature rises and the concentration of dissolved oxygen falls as heat is absorbed by suspended particles.

Effluents from pesticide industry

Agriculture relies heavily on the production of a wide range of fertilizer products from industrial plants. On the other hand, these industries are among the largest polluters of the environment by the emission of gaseous, liquid, and solid pollutants. Toxic anions, organic and inorganic chemicals, dissolved gases, insecticides, and heavy metals are important contaminants in the effluents of the fertilizer, pharmaceutical, tanning, and dying industries [C. Namasivayam 2007, V. Garg, P 2007, B. Hammadi 2006, Z. Juan 2011]. To ensure adequate treatment and eventual disposal, it is necessary to characterize liquid effluents on a regular and dependable basis [M.S. Podder 2016, Z. Xie2016, M.A. Zahed 2010] . Many recent studies have assessed effluent from textile mills, TNT industries, refineries, and olive mills and found water quality metrics to be over the acceptable limits [S. Amadi 2015, M. Iqbal 2015, S. Jafarinejad 2016, K. Legrouri 2017]. For this study, the effluent from several fertilizer units is characterized to assess their physicochemical characteristics [A.O. Majolagbe 2016, K.D. Ogundipe 2017, R. Patel 2017]. Four industrial facilities, two of which produced urea (U-1 and U-2), one of which produced diammonium sulphate, and one of which produced nitrophos and calcium ammonium nitrate, were sampled for effluent[K. Qureshi 2015, A. Shindy 2017]. For this purpose, the effluent's physicochemical characteristics were compared to norms provided by the National Environmental Quality Standard [C. Ukpaka 2016, C. Ukpaka, BTX degradation 2016].

Achyranthes aspera Linn.

Annual shrub *Achyranthes aspera Linn.* (Amaranthaceae) found in tropical and subtropical climates. India, Baluchistan, Sri Lanka, Tropical Asia, Africa and America are the most typical places to find this plant. Chirchita (Hindi), Apamarga (Sanskrit), Aghedi (Gujarati), Apang (Bengali), Nayurivi (Tamil), Kalalat (Malyalam), (Rege N.N., 1999) and Agadha (Marathi) in India are some of the names given to this wild tropical plant. It has been known to have a wide range of medical benefits and is often used as a diuretic, antimalarial, antihypercholesterolemic, antiestrogenic, and antileprotic in traditional Chinese medicine. Snakebite, hydrophobia, urinary calculi, rabies, influenza, otorrhoea, piles, bronchitis, diarrhea, renal dropsies, gonorrhea, and stomach discomfort are among the conditions for which it is prescribed as an antiasthmatic antitussive. Saponins, alkaloids (betaine, achyranthine) and triterpenoids (oleanolic acid and its glucoside) have been found in earlier phytochemical investigations, as well as amino acids, steroids, triterpenoids, phenolic content, and flavonoids, according to current research. Folklore claims that it possesses antiarthritic and antirheumatic properties. As a result, this research was set up to confirm the assertion that plant extracts have anti-inflammatory properties and to identify the phytochemicals responsible for this capability.

Effect of Effluents on *Withania somnifera*

Arsenic

It was shown that both concentration and duration of therapy were linked to the accumulation of the body. Although the species of differed, the results were generally the same. Total As accumulation in plants exposed to AsIII was larger than in plants exposed to AsV, and the roots acquired more As in comparison to the leaf. At 100 M, the maximum As accumulation in roots of plants exposed to AsIII or AsV was found to be as high as 320 mg g1 dry weight (DW) and as low as 173 mg g1 DW after 10 days. Amounts in leaves were 161 and 100 micrograms per gram of dry matter (DW) (Srivastava S 2007). When plants were exposed to higher concentrations of As, they were more hazardous than plants that were subjected to lower concentrations. AsIII and AsV both display varied accumulation under the same circumstances owing to changes in the modes of absorption and transport (Abedin MJ 2002). Previous research has shown that Withania plants may collect Cu (Khatun S 2008), Cr, Zn, Mn. Ni. and Pb. Significant amounts of metals including As have been observed to accumulate in other medicinal plants including Ocimum (Angelova V 2007). Withania somnifera's As tolerance and high As accumulation suggest consideration of probable dangers related with the uncontrolled and unregulated use of herbs for medical reasons, as shown in our previous work on Ocimum [Kulhari A 2013]. Plants from various parts of India were studied in a recent study for heavy metal concentrations. Some samples included levels of metals above allowable levels, while most were below the acceptable range. In their study of heavy metal accumulation in W. somnifera plants gathered from polluted areas, (Khan MI., et al., 2007) advised that sufficient regulatory checks be performed before the plants were used medicinally. A new research indicating that W. somnifera protects rats against As-induced adverse effects makes the case for ashwagandha's potential medicinal application all the more compelling. Consequently, W. somnifera has a broad variety of medicinal uses, and the only cautious action that must be done before using it is to conduct a thorough examination of it. Toxic effects of AsIII and AsV on photosynthetic pigments and water status were studied in this study There were significant differences in the amount of total chlorophylls and carotenoids that were adversely influenced by the presence of AsIII and AsV, although AsIII had a higher impact. AsIII exposure caused a drop in total chlorophylls and carotenoids of 7 to 83 percent, whereas AsV exposure caused a loss of 1 to 60 percent, while AsIII exposure caused a decline of 4 to 47 percent. One way arsenic influences pigment content is by interfering with the biosynthesis of an essential enzyme like -aminolevullinic acid dehydratase (Jain M 2004) and by increasing the activity of a degrading enzyme called chlorophyllase (Jain M 1997).

As exposure has also been cited as a possible cause of a reduction in pigment levels (Li W-X 2006). Photosynthetic pigments have been shown to decrease in response to As exposure in previous studies, and those findings are confirmed here. It's possible that a decrease in photosynthetic pigments might lead to a decrease in growth, which in turn could have an impact on the water supply (Srivastava S 2013). It was shown that RWC, a measure of the water status of plants, was impacted by AsIII exposure at 100 M for 10 days more than by AsV exposure (16%). Water absorption channels such as aquaporins of the plasmamembrane intrinsic protein (PIP) family have been implicated in the observed reduction in RWC [Li W-X, 2006].

Accumulation of heavy metal in Achyranthes aspera linn.

Lead is a contaminant that has no known physiological or metabolic function. Blood pressure increases, renal damage occurs, miscarriages and mild abortions are caused as well as brain damage, sperm damage, a drop in fertility, and a decrease in the capacities of children **[Jafarinejad, S. 2016]**. There was an allowed maximum of 0.43 parts per million of lead in edible plants, according to WHO (1992). It was established at 10 ppm for medicinal plants by China, Malaysia, Thailand, and the World Health Organization (WHO). All of the samples tested for lead content had levels that were much below the safe limit. Lead levels in roots were found to be 0.342 parts per million (ppm), in stems to be 0.033 ppm, and in leaves to be 0.08 ppm, according to our findings. Exposure to high levels of lead is dangerous to health. Users should not be concerned about the amount of Pb found in this research. Leafy plant samples have been found to have more Pb than fruit and root samples, according to reports. However, the results of this investigation do not support this theory. On the basis of traffic density and environmental pollution, the level of Pb contamination might vary.

Zinc

The *Achyranthes aspera* Linn. root had the greatest concentration of Zinc, at 3.523 ppm, while the stem had a content of 1.34 ppm, and the leaves had a concentration of 0.99 ppm. In addition to its involvement in metabolism, zinc is necessary for healthy growth, development, and overall well-being in all living things. Several enzymes in the body need it as a co-factor. Coronary heart disease and other metabolic problems are linked to zinc deficiency. People who eat mostly plant-based diets are being examined for possible zinc fortification programs. Potentially appealing treatments that might benefit the whole community as well as target vulnerable populations, such as children and pregnant women, can be found in the fortification of cereal staple foods. The incidence of stunting in many impoverished nations would be reduced if zinc were added to the diet, since zinc availability in the body affects linear growth.

Alakalinity effects

When alkaline wastes are deposited in old and abandoned landfills, the leachate may have a long-term effect on nearby waterways. geochemical behavior of alkaline leachate relies on infiltrating water's chemical composition, physical composition and age of residue, the nature of any co-deposited wastes, the hydrogeological environment (flow rates and redox state, residence period of water), and the qualities of the native ground. Chemical oxygen demand and oxygen depletion in the water column, excessive sulfate loadings, salinity, and a rise in the concentration of metals are some of the effects of alkaline leachate.

Mineral precipitation (mainly calcite) in the leachate streams is highly quick, making the leachate streams similar to natural travertine deposits (through CO2 vigorously in-gassing into the leachate waters). Leachate discharge has an ecological cost that is amplified if the precipitates smother macroinvertebrate populations and impede light penetration). pH, calcium and magnesium concentrations, alkalinity, and fish absence were all affected by the steel slag leaching in a tiny Pennsylvania stream known as Nine Mile Run. Another well-documented effect of old steel mills in the United Kingdom is that it exhibits many of the same problems that have been discussed so far. Steel slag was used to fill a wetland at Lake Calumet (Chicago, Illinois, USA) and Gorka Lake (Poland) and Kinghorn Loch (Scotland) to produce high levels of alkaline water. Studies on the long-term effects of alkaline residue contamination are few and few between. However, leachates from steel mill sites might persist for more than 30 years after closure, and residual discharges from Solvay waste beds harmed surface waterways for more than 15 years after operations were shut down. More than 100 years after the dumping of COPR waste, hyperalkaline water (pH > 12) has leached from the site. This means that long-term planning for alkaline residue repositories' closure should be part of the design process from the outset.

CONCLUSION

These findings suggest that the medicinal plant *Withania somnifera* and *Achrynthes aspera linn.*, which was the subject of this study, is a source of physiologically significant components, which may contribute to its therapeutic potential. As a result, it might function as a supplement to the body's macro and micronutrients. Ayurvedic formulas have proven effective in the treatment of a wide range of illnesses. The pharmacological function of medicinal plants is influenced by the activity of trace elements found in the plants.

Because of the variances in plant structure and the mineral makeup of their soil, elemental concentrations vary widely across plants. Variations in elements composition may also be caused by the plant's preference for absorbability, fertilizer application, irrigation, and climatological circumstances. There is no clear correlation between the plant's elemental composition and its capacity to heal. The results of these investigations, on the other hand, will provide us a better understanding of the herb's pharmacological activity and establish the missing connection. The lack of information on mineral accumulation in these therapeutic plants has led to their use as a source of mineral supplements in the body. It is extremely beneficial to conduct elemental composition screening on medicinal plants used in traditional medicine.

The study of *Withania somnifera* and *Achrynthes aspera linn.'s* elemental composition will aid in the development of novel Ayurvedic medicines that may be used to treat and prevent a wide range of illnesses. *Achyranthes aspera's* curative properties can only be better understood by investigating the relationship between soil and climate.

There are a number of circumstances that must be met in order for this medicinal herb to be effective. Iron, copper, calcium, and sodium are abundant in both of these medicinal plants, and it has been hypothesized that plants with high levels of these macro- and micronutrients might play an essential role in human health maintenance.

These plants may not pose a health risk to consumers, since all of the components found in them are below the World Health Organization's acceptable threshold for therapeutic plants.

The effluents that are eliminated from industries need to be treated properly with various bio methods for being less toxic for environment.

ACKNOWLEDGEMENTS

I want to acknowledge Dr. Ashok Kumar Verma, Associate Professor for his motivation and continuous support in finding the researches have been done in past and assisting me in finding the most effective research. With his help, I could finalize a review paper. Along with him, Arti Singh who has given her best effort in giving ideas on industrial effluent impacts on plants.

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