



Review Article

WITHANIA COAGULANS AND PSIDIUM GUAJAVA- AN OVERVIEW

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Abstract: In ancient system of medicine, many plants have been reported to cure various health problems and diseases. *Withania coagulans* (*W. coagulans*) Dual commonly known as 'Indian cheese maker' or 'vegetable rennet' belongs to family: Solanaceae and is one of the important medicinal plants. *W. coagulans* Dunal is a gray-whitish small shrub distributed in east of the Mediterranean region extending to South Asia. It is a common medicinal plant in many parts of Pakistan and India. In Ayurvedic system of medicine, *W. coagulans* is widely used in diabetic cases. *W. coagulans* is also used to treat nervous exhaustion, disability, insomnia, wasting diseases, failure to thrive in children and impotence. The active compounds, in particular, withanolides isolated from the plant are considered to have antimicrobial, anti-inflammatory, antitumor, hepatoprotective, anti hyperglycemic, cardiovascular, immuno-suppressive, free radical scavenging and central nervous system depressant activities. In the next of our series on Far Eastern plant we look at Guava or *Psidium guajava* Family: Myrtaceae Common names: Common guava, yellow guava, apple guava. Bayabas, kalimbahin, tayabas, guayabas. Bisayan: Bayabas. In folk medicine, extracts of roots, bark, and leaves are used to treat gastroenteritis, vomiting, diarrhoea, dysentery, wounds, ulcers, toothache, coughs, sore throat, and inflamed gums.

Keywords: *Withania coagulans*, *Psidium guajava*

1. INTRODUCTION

1.1 Introduction to *Withania coagulans*

Biological source: It consist of flower of *Withania coagulans*

Family: Solanaceae¹²



Fig: 1.1 flowers of *Withania coagulans*



Fig: 1.2 Herb of *Withania coagulans*

Habitat: It is branched shrub up to 1 m tall. Shoots rigid, greyish-green, and stellate-tomentose. Leaves 3-8 x 1.4-3.5 cm, elliptic-ovate to elliptic-lance late, obtuse or acute, cuneate, leathery, nerves faint. Petiole 5-10 mm long. Bisexual flowers: calyx cupular-campanulate, stellate-tomentose; lobes 1.5-2.5 mm long, acute. Corolla exceeding calyx, campanulate, stellate-tomentose outside, yellowish within. Stamens included. Stigma subexserted. Male flowers: stamens ± subexserted. Anthers c. 3.5 mm long; filaments 2.0 mm long. Female flowers: stamens included. Anthers smaller than in male flowers. Style glabrous. Berry globose, 10-12 mm broad, red.

Distribution: Iran, Afghanistan, Pakistan and India. Fairly, common in dry hot and stony places up to 1700 m. The fruit is emetic and diuretic and also has coagulating properties.

VERNACULAR NAMES:

Hindi - Akri, Punir.
Bengali - Ashwagandha
English - Indian cheese maker
Punjabi — Spin bajja, panir

TAXONOMICAL CLASSIFICATION

Kingdom: Planate, Plants
subkingdom: Tracheobionta, Vascular plants
super division: Spermatophyte, Seeds plants
division: Angiosperm
class: Dicotyledons
order: Tub florae
family: Solanaceae
genus: *Withania*
species: *coagulans*

1.2 Introduction to *Psidium guajava*

Biological source: It consists of fruits of *Psidium guajava*

Family: Myrtaceae³



Fig 1.3 Herb of *Psidium guajava*

Habitat: It is a low evergreen tree or shrub 6 to 25 feet high, with wide-spreading branches and square, downy twigs, is a native of tropical America. It is a common vegetation cover by roads and in waste places in Hawaii.

Distribution: It is a low evergreen tree or shrub 6 to 25 feet high, with wide-spreading branches and square, downy twigs, is a native of tropical America. It is a common vegetation cover by roads and in waste places in Hawaii. Guava is a tropical and semitropical plant. It is well known in the islands for its edible fruit. It is common in the backyards. The branches are crooked, bringing opposite leaves. The flowers are white, incurved petals, 2 or 3 in the leaf axils; they are fragrant, with four to six petals and yellow anthers. The fruit is small, 3 to 6 cm long, pear-shaped, reddish-yellow when ripe.

VERNACULAR NAMES:

Common guava

yellow guava

apple guava

Bayabas

Sans: Perala; Amratafalam; Amruta-phalam.

Hind: Lal sufrium (red); Amrut.

Ben: Lal peyara (red); Goachi-phal; Peyara; Pyara; Piya

Bom: Perala.

Tel: Jama; Jam-pandu; Goya-pandu

TAXONOMIC CLASSIFICATION:

Kingdom: Planate

Division: Magnoliophyta

Class: Magnoliopsida

Family: Myrtaceae

Genus: *Psidium*

Species: *Guajava*

2. CHEMICAL CONSTITUENTS

2.1 CHEMICAL CONSTITUENTS OF *WITHANIA COAGULANS*

Active compounds: Withanolides are a group of steroidal lactones found among members of Solanaceae. Withanolides are named after the name of the source plant *Withania* species. They are generally defined as C-28

steroidal lactones. The presence of a lactones ring with C-22 and C-26 oxygen functions to form a six or five member lactones ring on an Ergostane skeleton, intact ergostane or rearranged, constitutes the basic structure of all Withanolides. The Withanolides skeleton may be defined as 22-hydroxy ergostane-26-oic acid-26, 22-olide. Modifications of either the carboxylic skeleton or of the side chains result in many novel structural variants of Withanolides which are described as modified Withanolides or ergostane-type steroids related to Withanolides. It was reported that Withanolides possess anti-tumour, anti-antigenic, chemo preventive and anti-inflammatory activities. Therefore, Withanolides may represent useful leads for the development of potential anti-cancer drugs. Withanolides are reported to have antitumor activity. Component Withanolides, Withaferin A, inhibits angiogenesis. Withanolides have also been reported to inhibit metastatic and quinine reductase activity. Some of them have been shown to preferentially affect events in the cholinergic signal transduction cascade of the cortical and the basal forebrain, indicating their promise for the treatment of Alzheimer's diseases. Withanolides mediate their effects through suppression of the transcription factor nuclear factor-EB (NF-EB). The evidence is multifaceted. NF-EB is activated by various carcinogens, tumour promoters, and conditions in the tumour microenvironment (hypoxia and acidic pH), most inflammatory agents activate NF-EB. Chemo preventive agents have been shown to suppress NF-EB activity on Withanolides is potent suppressors of NF-EB activation induced by various agents and that this suppression is mediated through inhibition of IKK. This mechanism accounts for the ability of Withanolides to suppress the expression of gene products that regulate apoptosis, proliferation, angiogenesis and invasion. Anti proliferative, Preapoptotic, anti-invasive, anti-osteoclastogenic, anti antigenic, anti-metastatic, radio sensitizing, anti arthritic and cardio protective effects assigned to Withanolides may be mediated in part through the suppression of NF-EB and NF-EB regulated gene products. Diverse pharmacological activities reported that Withanolides, Withaferin-A includes anti-inflammatory, anti-tumor and anti-oxidant properties. Some studies have demonstrated that Withaferin-A has potent anti-inflammatory, anti-oxidant and antitumor properties.^{4, 5}

PROPERTIES OF WITHAFERIN-A AND ITS DERIVATIVES^{6, 7}

- Withaferin -A induces act in microfilament aggregation which is mediated by annexin- II.
- Withaferin - A is found to be a natural proteasome inhibitor.
- It induces apoptosis by inhibiting Topoisomerase –I DNA complex.
- Withaferin- A acts as a mitotic poison (arrest tumor cells at metaphase).
- The compound inhibits the umbilical vein endothelial cell sprouting.
- Methanolic extract of Withaferin-A promotes the formation of dendrites.
- 4-Dehydro-withaferin-A and Withaferin A diacetate shows most potent cytotoxic activity. Withanolides show antimicrobial activities against gram positive and gram negative bacteria.

- Withaferin-A shows anti-mitotic properties which affect the spindle microtubules in metaphase and membrane of cells in interphase.
- Withaferin-A is found to suppress adjuvant arthritis in rats.
- Withaferin-A and its glycosidic C-27 derivatives activate the peritoneal macrophages and increase the activity of lysosomal enzymes secreted by macrophages.
- Withaferin -A exerts immunosuppressant activities.
- mercaptoethanol when bind to free 5 beta, 6 beta-epoxide group of Withaferin- A then Withaferin- A lost its anticancer activity

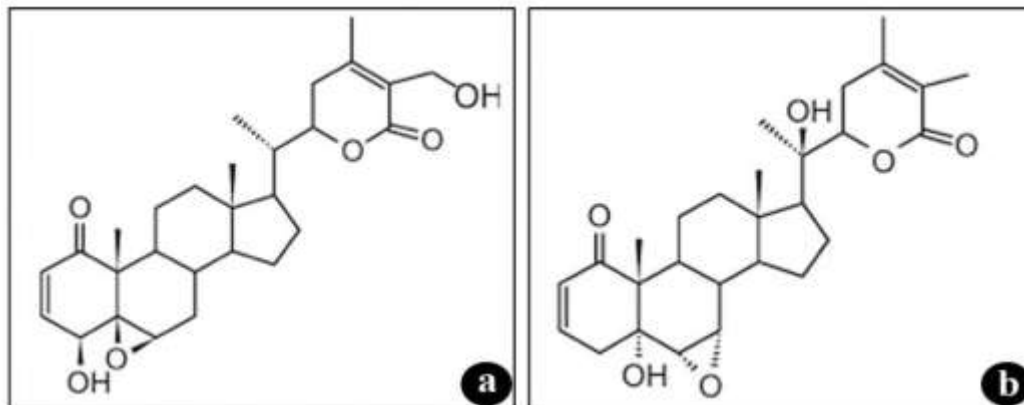


Fig: 1.4 Structures of important Withanolides: (a) Withaferin A and (b) Withanolide

2.2 CHEMICAL CONSTITUENTS OF *PSIDIUM GUAJAVA*

The fruits also contain vitamin C, vitamin A, iron, calcium and phosphorus. Guavas are up to 5 times richer in vitamin C than oranges. Manganese is also present in the plant in combination with phosphoric, oxalic and malice acids. The fruit contains saponin combined with oleanolic acid. Morin-3-O- α -L-lyxopyranoside and morin-3-O- α -L-arabopyranoside and flavonoids, guaijavarin and quercetin

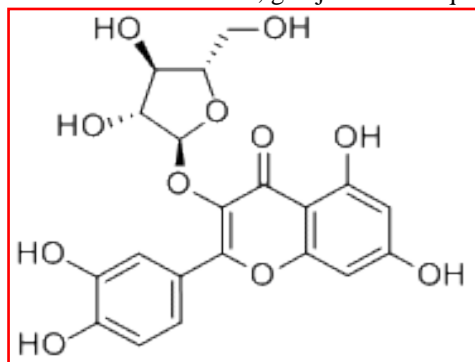


Fig: 1.5 Structure of guaijavarin

In the headspace, the major constituents are: hexanal (65.9%), γ -b(7.6%), (E)-2-hexenal (7.4%), (E,E)-2,4-hexadienal (2.2%), (Z)-3-hexenal (2%), (Z)-2-hexenal (1%), (Z)-3-hexenyl acetate (1.3%) and phenol (1.6%), while β -caryophyllene (24.1%), nerolidol (17.3%) 3-phenylpropyl acetate (5.3%) and caryophyllene oxide (5.1%) are the major volatile constituents present in the hydro distilled essential oil **The leaves** contain essential oil with the main components being α -pinene, β -pinene,. Pinene .leaves contains fixed oil 6%, and volatile oil 0.365% contains 'glycogen' 4.14% Avicularin. **Bark** contains 12-30% of tannin and one source says it contains tannin 27.4%, or **roots** also rich in tannin. The plant also contains leukocyanidins. The seeds contain 14% oil on dry weight, with 15% proteins and 13% starch .Ten phenolic and flavonoids compounds

including one new acylated flavones glycoside were isolated. The structures of the new compound quercetin-3-O- β -D-(2''-O-galloylglucoside)-4'-O-vinylpropionate and of the known compounds are elucidated. Another biologically interesting compound in the plant is guaijavarin, a glycoside (arabinopyroside) of quercetin. The leaves also contain essential oils and trite pen **seeds** are very small but abundant in the fruit and have been reported. **Twigs** contain calcium (0.30-1.00%), magnesium (0.06-0.30%), and phosphorous (0.10-m) .^{8, 9}

3. PHARMACOLOGICAL ACTIVITY

3.1 PHARMACOLOGICAL ACTIVITY OF *WITHANIA COAGULANS*

The chemical constituents of *Withania coagulans* have always been of great interest to the scientific community. The biologically active chemical constituents are alkaloids (ashwagandhine, cuscohygrine, anahygrine, tropine, etc), steroidal compounds including ergostane-type steroidal lactones, Withaferin a, Withanolides A-Y, withasomniferin A, withasomidienone, withasomniferols A-C, withanone, etc. Withaferin A (4 β , 27-dihydroxy-5 β , 6 β -epoxy-1-oxowitha-2, 24-dienolide), and withanolide A (5 α , 20 α -dihydroxy- 6 α , 7 α -epoxy-1-oxowitha-2, 24-dienolide) are the main withanolide active principles isolated from the plant. These are chemically similar but differed in their chemical constituents.^{10, 11}

Anti-inflammatory activities:

The anti-inflammatory potential of *W. coagulans* has been studied in details by several workers. It showed that the aqueous extract of fruits of *W. coagulans* has significant anti-inflammatory activity at 10 mg kg-1 in sub acute models of inflammation, such as granuloma formation and formalin-induced arthritis in rats. It reported that *it* possesses efficient anti-inflammatory activity as compared with hydrocortisone, a common anti-inflammatory drug. The effect *an* on glycosaminoglycan sync-thesis in the

granulation tissue of carrageen in-induced air pouch granuloma was studied. Oral administration of 1000 mg kg⁻¹ root powder decreased the glycosaminoglycan content by 92%, which was much higher than that of the hydrocortisone and phenylbutazone. It studied the granuloma-tissue formation inhibiting activity of various fractions of an extract of the aerial parts of drug using subcutaneous cotton-pellet implantation in rats. The methanol fractions of the extract showed high anti-inflammatory activity as compared to that of a 5 mg kg⁻¹ dose of hydrocortisone sodium succinate. The activity in both the species was attributed to the high content of biologically active steroids in the plant, of which Withaferin A is known to be a major component.

Anticancer and chemo protective activities:

The anticancer effect of *Withania* has been studied extensively and it was found that it is the most effective agent in preventing cancer through its ability to reduce the tumour size. Treatment of root extract on induced skin cancer in mice exhibited significant decrease in the incidence and average number of skin lesions compared to control group. Withaferin A showed tumour-inhibitory activity against cells derived from human carcinoma of the nasopharynx and it also inhibited the growth of roots of *Allium cepa* by arresting the cell division at metaphase in another study, it was evaluated for its antitumor effect in urethane-induced lung adenomas in adult male albino mice. Simultaneous administration of extract (200 mg kg⁻¹ body weight daily orally for seven months) and urethane (125 mg kg⁻¹ biweekly for seven months) reduced tumor incidence significantly. Additionally, in a different study the aqueous extract of *W. coagulans* was used for anti-cytotoxic effect in chicken lymphocytes and remarkable inhibitory activity of diethyl sulfoxide (DMSO)-induced cytotoxicity with a decrease in TNF-G production was reported.¹²

Immunomodulatory activity:

Withaferin A has been reported in various studies to possess both immune-activating and immunosuppressive properties. Withaferin A has specific immunosuppressive effects on human B and T lymphocytes viz. antigen recognition and proliferative capacity of B and T lymphocytes in mice, the Ashwagandha extract was able to suppress the cyclophosphamide-induced potentiating of delayed type hypersensitivity (DTH) reaction. A protective effect in cyclophosphamide-induced myeloid suppression was observed in animals treated with this extract. In another study, the aqueous suspension of root powder inhibited the mutagen induced lymphocyte proliferation and DTH reaction in rats. The root extract also enhanced total white blood cell count, inhibited delayed-type hypersensitivity reactions and enhanced phagocyte activity of macrophages. Significant increases in haemoglobin concentration, red blood cell count, white blood cell count, platelet count, and body weight were observed in-treated mice compared to untreated control mice. It isolated novel Withanolides, withacoagulins from the areal parts of *W. coagulans* and reported the inhibitory activity of the extract on T and B-lymphocyte proliferation in murine spleen cells. It was also observed that the ethanol extract showed strong activities in

inhibiting the T and B-lymphocyte proliferation. Coagulin H isolated from *W. coagulans* exhibited effects on the immune response, including an inhibitory effect on lymphocyte proliferation, and expression of interleukin-2 (IL-2) cytokine. A complete suppression of phytohaemagglutinin-activated T-cells were observed at ≥ 2.5 $\mu\text{g/ml}$ coagulin H. The Withanolides from both the plants are found to be useful as a general tonic, due to their beneficial effects on the cardiopulmonary system. These alkaloids had a prolonged hypotensive, bradycardiac, and respiratory-stimulant action in dogs.

Antifungal and antibacterial activities:

Antifungal and antibacterial properties have been demonstrated in the Withanolides isolated from the ethanol extract of the whole plant and leaves, respectively. The methanol extract possessed maximum inhibitory activity against a spectrum of bacteria. Oral administration of the aqueous fruit extracts successfully obliterated *Salmonella* infection in mice as revealed by increased survival rate, as well as less bacterial load in various vital organs of the treated animal.

Central nervous system (CNS) related activities:

The bioactive metabolites isolated from *Withania* have been found to be effective in alleviating many central nervous system disorders such as epilepsy, anxiety, depression, catalepsy, and sleep. The extracts for the different parts of both the plants have the capacity to modulate various neurotransmitters also. Observed that the extract work as a suppressor of corticosterone release and activating choline acetyl transferase, which in turn increase serotonin level in hippocampus. Withanolides A and withanolide IV roots promote neurite outgrowth in cultured neurons and in rodents injected with A β 25-35 and after oral administration of withanolide IV, somnifone, an aglycone of withanolide IV, was identified as the main metabolite revealed that the semi-purified extract of the roots of *W. somnifera* reversed behavioural deficits, plaque pathology, accumulation of β -amyloid peptides (A β) and oligomers in the brains of middle-aged Alzheimer's disease transgenic mice by enhancing low-density lipoprotein receptor-related protein in brain micro vessels and liver.

Free radical scavenging activities:

The effect of the aqueous solution of root extract on lipid per oxidation was investigated on stress induced rabbits and mice the oral administration of the extract prevented the elevation in lipid per oxidation by the free radical scavenging activity. The free radical scavenging activity of *W. coagulans* was detected. It was concluded that administration of aqueous extract of *W. coagulans* to diabetic rats significantly lowered the liver and serum lipid per oxidation. The presence of free radical scavenging activity and lipid per oxidation lowering activity in aqueous extract of *W. coagulans* might have helped in providing protection to some degree against oxidative damage to beta cells of pancreas.

3.2 PHARMACOLOGICAL ACTIVITY OF *PSIDIUM GUAJAVA*

Anti bacterial activity:

The bark was also shown to exhibit antibacterial effects. Four antibacterial compounds were isolated from leaves of guava (*P. guajava*) flavonoids glycosides, morin-3-O- α -L-lyxopyranoside and morin-3-O- α -L-arabopyranoside, and two known flavonoids, guaijavarin and quercetin *Psidium* dermatophytes viz. *Trichophyton tonsurans*, *T. rubrum*, *Trichosporon beigelii*, *Microsporum fulvum*, *M. gypseum* and *Candida albicans*. Bark tincture has higher efficacy in controlling the mycelia growth of dermatophytes than the leaf tincture. The tincture showed fungicidal property in different concentrations but exhibited only fungistatic property in case of *C. albicans*. Another good effect with the methanol extract. Three antibacterial substances have been detected in the leaves which are derivatives of quercetin. As in the barpolyphenols and many other substances are present.¹³

Anti diarrhoeal activity:

Leaf infusion is used for constipation, and in Adamawa with "red" potash for dysentery; a decoction is taken in Senegal to combat diarrhoea and dysentery; the shoots and roots may also be hile in neighbouring The Gambia the leaves are chewed for queasy tummy, a treatment that is said to work very well. A leaf infusion is drunk in Hawaii and Trinidad and in Indonesia for medical purposes. The ripe fruit is mild laxative. The unripe fruit is astringent, anti-diarrhoeic, and has medicinal use the ripe fruit is a good aperient, and should be eaten with the skin, for without it, costiveness results. The unripe fruit is said to indigestible, causing vomiting and feverishness, but it is sometimes employed for diarrhoea.

Anti-inflammatory effect:

The anti-inflammatory and analgesic activities of 70% ethanol extract of *Psidium guajava* in rats using carrageen induced hind paw oedema model. Extracts which exhibited anti-inflammatory activity were screened for analgesic activity using the Randall-Selitto method in rats. The extracts were administered at a dose of 300 mg/kg; p.o. Aspirin (300 mg/kg, p.o.) was employed as the reference drug. *Psidium guajava* leaves, showed significant anti-inflammatory activity with percentage inhibitions of 58.27%

Antispasmodic:

This plant is among the aromatic antispasmodics; a decoction of the young leaves and shoots is prescribed antispasmodic bath. In the West Indies it is used as a febrifuge, antispasmodic bath (decoction of shoots and young leaves). They are recommended flags.

CNS activity:

The leaves of the guava tree in decoction are used for spasms, epiand even for cerebral affections. The cerebral aspects of the plant may be seen in CNS depressant activity due to the presence of caryophyllene-oxide and β selinene that has been seen for the plant extracts exhibited mostly dose-dependent antinociceptive effects in chemical and thermal tests of analgesia. Extracts also produced dose-dependent prolongation of pentobarbitone-induced sleeping time In India the leaf infusion is used for cerebral infect.

This tincture has been employed by rubbing it into the spine of children suffering from convulsions

Antimicrobial activity:

The extract also showed in vitro anti microbial activity against *Escherichia coli*, *Salmonella typhus*, *Staphylococcus aureus*, *Proteus mirabilis*, and *Shigella dysenteries*. Another paper showed the effectiveness of the leaf extract against *Staphylococcus aureus*. It was shown to antibacterial in another study and in addition to *Staphylococcus aureus* was also useful against *Streptococcus* spp. The leaves are rich in tannin, and have antiseptic properties.

Anti-inflammatory effect:

The anti-inflammatory and analgesic activities of 70% ethanol extract of *Psidium guajava* leaves was investigated in rats using the carrageen induced hind paw oedema model. Extracts which exhibited anti-inflammatory activity were screened for analgesic activity using the Randall-Selitto method in rats. The essential oil has also been proven to have anti-inflammatory effect. The essential oil, steam-distilled from leaves of *P. guajava* leaves, was given orally rats to study its effects on the oxidative and proliferative phases of the inflammatory reaction (Carrageen an-induced paw oedema and cotton pellet induced granuloma models). The essential oil (0.8 mg/kg) significantly reduced oedema formation induced by Carrageen an. The essential oil (0.4 and 0.8 mg/kg) significantly reduced granuloma formation induced by cotton pellets. Another paper confirmed the anti-inflammatory and also showed significant antipyretic activity and anti-arthritic activity in rats. In Peru it is said to be good for oedema and was found to inhibit paw oedema induced by Carrageen an in rats.

Antispasmodic: This plant is among the aromatic antispasmodics; a decoction of the young leaves and shoots is prescribed in the West Indies for febrifuge and antispasmodic baths. In India and Ghana the stem and twigs are considered astringent (bark as well). In the West Indies it is used as a febrifuge, antispasmodic bath (decoction of shoots and young leaves). The decoction of young leaves and shoots are for spasms, fevers, worms, diabetes.

Conjunctivitis: Flowers are also used as a poultice for conjunctivitis and are also applied to painful eye conditions such as sun strain, conjunctivitis or eye injuries.

Coughs: Boiled with lemon grass to make a decoction that is drunk for coughs. A decoction is also taken in Senegal for trachea bronchitis. The leaves are also used for cough in Peru.

Diabetes:

The leaves are also used for several other ailments including diabetes. The leaf infusions are used in the Cape for diabetes Water in which the fruit is soaked is good for thirst in diabetes. Malaria the leaves are used as an ingredient in the preparation of fever "teas". They are also used as part of the pot herb used in steam treatment for malaria. Indeed, the main ethno therapeutic use in Africa is said to be for malaria. *Psidium guajava* stem bark extract contained anthraquinones, flavonoids, seccoirridoids and terpenoids

and was found to be effective for the treatment and/or prophylaxis of malaria in KwaZulu Natal province of South Africa. The in vitro antiplasmodial assay was carried out using a chloroquine-sensitive strain of malaria parasite.

Skin use:

The benefits are many and the plant can provide astringency, wound healing and skin damage repair properties that follow from the ethno pharmaceutical traditions of the plant. The antimicrobial properties of the plant may also be of benefit in certain product applications. In Mexico the leaves are said to be a remedy for itches. The leaves of the guava tree in decoction are used as a wash for ulcers and especially where an astringent remedy is needed. In the Amazon, a decoction of the bark and/or leaves or a flower infusion is used topically for wounds ulcers and skin sores. The use of the flowers may be applicable in eye products for their soothing effect. The Solvent extraction of the *Psidium guajava* leaves had an ant allergic activity. The study was performed in single-blind challenge test of *Psidium guajava* cream in 46 atopic dermatitis patients. Improvement of clinical symptoms (activity of eczema pruritus, sleep disturbance, etc) and various inflammatory markers were evaluated to examine the effect of the 0.45% *Psidium guajava* cream after 4-8 weeks. The result revealed that acute clinical symptoms were improved. Its cream may be a valuable adjunctive therapy in the management of atopic dermatitis. In the Philippines the astringent, unripe fruit, the leaves, the cortex of the bark and

roots though more often the leaves only in the form of a decoction, are used for washing ulcers and wounds.

Vaginal disorder:

In Uruguay, a decoction of the leaves is used as a vaginal and uterine wash, especially in leucorrhoea where it can be infused and applied as a douche the leaves of the guava tree in decoction are recommended for uterine haemorrhage. The same decoction is used as a wash for vaginal and uterine problems and especially where an astringent remedy is needed. Water in which the leaves have been boiled is taken in Senegal to assist menstruation. In Peruvian medicine the leaves are used for vaginal discharges, menstrual pain and haemorrhages.¹⁴

4. CONCLUSION

Medicinal plants are part and parcel of human society to combat diseases from the dawn of civilization. *Withania Coagulans* and *Psidium guajava* has been found to contain a vast array of biologically active compounds, which are chemically diverse and have got an enormous therapeutic potential. Very little work has been done on the biological activity and plausible medicinal applications of the compounds and hence extensive investigation is needed to exploit their therapeutic utility to combat diseases. Although crude extracts from various parts of *W. Coagulans* and *P. Guajava* have medicinal applications, modern drugs can be developed only after extensive investigation of their bioactivity, mechanism of action, pharmacotherapeutics, and toxicity and after proper standardization.

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