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Review on Pharmacological Activities of Herbal Plants: *Aloe vera* and Guava

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Abstract: Ethno veterinary medicine covers up knowledge, skills, methods, practices and beliefs of people about the indigenous care of their animals and themselves. The use of medicinal plants to treat infections is an old practice in developing countries where there is dependence on traditional medicine to maintain human and animal health. *Aloe vera* is perennial succulent xerophytes which develops water storage tissue in the leaves to survive in dry areas of low or erratic rainfall. Its name supposedly derived from *alloeh*, meaning bitter a tribute to the taste of the leaf exudate. The heterogenous composition of the Aloe vera may contribute to the diverse pharmacological and therapeutic activities. Guava is a phytotherapic plant and commonly known as poor man's apple. It is well accepted due to rich in minerals, vitamins and phenolic compounds. Both of herbal plants are well known for their pharmacological activates peculiarly for antimicrobial, anti-inflammatory, organo-protective, wound healing and anti-diabetic activities. Aloe vera plants has been associated with some adverse effects particularly hypersensitivity reaction, allergic reaction and sever dermatitis in condition. There is no reported toxic, mutagenic and abnormal interaction of guava leaf. Extensive investigation on its pharmacodynamics and kinetics is needed to exploit their therapeutic utility to combat various diseases.

Key words: Aloe Vera · Guava · Herbal Plants · Pharmacological Activities

INTRODUCTION

Ethno veterinary practice to animal health care is as old as the domestication of various livestock species [1]. The potential of many plants as a source of new drugs is still unexplored. Only a small percentage of herbal plants have been investigated for phytochemical, pharmacological and biological functions [2].

The *Aloe vera* plant has been known and used for centuries for its health, beauty, medicinal and skin care properties**.** *Aloe vera* gel contains polysaccharides, amino acids, lipids, plant sterols, tannins and enzymes, vitamins, minerals, sugars, lignin, saponins, salicylic acids and 75 other components [3]. *Aloe vera* is used externally for the treatment of skin irritation, burns, scalds, sunburn wounds, eczema, psoriasis, acne, dermatitis, ulcers and to stimulate cell regeneration. The plant is also used in the treatment of wound healing properties, effects on skin exposure to radiation, anti-inflammatory, antiviral and antitumor, moisturizing, anti-aging effect, antiseptic, enhance immune system, hypoglycemic, cytotoxic, antidiabetic effects, antibacterial effect, antioxidant and cardiovascular effect [4].

The pharmacological activities of guava leaf are due to its bioactive components that can combat against disease causing pathogens specifically essential oils rich in phytochemicals such resin, cellulose, tannins and flavonoids, phenols, saponins, lectins, vitamins, fibres and fatty acids [5]. The leaves and bark of *P. guajava* tree have a long history of medicinal uses that are still employed today [6].

The potential medicinal effects of guava leaves have been described in animal and human studies and suggested that it had anti-inflammatory effects, strong anti-oxidant properties, organo-protective and anti-cancer effects and used to treat diabetes and dyslipidemia [7].

The indiscriminate use of antibiotics has led to the emergence of antimicrobial resistance in various isolates of bacteria. Consumable animal products have been suggested as a possible source of both resistant bacteria and resistant genes that can be transferred to humans directly [8].

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Despite the fact of emergence of antimicrobial resistance in various isolate of micro-organisms, there is limited information on the use of herbal remedies as alternative approach to mitigate antibiotic resistance. Hence, in light to above facts this review was designed to highlight pharmacological activities of *Aloe vera* and Guava.

Historical Background of Medicinal Plants: History of herbal medicine believed to be began with the earliest man. The first written herbal record was in 2800BC and herbal medicine is practiced today in all countries around the world [9]. Their usage as many traditional health remedies is most popular all over the world and is reported to have minimal side effects [10].

Medicinal plants are used by almost 80% of the world's population especially in developing countries where there is dependence on traditional medicine to maintain basic health care of both human and animal due some advantages over the formulated drugs typically fewer side effects, low cost and their availability [11]. For the healthcare of the remaining 20%, population mainly residing in developed countries, are utilizing therapeutic product of plants.

There are many approaches to the search for new biologically active principles in higher plants. Folk medicine and systematic screening of them may result in the discovery of novel effective compounds. The plant extracts with known antimicrobial properties can be of great significance in treatment of various microbial infections. Numerous studies have been conducted in different countries to prove such efficiency in number of medicinal plants [12].

Overview of *Aloe vera* and Guava: *Aloe vera* is a species of succulent plant that probably originated in Northern Africa. The species does not have any naturally occurring populations, although closely related aloes do occur in Northern Africa [13]. It is perennial succulent xerophytes, cactus-like plant, which develops water storage tissue in the leaves to survive in dry areas of low or erratic rainfall [14].

The name "aloe" comes from the Greek αλοή (*aloí*), supposedly derived from the Hebrew *allal* or the similar Arabic word *alloeh*, both meaning bitter a tribute to the taste of the leaf exudate [15]. The aloe leaf can be divided into two major parts, namely the outer green rind, including the vascular bundles and the inner colourless parenchyma containing the aloe gel. The term pulp or parenchyma tissue refers to the intact fleshy inner part of the leaf including the cell walls and organelles, while gel or mucilage refers to the viscous clear liquid within the parenchyma cells [16].

The three components of the inner leaf pulp (cell walls, degenerated organelles and viscous liquid) have been shown to be distinctive from each other both in terms of morphology and sugar composition [17]. The raw pulp of *A. vera* contains approximately 98.5% water, while gel consists of about 99.5% water [18]. The remaining 0.5-1% solid material consists of a range of compounds including water-soluble and fat-soluble vitamins, minerals, enzymes, polysaccharides, phenolic compounds and organic acids. This heterogenous composition of the *Aloe vera* pulp may contribute to the diverse pharmacological and therapeutic activities [19].

Fig. 1: Photo of *Aloe barbadensis* (*Aloe vera*) plant

Psidium guajava is a phytotherapic plant commonly known as Guava. It is also known as poor man's apple [20]. It belongs to the Family Myrtaceae which contains at least 133 genera and more than 3800 plant species [21]. It grows in the tropical and subtropical areas of the world, adapts to different climatic conditions but prefers dry climates. *Psidium guajava* is a fruit and can be consumed fresh and processed forms, which including beverages, syrup, ice cream and jams [22]. Guava is well accepted by the consumers and makes a beneficial contribution to the human diet due to rich in minerals and functional components such as vitamins and phenolic compounds [23]. The leaves and bark of *P. guajava* tree have a long history of medicinal uses that are still employed today and led modern day researchers to study guava extracts [6].

Fig. 2: Photo of *Psidium guajava* (Guava) plant

Phytochemical Constituents of *Aloe vera* and Guava: Chemical composition of *Aloe vera* leaf pulp and exudates were anthraquinone, enzymes, vitamins, carbohydrate, organic compounds and lipids, proteins, essential and non essential amino acids, sterols, inorganic compounds and saccharides [24]. Arunkumar and Muthuselvam [25] performed the screening for phytochemical compounds and obtained a positive result for tannin, saponin, flavonoids and terpenoids but tests for steroids gave negative results.

The composition of guava varies significantly with variety, stage of maturity and season [26]. The budding leaves of *Psidium guajava* contained huge amounts of soluble polyphenolics including gallic acid, catechin, epicatechin, rutin, quercetin and rutin [27]. Different flavonoidal and triterpenoids compounds were isolated from *Psidium guajava* leaves through extraction, fractionation and isolation on the basis of comprehensive spectroscopic methods and molecular modeling calculation [28].

Pharmacological Activities of *Aloe Vera* and Guava

Anti-Bacterial Effects of *Aloe Vera* and Guava: Numerous studies have elucidated the antagonistic activity of *Aloe vera* against bacterial pathogens and it was screened against selected clinical pathogens by agar diffusion method using aqueous, ethanol and acetone extract of *Aloe vera* and showed that paramount enmity activity against *Escherichia coli, Bacillus subtilius, Salmonella typhi* and *Staphylococcus epidermidis* in acetone extract [29]. Aloe Vera plant leaves and gel were macerated in different organic solvents including ethanol, methanol and distilled water. Then, by using agar diffusion assay antibacterial activity was estimated. The *Aloe* vera extract of Methanol (MEA) showed the maximum antibacterial activity as compared to other solvent extracts [30].

Guava extracts of methanol (MEG) exerted antibacterial effects, preventing the growth of different strains from several bacteria such as *Staphylococcus aureus, Escherichia coli* and *Shigella spp*. [31]. Furthermore, different extracts of the leaves such as aqueous, acetone water, methanolic, spray-dried extracts and the essential oil, showed potential inhibitory activity against Gram-positive and Gram-negative bacteria and fungi [32]. Moreover, Bezerra *et al*. [33] evaluated the effect of guava leaves on different bacterial strains, concluding that the synergistic action between the leaves and various antibiotics boosted its anti-bacterial activity.

Anti-Viral Activity of *Aloe* vera and Guava: A component of *Aloe vera* gel, Acemannan, has been shown to have immune stimulating and antiviral activities. An extract of mannose from *Aloe* was treated in vitro and reduced HIV replication rate by as much as 30% as reported by Laura *et al.* [34]. Extract of *Aloe vera* is used for the treatment of genital herpes that is caused by virus [35]. *Aloe vera* juice mixed with fruit juice may be taken daily for chronic viral infections. Aloe emodin is effective against infectivity of herpes simplex virus and is capable of inactivating all of the viruses, including influenza virus and pseudorabies virus [36].

Guava leaf tea helped control of the growth of influenza viruses via the prevention of viral entry into host cells, probably due to the presence of flavonols [37]. *Psidium guajava* showed good curative effect on infantile rotaviral enteritis [38].

Anti-Tumor Effects of *Aloe vera* and Guava: The anti-tumour activity of polysaccharides isolated from *A. vera* and specifically acemannan has been investigated in many *in vitro* models as well as in different animal species. *A. vera* gel has also shown chemopreventative and anti genotoxic effects [19].

The aqueous extract of *Psidium guajava* leaves (AEG) bears an extremely high content of polyphenolic and isoflavonoids; it could be used as an anti-tumor chemoprevention in view of anti-angiogenesis and anti-migration. *Psidium guajava* extract was able to exert anti-cancer activity on cultures *in vitro* and *in vivo*, supporting the hypothesis of its anti-malignant pro-apoptotic modulation [39]. Treatment with *Psidium guajava* budding leaves of aqueous extract significantly diminished both the prostate specific antigen (PSA) serum levels and tumor size in a xenograft mouse tumor model. Guava leaf essential oil has been shown to possess cytotoxic effect on Human cervical cancer cell lines [40].

Anti-Inflammatory Activity of *Aloe vera* and Guava: Inflammation is a reaction by the body due to injury and is characterized by swelling, pain, redness, heat and loss of function. Aloe gel reduces inflammation that is induced by agents via promotion of prostaglandin synthesis as well as increased infiltration of leucocytes, but is less effective against inflammation caused by agents that produce allergic reactions [41]. Recently the novel anti-inflammatory compound called C-glucosyl chromone was isolated from gel extracts [42]. *Aloe vera* preparations have been evaluated for anti-inflammatory activity in controlled clinical trials whereby encouraging results have been obtained in the alleviation of irritant contact dermatitis [43].

Psidium guajava leaves was used worldwide for the treatment of various inflammatory diseases including rheumatism. The anti-inflammatory property of an aqueous leaf extract was investigated in rats using fresh egg albumin induced paw edema while the analgesic effect of the plant extract was evaluated by the hot plate and acetic acid test models of pain in mice [44].

Free Radical Scavenging Activities of *Aloe vera* and Guava: Antioxidants are substances that can prevent or delay oxidative damage of lipids, proteins and nucleic acids by reactive oxygen species. They scavenge radicals by inhibiting initiation and suppressing formation of free radicals by binding to the metal ions, reducing hydrogen peroxide and quenching superoxide and singlet oxygen [45].

Recently, natural plants have received much attention as sources of biological active substances including antioxidants. Oxygen derived free radicals such as superoxide anions; hydroxyl radicals and hydrogen peroxide are cytotoxic and give rise to tissue injuries [46]. In the body, free radicals are derived from two sources namely endogenous and exogenous sources [47].

The Aloe vera plant contains the important antioxidant vitamins (A, C and E), B (thiamine), niacin, B_2 (riboflavin), B_{12}, choline and folic acid which prevent damages caused by free radical, reducing risk of chronic diseases [48].

The extracts of guava leaf from different solvent namely aqueous water, 65% of ethanol and 95% of ethanol showed effects on scavenging hydroxyl radicals and inhibiting lipid peroxidation in the dose-dependent manner. Moreover, it had 50% effective concentration (EC50) on scavenging hydroxyl radicals and lipid peroxidation [49]. The *Psidium guajava* extracts of branch and leaf showed relatively higher antioxidant properties than those of fruits and seeds [50].

Organo Protective Activity of *Aloe vera* and Guava: *Hepatoprotective property*: - An increase in bile flow and bile solids as a result of treatment with the extract of *Aloe vera* suggests stimulation of the secretary activity of the liver cells. The hepatoprotective action of *Aloe vera* was also attributed to preserving the metabolizing enzymes of the liver through an antioxidant activity [51].

Psidium guajava aqueous leaf extracts possesses good hepatoprotective activity [52]. Atherosclerosis development was reduced in mice by guava leaf extracts mainly due to its crucial component of ethyl gallate and quercetin [53]. Aqueous leaf extracts on oral administration of guava leaf have shown to significantly reduce the elevated serum levels of alanine

aminotransferase, alkaline phosphatase, bilirubin and aspartate aminotransferase in acute liver damage induced by hepatotoxins in rats [52].

Gastroprotective Activity: The methanol extracts of the leaves of *Psidium guajava* were tested in three different ulcer models viz. aspirin, pyloric ligation and ethanol induced ulcer models in rats. The treatment of *Psidium guajava* at varying doses significantly inhibited the gastric lesions induced by asprin, pyloric ligation and ethanol respectively and the potency was found to be equivalent as compared to the standard drug, omeprazole. Secretory volume, acid secretion and increased gastric pH in the gastric were reduced. The results suggested that *Psidium guajava* possessed gastro protective as well as ulcer healing properties [54].

Nephroprotective Activity: Leaf aqueous extract of *Aloe barbadensis* were studied for their protective effects in gentamicin and Cisplatin induced nephrotoxic Wistar rats for 7 days and 5 days respectively. The extracts were given orally and consequently normalized blood urea, blood creatinine, urinary sodium, urinary creatinine, in a dose-dependent manner. Results suggest that the nephroprotective effect of Aloe barbadensis could be due to the inherent antioxidant and free radical scavenging principle(s) contained in the extract [55]. In rat kidneys with mild damage caused by type II diabetes, *A. vera* gel extract led to improvement in both histological and biochemical parameters, suggesting a protective effect [56].

Ethanolic extracts of guava leaf were reported to prevent renal damage induced by paracetamol in an animal model for nephrotoxicity. The extracts were given orally and consequently normalized blood urea, blood creatinine, urinary sodium, urinary creatinine, in a dose-dependent manner. The observations were also supported by histopathology [57]. A similar observation was also made in cisplatin induced nephrotoxicity in rats [58]. In addition, guava fruit extract has been shown to protect against kidney damage in diabetic rats [59].

Anti-Diabetic Effects of *Aloe vera* and Guava: Diabetes is a metabolic syndrome characterized by hyperglycemia, hyper cholesterolemia and hyper triglyceridemia. Hence, there is a need to search the anti diabetic drugs which apart from lowering the blood glucose levels can also modify the atherogenic lipid profile without producing many side effects. The anti-diabetic effect was evaluated in mice and significant blood glucose lowering effects were observed. Histological analysis revealed a significant reduction in the number of lipid droplets, decrease in serum levels of triglycerides, total cholesterol, low density lipoprotein cholesterol and a concomitant increase in high density lipoprotein cholesterol [60].

The significant decrease in‘Atherogenic index’ in *Aloe vera* treated group shows its protection against cardio vascular diseases [61]. The decreased plasma levels of high density lipoprotein cholesterol and increased levels of low density lipoprotein cholesterol in the streptozotocin-induced rats were restored to normal after treatment with aloe gel extract [62].

The antihyperglycemic efficacy and mechanisms of action of *Psidium guajava* in streptozotocin induced diabetic rats were investigated and found that oral administration of *Psidium guajava* leaf extract decreased the levels of blood glucose, glycosylated hemoglobin and improved the levels of plasma insulin and hemoglobin [63]. The extracts of *Psidium guajava* leaf may protect pancreatic tissues, including islet â-cells, against lipid peroxidation and DNA strand breaks induced by STZ and thus reduce the loss of insulin-positive â-cells and insulin secretion [64].

Anti-Parasitic Effects of *Aloe vera* and Guava: Coccidiosis is one the most common diseases in poultry farming industry with detrimental impacts on growth performance. Coccidiosis caused by the genus Eimeria has been controlled by various methods. However, the presence of drug resistance and public demands for residue free meat has encouraged the development of alternative control strategies [65]. *Aloe vera* is among the earliest known medicinal plant and it has been verified that dietary supplementation with Aloe vera inhibits invasion and replication of Eimeria maxima in the gut of chickens, suggesting that *Aloe vera* may be a safe and beneficial dietary supplement to control coccidiosis [66].

In a *Leishmania donovani* mouse model, oral administration of *Aloe vera* leaf exudate reduced parasitemia by in the liver, spleen and bone marrow without impairment of hepatic and renal functions by 90% and the authors conclude that *Aloe vera* leaf shows promising antileishmanial activity and may provide a new leading agent in the treatment of leishmaniasis [67].

Antihelminthic properties towards gastrointestinal nematodes have been found, as a result of the presence of condensed tannins in the guava plant, which raised the levels of hemoglobin, packed cell volume, total protein, globulin, glucose and calcium and lowered the levels of blood urea [68]. Leaf acetone extract of *Psidium guajava* has also exhibited moderate acaricidal and insecticidal activities causing the dead of Hippobosca maculata adult fly [69].

Akanji *et al*. [70] suggested that an ethanol extract from the leaves function as a trypanocidal agent. Furthermore, guava leaves have been suggested for managing sleeping sickness, since they exhibited trypanocidal effect in albino rats [71]. The extracts of guava leaves proposed as an anti-malaria agent, due to their inhibitory activity and the resistance indices [72]. The effect of guava leaf essential oil against toxoplasmosis caused by the growth of Toxoplasma gondii were reported [73].

Other Beneficial Effects of *Aloe vera* and Guava

Wound Healing Activity Of Aloe Vera: The wound is defined as a lesion and rupture on skin surface that is caused by physical or thermal trauma, which needs medical therapy. Improvement and healing of wound in human or developed animals occur with a completely complex and advanced mechanism passing through several phases including Thrombosis and inflammation, Proliferation and formation of new tissue, healing and Tissue retrieval or reconstruction [74].

Wound healing property is related to a compound that is called glucomannan, which is enriched with polysaccharides like mannose. The glucomannan affects fibroblast growth factor and stimulates the activity and proliferation of these cells and in turn improves collagen production and secretion. The mucilage of aloe vera not only increases amount of collagen on wound site, but also increases transverse connections among these bands rather than creation of change in collagen structure and as a result accelerates wound improvement [19].

Cosmetological Importance Of Aloe Vera: Aloe vera has been used since ancient times for healing infection and burns. In cosmetics, Aloe gel is added to cleansers, moisturizers, shampoos, suntan lotions and sunburn screens. Aloes in modulates melanogenesis via competitive inhibition of tyrosinase, thus holding promise as a pigmentation altering agent for cosmetic and therapeutic applications [75].

Cosmetological applications of *Aloe vera* incorporate diminishing the pigmentation and dark spots on the face by inhibiting secretion of skin cells melanocytes which initiate synthesis of melanin [76], activation of cellular regeneration against skin eruption [77], synthesis of elastin and collagen proteins against skin aging [78] and moisturizing agent [43].

Anti-Diarrheal Activity of Guava: The extracts of *Psidium guajava* leaf were tested against diarrhea-causing bacteria: *Staphylococcus aureus*, *Salmonella* spp. and *Echerichia coli*. *Staphylococcus aureus* strains were most inhibited by the extracts. Guava leaf extracts and essential oil are very active against *S. aureus* [79].

Spermatoprotective Activity: The extracts of the leaves of *Psidium guajava* Posses beneficial effects on sperm production and quality and may thus improve the sperm parameters of infertile males with oligospermia and non obstructive azoospermia [80].

Ethno veterinary Practice in Ethiopia: The application of traditional medicines to veterinary medicine has been termed as Ethno Veterinary Medicine (EVM). EVM has been defined in broad sense as an indigenous animal healthcare system that includes the traditional beliefs, knowledge, skills, methods and practices of a given society [81]. Ethiopia is believed to be home for about 6,000 species of higher plants with approximately 10% endemism [82].

Preparations of herbal medicine all over the world communities lie on leaf parts of plants [83]. The reason is that they are collected very easily than underground parts flowers, fruits and in scientific point of view leaves are active in photosynthesis and production of metabolites [84].

Livestock production is an integral part of the Ethiopian agricultural sector that approximately shares 40% of the national agricultural output [85]. However, due to the prevailing animal diseases, the economic benefits gained from this sector still remain marginal [86]. It is estimated that the traditional remedies are sometimes the only source of therapeutics for nearly 90% of livestock in Ethiopia of which 95% are plant origin [87].

Adverse Effects And Contraindications of *Aloe vera* and Guava: Eventhough *Aloe vera* plants have many reported merits; the use of *Aloe vera* has been associated with common adverse effects like increased sensitivity of skin to Ultra violet light [88] and an increased incidence of renal tubule pigmentation, nephropathy and mesenteric lymph nodes [89].

Intake of Aloe latex is contraindicated for pregnant and nursing animals because of its cathartic action and possibility of causing gastrointestinal distress in the nursing infant and not be used externally after caesarean delivery because it may delay wound healing after gynecologic surgery [90]. The use of *Aloe vera* preparation should be contraindicated in individuals with a known allergy to plants of *Liliaceae* family [91].

Traditional uses of herbal plants have been validated by scientific research. Toxicity studies in mice and other animal models as well as controlled human studies show both leaf and fruit are safe without any side effects. There is no toxic, mutagenic and abnormal interaction of guava leaf [92].

CONCLUSIONS AND RECOMMENDATIONS

An alarming consequence has been occurred due to widespread emergence of resistance among microorganisms against available antibiotics. In recent years, ethnobotanical and traditional uses of natural compounds, especially of herbal plant origin received much attention for their efficacy and generally believed to be safe for human and animal use. Both of herbal plants constitute numerous phytochemical compounds which are crucial for both pharmacological and biological activities. *Aloe vera*, has an important place among such wound healing medicinal plants, it can also be used in treating inflammation, pain, ulcer and antihyperglycemic agent. Guava plant has been extensively studied in terms of pharmacological activity of its major components and the results indicate potent anti-diarrheal, hepatoprotective, antioxidant, antimicrobial and anti-mutagenic activities. Based on the information mentioned in the review and conclusive remarks, the following recommendations are suggested:

- Herbal plants should be cultivated and managed for sustainable utilization accordingly.
- Government should create awareness in population to keep herbal plants for future use.
- Treating of animal and human with herbal plants should be practiced alternatively.
- Extensive investigation on its pharmacodynamics and kinetics is needed toexploit their therapeutic utility
- Further research is an immediate requirement for considering bioactivity of compound as well as isolating their purified form.

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