REVIEW OF MEDICINAL USES AND PHARMACOLOGICAL ACTIVITIES OF TRIDAX PROCUMBENS (L.)

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ABSTRACTS

Tridax procumbens is a very promising species that produces secondary metabolites reported to have a variety of Medicinal uses including among others, anti-anemic, anti-inflammatory, anti-diabetic and anesthetic properties. This species has a long history of traditional use by different communities. This study aimed to review the Scientific literature regarding the medicinal properties, biological activity and phytochemical components of T. Procumbens, a member of the Asteraceae family that originated in Central and South America. An extensive Literature review was done using Metadatabase EDS, Medline (PubMed), Science Direct, Web of Science, Academic Search Premier, Scielo, DOAJ Directory of Open Access Journals, JSTOR, and other sources to find Information relevant to the medicinal uses of T. procumbens. At total of 130 studies were found that contained Information about T. procumbens. Some of the papers were not included because of the relevance to this study, Ending with a total of 111 relevant citations reported here. This review shows the importance of more studies to Understand the potential of T. procumbens’ secondary metabolites for medicinal or preventive treatment, making It a promising ethnobotanical resource. This review provides important information of this species and indicates That this species could be an effective, safe and affordable treatment for some ailments, especially in tropical Areas where this plant is native and widely distributed.

KEYWORDS: Tridax procumbens, anti-inflammatory, anti-diabetic, immunomodulatory, antimicrobial, Hepatoprotection, anti-hypertensive, anti fungal.

INTRODUCTION

Tridax procumbens, also known as “coat buttons” is a perennial plant from the Asteraceae family, native to Central and South America (Hilliard, 1977; Ravi Kumar et al., 2005b).
Since ancient times, this species has been used in Ayurveda in India (Kethamakka and Deogade, 2014). The chemical constituents present are alkaloids, carotenoids, flavonoids (catechism and flavones), saponins and tannins. Mineral composition present in leaves is calcium, magnesium, potassium, sodium and selenium. Leaf mainly contains crude proteins 26%, crude fiber 17%. Soluble carbohydrates 39%, calcium oxide 5%, Lute Olin, glucoluteolin, quercetin and Isosquercetin. Whereas the oleanolic acid, fumeric acid, fl-sitosterol antennins present in go-arounds. Tridax procumbens is known for several potential therapeutic activities like antiviral, antioxidant, antibiotic efficacies, wound healing activity, insecticidal and anti-inflammatory activity.

**Botanical Description**

Tridax procumbens (family Asteraceae) is known by different names throughout the world (Table 1). Table 1. Common names of T. procumbens found throughout the world.

<table>
<thead>
<tr>
<th>Country/Language</th>
<th>Vernacular Names</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese</td>
<td>Kotobukigiku</td>
<td>Ankita and Jain 2012</td>
</tr>
<tr>
<td>English</td>
<td>Coat buttons, Tridax daisy</td>
<td>USDA, Kumaetal., 2012; Chauhan ;2008</td>
</tr>
<tr>
<td>Marathi</td>
<td>Dagadi Pala</td>
<td>Ankita and Jain 2012</td>
</tr>
<tr>
<td>Sanskrit</td>
<td>Jayanti Veda</td>
<td>Ankita and Jain 2012</td>
</tr>
</tbody>
</table>

**Tridax procumbens FAMILY: Asteraceae**

T. procumbens is found in tropical and subtropical areas of the world growing with annual crops, along roadsides, Pastures, fallow land, and waste areas (Holm et al., 1997). The species has a diploid number of 36 (Raghavan And Vinkatusabban, 1941). It has herbaceous, semi-prostrate habit, and can grow anywhere from 15-40 cm in height. The leaves are elongated, opposite, ovate with serrated margins, hirsute on the abaxial and adaxial sides (Powell, 1965).

The inflorescence is a capitulum with three-toothed white ligulate ray florets female and disc. Inner flowers yellow, tubular, bisexual, with corolla 6 mm long. The inflorescence results in abundant production of pappies achenes (Chadha and Johnson, 2008), 2 mm long, obovoid, setaceous, covered with stiff hairs, that can be carried by the wind for long distances, making this species a potential invasive species if not controlled.

T. procumbens is classified as a noxious weed in Alabama, Florida, Minnesota, North and South Carolina and Vermont.
Agriculture). In Guatemala T. procumbens is a weed that has a wide range of growth and can be found in either dry or damp soil, usually on previously cultivated ground from sea level to 2300 m (Pöll, 2005).

**Traditional Uses**

Traditional and complementary medicine is being increasingly recognized as an integrative approach to healthcare in many countries (WHO, 2013). The use of plants for medicinal purposes may date back to the Middle Palaeolithic age, approximately 60,000 years ago (Solecki, 1975). T. procumbens is found throughout the world (Table 2) and it has been used to treat anemia, colds, inflammation, and hepatopathies in Central America (Taddei and Rosas-Romero, 2000). In Guatemala, T. procumbens is used as an antibacterial, antifungal, and antiviral treatment (Caceres et al., 1998) as well as for vaginitis, stomach pain, diarrhea, mucosal inflammation, and skin infections (Taddei and Rosas-Romero, 2000). The leaf juice is bleeding used to treat wounds and stop bleeding (Caceres et al., 1998). A study done in Chiquimula, Guatemala, showed that lactating pregnant women suffering from anemia could reduce their symptoms by using Tridax (Calderon, unpublished results). This species is also used in the treatment of gastrointestinal and respiratory infections, high blood pressure, and diabetes (Pöll, 2005, Giovannini et al., 2016. Pardeshi and Brigade, 2016). In Guatemala, the entire plant is used for the treatment of protozoal infections (Caceres et al., 1998; Berger et al., 1998, Martín-Quintal et al., 2009, Gamboa-Leon et al., 2014, Ebiloma et al., 2017), including malaria, legitimatises and dysentery. Aqueous extracts of T. procumbens have strong anti-plasmodial activity against chloroquine-resistant P. falciparum parasites (Appiah-Opong et al., 2011); it has activity against Trypanosoma brucei, antibacterial and wound-healing properties. Scientific support for several of these traditional uses will be discussed later.

**Traditional uses and plant preparation**

<table>
<thead>
<tr>
<th>Location</th>
<th>Preparation/extract</th>
<th>Plant ailment uses</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaves: juice</td>
<td></td>
<td>colds, inflammation, hepatopathies, stomach pain, diarrhea, skin infections, bleeding.</td>
<td>Caceres et al., 198</td>
</tr>
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</table>

In Nigeria, the entire plant is used to treat typhoid fever, cough, fever, stomachache, backache, diarrhea and epilepsy (Soladoye et al., 2013; Mann et al., 2003). Farmers in Africa use the plant for treatment of livestock (Byavu et al., 2000); for example, tridax is used along vigna...
parkeri to treat chronic mastitis by grinding both plants, adding salt and water and applying to the udder. Ayyappa das et al. (2009) studied the antibacterial effect of tridax against mastitis-causing bacteria and found that the ethanolic extract had significant activity against staphylococcus aureus. However, there was little or no activity from the aqueous extracts against streptococcus uberis and klebsiella penumonia, in comparison with spathodea campanulata extracts. In benin, breeders complement the feed of rabbits (aboh et al., 2002) or other livestock combining with other plants (edeoga et al., 2005); although rabbits consume it in lower amounts than other fodder (aboh et al., 2002), probably due to low palatability.

In togo, the fresh, crushed leaves are used for dressing wounds. The decoction of the leaves is used against pain, to treat malaria, and against abdominal and gastrointestinal mycosis (agban et al., 2013). In india it is known as an insect repellent, used to treat diarrhea, and to help check for hemorrhages. In addition, some reports include the use as a cure for hair loss (policegoudra et al., 2014; saraf et al., 1990) and jaundice (saraf and dixit, 1991).

A study in tamilnadu, india, revealed that native inhabitants apply the juice from the leaves for the healing of wounds. The same study also infers that t. Procumbens is one of the most useful traditional medicinal plants (rajendran et al., 2003). It has also been shown to have many minerals like calcium, selenium, magnesium, potassium and sodium (ikewuchi et al., 2009). The people in udaipur, india, have traditionally ingested powdered t. Procumbens leaves, along with other herbs, to treat diabetes (pareek et al., 2009; pardeshi and bhiungade, 2016). The species has shown to be a great source of potassium, which is used for the treatment of cramps and a safe source ingredient for future medicinal uses. These traditional uses
Tridax procumbens linn plant (jayanthi, coat buttons)

Demonstrate the potential uses of this plant. (jayanthi, coat buttons)

❖ PHYATOCHEMISTRY

T. Procumbens use as a traditional medicine throughout various regions of the world has led to many publications on its photochemistry. The discovery of new bioactive compounds can lead to the development of new drugs for the treatment of various ailments (fabricant and farnsworth 2001). Different extraction techniques used to isolate various compounds found in t. Procumbens will be discussed.

□ PHYTOCHEMICAL SCREENING

Many studies have been done on the phytochemistry of tridax, given the potential of this species, resulting in a variety of compounds. For example, anthraquinones, anthrones, flavonoids, and steroids are found in leaves in relative abundance (nisha, 2011). The secondary metabolites that contain medicinal properties are discussed throughout this paper, showing the importance of these extraction methods. Although the compounds have been identified, the exact bioactive compounds responsible for the medicinal properties are still unknown. Many of the compounds identified have unknown metabolic Pathways and A Variety of Bioactive Compounds May Work InConjunction To Elicit Medicinal Properties.

□ PRIMARY METABOLITES

Primary metabolites involved in metabolic pathways present in all plants. There are a few specific primary metabolites that have been extracted from t. Procumbens: lipids are essential in living organisms; they influence the communication between cells, the cellular makeup, and act as an energy source for the organism. T. Procumbens contains common fats found in the asteraceae family. This species also exhibits some lipids that give the plant unique properties and promising medicinal uses. These unique fats have been extracted and include: methyl 14-oxooctadecanoate, methyl 14 oxononacosanoate, 3- methylnonadecylbenzene, heptacosanyl cyclohexane carboxylate, 1(2,2-dimethyl-3-hydroxypropyl)-2-isobutyl phthalate, 12-hydroxytetrasosan-15-one, 32-methyl-30-oxotetracont-31-en-1-ol and 30-methyl-28-oxotriacont-29-en-1-oic acid dotriacontanol, β-amyrone, δ12-dehydrolupen-3-one, β-amyrin, lupeol, fucosterol, 9-oxoheptadecane, 10-oxononadecane and sitosterol (verma and gupta, 1988). All these compounds play essential roles in plants and are common to many species.
SECONDARY METABOLITES
Secondary metabolites are compounds produced by plants that are not essential for the normal growth and development of the plant, but play an important role in plant defenses, communication, stress responses and others. Secondary metabolites contain bioactive compounds that often have useful and important medicinal properties. Some of the most important bioactive compounds for medicinal uses are found in compounds such as glycosides, nitrogenous, fat-soluble compounds, polyphenolic compounds, and minerals (Edeoga et al., 2005). T. Procumbens secondary metabolites have been included into six major groups: flavonoids, carotenoids, alkaloids, saponins, tannins, and terpenes.

FLAVONOIDS
Flavonoids are found in the leaves and other organs (Jhariya et al., 2015) and have been shown to be useful as anticoagulants, hair tonics, anti-fungal, against problems of bronchial catarrh, diarrhea, dysentery, and wound healing (Ali et al., 2001). The presence of procumbenetin and other flavonoids in tridax seem to decrease the deposition of calcium and oxalate in the kidneys (Sailaja et al., 2012). This secondary metabolite seems to help regenerate damaged beta cells of the pancreas (Petchi et al., 2013).

Evaluation of an aqueous extract of t. Procumbens for its effect on diabetic rats showed hypoglycemic activity (assumed from flavonoids), protection against oxidative stress (probably due to high content of ascorbic acid) and lowering of vldl cholesterol (probably due to the flavonoids) (Ikewuchi, 2012). Luteolin and quercetin were also isolated from tridax, along with the flavonoid procumbenetin (Jhariya et al., 2015). Lutein, glucoluteolin, and isoquercetin are found in the flowers of t. Procumbens (Kumar et al., 2012). Luteolin has anti-inflammatory and anti-carcinogenic activity (Rao et al., 2012), probably due to its anti-oxidant activity and its free-radical scavenging ability (Seelinger et al., 2008).

Inhibits cell replication and dna repair, which promote apoptosis (Yamashita and Kawanishi, 2000) and inhibits multidrug-resistant proteins (Rao et al., 2012) among other effects. Quercetin is an antioxidant, protecting against lipid peroxidation, with effective anti-ulcer activity against ethanol-induced ulcerogenesis (Coskun et al., 2004); it also increases the level of beta-carotene and decreases the level of retinol (Bando et al., 2010). All these properties indicate the potential applications of this remarkable plant.
TANNINS
Tannins are naturally occurring water-soluble polyphenols found in plants. Tannins have antimicrobial properties, as well as anti-carcinogenic and anti-mutagenic properties, potentially because of their antioxidant capabilities (Chung et al., 1998).

Several researchers have described the presence of tannins in t. Procumbens (Kumar et al., 2012, Edeoga et al., 2005). Acetone-water or chloroform-water showed the presence of tannins in leaf extracts of t. Procumbens. Tannins are present in the pedicle and buds of t. Procumbens (Ikewuchi, 2012).

CAROTENOIDS
Carotenoids are fat-soluble pigments found in the leaves (Ikewuchi et al., 2009) that have three main functions in a plant: light-harvesting, protection from photooxidative damage, and pigmentation to attract carotenoids have been postulated to prevent damage to DNA by oxidative stress (Wagener et al., 2012). Many types of these secondary metabolites have been isolated from t. Procumbens including beta-carotene, which can be converted to vitamin A (Ikewuchi et al., 2009), which is important for maintenance of epithelial tissues. Vitamin A deficiency can result in impairment of immunity and hematopoiesis, night blindness, and xerophthalmia (Sommer, 1995). Carotenoids such as beta-carotene and lutein have shown activity in the reduction of UV-induced erythema (Heinrich et al., 2003). The photoprotective properties have also been linked with the antioxidant properties of carotenoids (Wagener et al., 2012).

ALKALOIDS
Alkaloids are defined as any class of nitrogenous organic compounds of plant origin that have pronounced physiological effects on humans. The presence of some alkaloids has also been reported in t. Procumbens (Kumar et al., 2012). In a phytochemical screening analysis, using aqueous extraction of the leaves, thirty-nine alkaloids were present, mainly akuamidine (73.91%) and voacangine (22.33%) (Ikewuchi, 2012). Besides alkaloids, the extract contained sterols and tannins. Alkaloids of the pedicle and buds of t. Procumbens showed antimicrobial activity against Proteus mirabilis and Candida albicans; alkaloids from buds showed activity against E. Coli and Trichophyton mentagrophytes. The total amount of alkaloids in the pedicle was 32.25mg/gdw in the pedicles and 92.66mg/gdw in the buds (Jindal and Kumar, 2012). The presence of these alkaloids point once more to the great
potential of this plant.

**SAPONINS**

Saponins are steroidal glycosides that contain pharmacological and medicinal properties (atelle et al., 1999) and have been detected in t. Procumbens (edeoga et al., 2005), specifically a steroidal saponin and pβ-sitosterol-3-o-β-d-xylopyranoside in the flowers of the species (saxena and albert 2005). Another study determined that saponins from an ethanolic extract of t. Procumbens could potentially contain antidiabetic properties by inhibiting the sodium glucose co-transporter-1 (s-glut-1) in the intestines of male wistar albino rats (petchi et al., 2013).

**PHARMACOLOGICAL PROPERTIES**

The great variety of secondary metabolites in tridax, show the potential pharmacological properties of this species however, we have yet to see the use in allopathic medicine. These compounds have been used for their properties in anemia prevention, liver protection, immuno-enhancement, antioxidant, anticancer, antibacterial, antifungal, antiparasitic, antiplasmodial, and antiviral activities. This species could provide a bridge between traditional medicine and western medicine due to its pharmacological potential. More isolation and characterization of active components is needed. There is no research indicating whether there are changes in activity during the preparation and isolation of the pharmacological compounds. Validation in table 4 is still required; for example, ali et al. (2001) describes the isolation of flavonoids from aerial parts, but there is no correlation of the flavonoid procumbenetin to the antifungal activity. In other cases (policegoudra et al., 2014), 26 compounds with putative antifungal activity were described but there is no reference to the phytochemicals responsible for the activity. In the work of taddei and romero (2002) there is no antimicrobial activity against candida albicans contradicting the work done by policegoudra and collaborators.

It is possible that this is due to the different procedures used or to the type of bacterial strains used. Taddei and romero used a three-extraction method for 7 days using dichloromethane (1:1; 3x 1000 ml) and further extraction of the aqueous layer with n-hexane followed by ethyl acetate, these authors also used paper disks for analysis and did not indicate the source of bacterial strains. Policegoudra fractionated the methanol extract with dichloromethane, used known bacterial strains and used the agar-well diffusion method. This indicates that additional work needs to be done to resolve the issue.
> **ANTIMICROBIAL ACTIVITY**

Antimicrobial screenings have been done, but additional studies are needed to corroborate some of the results. Various species of bacteria and fungi have shown sensitivity to the antimicrobial properties of *T. Procumbens*. More recently, callus of stem and leaf has shown to be useful for the synthesis of silver nanoparticles that showed some antimicrobial activity against *E. Coli, V. Cholerae, A. Niger*, and *A. Flavus* petroleum, ether and ethanolic extracts of leaves of *T. Procumbens* showed antibacterial activity against *Bacillus faecalis*. This activity was reported to be probably due to the presence of alkaloids. The chloroform extracts showed antibacterial activity against *B. Faecalis, B. Subtilis, E. Coli*, and *Pseudomonas aeruginosa* but the experiments need better controls and descriptions of the procedures. Essences from *T. Procumbens* show the presence of alpha and beta pinenes, used in small quantities can help in treating bacterial and fungal infections (Manjamalai et al., 2012b). There are some contradictory results about the antimicrobial activity of this species (e.g. Policegoudra et al., 2014; Taddei and Romero, 2002). Some studies did not include significant biological activity compared to the antibiotic control (e.g. Jhample et al., 2015) but there is evidence for the potential of this species as anti-microbial so more studies need to be done in this area.

> **ANTIFUNGAL ACTIVITY**

Antifungal activity of *T. Procumbens* has been investigated. Different extraction methods have been used to find the optimum zone of inhibition from different fungal strains including *Microsporum fulvum, Microsporum gypseum, Trichophyton mentagrophytes, Trichophyton rubrum, Candida albicans*, and *Trichosporon beigelii*. Extracts of the aerial parts of this plant have shown activity against dermatophytes with zones of inhibition ranging from 17 to 25mm with dichloromethane (dcm) fraction resulting in the best response (Policegoudra et al., 2014). However, the authors do not describe which ones are the bioactive compounds responsible for the antifungal properties. The authors suggest that these compounds could be fatty acid derivatives and constituents but no evidence is given about this statement.

> **ANTIBACTERIAL ACTIVITY**

*Tridax procumbens* has shown to have antibacterial activity. It is one of the most common plants for treating bacterial infections in rural parts of the world (Taddei and Rosas-Romero, 2000). *Tridax* extracts have shown to be effective against a variety of bacteria. N-hexane extracts have activity against *Mycobacterium smegmatis, E. Coli, Klebsiella sp.*, *Salmonella*...
group c, and salmonella paratyphi.

The ethyl acetate extract was effective against gram-positive bacteria such as bacillus cereus, mycobacterium smegmatis, staphylococcus aureus, and gram-negative bacteria such as klebsiella sp. (taddei and rosas-romero, 2000). The essential oil extract of t. Procumbens shows significant activity against gram-positive bacteria: staphylococcus aureus and streptococcus Pneumonia.

- **ANTIOXIDANT ACTIVITY**

Free radicals are molecules that have an unpaired electron in an atomic orbital making them highly reactive. Some of these free radicals include reactive hydroxyl radicals (oh), superoxide anion radicals, hydrogen peroxides, reactive oxygen species (ros), and peroxyl. The instability of these radicals can damage many biologically important molecules like dna and macromolecules, thus leading to cell damage and homeostatic disturbance.

An antioxidant or a free radical scavenger is used to reduce this activity by preventing the oxidation within a biological system. Agrawal et al. (2009) analyzed the antioxidant activity of t. Procumbens and found significant activity (comparable to the activity of ascorbic acid) in the ethyl acetate and n-butanol fractions obtained from methanolic extracts, when using the 1,1-diphenyl-2-picrylhydrazyl (dpph) method. (2013) also reported a high antioxidant activity of tridax when using n-butanol and ethyl acetate fractions from methanolic extracts. habila et al., (2010) found a 96.7% antioxidant activity at a concentration of 250 mg/ml. the authors report a high reductive potential in tridax (0.89 nm) compared to the standard (0.99nm) and postulate that this strong antioxidant activity could be due to the high phenol content of the plant, making this plant a good natural source of antioxidants with potential medicinal value. t. procumbens is also said to reduce lipid- non- enzymatik antioxidants.

The essential oils of t. Procumbens have shown antioxidant activity by reducing the levels of oxidative stress when using the dpph assay. These essential oils seem to have higher antioxidant activity than ascorbic acid and increasing the concentration of the essential oil seemed to increase the antioxidant power. It is postulated that this characteristic of t. Procumbens makes it a great candidate for the treatment of inflammation and cancer withless
toxic effects (manjamalai and grace, 2004) but these claims are not properly researched and documented. For example, t. Procumbens has shown to reduce inflammation when applied as a leaf poultice and it has shown to be effective in the treatment of neuropathic and inflammatory pain in rodent models (sawant et al., 2014). Extract from the leaves of the plant decreased the severity of carrageenan-induced rat paw inflammation. T. Procumbens extract at dosages of 100mg/kg, 200mg/kg, and 400mg/kg did a better job of reducing edema than aspirin at the same dosages. The plant extract did not produce ulceration and proved to be safer than aspirin and phenylbutazone (diwan et al., 1989). Another study done more recently showed similar results. T. Procumbens aqueous extract from the leaves showed to reduce carrageenan-induced paw inflammation. In this study the plant extract was compared to ibuprofen instead of aspirin (awasthi et al., 2009), but both studies show the positive effect of tridax in reducing inflammation without the potential issues that could arise from the use of aspirin or ibuprofen.

ANTICANCER ACTIVITY
Cancer is a multifactorial disease. Only until recently has the anticancer activity of t. Procumbens been researched. Crude flower aqueous and acetone extracts were tested on prostate epithelial cancerous cells (pc3). Very weak anticancer activity was observed with the aqueous extract. The acetone extract showed an 82.28% activity against cancer cells within 24 hours of treatment (vishnu et al., 2011). The viability was analyzed using the mtt assay. The authors don’t explain the toxicity analysis so the results are inconclusive since the only extract that had effect was the acetone extract and the controls are not clearly indicated In the publication. This study also does not compare the results to standard therapeutic drugs and there is no report of the selectivity significant inhibition of tumor nodule formation in the lungs was observed when using t. Procumbens, probably due to the inhibition of formation of new blood vessels in response to monoterpenes (alpha and beta pinenes).there was also an increase of expression with p53 and caspase; indicating that the oils of this plants could induce apoptosis. Different studies have indicated that t.

Procumbens Shows Promise In The Treatment of Cancer, But More Research Needs To Be Done in Order To Understand The Molecular Mechanisms Involved In This Activity (Manjamalai et al., 2012a). In Addition, None of The Work Done on Anticancer Activity Followed The Proper Protocols For Research In This Area So The Research Is Inconclusive.
ANTIDIABETIC PROPERTIES

Diabetes Has Become A Worldwide Epidemic; Interestingly, T. Procumbens Has Shown Antidiabetic Properties. Streptozotocin-Induced Male Wistar Albino Diabetic Rats Were Given Ethanolic Extracts From The Whole Plant Of t. Procumbens. The Study Showed That The Extract Had Antidiabetic Activity That Is Comparable To The Drug Glibenclamide Used To Treat Diabetes Mellitus Type 2. The Drug Works By Increasing The Amount Of Insulin Produced By The Pancreas(Petchi et al., 2013). This Study Included Proper Controls And Two Different Concentrations Of Whole Plant Extract Of Tridax (250 mg/kg and 500 mg/kg). Anova And Dennett’s Post Hoc Test Showed Significant Antidiabetic Activity Compared To The Controls. The Extracts Also Showed A Positive Effect Again Against Hyperlipidaemia Associated With Diabetes Mellitus.

T. Procumbens slowed the rate of both alpha amylase and alpha glucosidase enzymes with ether, methanol, and chloroform extracts showing a significant reduction, enough to resemble common drugs used to slow the enzymes in diabetes treatment (sonawane et al., 2014). Alpha-amylase and the alpha-glucosidase enzymes are responsible for the breakdown of carbohydrate molecules, by slowing their breakdown rate, allowing the body to digest these carbohydrates in lower doses and therefore slowing the need for insulin, which is the main chemical affected in diabetes mellitus (sonawane et al., 2014). All these studies demonstrate the great pharmacological potential of tridax against diabetes and the importance of further research and clinical studies that could evaluate the effect in humans.

DISCUSSION

This review shows the importance and need to continuously research plants known to be used in traditional medicinal that could lead to the discovery and creation of new conventional medicines. Tridax procumbens has a long history of traditional use but isolation and evaluation of each phytochemical has not been properly related to its pharmacological properties and could show difficulty in reproducibility after isolation and evaluation. Different extracts have been used for isolation of metabolites and for treating different ailments. Based on the reviewed material many extraction studies analyzed did not do confirmatory work and some studies contradicted others. It appears that many of the extraction methods show some positive effect in a variety of disorders.

Data indicates a positive effect of tridax as an anti-diabetic when Compared to conventional medicine. At the time of the writing of This review, there was no research indicating the
concentration of specific phytochemicals in different plant organs, thus, determining dosage based on traditional uses is not possible. Future research needs to focus on the connection between specific phytochemical and their effects on various ailments. Others areas that have yet to be studied in depth include, but are not limited to yield of extraction, concentration and physiological activity of these phytochemicals. Discoveries in these areas will provide important information that could be used by the health community for preventative medicine and/or the discovery of new drugs. T. Procumbens still has many important properties that remain to be discovered.

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