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# A review on *Tridax procumbens*: a weed with immense phytochemical and pharmacological activities

**Funmilayo Adelowo** and **Oluwole Oladeji***

Department of Pure and Applied Chemistry, Ladoke Akintola University of Technology, P.M.B 4000, Ogbomoso, Nigeria.
*Author for correspondence: adelowo@lautech.edu.ng.

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Medicinal plants have provided mankind a large variety of potent drugs to alleviate or eradicate infections and suffering from diseases in spite of advancement in synthetic drugs, some of the plant-derived drugs still retained their importance and relevance. The use of plant-based drugs all over world is increasing. Natural products derived from plants for the treatment of diseases have proved that nature stands a golden mark to show the relationship between the interrelationship between man and his environment. The researches and utilization of herbal medicine in the treatment of diseases increases every day. There have been records of advances made in the modern medicine there are still a large number of ailments or diseases for which suitable drugs are yet to be found. This has brought an urgent need to develop safer drugs for the treatment of inflammatory disorders, diabetes, liver diseases, and gastrointestinal disorder. *Tridax procumbens* is a highly valuable drug and well known for number of pharmacological activities like wound healing, antidiabetic activity, hypotensive effect, immune-modulating property amongst other. Therefore, the phytochemical and pharmacological activities should be investigated.

***Highlighted Conclusions***

1. *Tridax procumbens* is commonly regarded as weed in most part of Africa continents and are known for its pharmacological activity.
2. The application of the plant are immense such as pharmacological activities, hepatoprotective effect, immunomodulating property, wound healing activity, antidiabetic, antimicrobial, anti-inflammatory and antioxidant, bronchial catarrh, diarrheal and dysentery.
3. Analysis revealed the presence of the biomolecules such as anthraquinone, catachol, flavonoids, phenolic compounds, saponins, steroids, tannins and terpernoids.
4. *Tridax procumbens* also desire development of novel therapeutic agents from the various types of compounds with diverse pharmacologic properties isolated from it.
5. Therefore, more work (study) should be encourage in direction of more pharmacological activities of *Tridax procumbens* and to elucidate the structures of the phytochemicals responsible for the therapeutic properties of the plant.

Over the years, nature has been a backbone for medicinal agents most especially in 20th century. Almost all the modern drugs are derived from medicinal plants. Traditional medicine has established itself as for the development of chemotherapeutic agents (Racio et al. 1989). Antimicrobials derived from medicinal plants have enormous therapeutic potential and have been used since time immemorial. These antimicrobials are effectively used in the treatment of infectious diseases simultaneously mitigating many of the side effects which are often associated with synthetic antibiotics (Iwu et al. 1999).

Natural products derived from plants for the treatment of diseases have proved that nature stands a golden mark to show the relationship between the interrelationship between man and his environment. The researches and utilization of herbal medicine in the treatment of diseases increases every day. In developing countries, more than 70% of the people depend on traditional medicines derived from plants. Because of this, there has been an increase in the search of these herbal plants. In Asia, more than 500 medicinal plants are mentioned in ancient

literature and around 800 plants have been used in indigenous systems of medicine (Chopra et al. 1956). Herbal medicine has become popular in recent times due to the ever increasing level of toxicity and side effects of allopathic medicines. The pharmacological treatment of disease began long ago with the use of herbs (Schulz et al. 2001). This led to sudden increase in the number of herbal drug manufactures (Agarwal 2005).

The introduction of plant derived dugs in modern medicine has been linked to the uses of plant derived materials as an indigenous cure in traditional system of medicine. Some of the plants have been found to possess significant antibacterial, antifungal, anticancer, antidiuretic, anti-inflammatory and antidiabetic properties. Some other uses of herbal medicines are in venom neutralization by lupeol acetate isolated from the root extract of *Hemides musindicus* (Chatterjee et al. 2006), treatment of hypertension and lowering of blood sugar by serpentine isolated from the root of *Rauwolfia serpentine*, treatment of Hodgkins, choriocarcinoma, non-hodgkins lymphomas, leukemia in children, testicular and neck cancer from vinblastine isolated from the *Catharanthus rosesus* (Farnsworth et al. 1967), treatment of acute lymphocytic leukaemia in childhood advanced stages of hodgkins, lymophosarcoma, cervical and breast cancer amongst others. Plant derived drugs are used to cure mental illness, skin diseases, tuberculosis, diabetes, jaundice, hypertension and cancer.

The indiscriminate uses of synthetic antimicrobial drugs in recent time have increased the resistance of pathogenic microorganisms (Karaman et al. 2003). Despite the problem encountered by synthetic drugs such as high cost and adverse side effect, the over dependence is alarming. The new modern diseases such as hypersensitivity, allergic reactions, and immunosuppression are believed to only be cure by synthetic drugs and are major burning global issues in treating infectious diseases (Schinor et al. 2007). The production of synthetic drugs by the pharmacology increases on daily basis, despite this, there are incidents of the increased rate of drug resistance by body pathogens. This situation is unacceptable but instead of the new drugs to provide solutions to these problems, the effects multiply more than ever expected and have exacerbated the situation (Nino et al. 2006). In order to arrest this scenario, introduction of reliable, safe, environmental friendly and development of new plant based drugs with better bioactive potential and least side and environmental effects are inevitable. The positive responses of plant based drugs might lies in the structure of the natural products which reacts with toxins and/or pathogens in such a way that less harm is done to other important molecules or physiology of host. This prompted the establishment of a new and effective new field of research commonly known as phytochemical study. Therefore, the study focuses on the investigation on the actively bioactive compounds or phytochemical compounds and the pharmacological activities of *Tridax procumbens* used in herbal medicines (Essawi and Srour 2000).

**Brief description of *Tridax procumbens***

*Tridax procumbens* (Asteraceae) is a species of flowering plant in the daisy family. It is native to tropical Africa (commonly found in Nigeria, Ghana, Liberia, Togo, Sierra Lonne), Asia, Australia and India. It has been recently introduced to tropical, subtropical and mild temperate regions worldwide. It's widespread and commonly known and distributed as weed due to its spreading stems and abundant seed production (Chauhan and Germination 2008).

*Tridax procumbens* is a small, weak straggling, semi prostate, annual, creeper perennial herb with short, hairy blade like leaves with a yellow (corolla) flowers. It is a common weed found in open places, coarse textured soils of tropical regions, sunny dry localities, fields, waste areas, meadows and dunes. Their stem is usually between the length of 30-50 cm, with short branches, sparsely hairy and rooting at nodes. Their flowers are tubular, yellow with hairs, inflorescence capitulum with two major types of flower: ray florets and disc florets with basal placentation (Khan et al. 2008). It is about 3-7 cm long irregularly toothed margin, base wedge shaped, shortly petioled, hairy on both surfaces. *Tridax* is about 12-24 cm long with few leaves of about 6-8 cm long and very long slender solitary peduncles a foot long and more. These leaves are simple, opposite, exstipulate lanceolate to ovate, acute, inflorescence capitulum. Their fruits are hard achene covered with stiff hairs and a feathery, plume like white pappus at one end. The plant is invasive in part because it produces so many achenes and each achene can catch the wind in its pappus and be carried some distance. Calyx is represented by scales or reduced to pappus (Jain et al. 2012).

**Common names and botanical classification of *Tridax procumbens***

*Tridax procumbens* is native to many parts of Africa, Asia, America, Australia and some part of Europe. They are given many names depending on the regions; some of the common names are given in Table 1.

*Tridax procumbens* is an important medicinal plant of high pharmacological activities and medicinal importance. In studying the plant, the botanical classification should be study. The botanical classification is given in Table 2 (Chong et al. 2009).

**Table 1. The common names of *Tridax procumbens*.**

| S/N | Common Name | Language or Tribe |
|---|---|---|
| 1. | Coat Buttons and Tridax Daisy | English |
| 2. | Ghamra | Hindi |
| 3. | Jayanti Veda | Sanskrit |
| 4. | Dagadi Pala | Marathi |
| 5. | Gaddi Chemanthi | Telugu |
| 6. | Thatapoodu | Tamil |
| 7. | Chiravanak | Malayalam |
| 8. | Cadillp Chisaca, | Spanish |
| 9. | Herbe Caille | French |
| 10. | Kotobukigiku | Chinese |
| 11. | Bisshalyakarani | Oriya |
| 12. | Kotobukigiku | Japanese |
| 13. | Gecko feet | Thai |
| 14 | Yunyun | Yoruba |

**The beauty of *Tridax procumbens* and other medicinal plants**

The most important and essential thirst of man is their search for good health and immortality. They have employed different approach in making this possible. One of this is known as Yoga; this is the techniques to elevate the physical and mental status of an individual. Also, Ayurveda; this involves the use of medicaments to maintain health, longevity and vitality of life. Plants have been used as an important source of medicine since ancient times and their products are being used for different purposes such as medicine, food, health care, agriculture, agrochemicals, pharmaceutical etc. (Natesh 2001). *Tridax procumbens* are used in crude form or even essence. With the advances made in phytochemistry and pharmacology, umpteen active principles of various medicinal plants were isolated and used as valuable drugs in contemporary medicine (Trivedi 2006).

From the result of their analysis, World Health Organization (WHO) discovered that about 80 % of the populations in developing countries (especially Africa and Asia countries) depends on medicinal plants as a source of therapeutic agents for maintaining, sustaining health and vitality. According to one estimate 20,000 to 35,000 species of plants are used as medicines, pharmaceuticals and neutraceuticals by different ethnic groups (Trivedi 2006). The medicinal properties of different plant species have contributed to the origin and evolution of many traditional herbal therapies. As many as three thousand species of medicinal plants are used as ethnomedicine (plants of empirical knowledge) and nearly 700 species are researched pharmacologically and chemically.

**Table 2. The botanical classification of *Tridax procumbens*.**

| Kingdom | Plantae |
|---|---|
| Phylum/Division | Magnoliophyta |
| Class | Eudicots |
| Order | Asterales |
| Family | Asteraceae |
| Genus | Tridax |
| Species | *Tridax procumbens* |
| Common names | Coat buttons |
| Status | Exotic / Natutalized / Cultivated |

**Secondary metabolites or chemical constituents in *Tridax procumbens***

The medicinal values of the plants depend on the presence of certain chemical substances (secondary metabolites) that are involved in production of different kinds of effects on human body. Secondary metabolites in plants involved in production of medicines are alkaloids, tannins, flavonoids, terpenes and phenolic compounds. These substances have role in plant defense mechanisms by protecting them against predation by insects, microorganisms and herbivores. Some compounds are responsible to give plants their specific odours and others are responsible for imparting different colours to plants. Some of these metabolites are involved in giving characteristic flavours to plants and others are used for the seasoning of food and obtain some active compounds of medicinal importance (Cowan 1999).

Pharmaceutical companies depend largely upon materials procured from naturally occurring stands that are being rapidly depleted because of the use of parts like roots, bark, wood, stem and the whole plant in the case of herbs. This poses a specific threat to the genetic stocks and to the diversity of medicinal plants.

Secondary metabolites are compounds produced in plants and in general not involved in metabolic activity and these include alkaloids, phenolics, lignins, essential oils, tannins, steroids etc.

**Phenolics and polyphenols**

Plants are able to make a wide range of aromatic compounds; more common among them are phenols or their derivatives having oxygen substitution. Phenolic compounds are plant secondary metabolites that constitute one of the most common and widespread groups of substances in plants. The term "phenolics" or "polyphenols" are defined as substances that possess an aromatic ring having one or more hydroxyl substituent and functional derivatives such as esters, methyl ethers, glycosides etc. (Bell 1980, Harborne 1980). The terms phenolics and polyphenols refer to all secondary natural metabolites arising biogenetically from the shikimate-phenylpropanoids-flavonoids pathways, producing monomeric and polymeric phenols and polyphenols. Phenolics with only few hydroxyl groups are soluble in ether, chloroform, ethyl acetate, methanol, and ethanol. Each class of phenolic compounds has distinctive absorption characteristics (Mabry et al.1970, Harborne 1984, Kliebenstein 2004). They may be divided into two classes: namely preformed phenolics that are synthesized during the normal development of plant tissues and induced phenolics that are synthesized by plants in response to physical injury, infection or when stressed by suitable elicitors such as heavy metal-salts, UV-irradiation, temperature etc. (phytoalexins). Induced phenolics may also be constitutively synthesized but, additionally, their synthesis is often enhanced under biotic or abiotic stress (Beckham 2000, Lattanzio et al. 2001, Winkel-Shirley 2002).

**Tannins**

Plant phenolic polymer with defensive properties is tannin. There are two categories of tannins, condensed and hydrolysable. Condensed tannins are compounds formed by the linkage of flavonoid units. They are frequent constituents of woody plants. Condensed tannins can often be hydrolyzed to anthocyanidins by treatment with strong acids and so are called "proanthochocyanidins". Hydrolyzable tannins are heterogeneous polymers containing phenolic acids, especially gallic acid and simple sugars. They may be hydrolyzed more easily with dilute acid.

The defensive properties of tannins have been attributed to their ability to bind proteins. The tannins can activate the herbivore's digestive enzymes by binding proteins and so creating complex aggregates (Oates et al. 1980, Clausen et al. 1992). It also acts as antimicrobial agents. For example, the nonliving heartwood of many trees contains high concentrations of tannins that help prevent fungal and bacterial decay (Schultz et al.1992).

**Flavonoids**

Flavonoids are the largest group of polyphenolic compounds. They are widely distributed throughout the plant kingdom. Flavonoids (Figure 1) are characterized as containing two or more aromatic rings, each bearing one or more phenolic hydroxyl groups, and connected by a carbon bridge (Beecher 2003). To date, more than 6,000 different flavonoids have been described and the number continues to increase (Harborne et al. 2000). When the three carbon chain is connected to a hydroxyl group, they form a cyclic structure (C ring), as a 6-membered ring. Most flavonoids bear this type of phenylbenzopyrane structure: They have further been subdivided into subclasses, based on the position of the B ring relative to the C ring, as well as the functional groups (ketones, hydroxyls) and presence of a double bond in the C ring. These subclasses are termed flavones, isoflavones and isoflavonones, flavanones, flavanols, anthocyanidins, chalcones and dihydrochalcones (Beecher 2003). Flavonoids which are widespread in the plant kingdom, serve specific functions in antimicrobial activities, flower pigmentation, UV-protection, plant defense against pathogens and legume nodulations (Dixon 1986). The flavonoids present in *Tridax procumbens* includes flavonols (Crozier et al. 1997), flavones (Wang et al. 2003, Walle and Walle 2007), flavan-3-ols, (Crozier et al. 2000, Aron and Kenndy 2008), anthocyanins (Prior et al. 2006), Isoflavones (Dixon 1986) and isoflavonoids (Ebel and Grisebach 2004).

**Lignin**

Lignin, which is the most abundant organic substance in plants, is generally formed from three different phenylpropane alcohols, coniferyl, coumaryl and sinapyl alcohol synthesized from phenylalanine via various cinnamic acid derivatives (Gottlieb 1992).

**Reports of phytochemical screening of *Tridax procumbens***

There are numerous reports on the phytochemical screening of *Tridax procumbens* describing the production of diverse secondary metabolites like anthocyanins, alkaloids, carotenoids, coumarins, steroidal alkaloids,

terpernoids, flavones, tannins, saponins, sterols and several others. A new flavonoid (procumbenetin), isolated from the aerial parts of *Tridax procumbens*, has been characterised as 3,6-dimethoxy-5,7,2',3',4'-pentahydroxyflavone 7-O-β-D-gluco- pyranoside on the basis of spectroscopic techniques and by chemical means (Aiyegoro and Okoh 2009).

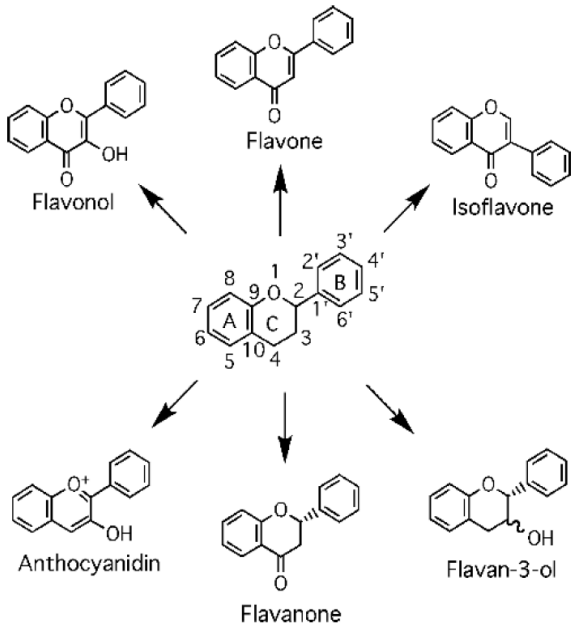


**Figure 1. The structures of the flavonoids.**

The phytochemical screening revealed the presence of alkaloids, carotenoids, flavonoids (catechins and flavones) and tannins. It is richly endowed with carotenoids and saponins. The proximate profile shows that the plant is rich in sodium, potassium and calcium (Harborne et al. 2000). Leaf of *Tridax* mainly contains crude proteins 26%, crude fiber 17% soluble carbohydrates 39% calcium oxide 5%, Luteolin, glucoluteolin, quercetin and isoquercetin have been reported from its flowers. Whereas the fumaric acid, and tannin has also been reported in the plant (Verma and Gupta 1988). Oleanolic acid was obtained in good amounts from *Tridax* and found to be a potential antidiabetic agent when tested against aglucosidase (Ali and Jahangir 2002).

The phytochemical screening of the plant revealed the presence of alkaloids, carotenoids, flavonoids (catechins and flavones) and tannins. It is richly endowed with carotenoids and saponins (Jude et al. 2009). In 2008, the mineral composition of *Tridax procumbens* reported from leaves is calcium, magnesium, potassium, sodium and selenium (Chen et al. 2008). Also, leaf of *Tridax* are known to contains crude proteins (26%), crude fiber (17%) soluble carbohydrates (39%) calcium oxide (5%), Luteolin, glucoluteolin, fumaric acid, fl-sitosterol, tannin quercetin and isoquercetin have also been discovered and reported from the flowers of *Tridax* (Verma and Gupta 1988, Ali and Jahangir 2002). Oleanolic acid was obtained in good amounts from *Tridax* and found to be a potential antidiabetic agent when tested against aglucosidase (Muhammad et al. 2002).

Studies have also reported the presence of dexamethasone, luteolin, lucoluteolin, beta sitosterol and quercetin (Subramanian et al. 1968, Setharami et al. 2006, Odelade and Oladeji 2016). Two water soluble polysaccharide; WSTP-IA and WSTP-IB containing β-(1->6)-DGalactan main chain has also been purified from the leaves of the plant (Raju and Davidson 1994). Four new terpenoids along with bis-bithiophene were reported from *Tridax procumbens*: taraxasteryl acetate, beta-amyrenone, lupeol and oleanolic acid (Ali and Jahangir 2002).

**Traditional applications of *Tridax procumbens***

*Tridax procumbes* has been in use in Nigeria, India, China and most part of Asia and African countries for healing wound, as anticoagulant, diarrhoea, dysentery, antifungal, antidiabetic and insect repellent. The extracts obtained from the leaf were known to treat infectious skin diseases in folk medicines. It is a well-known ayurvedic medicine for liver disorders or hepato-protective nature besides gastritis and heart burn. Traditionally, it is used for the treatment of bronchial catarrh, malaria, stomach ache and pain, diarrhoea, epilepsy, diabetes, high blood pressure, haemorrhage, liver problems and as a hair tonic (Ravikumar et al. 2005, Agarwal et al. 2010).

**The phytochemical and pharmacological activities of *Tridax procumbens***

**Antidiabetic activity**

Theaqueous and alcoholic extract of leaves of *Tridax procumbens* shows significant decrease in the blood glucose level and it shows antidiabetic activity in the model of alloxan-induced diabetes in rats (Bhagwat et al. 2008). In other experiment, the oral administration of acute and sub chronic doses of 50 % methanol extract of *Tridax procumbens* proved effective in the reduction offasting blood glucose levels in diabetic rats. This could also be applicable most especially in man; they are effective for reduction of blood sugar at early stage. This plant material does not affect the sugar levels in normal rats (Salahdeen et al. 2004, Pareek et al. 2009).

**Antimicrobial activity**

*Tridax* has been reported for its antimicrobial activity on bacteria. They are used for the treatment of cuts and wound. This can be done by squeezing the plant to obtain the juice. Fresh plant juice is applied twice a day for 3-4 days to cure cuts and wounds. The extract of *Tridax* showed antibacterial activity only against *Pseudomonas aeruginosa* infection by using disk diffusion method and also effective against the strains of bacteria such as *Bacillus subtilis*, *Staphylococus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa* (Mahato and Chaudhary 2005).

**Wound healing activity**

Wounds are the physical injuries that result in an opening and breaking of the skin and appropriate method for healing of the wound is essential for the restoration of the disrupted anatomical continuity and disturbed functional status of the skin (Manogaran and Sulochana 2004). The aqueous extract of whole plant of *Tridax procumbens* has ability to set the normal and immunocompromised wound healing in rats (Nia et al. 2003). The wound healing process by application of this plant material involves complex interaction between epidermal and dermal cells, the extra cellular matrix, controlled angiogenesis and plasma-derived proteins all coordinated by an array of cytokines and growth factors (Bhat et al. 2007). The plant not only increase lysyl oxidase but also, protein and nucleic acid content in the granulation tissue, probably due to increase of glycosamino glycan content (Udupa et al. 1991).

**Hepatoprotective activity**

The hepatoprotective activity of aerial parts of *Tridax* shows significant protection in alleviation of DGalactosamine/Lipopolysaccharide (D-GalN/LPS) induced hepatocellular injury. D-GalN/LPS have been proposed to be hepatotoxic due to its ability to destruct liver cells. The multifocal necrosis produced by D-GalN and the lesion of viral hepatitis in humans are similar. This amino sugar is known to selectively block the transcription and indirectly hepatic protein synthesis and as a consequence of endotoxin toxicity, it causes fulminant hepatitis within 8 h after administration (Vilwanathan et al. 2005).

**Anti-cancerous activity**

The effect of anti-cancer activity of *Tridax procumbens* flower crude aqueous and acetone extract was tested on prostate epithelial cancerous cells PC3 was determined by measuring cell viability by MTT assay. Experiment consists of cleavage of the soluble yellow coloured tetrazolium salt MTT [3-(4, 5-dimethyl – thiazole-2-yl)-2, 5- diphenyl tetrazolium bromide] to a blue coloured formazan by the mitochondrial succinate dehydrogenase. The assay was based on the capacity of mitochondrial enzymes of viable cells to reduce the yellow soluble salt MTT to purple blue insoluble formazan precipitate which is then quantified spectrophotometrically at 570 nm. The results of this analysis revealed the fact that flower crude extract has anti-cancer activity (Priya et al. 2011).

**Hypotensive effect**

The cardiovascular effect of aqueous extract obtained from the leaf of *Tridax procumbens* was investigated on anaesthetized Sprague-Dawley rat. The aqueous extract has ability to cause significant dose dependent decreases in the mean arterial blood pressure. The higher dose leads to significant reduction in heart rate where as lower dose did not cause any changes in the same. The leaves of *Tridax procumbens* shows hypotensive effect (Salahdeen et al. 2004).

**Repellency Activity**

*Tridax procumbens* was known to have high repellent activity against malerial parasite *Anopheles stephensi* in mosquito cages. The essential oils isolated were tested at three different concentrations (2, 4 and 6%). Of these, the essential oils of *Tridax* exhibited relatively high repellency effect (>300 minutes at 6 % concentration) and concluded that *Tridax* are promising as repellents at 6% concentration against *Anopheles stephensi* (Rajkumar and Jebanesan 2007).

**Other activities**

*Tridax procumbens* was also reported for its antiinflammatory, hepatoprotective, bronchial catarrh, dysentery, potent immunomodulating property, diarrhoea and to prevent falling of hair promotes the growth of hair, anti-inflammatory and antioxidant activity (Nia et al. 2003, Salahdeen et al. 2004, Rama et al. 2008). Leaves of *Tridax* were good hair growth promoters and has ability to prevent falling of hairs (Verma and Gupta 1988, Rathi et al. 2008). This plant was also used as a good bio-adsorbent for the removal of highly toxic ions of Cr (VI) from industrial wastewater. Hence, *Tridax procumbens* are recommended for bioremediation (Raina et al. 2008). This plant was also used for bronchial catarrh, dysentery, antiseptic, insecticidal and parasiticidal properties diarrhoea and in the West Africa and for a remedy against conjunctivitis (Mahato and Chaudhary 2005, Saxena and Albert 2005, Rajkumar and Jebanesan 2007, Rathi et al. 2008).

## CONCLUSION

*Tridax procumbens* is commonly regarded as weed in most part of Africa continents and are known for its pharmacological activity. The application of the plant are immense such as pharmacological activities, hepatoprotective effect, immunomodulating property, wound healing activity, antidiabetic, antimicrobial, anti-inflammatory and antioxidant, bronchial catarrh, diarrheal and dysentery. Analysis revealed the presence of the biomolecules such as anthraquinone, catachol, flavonoids, phenolic compounds, saponins, steroids, tannins and terpernoids. *Tridax procumbens* also desire development of novel therapeutic agents from the various types of compounds with diverse pharmacologic properties isolated from it. Therefore, more work (study) should be encourage in direction of more pharmacological activities of *Tridax procumbens* and to elucidate the structures of the phytochemicals responsible for the therapeutic properties of the plant.

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