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Antioxidant, Anti-inflammatory, Cytotoxic and Analgesic Activities of *Sensevieria trifasciata*

Sagorika Sing Pinky, Sirajum Monira, Md. Akbar Hossain and Amir Hossain

Department of Pharmacy, ASA University Bangladesh, Shaymoli, Dhaka, Bangladesh

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Abstract

Sansevieria trifasciata is a common perennial ornamental plant which freely grows and widely found in homes, parks, and woodlands. Traditionally, this plant has been used against acne, allergy, helminths and fungal infections. In the present study, the ethanolic extract of leaves of *Sansevieria trifasciata* (STET) has been used to study the phytoconstituents and several bioactivities. *In vitro* antioxidant activity of STET has been determined by DPPH scavenging assay and measuring the total tannins and phenolic contents. Anti-inflammatory activity has been evaluated by hypotonic solution and heat induced hemolysis. Moreover, cytotoxic and analgesic activities have also been evaluated by brine shrimp lethality assay and acetic acid induced writhing inhibition method, respectively. STET confirmed the presence of reducing sugar, combined reducing sugar, tannins, flavonoids, glycosides, proteins and steroids. In DPPH scavenging assay, STET revealed the IC_{50} value 2.19 µg/ml whereas the standard showed 1.39 µg/ml. In addition, the total tannins and total phenolic contents were found to be 10.78 mg and 31.99 mg GAE/g of dried plant extract, respectively. In hypotonic solution induced hemolysis test, the plant extract exhibited 39.27, 37.04 and 33.19 % inhibition at 0.5, 1.0 and 2.0 mg/ml concentration where the reference standard displayed 30.57 % inhibition. In heat-induced hemolysis, the STET also displayed 34.25 % inhibition of hemolysis at 1 mg/ml. Furthermore, in analgesic and cytotoxic activity tests, STET showed potential activities in a dose dependent manner. The results of the present studies suggest that STET has antioxidant, anti-inflammatory, cytotoxic and analgesic activities.

Key words: *Sensevieria trifasciata,* antioxidant, anti-inflammatory, cytotoxic, analgesic.

Introduction

Medicinal plants are proved, in different studies, to be beneficial against numerous disorders. Approximately one fourth of prescribed drugs accounts for plant origin and more than three quarter people depends on medicines that are derived from medicinal plants (Hoareau and DaSilva, 1999; Das *et al.,* 2011). To begin with the overview of medicines, man reclined on the healing belongings of medicinal plants (Ahvazi *et al.,* 2012). Some people worth these plants due to the ancient confidence speaks plants are bent to supply man with food, medical treatment, and other properties. Almost all philosophies from early time to the present day have recycled plants as a source of medicine (Kokwaro, 2009). However, In living organisms, the both ROS (reactive oxygen species) and RNS (reactive nitrogen species) are known to cause damage to lipids, proteins, enzymes, and nucleic acids leading to some ailments such as neurodegenerative disease, cancer, aging, malaria, atherosclerosis, diabetes, liver injury, Alzheimer, Parkinson, and some others pathological events (Duan *et al.,* 2006).

Sensevieria trifasciata (Family-Asparagaceae) is recognized by many names including mother-in-law's tongue, snake plant (English). It is an evergreen, succulent, perennial plant producing long, narrow, erect or slightly spreading sword-shaped leaves up to 75 cm long from a rhizomatous rootstock. The plant is cultivated for its fiber in several tropical countries, it is also harvested from the wild for local medicinal use. It is commonly

Corresponding author: Amir Hossain; Tel.: +880 1715 646476; Email: hellotoamir@gmail.com

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grown as an ornamental plant in tropical and subtropical regions, and as a pot plant in many other areas of the world (Rwawiire and Tomkova, 2015). In a study, antiallergic and anti-anaphylactic activities of ethanolic extract of *Sensevieria trifasciata* leaves have been evaluated (Andhare *et al.,* 2012). Mechanism of antidiabetic potentials has also been studied (Dey *et al.,* 2014). In addition, toxicity status and anti-ulcerative activity have also been investigated (Ighodaro *et al.,* 2017). In some other literatures, thrombolytic (Sikder *et al.,* 2011), analgesic and antipyretic (Anbu *et al.,* 2009) activities of the plant extract have been evaluated. In this context, we hypothesize that the leaf extracts of this plant might possess some compounds with antioxidant, cytotoxic, analgesic and membrane stabilizing activities.

Materials and Methods

Plant collection and extraction: S. trifasciata leaf was collected from Botanical garden Bangladesh in July 2018 and was recognized by the Bangladesh National Herbarium (BNH), Mirpur-1, Dhaka-1216 (voucher specimen no: DACB-45930).

Phytochemical screening: Several phytochemicals in STET, for example, reducing sugar have been identified by Fehling's solution and Benedict's reagent, alkaloid with Mayer's and Dragendroff's reagent, saponins with distilled water, glycosides with sodium hydroxide solution, steroids with H_2SO_4, tannins with ferric chloride and potassium dichromate, gum with Molisch reagent described by Ghani (2003).

Estimation of total phenolics and total tannins: Folin-Ciocalteu (FC) technique was implemented on the extract to identify the amount of phenolic and tannin content described previously (Hossain *et. al.,* 2016; Islam *et al.,* 2015).

DPPH Scavenging assay: In this test, the antioxidant activity of STET described by Sumi *et.al*. (2016) was estimated by DPPH free radical scavenging assay taking butylated hydroxytoluene (BHT) as standard.

Anti-inflammatory activity analysis: The anti-inflammatory activity of the STET has been evaluated following Shinde *et al.* (1999) by both hypotonic solution-induced hemolysis and heat-induced hemolysis of human erythrocytes taking indomethacin as standard.

Brine Shrimp Lethality Bioassay: Cytotoxic activity of STET was measured by brine-shrimp lethality bioassay where *Artemia salina* was used to perform this test (Meyer *et al.,* 1982; Hossain *et al.,* 2016).

Analgesic Activity evaluation: This test was performed by acetic acid induced writhing inhibition in mice of either sex (n=5) balancing 18–22 gm that was previously described (Hasan *et al.,* 2017).

Statistical analysis: All analyses were dual checked and passed in three replications. Mean ± SEM value was used to represent the data. All new parameters were evaluated for their consequence level by correlation and the t-tests (P<0.05) was used.

Results and Discussion

Phytochemical screening: Phytochemical screening of STET showed the presence of reducing sugar, combined reducing sugar, tannins, flavonoids, glycosides, proteins and steroids which is summarized in Table 1.

Table 1. Phytochemical group test of *S. trifasciata* leaf extract.

Phytochemical Group	Result
Reducing sugar	+
Combined reducing sugar	+
Tannins	+
Flavonoids	+
Saponin	+
Gums	-
Steroids	+
Alkaloids	+
Glycoside	+
Proteins	+
Acidic compounds	-

(+) indicates Presence; (-) indicates Absence

Total phenolic and tannin contents: The total tannin and phenolic contents were found to be 10.78 mg and 31.99 mg GAE/g of dried plant extract, respectively. The polyphenolic content of plant extract is represented in Table 2.

Table 2. Polyphenolic content of ethanol extract of *S. trifasciata*.

Polyphenolic compounds	Content (mg)
Total tannin	10.78 ± 0.007
Total phenolic	31.99 ± 0.001

Here, each value represents the average of three analysis ± standard error of mean expressed in terms of mg GAE/g dried plant extract.

DPPH free radical scavenging activity: The IC_{50} value was calculated and compared with ascorbic acid (Figure 1). IC_{50} value of STET was found to be 2.19 µg/ml whereas for standard ascorbic acid, it was 1.39 µg/ml.

Anti-inflammatory activity: The membrane stabilizing activity by two methods is shown on Table 3. In hypotonic solution induced hemolysis test, the plant showed 39.27%, 37.04% and 33.19% inhibition at 0.5, 1.0 and 2.0 mg/ml concentration whereas standard displayed 30.57% inhibition. STET also displayed, in heat induced hemolysis, 34.25% inhibition of hemolysis at 1 mg/ml whereas standard (Indomethacin) showed 30.75%.

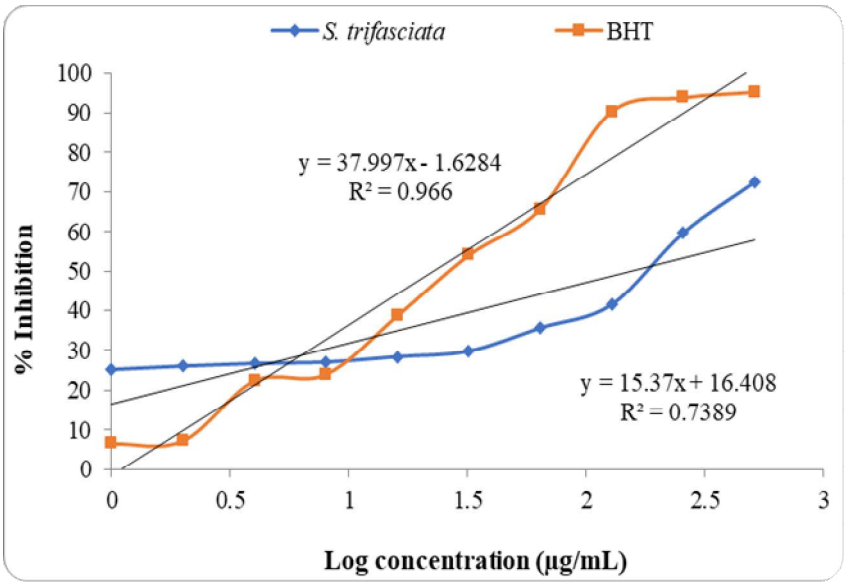

Figure 1. Comparison of % inhibition with log concentration for both standard (BHT: butylated hydroxytoluene) and *S. trifasciata* leaf extract.

Brine Shrimp Lethality Bioassay: The extract showed LC_{50} against brine shrimp nauplii at 58.67 µg/ml whereas vincristine sulphate (standard) showed toxicity at 0.4854 µg/ml.

Analgesic Activity: The results of the test showed that STET at the dose of 250 mg/kg and 500 mg/kg exhibit writhing reflex inhibition of 33.63% and 44.98%, respectively while the standard (diclofenac Na at dose 25mg/kg) drug showed 52.84 % inhibition (Figure 2). The extract (500mg/kg) and standard have been found statistically significant at $p<0.05$.

Phenolic compounds act as free radical terminators as they belong to a class of antioxidant (Shahidi *et al.*, 1992). Free radicals are known as major contributors of several clinical disorders such as diabetes mellitus, cancer, liver diseases, renal

failure, and degenerative diseases because of deficient natural antioxidant defense mechanism (Parr and Bolwell, 2000). Previous report has shown that phenolic compounds have hydroxyl group which is responsible for free radical scavenging activity (Sumi *et al*., 2016). This free radical scavenging activity depends on the compound's molecular weight, presence of aromatic ring and nature of OH group's substitution (Hagerman *et al*., 1998). Another important category of phenolic compound are flavonoids which have good antioxidant activity. Flavonoid and its derivatives exert a varied range of anti-inflammatory, antibacterial, anticancer, antiviral and anti-allergic activities. It is also considered to be highly effective against oxidizing molecules like singlet oxygen and various free radicals responsible for several diseases (Ruan *et al*., 2008).

Table 3. Percent inhibition of hemolysis of ethanol leaf extracts of *S. trifasciata.*

Sample code	Concentration	% inhibition of hemolysis	
		Hypotonic solution-induced hemolysis	Heat-induced hemolysis
Hypotonic medium	50 mM	2.47	--
Extract	2.0 mg/ml	33.198	34.25
	1.0 mg/ml	37.044	
	0.05 mg/ml	39.27	
Standard (Indomethacin)	0.1 mg/ml	30.57	30.75

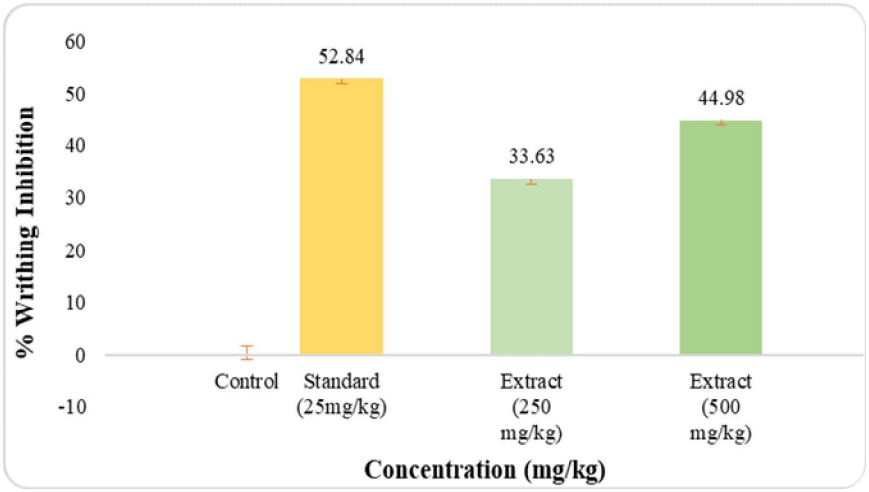

Figure 2. Percent writhing inhibition by the standard (diclofenac Na) and *S. trifasciata* leaf extract. The extract (500mg/kg) and standard have been found statistically significant at $p<0.05$.

It is found from the present study, STET contains a good amount of tannins which form complex with proteins and other macromolecules as they contain hydroxyl groups and free radicals (AfifyAel *et al*., 2012). Previous report has shown that tannins have antioxidant activity (Zhang and Lin, 2008). By donating hydrogen from hydroxyl group, antioxidants intercept the free radical chain reaction and form stable product. This product does not initiate or propagate further oxidation of lipid (Hadbaoui *et al.,* 2010). In such way, free radicals hinder cell damage. Besides, tannins have astringent properties. Tannins may act as a beneficial source of protein, but on the contrary, because of its

unpredictable amount, it may also cause toxicity and may also lead animals to death (Yang and Russell, 1992). The present study suggests that, the STET possesses a handsome amount of tannin content which refers further research for the protection of cell using free radicals.

The experiment also reveals that STET have anti-inflammatory activity which is evaluated by hypotonic solution induced hemolysis and heat induced hemolysis tests. It has been reported that flavonoids exert profound stabilizing effects on lysosomes both *in vitro* and *in vivo* in experimental animals (Omale *et al.*, 2008) while tannin and saponins have the ability to bind cations and other biomolecules, and are able to stabilize the erythrocyte membrane (Omale *et al.,* 2008). The high membrane stabilizing activity of the STET observed in this investigation may be due to its high tannin content.

Then, we carried out brine shrimp lethality bioassay which is a method to evaluate cytotoxic activity (Ahmed *et al.,* 2013). The plant contains saponins which has been reported to have wide range of pharmacological activities, such as, bactericidal, antiviral, cytotoxic, and anti-cancer (Ksouri *et al.,* 2009). It is also reported that there is correlation between brine shrimp lethality and cytotoxic activity (Mongelli *et al.,* 1995). For brine shrimp lethality bioassay LC_{50} values lower than 1000 µg/ml were considered bioactive (Martin-Cordero *et al.,* 1994). In our present study, STET showed a good lethality against brine shrimp compared to standard (vincristine sulphate) which needs further cell line assay for the evaluation of cytotoxic activity in more sensitive way.

Acetic acid induced by intraperitoneal route can cause pain by releasing prostaglandin E_2 and lipoxygenase (Sulaiman *et al.,* 2008). The STET may exert non-narcotic analgesic activity by the reduction of prostaglandin synthesis, includes writhing inhibition compared to that of standard diclofenac Na. As we know that the standard drug diclofenac sodium is a potent analgesic and it can produce stronger analgesic activity rather the ethanol leaf extract of *S. trifasciata.*

Conclusions

The ethanol extract of leaves of *S. trifasciata* has been confirmed the presence of reducing sugar, combined reducing sugar, tannins, flavonoids, glycosides, proteins, and steroids. In addition, the crude extract has potential antioxidant, cytotoxic, anti-inflammatory, and analgesic activities.

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