Available online on 15.08.2019 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Open Access Research Article

An Approach to Evaluate Anti-arthritic and Thrombolytic Activity of Different parts of *Solanum torvum* Sw. (Solanaceae) and *Smilax zeylanica* L. (Liliaceae)

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ABSTRACT

Phytochemical screening of chloroform and methanolic extracts of different parts of *Solanum torvum* and *Smilax zeylanica* was done. In vitro thrombolytic and anti-arthritic activities were assessed using the clot lysis method and egg albumin denaturation technique respectively. Between the chloroform and methanolic extracts, Chloroform extracts of both plants showed higher clot lysis activities (at 100 ppm solution). On the other hand, extracts of both plants performed better in terms of anti-arthritic activities (at 500 ppm solution). In the case of thrombolytic activity, between the plant extracts, the performance of *S. torvum* is higher compared to *S. zeylanica* plant. Among chloroform extracts of different plant parts, stem of *S. torvum* and root of *S. zeylanica* showed the highest, 35.44±1.89 % and 33.63±0.83 % activities respectively. Whereas, among the methanolic extracts of the plants, the root extracts of both plants showed the highest activities, 31.96±2.86 % for *S. torvum* and 32.01±1.46 % for *S. zeylanica*. In the case of anti-arthritic activity, the performance of *S. zeylanica* plant extracts is higher compared to that of *S. torvum*. Methanolic extract of leaf of *S. zeylanica* samples showed the best protein denaturation activity (52.38±2.12 %) followed by the Methanolic extract of stem sample of *S. torvum* (44.29±2.14 %).

Keywords: Thrombolytic, Anti-arthritic, *Solanum torvum* and *Smilax zeylanica*.

Article Info: Received 10 June 2019; Review Completed 18 July 2019; Accepted 26 July 2019; Available online 15 August 2019

Cite this article as:

Rahaman MS, Rahaman MS, Bari MA, Barua R, Islam JMM, Islam MS, MA Khan, An Approach to Evaluate Anti-arthritic and Thrombolytic Activity of Different parts of *Solanum torvum* Sw. (Solanaceae) and *Smilax zeylanica* L. (Liliaceae), Journal of Drug Delivery and Therapeutics. 2019; 9(4-s):155-164 **http://dx.doi.org/10.22270/jddt.v9i4-s.3186**

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INTRODUCTION:

Thrombosis (Blood clot) is a severe medical condition. In this condition, blood clots are formed usually in veins in the pelvis, thigh, lower leg, and sometimes in arms. Recovering from this leads illness, disability and even death.[1] This is the leading global cause of death because of cardiovascular disease (more than 17.9 million deaths in 2015) and the rate of death by this disease is expected to raise upto more than 23.6 million by 2030 per year.[2] Thrombolytic agents, that are commonality all around the world, are tissue plasminogen activator, streptokinase, urokinase, anti-streptokinase etc. These agents function by dissolve clots.[3] Till now thrombolytic agents suffer from complications related to bleeding, including the large quantity needed for being maximally effective, relative fibrin specificity and risk of hemorrhage.[4] Due to adverse effects of thrombolytic drugs, researches are in progress to design new and improved treatment and some of them have already been developed but safety is yet a key concern.[5] Significant efforts have been taken to discover and develop natural constituents from various animal and plant sources having thrombolytic,

antithrombotic, antiplatelet and anticoagulant activities.[6]. These studies and investigations in this area will open new horizon to encourage the advancement of the ultimate alternative thrombolytic therapy.[6]

Arthritis, an autoimmune disease, is another ubiquitous disease all over the world which is characterized by the association of pain, stiffness and swelling. It is caused by inflammation of the synovial joint as a consequence of immune mediated response. One fifth of the world's elderly suffer from arthritis.[7] Several drugs are used for arthritic treatment like NSAIDs, glucocorticoids, methotrexate, sulfasalazine, D-penicillamine, infliximab, etanercept, anakinra, abatacept, cyclosporine, azathioprine, and cyclophosphamide etc..[8–10] These therapeutic agents function by reducing the inflammation and joint destruction. Mainly, anti-arthritic activity means to hinder denaturation of protein and control the production of auto-antigen and membrane lysis in rheumatic disease.[11, 12] However, prolonged use of these drugs onsets several risks including cardiovascular intricacies, gastrointestinal ulcers, hematologic and pulmonary toxicities, nephrotoxicity, myelosuppression, stomatitis, hepatic fibrosis, diarrhoea, cirrhosis, immune and local injection-site reactions. Furthermore, high expense and side effects comprising malignancies and high risks of infections requires the need for continuous monitoring.[13] In contrast to the conventional medicines, Arthritic conditions if treated using traditional medicines, bring about considerable success causing no side effects. So there is an urge to develop new therapeutic agents with minimum side effects.

Herbal medicines are in use for treating various ailments since time immemorial.[14] They are formulated from the therapeutic expertise of generation of practicing physicians of centuries old ancient.[15] Medicinal plants are the blessings of nature which are widely distributed source of therapeutic agents for the preventive and curative measures of various diseases.[16]

Solanum torvum is an erect or spreading prickly shrub which is often used in traditional medicine for controlling diabetes and strengthening the bones, preventing gas trouble and teeth related diseases, curing paralysis. Extracts of different parts of this plant is very useful the treatment of waist stiffness, sick stomach, swelling beaten, heart pounding, no menstruation, eye and vision problems etc..[17, 18] Fruit and fruit coat of this plant possesses antifungal, antibacterial, antioxidant, antidiabetic, anthelmintic, immuno modulatory and erythropoietic, hepatoprotective, angiotensin-converting enzyme (ACE) inhibitory properties, cardiovascular and anti-platelet aggregation activities due to the presence of quality amount of phenols and flavonoids, isolated methyl caffeate.[19, 20, 21–28, 29–35] An isoflavonoid 'Torvanol A' was isolated from the seed of S. torvum which have antidepressant, anxiolytic and adaptogenic activities.[36] Methanolic and aqueous extracts of this plant show significant antiulcerogenic activity as well.[37] Spirostanol glycosides and steroidal lactone saponins prevailing in ethanolic extracts of the aerial parts of this plant have been proven to be responsible for cytotoxic effect.[17]

Smilax zeylanica L. is a climbing shrub with prickly stem, locally known as Kumarilata, has been used for the treatment of various minor and major ailments from ancient time. In tradition medicine, roots and leaves of S. zeylanica are used as a substitute for sarsaparilla, for the treatment of venereal diseases, eczema, abscess; the decoction is used for pain in the lower extremities, rheumatism, skin diseases, sores swellings, gonorrhea, gout, syphilis, blood purifier, and also used for dysentery controlling.[38] Alcohol and aqueous extracts of roots and rhizomes of S. zeylanica have been found potential for antiepileptic, hepato-protective activities.[38, 39] In vitro and vivo pharmacological activities of the extracts from the plant's different parts are attributed to the presence of Glycosides, Diosgenin, β-Sitosterol, Polyphenolic compounds and tannins, Saponins, Sarsasapogenin/ Smilagenin.[40-42] These compounds also bestow the plant extracts with antimicrobial, antidiabetic activity, anticonvulsant, anthelmintic properties as well as analgesic activities.[43–47]

Since there is no scientific report on thrombolytic and anti-arthritic potential of Solanum torvum and Smilax zeylanica extracts, in the present study evaluation of the thrombolytic and anti-arthritic effect of these plant extracts were assessed in vitro.

MATERIALS AND METHODS:

Preparation of extract

The plants (*Solanum torvum & Smilax zeylanica*) were collected from Savar, Dhaka and authentications were done by Bangladesh National Herbarium, Dhaka. Identification was completed previously by Prof. A.T.M. Nadiruzzaman, Department of Botany, University of Rajshahi, Rajshahi, Bangladesh. Different parts of Plants (in case of S. torvum, the experimented parts were leaf, stem, root & inflorescence and in case of S. zeylanica, the experimented parts were leaf, stem & root) were washed with ethanol and dried separately at room temperature (22 ± 0.5 °C) for 15 days and grounded into powder. Soxhelt's apparatus was used to get the extracts. In a soxhlet apparatus approximately 250 gm of each plant part were soaked for 7 days both in 1.0 L of chloroform ($CHCl_3$) and methanol (CH_3OH). Filtrates were obtained through Buchner funnel by filter paper No. 11 (whatman) and concentrated those by a rotary evaporator operating below 40°C. 10 mg of individual extract was suspended in 10 ml distilled water and vortexed vigorously by vortex mixer. In this manner, both methanolic and chloroform extracts of 100 ppm concentration were prepared for assessing the thrombolytic properties and the concentrations (66.5, 125, 250, 500 ppm) of both methanolic and chloroform extracts were prepared for screening for their antiarthritic activity.

Phytochemical screening

The phytochemical analysis of *S. torvum* & *S. zeylanica* was done through standard procedures as narrated in Trease & Evans (2009); Harbone (1998) and Tona (1998). Specifically, the extracts were assessed for the presence of secondary metabolites (saponins, glycosides, steroids, alkaloids, flavonoids, phenols, tannins & terpenoids) and macronutrients (carbohydrates & proteins).[48–50]

Test for Alkaloids:

For this test, an amount of 0.2 gm extracts were boiled on a steam bath with 2% HCl (5 ml). The solutions were then filtered and 1 ml of the filtrates was taken in separate test tubes. Filtrates in individual test tubes were then treated with 2 drops of the mayer's reagent (potassium mercury iodide solution). A precipitate of creamy white colour proves the presence of alkaloids.

Test for Flavonoids

An amount of 0.2 gm extracts were heated with ethyl acetate (10 ml) for 3 minutes in water bath at 100 °C. The solutions were filtered and filtrates were kept for the following tests:

(1) Ammonium test: Each of the filtrates (4 ml) was shaken vigorously with 1% dilute ammonia solution (1 ml). The

layers were allowed to separate. Presence of flavonoids confirms when yellow color forms at ammonia layer.

(2) Aluminum chloride test: Each of the filtrates (4 ml) was shaken vigorously with 1% aluminum chloride (1 ml) and determined for yellow color formation. Presence of flavonoids confirms when yellow precipitate forms.

Test for Glycosides

Keller-killiani test: A quantity (0.5 g) each of the extracts was once dissolved in 2ml of chloroform and filtered them. Then the filtrates were accrued in test tubes and evaporated to dryness. After that of glacial acetic acid (1 ml) and three drops of 5% w/v ferric chloride added. Afterwards 1 ml of focused sulphuric acid delivered cautiously via the aspect of the take a look at tube. The development of bluish green colour in higher layer suggests the presence of cardiac glycosides.

Test for Steroids

A volume (0.2 g) every of the extracts used to be dissolved in 2ml of chloroform. Then the following take a look at had been done.

(1) Salkowski test: Fuming sulphuric acid (2 ml) was once brought from the facet of the take a look at tube. The take a look at tube was once shaken for a few minutes. The development of red coloration in the chloroform layer indicates the presence of steroids.

(2) Liebermann-burchard test: Acetic anhydride (10 drops) was mixed properly with chloroform Then 2 ml of targeted sulphuric acid were added from the facet of the take a look at tube. The greenish transient coloration suggests the presence of steroids.

Test for Terpenoids

A quantity (0.2 g) each of the extracts was dissolved in 2ml of chloroform and evaporated to dryness. 2ml of conc. sulphuric acid used to be then added and heated for about 2 minutes. The presence of terpenoids confirms by development of grayish color.

Test for Saponins

Froth Test: Extracts (0.1g) had been diluted with distilled water to 15 ml and these were shaken in a graduated cylinder for 15 minutes. The presence of saponins confirms by formation of 1 cm layer of foam.

Test for Phenols

$FeCl_3$ Test: An extent (2 g) of the extracts had been boiled with 5 ml of 45 % ethanol for 5 min. The combination was cooled and filtered. The filtrate was subjected to the Ferric chloride test. An extent (1 ml) of the filtrate was diluted with distilled water and delivered 3 drops of 5% $FeCl_3$ (w/v). A transient greenish to black coloration shows the presence of phenols.

Test of Tannins

To the 0.2 g of extracts, 1% gelatin (3 ml) containing 10% NaCl (few drops) was added. White precipitate confirms the presence of tannins.

Test for Carbohydrates

An amount of 0.1 g of extracts was shaken with water vigorously and filtered. 5 drops of Molisch reagent (alpha-naphthol dissolved in ethanol) was added to aqueous filtrate and shaken vigorously. 1 ml of fuming sulphuric acid was added carefully. It was done to form a layer below the aqueous solution. The presence of carbohydrate proves by a brown ring at the interface.

Test for Proteins

(1) Biuret's Test:To 3 ml of extracts, 1 ml of 4% w/v sodium hydroxide and 1ml of 1% w/v copper sulphate had been added. The exchange in color of the answer to violet or pink indicates the presence of proteins.

(2) Xanthoprotein Test: To 3 ml of extracts, 1ml of concentrated sulphuric acid was added. The look of white precipitate which flip to yellow on boiling and orange on addition of ammonium hydroxide (1ml) suggests the presence of proteins containing tyrosine tryptophan.

In vitro Thrombolytic analysis

The thrombolytic recreation of *S. torvum* & *S. zeylanica* have been performed through following the approach of using streptokinase (SK) as a popular reference.[51, 52]

Preparation of Standard solution

Commercially available lyophilized Streptokinase vial of 15 zero I.U., 5 ml sterilized distilled water was mixed properly. This suspension was used as a stock from which a hundred µl (30,000 I.U) used to be used as Standard for in vitro thrombolysis. All chemical substances in this investigation were of analytical reagent grade.

Blood Collection

Whole blood (60 ml) was drawn from healthy human volunteers (n=15) by phlebotomist besides a history of oral contraceptive or anticoagulant therapy. 1ml of blood was transferred to each of the sixty before weighed falcon tubes to form clots.

Procedure

Drawn Blood was giver 15 minutes to form clots. Then the falcon tubes loaded with blood were centrifuged at 2000 rpm for 1 minute using centrifuge machine (Model: Remi- R-83 A). After that, blood serum was completely separated carefully without disturbing the blood clot and those falcon tubes were reweighted to measure clot weight. Each falcon tube containing clot was labeled correctly and 100 µl of different plant extracts were added to the falcon tubes. Positive control and negative control were used respectively 100 µl of SK & 100 µl of heparin of one of a kind concentration and 100 µl of distilled water. All falcon tubes were then kept in incubated at 37°C for 90 minutes to monitor the clot lysis. After 90 minutes of incubation, dissolved clot was removed and differences in weight of the falcon tubes after clot disruption were recorded by gravimetric method. The differences in weight were calculated as percentage of clot lysis. Each test was done in triplicate.

$$\% \text{ of clot lysis} = [(W_3 - W_1)/ (W_2 - W_1)] \times 100$$

Where,

W_1 = Weight of the empty falcon tube

W_2 = Clot weight after treatment with pre-weighted falcon tube

W_3 = Initial Clot weight with pre-weighted falcon tube

Each test was done in triplicate.

Antiarthritic Activity (Egg Albumin Denaturation Method)

The arthritic recreation of S. torvum and S. zeylanica had been carried out by using following the method of using Diclofenac Sodium as a preferred reference.[53]

Phosphate Buffer Saline pH 6.4

8 gm of sodium chloride (NaCl), 0.2 gm of potassium chloride (KCl), 1.44 g of disodium hydrogen phosphate (Na_2HPO_4) and 0.24 gm of potassium dihydrogen phosphate (KH_2PO_4) were dissolved in 800 ml distilled water. The pH was adjusted to 6.4 using 1N HCl and make up the quantity to one thousand ml with distilled water.

Procedure

The reaction mixture for anti-arthritic activity assessment (5 mL) consisted of 0.2 mL of egg albumin drawn from fresh hen's egg, 2.8 ml of phosphate-buffered saline (pH 6.4) and 2 mL of different concentrations of plant extracts (66.5, 125, 250, 500 ppm). As a control, similar volume of double-distilled water was served. . As the standard, varying concentrations of diclofenac sodium (66.5, 125, 250, 500 ppm) was used. After that, the mixtures were incubated at 37 ± 2°C in a BOD incubator for 15 minutes and right after that the mixture was heated at 70°C for 5 minutes in a water bath. After cooling, the absorbance was measured at 660 nm by a UV-Vis Spectrophotometer. Phosphate buffer saline was served as Blank. The denaturation of protein was calculated by using the following formula:

$$\% \text{ inhibition} = 100 \times [V / V_0 - 1]$$

Where,
V = Test Sample Absorbance

V_0 = Control Absorbance

Each test was done in triplicate.

Statistical Analysis:

Data are presented as the suggest ± Standard deviation of every triplicate test. The analysis was carried out with the aid of ANOVA followed by Dunnett's t-test. Significance was set at $P < 0.001$ and $P < 0.05$ levels.

RESULTS & DISCUSSION:

Preliminary phytochemical screening:

Medicinal plants are playing a central role in conventional medicine. Traditional health practitioners have long been using medicinal plants to treat various diseases.[54-56] The potential activity of the medicinal plants can be attributed to the presence of different kinds of pharmacologically active phytochemicals. In this experimental study preliminary phytochemical screening was done to qualitatively determine the active ingredients present in the plant extracts of S. torvum and S. zeylanica according to standard procedures. Preliminary phytochemical screening revealed the presence of flavonoid, tannin and glycosides in both methanolic and petroleum ether extracts. Polyphenolic compounds, like flavonoids, tannins and phenolic acids, commonly found in plants have been reported to have multiple biological effects.[55, 57, 58] The found phytochemicals are tabulated in the following table (Table 1). The positive signs of the phytochemicals confirm the presence of saponins, steroids, glycosides, terpenoids, carbohydrates, phenols, flavonoids, alkaloids and proteins in the plant extracts. However, the only phytochemical that is absent in all extracts is tannin (Table 1).

Table 1. Presence of different phytochemicals in two fractions (methanol & chloroform) of different parts of *Solanum torvum* and *Smilax zeylanica*.

Sample Name	Chemical Group Test									
	Saponin	Steroid	Glycoside	Terpenoid	Carbohydrate	Phenol	Flavonoid	Tannin	Alkaloid	Protein
Smt/Leaf/MeOH	+	+	+	+	+	+	++	-	+	-
Smt/Leaf/$CHCl_3$	+	+	+	-	+	+	-	-	+	++
Smt/Stem/MeOH	-	+	+	+	+	+	+	-	+	++
Smt/Stem/$CHCl_3$	-	+	-	-	+	+	-	-	+	++
Smt/Root/MeOH	-	-	-	+	+	+	-	-	+	++
Smt/Root/$CHCl_3$	-	+	+	+	+	+	-	-	+	+
Smt/Inflorescence/MeOH	+	+	+	+	+	+	+	-	+	++
Smt/Inflorescence/$CHCl_3$	-	+	+	+	+	+	-	-	-	++
Sxz/leaf/MeOH	-	+	+	+	+	+	++	-	+	+
Sxz/leaf/$CHCl_3$	-	+	+	+	+	+	-	-	+	++
Sxz/Stem/MeOH	-	+	+	+	+	+	++	-	+	++
Sxz/Stem/$CHCl_3$	-	-	-	-	+	+	-	-	-	++
Sxz/Root/MeOH	-	-	+	+	+	+	-	-	-	++
Sxz/Root/$CHCl_3$	-	-	+	-	+	+	-	-	-	+

NB: Smt indicates *Solanum torvum*, Szx indicates *Smilax zeylanica* and (+) indicates presence, (-) indicates absence

In vitro thrombolytic activity

The clot lysis percentage results of the methanolic and chloroform extracts of different parts of *S. torvum*, positive control (streptokinase) and negative control (water) are shown in Figure 1. For positive control (100 µL of streptokinase (30,000 IU), the clot lysis was found to be 76.15 ± 1.94 %, while in the case of negative control (water) a very negligible amount of clot lysis (3.59 ± 0.46%) was found.

It can be seen from the figure (Figure-1) that, *S. torvum* induced in vitro clot lysis 35.44 ± 1.89 %, 28.67 ± 2.59%, 25.9 ± 1.01 % & 20.51±2.83 % for 100 ppm concentration of chloroform ($CHCl_3$) extracts of stem, leaf, root & inflorescence samples and 31.96 ± 2.86 %, 31.0 ± 2.1 %, 22.05 ± 4.48 % & 21.82 ± 1.29 % for 100 ppm concentration of methanolic (CH_3OH) extracts of root, stem, inflorescence and leaf samples respectively.

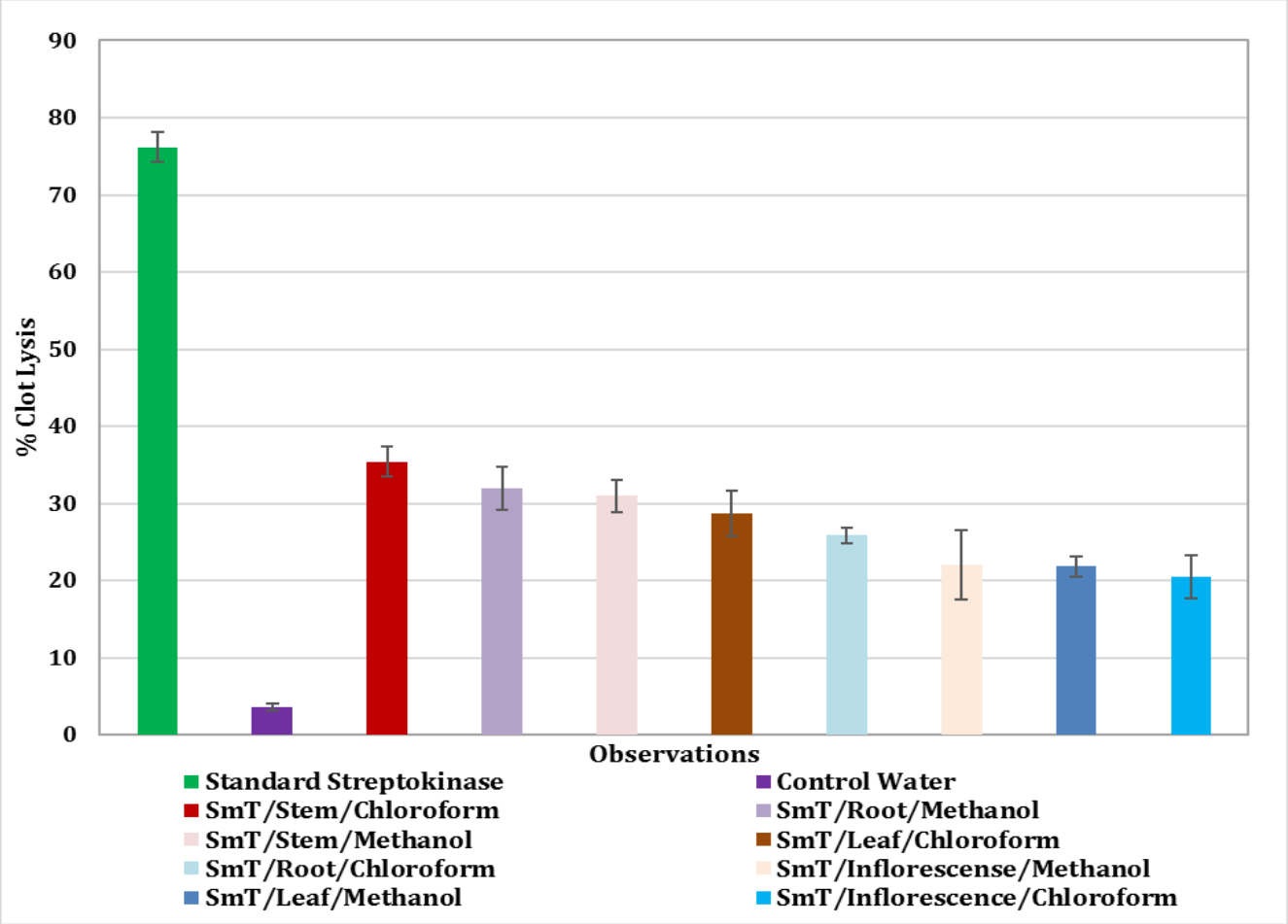

Figure 1. Thrombolytic properties of methanolic & Chloroform extracts of different parts of *Solanum torvum* compared with Standard (Streptokinase).

Figure 2 summarizes the clot lysis results by chloroform and methanolic extracts of different parts of *S. zeylanica* in percentage, positive control (streptokinase) and water as negative control. Clot lysis was 76.15 ± 1.94 % for the positive control (100 µL of 30,000 IU streptokinase). Compared to the positive control, the negative control (water) showed very negligible clot lysis (3.59 ± 0.46%).

It is shown in Figure 2 that *S. zeylanica* induced in vitro clot lysis 33.63 ± 0.83%, 31.61 ± 2.31 % & 17.19 ± 1.65 % for 100 ppm concentration of chloroform ($CHCl_3$) extracts of root, stem & leaf samples and 32.01 ± 1.46 %, 22.02 ± 1.70% and 15.02 ± 0.38 % for 100 ppm concentration of methanolic (CH_3OH) extracts of root, stem and leaf samples respectively.

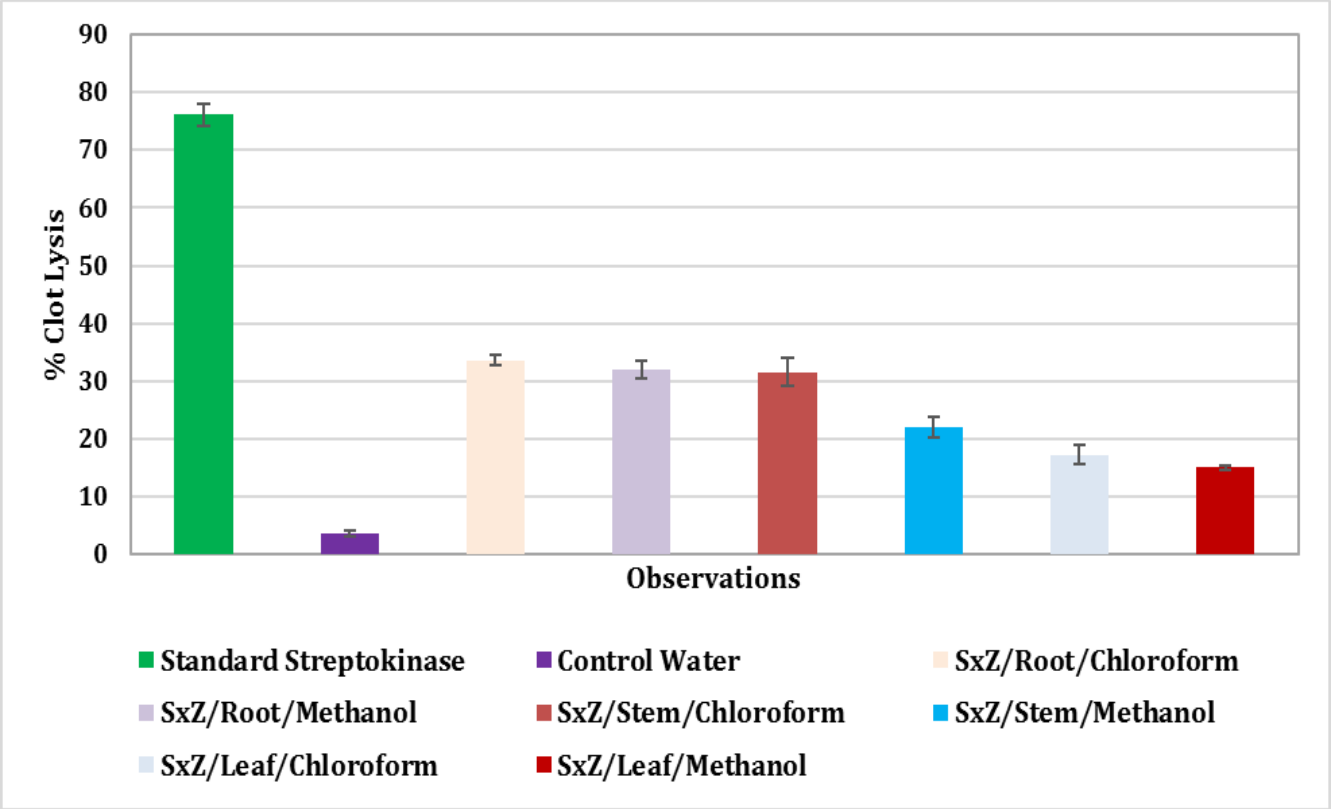

Figure 2. Thrombolytic properties of methanolic and Chloroform extracts of different parts of Smilax zeylanica compared with Standard (Streptokinase).

In vitro anti-arthritic activity:

The denaturations of proteins along with the membrane lysis action are held responsible for the production of auto antigens in certain arthritic diseases. Different plant extracts of different parts were subjected to monitor their anti arthritic activities in vitro. The results are shown in the following figures (Figure 3 and Figure 4). Figure 3 represents the data of antiarthritic activity of *S. torvum* plant extracts. For the plant The maximum protein denaturation inhibition percentage was observed for methanolic (CH_3OH) extracts of stem, leaf, inflorescence & root samples are 44.29 ± 2.14, 42.54 ± 0.49, 39.29 ± 0.71 & 21.14 ± 2.09 and chloroform ($CHCl_3$) extracts of root, leaf, stem & inflorescence samples are 35.15 ± 1.58, 33.85 ± 2.03, 33.28 ± 1.31 & 23.47 ± 1.07 at 500 ppm respectively for *S. torvum*. Whereas standard (diclofenac sodium) shown 85.10 ± 0.45 at same ppm (Fig. 3). The minimum inhibition percentage was observed in case of methanolic (CH_3OH) extracts of leaf, stem, inflorescence & root samples are15.52 ± 0.93, 10.07 ± 0.67, 9.27 ± 0.94 & 4.29 ± 0.62 and chloroform ($CHCl_3$) extracts of root, leaf, stem & inflorescence samples are16.29 ± 1.62, 10.29 ± 1.27, 8.71 ± 1.16 & 7.57 ± 0.89 at 66.5 ppm respectively for S. torvum. whereas standard (diclofenac sodium) shown 45.51 ± 1.21 % at the same ppm (Fig. 3).

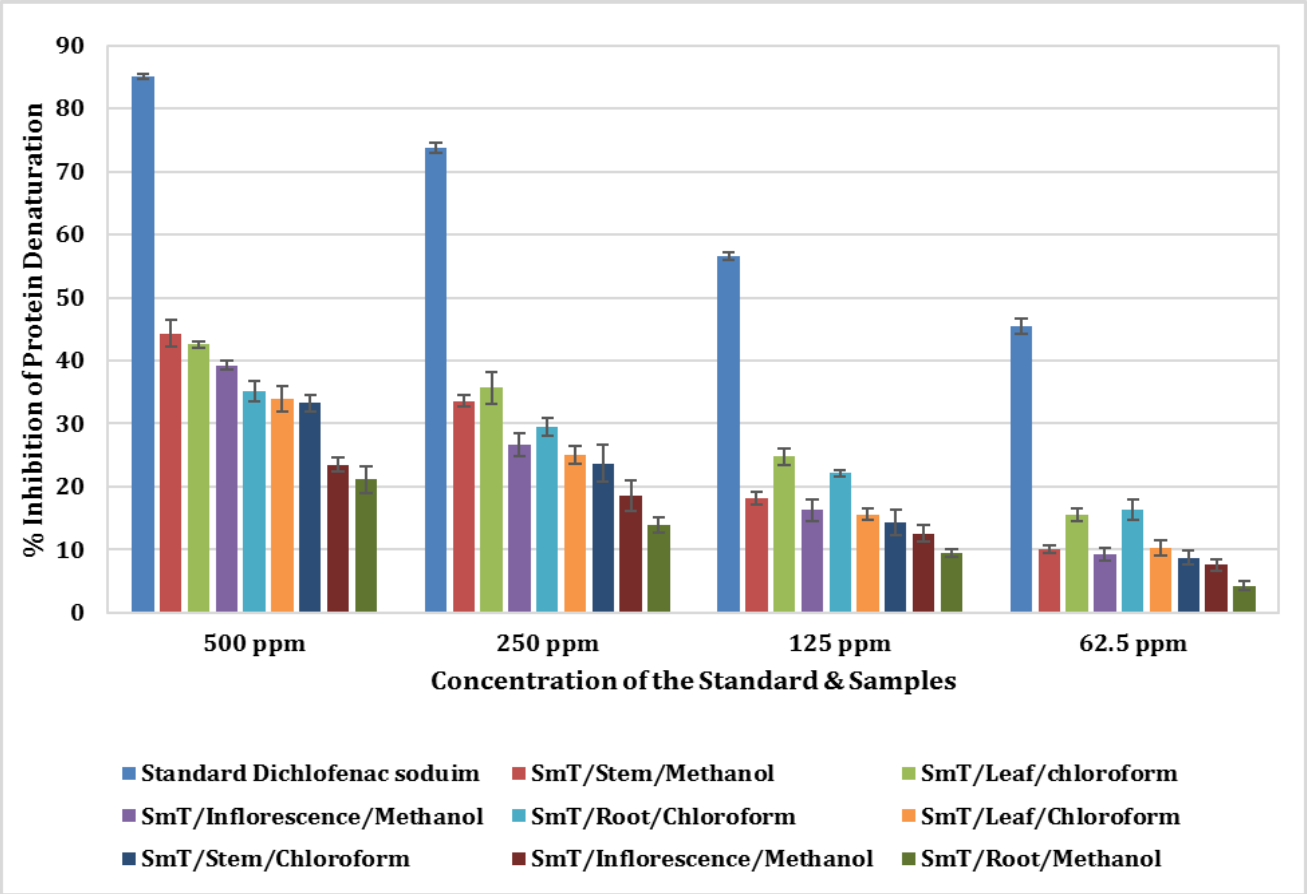

Figure 3. Antiarthritic activity of methanolic (CH_3OH) & chloroform ($CHCl_3$) extract of different parts of *Solanum torvum* compared with Standard (Diclofenac Sodium)

The maximum anti-arthritic activity was observed in methanolic (CH_3OH) extracts of leaf, stem & root samples are 52.38 ± 2.12, 32.24 ± 1.45 & 24.71 ± 1.76 and chloroform ($CHCl_3$) extracts of stem, root & leaf samples are 34.92 ± 1.28, 33.02 ± 0.81 & 30.32 ± 0.66 at 500 ppm respectively for *S. zeylanica*. Whereas standard (diclofenac sodium) showed an activity of 85.10 ± 0.45 at the same ppm (Fig. 4). The minimum was observed in methanolic (CH_3OH) extracts of leaf,stem & root samples are 25.24 ± 0.53, 9.45 ± 0.98 & 5.23 ± 0.51 and chloroform ($CHCl_3$) extracts of root, stem & leaf samples are 14.65 ± 1.53, 11.57 ± 1.25 & 8.73 ± 0.85 at 66.5 ppm respectively for *S. zeylanica*. Whereas standard (diclofenac sodium) showed 45.51 ± 1.21 at same ppm (Fig. 4).

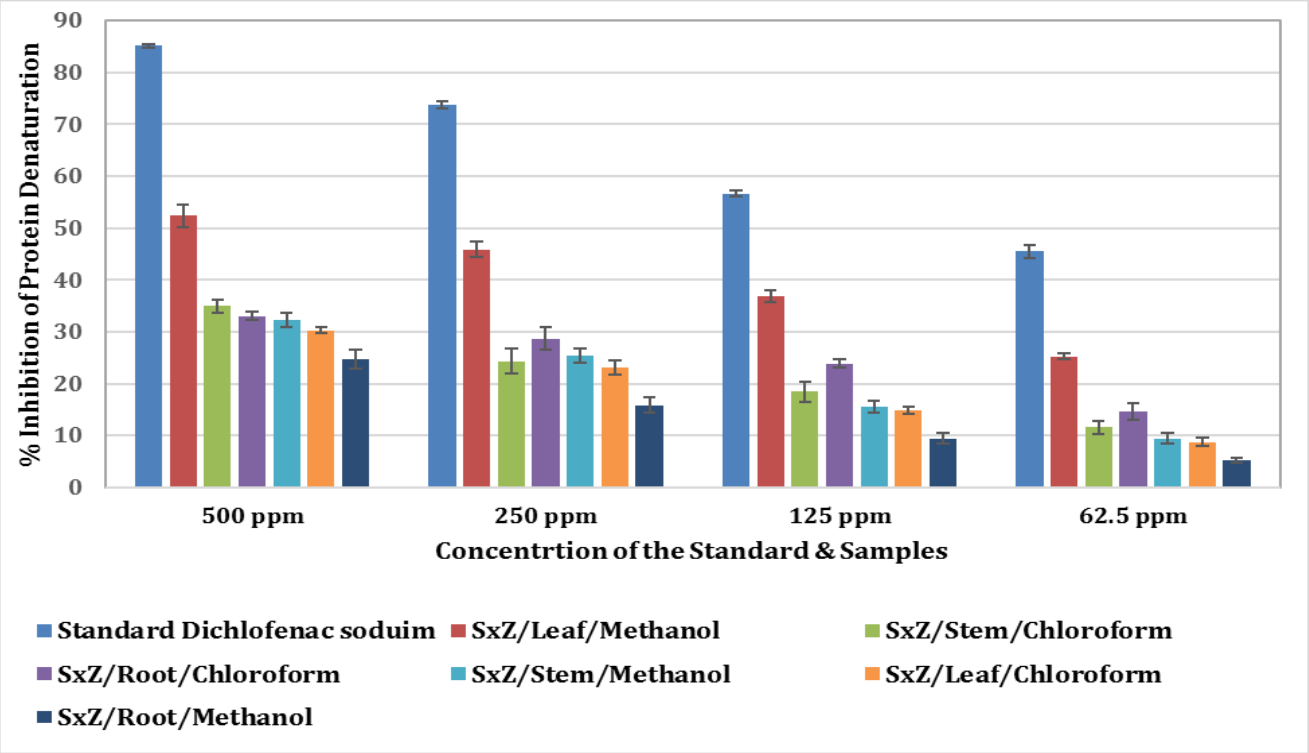

Figure 4. Antiarthritic activity of methanolic & chloroform extracts of different parts of *Smilax zeylanica* compared with Standard (Diclofenac Sodium)

The results of our study reveal that extracts of *S. torvum* and *S. zeylanica* have proven to be potential candidate in clot lysis, controlling the production of auto antigens. These extracts are also capable of inhibiting protein denaturation and membrane lysis in arthritic disease. Our present studies suggest that extracts of *S. torvum* and *S. zeylanica* exhibit moderate to low anti arthritic property but they could be potential sources of thrombolytic and anti-arthritic elements.

Anti-arthritic activity of the extracts of *S. torvum* and *S. zeylanica* might be due to the presence of active phytochemicals such as phenols, alkaloids, terpenoids, steroids, flavonoids and glycosides as they are proven to have these phytochemicals (Table 1).[59] Furthermore, phytochemicals such as terpenoids, alkaloids and flavonoids are held responsible for the thrombolytic activities of extracts of *S. torvum* and *S. zeylanica*.[60-62]

CONCLUSION:

Methanolic extracts of different parts of *Solanum torvum* and *Smilax zeylanica* possess mild to moderate thrombolytic and antiarthritic activity. Those may be a probable source of thrombolytic and arthritic drugs as a candidate for the future. However, in vivo clot lysis and antiarthritic activity and corresponding to active components responsible for the activity are yet to be found out. Positive results give us hope to develop drugs in the future and once found *S. torvum* and *S. Zeylanica* as a potent thrombolytic and antiarthritic agent, those will be incorporated for the improvement of suffering of the patients from atherothrombotic and rheumatism diseases respectively.

Conflicts of Interest: The authors declare no conflict of interest.

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