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Anti-Inflammatory Effect of Ethanolic Leaves Extract of *Sansevieria trifasciata* and *Sansevieria liberica* in Swiss Mice, (*Mus musculus*)

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Abstract

The aim of this study was to examine the anti-inflammatory properties of Sansevieria trifasciata, also known as mother-in-law tongue, and Sansevieria liberica ethanolic leaf extract on mice, (Mus musculus). In a

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scientific setting, plant powder was extracted using 70% ethanol over a 72-hour period. Using the test animals, the extracts' median lethal dose (LD_{50}) was established. The soluble portion of the extracts was given at working doses of 10, 20, and 30% of the LD_{50} to the corresponding experimental animal groups (i.e low, middle, and high dosages accordingly). Findings from Sansevieria trifasciata and S. liberica's phytochemical screening indicated the existence of secondary metabolites like terpenes, alkaloids, cardiac glycosides, and tannins. When given intraperitoneally, the LD_{50} of S. trifasciata and S. liberica were 387.30 and 353.55 mg/kg, respectively. The plant extracts' soluble fraction was given intraperitoneally (i.p.) by injection as well as orally. The phlogistic egg-albumin-induced inflammation significantly decreased ($p<0.05$) according to the results. However, the development of a strong anti-inflammatory drug with low toxicity and an improved therapeutic index may come from the isolation of these bioactive components.

Keywords: Anti-inflammatory, phytochemicals, mice, *Sansevieria trifasciata, Sansevieria liberica*

INTRODUCTION

Living tissues use the inflammatory process as a defense mechanism in response to injury, infections, stress, poisonous chemicals, and cell damage (Yoo *et al.,* 2021). According to Cheng *et al.* (2018), it is a complicated reaction that resolves stimuli and starts the healing process. Chronic inflammation may progress and lead to chronic inflammatory illnesses if acute inflammation is not managed (Cheng *et al.,* 2018, Fang *et al.,* 2014).

Steroids, opioids, and nonsteroidal anti-inflammatory drugs (NSAIDs) are recognized and commonly used to treat disorders linked to inflammation or to control symptoms of inflammation (Slater *et al.,* 2010). Nevertheless, because of their negative effects, doctors continue to use them cautiously and with prudence. Millions of individuals worldwide suffer from various diseases, with pain and inflammation being among their most prevalent symptoms (Raghav *et al.* 2006, Rang *et al.* 2011).

Traditional medicine practitioners, mostly in developing countries like Nigeria, have employed herbal medications to treat a variety of diseases, including pain and inflammation, even though there are efficient orthodox pharmaceuticals used to alleviate similar manifestations (Martini-Bettolo, 1980). It is deeply ingrained in Nigerian culture for the people to rely on traditional healers and plant remedies, particularly in rural areas, to meet their medical needs.

Sansevieria trifasciata and *S. liberica* are two plants that are used by practitioners of traditional medicine to cure a variety of diseases. According to Acevedo-Rodriguez and Stong (2005), these plants are native to tropical Africa. They are succulent plants with sturdy creeping rhizomes, leaves that are either one or two together, linear oblanceolate, stiffly erect, 30-100×3 cm, and transversely banded with contrasting green and whitish zones (Acevedo-Rodriguez and Stong (2005). Because it has been discovered that this species is among the most effective at purifying the air by eliminating toxins like formaldehyde that are present in homes and offices, it is frequently used as an indoor pit plant and is highly valued in the nursery industry (Wolverton *et al*., 1989). According to Osabohien and Egboh (2008) and Adeyemi *et al*. (2009), traditional medicine in Nigeria uses the leaves and roots of *S. liberica* to cure a variety of conditions, including asthma, gonorrhea, dermatitis, abdominal aches, colic, diarrhea, piles, sexual weakness, and foot sores.

Plants and their extracts have attracted a lot of interest in the last century as a potential new source for anti-inflammatory medicinal uses that are not invasive (Pountos *et al.,* 2011, Otimenyin, 2018). There are three phases to the progression of edema: the initial phase, when histamine and serotonin are released; the plateau period, when kinin and other substances sustain edema; and the accelerating phase, when prostaglandin release occurs (Amri *et al.,* 2018). More research should be carried out on their phytochemical components and pharmacological properties.

MATERIALS AND METHODS

Plants Collection *Sansevieria trifasciata* and *S. liberica* fresh leaves were obtained from Itak village (5°12′37″N7′47′38″E) in Ikono Local Government Area of Akwa Ibom State. The taxonomist (Professor Margaret Bassey) at the University of Uyo's Department of Botany and Ecological Studies verified the authenticity of the leaves. For future reference, voucher specimens with the numbers UUH/3788 and UUH/3789 were placed in their herbarium.

Experimental Animals

Fifty six (56) swiss mice (14-34g) of both sexes were obtained and kept in the Animal House of Department of Pharmacology and Toxicology, Faculty of Pharmacy of University of Uyo. The animals were housed in standard wooden cages, acclimatized for the period of 28 days (four weeks). The mice were maintained on standard pellet feed, water at libitum, good light conditions and ambient temperature prior to the experiment.

Plant powder and Extract preparation

Following collecting, the plant leaves were cleaned, cut into pieces, and allowed to air dry until they reached a consistent weight. The dried plants were ground into a fine powder using a power-driven blender (Braum Multiquick Immersion Hand Blender, B White Mixer MR 5550CA, Germany), weighed (187.3g and 283.3g, respectively), and stored in an airtight container until needed. Next, following the guidelines provided by Santana *et al*., 2013; Mukhtar and Huda, 2005; Fatope *et al*., 1999, the ethanolic leaf extracts were made. This required soaking 50 g of the powder in 50% ethanol at room temperature for a duration of 48 to 72 hours. To obtain the extracts, filtrate was then evaporated using a rotatory evaporator.

Determination of LD_{50}

After injecting carrageenan, the hind paw's diameter was assessed at an hour of 1.5, 3 and 6. Paw edema was assumed to be indicated by increases in the right hind paw's linear circumference. The difference between the injected right hind paw's linear circumference at time t (Ct) and zero time (Co) was used to measure the percentage increase in edema (%IO).

$$\%IO = Ct - Co/Co \times 100$$

Using the Amri *et al*. (2018) technique, the percentage suppression of the inflammatory response caused by carrageenan was computed:

$$\%\ inhibition = IOc - IOt/IOc \times 100$$

Where IOc and IOt represent the mean increase in paw circumference in control and treated groups, respectively.

Using the approach of Lorke (1983), the extract was injected interperitoneally (i.p.) into the animal. The animals were divided into four groups, each with three animals, and given varied

doses of 1 g of the extracts, which was weighed and diluted in 10mL of distilled water. The extracts were given to the animals at a dosage of 3000 and 2000 mg/kg, respectively, while they were housed in separate cages. After the first day's dosage, the animals were observed for symptoms of acute toxicity, and all of them perished within 24 hours. Toxins were administered to two (2) groups of four (4) mice each, corresponding to 800 and 500 mg/kg of extract, respectively. Within 24 hours after the second day's injection, they were all dead, and they were all being watched for signs of acute toxicity. Thirdly, three (3) members of each of the four (4) groups were given injections of 300 and 100 mg/kg. All of the animals did, however, survive after being monitored for indicators of acute toxicity and mortality within a day, which was calculated from 300 and 500 mg/kg for each plant, respectively.

Experimental Design

The work was designed to have about 8 groups of 3 mice in each group, with a total of twenty-four (24) mice used for the experiment. However, group I served as negative control for both plants, group II served as positive group for both the standard drug (Ibuprofen 40mg given at 0.1ml orally), group III was for low doses for two different groups of the different extract, group IV was for middle doses for different groups of different extract while group V was for high doses for different groups of the different extracts.

Induction of Inflammation

Egg albumin was the phlogistic substance employed in this investigation (Akah and Nwaniba, 1924). This test involved twenty-four (24) albino mice weighing between 14 and 40 grams. Eight groups, each consisting of three mice, were created from the mice. The animals were dehydrated and denied nourishment for a full day prior to and throughout the experiment. To cause the inflammation, 0.1 milliliters of fresh, undiluted egg albumin were utilized.

The increase in the hind paw's linear circumference following a sub-planter injection of fresh egg albumin was used to quantify acute inflammation. The difference in paw circumference between the control group and the group that received the phlogistic drug between 0.5 and 5 hours later was used to measure edema.

Group I served as negative control group of which nothing was given
Group II was a positive control with the administration of ibuprofen 40 mg/m standard drug
Group III had *S. trifasciata* extract was given the low dose of 39 mg/kg
Group IV had *S. trifasciata* extract given at middle dose of 77 mg/kg
Group V had *S. trifasciata* extract given at high dose of 116 mg/kg
Group VI had *S. liberica* extract given at low dose of 35 mg/kg
Group VII had *S. liberica* extract given at the middle dose of 71 mg/kg
Group VIII had *S. liberica* extract given at high dose of 106 mg/kg.

After the oral medication delivery and extraction, the animals in each group were given 0.1 ml of fresh, undiluted egg albumin (i.p.) thirty minutes later. Using a stopwatch and digital Veneer calipers, the linear circumference of the paw was measured every hour for five hours.

Statistical Analysis

The mean ±SEM and significant difference between the control and treated groups were reported in the results. Two-way analysis of variance, or ANOVA, was used to analyze the variations

amongst the groups. The Least Significant Difference (LSD) was used to differentiate the mean differences. A significance threshold of p=0.05 was applied to the likelihood.

RESULTS

Phytochemical screening of the ethanolic extract of *S. trifasciata* and *S. liberica* showed the presence of flavonoids, alkaloids, Tannins, phenols, streroids, cardiac glycosides, and saponins which might be responsible for the distinct anti-inflammatory activities (Table 1).

Table 1: Qualitative phytochemical analysis of the different extracts of *S. trifasciata and S. liberica*

	S. trifasciata	*S. liberica*	Test
Anthraqunones	+	-	Borntrager
Steroids/terpenes	+	+	Liebermann-Burchard
Cardiac glycoside	+	+	Keller-kiliani, Salkowsiki
Saponin	+	+	Frothing, Fehling solution, Na_2Co_3
Tannins and Phenols	+	+	Ferric Chloride, Pb acetate
Flavonoids	+	-	NaOH, Mayer, Wagner
Alkaloids	+	+	NaOH, Shinda
Phlobatannins	+	-	Dragendoff, Mayer, Wagner

+= Present - = Absent

Table 2: Strength of the different extracts at LD_{50} of 387.3 and 353.55mg/kg and the number of Animal

Extract's strength (mg/kg)	**Animal**	
	S. trifasciata	*S. liberica*
3000mg/kg	3/3	3/3
2000mg/kg	3/3	3/3
800mg/kg	3/3	3/3
500mg/kg	0/3	0/3
300mg/kg	0/3	0/3
100mg/kg	0/3	0/3

Tables 3 and 4 illustrate the amount of paw edema in each treatment group. The findings demonstrate that giving mice 3000 mg/kg of extract considerably reduced the amount of paw edema for 30 minutes, 60 minutes, 180 minutes, 240 minutes, and 300 minutes after treatment. Paw edema was significantly controlled by extracts applied between 30 and 60 minutes, and at 30 and 60 minutes, paw edema was inhibited by 100 mg/kg. The extract's effect on hind paw edema caused by egg albumin was comparable to that of ibuprofen, with the least amount of action observed at 100 mg/kg.

Research on the anti-inflammatory properties of *S. trifasciata* and *S. liberica* in hind paws induced by egg albumin Oedema in mice showed that these plants had anti-inflammatory qualities by decreasing hind paw oedema in a dose-dependent way; yet, these plants take longer to start

working than ibuprofen. This study represents the acute anti-inflammatory effects of the *S. trifasciata and S. liberica* extract in which innate immune cells form the first line of immune defense and regulate activation of adaptive immune responses (Jung *et al*., 2020). As an acute inflammation turns chronic, the majority of its characteristics worsen (Hong *et al*., 2020). These include diapedesis, the movement of neutrophils past the capillary wall into the infected tissue, and vasodilation, the expansion of blood vessels that results in an increase in blood flow. As a common inflammatory model for increasing capillary permeability and leukocyte infiltration, hind paw edema partially implicated substance.

Accordingly, the hypothesized mechanism of *S. trifasciata* and *S. liberica* may decrease the release of substance P or counteract its activity in the inflammatory process. Bradykinin and substance P are released during the first phase, which is also referred to as the neurogenic phase. Vasodilation and plasma exudation were brought on by the release of nitric oxide, which was triggered by substance P, a neurotransmitter in the central nervous system (Mainka *et al*., 2021). Thus, neurogenic inflammation may be the subject of *S. trifasciata* and *S. liberica's* anti-inflammatory qualities.

Table 3: Effect of *S. trifasciata* leaf extract on egg-albumin induced hind paw Oedema in Mice

	Water	Standard drug	Low dose	Middle dose	High dose
Initial egg albumin	$1.893^{a}\pm0.0554$	$1.937^{a}\pm0.0481$	$1.970^{a}\pm0.0058$	$1.987^{a}\pm0.039$	$2.0833^{a}\pm0.0167$
30 mins	$0.893^{b}\pm0.0556$	$0.088^{b}\pm0.0061$	$0.073^{a}\pm3.3333$	$0.019^{a}\pm0.0053$	$0.028^{a}\pm0.0041$
60 mins	$2.88^{c}\pm0.179$	$3.227^{c}\pm0.1073$	$3.147^{b}\pm0.0153$	$3.187^{b}\pm0.1278$	$3.420^{b}\pm0.0700$
120 mins	$2.5067^{d}\pm0.1297$	$3.070^{c}\pm0.0513$	$2.797^{b}\pm0.0753$	$2.903^{b}\pm0.0067$	$3.1266^{a}\pm0.1683$
180 mins	$2.5067^{c}\pm0.0433$	$2.817^{a}\pm0.1468$	$2.620^{b}\pm0.0476$	$2.683^{a}\pm0.0353$	$2.8533^{a}\pm0.1842$
240 mins	$2.703^{c}\pm0.0617$	$2.567^{b}\pm0.1301$	$2.580^{b}\pm0.0757$	$2.693^{a}\pm0.0481$	$2.7167^{a}\pm0.0996$
300 mins	$2.637^{c}\pm0.0584$	$2.470^{b}\pm0.0874$	$2.510^{b}\pm0.0873$	$2.537^{a}\pm0.0263$	$2.7067^{a}\pm0.0768$
	$22.61^{d}\pm0.0472$	$2.337^{b}\pm0.0328$	$2.463^{b}\pm0.0088$	$2.440^{a}\pm0.0058$	$2.5067^{a}\pm0.0811$

Table 4: Effect of *S. liberica* leaf extract on egg-albumin induced hind paw Oedema in Mice

	Water	Standard drug	Low dose	Middle dose	High dose
Initial egg albumin	$1.893^{a}\pm0.0554$	$1.937^{a}\pm0.0481$	$1.184^{a}\pm0.1322$	$2.050^{a}\pm0.0289$	$1.997^{a}\pm0.041$
30 mins	$0.893^{b}\pm0.0556$	$0.088^{b}\pm0.0061$	$0.006^{a}\pm0.0007$	$0.018^{a}\pm0.0023$	$0.025^{a}\pm0.003$
60 mins	$2.88^{c}\pm0.179$	$3.227^{a}\pm0.1073$	$2.833^{a}\pm0.0731$	$3.233^{a}\pm0.0384$	$3.034^{b}\pm0.038$
120 mins	$2.5067^{a}\pm0.1297$	$3.070^{b}\pm0.0513$	$2.793^{a}\pm0.151$	$2.943^{a}\pm0.1753$	$3.017^{a}\pm0.114$
180 mins	$2.5067^{a}\pm0.0433$	$2.817^{c}\pm0.1468$	$2.533^{a}\pm0.0353$	$2.730^{a}\pm0.1572$	$2.780^{b}\pm0.117$
240 mins	$2.703^{a}\pm0.0617$	$2.567^{c}\pm0.1301$	$2.660^{a}\pm0.0199$	$2.703^{a}\pm0.1074$	$2.603^{b}\pm0.129$
300 mins	$2.637^{a}\pm0.0584$	$0.0872^{c}\pm2.463$	$2.463^{b}\pm0.0219$	$2.557^{b}\pm0.1198$	$2.657^{b}\pm0.135$
	$22.61^{a}\pm0.0472$	$2.337^{c}\pm0.033$	$2.460^{b}\pm0.0500$	$2.477^{b}\pm0.0219$	$2.390^{c}\pm0.061$

DISCUSSION

The extract's unique anti-inflammatory properties may be attributed to the phytochemicals found in *S. trifasciata* and *S. liberica*, which include cardiac glycosides, flavonoids, triterpenoids, alkaloids, phenols, and saponins (Neekhra *et al*., 2017). According to Javan *et al.* (2000), flavonoids are helpful in acute inflammation because they work by preventing the release of arachidonic acid, which is essential for the synthesis of prostaglandin (Todera *et al*., 1994; Owolabi *et al*., 2018). Furthermore, flavonoids have antioxidative activity through the inhibition of cyclooxygenase and lipoxygenase enzymes, which lowers prostaglandin and leukotriene levels, disruption of the arachidonic acid pathway, and decrease in capillary permeability (Tordera *et al*., 1994). According to Lucetti *et al.* (2010) and Schmid *et al*. (2009), terpenoids may reduce the expression of inducible nitric oxide synthase (iNOS) in order to have their anti-inflammatory effects. Inducible nitric

oxide synthase (iNOS) and cyclooxygenase (COX)-2 mRNA expression were both lowered in paw 264.7 cells and paw edema was considerably dose-dependently suppressed by *Streblus asper* (SA), a putative anti-inflammatory drug (Sripanidkulchai *et al*., 2009). This study's findings about the impact of phenols on paw edema are consistent with those of earlier research by Jagan *et al*. (2000), Arts and Hollman (2005), and Singsai *et al*. (2020), which found that phenolic compounds inhibit the inflammatory process by blocking the lipoxygenase enzyme, which is involved in the conversion of arachidonic acid to inflammatory mediators and in the metabolism of arachidonic acid.

In their findings on the anti-inflammatory and associated activities of *Syzygium cuminii* seed extract, Nag-Chaudhuri *et al.* (1999) proposed that bradykinin, histamine, prostaglandin E1, and serotonin mediate carrageenan-induced rat paw oedema. It has been demonstrated that indomethacin inhibits cyclooxygenase, which in turn inhibits prostaglandin synthesis, which is how it exerts its anti-inflammatory effects (Rang *et al*. 2011). Additionally, it has been demonstrated that nonsteroidal anti-inflammatory medications may oppose mediators such capsaicin, bradykinin, and serotonin—some of which have been linked to paw oedema caused by carrageenan (Collier *et al* 1968). It is not unexpected that indomethacin reduced the rat right hind paw oedema caused by carrageenan in this investigation. Additionally, *S. trifasciata* reduced the oedema in the rat right hind paw caused by carrageenan, which may indicate that the plant species is likely influencing a variety of mediators to create its anti-inflammatory action. According to Gu *et. al* (2020) and Bruneton (1999), saponins have anti-inflammatory and analgesic effects. Thus, it's probable that saponins are also involved in *S. trifasciata's* antinociceptive and antiinflammatory properties in this investigation. The findings of this investigation are consistent with those of studies conducted by Muthusamy *et al.* (2010) and Nivedhitha *et al*. (2010), which discovered that an ethanolic extract of *D. fastuosa* roots exhibited anti-inflammatory activity when used as a standard medication to treat paw edema in rats caused by carrageenan.

CONCLUSION

Results generated in this study indicated that, the two plant species assessed have the potential to alleviate or control discomforting ailments like headache, earache, toothache, and inflammation. However, in order to better understand the anti-inflammatory mechanism of action of *S. trifasciata* and *S. liberica,* additional research is necessary.

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