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ANALGESIC AND ANTI-INFLAMMATORY ACTIVITIES OF THE AQUEOUS LEAF EXTRACT OF *Solanum nigrum* LINN (SOLANACEAE) IN RATS

***N. N. Wannang[1], J. A. Anuka[3], H.O. Kwanashie[3] and A. Auta[2]**

1 Department of Pharmacology,
2 Department of Clinical Pharmacy
University of Jos, Nigeria
3 Department of Pharmacology
Ahmadu Bello .University, Zaria Nigeria.

Abstract
The analgesic and anti-inflammatory activities of aqueous leaf extract of *S. nigrum* was investigated in rats. Thermally-induced pain and pressure-induced pain were used to assess the analgesic activity of the extract while egg albumin-induced oedema was used for anti-inflammatory activity. The aqueous leaf extract of *S. nigrum* at doses of 30 mg/kg and 60 mg/kg, ip exhibited a significant (P<0.05) dose- dependent analgesic activity on thermally-induced pain in rats. In the pressure-induced pain model, the extract increased pain threshold at dose levels of 40 mg/kg (P<0.05) and 60 mg/kg (P<0.01). The extract at 60 mg/kg produced analgesic activity similar to aspirin 10 mg/kg; however, the analgesic effect of the extract was not as prolonged as that obtained by the standard. The aqueous extract of *S. nigrum* at doses of 40 mg/kg and 60 mg/kg showed 23.5% (P<0.05) and 32.1% (P<0.01) inhibition of paw oedema respectively at the end of two hours. The present study indicates that the aqueous leaf extract of *S. nigrum* has anti-inflammatory and analgesic activities that could be mediated via modulators of pain and inflammation or through central activity.
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Keywords: *S. nigrum; analgesic; anti-inflammatory activity; rats*

INTRODUCTION

Pain is an unpleasant and unique physical and psychological experience. Chemicals released locally as a results of cell injury either produces pain by direct stimulation or by stimulation of nerve endings responsible for the mediation of pain (Clarke, 2001). Inflammation is a pathophysiological response of living tissue to injuries that leads to the local accumulation of plasmatic fluid and blood cells. Although it is a defense mechanism, the complex events and mediators involved in inflammatory reactions can be induced, maintained or aggravated by many diseases (Malaya *et al.*, 2003).

Solanum nigrum L. is a widely distributed tropical plant and is cultivated in some parts of the world as a food crop, both for its fruit and its leaves (Duke and Ayensu, 1985; Wannang and Bichi 2005). *S. nigrum* L. has been used in traditional medicine as an antipyretic and anticancer agent (Hoe *et al*., 2004; Sei-jung and Kye-Taek, 2006). Extracts of the plants have been used for their analgesic, anti-inflammatory and vasodilating properties (Duke and Ayensu, 1985). The plant has been used in the manufacture of local analgesic ointment and the juice of the fruit has been used as an analgesic for toothaches (Chiej, 1984). Previous investigations on the plant extract

* Corresponding author. nnwannang1@yahoo.com; Tel:+234-(0)-803-787-7988
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show some neuropharmacological actions (Perez *et al*., 1998; Wannang *et al.*, 2000; 2004). It is also a promising agent for the control of schistosomiasis (Ahmed and Rifaat, 2005).

Toxicity studies on the plant showed that the plant is slightly toxic with an LD_{50} of 763 mg/kg (Wannang and Bichi, 2005).

In this work, we investigated the analgesic and anti-inflammatory effect of the aqueous leaf extract of *S. nigrum* in rats to ascertain its acclaimed use in traditional medicine.

MATERIALS AND METHODS

Plant materials

S. nigrum plant was collected from the fields in Vel-Pankshin, Plateau State, Nigeria in June and was identified by Husseine, Professor of Taxonomy (University of Jos) and authenticated by M. Musa (Herbarium Department) of the Ahmadu Bello University Zaria, where it was deposited as voucher specimen.

Preparation of extract

100 g of the leaves were crushed and macerated in 500 mls of distilled water and exhaustively soxhlet extracted for 72 hours at a controlled temperature. The extract was evaporated in a rotary evaporator to dryness to obtain a concentration of 36% w/v. The extract was stored at 4°C in the refrigerator until use.

Animals

Adult albino rats of either sex (weighing 200-250 g) were obtained from National Veterinary Research Institute Vom, Nigeria. The animals were housed under standard environmental conditions and feed (24% protein, Pfizer products Lagos, Nigeria) and water provided *ad libitum.*

Thermally-Induced Pain

The animals were divided into 5 groups, of 5 animals each. Each rat was held in a suitable whole tail extending out. An area of the tail, 2-2cm was marked and immersed in a water bath thermostatically maintained at 51°C±0.5°C. Withdrawal time of the tail from hot water was noted as the reaction time or tail flick latency. Control group received normal saline; the second group of rats received dipyrone 10 mg/kg i.p and the remaining three groups received *S. nigrum* extract (20 mg/kg, 30 mg/kg and 60 mg/kg i.p). Pretreatment time of the extract and drug were 10, 20, 30, 60 and 120 mins. Cut-off reaction time of 20 sec was used to avoid any tissue injury during the process.

The readings were recorded at each point for each animal, the time taken and the mean increase in latency after drug administration was calculated.

Pressure-Induced Pain

80 adult rats of both sexes were used for this work. The rats were taken separately and the tip of the tail placed between the dipping point of the analgesiometer, connected to the electric source. The tendency of the rat to escape from the instrument as a result of pain sensation, induced by the pressure from it was an index of pain threshold. The animals were treated as follows

Group 1: normal saline
Group 2: aspirin 10 mg/kg dissolved in 5% ethanol
Group 3: 20 mg/kg extract
Group 4: 40 mg/kg extract
Group 5: 60 mg/kg extract

The animals were treated with the analgesiometer 10, 20, 30 and 60 mins. After treatment.

Egg Albumin-Induced Oedema

0.1 ml of egg albumin was injected in the right hind paw of each rat under the subplantar region to induce inflammation. Animals were injected with the extract (20, 40 and 60 mg/kg i.p) and indomethacine (1 mg/kg i.p) 1 hour before inducing inflammation while

control group was pretreated with normal saline. The paw volume was measured (2 hours after injection of egg albumin) using phlethysmometer and was used to estimate the degree of inflammation and percentage inhibition of oedema.

Statistical Analysis

Values (mean ±S.E.M) were analyzed for statistical significance using one-way ANOVA and all the statistical comparison were by student *t*-test. A *P* value of < 0.05 was considered significant.

RESULTS

The extract produced a dose-dependent analgesic effect on thermally-induced analgesia (Table 1). There was a statistical significance ($P<0.05$) for all the doses of the extract tested (table 1 and 2). The analgesic effect produced by the extract at 30 minutes pretreatment time when 30 and 60 mg/kg of the extract were administered decreases with time as compared with the standard, dipyrone 10 mg/kg whose activity increases within the time brackets.

Table 1: The effect of the aquoues leaf extract of *S. nigrum* on tail flick induced analgesia in rats

Treatment	Dose (mg/kg)	Time (mins.)				
		10	20	30	60	120
Control	-	0.42±0.02	0.47±0.01	0.47±0.10	0.44±0.02	0.40±0.01
Dipyrone	10	0.75±0.1	0.86±0.2	**2.01±0.12	**2.30±0.4	**3.16±0.3
Extract	20	0.65±0.1	0.73±0.01	0.80±0.04	0.75±0.02	0.40±0.40
Extract	30	0.60±0.12	0.65±0.02	*1.08±0.02	*0.86±0.01	0.38±2.1
Extract	60	0.69±0.04	0.88±0.02	*1.30±0.04	*1.10±0.04	*1.10±0.4

*$P<0.05$, **$P<0.02$ as compared with control.

Table 2: The effect of the aquoues leaf extract of *S. nigrum* on percentage tail flick latency

Treatment	Dose (mg/kg)	% latency/Time (mins.)			
		20	30	60	120
Control	-	0	0	0	0
Dipyrone	10	17	**64	** 72	**100
Extract	20	16	25	24	13
Extract	30	15	*34	*27	12
Extract	60	17	*41	*35	*39

*$P<0.05$, **$P<0.02$ as compared with control.

Administration of *S. nigrum* extract produced a dose-dependent analgesic effect on pressure induced pain in rats (Table 3). 40 mg/kg of the extract produced a significant ($P<0.05$) analgesic activity at 60 mins compared to control. Similarly, 60 mg/kg of the extract at 30 mins and 60 mins produced a significant ($P<0.01$) analgesic activity in rats. Low dose (20 mg/kg) of the extract did not produce a significant analgesic effect. The extract at 60 mg/kg produced analgesic activity similar to aspirin 10 mg/kg .

Table 3: The effect of aqueous leaf extract of *S. nigrum* on pressure induced pain in rats

Treatment	Dose (mg/kg)	Analgesiometer (mean latency/mins.)			
		10	20	30	60
Control	-	5.2±0.4	5.2±0.2	5.7±0.3	5.5±0.3
Aspirin	10	5.4±0.5	5.4±0.1	*15.6±1.5	** 26.3±2.1
Extract	20	5.0±0.5	5.2±0.4	5.7±0.3	6.0±0.8
Extract	40	5.7±0.1	6.2±1.0	8.2±1.0	*12.0±0.8
Extract	60	5.3±0.3	5.6±0.1	**20.5±1.2	**18.0±1.1

*P<0.05, **P<0.01 as compared with control

The experiments revealed significant difference between rat groups treated with the extract and that of the control (Table 4). The extract at 40 mg/kg and 60 mg/kg produced an inhibition of 23.5% and 32.1% respectively while the standard drug, indomethacine 1 mg/kg produced 42.2% inhibition of inflammation in rats. This signifies good anti-inflammatory properties of the extract as compared to standard.

Table 4: The effect of aqueous leaf extract of *S. nigrum* on egg albumin-induced inflammation in rats

Treatment	Dose (mg/kg)	Paw volume at 2hr	% increase in paw volume	% inhibition
Control	-	0.81±0.2	100	0
Indomethacine	1	**0.47±0.3	**56	42.2
Extract	20	0.80±0.32	98.7	1.3
Extract	40	*0.62±0.4	*76.5	23.5
Extract	60	**0.55±0.5	**67.9	32.1

*P<0.05, **P<0.01 as compared with control.

DISCUSSION

The aqueous extract of *S. nigrum* produced a significant dose dependent analgesic and anti-inflammatory effect as compared to control. The significant analgesic effect is indicated by the increase in the time taken for pain perception, while the anti-inflammatory effect is indicated by the decrease in paw oedema.

Aqueous leaf extract of *S. nigrum* at low doses tend to increase pain threshold both in the tail flick model and in the paw pressure induced pain model. The extract at 60 mg/kg produced a significant antinociceptive effect that persisted over 1 hour. Since previous investigations on the plant extract showed some neuropharmacological actions (Perez *et al*., 1998; Wannang *et al*., 2000; 2004); drugs that increase GABA levels induce antinociception in laboratory animals and there is possible involvement of higher centres in the action of agents that increase stress tolerance capacity in the tail-flick model (Chakraborty *et al*., 2004; Vogel and Vogel, 1997). It is possible that the analgesic effect of the extract could be as a result of its central activity.

Since most anti-inflammatory agents inhibit cyclooxygenase enzyme involved in prostaglandin synthesis at the site of inflammation, the anti-inflammatory effect of *S. nigrum* may involve prostaglandin synthesis inhibition.

The above results therefore show that the traditional use of *S. nigrum* in the treatment of various types of pain and inflammatory conditions has got a definitive basis.

References

Achinto S, Muhammad A.M, Alimuzzamani M, Sitesh C.B, Joydeb K.K and Bidyut K.D (2005): Analgesic and Anti-inflammatory Activities of *Imperita cylindrical*. Dhaka University *J. Pharm. Sc.*, 4(1)

Ahmad A.H and Rifaat M.M (2005): Effects of *Solanum nigrum* leaves water extract on the penetration and infectivity of *Schistosoma mansoni* cercariae. *J. Egypt Soc Parasitol*; 35(1): 33-40

Alimuzzaman M. and Muniruddin A (2005): Analgesic Activity of *Tragia involucrate*. Dhaka University *J. Pharm. Sc.,* 4(1).

Chakraborty A, Devi R.K, Rita S, Sharatchandra K and Singh T.I (2005): Preliminary studies on anti-inflammatory and analgesic activities of *Spilanthes acmella* in experimental animal models. Indian *J. Pharmacol,* 36: 148-150.

Chiej R (1984): Encyclopaedia of Medicinal Plants. MacDonald, ISBN 0-356-10541-5

Clarke C.R.A (2001): Neurological Diseases. In: Parveen K and Michael C (eds) Clinical Medicine. W.B Saunders. 1035-1036

Duke J.A and Ayensu. E S (1985): Medicinal Plants of China. Reference Publications, Inc., ISBN 0-917256-20-4.

Heo K.S, Lee S. J, Ko J.H, Lim K. and Lim K.T (2004):. Glycoprotein isolated from *Solanum nigrum* L. inhibits the DNA-binding activities of NF-êB and AP-1, and increases the production of nitric oxide in TPA-stimulated MCF-7 cells. *J. Toxicol. in vitro,* 18(6): 755-763.

Malaya G, Upal K.M, Ramanathan S.K and Thangavel S.K (2003): Studies on Anti-inflammatory, Analgesic and Antipyretic properties of methanolic extract of *Caesalpinia bonducella* leaves in experimental animal models. Iranian *J. Pharmacol. and Therapeutics.* 2:30-34.

Perez R.M, Perez J.A, Garcia L.M and Sossa H (1998): Neuropharmacological activity of *Solanum nigrum* fruit. *J. Ethnopharmacol.;* 62(1):43-48

Sei-Jung L and Kye-Taek L (2006): Apoptosis induced by glycoprotein (150-kDa) isolated from *Solanum nigrum* L. is not related to intracellular reactive oxygen species (ROS) in HCT-116 cells. *J. Cancer Chemothe. and Pharmacol.,* 57(4): 507-516.

Vogel, H.G. and Vogel, W.H. (1997): Drug Discovery and Evaluation: Pharmacological Assays. Springer Verlag, Germany, Chapter H, 368-370.

Wannang N.N., Anuka J.A., Kwanashie H.O. and Bichi L.A. (2004): Effects of *Solanum nigrum* Linn aqueous extracts on the behavioural activities in chicks. *Bio. Env. Sc. J. for the tropics.* 1(1):139-142.

Wannang N.N. and Bichi L.A. (2005): Determination of LD50 of the aqueous extract of *Solanum nigrum* Linn in rats. *Bio. Env. Sc. J. for the tropics.* 2(1):117-119.

Wannang N.N. and Bichi L.A., Odutola A.A. and Anuka J.A. (2000): Effects of the aqueous extract of *S. nigrum* on electrically-induced seizures. 28th Ann. Reg. Conf. (West African Society for Pharmacology) Port Harcourt. October, 15-20 Supplementary (1):16.