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Original Article

Analgesic and Anti-inflammatory Activity of *Physalis angulata* Linn. (Solanaceae) Leaf Methanolic Extract in Swiss Albino Mice

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Physalis angulata is a medicinal plant used for the treatment of malaria, ulcer, pains and other diverse ailments. The present study evaluated the analgesic and anti-inflammatory activity of methanolic leaf extract of the plant. Acetic acid-induced abdominal contraction or writhing analgesic models in Swiss albino mice (13-23g) were used for studying analgesic activity of the leaf extract. 200, 300 and 400 mg/kg body weight of the extract were administered intraperitoneally. Analgesic activities of the extract were compared with standard reference drug ibuprofen (100 mg/kg) and negative control. The plant extract showed a significant dose dependent analgesic effect, with 72.7% inhibition at 400 mg/kg compared to that of the 100 mg/kg standard drug ibuprofen which showed 21.2% inhibition ($P< 0.05$). The anti-inflammatory activity of the extract against carrageenan-induced paw edema was also dose-dependent with 62.71% inhibition at 400 mg/kg when compared to that of the standard drug with 34.31% inhibition. The study showed that *P. angulata* was effective in pain reduction (analgesia) and acted as a good anti-inflammatory agent, which supports the claim in traditional medicine.

Keywords: *Physalis angulata*, analgesic, anti-inflammatory, Carrageenan

From the ancient time plants have been used in medicinal preparations for treatment of various human and animals diseases. Reduced efficacy of synthetic preparations due to various reasons leads the global interest in the preparation of therapeutic medicine from plants (1). According to the world health organization (WHO), 70-80% of world population uses the plant derived drugs for treatment of various health problems (2).

Physalis is an important genus of the Solanaceae family. In Hausa language (Nigeria) the plant is called "Saadi Birii' and cut-leaf ground cherry in English. Most of species are herbaceous annual or perennial, native of tropical North and South America. Some species have edible fruits and are considered within popular medicine. Many of the species are used for treating asthma, urinary problems, rheumatism and tumor (3). It is a medically important plant used in traditional medicine as anti-rheumatic agent, and also for sore throat and abdominal pain treatment. It is considered as antipyretic, anti-diuretic, and also efficient for hepa-

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Figure 1. *Physalis angulata* plant found in Donga Taraba State, Nigeria.

titis and cervicitis treatment (4). Each fruit is like a yellow pearl a small lantern-shaped pod (Figure 1) and very delicious to eat (5).

Different phytosterols, carbohydrates, vitamins, minerals and lipids are contained by the genus *Physalis* and lead to the formation of the withanolides type structure (6), which had demonstrated *in vitro* genotoxic effect of aqueous extract on human lymphocytes using the comet and micronucleus assays (7).

This present study aimed at evaluating the analgesic and anti-inflammatory properties of *Physalis angulata* leaf methanolic extract in Swiss albino mice to ascertain its acclaimed use in traditional medicine.

Materials and methods

Collection and identification of plant

The leaves of *Physalis angulata* were collected from Akate, Donga, Taraba state, Nigeria. The authenticity of the plant was made by Cletus A.U a taxonomist in the Department of Science Laboratory Technology, Federal Polytechnic Bali where a voucher number SOL001 was deposited for the plant. The leaves were air-dried and grounded to powdered form, which was then kept in air-tight brown bottle until use.

Extraction and preparation of plant material

Dried leaf powdered of *Physalis angulata* was extracted with methanol. The extract of *Physalis angulata* were obtained by taking 300 g of powdered leaf in a separating funnel. 900 mL of methanol was added for 24 h by cold maceration. The cap was screwed and shaken vigorously to dissolve or disperse the materials in the solvent. The extract was filtered through whatman filter paper, while the residue was further extracted under the same condition. The extract was evaporated under reducing pressure using water bath, concentrated, weighed and stored in desiccators prior to use. The percentage yield of 10.43 % (w/w) was obtained and prepared into solution for administering to the mice via intra peritoneal route (i.p) (8).

Acetic acid induced writhing in mice and animals grouping

Twenty-five Swiss albino mice were each weighed and divided into five groups of five mice each. Animals from group 1 (negative control) were administered intraperitoneally (i.p) with normal saline, group 2 (positive control) were administered with 100 mg/kg Ibuprofen, while groups 3, 4 and 5 were given 200, 300, and 400 mg/kg of the methanolic extract, respectively. After 30 min, the animals were given 0.2 mL acetic acid (i.p), 0.6% (v/v), and observed for abdominal contractions by viewing the mice on the abdomen for contraction of abdominal muscles using hand lens for 10 min after simulation period of about 5 min. Percentage (%) inhibition of writhing was calculated using the formula below:

$$(MnWc - MnWt / MnWc) \times 100$$

Where;

Mn Wc = mean number of writhing in negative control.

MnWt = mean number of writhing in treated group.

Carrageenan-induced paw edema in mice

Carrageenan was administered to the paw of the animals to manifest edema, followed by test drug administration in the presence of the positive control (Ibuprofen). The mice were also divided into five groups of 5 mice each. Group 1 was the negative control (10 mL normal saline) and group 2 was the positive control (100 mg/kg Ibuprofen) given i.p. Groups 3, 4 and 5 received each 200, 300, and 400

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mg/kg of the crude extract, respectively. Acute inflammation was produced by sub-planar administration of 0.1 mL 1 % carrageenan in right hind paw of the animals in all the groups. Paw volume were then measured at 0, 1, 2, 3 and 4 h after carrageenan injection using vernier calipers (8). Percentage (%) inhibition of paw was calculated using the formula below:

$$(Do - Di/Do) \times 100$$

Where;

Do = mean number of paw diameter in negative control group.

Di = mean number of paw diameter in treated group.

Statistical analysis

Raw data obtained were analyzed by one-way analysis of variance (ANOVA) using SPSS software version 22. $P < 0.05$ was considered as statistically significant.

Results

Analgesic effect of *P. angulata* extract

The methanolic extract of *P. angulata* showed decreased production of irritant and blockage of the pain sensitizing mechanism against writhing caused by acetic acid (Table 1). The inhibition was obtained with 400 mg/kg of the extract (group 5). A dose dependent anti-nociceptive activity (analgesic) of *P angulata* was observed.

Anti-inflammatory effect of *P. angulata* extract

Anti-inflammatory activities were dose dependent with the highest effect at 400 mg/kg of extract (Table 2).

Table 1. Effect of Physalis angulate methanolic extract on acetic acid-induced writhing in mice

nimal groups	Abdominal contractions	Percentage inhibition (%)
Group 1	33±0.06	-
Group 2	26±0.09	**21.2**
Group 3	16±0.04	**51.5**
Group 4	14±0.07	**57.6**
Group 5	9±0.06	**72.7**

Group 1: negative control; group 2: positive control; groups 3, 4 and 5 were given 200, 300, and 400 mg/kg of the methanolic extract, respectively. Number of abdominal contractions after 10 min are presented as mean ± SEM.

Table 2. Effect of *P. angulata* methanolic extract on carrageenan-induced paw edema in mice

Animal groups	Paw diameter (mm)				Mean % inhibition
	1h	2h	3h	4h	
Group 1	0.96±0.006[a]	0.98±0.006[a]	1.10±0.058[e]	2.12±0.006[a]	-
	-	-	-	-	
Group 2	0.89±0.006[a]	0.74±0.006[a]	0.68±0.0115[d]	0.52±0.004[b]	34.31
	(7.29%)	**(24.48%)**	**(30.00%)**	**(75.47%)**	
Group 3	0.81±0.006[a]	0.72±0.006[a]	0.62±0.006[a]	0.46±0.009[c]	41.03
	(15.63%)	**(26.53%)**	**(43.64%)**	**(78.30%)**	
Group 4	0.73±0.006[a]	0.68±0.009[c]	0.54±0.004[b]	0.34±0.009[c]	47.36
	(23.96%)	**(30.61%)**	**(50.91%)**	**(83.96%)**	
Group 5	0.56±0.004[b]	0.44±0.009[c]	0.36±0.004[b]	0.28±0.0006[a]	62.71
	(41.67%)	**(55.10%)**	**(67.27%)**	**(86.79%)**	

Group 1: negative control; group 2: positive control; groups 3, 4 and 5 were given 200, 300, and 400 mg/kg of the methanolic extract, respectively. Paw diameters are presented as mean ± SEM. Numbers that are followed by the same alphabets are statistically significant at $P<0.05$ (one-way ANOVA). Numbers in bracket bold are the percentage of paw diameter for each hour.

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Discussion

Acetic acid-induced writhing test is commonly used as an experimental animal model for analgesic test. This method is very sensitive, and able to detect an analgesic at doses that may appear to be inactive in other analgesic screening procedures (9). Carrageenan induced edema is an experimental model for acute in-inflammation which is biphasic; the first phase is mediated by the release of histamine and serotonin in the early stage followed by kinine, and then prostaglandins release (10). Clinical symptoms of inflammation have been recognized as swellings, redness, pains, as indicated by edema (swelling) caused by Carrageenan injection. Anti-inflammatory agents must be able to reduce these pains to make them potent drug. The present study showed that methanolic leaf extract of *P. angulata* had analgesic and anti-inflammatory properties which were dose-dependent; that is, it can be used to reduce pains, swellings, redness etc…, and therefore provide a good source for new drug development.

The observed data also justify the use of *P. angulate* in folk medicine.

In this study, the following recommendations were put forward; more analgesic and inflammatory investigation should be carried out on other parts of the plant including seeds, flowers, roots and fruits for a conclusive study; other solvents should also be used such as less polar ones or a combination of lower and higher polar solvent in order to know which one has more effect in reducing pains and swelling, and there is the need to determine the component that showed these observed properties using column chromatography techniques or other advanced methods.

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Conflict of interest

The authors declared no conflict of interest.

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