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Original Article

ANTI-INFLAMMATORY AND ANALGESIC PROPERTIES OF THE RHIZOME EXTRACT OF *ZINGIBER OFFICINALE*

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The rhizome extract of Zingiber officinale was investigated for anti inflammatory and analgesic properties in albino rats and Swiss mice respectively. The extract (50 and 100 mg/kg b.w) produced significantly (P<0.05) inhibition of the carrageenan – induced rat paw oedema and a reduction in the number of writhing induced by acetic acid in mice. The results show that rhizome extract of Z. officinale possesses anti inflammatory and analgesic agent(s).
Key Words: Z. officinale, anti-inflammation, analgesic

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INTRODUCTION

Ginger, the rhizome of *Zingiber officinale* (Zingiberaceae) is a perennial herb with an aromatic pungent taste. The exact country of origin is uncertain, but was thought to be originally native of tropical south East Asia before it spread to Africa. It is now grown abundantly in Northern Nigeria.

The rhizomes of ginger are used as spice in food and beverages and in traditional medicine as carminative, antipyrexia and treatment of waist pain rheumatism and bronchitis. It is used for the treatment of gastrointestinal disorders and piles (Iwu, 1993). However it has no effect on gastric emptying rate (Phillips *et al*.1993), but has protective activity on gastric ulcerogenesis (Serthe *et al*. 1991). Organic solvent extract of ginger rhizomes has also been shown to cause significant inhibition of skin tumour (Katiyar *et al*, 1996).

On the basis of these common uses of this plant in traditional folk medicine and its above reported activities in the literature, we have evaluated the anti-inflammatory and analgesic properties of the rhizome extract of *Z. officinale* in rats and mice respectively.

MATERIAL AND METHODS

Animals: Adults male Wistar strain albino rats (180 – 190g) and Swiss albino mice (20-25g) were used for this study. The animals were bred and housed in the pre-clinical animal house, College of Medicine, University of Ibadan. The animals had free access to food (Ladokun Feeds, Ibadan) and water *ad libitum*.

Plant Material: The rhizomes of *Zingiber officinale* were purchased from Bodija market, Ibadan Nigeria. The plant material was authenticated in the Department of Pharmacognosy, University of Ibadan.

The rhizome were dried under shelter, finely cut, and then ground into powder. Cold extraction of this powder (50g) in a Soxhlet apparatus using absolute ethanol (200ml) was carried out. The collected extracts were concentrated and dried *in vacuo*. The pharmacological tests were carried out with the dry extract dissolved in 0.9% physiological saline solution.

LD_{50} Determination: LD_{50} determination was carried out according to the method of Meyer *et al, (*1982) using brine shrimp *(Artemia Salina Leach).* This method determines LD_{50} µg/ml values of *Z. officinale* ethanol extract, in the brine medium. Activities of a broad range of *Z. officinale* extract were manifested as

toxicity to the shrimp. Appropriate amounts of ethanol extract (100, 1000, 2000, 3000, 4000, 5000 µg/ml) were assayed (LD_{50} values were determined from 24 h counts using probit analysis.

Carrageenan–induced paw oedema in rats: Pedal inflammation in rats was induced essentially as described by Winter *et al* (1962). An injection was made of 0.1ml of 1% carrageenan suspension into the right hind foot of each rat under the subplantar aponeurosis. The test groups of rats were treated intraperitoneally with 50 and 100 mg/kg of ginger extract 1h before carrageenan injection.

The control group received only the vehicle (0.2ml normal saline) and the reference group received 150 mg/kg Aspirin (i.p). Paw volume measurement was done by wrapping a piece of cotton thread round the paw of each rat and measuring the circumference with a meter rule (Hess and Milonig, 1972; Bamgbose and Noamesi, 1981). This procedure was done prior to irritant injection, and 1,2 and 3h later. The percentage of oedema inhibition in drug treated rats versus control was calculated using the following formula:

% Inhibition =

$$\frac{100 \times (C_t - C_0)\ Control \;-\; (C_t - C_0)\ Treated}{(C_t - C_0)\ Control}$$

Where C_t is paw size 1h, 2 h or 2 h after carrageenan injection and C_0 is paw size before carrageenan injection.

Acetic acid – induced writhing in mice: Swiss mice were divided into various treatment and control groups of five mice per group. Writhings were induced by the method of Koster *et al* (1959). The test groups were administered 50 and 100 mg/kg of ginger extract i.p, while the control group received 0.2ml normal saline. The reference group received 150 mg/kg aspirin, i.p. The animals were fasted for 16 h prior to the treatments. One hour after treatment, the mice were injected i.p with 0.2ml of 3% acetic acid solution to induce the writhing. The number of abdominal constrictions (writhing) and stretching with a jerk of the hind limb was counted between 5 and 15 minutes after acetic acid injection. The response of the extract and aspirin treated groups were compared with those of the animals in the control group (0.2ml saline).

Percentage protection against writhing movement (% inhibition of writhing) was taken as an index of analgesia and it was calculated as follows:

% Inhibition=

Wr(Control) – Wr (test group) / Wr (Control)

Where Wr = Mean number of writhing

Statistical Analysis: Data were expressed as mean ± S.E. The results were statistically analysed by the students *t* – test; $P<0.05$ versus respective control was taken as significant.

RESULTS

LD_{50} determination value for the ethanol extract of *Z. officinale* rhizome extract is 458 µg/ml.

Carrageenan-induced paw edema in rats: In the experimental conditions used in this study, the ethanol extract of *Z. officinale* shows a significant inhibition of carrageenan paw edema in rats ($P<0.05$). This inhibition appears to be dose- dependent and decreases at the third hour (Table 1).

The reference drug (150 mg/kg, aspirin) shows an analogous trend with comparable values at 100 mg/kg zingiber extract.

Table 1: Effect of *Z. officinale* extract on Carrageenan induced rat paw edema.

Treatment groups (i.p)	% Inhibition of edema (mean ± S.E)		
	1hr	2hr	3hr
Z . officinale (50 mg/kg b.w, i.p)	43.0 ± 0.06	27.0 ±0.04	19.0 ±0.03
Z . officinale (100 mg/kg b.w, i.p)	58.0 ±0.08	31.0 ±0.04	21.0 ±0.04
Z. officinale (150 mg/kg b.w, i.p)	62.0 ±0.07	39 ±0.06	23.0 ±0.03

Acetic acid –induced writhings in mice: The results summarized in Table 2 demonstrate that *Z. officinale* extract administered i.p significantly (P<.0.05) protected mice against acetic acid-induced writhings.

DISCUSSION

This study showed that ethanol extract of *Zingiber officinale* rhizome inhibited carrageenan – induced suplantar edema in rats. Carrageenan – induced rat paw edema is a valuable test used in predicting the value of anti-inflammatory agents acting by inhibiting the mediators of acute inflammation (Mossa *et al* 1995). Many substances have been proposed as inflammatory mediators, released locally at the site of inflammation and having biological properties that cause or enhance the signs and symptoms of inflammation (Galti *et al*, 2001).

Table 2: Effect of *Z. officinale extract* on Acetic acid – induced writhings in mice

Treatment group (i.p)	Number of writhings Mean± S.E.	% Inhibition
Control (0.2ml normal saline)	36.2±0.98	-
Z . officinale (50 mg/kg b.w)	19.0±1.41*	47.51
Z. officinale (100 mg/kg b.w)	10.2±1.49*	71.82
Aspirin (150 mg/kg b.w)	10.0± 1.70*	72.38

** P<0.05*

Perturbation of the neutrophil membrane is an important even elicited by an inflammatory stimulus. This usually produced highly reactive oxygen species such as superoxide. The effect of Zinbiger extract becomes enhanced within 2 hours. This period is known to coincide with the nonphagocytic phase of carragenan-induced inflammation, when the mast cells release cytoplasmic enzymes and serotonin (Vinegar *et al*, 1987). Katiyar *et al* (1996) showed that water or organic solvent extract of ginger possesses antioxidatvie property, which inhibits tumour promotion in mouse skin. Thus zingiber extract is postulated to probably contain anti-inflammatory agents with antioxidant activity.

The chief constituents of zinger include sequiterpene, gingerol, Cult 1403 and inoleoresin (Tanabe *et al,* 1993).

The extract of *Z. officinale* rhizome exhibited analgesic activity in mice, by inhibiting the acetic acid – induced writhing. This is a model of visceral pain (Vyklicky, 1979), which is a very sensitive test for analgesic drug development, but not a selective pain test.

The above findings corroborate the various use of *Zingiber officinale* rhizome in various ailments. Further studies in progress in our laboratory are expected to identify the bioactive component(s) responsible for the anti- inflammatory and analgesic activities of *Zingiber* rhizome.

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