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Evaluation of the anti-inflammatory activity of aqueous extracts from *Corchorus olitorius* (Malvaceae)

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Abstract
The decoction of *Corchorus olitorius* leaves is used by ivorian traditional healers for the treatment of inflammation. Regarding the decoction used, this study was carried out to evaluate the anti-inflammatory activity of the acqueous extracts from *C. olitorius* leaves. These extracts were tested according to the model of acute edema of rat paw induced by carrageenan 1%. The doses of drug orally administered to the animals were as follow: 1470, 2450, 7350 mg / kg. The results obtained with the aqueous extracts of *C. olitorius* leaves were firstly compared with those of physiological control (NaCl 0.9%) and secondly with those of the reference anti-inflammatory (diclofenac sodium 25 mg / kg). The different comparisons were set up at 1 h, 2 h, 3 h, 4 h, 5 h, 6 h, 12 h and 24 h after the injection of carrageenan to the rats. The parameter considered to appreciate the activity of each treatment was the percentage of increase in leg circumference (% AUG). The results exhibited significant difference (p<0.001) between the % AUG of treatments from extracts of *C. olitorius* for different doses and those of NaCl. For a dose of 7350 mg / kg administered orally, AUG percentages of plant treatment are statically the same with those of diclofenac 25 mg / kg. This study revealed that the aqueous extracts from *C. olitorius* leaves have anti-inflammatory properties. It could be considered as a scientific basis for the empirical use of *C. olitorius* leaves in the treatment of inflammation.

Keywords: Côte d'Ivoire, *Corchorus olitorius*, Anti-inflammatory

1. Introduction
Inflammation is a defensive reaction of the body to various attacks that may be physical, chemical, biological or infectious [1]. In modern medicine, this disease is treated with steroidal and non-steroidal anti-inflammatory drugs. Unfortunately, these chemical products cause many problems including cardiovascular diseases [2]. The use of plant drug is more and more encouraged.
In Côte d'Ivoire, ethnomedicinal investigations were conducted on *Corchorus* genus. This survey showed that the decoction of *Corchorus olitorius* leaves is used to resolve anti-inflammatory problems by traditional medicine [3, 4]. However, in the country, no scientific study has yet evaluated the anti-inflammatory activity of the leaves of *Corchorus olitorius*. This study makes it possible by researching the anti-inflammatory properties of these organs. Thus, this study aims to evaluate anti-inflammatory activity of aqueous extracts of *Corchorus olitorius* leaves at different doses.

Material and Method
Biological materials
The plant material used for this study were the leaves of *Corchorus olitorius.* The plants were harvested in Bingerville (Côte d'Ivoire). Experimentations were performed with adult's rats of Wistar race aged 2 to 3 months, weighing between 180 to 220g. They were feed with crops from the FACI society and had tap water for drink. The animals were kept at pharmacology laboratory of Félix Houphouet Boigny University according to the recommended hygiene conditions.

Technical material and chemical products used
An electronic caliper with a capacity of 0 to 150 mm was used for the measurement of the circumference of animals' paws. The preparation of the extracts required the use of hydrophilic cotton, an electronic balance, a graduated test tube, distilled water, an insulin syringe for the injection of carrageenan solution. This solution was used to cause swollen rat

paw edema. The reference anti-inflammatory was diclofenac sodium 25 mg / kg (Olfen-75 SR). We also needed saline (NaCl) as physiological control during the experimentations.

Preparation of aqueous extracts

In this study, the aqueous extracts were used to comply with traditional practitioners. Three (3) liters of the decoction of *Corchorus olitorius* leaves were first wrung out in a square of clean tissue, successively filtered twice on hydrophilic cotton and on Wattman paper (3 mm). The filtrate (approximately 3 l) was evaporated in a rotavapor and in an oven at 60 ° C. After 2 days, the resulting crystals were powdered with a porcelain mortar and pestle. In laboratory, we obtained the saturation concentration or maximum concentration of the powder at 245 mg / ml. This concentration was diluted successively to 1/3 and 1/5 to give 81.66 and 49 mg / ml. Therefore, the following concentrations were used for the experimentations: 245; 81.66 and 49 mg / ml. The corresponding doses in mg / kg of body weight for these different concentrations were respectively: 7350; 2450; 1470 mg / kg in oral administration. These doses were coded: ECO1, ECO2 and ECO3.

Conditioning, constitution of batches and feeding of rats

The animals were conditioned, fasted for 16 hours before treatment and divided into 5 batches of 6 rats. The batching was made according to the following treatments:

-batch 01: rats treated with Nacl at 10 ml / kg
-batch 02: rats treated with ECO1 at 7350 mg / kg / VO (VO = in oral administration)
-batch 03: rats treated with ECO2 at 2450 mg / kg / VO
-batch 04: rats treated with ECO3 at 1470 mg / kg / VO
-batch 05: rats treated with diclofenac 25 mg / kg

Induction of inflammation

The experiment was carried out on the model of acute edema of the rat paw induced by carrageenan [5]. According to this method, 0.2 ml of carrageenan solution 1% is injected under the sole of the right leg of each rat 1 hour after the administration of the different treatments. The circumference of paw is measured with calipers at 1 h, 2 h, 3 h, 4 h, 5 h, 6 h, 12 h and 24 h after the injection of carrageenan solution.

Parameter evaluated

In this study the parameter evaluated was the percentage of the increase in edema paw circumference (% AUG). This calculation was perfomed according to following formulas already applied in other studies [1, 6].

$$\%\ AUG = \frac{\text{Leg circumference at time t} - \text{Initial leg circumference (Co)}}{\text{Initial leg circumference (Co)}} \times 100$$

Statistical analysis of anti-inflammatory activity data

The averages of increased circumferences of the legs infected with carrageenin inflammation for each hour were calculated using the Graphpad Prism 5.0 software. The percentages increase in leg circumference (% AUG) of aqueous extracts of *Corchorus olitorius* leaves were compared with those of NaCl (physiological control) and those of diclofenac (reference anti-inflammatory) using one-way ANOVA test completed with the test of Turkey for multiples comparisons.

Results

Evolution of the circumference of infected paw

The different measurements of the circumference of the displaced leg led to averages calculated with standard deviation at each hour for all treatments. These averages are shown in figure 1. The figure reveals fives curves corresponding to the treatments: physiological control (Nacl 9%), diclofenac 25mg/kg, aqueous extracts of *Corchorus olitorius* at the following doses: 7350 mg/kg (ECO1), 2450 mg/kg (ECO2) et 1470 mg/kg (ECO3). The fives curves present the same progressions with an optimal threshold at the fourth hour. However, we notice a greater increase in circumference of the infected leg for NaCl treatment followed respectively by ECO3, ECO2, ECO1 and diclofenac (the reference anti-inflammatory).

Percentages increase in circumferences of the infected paw (% AUG)

The AUG percentages, the results of the statistical tests carried out are recorded in Table I. This table shows that there is a significant difference (P<0.001) between the percentages of the increase in leg circumferences (AUG) of the animals treated with NaCl (physiological control) and those animals treated with the plant extracts ECO1, ECO2, ECO3. There is also a significant different (P<0.001) between the percentages of the increase in leg circumferences (AUG) of the animals treated with NaCl and those animals treated with the diclofenac (the reference anti-inflammatory). However, there is no significant difference between the AUG percentages of diclofenac and those of *Corchorus olitorius* leaves extract at the dose of 7350 mg/kg (ECO1) during the experimentation. The AUG percentages of diclofenac and those of ECO1 are low. They range from 1.88 ± 1.36% to 20.07 ± 5.94% for diclofenac and from 1.37 ± 0.80% to 18.19 ± 4.30% for ECO1. There is a significant difference for P<0.001 between the AUG percentages of diclofenac treatment and those of ECO2 treatments (from 24.84 ± 8.23 % to 46.22 ± 0.67 %) and ECO3 (from 37.15 ± 7.75 % to 57.88 ± 20.87 %). The AUG of diclofenac are less important than those of ECO2 and ECO3. Concerning comparisons between different doses of aqueous extracts of *Corchorus olitorius*, there is a significant difference between AUG of ECO1 (P<0.001) and those of ECO2 and ECO3. The AUG of ECO1 are less important than those of ECO2 which are also less important than those of ECO3. These different comparisons of AUG percentages showed that the aqueous extracts of *Corchorus olitorius* have an anti-inflammatory activity. This anti-inflammatory activity is important when the dose of aqueous extract increases

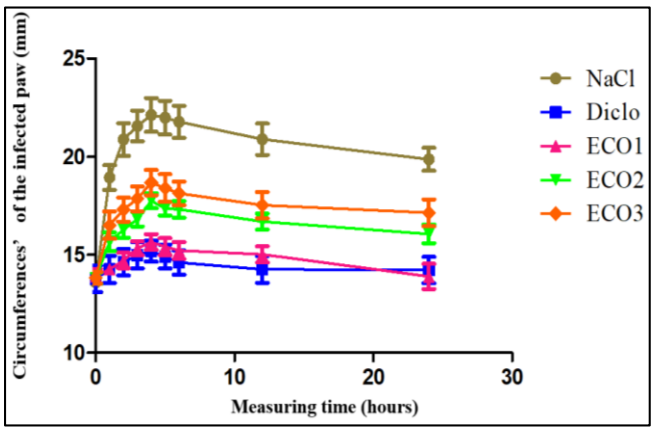

Fig 1: Evolution of the circumferences of the paw infected by carrageenan

Table I: Evolution of percentages increase in circumferences of the infected paw for different treatments

Treatments / Measuring time (Dose/kg)	1h	2h	3h	4h	5h	6h	12h	24h
NaCl 0.9%(10ml)	56.30 ± 6.72^{e}	78.45 ±8.69^{e}	83.71 ±6.18^{e}	88.71 ± 5.91^{e}	87.55 ± 5.95^{e}	85.76 ± 6.02^{e}	82.15 ± 10.67^{e}	78.53 ± 12.72^{e}
Diclofenac(25mg)	1.88 ± 1.36^{a}	8.10 ± 1.93^{a}	12.57± 3.43^{a}	20.07 ± 5.94^{a}	12.17 ± 4.38^{a}	8.86 ± 3.26^{a}	4.92 ± 1.14^{a}	4.92 ± 1.20^{a}
ECO1 (7350mg)	4.89 ± 1.66^{b}	8.81 ± 3.12^{b}	14.47 ± 2.85^{b}	18.19± 4.3^{b}	15.33 ± 3.98^{b}	13.47± 3.26^{b}	11.25 ± 2.22^{b}	1.37± 0.86^{b}
ECO2 (2450mg)	24.84 ± 8.23^{c}	34.05 ± 6.07^{c}	39.54± 2.33^{c}	42.92 ± 2.14^{c}	46.22 ± 0.67^{c}	40.45 ± 0.70^{c}	33.82 ± 0.89^{c}	28.34 ± 1.79^{c}
ECO3 (1470mg)	37.15± 7.75^{d}	47.7 ± 10.71^{d}	56.02± 8.4^{d}	55.92 ± 10.96^{d}	57.88 ± 20.87^{d}	52.31± 11.04^{d}	44.67± 6.23^{d}	41.65 ± 6.91^{d}

Values are means of 6 replicate readings. Means followed by different superscripts in the same column are significantly different (p<0.001).

Discussion

The results show that aqueous extracts of leaves of *Corchorus olitorius* exert anti-inflammatory activity. This activity is similar to that of diclofenac sodium 25mg / kg at 7350 mg / kg. The use of decocted leaves of *Corchorus olitorius* in the treatment of inflammatory diseases could be scientifically justified. This result corroborates that of Handoussa *et al*. [7] who also showed that *Corchorus olitorius* has an anti-inflammatory activity. This plant could be used in the treatment of inflammatory diseases as *Bougainvillea glabra* [8], *Buchholzia coriacea* [9], *Maytenus senegalensis*, *Stereospermum kuntrianum* and *Tricrilia emetica* [10]. The anti-inflammatory properties of *Corchorus olitorius* leaves could be explained by the presence of alkaloids [3, 11]. According to N'Guessan *et al*. [12], this chimical group treats inflammatory pathologies. In view of the cardiovascular problems caused by the anti-inflammatory drugs (anti-inflammatory steroidal and non-steroidal) prescribed by modern medicine [2], the use of this plant would be desirable and encouraged in Côte d'Ivoire. Moreover, the diclofenac, used in this study as a reference anti-inflammatory has health disadvantages. This drug increases the risk of arterial thrombosis for patients who absorb it [13].

Conclusion

The leaves of *Corchorus olitorius* showed efficacy on acute carrageenan induced paw edema, with better activity at 7350 mg / kg by oral administration. These organs therefore have anti-inflammatory properties. These results could justify the empirical use of the plant in the treatment of inflammation in Côte d'Ivoire. This study could be considered as a scientific basis for the research of other solutions to solve inflammatory problems with lower risk.

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