

Pharmacological Effects of the Roots and the Stem Barks Extracts of *Erythrina senegalensis* DC (Fabaceae) in Mammalians

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Available online: 4th October, 2013

ABSTRACT

Erythrina senegalensis (Fabaceae) is a medicinal plant which is used to cure many diseases. The present study aim was to evaluate the effects of this plant on mammalian heart activity and respiratory. The ethanolic extracts of this plant (ES) were administrated intravenously at doses ranging from 5.15×10^{-10} g/kg to 3.15×10^{-3} g/kg b.w. to rabbits that had been anaesthetized before. This extract induced a significant ($p < 0.001$) hypotension in the rabbit at higher doses than 5.72×10^{-5} g/kg b.w. With the same doses, ES causes a significant increase of the amplitude and respiratory rate in the rabbit. ES at the concentration ranging from 10^{-8} to 10^{-4} mg/ml induced a significant ($p < 0.001$) negatives inotropic and chronotropic effects on the isolated heart of rat. In the presence of atropine (10^{-8} mg/ml), this effects of ES was reduced. These results suggest the presence of cholinomimetic substances.

Key Words: *Erythrina senegalensis*, hypotension, cholinomimetic substance, mammalians.

INTRODUCTION

In Africa, the medicinal plants are used to cure many diseases. Most African peoples have strong beliefs in the use and effectiveness of ethnomedicines¹ and in herbal medicines which are important part of the culture². It is used in the treatment of several pathologies. According to Hostettmann and Potterat³, the active compounds from plants represent 25% of prescription drugs. From the perspective of drug development to enhance the traditional Pharmacopoeia, we undertook the pharmacological study of *Erythrina senegalensis* DC (Fabaceae). This plant is a thorny shrub or small tree with bright red flowers found in Sudanese savannah regions⁴. *Erythrina senegalensis* are coral trees which are used widely in the tropics and subtropics as street and parks trees, especially in drier areas^{5, 6, 7}. The fruit pods are thin-walled, strongly curved or coiled, 8 - 15 cm long. The bright red seeds are ovoid⁸.

Traditionally, *Erythrina senegalensis* is used to relieve many diseases such as malaria, gastrointestinal disorders, body pain⁹. This plant is used too against liver disorders¹⁰. *Erythrina senegalensis* is also used as a diuretic and is indicated in the treatment of asthma, generalized oedema and against abortion¹¹. It is also know to cure urinary bilharzias and eye infections¹².

The pharmacological studies of this plant are demonstrated and include antibacterial antifungal and antiplasmodial activities^{13, 14, 15, 16, 17}. The genus *Erythrina* possesses anti-inflammatory activity¹⁸. It is also induce analgesic and antipyretic action¹³.

In view of this, the present study was carried out to evaluate *in vivo* the effects of the ethanolic extract from the roots and the stem bark on the blood pressure in the

rabbit and *in vitro* the effects of the same extract on the isolated heart of rat.

MATERIAL AND METHODS

Plant material: The plant material of the present study, the roots and stem barks of *Erythrina senegalensis* were harvested around the town of Ferkessesougou (Northern Côte d'Ivoire). These plant parts were identified by the Ivorian botanist Henri Téré and were deposited in the herbarium of the Centre Suisse de Recherches Scientifiques (CSRS) in Adiopodoumé (Côte d'Ivoire).

Preparation of the ethanolic extract: The root and the stem barks were dried in an air-conditioned room (18°C) and powdered with a micro-crusher. The powder obtained (25 g) was macerated in a 10-fold excess of 90 % ethanol (250 ml) during 14 hours using magnetic stirrer. The supernatant was filtered with Whatman No 1 filter paper and it was evaporated using rotating evaporator at 40°C. The solvent was completely removed. The extract obtained, was frozen, lyophilised and stored at 4°C. The concentrations to be tested were prepared extemporaneously by dilution in Mac Ewen (ME) physiological solution of the following composition (mM): NaCl 130, KCl 2.5, CaCl₂ 2.42, Na₂HPO₄ 1.18, NaHCO₃ 11.90, MgCl₂ 0.24, glucose 2.2 and pH=7.4.

Animals: Rabbits of *Oryctolagus cuniculus* species and rats of *Rattus norvegicus* species were used in our experiments. They were bred in animal house of UFR Biosciences (Animal Physiology laboratory, University of Cocody-Abidjan) and had access to food and water *ad libitum*. The animals were acclimatized to laboratory condition before start of experiment. All procedures were approved by the ethical committee of Cocody University,

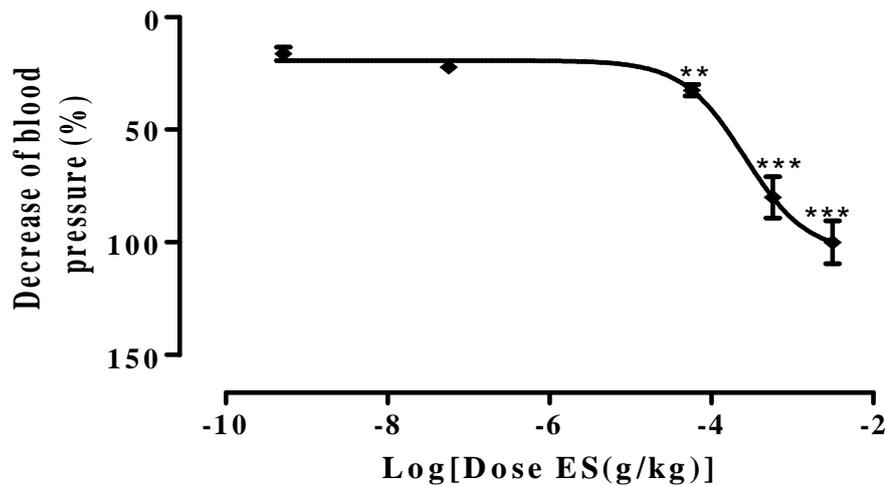


Figure 1: Dose-response effects of the ethanolic extract of *Erythrina senegalensis* on blood pressure in rabbit. ES induced significant hypotension for the doses ranging 5.72×10^{-5} to 3.15×10^{-3} g/kg b.w. (Mean \pm ESM, ** $p < 0.01$; *** $p < 0.001$, $n=4$).

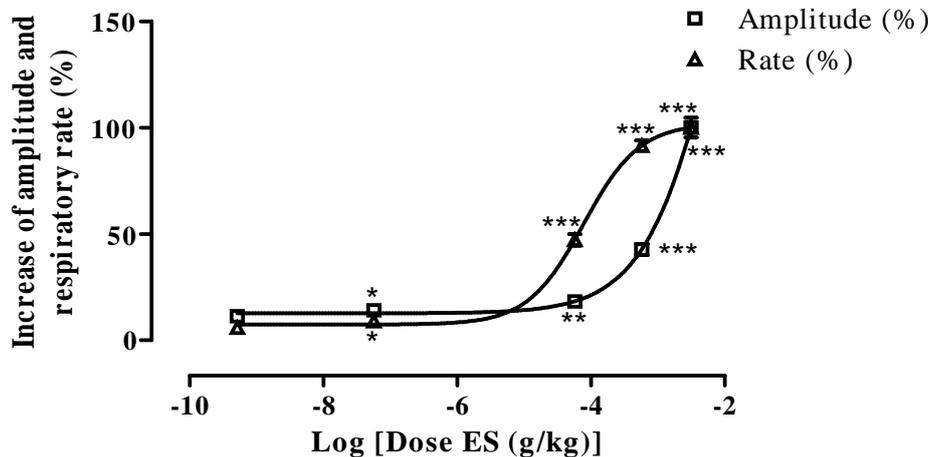


Figure 2: Effects of increasing doses of ES on the amplitude and respiratory rate in situ in rabbit. ES induces an increase in the amplitude and respiratory rate dose-dependent manner. (Mean \pm ESM, * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$, $n=4$).

Abidjan and conducted in accordance with the national government accepted principles for laboratory animal use and care. Rabbits and rats were anaesthetized with ethyl urethane.

Recording of rabbit blood pressure and respiratory movements: The experimental device used for recording blood pressure in the rabbit is based on the principle of the mercury manometer of Ludwig. The rabbits (1.5-2 kg) were anesthetized by intraperitoneal injection of ethyl-urethane 40% dosed at 1 g/kg of body weight (bw). His carotid artery was exposed and intubated using a catheter connected to a U-tube manometer, which collects directly the intra-carotid. This method measures the level of reference pressure in rabbits. Changes in the carotid pressure, transmitted to the mercury column of the device are recorded with a pen that translates the movements of mercury on the paper placed on a cylinder driven at constant speed. For the respiratory activity, rabbits were anaesthetized with intraperitoneal injection of ethyl-

urethane 40% dosed at 1 g/kg of body weight (bw). A tracheal cannula was tied in place and connected through rebreathing valves with a closed-circuit system containing carbon dioxide absorber and a Benedict spirometer, 6 cm internal diameter, together with means for admitting oxygen to the system when desired. Inspiration produced an upward movement of the recorded trace. Pharmacodynamic substances and ethanolic extract of *Erythrina senegalensis* are injected into the animal through the saphenous vein.

Recording of the contractile activity of the rat isolated cardiac muscle: Male rats weighting 150-200 g, anesthetized by intraperitoneal injection with ethyl urethane (20 %) at a dose of 1g/kg b.w. were put under artificial respiration. A thoracotomy was practised in order to reach the heart. After isolating the heart, the heparinized physiological solution was injected to dissolve possible blood clots. The isolated heart was fixed on the exit of a tap through multiple connections to

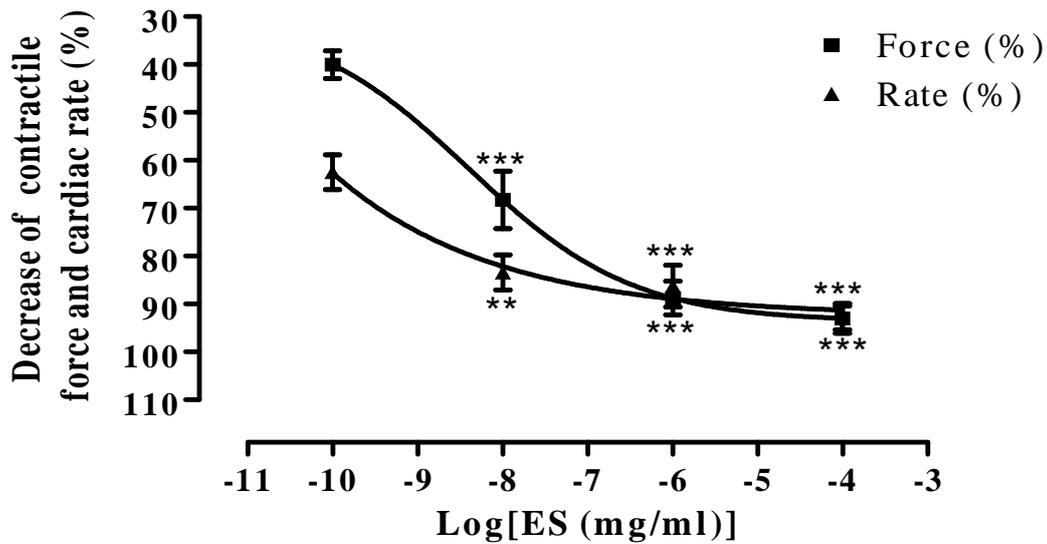


Figure 3: Concentration-response effect of ES on the mechanical activity of isolated heart. ES induced a decrease in the contractile activity and heart rate in rat, (Mean ± ESM, **p<0.01; ***p<0.001, n=6)

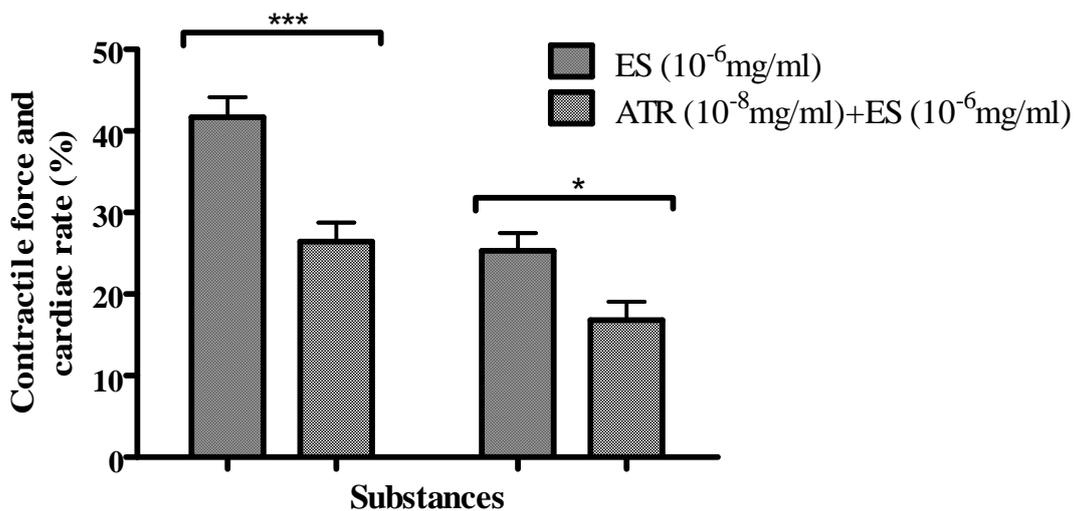


Figure 4: Effects of ES in the presence of Atropine. The use of Atropine reduced the effect induced by ES on the contractile activity and heart rate in rat. (Mean ± ESM, *p<0.05; ***p<0.001, n=6)

bottles which contained the solutions to be tested and were oxygenated. The liquids contained in these bottles were allowed to pass by through a polyvinyl catheter, followed by the collection of serpentines in a thermostat Marie bath at 37 ° C. The apex of the heart was connected to an inscriptor stylet, which transmitted the movements on paper and moving by an engine.

Chemical used: Atropine (ATR) which is used in this study was purchased from Prolabo (French).

STATISTICAL ANALYSIS

Statistical analysis was performed using one-way analysis of variance (ANOVA) of multiple test of comparison of Tukey-Kramer. P<0.05 was considered significant. All values are expressed as mean ± SEM. The GraphPad Software (version 4.0; San Diego, CA, USA) was used for data analysis.

RESULTS

Dose-response effect of the ethanolic extract of Erythrina senegalensis on blood pressure and amplitude and respiratory rate in rabbit: The effects of the ethanolic extracts were investigated in rabbit. These extracts are used at the doses from 5.71×10⁻¹⁰ to 3.15×10⁻³ g/kg b.w. This study shown that, the ethanolic extract of the roots and the stem bark of Erythrina senegalensis (ES) induced dose-dependent effect on the blood pressure and the amplitude and respiratory rate inn rabbit. On the blood pressure ES provokes hypotension with a significant decrease of this parameter for the doses ranging from 5.72×10⁻⁵ to 3.15×10⁻³ g/kg b.w. (Figure 1). The maximum hypotension is reached at the dose of 3.15×10⁻³ g/kg b.w. For the same doses, ES induced the dose-

dependent increase in the amplitude and respiratory rate in rabbit (Figure 2). This significantly increase ($p < 0.001$) for amplitude and respiratory rate is reached at the dose of 3.15×10^{-3} g/kg b.w.

In vitro effect of ethanolic extract of *Erythrina senegalensis* on activity of isolated heart in rat: The concentrations of ES ranging from 10^{-10} to 10^{-4} mg/ml affected the contractile activity of the isolated heart of the rat. For these concentrations, ES induced negative inotropic and chronotropic effects. ES, for the concentrations ranging from 10^{-8} to 10^{-4} mg/ml significantly ($p < 0.001$) decrease the contractile activity of the heart of the rat (Figure 3).

For the same concentrations, ES causes a decrease of the heart rate in rat. The maximum decrease ($p < 0.001$) of heart rate is reached at the concentration of 10^{-4} mg/ml which increase of 48.58 % ($p < 0.001$).

Effect of the extract of *Erythrina senegalensis* in presence of Atropine on the isolated heart in rat: In the presence of atropine (10^{-8} mg/ml), the effect of ES (10^{-6} mg/ml) is reduced on the contractile activity and the heart rate (Figure 4). In presence of atropine, ES decreases the contractile activity from 22.56 % ($p < 0.001$) versus 42.12 % in absence of atropine. In the same conditions, the heart rate decreases from 10.14 % ($p < 0.001$) in presence of atropine versus 24.22 % in the absence of atropine.

DISCUSSION

In the present study the effects of *Erythrina senegalensis* extracts on cardiovascular activity and the amplitude and respiratory rate were investigated. In this study, the results indicate that the ethanolic extract of the roots and stem bark of *Erythrina senegalensis* possesses dose-dependent hypotensive effects and causes an increase of the amplitude and the respiratory rate. This extract induces cardio-depressant activity in mammals. Similar results were obtained in dogs and frogs with the extract of *Achyranthes aspera*^{19, 20}. According to these authors, a water-soluble alkaloid isolated from this plant decreased blood pressure and increased the rate and amplitude of respiration. The effects of ES on these parameters observed during this study are therefore due to the presence of alkaloid isolated from the methanol extract of *Erythrina senegalensis* by Wandj et al.²¹.

The ethanolic extract of *Erythrina senegalensis* was tested for concentrations ranging from 10^{-10} to 10^{-4} mg/ml on the isolated heart of rat. For these concentrations, ES induced a negative inotropic and chronotropic effects. Similar effects were observed with aqueous-ethanolic extract of *Achillea millefolium* which showed a negative cardiac inotropic and chronotropic effects²². As the ethanolic extract of *Erythrina senegalensis*, the ethanol extract of *Sideritis raeseri* spp. *raeseri* Boiss & Heldr can produce negative chronotropic and inotropic effects²³. These effects of ES are believed to participate in the effects of cholinergic attenuation of heart rate. In presence of atropine, an antagonist of muscarinic receptor of acetylcholine, these effects of ES are reduced. Kurian et al.²⁴ were observed the similar responses with methanol extract of the root of *Desmodium gangeticum*

on the isolated frog heart. Acetylcholine has for long been known as a transmitter that has the property of lowering the blood pressure and also bringing about bradycardia through its muscarinic receptor²⁵. The fixation of this substance can decrease Ca^{2+} entry to the cell, which can in turn result in reduction of contractile force²⁶. Otherwise Mugabo et al.²⁷ showed that the hippadine an alkaloid isolated from bulbs of *Crinum macowanii* induced a negative chronotropic and inotropic effect on isolated heart in rat.

In conclusion, the results of this study show that the ethanolic extract of *Erythrina senegalensis* has hypotensive effect and induces an increase of the amplitude and the respiratory rate in rabbits. This extract causes a negative chronotropic and inotropic effect on isolated heart in rat. These observations suggest that the ethanolic extract of *Erythrina senegalensis* contains the cholinomimetic substances which induce a cardio-depression. These effects are linked to the presence of alkaloids.

ACKNOWLEDGEMENTS

The authors are grateful to Professor Koné Mamidou Witabouna, University Nangui Abrogoua, Côte d'Ivoire and Swiss Center for Scientific Research in Côte d'Ivoire for their assistance in the extraction process.

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