

Diuretic and Salidiuretics Activity of an Aqueous Extract of Leafy Branches of *Mimosa invisa* Mart. ex. Colla (Fabaceae) in Rats

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Abstract: In this study, the aqueous extract of *Mimosa invisa* (Miv), at doses ranging from 5 to 20 mg / kg b.w., causes a dose-dependent and significant increase ($p < 0.001$) of the volume of urinary excretion measured during 24 hours and at dose of 20 mg / kg b.w, a significant decrease ($p < 0.01$) of time of the first micturition (TFM) in rats treated. These effects of Miv suggest that this extract is a diuretic. In addition, Miv significantly increases urinary excretion of Na^+ , K^+ and Cl^- ($p < 0.01$). However, the urinary ratio Na^+/K^+ does not vary significantly in the presence of Miv, which is in favor of a more pronounced action of this extract on the renal tubules. In addition, the effects of Miv on diuresis and the TFM are similar to those of hydrochlorothiazide, furosemide and spiro lactone at doses of 20 mg / kg b.w. The salidiuretic effects of Miv are also similar to those of hydrochlorothiazide and furosemide, but differs from that of the spiro lactone which to him decreases ($p < 0,05$) the urinary excretion of K. In addition, unlike Miv, spironolactone has an increase ($p < 0.01$) of the urinary ratio Na^+ / K^+ . This study shows that the extract of *Mimosa invisa* is a diuretic whose effects are similar to those of furosemide and hydrochlorothiazide. These diuretic properties of Miv justify the use of *Mimosa invisa* (Fabaceae) in traditional medicine to treat arterial hypertension.

Keywords: *Mimosa invisa*, diuretic and salidiuretic, furosemide, hydrochlorothiazide, spiro lactone.

1. Introduction

Africa has a large variety of medicinal plants (Dibong et al., 2011) that treat various diseases. This is the case of *Mimosa invisa* Mart ex. Colla (Fabaceae), a plant used in traditional medicine in Africa in the treatment of arterial hypertension, diabetes and other diseases (Mansroi, 2011; Harjanti, 2009). *Mimosa invisa* is a shrubby plant, prostrate or ascending to trend lianescent, reaching 1-2 m (Garcia, 1982). It is native to South America, and has long been considered invasive (Larrue, 2008).

Today, *Mimosa invisa* is increasingly the subject of pharmacological studies. Thus, the toxic effect of fresh juice and antidiabetic activity of *Mimosa invisa* ethanol extract have been shown respectively by Usha (2009) and Harjanti (2009). The potential hypoglycemic effect of aqueous extract of this plant has been revealed by Mansroi (2011).

This study aims to evaluate the effect of the aqueous extract of leafy branches of *Mimosa invisa* (Fabaceae) on diuresis and urinary excretion of Na^+ , K^+ and Cl^- in rats.

2. Materials and Method

Plant Materiel

The plant material consists of leafy branches of *Mimosa invisa* ex Mart. Colla (Fabaceae). This plant was harvested in Cocody and identified at the National Centre of Floristic of Felix Houphouet Boigny University (Abidjan, Ivory Coast). The identification was made by comparison with herbarium No. 7160 of 14 December 1963 Laurent Ake-Assi Emeritus Professor of Botany and No.199 of June 18, 1992 Emmanuelle Ake-Assi Doctor of Botany at Felix Houphouet Boigny Cocody University.

Preparation of extract

For extraction, 200 g of fresh leafy branches of *Mimosa invisa* (Fabaceae) are placed in 3 liters of distilled water and placed in boiling for 45 minutes. The decoction obtained is filtered first 3 times on absorbent cotton, and then 2 times on filter paper (Whatman No. 1). The filtrate collected was dried in an oven at 50 °C to obtain a yellow orange powder which is the aqueous extract of *Mimosa invisa* (Miv).

Animal material

Rats of the *Rattus norvegicus* species (Muridae), Wistar strain (Musa) coming from the animalery of the Training and Research Unit of Biosciences from the Felix Houphouet-Boigny University, were used for this study. These animals weigh between 100 and 120 g.

Study Method of diuretic activity and analysis of electrolytes

In a first series of experiment, 25 rats set out again in 5 batches of 5 in the cages metabolic and acclimatized during 48 hours. Before the tests, these animals are put at jeun during 18 hours before receiving each one 50 distilled water ml/kg b.w. orally. Thereafter, the rats of the control batch receive 0,5 ml NaCl 9 ‰ by intraperitoneal way. The rats of the 4 other batches receive the aqueous extract of *Mimosa invisa* (Miv) to the respective doses of 5, 10, 15 and 20 mg/kg b.w. and the urinary volume of the rats of each batch is measured during 24 hours.

In a second series of experiment 25 other rats set out again in 5 batches and put under the same conditions as those of the first series of experiment. The rats of the witness group also receive 0.5 ml of NaCl 9 ‰ intraperitoneally. The rats of the 4 other batches receive 0,5 ml of 20 mg / kg b.w. of the aqueous extract of *Mimosa invisa* (Miv), hydrochlorothiazide

(Novartis Pharma, Switzerland), the spiro lactone (Pfizer Holding France) and furosemide (Sanofi Aventis, France) respectively. The rats of each batch are treated with a dose of a substance. The method used for these tests is that of Gallez *et al.* (1999) as amended.

After the treatment of the rats with the various substances, the time of first micturition (TPM) is noted and urinary volume is measured during 24 hours.

Using a multi-parameter automated analyzer (Cobas C311 HITACHI, Roche), Na^+ , K^+ and Cl^- are assayed in the urine of rats, freshly collected after 24 hours.

Methods of statistical analysis and plot graphs

Results are analyzed by analysis of variance ANOVA multiple comparison test of Tukey-Kramer. $P < 0.05$ is considered significant. The values are presented as average, followed by the error of the mean ($M \pm \text{SEM}$). GraphPad Prism software (San Diego CA USA) is used to draw the graphs.

3. Results

3.1 Dose-response effect of an aqueous extract of *Mimosa invisa* (Fabaceae) on the volume of urinary excretion of rats

The intraperitoneal administration of *Mimosa invisa* aqueous extract (Miv), the doses of 5, 10, 15 and 20 mg/kg b.w., causes, with time, significant increases in the volume of urinary excretion some rats. These diuresis increases are dose-dependent (Figure 1). Miv is more active on diuresis at doses of 20 mg / kg b.w. and maximum effects of this extract are obtained about 08 hours after treatment.

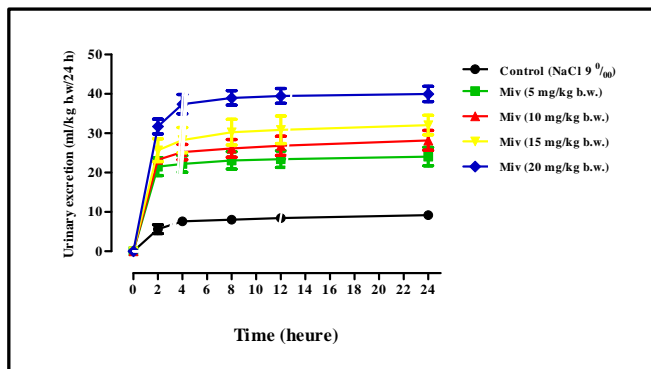


Figure 1: Dose response effect of aqueous extract of *Mimosa invisa* (Miv) on diuresis in rats (n = 3)

3.2 Effects of an aqueous extract of *Mimosa invisa* (Fabaceae), hydrochlorothiazide, furosemide and spiro lactone on the volume of urinary excretion of rats

Treatment of rats with aqueous extract of *Mimosa invisa* (Miv), hydrochlorothiazide, or spiro lactone furosemide brings up significant increases ($p < 0.001$) urine volume compared to control rats diuresis. Indeed, in the control rats, the urinary volume measured after 24 hours is of $10,46 \pm 0,98$ ml /kg b.w. /24 h (Table 1). When the rats are treated with Miv, hydrochlorothiazide, furosemide or spiro lactone at

doses of 20 mg/kg b.w, urinary volumes measured 24 hours after increase respectively of 293.5 %, 312.5 %, 264.7 % and 330.7 % compared to that of the rats in the control group. The volumes of urinary excretion, as measured 24 hours after the treatment of rats for 3 sets of experiments are given in Figure 2.

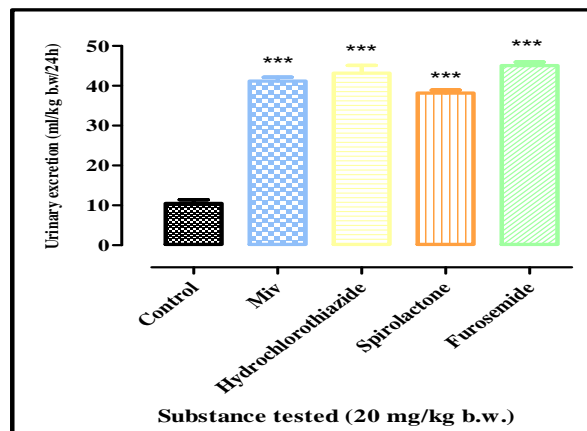


Figure 2: Effects of the aqueous extract of *Mimosa invisa* (Miv), hydrochlorothiazide, the spiro lactone and furosemide on the volume of urinary excretion of rats (n = 3)
 ***: ($P < 0.001$)

3.3 Effects of an aqueous extract of *Mimosa invisa* (Fabaceae), hydrochlorothiazide, furosemide and spiro lactone on the time of first micturition (TFM) in rats

The intraperitoneal administration of aqueous extract of *Mimosa invisa* (Miv) at a dose of 20 mg/kg b.w leads to a reduction of the first time of micturition (TPM) to 40.06% ($p < 0.001$) compared that of rats in the control group. Indeed, for 3 series of experiments, the TFM of the rats having received Miv is of $38,6 \pm 1,8$ min, whereas that of the control rats is of $64,4 \pm 3,2$ min (Table 1). Similarly, the administration of hydrochlorothiazide, spiro lactone or furosemide cause significant reductions ($p < 0.001$) of TFM. Compared to the TFM of the control rats, the reductions are 47,51 %, 19,25 % and 53,72 % respectively for the hydrochlorothiazide, the spiro lactone and the furosemide with dose of 20 mg/kg b.w. (Figure 3).

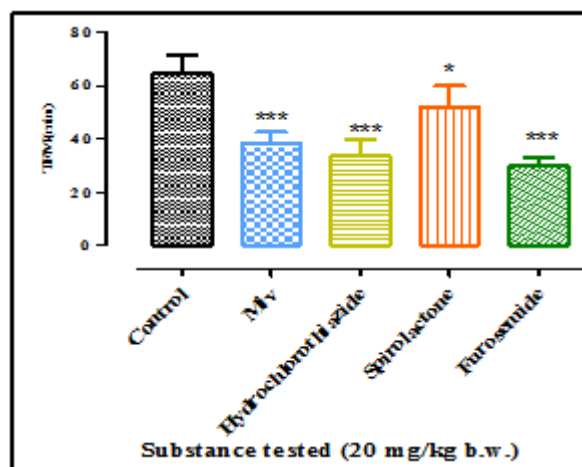


Figure 3: the first time micturition (TFM) in rats after administration of the aqueous extract of *Mimosa invisa* (Miv), hydrochlorothiazide, the spiro lactone and furosemide (n = 3) : ($p < 0,05$) ; *** : ($p < 0,001$)

Table 1: The Urinary volumes and time of the first micturition (TFM) in rats after administration of the aqueous extract of *Mimosa invisa* (Miv), hydrochlorothiazide, the spiro lactone and furosemide (n = 3)

Substance tested	Urinary Volume (ml/kg b.w./24h)	Time of first micturition (min)
Control (NaCl 9 ‰)	10,46 ± 0,98	64,4 ± 3,04
Miv (20 mg/kg b.w.)	41,16 ± 1,87 ***	38,6 ± 1,8 ***
Hydrochlorothiazide (20 mg/kg b.w.)	43,15 ± 1,40 ***	33,8 ± 2,76 ***
Spirolactone (20 mg/kg b.w.)	38,15 ± 1,14 ***	52,00 ± 3,63 *
Furosemide (20 mg/kg b.w.)	45,05 ± 0,80 ***	29,80 ± 1,53 ***

* : (p < 0,05) ; *** : (p < 0,001)

3.4 Effects of an aqueous extract of *Mimosa invisa* (Fabaceae), hydrochlorothiazide, the spiro lactone and furosemide on the urinary excretion of sodium, potassium and chlorine in rats

The aqueous extract of *Mimosa invisa* (Miv), hydrochlorothiazide and furosemide significantly increase the levels of sodium, potassium and chlore. Indeed, Miv increases the rate of Na⁺, K⁺ and Cl⁻ respectively of 95.75 %, 107.7 % and 29.93 %. For the hydrochlorothiazide, these increases are respectively 102,42 %, 128,07 % and 87,57 % in the urines of the treated rats. With the furosemide, the rates of Na⁺, K⁺ and Cl⁻ increase by 169,69 %, 237,7 % and 70,06 % respectively. By cons, the spiro lactone reduces the potassium rate of 34,61 % (p < 0,05), but does not have significant effects (p > 0,05) on the chlorine and sodium rates in the urines of the treated rats. The effects of these substances on the urinary excretion of the ions sodium, potassium and chlorine in the rat are given by figures 4, 5 and 6. Table 2 indicates the rates after 24 hours of these ions in the urines of the control rats or treaties.

The urinary ratio Na⁺/K⁺ of the rats treated with Miv, the hydrochlorothiazide and the furosemide does not vary significantly (p > 0,05) compared to that of the rats of the control batch. By cons, in the rats treated with the spiro lactone, the ratio Na⁺ / K⁺ is of 2,05 ± 0,15 (p < 0,01).

Table 2: Urinary chlorine and potassium, sodium rates in rats 24 hours after the administration of the aqueous extract of *Mimosa invisa* (Miv), of the hydrochlorothiazide, the spiro lactone and the furosemide

Substance tested	Na ⁺ rate (mEq/l / 24 h)	K ⁺ rate (mEq / l / 24 h)	Cl ⁻ rate (mEq / l / 24 h)
Control (NaCl 9 ‰)	33 ± 4,56	29,06 ± 2,92	62,8 ± 1,8
Miv (20 mg/kg b.w.)	64,6 ± 3,35**	60,38 ± 3,74**	81,6 ± 3,66**
Hydrochlorothiazide (20 mg/kg b.w.)	66,8 ± 7,48**	66,26 ± 3,45***	117,8 ± 1,68***
Spirolactone (20 mg/kg b.w.)	39 ± 1,81	19 ± 2,59*	66,8 ± 5,58
Furosemide (20 mg/kg b.w.)	89 ± 8,35***	98,16 ± 8,79***	106,8 ± 3,35***

** : (p < 0,01) ; *** : (p < 0,001)

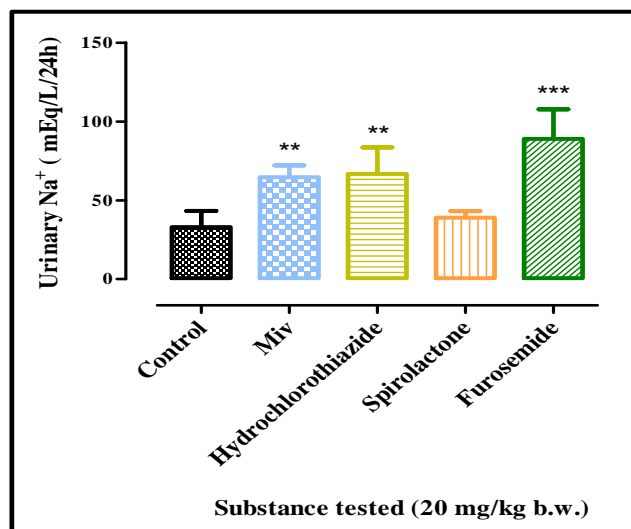


Figure 4: Urinary sodium rates in the rats 24 hours after the administration of the aqueous extract of *Mimosa invisa* (Miv) of the hydrochlorothiazide, the spiro lactone and the furosemide (n = 3)

** : (p < 0,01) ; *** : (p < 0,001)

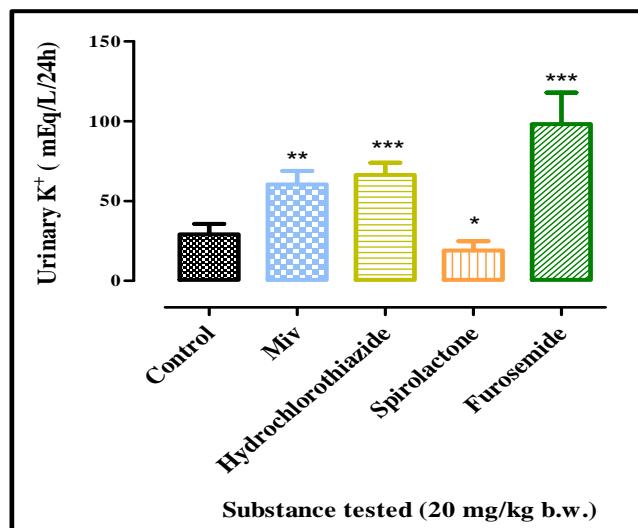


Figure 5: Urinary potassium rates in the rats 24 hours after the administration of the aqueous extract of *Mimosa invisa* (Miv) of the hydrochlorothiazide, the spiro lactone and the furosemide (n = 3)

* : (p < 0,05) ; ** : (p < 0,01) ; *** : (p < 0,001)

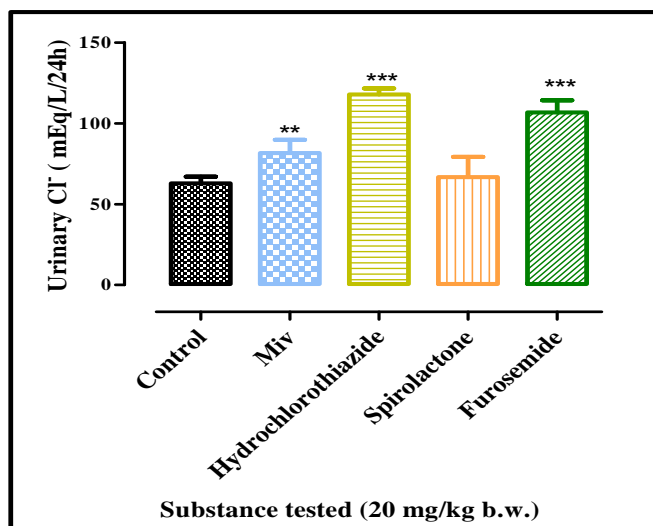


Figure 6: Urinary chlorine rates in the rats 24 hours after the administration of the aqueous extract of *Mimosa invisa* (Miv) of the hydrochlorothiazide, the spirolactone and the furosemide (n = 3)
 : (p < 0,01) ; * : (p < 0,001)

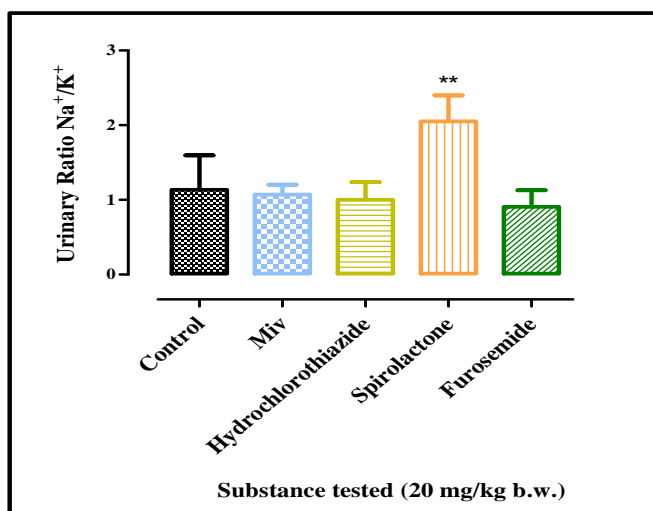


Figure 7: Ratio Sodium /potassium of the urinary excretion of the electrolytes in rats 24 hours after the administration of the aqueous extract of *Mimosa invisa* (Miv) of the hydrochlorothiazide, the spirolactone and the furosemide
 **: (p < 0,01)

4. Discussion

The aqueous extract of *Mimosa invisa* (Miv), at doses ranging from 5 to 20 mg/kg b.w, causes a dose-dependent and significant increase (p < 0.001) of urinary excretion measured during 24 hours and at the dose 20 mg/kg b.w., a significant decrease (p < 0.001) of time of first micturition (TFM) in rats treated. The increase of the diuresis in the treated rats with Miv suggests that this extract is a diuretic. Indeed, diuretics are pharmacological agents aimed at increasing the volume of urine excreted (Safaridis, 2010). This increase of the volume of urine excreted induced by Miv could be due at a direct effect on the active components of transport, or an indirect purpose by modifying the pressures oncotic and hydrostatic in the peritubular capillaries (Lewy

and Windhager, 1968; Brenner et al., 1969; Jouad and Al, 2001; Maghrani, 2005). This effect can be produced by the stimulation of regional blood circulation or the initial vasodilatation or by inhibiting the tubular reabsorption of water and the electrolytes (Pantoja et al., 1993; Stanic and Samarzija, 1993). The reduction of the latency time is a characteristic of most plants diuretics (Sanogo, 2009). Thus, this reduction of the TFM induced by Miv confirms the diuretic properties of this extract.

In addition, the aqueous extract of *Mimosa invisa* causes a significant increase (p < 0,01) in the urinary rate of excretion of Na⁺, K⁺ and Cl⁻ in the treated rats. This salidiuretic effect induced by Miv indicates that this extract inhibits the tubular reabsorption of these ions. This will result, by increased excretion of water. Under the same experimental conditions, the hydrochlorothiazide, the spirolactone and the furosemide at doses of 20 mg / kg b.w., also cause increasing in diuresis and reduces TPM in rats. The effects of Miv at 20 mg/kg b.w. are nearly identical to those of the hydrochlorothiazide, but less significant than those of the furosemide. However Miv are more active than the spirolactone on these measured parameters. Just like Miv, the hydrochlorothiazide and the furosemide provokes a significant increase in the urinary excretion rate of Na⁺, K⁺ and Cl⁻.

For these three substances, the ratio Na⁺/K⁺ does not vary significantly. By cons the spironolactone, a potassium-sparing diuretic (aldosterone antagonist) has no significant effect on the rate of urinary excretion of Na⁺ and Cl⁻, but reduces that of K⁺ (p < 0.05) and increases the ratio Na⁺/K⁺ significantly (p < 0.01). It appears thus that Miv has diuretic and salidiuretic effects similar to those of the hydrochlorothiazide which is thiazidic diuretic, and furosemide which is diuretic of loop of Henlé. Thus Miv, just like hydrochlorothiazide and furosemide, could inhibit the reabsorption of NaCl in the distal convoluted tubule (dilution segment) and/or inhibit the level transport of loop of Henle, are thus opposed to the reabsorption of sodium and other ions (Bartoreli, 1959). The increase in the natriurèse would be accompanied by an increase of the renal excretion of water and proportionally of kaliurèse and chlorurie. The ratio Na⁺/K⁺ characterizes serum aldosterone. Thus, if this ratio is lower than the normal, the secretion of the aldosterone decreases, whereas if it is higher than the normal the secretion of the aldosterone will be high (Nayak, 2013). Miv, unlike spirolactone, would not affect the serum aldosterone, which justifies its action more pronounced in the renal tubules. The increase by Miv of excretion of water and sodium also provides a basis for its hypotensive activity (Jouad, 2001).

5. Conclusion

This study shows that the effects of aqueous extract of *Mimosa invisa* (Fabaceae) on diuresis, TFM and urinary excretion of Na⁺, K⁺ and Cl⁻ are similar to those of certain diuretics, primarily hydrochlorothiazide, a thiazidic diuretic. The diuretic and salidiuretic effects of this extract may be beneficial in the treatment of some cases of hypertension in so far as it acts by urinary elimination of a part of the water

and sodium present in the blood. This justifies the traditional use of this plant in the treatment of hypertension.

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