Scholars Academic Journal of Biosciences
Abbreviated Key Title: Sch Acad J Biosci
ISSN 2347-9515 (Print) | ISSN 2321-6883 (Online)
Journal homepage: https://saspublishers.com
NLM ID:101629416
OPEN ACCESS
Biology

Hypotensive Effect of an Aqueous Extract of Leaves of *Lophira lanceolata* (Ochnaceae), A Plant Known to Be Antihypertensive, in Rabbits

Coulibaly Sirabana[1*], Koffi Severin[2], MIAN Jean-Claude[3], Soro Tianga Yaya[4]

[1]Animal Biology Laboratory, Animal Physiology, Phytotherapy and Pharmacology Specialty, Alassane Ouattara University, Bouaké, Ivory Coast
[2]Animal Biology Laboratory, Endocrinology and Reproductive Biology Specialty, Alassane Ouattara University, Bouaké, Ivory Coast
[3]Department of Animal Biology, Phytotherapy and Pharmacology Specialty, Peleforo Gon Coulibaly University, Korhogo, Ivory Coast
[4]Laboratory of Biology and health, Animal Physiology, Phytotherapy and Pharmacology Specialty, Felix Houphouët Boigny University, Abidjan, Ivory Coast

DOI: https://doi.org/10.36347/sajb.2025.v13i09.005 | **Received:** 04.06.2025 | **Accepted:** 10.08.2025 | **Published:** 08.09.2025

***Corresponding author:** Coulibaly Sirabana
Animal Biology Laboratory, Animal Physiology, Phytotherapy and Pharmacology Specialty, Alassane Ouattara University, Bouaké, Ivory Coast

Abstract | **Original Research Article**

Lophira lanceolata (Ochnaceae) is a plant commonly used in traditional African medicine to treat a number of illnesses, including hypertension. The aim of the present study was to evaluate the hypotensive effects of an aqueous extract of leaves of *Lophira lanceolata* on arterial hypertension in rabbits. A qualitative phytochemical study was conducted to determine the various secondary compounds contained in this extract. Using a Ludwig manometer, consisting of a U-shaped tube containing mercury surmounted by a writing stylus, the blood pressure of rabbits was recorded on smoked paper wound around a cylinder rotating at constant speed. The doses of test substances are administered to the rabbits via its exposed saphenous vein. The qualitative phytochemical study carried out with the aqueous extract of dried Lophira lanceolata leaves revealed the presence of sterols, polyphenols, flavonoids, saponosides, quinone compounds, alkaloids and gall tannins. Aqueous extract of *Lophira lanceolata*, in doses ranging from 1 to 25 mg/kg body weight, induces dose-dependent hypotension. This hypotension is considerably reduced by atropine, a competitive inhibitor of muscarinic cholinergic receptors. This suggests the presence of muscarinic cholinomimetic active ingredients in the aqueous extract of dried *Lophira lanceolata* leaves. These principles could be alkaloids and/or flavonoids contained in this extract.

Keywords: *Lophira lanceolata,* hypotension, cholinomimetic substances.

1. INTRODUCTION

Arterial hypertension is a chronic cardiovascular disease characterized by elevated blood pressure above the normal range. It is a real trigger for most non-communicable diseases. It is a serious highly lethal pathology, occurring in virtually equal proportions in both developed and developing countries (Bertrand, 1987). Reports on global prevalence are increasingly alarming. In 2000, more than a quarter of the world's adult population was hypertensive, and this proportion is expected to rise to 29.2% by 2025, representing almost 1.6 billion hypertensive subjects (Kearney *et al.*, 2005). In Africa, it is a public health problem with a population frequency of between 15 and 40% and a hospital frequency of between 30 and 70% (Diallo *et al.*, 2010). In Côte d'Ivoire, in 2015, the prevalence of high blood pressure was 20.4% (Kramo *et al.*, 2019). A concoction of the root has been used by women against menstrual pain, intestinal troubles and malaria and pulmonary diseases. In southern Nigeria, the bark of the root has been used to manage gastrointestinal problems and yellow fever (Onyeto *et al.*, 2014). Previous studies on the leaves of *L. lanceolata* have shown antihypertensive, anti-diarrheal, anti-plasmodial and antioxidant effects of the water and methanol extracts (Igboeli *et al.*, 2015).

The objective of this work is to evaluate the hypotensive effect of the aqueous extract of leaves of *Lophira lanceolata* (Ochnaceae), in rabbits.

2. MATERIALS AND METHODS

2.1. Materials

2.1.1. Plant Material

Lophira lanceolata leaves were collected in June 2023 in Korhogo, a town in northern Côte d'Ivoire, 496 km from Abidjan. They were identified at the national floristics center (CNF) in comparison with sample N° UCJ013145 existing in this center.

2.1.2. Animal Material

Rabbits of the species *Oryctolagus cuniculus* (Leporidae) weighing between 1.7 and 2.1 kg were used for the pharmacological tests. They came from a breeding farm in Gonzagueville, a district of the Port-Bouet commune in Abidjan, and had been acclimatized for 48 hours in the vivarium of Ecole Normale Supérieure in Abidjan prior to handling. The average temperature of the animal house was 28° ± 3°C with a relative humidity of 70%. The photoperiod was 12/24. The animals have free access to water and food. The animals have free access to water and food.

2.1.3. Physiological solution and pharmacological substances

The physiological solution is a 9‰ NaCl solution (Fluka, Germany), used for the study of blood pressure. The chemical substances used during the experiments are Heparin Choay 5000 IU (sanofi-aventis, France) to prevent blood clotting in the cannulas of the Ludwig device, the reference substance is Acetylcholine (SIGMA laboratory St Louis, MO USA, PM: 181.68) with Atropine (prolabo, PM: 289.38) as an antagonist substance and Thiopental 500 mg (neon laboratories limited, India) which was used for the anesthesia of the animals.

2.2. METHODS

2.2.1. Preparation of the aqueous extract of leaves of *Lophira lanceolata* (Ochnaceae)

Freshly harvested *Lophira lanceolata* leaves were shade-dried and ground in the UFR pharmacie laboratory. Next, 200g of this leaf powder was boiled at 100°C in two liters of distilled water for 30 min. The resulting decoctate was filtered successively through cotton wool and Wattman paper (4mm). The filtrate obtained was oven-dried at 60°C for 72 hours. A perfectly water-soluble powder is obtained, which constitutes the aqueous extract of *Lophira lanceolata* leaves (EALl).

2.2.2. Qualitative phytochemical characterisation of the aqueous extract of leaves of *Lophira lanceolata*

This qualitative study allowed us to determine the groups of chemical constituents of pharmacological interest present in the aqueous extract of *Lophira lanceolata* leaves, namely sterols, polyterpenes, polyphenols, flavonoids, tannins, quinone compounds, saponosides and alkaloids. Detection of these chemical compounds is based on the principle that they induce chemical reactions in the presence of suitable reagents (Wagner et Bladt, 2001). These tests were carried out using the analytical techniques described in the work of Mea *et al.* (2017). For these tests, a solution of the aqueous extract of *Lophira lanceolata* is prepared by dissolving 5 g of the extract in 50 ml of distilled water.

2.2.3. Study of the effects of the aqueous extract of leaves of *Lophira lanceolata* on the blood pressure of rabbits

2.2.3.1. Experimental device for recording blood pressure in rabbits

The device used for recording blood pressure is the Ludwig manometer. It is composed of a U-shaped tube whose two branches contain mercury topped with a writing stylus. This writing stylus is used to transcribe the rabbit's blood pressure onto a cylinder covered with carbon black-coated paper and driven by a constant-speed motor.

2.2.3.2. Recording Technical for Blood Pressure in Rabbits

The animal is anesthetized by intraperitoneal injection of Thiopental at a rate of 1 g/kg bw, its carotid is connected to one of the branches of the Ludwig manometer. The variations in the rabbit's blood pressure are transmitted to the mercury column. Indeed, since the manometer has a uniform section, any variation in the mercury level in each branch containing the writing stylus corresponds to an equal variation, but in the opposite direction, in the other branch. Thus, to determine the exact value of the variations in the rabbit's blood pressure, the pressure variations must be multiplied by two. Given the float and the metal rod of the writing stylus on the paper, there is a certain loss of blood pressure in the measuring device.

2.2.4. Treatment of Results

The recordings made on the smoked paper are varnished in order to fix the carbon black, then scanned before being inverted using MICROSOFT Paint software. The statistical analyses of the values and the graphical representation of the data were carried out using Graph Pad Prism 8 software (San Diego, California, USA). The statistical difference between the results was carried out using the analysis of variances (ANOVA). All values are presented in the form of mean ± SEM (Standard Error of the Mean) and for $P < 0.05$ the observed difference is significant.

3. RESULTS

3.1. Qualitative phytochemical composition of the aqueous extract of leaves of *Lophira lanceolata*

The qualitative phytochemical study, carried out on the aqueous extract of Lophira lanceolata dry leaves, revealed the presence of sterols and polyterpenes, polyphenols, flavonoids, saponosides, quinone compounds, alkaloids and gall tannins. However, catechic tannins are absent (Table 1).

Table 1: Chemical composition of the aqueous extract of leaves of *Lophira lanceolata*

Compounds researched		Tests or reagents	Results
Sterols and polyterpenes		Liebermann	+
Polyphénols		Ferric chloride	+
Flavonoids		Cyanidine	+
Saponosides		Vigorous agitation	+
Quinone compounds		Borntraegen	+
Alkaloids		Dragendorff	+
		Bouchardat	+
Tanins	catechics	Stiasny	-
	Gallic	Hydrochloric acid	+

(+): Presence of the compound **(-)**: Absence of the compound

3.2. Dose-response effects of the aqueous extract of leaves of *Lophira lanceolata* (EALl) on the blood pressure of rabbits

A typical recording of the effect of EALl is shown in Figure 1A. Under our experimental conditions, the mean reference arterial pressure of the rabbits used was 120 ± 6.7 mmHg. For doses between 1 and 25 mg/kg b.w., there was a significant increase in hypotension. This increase went from 4 ± 1.5 to 32 ± 1.4 mmHg, corresponding to a decrease from 3.33% to 25.66% of normal blood pressure.

The mean pressure values obtained (n = 3) made it possible to plot the curve expressing the decrease in blood pressure as a function of the dose of EALl (Figure 1B).

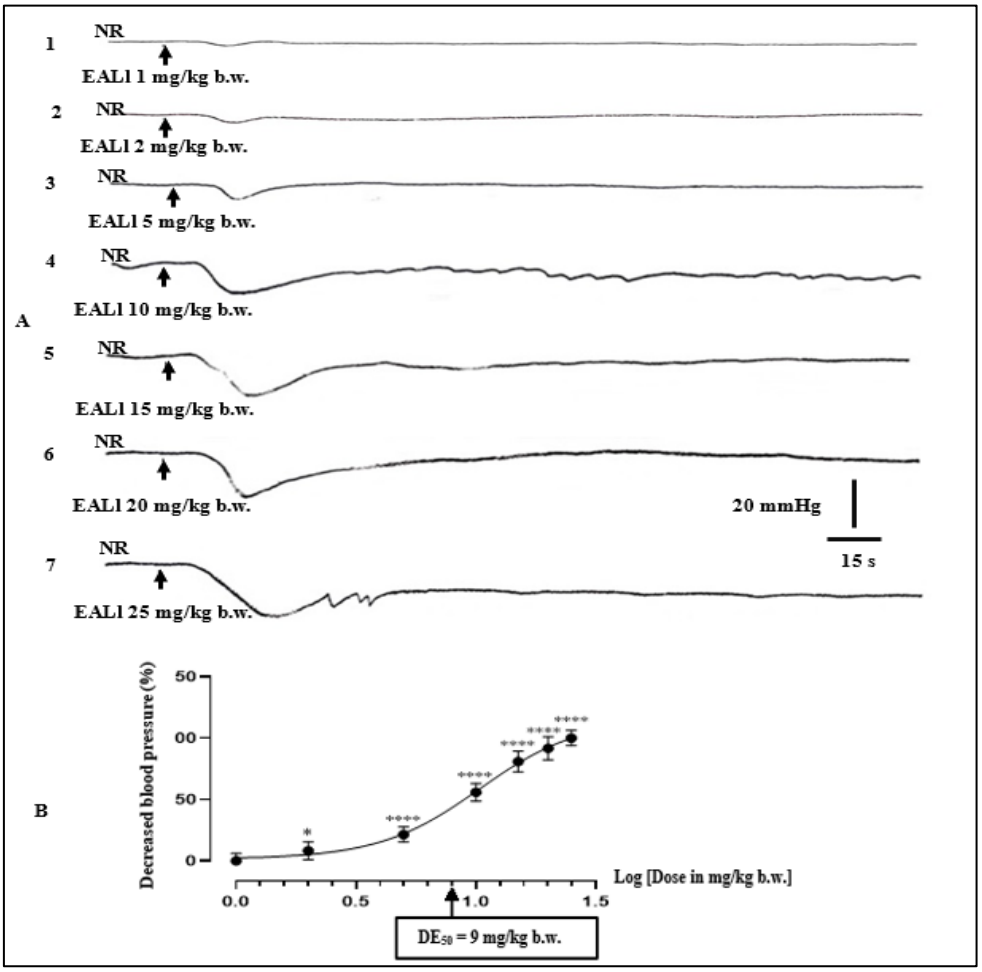

Figure 1: Effects of the aqueous extract of leaves of *Lophira lanceolata* on the blood pressure of rabbits A-Dose-response effects of EALl:

NR (1), Effects of EALl at 1 mg/kg b.w. (2); 5 1 mg/kg b.w. (3); 10 mg/kg b.w. (4); 15 mg/kg b.w. (5); 20 mg/kg b.w. (6) and 25 mg/kg b.w. (7)

EALl induces dose-dependent hypotension

B-Decrease in rabbit blood pressure as a function of the logarithm of the EALl dose

This curve allows to determine a fifty percent effective dose (ED50) equal to 9 mg/kg b.w.

The values express the percentages of maximum decrease in blood pressure compared to the control (Mean ± SEM n = 3; ** p < 0.01; **** p < 0.0001).

NR: Normal recording; EALl: Aqueous extract of leaves of Lophira lanceolata, SEM: Standard Error of the Mean

3.3. Dose-response effects of acetylcholine on rabbit blood pressure

Figure 2A shows the effect of increasing doses of acetylcholine (Ach) on rabbit blood pressure. At doses between 10^{-6} and 10^{-3} mg/kg b.w., Ach causes an increasing hypotension from 12 ± 2.02 to 32 ± 1.45 mmHg, corresponding to a decrease ranging from 10% to 26.66%. The curve in figure 2B, obtained from the mean values of three experiments (n = 3), shows the decrease in arterial pressure as a function of the logarithm of the ACh dose.

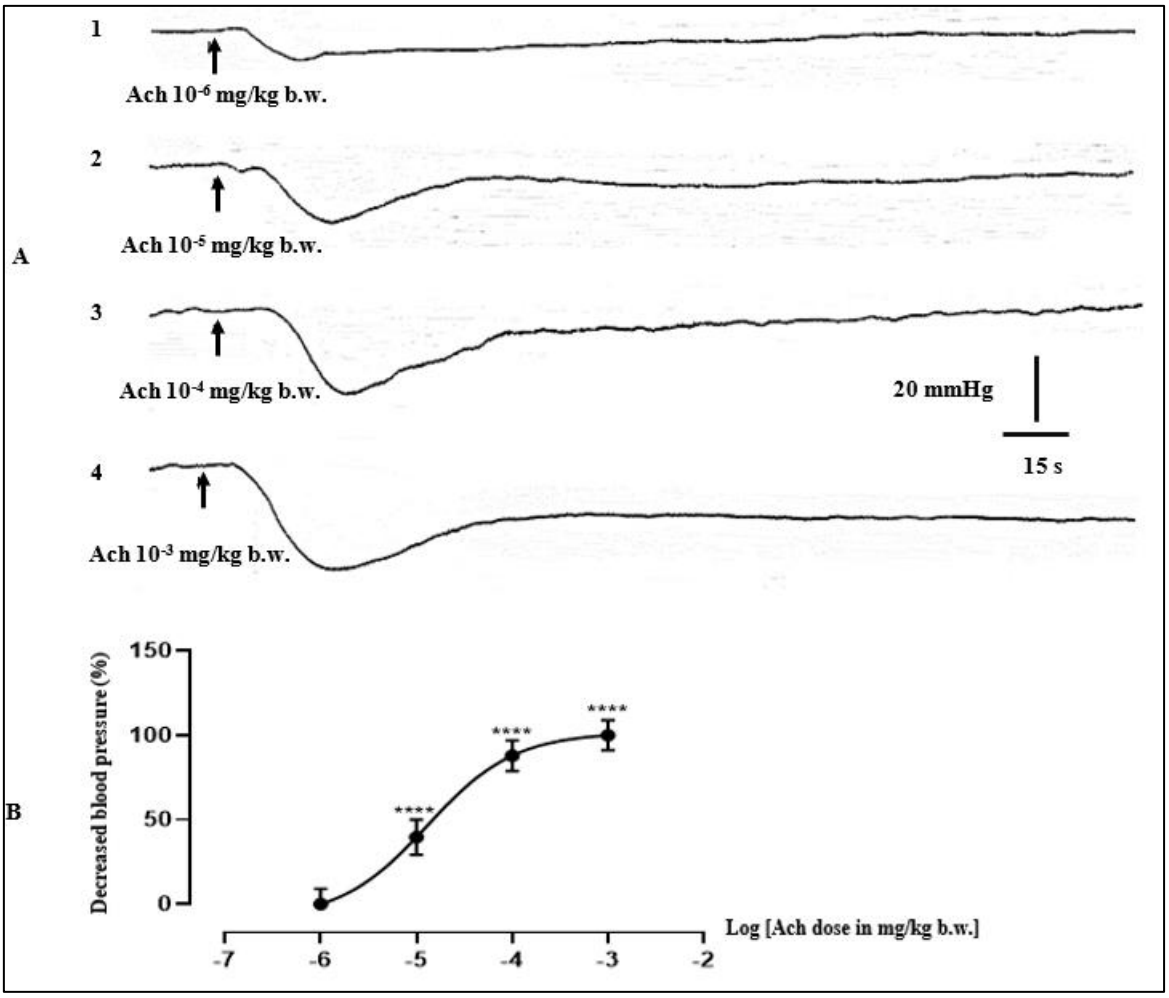

Figure 2: Effect of acetylcholine on blood pressure in rabbits

A-Dose-response effect of ACh

Effects of ACh at 10^{-6} mg/kg b.w. (1); 10^{-5} mg/kg b.w. (2); 10^{-4} mg/kg b.w. (3); 10^{-3} mg/kg b.w. (4).

ACh induces dose-dependent hypotension

B-Curve of decrease in blood pressure in rabbits as a function of the dose of ACh

The values express percentages of maximum decrease in blood pressure compared to the control (Moyenne ± ESM n = 3 ; **** p< 0,0001).

ACh: Acetylcholine; **SEM**: Standard Error of the Mean

3.4. Effects of the aqueous extract of *Lophira lanceolata* leaves in the presence of increasing doses of atropine

Figure 3A shows the effects of EALl in the presence of atropine (ATr) on rabbit blood pressure. In the presence of atropine at doses ranging from 10^{-6} to 10^{-3} mg/kg b.w., the hypotension induced by EALl at 20 mg/kg bw is strongly inhibited, ranging from 10 ± 1.73 to 6 ± 2.30 mmHg, equivalent to a significant decrease ($p < 0.0001$) in the hypotensive effect of EALl. The decrease in hypotension induced by EALl in the presence of atropine is reflected in the histogram in figure 3B,

obtained from the mean values of several experiments (n = 3).

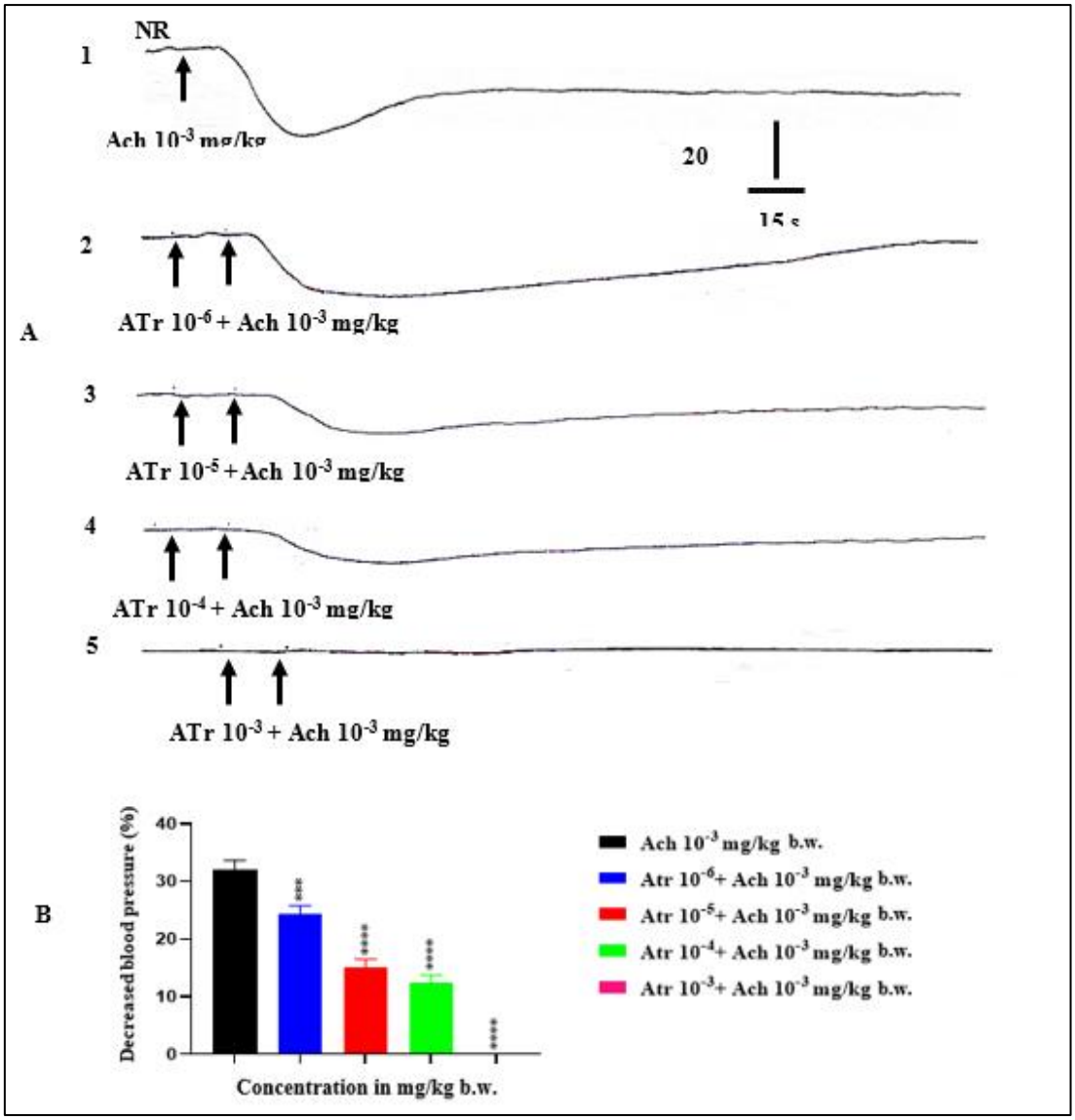

Figure 3: Effects of the aqueous extract of *Lophira lanceolata* leaves in the presence of atropine

A-Interaction ATr- EALl.

1: Effect of EALl at 20 mg/kg b.w.

2 to 5: Effects of EALl at 20 mg/kg b.w.in the presence of Atr at 10^{-6} (2), 10^{-5} (3); 10^{-4} (4) and 10^{-3} mg/kg b.w. (5).

B-Histogram of the evolution of hypotension induced by EALl in the presence of atropine.

The values express percentages of maximum decrease in blood pressure compared to the control (Mean ± SEM, n = 3**** $p < 0.0001$).

NR: Normal recording; Atr: Atropine, EALl: Aqueous extract of leaves of *Lophira lanceolata*; SEM: Standard Error of the Mean

3.5. Effect of acetylcholine on rabbit blood pressure in the presence of atropine

In the presence of atropine doses ranging from 10^{-6} mg/kg bw to 10^{-3} mg/kg b.w., the hypotension induced by Ach at 10^{-3} mg/kg b.w.is progressively suppressed (figure 4A). In fact, this hypotension, which is equal to 32 ± 1.73 mmHg (26.66%) with Ach alone, decreases successively to 20%, 11.66%, 10% and 0.83% respectively with atropine doses of 10^{-6}, 10^{-5}, 10^{-4} and 10^{-3} mg/kg b.w.. This reduction is highly significant.

The Histogram in Figure 4B represents the decrease in rabbit blood pressure induced by Ach at 10^{-3} mg/kg b.w. in the presence of atropine. It was plotted using mean values obtained for three experiments (n = 3).

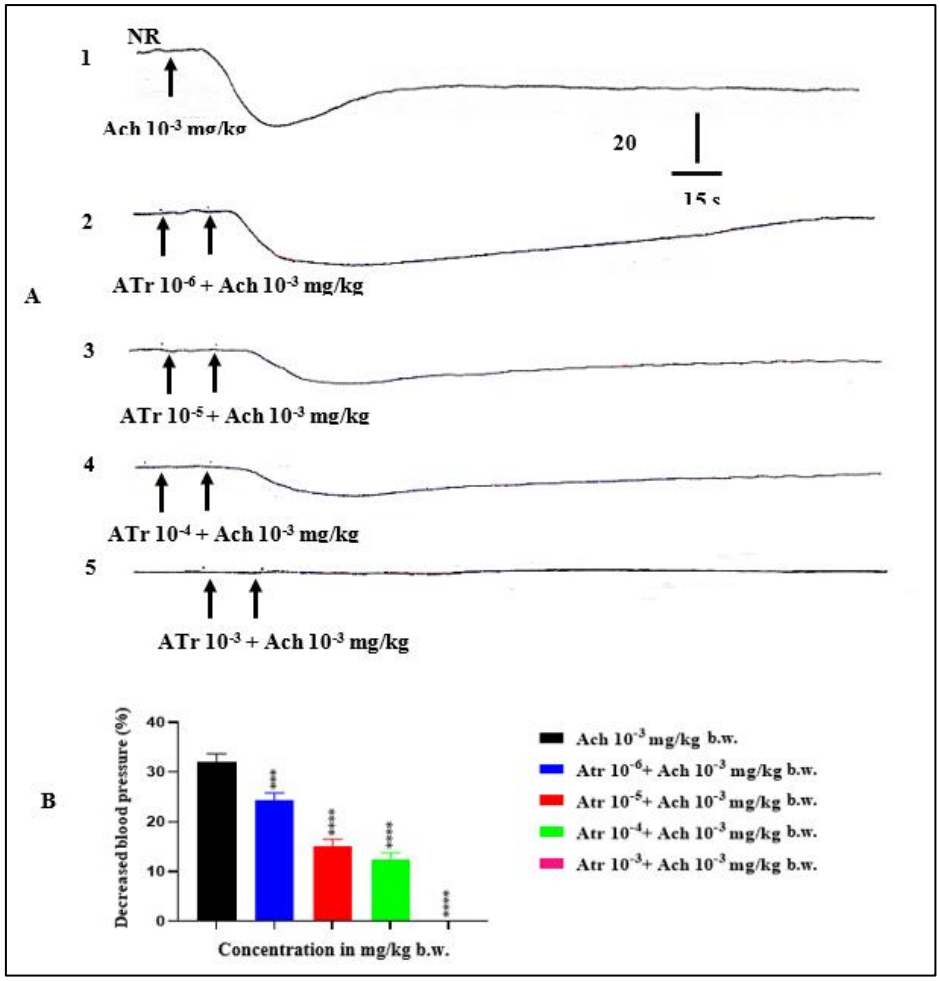

Figure 4: Effect of acetylcholine on rabbit blood pressure in the presence of atropine

A-Interaction ATr- Ach.

1: Effect of Ach at 10^{-3} mg/kg b.w.

2 to 5: Effects of Ach at 10^{-3} mg/kg b.w.in the presence of ATr at 10^{-6} (2), 10^{-5} (3); 10^{-4} (4) and 10^{-3} mg/kg b.w. (5).

B-Histogram of the evolution of hypotension induced by Ach in the presence of atropine.

The values express percentages of maximum decrease in blood pressure compared to the control (Mean ± SEM, n = 3; *** p< 0,001; **** p< 0,0001).

NR: Normal recording; Atr: Atropine; Ach: Acetylcholine; SEM: Standard Error of the Mean

Atropine at dodes between 10^{-6} et 10^{-3} mg/kg b.w.strogly inhibits hypotension induced by Ach at 10^{-3} mg/kg b.w.

4. DISCUSSION

Phytochemical tests carried out using the analytical techniques described in the work of Mea *et al.* (2017), with the aqueous extract of dried leaves of *Lophira lanceolata*, revealed the presence of sterols, polyterpenes, polyphenols, flavonoids, saponosides, quinone compounds, alkaloids and gall tannins. On the other hand, there was an absence of catechic tannins in the extract. These results differ from those of Houmènou *et al*. (2018), who demonstrated the presence of the above-mentioned compounds, with the exception of alkaloids, in the dried fruits of *Tetrapleura tetraptera*. The richness of this aqueous extract in chemically active compounds could explain the use of *Lophira lanceolata* in traditional medicine to treat numerous illnesses such as malaria, yellow fever, stomach aches, muscular pains and high blood pressure (Dicko *et al.*, 2017). Several authors (Lorenzana-Jiménez *et al.*, 2006; N'dia *et al.*, 2013) have demonstrated the beneficial effects of phenols and flavonoids on the cardiovascular system of laboratory animals through their cardioinhibitory, vasodilatory and hypertensive activities. According to Ojewole (2005), the hypotensive effects of the aqueous extract of the leaves of *Psidium guajaval* L. (Myrtaceae) are linked to the presence of polyphenols, flavonoids and tannins. It is therefore likely that the presence of these compounds in EALl is a strong indicator of pharmacological activity on the cardiovascular system. Concerning the study of the effects of EALl on rabbit blood pressure, we found that, for doses between 1 and 25 mg/kg body weight, EALl induced a dose-dependent hypotension.

This hypotensive effect is similar to that induced by acetylcholine (Belentougri *et al.*, 2001) and extracts of certain medicinal plants such as *Swartzia*

madagascariensis (Cesalpiniaceae) (Soro *et al*., 2004), *Parkia biglobosa* (Mimosaceae) (Kassi *et al.*, 2007) and *Heliotropium indicum* (Boraginaceae) (Zahoui *et al*., 2016) on rabbit blood pressure. It is therefore likely that EALl contains cholinomimetic substances. We conducted a comparative study of ATr-EALl and ATr-ACh antagonists to test this hypothesis. The results show that the hypotensive effect of ACh is totally inhibited by ATr, a competitive inhibitor of muscarinic cholinergic receptors (Katzung, 2007), and that of EALl is considerably reduced compared with the dose administered without interaction with ATr. Consequently, this study suggests the existence of muscarinic-type cholinomimetic substances in the aqueous extract of dried Lophira lanceolata leaves. This substance may act by the same mechanism as acetylcholine. By binding to cardiac M2 (Dhein *et al.*, 2001) and vascular M3 (Vanhoutte, 1976; Neal, 1997) muscarinic receptors, ACh induces cardioinhibition and vasodilation, resulting in hypotension. Cardioinhibition results from bradycardia due to a sinus effect, reduced atrioventricular conduction and reduced ventricular contraction force. The induced bradycardia is partly explained by cellular hyperpolarisation, which results from the opening of potassium channels directly linked to G proteins (Kurachi and Ishii, 2003; Fischmeister and Hartzell, 1996). The reduction in contraction force is due to a reduction in Ca2+ entry into the cell, probably through inhibition of adenilcyclase (Jurevièius and Fischmeister, 1996; Han *et al*., 1998). Vasodilatation occurs as a result of the endothelium releasing a vasodilating substance, nitric oxide (NO), or a hyperpolarising factor (EDHF) (Takano *et al*., 2004; Jiang *et al*., 2005). The aqueous extract of dried *Lophira lanceolata* leaves could have the same effects on the vessels, which would contribute to its antihypertensive effect. The hypotensive properties of the aqueous extract of dried *Lophira lanceolata* leaves are thought to be conferred by the active chemical compounds revealed by the phytochemical study. Indeed, several authors have revealed the cardioinhibitory, vasodilatory and hypotensive properties of polyphenols, flavonoids and tannins (Zenebe *et al*., 2003, Ghayur et Gilani., 2006). These compounds are thought to be responsible for the hypotensive effects of the aqueous extract of dried Lophira lanceolata leaves.

4. CONCLUSION

The aqueous extract of leaves of *Lophira lanceolata* contains polyphenols, sterols and polyterpenes, flavonoids, gallic tannins, saponins, quinonic compounds and alkaloids. An absence of catechic tannins is noted.The aqueous extract of dried leaves of *Lophira lanceolata* has a dose-dependent hypotensive effect on rabbit blood pressure, which is considerably reduced by atropine. Flavonoids and alkaloids could be at the basis of its hypotensive property similar to that of acetylcholine induced by muscarinic cholinomimetic receptors. The hypotensive properties of this extract could underpin and justify the use of *Lophira lanceolata* (Ochnaceae) leaves in traditional medicine for the treatment of high blood pressure.

REFERENCES

- Belentougri R.G., Schmid K. & Melzig M.F. (2001). In vitro spasmolytic effects of extracts *from Lophira lanceolata* and some of its constituents on rat ileum. *Journal of Ethnopharmacology*, *76*(3), 293-296.
- Bertrand E. (1987). Maladies cardiovasculaires dans les tropiques. Les maladies tropicales de Manson. *Baillère-Tindall Londres*, *19*, 1011-1030.
- Dhein S., Mohr W. & Muller M. (2001) "The role of muscarinic receptors in the regulation of cardiac function." *Cardiovascular Research*, *52*(2), 209-220.
- Diallo D., Guissou I.P., Tall C. & Kasilo O.M.J. (2010). Recherche sur la médecine traditionnelle africaine : hypertension. *The African Health Monitor : Special issue*, *14*, 6.
- Dicko A., Natta A.K. & Bloua H.S. (2017). Connaissances ethnobotaniques et conservation de Lophira lanceolata (Ochnaceae) au Bénin (Afrique de l'ouest). *Annales des sciences agronomiques*, *21*(1), 19-35.
- Fischmeister H. & Hartzell H.C. (1996). Regulation of cardiac calcium channels by G proteins. *Annual Review of Physiology*, *58*(1), 11-34.
- Ghayur M.N. & Gilani A.H. (2006). Radish seed extract mediates it cardiovascular inhibitory effects via muscarinic receptor activation. *Fundamental and Clinical pharmacology*, *20*(1), 5763.
- Han X., Kobayashi K. & Jones L.R. (1998). Inhibition of cardiac muscle contraction by phospholamban: role of phosphorylation. *American journal of Physiology-Heart and Circulatory physiology*, *274*(1), H81-H91.
- Houmènou V., Adjatin A., Assigba F., Gbénou J. & Akoègnissou A. (2018). Etude phytochimique et de cytotoxicité de quelques plantes utilisées dans le traitement de la stérilité féminine au sud-Bénin. *European scientific journal*, *14*, 1857-7881.
- Igboeli N., Onyeto C.A., Okorie A.N., Mbaoji F.N., Nwabunike I.A. & Alagboso D.I. (2015). Antidiarrheal activity of methanol leaf extract of *Lophira lanceolata Tiegh* (Ochnaceae). *Merit Res. J. Environ. Sci. Toxicol.*, *3*(4), 059-064.
- Jiang Z.G., Nuttal A.L., Zhao H., Dai C.F., Guan B.C., Si J.Q. & Yang Y.Q. (2005). Electrical coupling and release of K^+ from endothelial cells co-mediate Ach-induced smooth muscle hyperpolarization in guinea-pig inner ear artery. *Journal of physiology*, *564* (2), 475-487.
- Jurevièius J. & Fischmeister R. (1996). cAMP compartmentation is responsible for a local activation of cardiac Ca^{2+} channel by β_2- adrenergic receptors. *Proceedings of the National Academy of Sciences*, *93*(1), 295-299.
- Kassi Y., Aka J., Souza A., Abo K.J.C., Kanko C. & Ehile E.E. (2007). Potentialisation par un extrait

aqueux d'ecorce de *Parkia biglobosa* (Mimosaceae) de l'hypertension induite par l'ACh. *Revue medecine et pharmacopée Africaine, 20*, 133-146.

- Katzung B.G. (2007). Pharmacologie fondamentale et clinique. *7e Édition Piccin* (Padoue–Italie), 1150 p.
- Kearney P.M., Whelton M., Reynolds K., Muntner P., Whelton P.K. & He J. (2005). Global burden of hypertension: analysis of worldwide data. *Lancet*, *365*(9455), 217-23.
- Kramoh E.K., Ekoua D., Abina A., Koffi K.F., Koffi D.B., Boka B., Aké-Traboulsi E., N'Cho-Mottoh M.P., Tanoh M., Kouakou N.Y.N., Konin C., Anzouan-Kacou J.B., N'Guetta R., Coulibaly I., Xia X., Beaney T., Poulter N.R. & Assi S.R. (2019). May Measurement Month 2017: an analysis of blood pressure screening results in Côte d'Ivoire-Sub-Saharan Africa. *European Heart Journal Supplements*, 47-49.
- Kurachi Y. & Ishii M. (2003). Cell signal control of the G protein-gated potassium channel and its subcellular localization. *Journal of physiology*, *554*, 285-294.
- Lorenzana-Jiménez M., Guerrero G.A.M., Gonzalez X.G., Granados E.G. & Cassani J. (2006). Phytochimical and pharmacological preliminary study of the methanolic extract from struthanthus venetus in cardiovascular system of anesthetized rat. *Pharmacologyonline*, *3*, 359-364.
- Méa A., Ekissi Y.H.R., Abo K.J.C. & Kahou B.G.P. (2017). Hypoglyceamiant and anti-hyperglycaemiant effect of *Juscticia secunda* m. vahl (acanthaceae) on glycaemia in the wistar rat. *International journal of development research*, *07*(06), 13178-13184.
- N'dia K.F., Kouakou K.L., Bleyere N.M., Yapo A.P. & Ehile E.E. (2013). Hypotensive effect of a butanol active fraction from leaves of *Blighia unijugata back*. (Sapindaceae) on arterial blood pressure of robbit. *World journal of pharmacy and pharmaceutical sciences*, *2*(6): 6693-6705.
- Ojewole J.A. (2005). Hypoglycemic and hypertensive effects of Psidium guajava Linn. (Myrtaceae) leaf aqueous extract. Methods and Finding. *Experimental and clinical pharmacology*, *27*(10):689-695.
- Onyeto C.A., Akah A.A., Nworu S.C., Okoye T.C., Okorie N.A., Mbaoji F.N., Nwabunike I.A., Okumah N. & Okpara O. (2014). Antiplasmodial and antioxidant activities of methanol extract of the fresh leaf of *Lophira lanceolate* (Ochnaceae). *African Journal of Biotechnology*, *13*(16), 1731-1738.
- Soro Y.T., Traoré F., Zahoui S.O. & Koné PP. (2004). Effet pharmacologiques de Swartzia madagascariensis (Caesalpiniaceae) sur le système cardiovasculaire de mammifères. *Revue de médecine et pharmacologie africaine*, *18*, 59-70.
- Takano H., Dora K.A., spitaler M.M. & Garland C.J. (2004). Spreading dilatation in rat mesenteric arteries associated with calcium independent endothelial cell hyperpolarization. *Journal of Physiology, 556*, 887-903.
- Vanhoutte P.M. (1976). Inhibition by acetylcholine of adrenergic neurotransmission in vascular smooth muscle. *In physiology smooth muscle*, 369-376.
- Wagner H. & Bladt S. (2001). Plant drug Analysis. A thin layer chromatography atlas. *2ème* edition. *Springer* (Berlin, Allemagne), 384 p.
- Zahoui O.S., Nene-Bi S.A., Soro T.Y. & Traore F. (2016). Hypotensive effect of an aqueous extract from Heliotropium indicum Linn. 1753 (Boraginaceae), *international journal of current microbiology applied sciences*, *5* (2), 475-482.
- Zenebe W., Pechanova O. & Andriantsitohaina R. (2003). Red wine polyphenols induce vasorelaxation by increased nitric oxide bioactivity. *Physiology Research*, *52*(4), 425-432.