



Anti-hyperglycemic Effect of the Aqueous Extract of *Carapa procera* on Rats Submitted to a High-calorie Diet

Brahima kouame Koffi Raoul^{a*},
Kamenan Koua Christ Delor^a
and Ackah Jacques Auguste Alfred Bognan^a

^a Department of Biochemistry-Microbiology, UFR Agroforestry, Jean Lorougnon Guédé University, Côte d'Ivoire.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Remains today a metabolic disease that is gaining ground. It is linked to some health complications that lead to disastrous consequences in terms of loss of human life. It is necessary to take measures to stem this pathology. So, a plant species has been tested for its effect on hyperglycemia indicator of diabetes.

Aim: Evaluate the antihyperglycemia effect of the aqueous extract of carapa procera bark.

Methodology: The aqueous extract of the bark of *Carapa procera* was tested on rats subjected to a high-calorie diet and the biochemical parameters were evaluated. In addition, a phytochemical characterization was carried out.

Results: The high-calorie diet caused an increase in weight as well as an increase of glycemia. The aqueous extract of *Carapa procera* stabilized the glycemia.

Conclusion: Aqueous extract of *Carapa procera* has an antihyperglycemic activity.

*Corresponding author: E-mail: raoulkouamekoffi@gmail.com;

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1. INTRODUCTION

Diabetes is a metabolic affection caused by the body's bad use of glucose, leading to chronic hyperglycemia. [1] According to the World Health Organization, diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin or when the body is unable to use the insulin it produces effectively. This results in an increase of sugar in the blood (glycemia): this is called hyperglycemia [2]. Diabetes is a real public health problem. According to figures from International Diabetes Day 2021, the number of diabetics in the world was 463 million in 2019 and reached 537 million in 2021, an increase of 74 million in 2 years and around 24 million people live with diabetes in Africa in 2021. The number of Africans suffering from diabetes is expected to reach 55 million by 2045, an increase of 134% compared to the data available in 2021. In Côte d'Ivoire, the Ministry of Health and Public Hygiene claims that there are 6.2% of people with diabetes in 2019.

Treatments for diabetes are generally based on the administration of insulin and antidiabetic or antihyperglycemic agents. Among these diabetes treatments, there are also phytotherapy or traditional medicine treatments. WHO encourages intensified research into avenues including those using traditional treatments based on medicinal Plants [3]. Medicinal plants according to ethnopharmacological studies are used in our societies for the medical management of so-called chronic pathologies and are the most reassuring way [4]. In general, medicinal plants contain bioactive molecules (saponins, alkaloids, sterol and terpenes and phenolic compounds) which are secondary metabolites with high therapeutic activity [5]. So, the plant species *Carapa procera* used in the traditional environment in Côte d'Ivoire for the treatment of some metabolic diseases such as diabetes, hypertension and obesity motivated this work, the general objective of which is to evaluate the anti-hyperglycemic effect of the aqueous extract of *Carapa procera* on rats placed on a hyperglycemic diet.

2. MATERIALS AND METHODS

2.1 Plant Extraction

The plant substance used for this study is a powder obtained from the bark dried of the stem

of *Carapa procera*. The animals used were female albinos rats native from Wistar source (*Rattus norvegicus*). The bark was cleaned, sorted, washed, then dried away from the sun for several days and then ground into a powder. The extract was prepared by infusion according to the following protocol: 30 g plant powder has been dissolved in 100 ml of boiling distilled water. The set has been left to rest for 10 min then filtered successively on absorbent cotton and on wattman paper. The filtrate obtained with an amount of 65 ml and a concentration of 300 mg/kg of body weight was administered by gavage to the animals.

2.2 Experimental

The animals used weighed an average of 200 g, the age was between 3 and 4 months. We chose the females because they have an ease of fat accumulation. The distribution of the spleens according to the treatments was made as follows: three (3) lots of four (4) animals each were made up as follows:

- 1 lot of animals subject to the normal diet receiving distilled water 10mL/kg;
- 1 lot of animals subject to high-calorie diet (HD) (hyperlipidic: 100% animal fat, hypercarbohydrate: simple sugar + complex sugar and normoprotein. Designed to induce experimental type 2 diabetes.) receiving distilled water 10mL/kg;
- 1 lot of animals subject to high-calorie diet (HD) treated with the aqueous extract of *Carapa procera* at a dose of 300mg/kg. The extract was administered by gavage twice a day: in the morning and in the evening for three weeks. The weight and glycemia of the rats were measured every three days, during the period of the experiment.

Twenty-four hours after the last gavage, the rats were fasted for 14 hours. The animals were then sacrificed and the blood collected. Blood samples were centrifuged at 3000 rpm for 5 minutes. The collected serum was aliquoted then sent for the dosage of the biochemical parameters to the clinical biochemistry laboratory of "Institut Pasteur de Côte d'Ivoire". The phytochemicals tests of the aqueous extract were carried out by the qualitative characterization technic of coloration. The four

main chemical groups saponosides, sterols and terpenes, alkaloids and phenolic compounds were searched.

2.3 Data Analysis

Statistical analyses were performed using the Graph Pad Pism 5 Demo software. The results are presented as the mean (\pm). The test of Student and the ANOVA test were used for the comparison of means. A value of $p < 0,05$ has been considered as significant. The significant statistical differences are presented in Table 2 by one star (*), very significant statistical differences by two stars (**), and very very significant statistical differences by three stars (***).

3. RESULTS

The results summarized in Table 1 show weight gain or loss. The statistical analyses of these values indicate that the rats treated with the extract and subjected to high-calorie diet did not show any significant value on their body weight compared to the control rats. However, we see weight gain body that gradually increase until the last day (day21) with the rats fed with high-calorie diet, not treated with the extract (positive controls).

The results summarized in the Table 2 present the different values of glycemia on control rats, rats submitted to high-calorie diet untreated and rats submitted to high-calorie diet treated with the extract. The glycemia with rats submitted to high-calorie diet untreated are significantly upper ($p < 0,05$) to those of control rats. For the rats group submitted to high-calorie diet and treated with plant extracts, the results show no increase in glycemia compared to the one of baseline.

4. DISCUSSION

During the past two decades, researches in herbal medicine have become one of the greatest scientific concerns [6]. Historically, medicinal plants have been used to prevent or treat various diseases. According to ethnopharmacological studies, more than 1200 plants are used throughout the world, in traditional medicine, for their biological activities [7].

The analysis of the body weight of rats subjected to high-calorie diet without treatment leads to a gradual increase in body weight. This shows that such a diet could cause overweight. The hypercaloric diet causing weight gain and hyperglycemia with rats not treated with the extract, could contribute to the onset of type II diabetes. This diet is the "high fat" that can lead to obesity, hyperinsulinemia and the alteration of the homeostasis glucose due to insufficient islet compensation [8]. After oral administration of the extract, a slight increase in body weight is observed on the treated rats compared to the control rats. This weight increase without significant difference is due to the normal growth of the rats. Phytochemical tests revealed the presence of saponosides, sterols and terpenes, alkaloids and phenolic compounds in the extract of *Carapa procera*. The substances contained in our extract would be responsible for the pharmacological activities of this extract. Indeed, substances such as polyphenols and flavonoids from the large group of phenolic compounds are generally recognized as having hypoglycemic effects [9-11]. This explains the anti-hyperglycemic effect of the extract of *Carapa procera* on the glycemia of the treated rats despite the fact that those ones they are subjected to the hypercaloric diet.

Table 1. Variation in body weight of control rats and rats treated with the extract

Day 3	Day 6	Day 9	Day 12	Day 15	Day 18	Day 21	
Control	+ 1.16	+0.46	+0.45	+0.19	-0.03	+0.48	+0.45
HD	+ 1.60	+ 1.40	+ 1.80	+ 2.2	+2.4	+2.9	+3.4
HD + Extract	+ 1.54	- 2.41	- 0.92	- 5.5	+0.07	+0.11	+0.10

(-): weight loss (+) weight gain

Table 2. Dosage of glycaemia of control rats and rats treated with the extract

Day 3	Day 6	Day 9	Day 12	Day 15	Day 18	Day 21	
WitnessHD	0.77	0.85	0.87	0.80	0.78	0.88	0.73
HD + Extract	0.96***	0.98**	1.20***	0.98**	1.15***	1.40***	0.98***
	0.87**	0.86	0.83	0.80	0.82	0.70**	0.71

5. CONCLUSION

This study showed that the hypercaloric diet leads to weight gain as well as increase of glycemia. The aqueous extract from the bark of *Carapa procera* induces hypoglycemia for doses equal to 600 mg/kg body weight and anti-hyperglycemic effects. Polyphenols and flavonoids from the large group of phenolic compounds could be the basis of the antihyperglycemic activity of our plant. This study therefore reveals that the extract has good hypoglycemic and anti-hyperglycemic potential, which justifies its use in traditional medicine in the treatment of diabetes.

CONSENT

As per international standard or university standard written ethical approval has been collected and preserved by the author (s)

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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