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Potential effect antidiabetic of a medicamentous receipt made up of *Parquetina nigrescens* (Periplocaceae) and *Erythrina senegalensis* (Fabaceae) and effects on the lipidic profile and the glycation of hemoglobin in rats diabetics

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Abstract
The medicinal recipe composed of *Parquetina nigrescens* (Periplocaceae) and *Erythrina senegalensis* (Fabaceae) is a remedy used in traditional medicine in Côte d'Ivoire to treat diabetes. this study aims to assess the potential anti-diabetic effect of the drug recipe (RPNES) and its effect on the lipid profile and hemoglobin glycation in diabetic rats. Diabetes mellitus is induced by an intraperitoneal injection of streptozotocin, dissolved in a citrate buffer solution, at a dose of 65 mg/kg BW and a nicotinamide solution at a dose of 230 mg/kg BW to Wistar rats. Healthy rats and diabetic rats are treated orally with RPNES daily for 28 days and blood samples from control and treated rats are taken for assay of biochemical parameters. This study shows that RPNES, administered at doses greater than or equal to 600 mg/kg BW, causes a significant decrease in blood sugar in diabetic rats. in addition, a significant decrease in serum total cholesterol and triglyceride levels, associated with an increase in serum HDL cholesterol level, was observed in diabetic rats which received RPNES at 800 mg/kg BW, after 28 days treatment. In addition, after 90 days of treatment, RPNES (800 mg/kg BW) induces a significant decrease in the percentage of glycated hemoglobin in diabetic rats. This study also revealed that, in diabetic rats, RPNES had antihyperglycemic and antidiabetic effects similar to those of glibenclamide. RPNES is also a hypolipemic substance which corrects lipid disorders associated with diabetes, normalizes HDL cholesterol and lowers HbA1c levels in diabetic rats. These results justify the use in traditional medicine of this medicinal recipe composed of *Parquetina nigrescens* and *Erythrina senegalensis* to treat diabetes.

Keywords: Diabetes, antidiabetic, glycated hemoglobin, hypolipemic, *Parquetina nigrescens*, *Erythrina senegalensis*, drug recipe

1. Introduction
Consistently elevated glucose levels lead to irreversible hemoglobin glycation and the formation of advanced glycation end products (AGEs) [1]. In fact, glycated hemoglobin (HbA1C) increases in response to chronic or prolonged exposure to glucose [2]. Thus, HbA1C is used both as an index of mean blood sugar and as a measure of risk for the development of complications of diabetes.
Diabetes is also associated with dyslipidemia characterized by both hypercholesterolemia and hypertriglyceridemia, two risk factors for cardiovascular disease [3]. Currently, there are over 366 million people with diabetes worldwide, with 3.2 million deaths per year [4]. Given the high incidence of vascular complications associated with diabetes mellitus, various studies are underway to find cures against it. Thus, an ethnobotanical survey carried out in Ivory Coast, identified *Parquetina nigrescens* (Periplocaceae) and *Erythrina senegalensis* (Fabaceae), two plants associated to obtain a medicinal recipe used by traditional healers for treat diabetes.
The aim of this study is to evaluate the potential anti-diabetic effect of the aqueous extract of this drug recipe (RPNES) and its effects on the lipid profile and on the glycation of hemoglobin in diabetic rats.

2. Materials and methods
2.1 Plant material
The plant material consists of dry leaves of Parquetina nigrescens (Periplocaceae) and *Erythrina senegalensis* (Fabaceae). The leaves of these plants were collected in Dimbokro (Côte dIvoire), in October 2018. They were identified and authenticated at the National Floristic Center (CNF) of the Félix Houphouët-Boigny University (Abidjan, Côte dIvoire) by

ASSI Jean, Technician in this research center, in comparison respectively with the herbaria CNF, numbers 15031 and 14625, of these plants discovered on 12/28/1979 and 01/17/1979 in the Bamoro forest (Bouaké, Ivory Coast) by the late Ake-Assi Laurent, Emeritus Professor of Botany at the UFHB.

2.2 Animal material

White rats, Rattus norvegicus (Muridae), are used for blood sugar studies. Their mass varies between 150 g and 200 g. They are reared in the animal house of the Biosciences Training and Research Unit (UFR), at the UFHB, at 25 ± 2 ° C, and under light during the day and dark at night. .they are fed with food supplied by the IVOGRAIN® company in Abidjan, and have free access to water.all experimental protocols on these animals are conducted in accordance with directive 2010/63/EU of the european parliament and of the council of 22 September 2010 on the protection of animals used for scientific purposes and under the .Commission recommendation 2007/526/EC concerning guidelines for the housing and care of animals used for experimental and other scientific purposes [5].

2.3 Methods

2.3.1 Preparation of the drug recipe extract

The preparation is made according to the method described by [6] seventy gram (70 g) of powder of dry leaves of *Parquetina nigrescens* and 30 g of powder of dry leaves of *Erythrina senegalensis* are put together in 1 L of distilled water. The mixture is brought to the boil at 100 ° C for 20 min. The decocté obtained is allowed to cool to room temperature (25-30 ° C) and filtered 3 times through cotton wool before being filtered with Whatman n °2 filter paper, then dried in an oven (Memmert, Germany) at 50 °C. The powder obtained constitutes the medicinal recipe (RPNES).

2.3.2 Study of the effects of the drug recipe (RPNES) on the glycemia of diabetic rats

2.3.2.1 Induction of experimental diabetes in rats

Diabetes is induced in rats by subcutaneous injection of streptozotocin (Sigma Aldrich, Germany) dissolved in citrate buffer solution (pH = 4.5) at a dose of 65 mg/kg BW. fifteen minutes (15 min) later, they receive a nicotinamide solution at a dose of 230 mg/kg BW subcutaneously.

Two weeks after the injection of streptozotocin, the rats with a fasting blood sugar level greater than or equal to 2 g/L are considered to be diabetic and selected for the study.

2.3.2.2 Methods for Measuring Blood Glucose in Rats

The method used is that described by [7, 1, 8]. Blood glucose is measured using an Accu-Chek Active® blood glucose meter, complete with test strips. This strip has an absorbent layer on which is deposited a drop of blood from an incision in the caudal end of the rat. The blood glucose value is given in g/L.

2.3.2.3 Studies of the effects of the drug recipe (RPNES) and glibenclamide on the glycemia of healthy rats and diabetic rats

In this study, 60 Wistar rats are fasted for 12 hours before the experiments and are divided into six (6) groups of 10 rats.

- Batch 1: Rats normoglycemic receiving only distilled water.
- Batch 2: Rats diabetics receiving only distilled water;
- Batch 3: Rats diabetics treated daily with the glibenclamide (antidiabetic substance of reference) with the amount of 10 mg/kg BW.
- Batches 4,5 and 6: Rats diabetics treated daily with respectively 400,600 and 800 mg/kg BW of RPNES.

These rats are given distilled water or the test substances orally. The experiment lasts 28 days and the blood sugar is measured at times D_0 (before the start of force-feeding), then D_7, D_{14}, D_{21}, and D_{28} corresponding to the 7th, 14th, 21th and 28th days respectively after the start of force-feeding

2.3.3 Studies of the effects of the drug recipe (RPNES) on the lipid profile and on the total hemoglobin level of healthy rats and diabetic rats

2.3.3.1 Experimental protocol

In this study, 40 Wistar rats were divided into 4 groups of 10 rats.

- Batch 1 is composed of healthy control rats (normoglycaemic) which receive distilled water.
- Batch 2 is composed of diabetic control rats receiving distilled water.
- Lots 3 and 4 are those of diabetic rats treated respectively with 800 mg/kg BW of RPNES and glibenclamide at a dose of 10 mg/kg BW.

The experiment lasts 28 days during which blood samples are taken from the retro orbital sinus [9] at time D_0 (before the start of force-feeding), then D_7, D_{14}, D_{21}, and D_{28} (7th, 14th, 21th and 28th days) afterstart of gavage, in dry tubes, and centrifuged at 4500 rpm for 10 minutes.the serum is collected in Eppendorf tubes and stored at -20 °C. while awaiting the assay of the lipid parameters and of the serum hemoglobin level.

2.3.3.2 Methods of assaying lipid parameters

Serum parameters related to lipid metabolism (total cholesterol, HDL-cholesterol and triglycerides) are assayed using a spectrophotometer of the BIOLABO Diagnostics type (France). This spectrophotometer used is equipped with a 9 positions incubator and an 18 µL micro-suction chamber.

Serum samples are analyzed by lipid profile markers the total cholesterol is determined by the CHOD/POD method [10]. HDL cholesterol is assayed according to the method described by Lopez-virella *et al.*, [11] and triglycerides are determined using the GPO/POD method [12, 13].

2.3.3.3 Method for determining the total hemoglobin

Level the serum total hemoglobin level is measured by the complete blood count carried out using the Sysmex brand electronic analysis counter (Diamond Diagnostics, USA) on the blood samples taken from the retro-orbital sinusrats in EDTA tubes at time D_0 (before the start of the force-feeding) and on the 7th, 14th, 21th and 28th days after the force-feeding.

2.3.4 Study of the effects of RPNES on the glycated hemoglobin (HbA1c) level of healthy rats and diabetic rats

2.3.4.1 Experimental protocol

Forty (40) Wistar rats are divided into 4 batches identical to those used for the assay of the lipid parameters.

But, for this study, the rats of each group are treated for 90 days. It is after 90 days of experimentation that the blood of the rats is taken from the retro-orbital sinus [9] in EDTA tubes for the determination of the level of HbA1c.

2.3.4.2 Method for determining the level of glycated hemoglobin (HbA1c)

The percentage of glycohemoglobin is assayed by the immuno-turbidimetric method [14, 1] using an automatic, electronic analysis counter of the Sysmex KX21N type (Diamond Diagnostics, USA).

From the hemolyzed blood, the total hemoglobin concentration is determined by measuring by photometry at 525 nm the hemoglobin released from the erythrocytes. The concentration of glycated hemoglobin is determined by measuring the absorbance at 625 nm of the complex formed of polyhapten and anti-HbA1c antibodies. The ratio of the two absorbances gives the percentage of HbA1c

2.3.5 Statistical analysis and plotting methods

Data analysis is done using GraphPad Instat software (San Diego CA, USA). The results are given as the mean followed by the standard error on the mean (M ± ESM). The difference between two values is determined by the Turkey-Kramer comparison test and is considered not significant for p> 0.05, not very significant for p <0.05 (*), significant for p <0.01 (**) and very significant for p <0.001 (***). GraphPad Prism 8 software (San Diego CA, USA) is used to plot the graphics.

3. Results

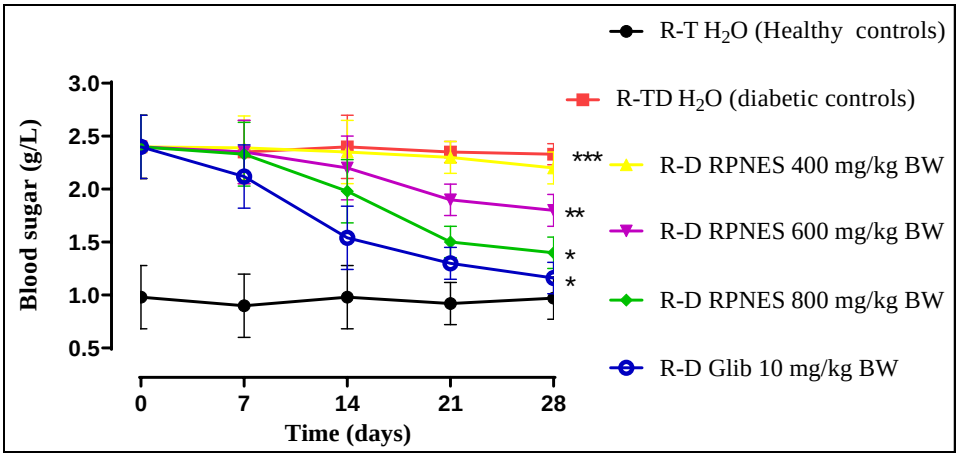
3.1 Dose-response effects of drug recipe (RPNES) and glibenclamide on blood glucose levels in diabetic rats

During the 28 days of the experiment, the glycemia in the healthy control rats (normoglycemic controls) did not vary significantly (p > 0,05). It is of the order of 0,98 ± 0,25 g/L (Figure 1).

After the injection of streptozotocin (STZ) into the rats, the glycemia of these animals increases from 0,98 ± 0,25 g/L to 2,40 ± 0,17 g/L ; that is to say an increase in blood sugar 1,42 ± 0,17 g/L (140 %). In the rats which are made diabetic and which are not treated (diabetic controls), this glycemia (hyperglycemia) does not vary significantly (p > 0,05) during the 28 days of experimentation.

The drug recipe extract (RPNES), administered at a dose of 400 mg/kg BW, had no significant effect (p > 0,05) on the blood glucose levels of diabetic rats. however, administered at doses of 600 and 800 mg/kg BW, RPNES causes significant (p < 0,01) and dose-dependent decreases in blood glucose from the 14th day of treatment. these reductions in blood sugar increased over time and, after 28 days of treatment with RPNES at 600 and 800 mg/kg BW, the blood sugar levels of the treated rats were no more than 1,80 ± 0,12 g/L and 1, 40 ± 0,10 g/L respectively; or reductions 42,25 % and 70,42 % (p < 0,001) of streptozotocin-induced hyperglycemia, respectively, when diabetic rats are treated with RPNES.

Likewise, from the 7th day of administration of glibenclamide, the glycemia of the treated diabetic rats drops significantly (p <0,01). Thus, the blood sugar level is no more than 1,16 ± 0,09 g/L on the 28th day; or 91,54 % reduction (p < 0,001) in hyperglycemia induced by streptozotocin in diabetic rats treated with glibenclamide.



n = 10; * p < 0.05; ** p < 0.01; *** p < 0.001 compared to healthy control rats

R-T H_2O : Normoglycemic control rats receiving only distilled water

R-TD H_2O : Diabetic Control Rats Receiving Distilled Water Only

R-D RPNES : Diabetic rats treated with RPNES at 400, 600 or 800 mg/kg BW

R-D Glib : Diabetic rats treated with glibenclamide (10 mg/kg BW)

Fig 1: Dose-response effects of the drug recipe (RPNES) and glibenclamide on the glycemia of diabetic rats

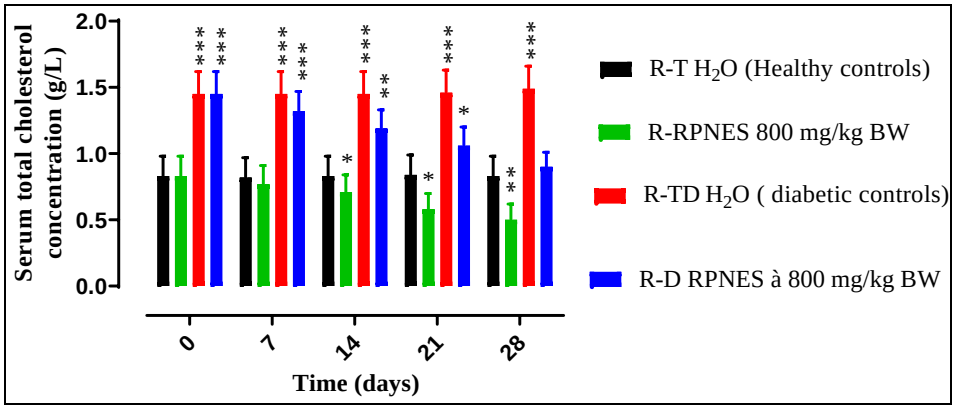
3.2 Effects of Drug Recipe (RPNES) on Serum Lipid Profile in Diabetic Rats

3.2.1 Effects of RPNES on the Serum Total Cholesterol Level of Healthy Rats and Diabetic Rats

The total serum cholesterol level of the healthy control rats is of the order of 0,83 ± 0,15 g/L, during the 28 days of the experiment (Figure 2).

After 7 days of treatment of healthy rats, RPNES at a dose of 800 mg/kg BW had no significant effect on the serum total cholesterol level of these animals. however, from the 14th day of treatment, RPNES causes a significant (p < 0,05) and progressive drop in total cholesterol in these healthy rats, up to the 28th of treatment. thus, this rate is 0,50 ± 0,12 g/L at the end of the treatment; that is a significant drop of 39,76 % (p < 0,01) compared to that of the healthy control rats.

On the other hand, when the rats are made diabetic, this rate increases significantly and reaches 1,45 ± 0,17 g/L; that is an increase of 74,70 % (p < 0,001) over that of the healthy control rats, then maintained (p < 0,05) throughoutthe duration of the experiment.after 7 days of treatment of the rats rendered diabetic with RPNES at a dose of 800 mg/kg BW, the total serum cholesterol level of these animals does not vary significantly (p < 0,05) compared to that of the diabetic control rats. But, from the 14th day, RPNES causes a significant (p <0,05) and progressive drop in the total cholesterol level in these diabetic rats. Thus, on the 28th day of treatment, this total cholesterol level is no more than 0,90 ± 0,11 g/L, therefore substantially identical (p < 0,05) to the cholesterolemia of the healthy control rats.



n = 10; * $p < 0,05$; ** $p < 0,01$; *** $p < 0,001$ compared to healthy control rats
R-T H2O : Normoglycemic control rats receiving only distilled water
R-RPNES : Normoglycemic rats treated with RPNES at 800 mg/kg BW
R-TD H2O : Diabetic Control Rats Receiving Distilled Water Only
R-D RPNES : Diabetic rats treated with RPNES at 800 mg/kg BW

Fig 2: Effects of the drug recipe (RPNES) on the serum total cholesterol level in healthy rats and diabetic rats

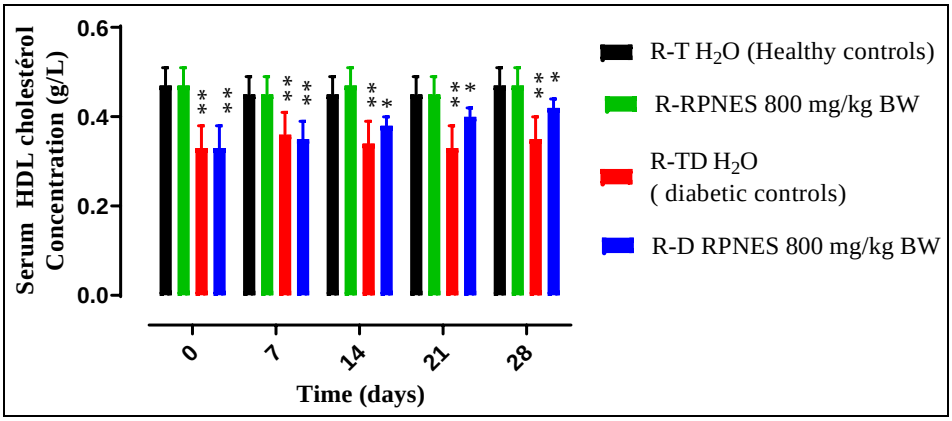
3.2.2 Effects of RPNES on Serum HDL Cholesterol Levels in Healthy Rats and Diabetic Rats

In healthy control rats, the serum HDL cholesterol (HDLc) level is 0,47 ± 0,04 g/L. This rate remains constant ($p > 0,05$) during the 28 days of experimentation (Figure 3).

similarly, the serum HDLc level of healthy rats treated with 800 mg/kg BW RPNES was not different ($p > 0,05$) from that of healthy control rats during this experiment.

In diabetic controls, this rate drops significantly to 0,33 ± 0,05 g/L; or 29,79 % decrease ($p < 0,01$) in serum HDL cholesterol level compared to that of healthy control rats, after induction of diabetes, then it isstabilizes ($p < 0,05$) until the end of the experiment. In diabetic rats treated with RPNES at a dose of 800 mg/kg BW, after 7 days of treatment, the HDLc level of the rats did not vary significantly ($p > 0,05$) compared to that of the diabetic control rats.

From the 14th day of treatment, this rate increases significantly ($p < 0,05$) and gradually. Thus, it goes from 0,33 ± 0,05 g/L (before treatment) to 0,42 ± 0,02 g/L on the 28th day of treatment, whereas in healthy control rats, the HDLc level is of 0,47 ± 0,04 g/L. This represents a hypocholesterolemia of 10,64 % ($p < 0,05$) compared to the HDLc levels of the healthy control rats and a reduction in hypocholesterolemia observed in the rats made diabetic by 64,29 %.



n = 10; * $p < 0,05$; ** $p < 0,01$ compared to healthy control rats
R-T H2O : Normoglycemic control rats receiving only distilled water
R RPNES : Normoglycemic rats treated with RPNES at 800 mg / kg BW
R-TD H2O : Diabetic Control Rats Receiving Distilled Water Only
R-D RPNES : Diabetic rats treated with RPNES at 800 mg / kg BW

Fig 3: Effects of Drug Recipe (RPNES) on Serum HDL Cholesterol Levels in Healthy Rats and Diabetic Rats

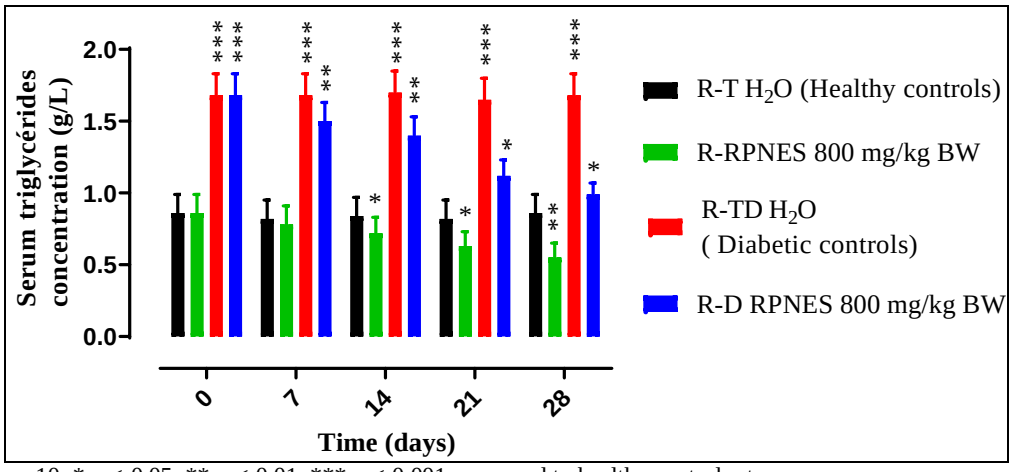
3.2.3 Effects of RPNES on the Serum Triglyceride Levels of Healthy Rats and Diabetic Rats

The serum triglyceride level of the healthy control rats is constant ($p > 0,05$) during the 28 days of experimentation. It is of the order of 0,86 ± 0,13 g/L.

From the 14th day of treatment of healthy rats, RPNES at a dose of 800 mg/kg BW causes a significant drop ($p < 0,05$) in the serum triglyceride level of these animals which is progressive until the end of the treatment. Thus, on the 28th day, this rate is 0,56 ± 0,10 g/L ; that is a significant drop ($p <$ 0,01) of 34,88 % compared to the triglyceride level in healthy control rats (Figure 4).

The serum triglyceride level of diabetic control rats increased after induction of diabetes and was maintained ($p > 0,05$) until the end of the experiment at 1,68 ± 0,15 g/L ; that is an increase of 95,35 % ($p < 0,001$) compared to thathealthy control rats.From the 7th day of treatment with RPNES at a dose of 800 mg/kg BW, the serum triglyceride level in diabetic rats decreases significantly ($p < 0,05$) and gradually. Thus, after 28 days of treatment, this level in diabetic rats

treated with RPNES is no more than 0,99 ± 0,08 g/L ; or a hypertriglyceridemia of 15,12 % ($p < 0,05$) which persists on the 28th day in diabetic rats treated with RPNES. Thus RPNES at 800 mg/kg BW reduced hypertriglyceridemia observed in rats made diabetic by 84,14 %.



n = 10; * $p < 0,05$; ** $p < 0,01$; *** $p < 0,001$ compared to healthy control rats
R-T H_2O : Normoglycemic control rats receiving only distilled water
R-RPNES : Normoglycemic rats treated with RPNES at 800 mg/kg BW
R-TD H_2O : Diabetic Control Rats Receiving Distilled Water Only
R-D RPNES : Diabetic rats treated with RPNES at 800 mg/kg BW

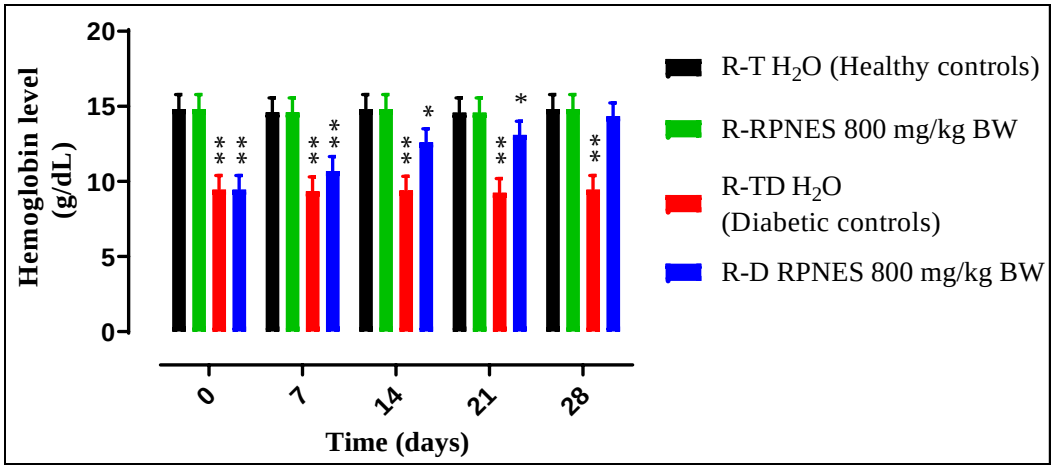
Fig 4: Effects of Drug Recipe (RPNES) on Serum Triglyceride Levels in Healthy Rats and Diabetic Rats

3.3 Effects of Drug Recipe (RPNES) on Hemoglobin Levels in Healthy Rats and Diabetic Rats

The hemoglobin level of the healthy control rats did not vary significantly during the 28 days of the experiment. This rate is of the order of 14,82 ± 0,97 g/dL **(Figure 5)**.

Similarly, the hemoglobin level of healthy rats treated with 800 mg/kg BW of RPNES remains identical ($p > 0,05$) to that of healthy control rats.

When rats are made diabetic by STZ, the hemoglobin level decreases from 14,82 ± 0,97 g/dL to 9,45 ± 0,95 g/dL; that is a significant drop of 36,23 % ($p < 0,01$) compared to that of the healthy control rats, then this rate remainsconstant ($p > 0,05$) until the end of the experiment in diabetic control rats. After 7 days of treatment of the rats rendered diabetic with RPNES at a dose of 800 mg/kg BW, a non-significant increase ($p > 0,05$) in the hemoglobin level of these animals appears. This increase continues over time and, thus, compared to the hemoglobin level of the diabetic control rats, becomes significant from the 14th day of treatment with RPNES. It drops to 14,35 ± 0,88 g/dL after 28 days of treatment; that is ther a normalization of the hemoglobin level which becomes statistically identical ($p > 0,05$) to that of the healthy control rats when the diabetic rats receive RPNES at 800 mg/kg BW.



n = 10; * $p < 0,05$; ** $p < 0,01$ compared to healthy control rats
R-T H2O : Normoglycemic control rats receiving only distilled water
R-RPNES : Normoglycemic rats treated with RPNES at 800 mg/kg BW
R-TD H2O : Diabetic Control Rats Receiving Distilled Water Only
R-D RPNES : Diabetic rats treated with RPNES at 800 mg / kg BW

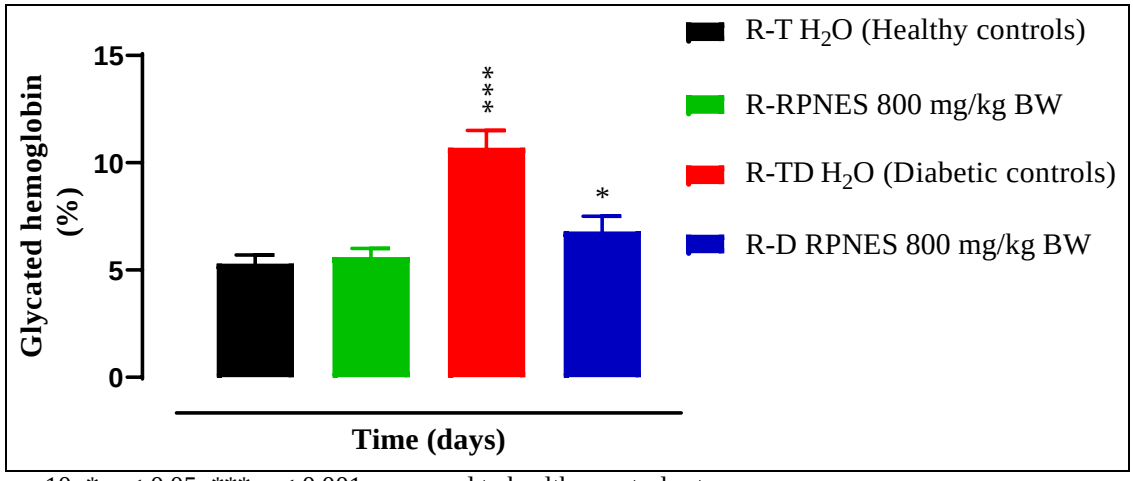
Fig 5: Effects of Drug Recipe (RPNES) on Hemoglobin Levels in Healthy Rats and Diabetic Rats

3.4 Effects of Drug Recipe (RPNES) on Glycated Hemoglobin Levels in Healthy Rats and Diabetic Rats

At the end of 90 days of experimentation, the level of glycated hemoglobin (HbA1c) of the healthy control rats (normoglycaemia) is 5,30 ± 0,40 % (Figure 6). This HbA1c level is statistically identical ($p > 0,05$) to that of healthy rats treated for 90 days with RPNES at 800 mg/kg BW.

On the other hand, the glycated hemoglobin level of the

diabetic rats is 10,70 ± 0,80 % ; or a significant increase (p < 0,001) in the HbA1c level of 101,89 % when the rats are made diabetic. when diabetic rats are treated for 90 days with RPNES (800 mg/kg BW), their HbA1c level drops from 10,70 ± 0,80 % to 6,80 ± 0,70 %. Thus treatment of rats for 90 days with RPNES results in a reduction in the increase in glycated hemoglobin level in diabetic rats by 72,22 % (p < 0,001).



n = 10; * p < 0,05; *** p < 0,001 compared to healthy control rats
R-T H_2O : Normoglycemic control rats receiving only distilled water
R-RPNES : Normoglycemic rats treated with RPNES at 800 mg/kg BW
R-TD H_2O : Diabetic control rats receiving only distilled water
R-D RPNES : Diabetic rats treated with RPNES at 800 mg/kg BW

Fig 6: Effects of the drug recipe (RPNES) on the level of glycated hemoglobin (HbA1c) in healthy rats and diabetic rats

4. Discussion

Injection of streptozotocin (a diabetogenic compound) into rats results in an increase in blood sugar which remains high, reflecting the onset of experimental diabetes following necrosis of the β cells of the pancreas. Streptozotocin (STZ) is an antibiotic isolated from a strain of bacteria: Streptomyces achromogenes [15], which causes the massive destruction of β cells in islets of Langerhans. Streptozotocin is taken up by the pancreatic β cell via the glucose transporter GLUT2. STZ deteriorates the oxidation of glucose and causes insulitis and decreased sensitivity of β cells to glucose [16]. Streptozotocin also induces the formation of free radicals which contribute to the destruction of pancreatic β cells. After their formation, these molecules act in synergy with STZ to generate DNA damage, thus leading to the diabetic state [17].

The hyperglycaemia which occurs following the injection of streptozotocin persisted during the 28 days of the experiment in untreated diabetic rats. On the other hand, when the rats rendered diabetic are treated with RPNES at doses greater than or equal to 600 mg/kg BW, or with glibenclamide, the hyperglycemia significantly decreases in a dose-dependent manner and the glycemia tends to return to the normal for the RPNES dose of 800 mg/kg BW, as for glibenclamide at 10 mg/kg BW. The same effects were observed by Saba *et al.*, [18] Kahou *et al.*, [19] and Bilanda *et al.*, [20]. In fact, these authors have shown that the aqueous extracts of *Parquetina nigrescens* (Periplocaceae), *Pseudarthria hookeri* (Fabaceae) and *Erythrina senegalensis* (Fabaceae) reduce hyperglycemia in diabetic rats.

It thus appears that RPNES, like glibenclamide, has antidiabetic properties. In fact, glibenclamide, administered on an empty stomach, stimulates insulin secretion, decreases the secretion of glucagon, inhibits the hepatic release of glucose and potentiates the effects of insulin in the liver [21]. The similar effects of RPNES with those of glibenclamide in diabetic rats suggest that this extract may act by the same mechanism as glibenclamide. Thus, the antidiabetic effects of the drug recipe could be induced by the increased secretion of insulin by the pancreas. More over, these effects of this extract could also be explained by a decrease in intestinal glucose uptake by an extrapancreatic which includes stimulation of peripheral glucose utilization, or by processesglycolytics and glycogenics with a concomitant decrease in glycogenolysis and gluconeogenesis [22].

The study of the effects of the aqueous extract of the medicinal recipe (RPNES) on the lipid profile shows that the treatment of healthy rats for 28 days with this extract at a dose of 800 mg/kg BW leads to a decrease in cholesterolemia and bloodtriglyceridemia. RPNES therefore has hypocholesterolemic and hypotriglyceridemic properties. Similar results have been reported by Kahou *et al.*, [3] who showed that *Pseudarthria hookeri* (Fabaceae) decreases cholesterol and triglyceride levels. The decrease in cholesterol and triglyceride levels by RPNES also indicates that this medicinal recipe would have cardioprotective effects and could prevent and reduce the risk of cardiovascular diseases.

When the rats are made diabetic by administration of streptozotocin, their total cholesterolemia and their triglyceridemia increase significantly compared to those of healthy control rats, while that of HDLc decreases. The hyperlipidemia observed following the injection of STZ is justified by a degradation of lipid reserves under the action of lipolytic hormones on adipose tissue. Indeed, Yousfi and Zadi [22] have shown that lipoprotein lipase (LDL) activity is reduced in diabetic mice. Khanna *et al.*, [23] indicate that the high abnormal concentration of serum lipids observed in diabetic subjects is mainly due to the increased mobilization of fatty acids from adipose tissue.

This study shows RPNES, administered at a dose of 800 mg/kg BW to diabetic rats, causes a significant increase in serum HDLc and a significant decrease in serum total cholesterol, while triglyceridemia decreases and normalizes. These results show that RPNES has antihyperlipidemic effects. RPNES, by increasing the level of HDL cholesterol or "good cholesterol", could prevent cardiovascular diseases.

Similar results have been reported by Kahou *et al.*, [3] who showed that the aqueous extract of *Pseudarthria hookeri* (Fabaceae) at a dose of 1200 mg/kg BW causes an increase in serum HDL cholesterol levels and a reduction in total cholesterol and triglyceride levels in diabetic rats after 28 days of treatment.

The decrease in lipidemia in diabetic rats treated with RPNES could be explained by a decrease in fatty acid synthesis or by an increase in the catabolism of LDL cholesterol. In fact, lecithin cholesterol acyltransferase (LCAT) is an enzyme responsible for transferring free cholesterol into esterified cholesterol which migrates to the center of the lipoprotein (HDL), which promotes the reduction in its concentrationplasma [24]. The decrease in cholesterol and triglycerides results from the modification of lipoprotein metabolism, the decrease in fatty acid synthesis [25], the activation of lecithin cholesterol acyltransferase (LCAT)and tissue lipases [23] and/or acetyl-CoA carboxylase inhibition [26]. This reduction would also be due to the production of triglyceride precursors such as acetyl-CoA and glycerol phosphate.

The decrease in total hemoglobin is to the benefit of the increase in glycated hemoglobin (HbA1c). Glycated hemoglobin (HbA1c) increased in diabetic rats by more than 10 % compared to the healthy control group (5,3 %), while total hemoglobin decreased by 56,82 % compared to that in healthy control rats. this indicates poor glycemic control for hyperglycemia in diabetic rats [3, 27]. The significant increase in the percentage of HbA1c in untreated diabetic rats is explained by the binding of a sugar to the N-terminal amine function of a protein (NH2) of the β chains of hemoglobin A1 [28, 29]. The percentages of HbA1c decrease after administration of RPNES to diabetic rats. This is shown by the increased total hemoglobin level in treated diabetic rats. Similar results have been reported by Kahou *et al.*, [3] who also demonstrated that the aqueous extract of *Pseudarthria hookeri* (Fabaceae) has antihyperglycemic effects and reduces the level of HbA1c in diabetic rats.

5. Conclusion

This study shows that the drug recipe (RPNES), administered at doses of 600 and 800 mg/kg BW significantly reduced hyperglycemia in diabetic rats just like glibenclamide. Thus, RPNES has antihyperglycemic and antidiabetic properties. In addition, total cholesterol and triglyceride levels were significantly reduced in diabetic rats treated with RPNES at 800 mg/kg BW. RPNES is therefore a hypolipemic substance which corrects lipid abnormalities associated with diabetes. In addition, RPNES normalizes HDL cholesterol and lowers HbA1c (HbA1c < 7%) in diabetic rats and provides better blood sugar control thanks to its antihyperglycemic and hypolipemic properties. Thus, RPNES is found to be an anti-diabetic substance which normalizes glycemic control and corrects lipid disorders in diabetics. This justifies the use by traditional therapists of this medicinal recipe composed of *Parquetina nigrescens* and *Erythrina senegalensis* to treat diabetes.

6. References

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