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Antihyperglycemic Effect of Aqueous Extract of *Boscia Senegalensis* in Rabbits

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ABSTRACT

Introduction

Diabetes is a serious chronic disease that occurs when the pancreas does not produce enough insulin or when the body does not properly use the insulin produced. A distinction is made between type 1 and type 2 diabetes, which increases the risk of death. This work aims to study the anti *hyperglycemic effect of B. senegalensis* used in Chad to fight type II diabetes and metabolic syndrome.

Methodology

The Oral Glucose Tolerance Test was carried out, causing hyperglycemia in rabbits, followed by the incorporation of aqueous extract of *Boscia senegalensis* in the treatment batch. Then, a toxicity study was carried out using a standard method.

Results

The results showed that in treated rabbits, the incorporation of aqueous extract of B. *senegalensis* after *glucose administration, led to a drop in blood sugar (1.35mg*/dl to 1.22 mg/dl). The increase in blood glucose in control rabbits (1.23 mg/dl to 1.38 mg/dl) due to glucose administration persisted. The ratio of organ weight and body weight of the two lots of rabbits showed no significant difference.

Conclusion

This study confirmed the safety of *B. senegalensis* extract and reduce significantly the rate of glucose in the blood fighting against type 2 diabetes.

Keywords: hyperglycemia, *Boscia senegalensis, toxicity.*

Introduction:

Today, diabetes is a major public health problem (WHO, 2016). According to the World Health Organization (WHO), the world will have 300 million diabetics in 2025 (Carmoi et al., 2007). The global (age-standardized) prevalence of diabetes has almost doubled since 1980, from 4.7% to 8.5% in the adult population (WHO, 2016). In 2013, almost half of all adult diabetes deaths were recorded in the under-60 age group and in less developed regions such as sub-Saharan Africa (IDF, 2013). Indeed, diabetes is a

metabolic disease characterized by a chronic abnormal rise in blood sugar levels. This increase in blood sugar is caused by a dysfunction in the secretion or action of insulin. Most often, diabetes cases fall into two categories: type 1 or insulin-dependent diabetes and type 2 or non-insulin-dependent diabetes.

The descriptive epidemiological survey ENTRED 2007 (National Representative Control Sample of Diabetics) shows that the vast majority of people (90%) have type 2 diabetes (Druet, 2013). Type 2 diabetes or non-insulin-dependent diabetes is characterized by chronic hyperglycemia whose pathophysiological elements include increased resistance of peripheral tissues (liver, muscle, adipose tissue) to the action of insulin (Braillard and Gastaldi, 2017). This form of diabetes is most often established in adults and overwhelmingly overweight. Type 2 diabetes is a cause of premature death in France at an average age of 74 years for men and 80 years for women (InVS et al., 2010). Possible complications of type 2 diabetes include myocardial infarction, stroke, insufficiency, leg amputation, vision loss, and other complications (WHO, 2016).

In addition, there are many antidiabetic treatments such as drugs that improve insulin sensitivity or, at the very least, reduce insulin requirements in the case of type 2 diabetes (Scheen, 2003), such as metformin, thiazolidinediones or glitazones. To this must also be added hygienic-dietary measures such as regular physical activity and good food hygiene (Roriveet al., 2005).

In addition, these essential medicines, which are essential for controlling diabetes, are rarely available in low- and middle-income countries (WHO, 2016). To this end, people are leaning towards traditional medicine in order to find a solution to their problem. With this in mind, this work aims to evaluate the anti-hyperglycemic effect of the aqueous *extract of* Boscia senegalensis used in Chad to fight type II diabetes and metabolic syndrome.

Material and methodology:

Hardware

Plant material

Bare seed samples *of Boscia senegalensis* (Figures 1 and 2)
(Capparaceae) which were the subject of this study were purchased from the weekly market of Bokoro located 300km east of Ndjaména (Chad).

Figure 1: Boscia senegalensis seeds

Figure 2: Boscia senegalensis bare seeds

Boscia senegalensis is a multicrop shrub of the capparaceae family, ranging in height from 2 to 3 m (Becker 1983). It is a ubiquitous species with various anatomical devices allowing it to store the water it uses in the dry season, which gives it a good adaptation to the arid environment (Mahamane and SAADOU, 2009). The species grows as a green bush, with a rounded and dense crown. Its geographic area includes Burkina Faso, Cameroon, Côte d'Ivoire, Ethiopia, Mauritania, Mali, Nigeria, Niger, Senegal, Sudan and Chad (Mamounataet al., 2017; Arbonnier, 2000). The fruits of Boscia senegalensiare berries of spherical shape, usually of diameter between 12 and 15 mm, containing 1-4 seeds, which parts of the plants used in this study.

Experimental animals

The experimental animals (n = 16) are rabbits of the breed «fauve de bourgogne» from the pet shop of the Food Quality Control Center (CECOQDA). The young rabbits are three (3) months old and average weight about 1kg. They are placed in four cages 2m long, 1.5m wide and 1m high (4 animals/cage). During a 7-day acclimatization period (40-45°C), they are fed *ad libitumwith a standard food (Food formulated by the bromatology department of the* Institut de Recherche en Élevage pour le Développement, IRED). Thus, each rabbit is entitled to 94.9g of concentrate per day. This amount is significantly increased as rabbits grow. To this must also be added the fresh leaves of the panicum (herbaceous plant of the scientific name Panicum maximum).

Method

Extraction: Maceration

The extraction process consisted of weighing 15 g of powder from B. senegalensis*ob seeds* after mixing with a mixer (panasonic). The weighed sample was introduced into a beaker containing 100 ml of distilled water. Once homogenized, the mixture was brought to a boil at 80°C for 1 hour using a magnetic stirrer and placed in a refrigerator for settling for 24 hours. The resulting solution was filtered with a strainer and the filtrate thus collected was then centrifuged. The dry extract obtained served as a solution for gavage of rabbits.

Oral Glucose Tolerance Test (OGTT)

This test was carried out according to the method of Normand (2020). Four (4) lots of four rabbits each, of both sexes, were constructed. To avoid situations of gestation, the males and females were not in the same cages. Rabbits on an empty stomach 4 hours before the start of the experiment, were previously weighed and marked with a marker at the ears to allow individual identification. Then, using a glycometer, the basic blood glucose of each rabbit previously restrained was taken at a time T0, followed by the

administration of glucose (10%) at a dose of 2g/kg body weight to each rabbit in the treatment batch (n=8) and those in the control batch (n=8), to observe the evolution of blood sugar. After 15 minutes, the blood sugar of each rabbit in the two batches was collected. Then, each rabbit in the treatment batch (n=8) received at a dose of 2g/kg body weight a solution of aqueous extract of *Boscia sénegalensis*. The rabbits in the control batch received the same dose of demineralized water. In the rest of the experiment, the blood sugar of each rabbit was taken every 15min for 75min, or 1h15min.

Toxicity: standard NOEL method (No Observed Adverse Effect Level)

One week after the glucose tolerance test, rabbits in the treatment lot (n=8) were subjected to gavage with aqueous extract of *Boscia sénegalensis* at a dose of 2g/kg body weight for a period of seven days. During the experiment, rabbits were weighed two days after each gavage. In addition, those in the control batch (n=8) had a normal diet without any modification.

After the seventh day of gavage, the sixteen rabbits were sacrificed to the pet store of the Food Quality Control Center (CECOQDA) according to the protocol of the laboratory. Once sacrificed, the organs of each rabbit in the two lots were removed and weighed for comparison. To do this, we determined the Organ/Body Weight ratio of each rabbit in the two batches, such as:

$$RO/P = \frac{PO\ (Kg)}{PC\ (g)}$$

RO/P: ratio of organ Weight

PO: organ weight

BW

Data analysis

The data was processed by the Excel software. The statistical analysis of the obtained values was carried out according to the student test, and the threshold of statistical significance was set at 5%.

Results and discussion

Results

- Following the glucose tolerance test, the results are given in figure 1 below:

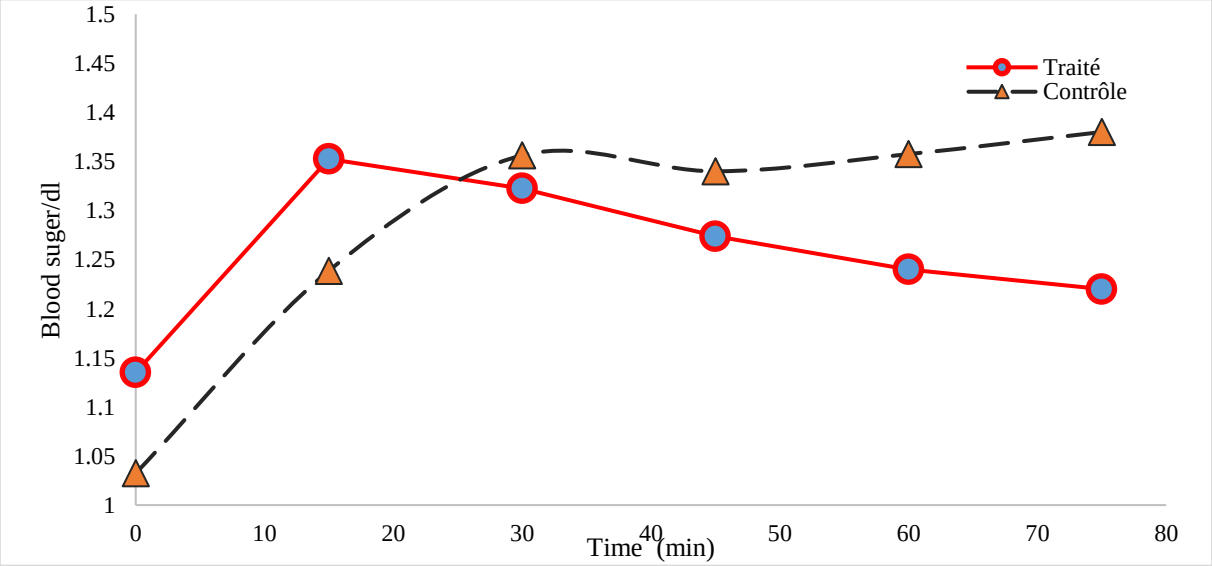

Figure 1: Study of the effect of *Boscia senegalensis* extract on acute blood glucose in rabbits.

The figure above illustrates the evolution of blood sugar in rabbits as a function of time From time T_0 to time T_{15}, after administration of glucose solution to two lots of rabbits, and before administration of *Boscia senégalensis* extract to treated rabbits, we find that the blood sugar of the treated rabbits is higher than that of the control rabbits, namely the respective values of (1.13 to 1.35 mg/dl) and (1.03 to 1.23 mg/dl). From time T_{30} *(T=30 min), the blood sugar of the treated rabbits drops to 1.32 mg/dl, following the incorporation of the Boscia senegalensis* extract, while the blood sugar of the control rabbits continues to increase, under the effect of the administration of glucose solution, and rises to 1,36mg/dl. For the control batch, an amount of demineralized water equivalent to the amount of *Boscia senegalensisa* extract solution *was administered by the same approach.*

This drop in blood sugar in rabbits receiving the *Boscia senegalensis* acqueux extract, *becomes persistent and significant at the 5% threshold compared to that of the control rabbits which remained higher until the end of the experiment at* T_{75} (T = 1h15min).

- Following the removal of the various organs, following the gavage of the rabbits, according to the Noel toxicity method, a comparative study between these different organs was conducted by determining the Organ Weight/ Body Weight ratio of the rabbits. The results are presented in Tables 2a, 2b, 2c, 2d, 2e below:

Table 1: Summary of Organ Weight/Body Weight Ratio of Treated Versus Control Rabbits

Average body weight (kg)			**Average organ weight (g)**		**Organ Weight/Body Weight Ratio (g/kg)**		**P – value***
Witnesses	**Treaties**	**Organs**	**Witnesses**	**Treaties**	**Witnesses**	**Treaties**	
1.240625	**1.131875**	Heart	3.241	2.591	2.560	2.378	**0.205**
		Left kidney	3.292	2.901	2.649	2.664	**0.470**
		Right kidney	3.346	3.031	2.705	2.759	**0.369**
		Rate	0.297	0.336	0.238	0.319	**0.064**
		Liver	26.197	23.726	20.357	21.257	**0.311**

Following the determination of the organ weight/body weight ratio, the above table shows that for each organ sampled, in particular, the liver, kidneys and spleen sampled from rabbits treated with aqueous extract of *Boscia senegalensins* imperatively to those of control rabbits, there is no significant difference at the 5% threshold. Indeed, the incorporation of the aqueous extract of *Boscia senegalensis*, in the treated rabbits did not lead to any modification of the organs, that is to say no atrophy or hypertrophy of the organs was observed.

Discussion

The results obtained after the study on the effect of Boscia senegalensissur extract on acute blood sugar, showed a decrease in blood sugar in treated rabbits after administration of Boscia senegalensis extract.

These results support those obtained by Bruno et *al.,* (2013) on the study of Boscisucrophage (extract *Boscia senegalensis)* on acute glucose in Winstar rats. They also confirm the results obtained by Sakine et *al.,* (2011) on the antihyperglycemic effect of extracts of *Boscia senegalensis* (Pers.) Lam. Ex Poiret and de *Colocynthis vulgaris* (L.).

The toxicity study using the standard NOEL method after seven days of gavage with the aqueous extract of *Boscia senegalensis,* led us to the observation that the organ weight/body weight ratio of rabbits showed

no significant difference. Thus, the incorporation of the acqusal extract of *Boscia senegalensis* has made no changes to the organs removed. From this study, it seems that the extract of *Boscia senegalensisne* has no toxic effect on the organs. For this purpose further studies of the extract of *Boscia senegalensis sur rabbits allow us to describe the process.*

These results confirm those obtained by Bruno et *al.*, (2013).

In addition, the observation made during the weighing of the various organs of the rabbits of the two lots is logically that the higher the body weight of the animal, the greater the organ weight. This can be explained by the phenomenon of relative growth in rabbits. Relative growth is the growth of a tissue, organ or apparatus in relation to the development of the organism.

Conclusion

This study allowed us to confirm the anti-hyperglycemic effect of Boscia senegalensis. After incorporation of the aqueous extract of Boscia senegalensis in rabbits, following the induction of glucose, there is a decrease in sugar absorption, which materialized by decrease in blood sugar in treated rabbits. This incorporation of Boscia sénegalensis did not lead to any modification of the organs in these rabbits, which confirms the safety of the latter, hence its use by the population affected by diabetes.

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