Research Paper

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Evaluation of Hypoglycemic Effect of Aloe Vera in Guinea-Pigs

Medical Science

KEYWORDS : Hypoglycemic effect, Aloe vera, guinea-pig

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ABSTRACT

The objective of this study was to evaluate the hypoglycemic effect of the methanolic extract of Aloe vera plant's leaves on cavia porcellus, used in Congolese traditional medicine for diabetes treatment. A hyperglycemia test caused orally was done on 24 guinea-pigs divided into 3 groups of 8 guinea-pigs each. The first group (group 1), received 2 g/kg of glucose solution, and 6 mg/kg of physiological saline solution (control); the second group (group 2) received the same amount of glucose, then 6 mg/kg of glibenclamide solution (oral antidiabetic); the last group (group 3) received the same amount of glucose, with 300 mg/kg of methanolic extract of Aloe vera plant's leaves. For glycemia test, blood samples were taken 15 minutes before the overload in glucose (T –15), then a few seconds before this overload (T0), and finally 15 minutes (T15), 30 minutes (T30), 60 minutes (T60), 90 minutes (T90), 120 minutes (T120), 150 minutes (T150) and 180 minutes (T180) after the overload in glucose.

In group 1, the glycemia increased by 73% at T15 to reach the peak at T60, i.e. an increase of 136% compared to baseline (T0). This increase in glycemia was significantly higher than that observed at the same time in groups 2 and 3. Then, between T 90 and T180, we observed in group 1 a progressive reduction of glycemia. But this reduction was significantly weaker than that observed in groups 2 and 3. When we compared the glycemia evolution in animals of groups 2 and 3, we observed the same increase at T15, respectively 47% and 53%. However, in group 3, glycemia continued to increase to reach the peak at T30, i.e. an increase of 92% compared to baseline, although in group 2, glycemia started to decrease at T30. We concluded that the methanolic extract of Aloe vera plant's leaves has a hypoglycemic effect but this effect is weaker than that of glibenclamide.

INTRODUCTION

The sweetened diabetes became in less than one quarter century a public health concern in developing countries. It appears among the five main chronic diseases for which the World Health Organization published a report inviting to take action (TAYLOR et al., 1994).

According to the calculations, Africa will face the most significant progression of diabetics in the world from 2013 to 2035. The number of people suffering from diabetes in this continent will increase by 109 % during the twenty next years, passing from 19, 8 to 41,5 million in 2035. On this date, the prevalence of this disease will reach 6% of the African population (BENHAMOU, 2005).

In Democratic Republic of Congo (DRC), the prevalence of diabetes varies between 5-7% and the case fatality rate in rural hospital areas is 12% (BIELELI et al., 2000; ILUNGA, 2004).

Most Africans believe that once a disease is treated, thus that it is cured. It is very difficult to a patient to admit that his disease is incurable and to be subject to medicinal treatment all the rest of his life. Thus, many patients stop their treatment and turn towards the traditionalist practitioners who promise a complete cure to them. Moreover, the character of chronicity of diabetes which imposes a medicinal treatment for life and generates a permanent expenditure to the patient and his family makes very difficult the access to the treatment in poor countries like DRC. However, although a recent study (TSHIBUMBU et al., 2013) proved the hypoglycemic properties of Vitex madiensis, another study (MWAMBA, 2004) had shown that many plants used in the traditional medicine for diabetes treatment in DRC do not have any hypoglycemic effect. Consequently, the main objective of this study was to evaluate the hypoglycemic activity of Aloe vera, plant commonly used in DRC, on guinea-pigs overloaded beforehand in glucose.

STUDY AREA, MATERIEL AND METHODS

Study area

This study was conducted in Lubumbashi, the second city of DRC. This city is located at 12° 36' 19 "of Southern latitude, 27° 28' 51" of longitude, and 1268 m of altitude. Its climate is characterized by 6 months of dry season which are succeed by 6 months of rains season. The annual average temperature is 20° C (LE BLANC and MALAISSE, 1978).

Material

Vegetable material: the vegetable material used was the leaves of Aloe vera. The powder of these leaves was obtained after drying in the shade and the free air, then manual crushing using metallic mortar and pestle.

Animals: 24 males guinea-pigs (Cavia porcellus L.) bought 12 days before the experimentation in various markets in Lubumbashi were kept in cages under the same conditions. These animals had an average weight of 416 ± 38 g and were fed with granules for rodents and fodder. The animals had unrestricted access to water throughout the experiment. Before the beginning of the experimentation, the animals were subjected to a food fast of approximately 10 hours.

Small material: glass wares, metallic mortar and pestle, wadding, syringes, gloves, filter papers, razor blades, stop watch and reactive strips.

Equipment: analytical balance, freezer, sterilizer, rotary evaporator, refrigerator, hotplate and glucometer.

Reagents and solvents: distilled water, denaturized alcohol, dimethylsulfoxyde, methanol, solutions of glucose and glibenclamide.

Methods

Preparation of the solutions: the preparation of methanolic extract of Aloe vera plant's leaves, and of glucose and glibenclamide solutions were carried out according to procedures described by TSHIBUMBU et al. (2013).

Dosage of glycemia: the determination of glycemia in

guinea-pigs was done using the glucometer according to the method described by NZUZI et al. (2014). The dosage of glycemia was initially carried out in all guinea-pigs 15 minutes (T_{-15}) and a few seconds before the oral administration of a glucose solution (2g/kg), then 15 minutes (T_{15}), 30 minutes (T_{30}), 60 minutes (T_{60}), 90 minutes (T_{90}), 120 minutes (T_{120}), 150 minutes (T_{150}), 180 minutes (T_{180}) and 210 minutes (T_{210}) afterwards.

Test of in vivo activity: the biological tests with methanolic extract of Aloe vera leaves on the 24 guinea-pigs were led as follows:

Group 1: it included 8 guinea-pigs which received the solution of glucose (2 g/kg) in addition to the physiological saline solution (6 ml/kg).

Group 2: including 8 guinea-pigs which received the solution of glucose (2 g/kg) in addition to the glibenclamide solution (6 mg/kg).

Group 3: it included 8 guinea-pigs which received the solution of glucose (2 g/kg) in addition to methanolic extract of Aloe vera leaves (300 mg/kg)

Statistical analysis : the differences of the mean concentrations of glycemia between the 3 groups were assessed using an analysis of variance for repeated measures with the treatment (physiological saline solution, glibenclamide solution, methanolic extract) and the time of sampling as main factors of variation (SAS, 1989). Animals' effects were assumed to be random. The statistical significance was declared at 95% confidence interval level ($P < 0.05$).

RESULTS

The results obtained are recorded in table I and figure 1.

Table I. Mean concentrations of glycemia (mg/dl) in guinea-pigs overloaded in glucose before receiving physiological saline solution (group 1), glibenclamide solution (group 2) and methanolic extract of Aloe vera leaves (group 3).

Time (minutes)	Group 1	Group 2	Group 3
T_{-15}	82.4 ± 8.7^{a}	87.6 ± 7.9^{a}	90.6 ± 8.2^{a}
T_{0}	88.0 ± 10.3^{a}	85.8 ± 5.2^{a}	84.0 ± 9.4^{a}
T_{15}	152.2 ± 17.9^{a}	126.5 ± 6.4^{b}	129.1 ± 15.6^{b}
T_{30}	195.0 ± 13.8^{a}	108.2 ± 7.8^{b}	161.3 ± 18.0^{c}
T_{60}	207.6 ± 23.3^{a}	89.0 ± 4.6^{b}	122.9 ± 13.1^{c}
T_{90}	173.5 ± 14.4^{a}	84.4 ± 5.7^{b}	88.4 ± 11.9^{b}
T_{120}	120.8 ± 10.1^{a}	78.2 ± 8.0^{b}	86.7 ± 14.5^{b}
T_{150}	93. 3 ± 12.5^{a}	85.7 ± 8.1^{ab}	81.4 ± 8.7^{b}
T_{180}	88.2 ± 8.4^{a}	92.4 ± 7.4^{a}	86.2 ± 10.1^{a}
T_{210}	92.7 ± 10.3^{a}	88.1 ± 5.9^{a}	91.9 ± 10.8^{a}

All enumerated values in the table are means ± SE, with n = 8.

$^{a, b, c}$ The mean values in the same line which do not have a common letter in index are significantly different ($P < 0.05$).

The examination of table I allows to make the following observations:

At T_{-15}, T_{0}, T_{180} and T_{210}, the mean concentrations of glycemia were statistically equal for the 3 groups of guinea-pigs.

At T_{15}, we observed an increase in glycemia in the 3 groups but this increase was significantly more considerable ($P < 0.05$) in group 1 than in groups 2 and 3.

In group 2, we reached already the peak value of 126.5 mg/dl, i.e. an increase of 47% compared to the baseline.

At T_{30}, glycemia started to decrease in group 2 while it continued to increase in groups 1 and 3. However this increase was more important ($P < 0.05$) in group 1 than in group 3. In addition, it was at T_{30} that the peak value (161.3 mg/dl) was reached in group 3, i.e. an increase of 92% compared to the baseline.

At T_{60}, glycemia continued to decrease in group 2 to reach the lower values than the physiological standards at T_{90} and T_{120}. In group 3, it started to decrease while in group 1, it continued to increase to reach the peak value of 207.6 mg/dl, i.e. an increase of 136% compared to the initial value.

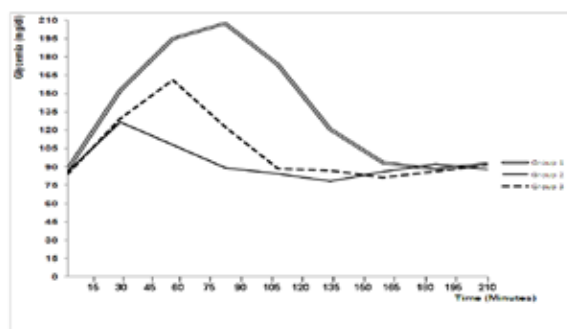

Figure 1. Kinetic evolution of glycemia in guinea-pigs overloaded in glucose before receiving either physiological saline solution (Group 1), glibenclamide solution (Group 2) or methanolic extract of Aloe vera leaves (Group 3)

The examination of figure 1 showed that in group 1, glycemia increased quickly after the overload in glucose and holded a long time at high values compared to the two other groups. In group 2, glycemia increased slightly and decreased more quickly while in group 3, it adopted the same pattern as in group 2 with the only difference that the rising was more important and the decreasing slower than in group 2.

DISCUSSION

In the present study, guinea-pigs were divided into three groups, in proportion of eight guinea-pigs by group, to that were given either physiological saline solution (group 1), glibenclamide solution (group 2) or the methanolic extract of Aloe vera leaves (group 3) after being overloaded in glucose.

The results obtained in guinea-pigs of group 1 gave an idea on the feature of glycemia in the animals that had not received any antihyperglycemic treatment after an overload in glucose. We noted that in this group 1, glycemia increased by 73% at T_{15} after the overload in glucose and reached the peak value (207.6 mg/dl) at T_{60}, i.e. an increase of 136% compared to the initial value. This increase in glycemia observed in group 1 was significantly more consid-

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erable ($P < 0.05$) than that observed at the same time in groups 2 and 3. Then, between T_{90} and T_{180}, we observed a progressive decrease in glycemia but this decrease was significantly slower ($P < 0.05$) than that observed in groups 2 and 3. The profile of glycemia in guinea-pigs of group 1 was similar to that generally observed in man (HENNEN, 1996) and in animals (TSHIBUMBU, 2013) after a hyperglycemia test caused orally.

The glycemia decrease which was observed between T_{90} and T_{180} was certainly due to a significant secretion of insulin by the pancreas to restore glucidic homeostasis (CLERCK, 1988). With regard to the animals of groups 2 and 3, we observed an increase in glycemia of the same magnitude at T_{15} ($p > 0.05$), respectively 47% and 53 %. But in group 3, glycemia continued to increase to reach the peak value at T_{30}, i.e. an increase of 92% compared to the initial value, whereas in group 2 glycemia started to fall. In animals of group 3, the fall of glycemia started at T_{60}, i.e. 15 minutes after that of animals of group 2.

Glibenclamide is a molecule which belongs to the family of the hypoglycemic sulfamides and which is generally used in type II diabetes' treatment. It acts by stimulation of the insulin secretion by the β cells of the pancreas (GERD, 2004).

In this study, this effect of glibenclamide was demonstrated by the weakest increase and the highest and fastest decrease of glycemia which were observed in group 2 guinea-pigs, compared to those of groups 1 and 3.

The comparison of the results of groups 1 and 3 showed that the increase in glycemia after the overload in glucose was significantly weaker ($P < 0.05$) in group 3 than in group 1. In the same way, the decrease in glycemia was significantly faster ($P < 0.05$) in group 3 than in group 1.

Our observations were similar with those of TSHIBUMBU et al. (2013) on Vitex madiensis and indicated that the methanolic extract of Aloe vera leaves had really a hypoglycemic effect. Yet, this effect was weak in comparison with that of glibenclamide and, perhaps that by increasing the extract methanolic dose, we could have an antihyperglycemic effect much higher.

Actually, the problem of the dose is often difficult to solve in this kind of experimentation as in MWAMBA's study (2004) using extracts of several plants well identified by the traditionalist practitioners like having antibiabetic effects, no antihyperglycemic effect was observed after administration in diabetics.

CONCLUSION

This study was conducted on traditional medicine treatment of the sweetened diabetes in DRC. We studied in guinea-pigs overloaded previously in glucose the hypoglycemic effect of methanolic extract activity of Aloe vera leaves, plant used in Congolese traditional medicine for diabetes treatment. In guinea-pigs having received 300 mg/kg of methanolic extract of Aloe vera, glycemia passed from 84.0 mg/dl at T_0 to 129.1 mg/dl at T_{15} to reach the peak value of 161.3 mg/dl at T_{30}, i.e. an increase of 92% compared to the initial value. Then, it decreased gradually between T_{60} and T_{150}. The increase in glycemia obtained in guinea-pigs treated with the methanolic extract of the plant was significantly more considerable than that obtained in guinea-pigs treated with gibenclamide solution but significantly slower than that obtained in guinea-pigs treated with the physiological saline solution. In the same way, the reduction in glycemia perceived in guinea-pigs treated with the plant was significantly slower than that obtained in guinea-pigs treated with glibenclamide solution but significantly faster than that obtained in guinea-pigs treated with the physiological saline solution.

We concluded that the methanolic extract of Aloe vera leaves had a hypoglycemic activity but this activity is weaker than that of glibenclamide.

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