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Effect of Aqueous Extract of *Phaseolus Vulgaris* on the Regulation of Glucose and Lipid Metabolism in Diabetic Rats

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Abstract: *The objective of this work was to evaluate the hypoglycemic and lipid-lowering effect of the aqueous extract of Phaseolus vulgaris in rat rendered diabetic by diet. The effects of the nutritional supplementation of Phaseolus vulgaris, at the rates of 300 mg / Kg in high carbohydrate and high fat diets, diabetic Wistar rat race, for 6 weeks, were analyzed on several measures of glucose and lipid metabolism. The aqueous extract of bean seed germinated is highly effective in reducing the level of glucose in the blood of diabetic rats, while increasing insulin levels. The concurrent negative biochemical factors in the type 2 diabetes, such as triglycerides, total cholesterol, and LDL cholesterol undergo a decrease, while the HDL cholesterol increased in diabetic rats having ingested the aqueous extract of bean seed. Thus, Phaseolus vulgaris is an important contribution in the formulation of dietetic diets, because it constitutes a useful supplement which would permit to decrease the dosages of oral hypoglycemic in the case of the non insulino-dependent diabetes, by giving a greater comfort of life to the patient, and by decreasing the importance of the side effects related to the anti-diabetic medications which are far from being negligible.*

Keywords: *Seeds of bean, Phaseolus vulgaris, anti-diabetic effects, rats induced diabetics.*

I. Introduction

The diabetes is a metabolic disorder caused by a bad use of glucose by the body, characterized by a disorder in the regulation of the carbohydrate metabolism and leading to the hyperglycemia. According to the World Health Organization (WHO), the prevalence of diabetes has revealed that 221 million people worldwide had diabetes. That represents 6.6% of the population [27]. In Africa, the diabetes is now considered as a public health problem [15]; [22]. The World Health Organization estimates that there are 14 million people with diabetes in Africa. The Côte d'Ivoire is not spared by this scourge of modern times. According to the health statistics, 5.7% of the population are affected in Cote d'Ivoire [27]. The diabetes is due to a state of dysregulation of energy reserves by external factors (lifestyle, environment) and / or internal. Diabetes is largely due to the westernization of the food [11]. Experimental and epidemiological data suggest that a high-carbohydrate diet favors the development of diabetes and there is a direct correlation between the carbohydrate intake and the type 2 diabetes [2]. During the past two decades, the research in herbal medicine is become one of the largest scientific concerns [23]. Since always, the vegetables have been used to prevent or treat various diseases. The legumes contain bioactive molecules that represent multiple interests exploited in different domains. Among these compounds, secondary metabolites which are especially illustrated in the therapeutic domain [4]. Some legumes, such as the beans (*Phaseolus vulgaris*) contains polyphenolic compounds and oligosaccharides known for their beneficial effects on health [8]; [17]. It has been shown that there is a relationship between the ingestion of the bean-based food (*Phaseolus vulgaris*) and the combined effects of bioactive compounds on metabolic regulation of diabetes in rats.

It is in the context of the positive effects of the consumption of legumes on the health that we have undertaken to assess the hypoglycemic effect and hypolipidemia of the aqueous extract of *Phaseolus vulgaris* (with a dose of 5.71 mg / ml for 30 days) in rat made diabetic by diet.

It will be to assess the anti-diabetic effect of aqueous extract of the germinated seed of *Phaseolus vulgaris* in order to know if these qualified bioactive compounds confer to the seed it's dietary and therapeutic properties, in a high carbohydrate diet on one hand, and on other hand, in a high fat diet in induced diabetic rats

II. Materiel And Methods

2.1 Material

2.1.1. Vegetal material

The vegetal material used is the germinated seed of *Phaseolus vulgaris* coming from the experimental plantation of the CNRA (Côte d'Ivoire). After the recovery of sprouted seed, they are cleaned and dried away, protected for the sunlight, ant at the room temperature. The dry seeds are then ground finely.

2.1.2 Preparation of the aqueous extract

10g of powder of seeds dissolved in 150ml of distilled water were heated to reflux during 2h. After cold filtration, the filtrate was then evaporated to dryness under reduced pressure at 65 ° C using a rotary evaporator [20].

2.1.3 Animal material

A staff of 42 or 30 male diabetic rats and 12 normal rats of Wistar race, aged of 5 weeks were used in the experiment. These rats weigh between 175 and 185g (180 ± 2.27 g). They were divided into 7 groups, and placed in a rat cage provided with a ventilation system and a regulating system of dark periods (10 h) and of light (14 h), with a stable humidity, and in which the temperature was controlled at 22 ◦C. Les rats were individually housed in cages, and the water was provided *ad-libitum*. The animals were subjected to a period of adjustment during a week in which they were fed with a maintenance diet (ONAB).

2.1.4 Induction of diabetes

The induction of type 2 diabetes was carried out by intravenous injection of streptozotocin previously dissolved in sodium chloride (NaCl) at 0.9% into the dorsal vein of the penis of each animal after an anesthesia with the diethyl ether in a proportion of 55mg / kg. The testing was done after 3 days later by measuring blood sugar with a glucometer (Glucotrend 2). Were considered as diabetic and selected in the experimental procedure, the animals which showed fasting blood glucose greater than or equal to 150mg / dL. The animals were treated as controls received distilled water at 10 ml/kg.

2- Methods

2.1 Animal Treatment

After induction of diabetes, the diabetic and the non-diabetic rats were divided into seven groups of six rats each, and kept in the same conditions:

(A) A group 1 of normal control rats (n = 6) untreated receiving the control diet.
(B) A group 2 of normal rats (n = 6) receiving the experimental diet and a solution of *Phaseolus vulgaris* (50 mg / kg of body weight) daily by gavage for 6 weeks;
(C) A group 3 of diabetic rats (n = 6), receiving the experimental diet.
(D) A group 4 of diabetic rats (n = 6) receiving the experimental diet and a solution of *Phaseolus vulgaris* (100 mg / kg of body weight) by daily gavage for 6 weeks
(E) A group of five diabetic rats (n = 6) receiving the experimental diet and a solution of *Phaseolus vulgaris* (200 mg / kg of body weight) by daily gavage for 6 weeks;
(F) A group of 6 diabetic rats (n = 6) receiving the experimental diet and a solution of *Phaseolus vulgaris* (300 mg / kg of body weight) by daily gavage for 6 weeks
(G) A group of 7: diabetic rats (n = 6) receiving the experimental diet and the glibenclamide (600µl) by daily gavage for 6 weeks.

2.2 Blood sample

The rats are anesthetized by chloroform (94%) after 16 h of fasting and are sacrificed (by decapitation). At sacrifice, the blood is collected in eppendorf tubes containing EDTA at 0.5%. After centrifugation at 3000 revolutions / minute for 10 minutes, serum and plasma are collected and stored at -20 ° C until the assay.

2.3 Evaluation of physiological parameters of carbohydrate metabolites

The glycemia was determined using the Glucose Trinder Kit (Sigma, France). The postprandial glycemia was performed on samples taken two hours after ingesting of the extract of *Phaseolus vulgaris*. The glucose was assayed as above using the glucose oxidase method. The glycemic index (GI) was performed according to the protocol FAO / WHO (1998).

The glycemic load is calculated by multiplying the glycemic index by the amount of carbohydrates in the portion of the food served. The oral glucose tolerance test (OGTT) was evaluated by the effects of the extract of *Phaseolus vulgaris* on hyperglycemia induced by oral glucose load. The assay of glycated hemoglobin was carried out by the technical of micro-chromatographic column using an ion exchange resin (Human, Wiesbaden, Germany) .The dosage of insulin was carried out by the radio immuno assay method (Kit, CIS - BIO, France).100µl of the hemolyzed blood, treated to remove the labile fraction were assayed on the ion exchange resin column, was used to isolate the A1 fraction. The determination of the insulin resistance is carry out by the HOMA-IR index. This homeostasis was used as a measurement index of the degree of insulin resistance and the calculation was done by the HOMA-IR formula.

$$HOMA = \frac{\text{Insulin } (U\mu ml^{-1}) \text{ x Glucose nmol } L^{-1}}{22,5}$$

2.4 Evaluation of physiological parameters of lipid metabolites

The triglyceride determination is performed by using the enzymatic triglyceride kit PAP 1000 (Bio Merieux, Marcy star, France) based on the enzymatic method [10]. The determination of total cholesterol (free cholesterol + esterified cholesterol) is made with the PAP 500 kit cholesterol (Bio Mérieux, Marcy star, France) based on the following enzymatic method [3]. The determination of HDL cholesterol is carried out with the HDL cholesterol assay kit Direct (Bio Mérieux, Marcy star, France). The dosage of LDL cholesterol was carried out by the enzymatic method (LDL-C Enz). The lipoproteins were separated by polyacrylamide gel electrophoresis (Lipofilm, Sebia, Issy-les-Moulineaux).

2.5 Data Analysis

The statistical analysis was performed using the software (SAS Institute, Cary, NC, USA). The results were expressed ender the form of mean ± SE. The statistical significance of differences between the experimental groups was determined by the analysis of variance (ANOVA) followed by the Student test. Les differences are considered significant when $p < 0.05$.

III. Results And Discussion

The plasma glucose of rats having ingested 300 mg of *Phaseolus vulgaris* extract pass from 78 ± 2.6 g / l to 115 ± 3.8 g/l, 30 minutes after ingestion (Figure 1). The control diet (glucose) induced a significant increase in blood sugar that increases from 80 ± 2 g/l to 135 ± 3.7 g/l. One hour and a half (1:30) after the ingestion of food, the difference between the glycemic control animals and those who ingested the *Phaseolus vulgaris* extract is most significant. This blood sugar is stabilized at 86 ± 2.9 g/l. The glycemic index of the *Phaseolus vulgaris* extract is of 38% and the glycemic load is of 4.

The glycemic delta of the rats having ingested 300 mg of *Phaseolus vulgaris* extract, pass from 0 to 24 mg/dl 30 minutes after ingestion (Figure 2). The control diet (glucose) induces a greater increase of the glycemic delta, which pass from 0 to 38 mg/dl (Figure 2). One hour and a half (1:30) after ingestion of food, the difference between the glycemic delta of the control animals and those who had ingested the extract of *Phaseolus vulgaris* remains important. The glycemic delta of the controls pass to 28 ± 0.3 mg/dl, while that of the rats having received the extract of *Phaseolus vulgaris* is stabilized at 18 ± 0.1 mg / dl.

The fasting glucose of the normoglycemic rats varies between 82 and 84 mg / dl. The variation between the groups of rats is significant ($P < 0.05$). When these rats are treated with 100g to 300g of *Phaseolus vulgaris* extract per kg of rat, the post prandial blood glucose levels measured two hours after the alimentation, varies between 87 and 84 mg/dl according the injected dose extract, against 84 mg / dl in controls. Moreover, after 4 hours, the glycemia is stabilized at the values ranging between 83 and 81mg/dl and the differences are not significant, regardless of the extract dose ingested. Under the same conditions, the glycemia of rats treated with different doses of glibenclamide, 0.05 and 0.1 g / kg, range between 87 and 84 mg/dl respectively 2 hours after ingestion; 4 hours after, the glycemia varies slightly between 84 and 83mg/dl, and the difference between animals is not significative. These animals are normo-glycemic six hours after the food; the difference between the glycemia of rats treated with different doses of extract of Phaseolus vulgaris or with the glibenclamide is no longer significant. In such normal rats treated with 300 mg of the extract of Phaseolus vulgaris associated with increasing doses of glibenclamide (0.50 g to 0.20 g per kg of rat), the postprandial glycemia measured two hours after feeding, varies between 60 and 68 mg/dl according the glibenclamide dose associated. These values are lower than those seen in normal rats treated with *the Phaseolus vulgaris* extract alone or by the glibenclamide alone (Table I). The association of the *Phaseolus vulgaris* extracts and the glibenclamide induce hypoglycemia in normal rats after 1 hour.

Six hours after the treatment with the combination of *Phaseolus vulgaris* extract and the glibenclamide, the glycemia measured is lower (44-38 mg / dl) and the importance of low blood sugar is dependent on the dose of glibenclamide associated. The post prandial glycemia of the untreated diabetic rats evolves considerably; it passes from 162 to 238mg/dl. The additive effect of *Phaseolus vulgaris* and/or glibenclamide is also observed in diabetic rats. Indeed, fasting glycemia of diabetic rats that varies between 194 and 164mg / dl (Table I). Two hours after feeding, the glycemia passes to 170mg / dl, 175mg / dl and 84 mg /dl respectively in rats treated with 300 g / kg *of Phaseolus vulgaris* extract in rats treated with 0.2 g / kg of glibenclamide, and with those treated with the combination of the Phaseolus vulgaris extract and the glibenclamide (300g / 0.2g). Six hours later that

glycemia does not drop below 100 mg/dl for the rats submit to the treatment of the Phaseolus vulgaris extract (100 and 200 g / kg) or glibenclamide (0.05 and 0.1 g / kg). The hypoglycemic effect of the *Phaseolus vulgaris* extract and of the glibenclamide alone is not observed in the diabetic rats with these levels (Table I). However, six hours later, the hypoglycemic effect was observed in animals submitted to *Phaseolus vulgaris* extract at the dose of 300 g / kg or to the glibenclamide at the of 0.2 g/kg. The hypoglycemic effect is important with the combination of the *Phaseolus vulgaris* extract (300g / kg) and of the glibenclamide (0.2g/kg).

The plasma insulin levels (11.04 ± 0.72 uU / ml) and the glycated hemoglobin (0.21 ± 0.01 mg / g Hb) of normal rats treated with the *Phaseolus vulgaris* extract at the dose of 300mg/kg were not significantly different from controls. At the opposite, the rate of the total hemoglobin (13.20 ± 0.56 g / dl) of normal rats treated with the *Phaseolus vulgaris* extract is significantly higher than those of control which is of 12.01 ± 0.63 g/dl (Table II).

In diabetic rats, the plasma insulin levels (4.2 ± 0.06 uU / ml) and the total hemoglobin (8.6 ± 0.01 mg / g Hb) were significantly lower than controls ($P < 0.05$). Treatments with the Phaseolus vulgaris extract or with the glibenclamide increase significantly the plasma insulin levels from 4.20 ± 0.06 uU / ml to 9.28 ± 0,41µU / ml and of 9.52 ± 0.34 µU / ml respectively. The treatments also increase the total hemoglobin levels from 8.86 ± 0.07 g / dL to 11.60 ± 0.86 g / dl and 11.36 ± 0.95 g / dL, but decreases the glycated hemoglobin from 0.77 ± 0.04 mg /g Hb at the normal (0.23 ± 0.03 mg / g Hb)

The levels of the blood glucose and of the insulin and the degree of insulin resistance show no difference between the normal rats treated with the *Phaseolus vulgaris* extract and the control rats. In diabetic rats, the blood glucose levels (196.80 ± 2.39 nmol-1), insulin (89.70 ± 4.00 µUmol-1) and the degree of insulin resistance (21, 58 ± 1.02) were higher than those of normal rats. When these diabetic animals were treated with the *Phaseolus vulgaris* extract or with the glibenclamide, the values of the parameters analyzed decreased to the levels of those of the controls (Table III).

Because of its low glycemic index and load, the intake of the extract of the seeds of *Phaseolus vulgaris* as food or food supplement could not theoretically induce the physiological disturbances such as postprandial hyperglycemia and the high insulin response reported by [24]. The use of the seeds extract of *Phaseolus vulgaris* as a dietary supplement in the normal rats, has show that, at the doses of 50mg / kg to 300mg / kg, the postprandial blood glucose is not significantly affected. After ingestion by gavage with food supplement, the glycemia levels rise transiently back down to the baseline within 3 to 4 hours. This evolution of the glycemia is characteristic of the consumption of energy food. However, a hypoglycemic effect is observed when the animals are not nourished after 4 hours [28].

The hypoglycemic effect of the *Phaseolus vulgaris* seeds extracts could result from an activation of the utilization of the cellular glucose, without a simultaneous activation of the glucose from the glycogen in the liver. The hypoglycemic effect of the glibenclamide is earlier than that of the extract from the seeds of *Phaseolus vulgaris*. Both, the two products have a synergistic or additive action leading to the hypoglycemia, even 1 hour after the consumption of high carbohydrate food.

The additive or synergistic effect shows that the extract of the seeds of *Phaseolus vulgaris* and the glibenclamide may have the same mechanism of action. In fact, biochemically, the *Phaseolus vulgaris* extract contains minerals, tannins and others. This could suggest the existence of an antidiabetic mechanism of action as for the glibenclamide. The sulfonylureas such as the glibenclamide act in the β cells of the islets of Langerhans, by blocking the potassium channels sensitive to ATP (K + ATP). It follows a depolarization of the plasma membrane with, as consequence, a calcium entry in the β cells responsible of the exocytosis of insulin storage granules.

It appears in this study some results of the antidiabetic activity of the *Phaseolus vulgaris* extract, comparable to that of the glibenclamide. A treatment with the *Phaseolus vulgaris* extract allows the control of the hyperglycemia of the rats, with comparable results in the same conditions with the glibenclamide. So, we may assume that there is a mechanism of action of similarity between the *Phaseolus vulgaris* extract and the glibenclamide. This hypothesis remains unproven. The consumption of the extract of *Phaseolus vulgaris* seed in food supplementation does not change in rats their glucose tolerance, neither their glycated and total hemoglobin or their insulin resistance, but slightly increases insulin levels plasma.

These results clearly show that the extract of *Phaseolus vulgaris* seeds acts on the regulation of sugar metabolism by favoring the glucose consumption at the expense of its biogenesis from the glycogen. The complementation of the energy food (hyperglucidic) of the type2 diabetic rats by the *Phaseolus vulgaris* extract during six weeks, decrease the glycemia of these rats to a normal level, increases their glucose tolerance, cancels their insulin resistance and greatly decrease the blood glycated hemoglobin. These results clearly highlight the anti-diabetic effect of the extract of *Phaseolus vulgaris* used in food supplementation in the rats. This extract is capable of restoring the regulation of the glucose metabolism disturbed by the injection of the streptozotocin. Our results confirm those of [14]; [26]; [16] that showed the consequences of glycated hemoglobin on the diabetes by an increase of the level of HbA1c in the diabetic rats; these authors had also noted that the total

hemoglobin decreased in the group of the diabetic rats probably due to the increased of the HbA1c formation. This increase of the glycosylated hemoglobin in diabetic rats also shows a change in its affinity for oxygen, which may be a tissue anoxia factor, and promotes the production of free radicals [13]. The *Phaseolus vulgaris* extract may prevent the devastating effects of glycation. Although the action mechanism of the extract is unknown, a number of other plants have been reported in the release of insulin stimulation and of the anti-hyperglycemic effects [12]; [25]. Other medicinal plants such as *Cassia auriculata* and *Scorpiara dulcis* have also been reported as having the same effects [18]. These medicinal plants also have the ability to reduce the HbA1c levels in diabetic rats. The good glucose tolerance of the treated diabetic animals shows that the anti-diabetic effect of the *Phaseolus vulgaris* extract would be located primarily at the level of the cellular glucose utilization. In fact the cellular glucose utilization is regulated by the insulin and any disturbance modifying the normal operation of this hormone (non-secretion by cell destruction, reduction or blocking of insulin receptors) leads to diabetes. The diabetic animals induced and untreated have a defect of insulin production which is corrected by the treatment with the *Phaseolus vulgaris* extract. The anti-diabetic effect of the *Phaseolus vulgaris* extract could be explained by a rapid cell regeneration partially destroyed by the streptozotocin injection. The resistance of cells to insulin is one of the factors leading to type 2 diabetes [21]. According to everal authors, the cysteine and the arginine would be directly involved in the sensitivity of cells to insulin [5], [6], [7], [19]. The proteins of the *Phaseolus vulgaris* extract can then enhance the cells sensitivity to the insulin in the diabetic rats.

The triglyceride levels of diabetic rats treated with the *Phaseolus vulgaris* extract (5.72 ± 2,27mmol / L) and with the glibenclamide (5.10 ± 2,27mmol / L) are close to those of the control rats (4.81 ± 2,27mmol / L), but lower than those of untreated diabetic rats. In untreated diabetic rats, the rate of HDL-Cholesterol (18.17 ± 0,01mmol / L) is lower and that of the LDL-C (132.10 ± 5,17mmol / L) is higher compared to the controls (table IV).

The dysregulation of the glucose metabolism presents serious physiological consequences multilevel in the lipids metabolism. The induced diabetic rats submitted to high fat diet, have presented blood triglyceride levels, the total cholesterol and the low density lipoprotein cholesterol (LDL-Cholesterol) higher than the controls. This hypertriglyceridemia could be explained by the increasing hepatic production of VLDL and the reduction of the VLDL catabolism, by the decreasing of the lipoprotein lipase activity [1]. The increasing of the LDL-Cholesterol shows a significant degree of peroxidation in diabetic rats and favors their catabolism by the macrophages. In the same conditions, the rate of the high density lipoproteins cholesterol (HDL-Cholesterol) observed in these diabetic rats was lower. These disturbances of lipid metabolism are corrected by the supplementation during six weeks with the high fat food and the *Phaseolus vulgaris* extract.

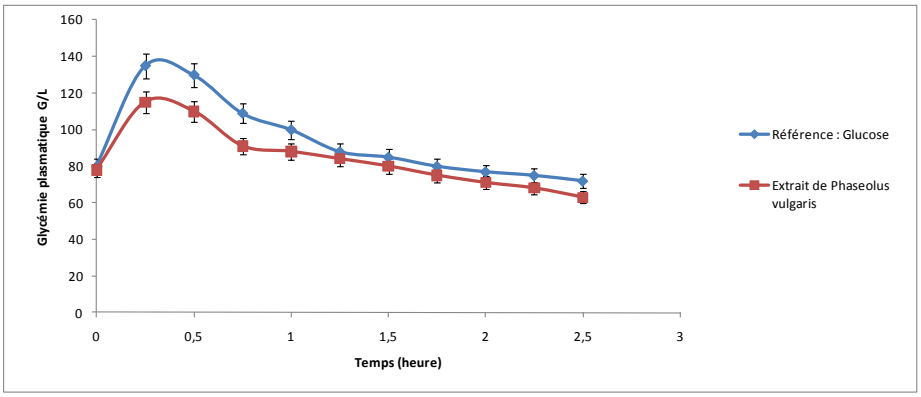

Figure 1: Evolution of blood glucose levels induced by the extract of *Phaseolus vulgaris* in rats.

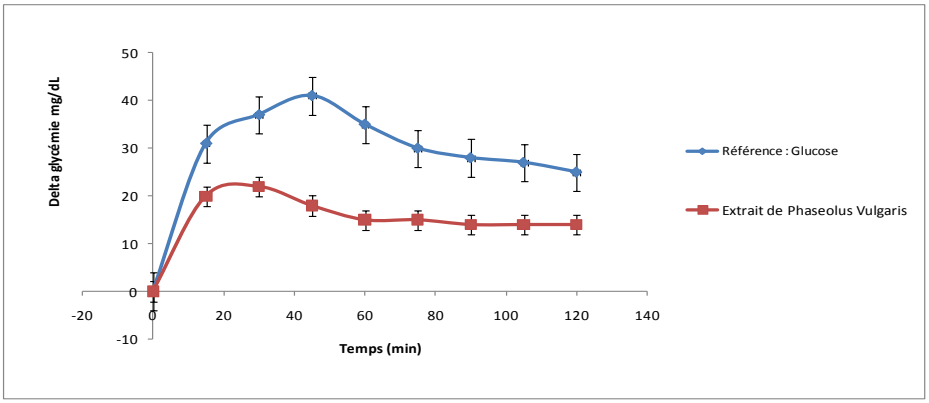

Figure 2: Effect *of Phaseolus vulgaris* extract on glycemic delta in diabetic rats

Table I: Glucose tolerance in normal and diabetic rats

Blood glucose (mg/dl)				
0 min	30 min	60min	90min	120m
Normal 82,00±4,11[a]	162,90±5,15[a]	145,71±4,51[a]	103,90±4,30[a]	83,45± 3,19[a]
Normal + P v80,66±5,11[a]	162,20±7,25[a]	138,17±3,39[a]	100,20± 5,15[a]	82,40±5,22[a]
Diabète				
Induces 262,13±8,01[b]	353,43± 7,11[b]	387,51±7,29[b]	358,67±5,21[b]	325,91± 4,41[b]
Diabetes + P v 91,60± 3,12[c]	154,22±3,70[c]	142,11±5,30[c]	122,16 ±6,19[c]	97,89± 5,72[c]
(300 mg)				
Diabetes +Glibenclamide 97,52± 1,71[d]	193,68 ± 3,51[d]	172,33±4,49[d]	132,44±3,79[d]	116,70±6,76[d]
(600µl)				

Table II: Effect of *Phaseolus vulgaris* extract on plasma insulin levels, total hemoglobin and glycated hemoglobin in normal and diabetic rats.

Groupe	Insuline plasma (µU/ml)	Hémogbobine totale (g/dl)	Hémogbobine glyquée (mg/g Hb)
Normal	10,38± 0,74[a]	12,01± 0,63[a]	0,22± 0,02[a]
Normal + P v (300 mg)	11,04 ±0,72[a]	13,20± 0,56[b]	0,21± 0,01[a]
Diabète induit	4,20± 0,06[b]	8,86 ± 0,07[c]	0,77 ± 0,04[b]
Diabète + P v (300 mg)	9,28± 0,41[c]	11,60 ±0,86[a]	0,23±0,03[c]
Diabète + glibenclamide (600µl)	8,52 ± 0,34[c]	11,36± 0,95[a]	0,23±0,02[c]

Table III: Effect of the *Phaseolus vulgaris* extract on the blood plasma, the insulin and the insulin resistance.

Parameters	Blood glucose (nmol^{-1})	Insulin (µUmol^{-1})	Insulin résistance (Index HOMA-IR)
Normal	80,22± 7,80[a]	51,21± 4,02[a]	12,51± 1,24[a]
Normal + P v (300 mg)	83,99 ±6,64[a]	56,40± 8,04[b]	12,69± 1,57[a]
Diabetes induced	96,35± 2,39[b]	89,70 ± 4,00[c]	21,58 ± 1,02[b]
Diabetes + P v (300 mg)	84,52± 6,24[c]	58,63 ±5,50[a]	13,55±0,67[c]
Diabetes + glibenclamide (600µl)	85,52 ± 0,34[c]	60,36± 0,95[d]	12,23±0,02[d]

Table IV: Effect of the *Phaseolus vulgaris* extract on the triglycerides and the cholesterol

Parameters	Normal	Diabetes induced	Diabetes + P v (300mg)	Diabetes + glibenclamide
TG (mmol/L)	4,81 ±0,44 a	13,61±0,21b	5,72 ±2,27 a	5,10±0,27 a
Chol-T (mmol/L)	11,91 ±0,11 a	32,21 ±1,7 a	9,01 ±0,16 a	10,41 ±0,17 a
Chol HDL (mmol/L)	26,07 ±0,01 a	18,17±0,01 b	24,21 ±0,01 a	21,01±0,01 a
Cho LDL (g/mL)l	46,21 ±3,11a	132,10 ±5,17 b	67,12 ±4,11 a	52,10 ±3,17 a

IV. Conclusion

The aqueous extract of the germinated seeds of *Phaseolus vulgaris* used in supplementation during six weeks, in a high carbohydrate diet, can reduce or restore the disturbances of carbohydrate and hormonal metabolism caused by the type 2 diabetes rats: the blood levels of glucose and glycated hemoglobin return to the normal. It is the same for the increased insulin levels and the glucose tolerance. The aqueous extract of the germinated seeds of *Phaseolus vulgaris* used in supplementation during six weeks in a high fat diet, also restores the disturbances caused by the type 2 diabetes. The aqueous extract of the germinated seeds of *Phaseolus vulgaris* in hyperlipidic diet reduces the normal levels of the concurrent negative biochemical factors

in the type 2 diabetes, such as the triglycerides, the total cholesterol and the LDL cholesterol. Thus, despite the considerable progress in the understanding and the managing of the diabetes, the disease and its complications continue to rise. Therefore, it is urgent to identify the natural sources of new active substances against the disease. Although we cannot abandon the synthetic medications in the treatment of the diabetes, some legumes might constitute useful adjuncts that would reduce the oral hypoglycemic drugs in the case of the non-insulin-dependent diabetes, giving a more comfortable life to the patient, and by the diminishing of the side effects associated with anti diabetic medications that are far from negligible. This is the case of *Phaseolus vulgaris* that constitute an important contribution in the formulation of the dietary regimens.

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