



## **A Case Report of Diabetes Mellitus Type 2 with Adjuvant Use of *Bauhinia forficata* in Pharmacological Treatment**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors IDdS, EMR, FJMdR and VAdN designed the study. Authors IDdS, HMRV, GGF, IBR, PAMT, ACGR and JPL performed the analysis and wrote the first version of the manuscript. Authors ACdA, EMR and FJMdR administered the study analyzes and literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Introduction:** *Bauhinia forficata*, has presented in several interesting effects for the diabetic human organism as the adjuvant treatment. Its effects have been tested and proven in scientific studies in the Unified Health System in Brazil.

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**Aims:** Verify the effects of the medicinal plant *Bauhinia forficata* as an aid in the control of glycemic indexes.

**Methodology:** Case report with exploratory descriptive study with a quantitative approach, using direct observation techniques of the Dáder method adapted to the use of herbal medicines such as *Bauhinia forficata*.

**Results:** In this study, there was a decrease in triglyceride levels with a drop of 77%, which despite not reaching the recommended values for diabetic patients (<150 mg/dl) is quite significant.

**Conclusion:** *Bauhinia forficata* used in the treatment of diabetes mellitus has anti-inflammatory actions that contribute to reduce glycosylated hemoglobin and, thus decrease fasting and postprandial glucose.

**Keywords:** *Bauhinia forficata*; diabetes; hyperglycemia; metabolic syndrome.

## 1. INTRODUCTION

Diabetes mellitus is a chronic and progressive disease, which should receive early intervention with the patient's involvement in its own surveillance and treatment [1]. In Brazil, it is an important public health problem [2]. Worldwide, it has shown a high incidence and prevalence [2,1]. About 17 million Brazilians between 20 and 79 years of age are diabetic, which is equivalent to 11.4% of the population in this age group [3]. Brazil is the fifth country in the world in cases of diabetes mellitus, behind only China, India, the United States and Pakistan [4,2,1].

Diabetes mellitus is a disease with rapid evolution [5,6,3]. In recent years, new oral antidiabetics and new insulins have been obtained with review of therapeutic objectives [4,2,3,1].

Brazil has the greatest biological diversity in the world, and has a rich flora, which has aroused interest in international scientific communities [2]. These medicinal plants are used as raw material in the manufacture of tranquilizers, diuretics, laxatives, hyperglycemics or antibiotics [7,8].

The plants used as herbal medicines are known in Brazil for their effectiveness and risk of use, as well as for their reproducibility and consistency in quality [8,9,3]. The Unified Health System (SUS) has used complementary therapies with medicinal plants [3]. The use of the "cow's leg", a leaf from the *Bauhinia forficata* tree, has demonstrated several interesting effects for the human organism, mainly in the parallel treatment in cases of diabetes mellitus [7,10]. These effects have been tested and proven in scientific studies in the Unified Health System (SUS) [9]. *Bauhinia forficata* involves approximately 300 species belonging to the Fabaceae family and are found

mainly in countries with a predominantly tropical climate [9,3].

The plants of the genus *Bauhinia forficata* favored the identification of a chemical marker known as Kaempferitrin found only in the leaves of *Bauhinia forficata* popularly known as "Pata de Vaca" that brings hypoglycemic activity [11,10]. This species is on the Brazilian list of RENISUS [9].

Some studies in the Unified Health System have shown a reduction in hyperglycemia in individuals who have used *Bauhinia forficata* [12]. The use of medicinal plants such as *Bauhinia forficata* can lead to a reduction in spending on medicines, especially in prolonged use of hyperglycemic agents [12,3]. This case report aimed to verify the effects of the medicinal plant *Bauhinia forficata* as an aid in the control of glycemic indexes.

## 2. METHODOLOGY

The participating patient was selected from users who carry out medical follow-up at primary health care services in the SUS network in Brazil in the city of Campo Grande/MS. She is a carrier of diabetes mellitus who used *Bauhinia forficata* in parallel with that of pharmacological drugs. The study was carried out during the period from May to August 2020 at the residence of the user selected for herbal monitoring through weekly monitoring for the responsibility of the SUS network. During the execution of the study, all the volunteer's rights were respected.

The initial interview was carried out according to the method described by Cipolle and collaborators (2000) [13]. Data collection was performed through a descriptive exploratory study with a quantitative approach and, thus, using direct observation techniques of the Dáder

method adapted to the use of herbal medicines [13].

In the first interview, the user was asked to present her medical prescriptions and medications in use and the main laboratory tests already performed. After signing the Free and Informed Consent Term, the meetings took place in the weekly periods, with the same being oriented on the conduct plan, pharmaceutical and herbal interventions, the importance of measuring parameters, the guidance on the main doubts regarding their medicine and the use of *Bauhinia forficata* and hypotheses of diagnoses and associated pathologies.

A total of 18 direct interviews were carried out with the user, and during this period an interview form of plans and conducts was outlined with the following activities planned during the herbal monitoring, in this case, identification of the user's health problems and the medications used in the treatment. treatment and alternatives for resolution and expected results. During the interviews, the biochemical, physiological and anthropometric parameters were monitored, as well as these data were recorded on a phytotherapeutic accompaniment card elaborated during the study period.

### 3. RESULTS

#### 3.1 Clinical History

A 67-year-old white female patient with Type 2 Diabetes Mellitus for 30 years with a paternal and maternal family history and with pharmacological drug treatment orally at the time, without the presence of hypothyroidism.

In May 2020, when the patient returned to routine consultations, dyslipidemia was identified and treatment with simvastatin (20 mg/day) was started. Patient 1.62 in height and 79.5 kg with BMI of 30.34 kg/m<sup>2</sup>, with incomplete elementary school and lives with husband and daughter. User does not use alcohol, sedentary, makes no food restrictions. He has the habit of having breakfast, during the night he makes some meals, and the portions in larger quantities are consumed during the day.

#### 3.2 Registration of Medicines Used

It is possible to verify that the drugs used belong to the dyslipidemic groups of the statin class (Simvastatin). From the biguanide class, antidiabetics (Metformin) and the sulfonylurea

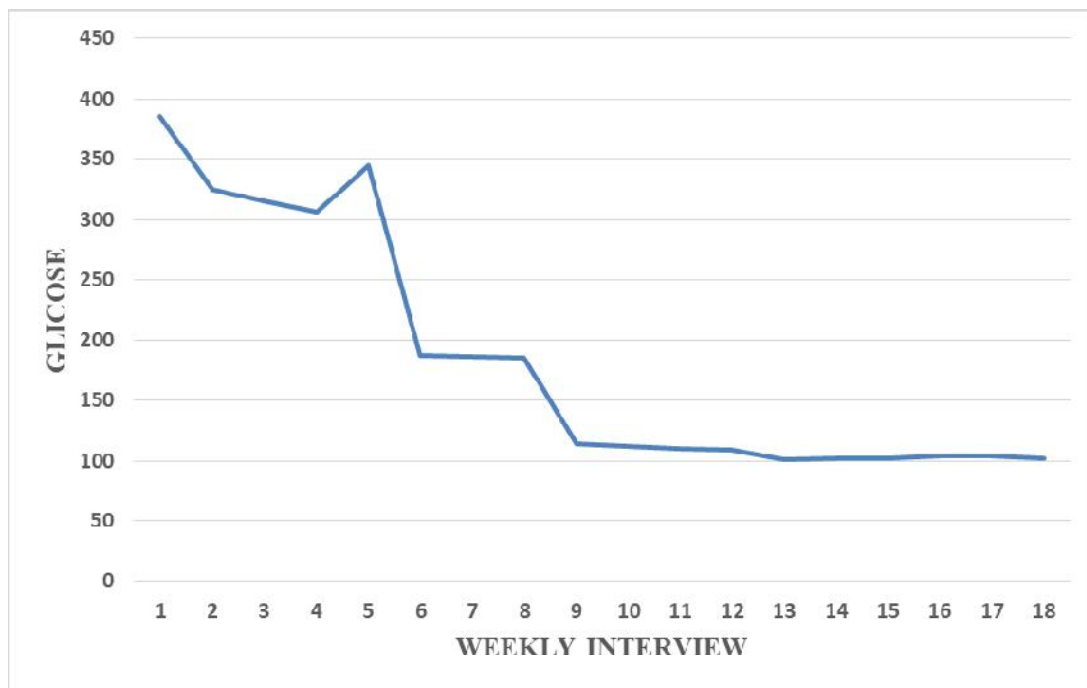
class (Glibenclamide) were used. Drug prescriptions were in accordance with the therapeutic dose recommended in the Brazilian Unified Health System. The patient has no difficulties in following the appropriate pharmacotherapy according to her frequent intake habits.

In this way, an action plan for the daily use of *Bauhinia forficata* was created with guidance on the daily time to take care of health. The importance of physical activities, healthier eating and the risks of not administering the medications according to the medical prescription of an endocrinologist and the guidance on the dose of using *Bauhinia forficata* (500 mg/day). The importance of routine in habits was also shown due to the daily use of *Bauhinia forficata* in monitoring biochemical, physiological and anthropometric parameters. Monitoring of the patient showed the presence of some problems in the herbal use of *Bauhinia forficata* which were listed in Table 1. However, after the identification of the problems, interventions were developed in the care and therapeutic use of *Bauhinia forficata*. These interventions were performed during weekly patient monitoring meetings.

However, no serious interactions have been detected between *Bauhinia forficata* and medicines in daily use for diabetes. As for the drug-food interaction, it was possible to verify an important interaction applicable to the patient, in this case caffeine, decreased the action of *Bauhinia forficata* in the period from May to June. This change is duly notified through the Health Surveillance Notification System (ANVISA). In the 8th follow-up meeting, the patient had a weight loss in body weight of 4.8 kg (74.7 kg) and decreased value in fasting capillary glucose (Fig. 1). From this, the IMC was calculated at 30.34 kg/m<sup>2</sup> and according to the World Health Organization, IMC equal to or greater than 30 kg/m<sup>2</sup> determines obesity [1]. IMC was used and calculated, who is the practical way to assess the presence of metabolic syndrome and cardiovascular risk in situations where the technological material and adequate training to assess mainly abdominal circumference is not possible. During the patient's follow-up period, some basic laboratory tests were requested to check total cholesterol, glucose, glyated hemoglobin and triglycerides in order to make a comparison during the use of *Bauhinia forficata* during the established treatment period (Table 2).

**Table 1. Problems related to the use of *Bauhinia forficata* and negative results associated with the identified routine medicine and therapeutic interventions performed**

Problems Identified	Problem Definition	Phytotherapy Intervention In Diabetic Patient Care
Adverse reaction to <i>Bauhinia forficata</i>	Non-quantitative insecurity	Take <i>Bauhinia forficata</i> after meals.
Higher dose in daily use	Quantitative insecurity	Guidance on monitoring the use of <i>Bauhinia forficata</i> as prescribed and protocols used in SUS with a dose equivalent to 500 mg/day.
Interaction between <i>Bauhinia forficata</i> and diabetes drugs	Quantitative ineffectiveness	Advise to observe changes with other drugs for routine use and register the main changes such as: potentiation in oral hypoglycemic agents.
Inadequate storage of the medicine.	Quantitative ineffectiveness	Guidance on the storage of <i>Bauhinia forficata</i> .
Not taken from <i>Bauhinia forficata</i>	Need	Advice and preparation of a daily schedule of dose and time for ingestion of <i>Bauhinia forficata</i>



**Fig. 1. Fasting capillary blood glucose values of a diabetic user during herbal therapy using *Bauhinia forficata***

Glucose levels decreased with the use of *Bauhinia forficata* in parallel to drug treatment after the 6th interview and were kept within the values considered acceptable by the protocols of the Ministry of Health in Brazil (Fig. 2) [2].

However, two peaks of fasting capillary blood glucose can be observed in the 5th week and 8th week of the interview to monitor the patient (Fig.

1). This deviation occurred due to the suspension and withdrawal of the drug treatment of the metformin medication after monthly medical follow-up with the endocrinologist and introduction of the medication Glimperide 2 mg (Fig. 2). Regarding blood pressure, the patient presented in all interviews the average of normal blood pressure, with values for 120 per 75 mmHg prevailing.

The use of *Bauhinia forficata* in the postprandial glycemic control at the end of the treatment period, it was possible to verify a regression (Table 2 and Fig. 2). The glycated hemoglobin was performed in order to recognize the patient's real metabolic conditions, where it was possible to verify a regression to 7.6 mg/dl (Table 2). In Table 2, the different results of the fasting blood glucose were demonstrated after 18 interviews with the patient using *Bauhinia forficata* with a total of 102 mg/dl. There was also a reduction in triglycerides to 282.9 mg / dl.

Table 2 shows the changes in laboratory parameters over the 4-month study period. The results showed statistically significant differences

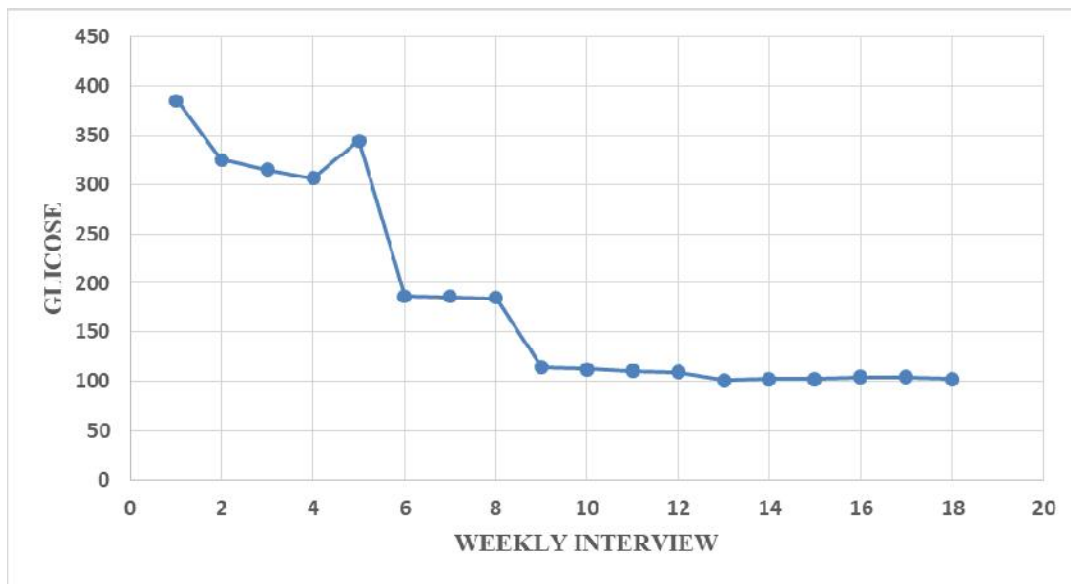
in glycated hemoglobin with a reduction of 0.3 mg/dl and fasting postprandial glucose (Fig. 2).

#### 4. DISCUSSION

This patient with a history of diabetes mellitus for 30 years remained with pharmacological drug treatment in the same period. However, he developed Metabolic Syndrome (MS) according to the criteria of the Ministry of Health (MS), which is usual in this phenotype [14,15]. Azambuja (2015) evidenced in previous studies, the obligation for the measurement of waist circumference to be representative of central obesity in order to facilitate the inclusion of the main subjects in the diagnosis of Metabolic Syndrome (MS) [16].

**Table 2. Laboratory tests performed by the patient during the herbal treatment with *Bauhinia forficata***

Biological Parameters	Before Phytotherapy Intervention	After Phytotherapy Intervention
LDL (mg/dl)	160	127,5
HDL (mg/dl)	36,8	38,9
VLDL (mg/dl)	187	102,2
Total cholesterol (mg/dl)	181,4	166,4
Triglycerides (mg/dl)	363,8	282,9
TSH (UI/ml)	2,76	2,37
T4 (ng/dl)	1,75	1,39
Fasting Glucose (mg%)	375	102
Postmeal glucose (mg%)	385	102
Glycated Hemoglobin (mg/dl)	7,9	7,6



**Fig. 2. Values of the postprandial of the diabetic user during the herbal treatment with the use of *Bauhinia forficata***

Regarding cholesterol levels, there is an 8.4% reduction in the baseline [15]. Generally, these lipid-lowering effects can be attributed to both standardized trigonelline compounds and rutin as well as those derived from quercetin and flavanols present in the leaves [11,3,17]. Quercetin derivatives directly improve lipid metabolism in the liver and are pancreatic lipase inhibitors [11]. Quercetin stimulates the metabolism of liver lipids that reduce the level of plasma lipids by suppressing the accumulation of fat in the liver and adipose tissue [11,18].

Trigonellin inhibits the key enzymes of lipid metabolism and absorption, mainly with the action of lipase in the small intestine which leads to a decrease in triglycerides and cholesterol in animals [6,15,8]. In this study, the decrease in triglyceride levels was highlighted with a 77% decrease, which despite not reaching the recommended values for diabetic patients (<150 mg/dl) is quite significant [8,2]. The use of *Bauhinia forficata* as complementary therapy in type 2 diabetic patients can reduce the levels of triglycerides and total cholesterol [19,20,21]. However, this reduction may not be clinically significant, as additional studies are suggested in order to further evaluate the clinical effect of *Bauhinia forficata* mainly on the lipid profile as on total cholesterol, LDL and HDL, with longer study time and a larger sample of patients [15,22,2,11]. The use of *Bauhinia forficata* in the form of pharmaceutical capsules, in a previous study, pointed out that the dry extract obtained by spray-drying and dry granulation results in a hypoglycemic and hypolipidemic action from the concentration of 200 mg/kg [22,9]. This capsule model was used in this study [16,23,24]. A decrease in glucose and glycated hemoglobin levels was also observed in this patient who ingested the *Bauhinia forficata* capsule (500 mg/day) adjuvant to the treatment of type 2 diabetes [19,9]. This decrease was noticeable after 120 days in accordance with the study of Kojic et al. (2014). Glycated hemoglobin is the main parameter for monitoring the regulation of diabetes and assessing the risk of microvascular complications [11,25,17]. Its concentration reflects the average blood glucose value in the past three months [9,11]. With this we can affirm that even presenting a difference equivalent to 0.3 mg/dl it is considered a measure of the success rate for the treatment of diabetes [8,9,3]. In recent years, studies of flavonoids with anti-inflammatory activities have gained prominence in the fight against diabetes [11,3,10]. Flavonoids mainly in the leaf extract of *Bauhinia forficata*

include the presence of canferol and quercetin [11]. In the cellular inflammatory process, the action of flavonoids was reported as an antioxidant mainly in modulating the gene expression of molecular receptors for adhesion in enzymatic activity [21, 11,17]. For example, in the process of activating adipogenesis, PPAR $\gamma$  performs the activation function by inducing the synthesis and storage of fatty acids and thus, it can be inhibited by the action of AMPK [25,17,18]. Therefore, the use of *Bauhinia forficata* reduces inflammatory cell infiltration [25,17], and reduced the levels of pro-inflammatory cytokines and tissue fibrosis [3]. The daily use of *Bauhinia forficata* is a potential source of natural antioxidant and can act to prevent diabetic complications associated mainly with inflammation and oxidative stress and can also consider antimicrobial, antiproliferative and apoptotic actions [20,27,21,12]. This study proves that the therapeutic treatment of *Bauhinia forficata* in diabetes mellitus, based on several other previous scientific studies, mainly experimental models, since the main antidiabetic property attributed to the presence of canferolic and quercetin glycosides are present in the leaf of *Bauhinia forficata* [26,27,12]. The use of *Bauhinia forficata* capsules in the treatment of diabetes mellitus has significant anti-inflammatory activity and contributes directly to the reduction of glycated hemoglobin (HbA1c) and thus regulates insulin levels [26,22,20,8,21]. Therefore, the consumption of *Bauhinia forficata* capsules in parallel with the pharmacological drug treatment brings benefits and protection to individuals affected by type 2 diabetes mellitus, improving their quality of life and health [22,2].

## 5. CONCLUSION

In this case report it was possible to observe that the daily use in parallel to the pharmacological treatment in the extract of *Bauhinia forficata* used in the treatment of diabetes mellitus has anti-inflammatory actions that contribute to reduce glycated hemoglobin and, thus, to reduce glucose in fasting and post powders-prandial. It is concluded that using *Bauhinia forficata* has additional benefits in protecting against complications in patients with diabetes mellitus by improving their quality of life and health.

## CONSENT AND ETHICAL APPROVAL

As per university standard guideline, participant consent and ethical approval have been collected and preserved by the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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