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EFFECT OF *CAESALPINIA BONDUCELLA* SEEDS ON BLOOD GLUCOSE IN RABBITS

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ABSTRACT

The seeds of Caesalpinia bonducella *(L.) Flem. (Caesalpiniaceae) are sold in shops in Dar es Salaam, Tanzania, for the treatment of diabetes mellitus. A suspension of the powdered seed kernel in 0.5% carboxymethylcellulose (CMC) was tested for ability to lower blood glucose in fasted and glucose-fed normal albino rabbits. Following administration of 0.2, 0.4 and 0.8 g/kg body weight of the powder there was no difference in areas under the fasting blood glucose and oral glucose tolerance test (OGTT) curves as compared to controls given CMC ($P > 0.05$). Similarly, 0.2 g/kg body weight of the powder administered for 7 consecutive days had no effect on either fasting blood glucose or the clearance of a glucose load from the blood. However, 0.1 g/kg body weight chlorpropamide significantly decreased the area under the fasting blood glucose and OGTT curves as compared to controls given CMC ($P \leq 0.05$). Thus, contrary to a previous report, we could not detect any hypoglycaemic activity in the seeds of* Caesalpinia bonducella *growing in Dar es Salaam.*

INTRODUCTION

Caesalpinia bonducella (L.) Flem. (Caesalpiniaceae) is a tropical shrub found in Asia, South America and South and Eastern Africa. It is known by several names which include fever nut, nicker nut and in Swahili as *mkomve* or *msoro* (Watt & Breyer-Brandwijk, 1962). In Dar es Salaam, the seeds are known as *kete*, *solo* or *kankaj*. Apart from their medicinal use, the seeds are used in a game called *bao*. Decoctions of parts of the plant are used to treat dysmenorrhoea (Samuelsson et al., 1991), malaria (Chopra & Gosh, 1929; Katti, 1930; Ayensu, 1978; Adesina, 1982; Aminuddin & Khan, 1994), as an emmenagogue (Saha et al., 1961; Watt & Breyer-Brandwijk, 1962; Al-Rawi & Chakravarty, 1964; Barrau, 1974; Kamboj, 1988) and anticonvulsant (Barrau, 1974). A hot water extract of the leaves is used to prevent abortion (Nagaraju and Rao, 1990) and as a uterine tonic immediately after delivery (Quinsumbing, 1951). The seeds are used to treat stomach or bowel upsets (Watt & Breyer-Brandwij, 1962), diabetes, diarrhoea and inflammation (Asprey & Thornton, 1955). In Jamaica, the seeds are dried and ground to make powder for diabetes and for the treatment of blood pressure (Ausprey & Thornton, 1955).

Some of these biological activities have been confirmed experimentally. These include inhibition of strychnine and metrazole-induced convulsions in mice by a 70% ethanolic extract of the leaves (Adesina, 1982) and the lowering of blood pressure in dogs (Watt & Breyer-Brandwij, 1962). Others are antiviral activity against the *Vaccinia* virus (Dhar et al., 1968), uterine stimulant activity on the rat (Feng et al., 1964), antidiarrhoeal activity against senna-induced catharsis in mice (Iyengar & Pendse, 1965) and, recently, the seeds were reported to have hypoglycaemic activity in rabbits (Rao et al., 1994). Similarly, constituents with antihelminthic, antipyretic, antidiuretic and antibiotic activity have been isolated from the seeds (Watt & Breyer-Brandwij, 1962).

Some of the compounds isolated from parts of the plant include flavonoids (Purushothaman et al., 1982), diterpenes (Balmain et al., 1967; Gunatilaka et al., 1980; Pascoe et al., 1986) and alkaloids (Ali & Qudrat-I-Khuda, 1960). In this work we tested the

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seeds of *Caesalpinia bonducella* sold in the shops in Dar es Salaam for hypoglycaemic activity and we compared the results with those obtained using Indian *Caesalpinia bonducella* (Rao et al., 1994).

METHODOLOGY

Materials

D-(+)-Glucose was bought from Fluka-chemie AG (Germany), and chlorpropamide, carboxymethlycellulose (CMC), sodium fluoride and potassium oxalate were bought from BDH (UK).

Collection and Preparation of Seeds

Seeds were bought from a shop in the Kariakoo area (Ilala District, Dar es Salaam). The seeds were identified by Mr. E. B. Mhoro (Voucher no. MJ 75). A voucher specimen is deposited in the herbarium of the Institute of Traditional Medicine, Muhimbili University College of Health Sciences, Dar es Salaam, Tanzania.

The seeds were crushed and the outer cover removed. The kernel was ground into a fine powder with a blender, kept in an air-tight bottle, and stored at –20°C. On the day of the experiment, the stored bottle of powder was retrieved and allowed to warm to room temperature. The powder was then suspended in 0.5% CMC as described previously (Akhtar et al., 1981) at a concentration of either 0.1 or 0.2 g/ml.

Animal Studies

Male and female healthy Australian white albino rabbits weighing 1.2–2.2 kg were used for the study. The rabbits were used only once.

Effect of the Seeds on Oral Glucose Tolerance Test (OGTT)

Rabbits starved for 20 hr were divided into 2 groups each containing 11 rabbits. Blood samples were collected for the measurement of fasting blood glucose. The rabbits in group 1, the controls, were given orally 2 ml/kg body weight 0.5% CMC. Those in group 2 were given 0.2 g/kg body weight of the powdered seed kernel suspended in 0.5% CMC. Rabbits in both groups were given an oral glucose load of 1 g/kg body weight (Perfumi et al., 1991), 30 min after either CMC or the powdered kernel suspension. Blood samples were collected from rabbits in both groups at 0.5, 1, 2, 3 and 4 hr, after the oral glucose, for the measurement of blood glucose. The experiment was repeated using 0.4 and 0.8 g/kg body weight of the seed powder compared with 0.1 g/kg body weight chlorpropamide (Naik et al., 1991). Three groups were used each containing 11 rabbits; for 0.5% CMC, seed powder and chlorpropamide, respectively. Blood samples were collected from these rabbits 0.5, 1, 2, 3, and 4 hr, after the oral glucose, for the measurement of blood glucose.

Effect of Repeat Dosing (Sub-acute Treatment) on Fasting Blood Glucose and OGTT

Rabbits starved for 20 hr were randomly divided into two groups each containing 11 rabbits. Blood samples were collected for the measurement of fasting blood glucose. The rabbits in one group were given 2 ml/kg body weight of 0.5% CMC once daily, between 8 and 11 am, for 7 days. Those in the second group were given a once daily dose of 0.2 g/kg body weight of powdered seed kernel in 0.5% CMC for 7 days (Perfumi et al., 1991). On the seventh day, the rabbits in the two groups were fasted for 20 hr after which blood samples were collected for the measurement of fasting blood glucose. After collection of blood for fasting glucose the rabbits were again dosed with either 0.5% CMC or 0.2 g/kg body weight of powdered seed kernel followed by 1 g/kg body weight oral glucose 30 min later. Blood samples were collected from both groups at 0.5, 1, 2, 3 and 4 hr after the oral glucose for the measurement of blood glucose.

Effect on Fasting Blood Glucose

Rabbits starved for 20 hr were randomly divided into three groups each containing 11 rabbits. Blood samples were collected for measurement of fasting blood glucose. The rabbits in group 1 were orally given 2 ml/kg body weight of 0.5% CMC in water. Those in groups 2 and 3 were given orally suspensions in 0.5% CMC of 0.8 g/kg body weight of powdered seed kernel and 0.1 g/kg body weight chlorpropamide, respectively. Blood samples were collected at 1, 2, 3, 4 and 6 hr, after the oral dosing, for the measurement of blood glucose.

Collection and Measurement of Blood Glucose

The rabbits were held in a wooden rabbit holder and blood collected from the marginal ear vein after wiping the ear with xylene (Akhtar et al., 1981). Volumes of 0.5 ml were then collected into universal bottles containing sodium fluoride and potassium oxalate as an anticoagulant and anti-glycolytic mixture. After blood collection, the pricked side of the ear was rubbed with cotton wool soaked with absolute alcohol to protect the rabbit against infection (Akhtar et al., 1981). Blood glucose was measured using a YSI glucose analyzer

model 23 AM (Yellow Springs Instruments Co. Inc., Yellow Springs, Ohio 45387, USA).

Data Analysis

The data for glucose tolerance were analyzed using oneway analysis of variance for repeated measurements. The Neuman-Keuls range test was used to determine differences at each point. Differences at each point were considered significant when $P \leq 0.05$. The paired *t*-test was used to compare fasting blood glucose levels in sub-acute dosing.

RESULTS

Effect of Acute Treatment on OGTT

Administration of 0.2 g/kg body weight of the powdered kernel of the seeds of *Caesalpinia bonducella* did not alter the clearance of an administered glucose load from the blood of rabbits as compared with controls given 0.5% CMC. Figure 1 shows there was no significant difference in blood glucose levels between rabbits given CMC and those given 0.2 g/kg body weight of the seed powder ($P > 0.05$). Figure 2 shows that increasing the dose of the seed powder to 0.4 and 0.8 g/kg body weight also did not enhance the clearance of glucose from the blood of these rabbits as compared to 0.5% CMC. However, in the third group, in which chlorpropamide was used, glucose clearance was significantly higher than for the rabbits given 0.5% CMC or the seed powder ($P \leq 0.05$).

Effect of Repeat Dosing on Fasting Glucose and OGTT

Administration of 0.2 g/kg body weight of the powdered kernel for 7 consecutive days did not alter levels of fasting blood glucose. The mean fasting blood glucose for rabbits given 0.5% CMC was 4.0 ± 0.2 and 4.1 ± 0.2 (mean ± SEM) mmol/l on the first and seventh days, respectively. The mean fasting blood glucose for those given the seed powder was 4.1 ± 0.2 (mean ± SEM) mmol/l both on the first and seventh days. Figure 1 shows there was no significant difference between the controls and treated rabbits in the ability to clear a

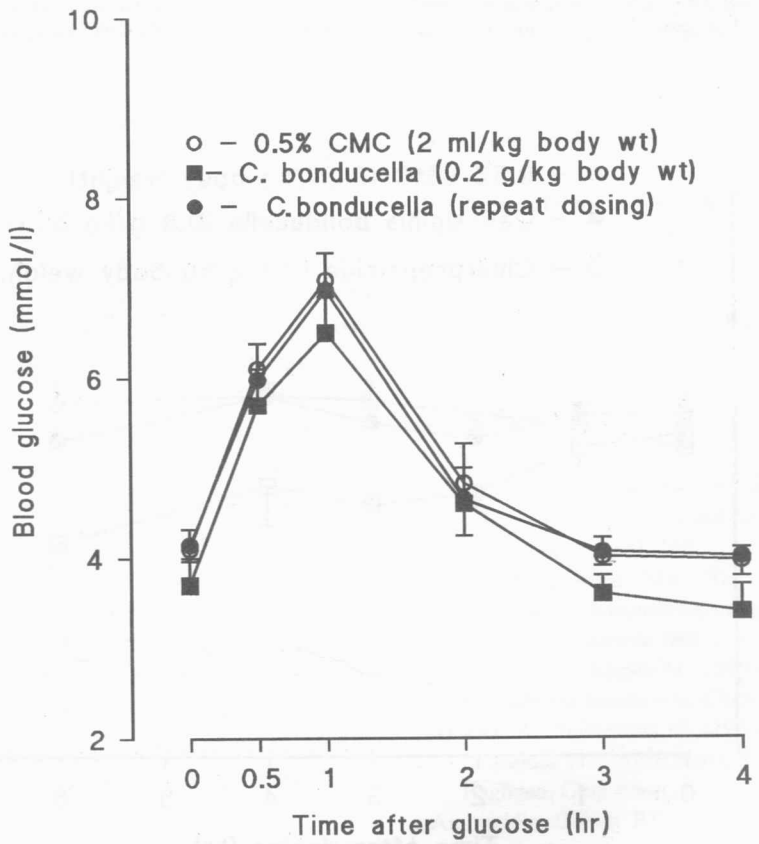

Fig. 1. The effect of a single and a daily dose of 0.2 g/kg body weight (for 7 consecutive days) of the powdered kernel of *Caesalpinia bonducella* seeds on OGTT in rabbits compared with controls given 2 ml/kg body weight of 0.5% CMC. Each point represents mean ± SEM (n = 11).

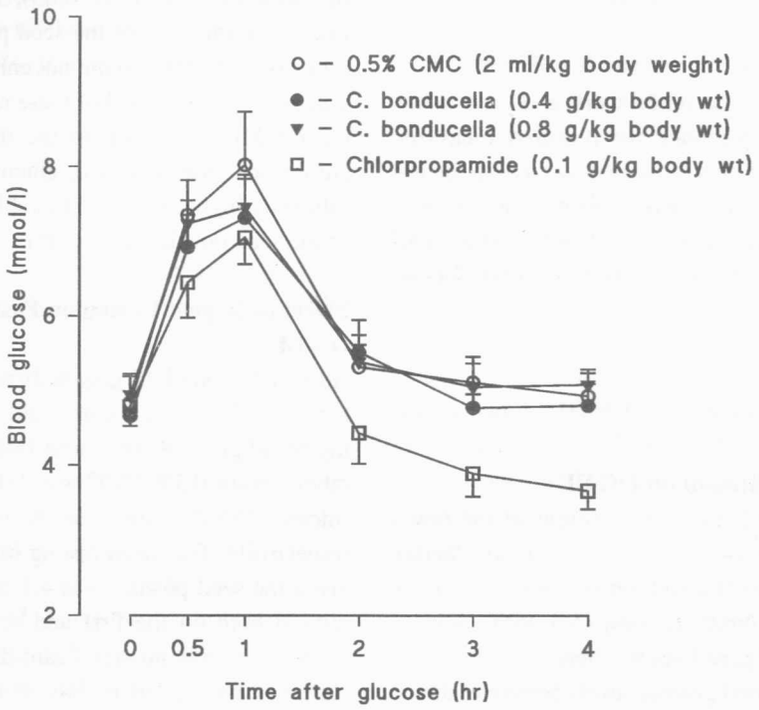

Fig. 2. The effect of 0.4 and 0.8 g/kg body weight of powdered kernel of *Caesalpinia bonducella* seeds and 0.1 g/kg body weight chlorpropamide on OGTT in rabbits compared with controls given 2 ml/kg body weight of 0.5% CMC. Each point represents mean ± SEM (n = 11).

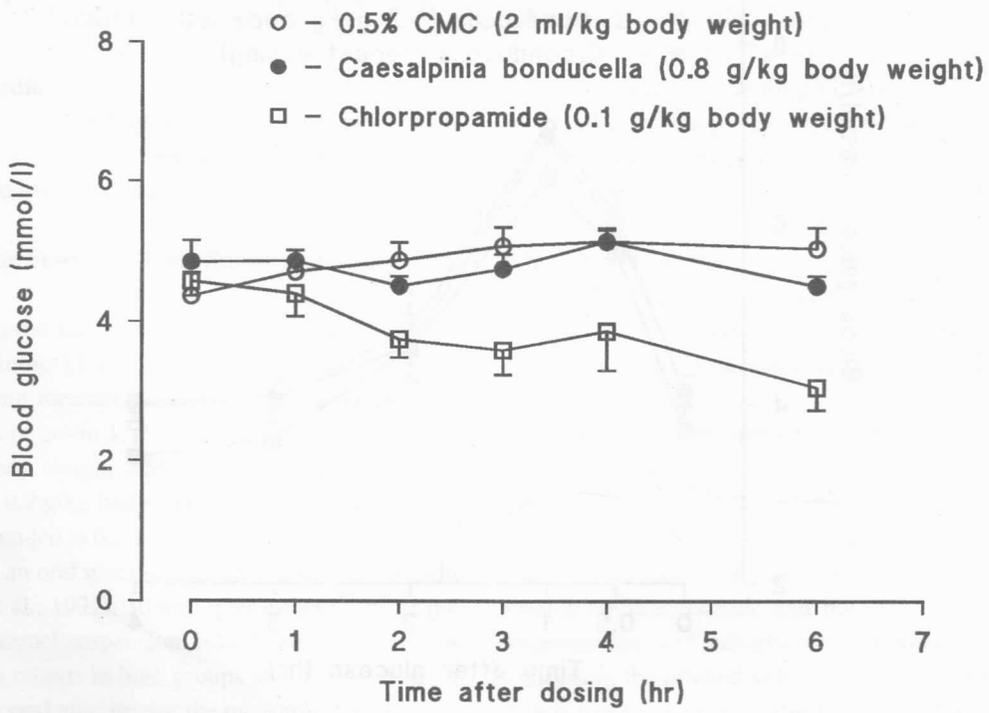

Fig. 3. The effect of 0.8 g/kg body weight of powdered kernel of *Caesalpinia bonducella* seeds and 0.1 g/ kg body weight chlorpropamide on fasting blood glucose compared to controls given 2 ml/kg body weight of 0.5% CMC. Each point represents mean ± SEM (n = 11).

glucose load from the blood ($P > 0.05$). Similarly, the mean body weights of the rabbits was unaffected by feeding on the seed powder and remained almost the same, i.e., 1.6 ± 0.2 (mean ± SEM) kg and 1.6 ± 0.2 (mean ± SEM) kg for the controls and 1.6 ± 0.1 and 1.7 ± 0.1 (mean ± SEM) kg for the rabbits given the seed powder, on the first and eighth days, respectively. There were not any adverse effects observed during the course of feeding the rabbits on *Caesalpinia bonducella* seed powder.

Effect on Fasting Blood Glucose

The powdered seed kernel of *Caesalpinia bonducella* at a dose of 0.8 g/kg body weight had no effect on fasting blood glucose. The values of blood glucose measured between 1 hr and 6 hr after either 0.5% CMC or the powdered seeds were not significantly different ($P > 0.05$). On the other hand, chlorpropamide, at a dose of 0.1 g/kg body weight, significantly lowered fasting blood glucose as compared to either CMC or the seed powder ($P \leq 0.05$). Figure 3 shows that the mean fasting glucose in the rabbits given chlorpropamide were still falling 6 hr after dosing.

DISCUSSION

The results obtained in this work show no evidence for the presence of hypoglycaemic activity in the powdered kernel of *Caesalpinia bonducella* seeds. The powder had no effect on blood glucose both in the fasted and glucose-fed normal rabbits. On the other hand, chlorpropamide, which is a known oral hypoglycaemic agent, lowered blood glucose in the fasted and glucose-fed rabbits thus reducing areas under the blood glucose curves in both cases.

In a survey of shops that sell these seeds for the treatment of diabetes, we learned that the dose given is the powdered kernel of one seed taken with a glass of water twice a day. This is equivalent to a mean dose of 0.6 g (range 0.4–0.8 g) twice daily, body weight not considered. The doses administered in our work were 14, 28 and 56 g per 70 kg body weight, respectively. These doses are several times higher compared to the ones traditionally used. We also observed that, at a dose of 0.8 g/kg body weight the powdered kernel had no effect on fasting blood glucose in alloxan diabetic rabbits (data not shown).

Using albino rabbits, Rao et al. (1994) showed that the seeds of *C. bonducella* had hypoglycaemic activity at doses of 0.5–1.5 g/kg body weight. In our work we did not detect any hypoglycaemic activity at the doses of 0.2–0.8 g/kg body weight. Two doses used in our work, 0.4 and 0.8 g/kg body weight, fall within the range of the doses used by Rao et al. (1994). It is possible the seeds of *Caesalpinia bonducella* growing in Dar es Salaam do not have hypoglycaemic activity. However, in contrast to our study, in the experiments by Rao et al., the rabbits were given food and water *ad libitum* during the entire period of experimentation. This is likely to cause variations in the measured blood glucose levels because the amount of food taken by the rabbits was uncontrolled. Similarly, there was no attempt in their study to measure fasting blood glucose.

CONCLUSION

The seeds of *Caesalpinia bonducella* failed to lower blood glucose in fasted and glucose-fed healthy rabbits. Using the same experiments, chlorpropamide, a standard hypoglycaemic drug lowered blood glucose in fasted rabbits and enhanced clearance of an administered glucose load from the blood. We conclude that, contrary to a previous report, we could not detect any hypoglycaemic activity in the seeds of *Caesalpinia bonducella* growing in Dar es Salaam.

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