Effects of Aqueous Stem Bark Extract of *Cissus populnea* on Serum Electrolytes in Alloxan Induced Diabetic Rats

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Abstract

This study was undertaken to confirm the safety and reliability of the continued use of the mucilaginous stem bark of *Cissus populnea* as thickening agent in soup, its palatability and characteristic "goo" or slimy nature for easy swallowing of solid food. The results suggest that alloxan induced diabetes mellitus in rats’ causes a increase in the serum levels of sodium (from 100.60±3.10 mmol/L to 110.00±5.75 mmol/L), Chloride (from 100.60±1.10 mmol/L to 110.00±7.00mmol/L) and inorganic phosphate (1.94±0.85mmol/L to 2.38±0.08mmol/L). The levels of bicarbonate and potassium were decreased. From 26.20±1.25mmol/L to 21.36±1.80mmol/L (bicarbonate) and 3.80±1.00mmol/L to 3.35±0.50mmol/L (potassium). The administration of Cissus stem bark extract in diabetic rats however elevated the level of these electrolytes (sodium, potassium, bicarbonate and inorganic phosphate) towards normal values. Cissus stem bark extract appears to have high margin of safety or is non-toxic.

Introduction

The significance of electrolytes in clinical biochemistry cannot be overstated, but it is important also to recognize that there are many more electrolytes in serum than the sodium, potassium, chloride, and bicarbonate usually examined by most chemical pathologists. Electrolytes is composed of a wide variety of compounds, from simple inorganic salts of sodium, potassium and magnesium to complex organic molecules often synthesized by and unique to the individual. Electrolytes share with water the phenomenon of dissociating into positively and negatively charged ions and have the additional property of variably affecting the concentration of hydrogen ions in a solution: this effect depends both on the individual ion characteristics and on interaction with other completely and partially ionized substances in the solution (Maxwell and Kleeman, 1980). Major differences in specific ion characteristics exist between cell fluid and extra cellular fluid; these differences are maintained by a substantial expenditure of energy by cells and are critical to cell metabolism and survival (Hassan et al, 2015).

In any normal individual there is a difference between serum Na⁺ (the major extra cellular cation) and the sum of serum Cl⁻ and HCO₃⁻ (the major extra cellular anions). This difference is partially due to the presence of organic acids, the end products of metabolism, which contribute hydrogen ions and organic anions to the serum. Another portion of this difference (gap) is attributable to phosphate salt, since HCO₃⁻ is a major source of buffering anions in blood, addition of organic acid results in a fall in HCO₃⁻, with replacement of the HCO₃⁻ by unmeasured organic anion. Thus, the sum of the measured anions diminishes and the gap between this sum and the serum sodium concentration increases (Weil and Bailie, 1977).

It has been noted for many years that patients with type I diabetes may exhibit striking elevations of the glomerular filtration rate (GFR). Hyper filtration is often seen at the time diabetes is diagnosed in type I and at times, type II diabetic patient. This glomerular hyper-filtration, noted Brenner and Anderson, (1990) is usually accompanied by increments in renal plasma flow and by a substantial increase in kidney size.

These early functional changes related to the development of diabetic micro angiopathy. Brenner and Anderson (1990) also postulated that the increased GFR and filtration fraction were associated with increased filtration pressure or increased permeability of the glomerular capillary wall, which in turn contributed to morphological injury. Those patient with the highest values for GFR in the early stages of diabetes are more likely to progress to persistent proteinuria or diabetic glomerulopathy than those patients who do not exhibit early hyper-filtration.
Materials and Methods

Experimental Plant Material.

*Cissus populnea* (Family Ampelidaceae) locally called *okoho* purchased fresh from the open market in Jos was harvested from the wild in Tilden Fulani (Longitude 9° Latitude 10°) on the out skirts of Jos, Nigeria in winter (Tyler et al, 1976). It was cleaned by scraping the powdery ash coloured bark with a knife. This was then pounded lightly with a large pestle to expose the strips of thread-like part containing the mucilaginous substance. These were separated from the inner wooden core and then room dried (Tyler et al, 1976). The dried threaded strips were then pounded in a mortar to get a clear brownish ground Cissus. This was stored in a glass stoppered brown bottle until use.

Experimental Animals

White wistar strain albino rats weighing 100-180g used in the study were purchased from the animal house unit of the Department of Biochemistry, University of Jos. All the animals were adult males. The blood samples for electrolytes, obtained after sacrificing the rats, were allowed to clot and sera separated after centrifuging at 3000rpm for five minutes.

Preparation of Aqueous Extract of Ground Cissus Stem Bark For Intubation.

Ground *Cissus populnea* stem bark, 100g, was dissolved in 1000 ml of distilled water overnight, warmed to 70°C cooled to room temperature and filtered to give a final concentration of 10mg/ml. This was prepared fresh daily. Pre-weighed rats in groups ii and iv were administered 10mg/ml /100g body weight of rats for 4 weeks using intubation tube and syringe containing the extract.

Diabetes Induction

The rats in diabetic control and diabetic treated with the extract groups were induced with diabetes by administering single intraperitoneal injection of alloxan monohydrate at a dose of 17.5mg/100g-body weight. Three days later their blood glucose levels were checked. Those with 180 mg/d1 or above were assumed diabetic.(Enyikwola and Magaji, 1997).

Procedure with rats

The experimental animals, which were acclimatized for one week, were reweighed and divided into four groups of nine rats each. The four groups and the treatments they received were as follows:

Group I: Normal Control group on unrestricted but measured standard diet and water *ad libitum* for 4 weeks,

Group II: Normal rats on unrestricted but measured standard diet and water *ad libitum* and intubated with 10mg/ml/100g body weight aqueous extract of Cissus stem bark for 4 weeks.

Group III: Diabetic control on unrestricted but measured standard diet and water *ad libitum* for 4 weeks.

Group IV: Diabetic rats on unrestricted but measured diet, water *ad- libitum* and intubated with 10mg/ml/100g body weight aqueous extract of cissus stem bark for 4 weeks.

Estimation of Serum Bicarbonate

This was determined by the method as described by Tietz et al, (1987).

Estimation of Serum Inorganic Phosphate

This was determined by the method as described by Munoz et al (1983).

Estimation of Sodium and Potassium

This was determined by the method as described by Kulpmaunn (1991)

Estimation of Chloride

Chloride was determined by the AACC method (1964)

Results

Diabetes Induction Test Result:
The intraperitoneal injection in a single dose of 17.5mg/100g body weight of alloxan monohydrate produced a fasting average blood glucose concentration of 189mg/dl ± 5.2 for groups III and IV after 48 hours. This result is consistent with the establishment of hyperglycemia and as a corollary diabetes mellitus.

**Effects of Cissus Stem Bark Extract on Serum Electrolytes:**

Table 1 below shows the effects of four weeks oral administration of *Cissus populnea* s aqueous stem bark extract on some serum electrolytes in normal and alloxan induced diabetic wister strain albino rats.

**Discussion**

The principal cations of serum are sodium, potassium, calcium and magnesium. Constancy of the concentration of each of these cations is important for three reasons. Firstly, The concentration of each cation, both individually and in relation to the other has a marked influence on the activities of many vital tissues, including the regulation of blood volume, renal function and cardiac conduction among others. Secondly, the sum of the concentrations of the cations determines the quantity of anions that can be kept in electric neutrality at the pH of serum. (3) The sum of cation concentrations is the determining factor in the total osmotic pressure of serum and interstitial fluids and therefore of intracellular fluids (Hoffman, 1973). Intrarenal factors controlling electrolyte balance (e.g. sodium) include glomerular filtration rate (GFR) and tubular reabsorption. Since 99.5% of filtered sodium is usually reabsorbed, a small change in filtration rate represents a substantial reduction in the filtered load of sodium. With a rise in glomerular filtration rate (GFR) there is relatively little increase in sodium excreted, while a fall in GFR results in a disproportionate decrease in Sodium excretion. Type I diabetic patients may exhibit striking elevations of the glomerular filtration rate. Hyper-filtration is frequently found at the time diabetes is diagnosed in type I and in some cases, type II diabetes (Brenner and Anderson, 1988). The study revealed that diabetes increases the serum levels of sodium, potassium, chloride and inorganic phosphate. However, decrease is noticed in the same parameters in those administered with cissus extract. This suggests that the extract contains substances that counteract the derangements associated with diabetes (e.g. hyperglycemia that in turn manifests in the normalization of renal function. From the studies it can be concluded that Cissus stem bark extract appears to have high margin of safety or is non-toxic.

**References**