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Mini Review

Sodium Bicarbonate, *Artemisia* and Diabetes

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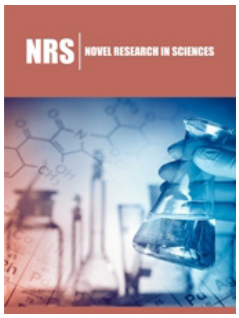

Abstract

Artemisia plants are known for their medical properties. In our own clinical trials we have been able to confirm that *Artemisia afra*, a local and legal plant in Africa, not only has therapeutical, but also prophylactic properties against malaria, schistosomiasis, typhoid fever, tuberculosis, Buruli ulcer, leishmaniasis and diabetes. A literature survey and preliminary results from Palestine indicate that sodium bicarbonate might enhance these properties. This review paper concentrates on the potential effects of sodium bicarbonate on diabetes.

Keywords: Sodium bicarbonate; Artemisia; Diabetes; Malaria; Schistosomiasis; Typhoid fever; Tuberculosis

Abbreviation: IFG: Impaired Fasting Glucose

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Literature Review

Low serum bicarbonate is closely related to type 2 diabetes mellitus. However, the precise role of bicarbonate on glucose homeostasis and insulin secretion remains unknown. In a Chinese study, the effects of bicarbonate concentration on pancreatic β-cells were investigated. It was observed that the high bicarbonate concentration of the cell culture medium significantly increased the glucose-induced insulin secretion levels in mouse islets and the β cells. Further study demonstrated that a low concentration of extracellular bicarbonate significantly impaired the functioning of pancreatic β-cells. Taken together, these results show that bicarbonate may serve as a novel target in diabetes prevention-related research [1]. Since sodium bicarbonate had never been tested in an experimental mouse model for diabetic autoimmunity, a group of students in Minnesota studied the effects of sodium bicarbonate treatment on incidence and severity of streptozotocin-induced diabetes in 8-week-old mice. Mice were treated with 200mM sodium bicarbonate in drinking water from 7 to 12 weeks of age. One week after the initiation of treatment, each mouse, control and treatment, received a daily low-dose of streptotocin for a period of 5 days to induce diabetes. Prior to the induction of diabetes (Day -7) there were no differences in glucose levels observed between the control and treatment groups. This is in line with previous anecdotic reports where no effect on glycemia had been noticed for sodium bicarbonate on healthy persons not suffering from diabetes. At 9 weeks of age, biweekly glucose measurements were taken until the end of the experiment (Day 7 to Day 28). The treatment significantly decelerated diabetes development and decreased diabetes incidence compared to control group. On Day 14, 47.6% of sodium bicarbonate treated mice were diabetes-free while only 14.3% of the control mice [2]; (Figure 1). A prospective study from India on 205 patients with acute pancreatis showed that patients with low arterial bicarbonate levels displayed much higher frequency of organ failure, respiratory failure and mortality [3]. In a prospective study plasma bicarbonate was measured in 630 women who did not have type 2 diabetes mellitus at the time of blood draw in 1989-1990 but developed type 2 diabetes mellitus during 10 years of follow-up. Higher

plasma bicarbonate levels were associated with lower odds of incident type 2 diabetes mellitus [4,5]; (Table 1). A Chinese study found an association between lower serum bicarbonate and higher risk of progressing to diabetes in Chinese people. The prevention of diabetes mellitus could benefit from controlling serum bicarbonate at a relatively higher level within the normal range in the population (Figure 2); [6]. The pancreas generates a lot of bicarbonate which may react with polyphenols. The oxidation of polyphenols is strongly enhanced by sodium bicarbonate. Much more than by other substances like glucose, amino acids, vitamins, NaH_2PO_4 or other inorganic salts [7].

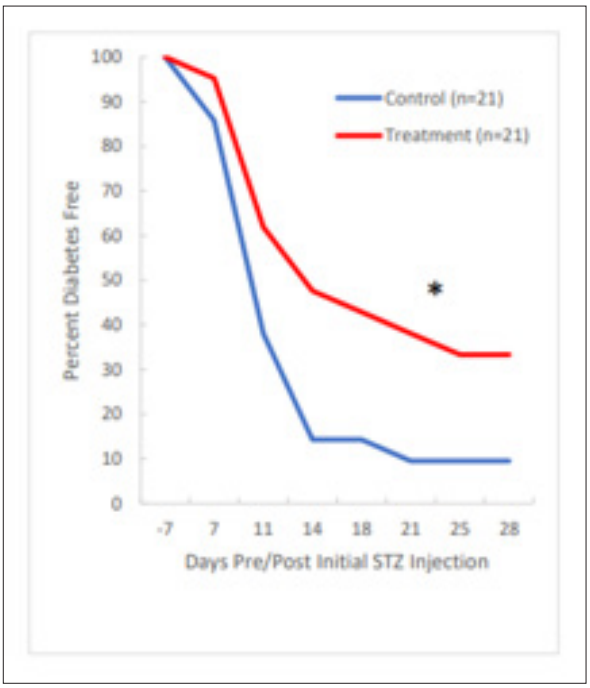

Figure 1: Incidence of diabetes in STZ-administered mice treated by 200mM sodium bicarbonate vs control group.

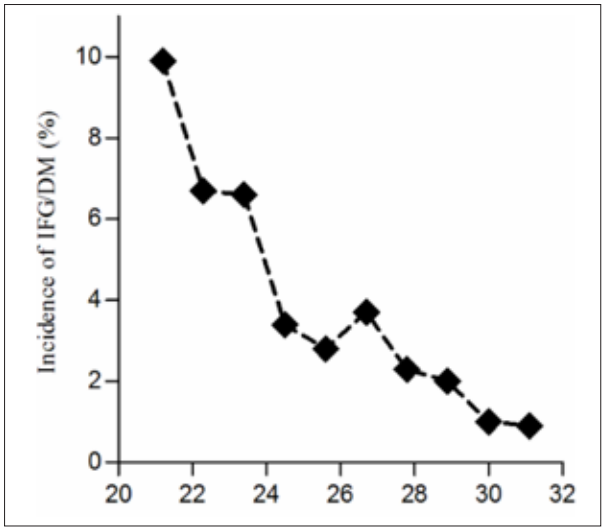

Figure 2: Prevalence of Impaired Fasting Glucose (IFG) by deciles of the baseline serum bicarbonate. DM, diabetes mellitus.

Table 1: Controls by quartile of plasma bicarbonate.

Insulin, µU/ml	8.1 (4.9-12.0)	8.6 (4.4-12.8)	9.7 (6.5-12.8)	9.3 (5.0-13.2)
Plasma bicarbonate, mmol/L	19.5 (18.3-19.9)	21.4 (20.9-21.7)	23.1 (22.7-23.6)	25.3 (24.4-26.4)

Artemisia annua is very rich in bicarbonate. A study from Pakistan analyzing 10 medicinal herbs finds that it is top ranking (Table 2); [8]. Bicarbonate contents are higher in roots and stems than in leaves [9]. As stems are also richer than leaves in many important constituents with therapeutic value: nitrate, inulin, starch, amino acids, tannins, fungal endophytes, and poorer in phytates, it is important to prepare the infusions not only with leaves but also to include petioles and stems. The results obtained by the Al Quds University on the promotion of the inhibitory effect of sodium bicarbonate on beta-hematin by Artemisia infusions indicate that this salt enhances the extraction of active constituents [10]; (Figure 3). Sodium bicarbonate also enhances the extraction of tannins from medicinal herbs. The feature is used in Turkish tea houses. Some bicarbonate is added to the water used for decoction and the infusion becomes darker [11]. It is easy to determine the bicarbonate content in an infusion with methyl orange. All these studies indicate that a sufficient availability of the bicarbonate anion is required to allow a normal process of glucose-stimulated insulin release. The bicarbonate ion has a fundamental role in vital systems. Impaired bicarbonate transport leads to various diseases, including immune disorders, cystic fibrosis, tumorigenesis, kidney diseases, brain dysfunction, tooth fracture, ischemic reperfusion injury, hypertension, impaired reproductive system, and systemic acidosis. But as it is the case for any drug or mineral, homeostasis and hormesis play a role. Overdoses of sodium bicarbonate may be harmful [12,13].

Table 2: Analysis of inorganic constituents in ten selected medicinal plants (ppm).

S No.	Sample Code	Calcium	Chloride	HCO_3
1	*Acorus calamus*	32	35.5	100
2.	*Artemesia annua*	16	92.3	330
3.	*Chenopodium foliosum*	59	68	86
4.	*Cupressus Sempervirens*	16	28.4	120
5.	*Euphorbia helioscopia*	40	l34.9	260
6.	*Lepedium Sativum*	16	77	103
7.	*Nerium oleander*	32	63.9	200
8.	*Rananculas ripens*	31	85	103
9.	*Tecoma stans*	24	42.6	200
10	*Urtica dioca*	12.5	51	327

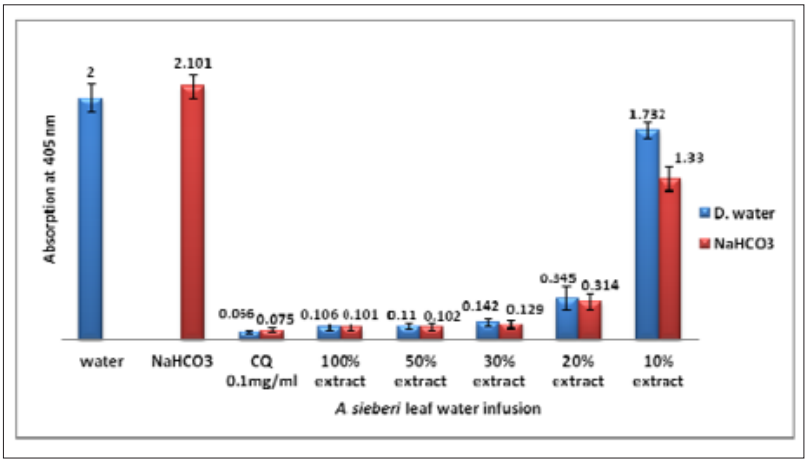

Figure 3: Column diagram of potential anti-malarial A. Sieberi leaf water infusion. Bicarbonate in-vitro effect on beta-hematin inhibition by Artemisia Sieberi aqueous infusion.

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