



## Changes in Serum Electrolytes, Urea, and Creatinine in *Aloe Vera*-treated Rats

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### ABSTRACT

This study was carried out to investigate the effect of *Aloe vera* extract (AvE) on serum electrolytes, urea, and creatinine as indices of renal function in Sprague-Dawley rats. Twelve male Sprague-Dawley rats weighing between 80 and 130 g were used. Rats were divided into two groups: The control and the test groups ( $n=6$ ). The test group received 1 ml of AvE daily for 28 days. Both the groups fed on standard rat chow and water *ad libitum*. The results showed a decrease in serum levels of sodium, and potassium, but an increase in the serum levels of bicarbonate, urea, and creatinine in the test group. The changes seen were, however, statistically insignificant, except for the serum levels of sodium and creatinine ( $P<0.05$ ). It is thus concluded that AvE impairs renal handling of electrolytes with consequent hyponatremia and hypercreatinemia. However, this might be of therapeutic value in conditions associated with hyponatremia.

**Key words:** *Aloe vera*, creatinine, electrolytes, kidney, urea

### INTRODUCTION

*Aloe vera*, also known as medicinal aloe, is widely used in food products, pharmaceuticals, and cosmetics due to its therapeutic properties.<sup>[1,2]</sup> Its biologically active compounds include polysaccharides, mannans, lectins, chromes, anthraquinone, and anthrone derivatives.<sup>[3]</sup> Aloin has been reported to be the major anthraquinone of aloe exudates

and gels<sup>[4]</sup> and it is characterized as the c-glycoside of aloe-emodin.<sup>[5]</sup>

*Aloe* has been reported to have hypoglycemic properties,<sup>[6,7]</sup> normalize plasma lipid status,<sup>[8]</sup> and laxative properties.<sup>[9]</sup> It has also been associated with the increase in the alcohol oxidation rate in rats,<sup>[10]</sup> cytotoxicity against human breast cancer cell lines,<sup>[11]</sup> and changes in urinary compositions.<sup>[12,13]</sup> Its laxative property has been reported to be the major adverse effect.<sup>[14]</sup>

From literature search, although the effects of *Aloe* on urinary compositions and its laxative effects have been reported, no study has clearly demonstrated its influence on plasma electrolytes, urea, and creatinine in association with urinary composition changes previously reported. This study thus sought to investigate the effect of aloe

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on serum electrolytes, urea, and creatinine as indicators of renal function.

## MATERIALS AND METHODS

### Animals

Male Sprague-Dawley rats weighing between 80 and 130 g and 6–8 weeks old were used for the experiment. They were housed in standard rat cages under laboratory conditions with 12:12 h light/dark cycle at  $25^{\circ}\text{C} \pm 2$ . The animals were allowed to acclimatize for 2 weeks.<sup>[15]</sup>

### Treatment

Animals were divided into two groups ( $n=6$ ); the control and test groups. The test group was treated with 1 ml of *Aloe vera* juice daily for 28 days. All rats, both the control and the test groups, were fed on standard rat chow and water *ad libitum*.

### Extraction of *Aloe vera*

Fresh stems of *Aloe vera* were washed thoroughly to get rid of all forms of debris. The leaves were then sliced longitudinally to cut open the inner part of the leaves. The gel in the leaves was scrapped into a clean bowl and blended to obtain a finer and liquefied form of the gel, the aloe juice. The juice was refrigerated below  $4^{\circ}\text{C}$  for preservation.<sup>[16]</sup>

### Blood sample collection

After the 28 days of administration of *Aloe vera* juice, the blood sample from the animals were initially collected *via* the retro-orbital plexus, after which they were killed by cervical dislocation and more blood samples were obtained *via* heart puncture. The blood sample obtained from each rat was put in lithium-heparinized sample bottles. Serum was obtained by centrifuging at 3000 rpm for 15 min.<sup>[17]</sup>

### Determination of serum electrolytes, urea, and creatinine

Serum sodium and potassium levels were determined using the Flame photometry method (410 flame photometer, Chiron Diagnostics) following the manufacturer's guidelines.<sup>[18]</sup> Serum bicarbonate, urea, and creatinine were determined using the standard assay kit following back titration, diacetyl monoxime, and alkaline picrate methods, respectively.

### Statistical analysis

Data are expressed as mean  $\pm$  standard deviation (SD). The significant difference between the test group and the

control group were analyzed using unpaired *t*-tests. Data were analyzed using the SPSS software (SPSS Inc., Chicago, USA).  $P < 0.05$  was set as the level of significance.

### Ethics

All animals received humane care in compliance with the institution's guidelines and criteria for humane care as outlined in the National Institute of Health Guidelines for the care and use of Laboratory Animals.

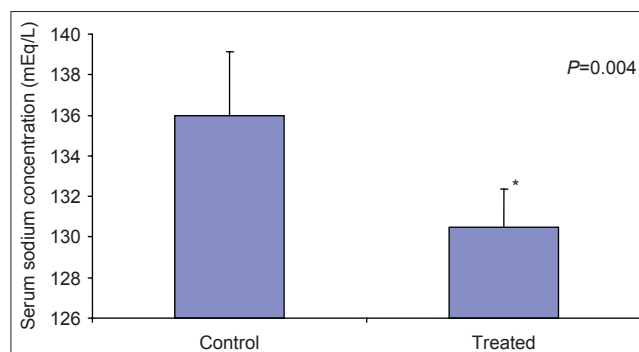
## RESULTS

The result showed a significant decrease in the serum sodium level in the test group after administration of the *Aloe vera* extract (AvE) as compared to the control rats ( $P=0.004$ ) [Figure 1]. There was a nonsignificant decrease in the potassium level in the test rats as compared to the control rats ( $P=0.549$ ) [Figure 2]. The serum level of bicarbonate also showed a nonsignificant increase in the test rats when compared to that of the control rats ( $P=0.305$ ) [Figure 3].

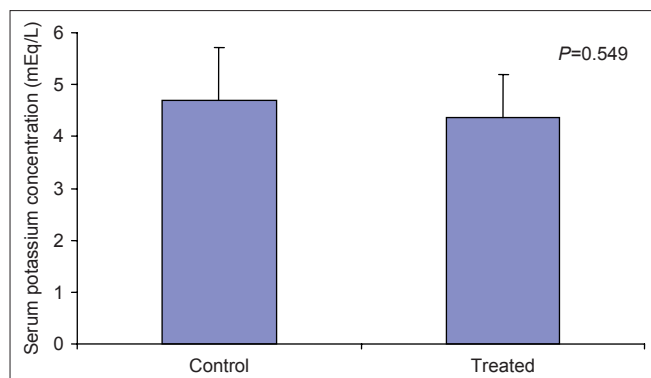
Similarly, there was a nonsignificant increase in the urea level in the test rats when compared to the control rats ( $P=0.221$ ) [Figure 4]. The serum level of creatinine showed a significant increase in the test rats when compared to the control rats ( $P=0.042$ ) [Figure 5].

## DISCUSSION

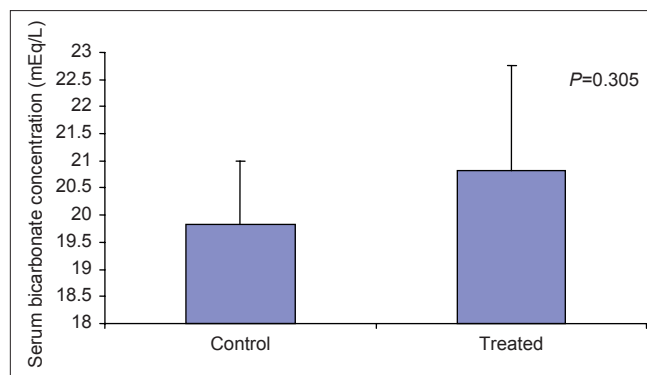
This study aimed at investigating the effect of AvE on renal function by evaluating the serum concentrations of electrolytes, urea, and creatinine. This appears to be the first study to investigate and document changes in serum electrolytes as indices of renal function following aloe treatment in association with changes in urinary composition previously reported. The result from this study demonstrated that AvE treatment induced electrolyte



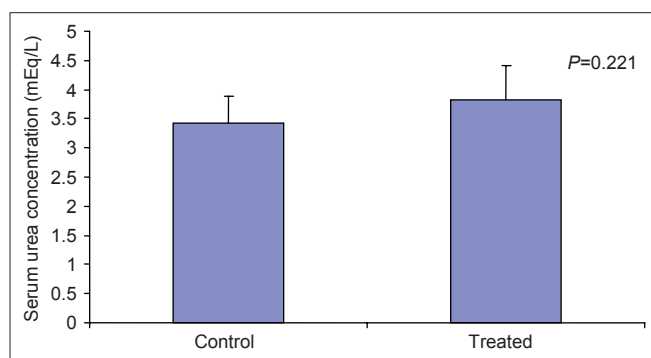
**Figure 1:** Effect of *Aloe vera* extract on serum sodium concentration (\* $P < 0.05$  vs. control)



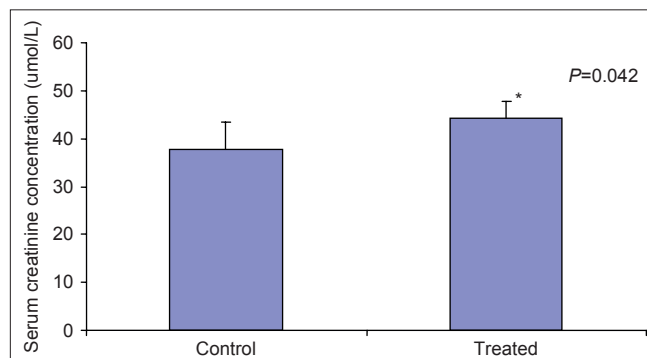
**Figure 2:** Effect of *Aloe vera* extract on serum potassium concentration



**Figure 3:** Effect of *Aloe vera* extract on serum bicarbonate concentration



**Figure 4:** Effect of *Aloe vera* extract on serum urea concentration



**Figure 5:** Effect of the *Aloe vera* extract on the serum creatinine concentration (\* $P<0.05$  vs. control)

imbalance in experimental animals. This is in tandem with findings of the previous studies.<sup>[9,12,13]</sup> Sodium is the most abundant extracellular ion, and it plays an important role in muscle contraction. Similarly, potassium, an abundant intracellular ion, plays a vital role in muscle contraction. The electrolyte derangement resulting from the reduced serum level of sodium seen in this study thus provides evidence that the use of aloe could present a risk for arrhythmia, abdominal pain and cramping, and muscle weakness.

The observation that aloe induces electrolyte imbalance corroborates findings in the previous study that reported its laxative properties.<sup>[14]</sup> It causes excess water loss accompanied by sodium loss, thus contracting the extracellular fluid with resultant electrolyte imbalance and consequent impairment of muscle contraction.

Ranganath and Gould<sup>[19]</sup> associated reduction in sodium and potassium ions with the increased bicarbonate level. This study seems to be the first to report the effect of aloe on plasma pH by evaluating serum bicarbonate concentration. Although there were reductions in the serum level of sodium and potassium, and a rise in serum bicarbonate concentration, only the reduction in sodium concentration was significant ( $P<0.05$ ), while changes in potassium and bicarbonate ions were nonsignificant ( $P>0.05$ ). This shows that aloe-induced electrolyte imbalance evident by low

plasma level of sodium, though significant, was not enough to cause metabolic alkalosis.

Creatinine clearance calculated from creatinine concentrations in urine and plasma samples, and the urine flow rate, as well as urea clearance, is used to determine the glomerular filtration rate of the kidneys. Although not commonly done anymore, they remain useful tests for renal function.<sup>[20]</sup> Thus, plasma concentrations of creatinine and urea could be used as indicators of nephrotoxicity.<sup>[21-25]</sup> Low clearance of creatinine or/and urea indicates a diminished impaired ability of the kidneys to filter these waste products from the blood and excrete them in urine. As their clearance values decrease, their blood levels increase. Hence, an abnormally elevated blood creatinine is diagnostic of impaired renal function.<sup>[21-25]</sup>

This study revealed that aloe induces a significant rise in serum creatinine. This is in consonance with the study of Avila *et al.*<sup>[26]</sup> that reported the cytotoxic effect of aloe. This study suggests that aloe promotes nephrotoxicity, thus causing impaired renal function evident by an increase in serum creatinine concentration. This could also explain the electrolyte imbalance associated with the aloe use. The altered level of plasma sodium seen in aloe treatment might be as a result of sodium loss due to its cytotoxic effect.

It is noteworthy that hyponatremia is a major challenge associated with the aloe use, however, if given with close monitoring of serum electrolytes might be beneficial in conditions associated with hypernatremia.

## CONCLUSION

This study showed that oral administration of aloe is associated with renal dysfunction, evident by serum electrolyte imbalance, leading to hyponatremia and hypercreatinemia. However, this might be beneficial in conditions associated with hypernatremia.

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