

# Exploration of Effects of Reducing Salts on the Acid-Base Equilibrium in the Human Body

Xinya Zhou, Junjie Mao, Meifeng Chen, Qianfeng Zhang\*

Institute of Molecular Engineering and Applied Chemistry, Anhui University of Technology, Ma'anshan, China

Email: \*zhangqf@ahut.edu.cn

**How to cite this paper:** Zhou, X.Y., Mao, J.J., Chen, M.F. and Zhang, Q.F. (2026) Exploration of Effects of Reducing Salts on the Acid-Base Equilibrium in the Human Body. *Journal of Biosciences and Medicines*, 14, 428-439.

<https://doi.org/10.4236/jbm.2026.143032>

**Received:** February 2, 2026

**Accepted:** March 15, 2026

**Published:** March 18, 2026

Copyright © 2026 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

## Abstract

**Background:** Acid-base equilibrium in the human body is essential for the maintenance of normal cellular physiological functions, metabolic homeostasis, and immune regulation. The proper functioning of nearly all physiological processes is dependent upon maintaining an appropriate acid-base equilibrium. Health is contingent upon this equilibrium being maintained within a healthy pH range; once disrupted, it correspondingly impacts human well-being. Chronic acidosis and an increased systemic acid load may be induced by the consumption of an acidogenic diet. Consequently, acid-base homeostasis can be supported through dietary modification, primarily via the buffering or alkalinizing effects of certain mineral salts. **Conclusion:** This review summarizes the significance of acid-base equilibrium for human health, disorders associated with its dysregulation, the body's compensatory mechanisms, and the therapeutic roles as well as limitations of common alkalinizing salts. It aims to provide insights for subsequent research into methods for sustaining acid-base equilibrium.

## Keywords

Acid-Base Equilibrium, Acid Load, Alkalinizing Salts, Bicarbonate, Metabolic Acidosis

## 1. Introduction

The maintenance of normal cellular physiological functions, metabolic homeostasis, and immune regulation is fundamentally dependent on acid-base equilibrium in the human body [1]. Its core parameters—arterial blood pH, bicarbonate concentration, and partial pressure of carbon dioxide—must be strictly maintained within narrow physiological ranges [2]. The proper functioning of nearly all physiological processes in humans depends on the maintenance of an appropriate

acid-base equilibrium. Intracellular and interstitial pH values are largely determined by arterial blood pH. The regulation of blood pH, which extends to the entire extracellular fluid compartment, relies on the interaction between (i) the urinary system, which controls the blood bicarbonate concentration ( $[\text{HCO}_3^-]$ ) [3], and (ii) the neuro-respiratory system, which controls the partial pressure of carbon dioxide. The kidney's task is to generate  $\text{HCO}_3^-$ , secrete it into the circulation, and reabsorb  $\text{HCO}_3^-$  from the filtered plasma back into the bloodstream. The lungs exhale carbon dioxide, with respiratory drive being controlled by chemosensitive neural circuits [4]. A third line of defense, which minimizes pH changes, is provided by the extensive buffer systems present in the extracellular fluid compartment. Persistent adherence to an acidogenic diet leads to sustained acid-base disturbances, resulting in chronic latent acidosis. Athletes engaged in anaerobic exercise often adhere to such acidogenic diets, characterized by high intake of animal protein and simple carbohydrates. Compared with plant-based protein and complex carbohydrate sources, acidogenic diets increase the risk of gastrointestinal stress and gut microbiota dysbiosis, and elevate the systemic acid load [5]. Therefore, maintaining an equilibrative acid-base status through dietary and lifestyle modifications may have positive impacts on health [6].

In the 1830s, cholera patients were infused with sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) to compensate for the loss of serum alkali due to diarrhea, while the commercial production of sodium bicarbonate ( $\text{NaHCO}_3$ ) as an antacid could be dated back to the 1880s. Since then, decades of research progress have led to a widespread recognition of the importance of acid-base equilibrium in health and disease. As crucial substances for correcting acid-base non-equilibrium in both clinical and everyday settings, alkalizing salts play a key role in regulating body fluid acidity by directly supplementing bicarbonate or metabolizing to generate alkaline substances [7]. The maintenance of human acid-base equilibrium relies on the synergistic action of multiple systems, with the  $\text{CO}_2/\text{HCO}_3^-$  buffer system being the most central humoral buffering mechanism. This system facilitates the dynamic buffering of  $\text{H}^+$  through the rapid conversion of  $\text{CO}_2$  and  $\text{H}_2\text{O}$  catalyzed by carbonic anhydrase. The Henderson-Hasselbalch equation describes how pH is determined by  $[\text{HCO}_3^-]$  and  $p(\text{CO}_2)$ :

$$\text{pH} = pK_{\text{CO}_2} + \log_{10} \frac{[\text{HCO}_3^-]}{s \cdot p\text{CO}_2}$$

Under normal physiological conditions, arterial blood pH is strictly maintained within the range of 7.35 - 7.45. Deviation from this range significantly affects the activity of pH-dependent enzymes, the function of membrane transport proteins, and metabolic pathways: acidemia can lead to arterial dilation, insulin resistance, and decreased immune function, while alkalemia may trigger myocardial hypoperfusion and seizures [8]. During acute inflammatory processes, particularly in infection and the more severe condition of sepsis, acid-base equilibrium is often severely challenged. The pH disturbances in the extracellular environment disrupt

a wide range of immune functions [9]. The key regulatory role of metabolic acidosis in early inflammatory processes may influence the prognosis of sepsis. It has been reported that proton-sensing *G* protein-coupled receptors, including OGR1, GPR4, and TDAG8, are crucial for physiological pH homeostasis and inflammation control [10]. Integrating relevant research findings on acid-base equilibrium, this article systematically reviews the significant impact of acid-base equilibrium on human health, common diseases resulting from acid-base non-equilibria, the acid-base regulatory role of alkalinizing salts, and the limitations of current applications. It aims to provide a reference for research and practice in the related fields.

## 2. Common Disorders Associated with Acid-Base Non-Equilibrium

Charanya Suresh compared the level of awareness among dental students regarding several aspects of acid-base equilibrium in relation to maintaining oral health [11]. The findings of the study included a statistical analysis of dental students' knowledge of salivary pH, as well as the impact of acid-base equilibrium on periodontal diseases and dental caries. The results indicated that attention to dietary components influences acid-base equilibrium. Maintaining a proper acid-base equilibrium requires greater knowledge concerning protein consumption. Concurrently, the study also highlighted potential links between salivary parameters, oral hygiene, and conditions such as dental caries and periodontitis, which warrant further investigation in the future.

The role of diet in regulating human acid-base equilibrium is crucial. The contemporary Western diet is characterized by high consumption of acidogenic foods, such as meats and cheeses, alongside low intake of vegetables and fruits. This dietary pattern leads to increased endogenous acid production, thereby inducing an acid-base non-equilibrium manifested as acid stress, and in its most severe form, low-grade metabolic acidosis [12]-[14]. It is important to clarify that mild metabolic acidosis is primarily regarded as a measurable biochemical state, characterized by serum bicarbonate levels at the lower end of the normal range and increased net acid excretion. Furthermore, when this state is sustained and associated with adverse health outcomes, it may also be considered a clinically relevant pathophysiological diagnosis. In addition, a high dietary acid load (DAL) is associated with numerous adverse clinical outcomes, such as cardiometabolic diseases and liver dysfunction [15]. These findings underscore the importance of effective dietary strategies to mitigate diet-related acid load and its detrimental consequences. Bicarbonate-rich mineral water serves as an effective method to counteract diet-induced acid stress, exerting positive effects on cardiovascular health, gastrointestinal function, and hepatic metabolism. Additional findings indicate that increased acid load is also positively correlated with markers of liver injury, including advanced liver fibrosis [16].

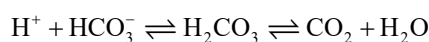
The relationship between a high dietary acid load and osteoporosis remains

somewhat contentious. According to the acid-ash hypothesis, a chronic acid load may promote bone demineralization by mobilizing calcium from bone to buffer acids. However, the extent and clinical relevance of this mechanism are subjects of debate.

### 3. Acid-Base Regulatory Effects and Mechanisms of Common Alkalinizing Salts

#### 3.1. Sodium Bicarbonate (NaHCO<sub>3</sub>)

Sodium bicarbonate (SB) is the most widely used alkalinizing salt in clinical practice. Its core function is to directly supplement HCO<sub>3</sub><sup>-</sup> in body fluids, thereby neutralizing excess H<sup>+</sup> produced by metabolism and rapidly correcting metabolic acidosis. Multiple mechanisms contribute to buffering and eliminating excess H<sup>+</sup> to maintain acid-base equilibrium in response to an acid load. As a first line of defense, acid is buffered by both intracellular and extracellular buffers, and subsequently excreted by the kidneys and lungs. Carbon dioxide (CO<sub>2</sub>), a volatile acid generated from the metabolism or breakdown of the bicarbonate buffer, is eliminated *via* ventilation. The constant CO<sub>2</sub> concentration, set by respiratory control, regulates arterial pH in concert with the bicarbonate buffer system.



Chronic kidney disease (CKD) constitutes a global health burden, and metabolic acidosis is a frequent complication that can accelerate disease progression, leading to muscle wasting, bone demineralization, and systemic inflammation [17]. Sodium bicarbonate (SB) supplementation represents the most widely utilized alkali therapy, offering a direct and cost-effective method to buffer excess acid and restore acid-base equilibrium. Both experimental and clinical data indicate that sodium bicarbonate not only corrects metabolic acidosis but also mitigates the progression of CKD by reducing tubulointerstitial injury, oxidative stress, and inflammatory pathways [18].

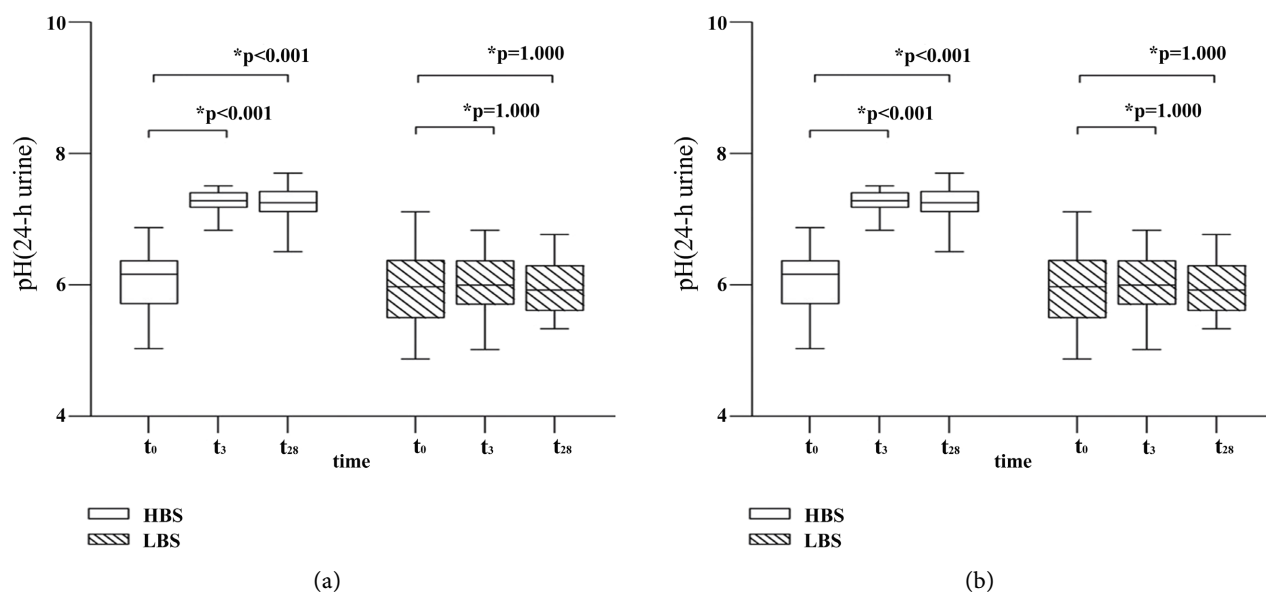
Consuming mineral water has emerged as a promising method for improving acid-base equilibrium [19] [20]. The bioactive constituents present in mineral water, including essential minerals such as calcium, magnesium, potassium, and sodium, can improve the potential renal acid load (PRAL) and counteract acidogenic dietary components [21]. Some mineral waters also contain high levels of bicarbonate, which is a natural component of the body's bicarbonate buffer system and plays a key role in neutralizing acids and maintaining systemic acid-base equilibrium [22] [23]. The alkalinizing effect of bicarbonate-rich mineral water can enhance insulin sensitivity by improving insulin receptor binding, thereby improving glycemic control. Regarding lipid metabolism, bicarbonate-rich mineral water may reduce cholesterol levels by altering gut conditions and increasing bile acid excretion. Both effects on glucose and lipid metabolism can positively impact cardiovascular health. Daily consumption

(1500 - 2000 mL) of mineral water high in bicarbonate and sodium can favorably influence urinary acid-base parameters and reduce net acid excretion (NAE). As shown in **Table 1**, drinking mineral water with very high bicarbonate and relatively high sodium content (HBS water) can effectively reduce renal acid load [24]. As illustrated in **Figure 1**, individuals consuming high-bicarbonate mineral water exhibited slightly higher urine pH compared with that consuming low-bicarbonate mineral water (LBS water). Further analysis of the 28-day prolonged intervention revealed (**Table 2**) that HBS intake led to elevated urinary pH (in both 24-h and spot urine samples) and increased bicarbonate levels, whereas LBS intake showed no significant effect on urinary pH but resulted in a slight decrease in bicarbonate. Furthermore, consumption of mineral water rich in bicarbonate and sodium effectively reduced the net acid excretion (NAE) value. Despite their high sodium content, the impact of these waters on blood pressure is mostly neutral or positive. Concurrently, these waters are also beneficial for individuals with gastrointestinal disorders such as dyspepsia and heartburn, likely due to improved gastric motility and acid-buffering capacity. This indicates an absence of adverse effects on human health while maintaining acid-base equilibrium. These findings underscore the importance of mineral water composition in acid-base regulation. In summary, bicarbonate-rich mineral water represents a promising non-pharmacological strategy for reducing acid load and promoting metabolic, cardiovascular, and gastrointestinal health.

**Table 1.** Mineral contents and PRAL of the testing products. [24]

Mineral	Test product	
	HBS mineral water	LBS mineral water
HCO <sub>3</sub> <sup>-</sup> (mg/L)	4368	228
Na <sup>+</sup> (mg/L)	1708	8.4
Cl <sup>-</sup> (mg/L)	322	11
SO <sub>4</sub> <sup>2-</sup> (mg/L)	174	15
K <sup>+</sup> (mg/L)	110	2.3
Ca <sup>2+</sup> (mg/L)	90	67.5
Mg <sup>2+</sup> (mg/L)	11	6.9
P (mg/L)	0.0**	0.0**
PRAL (mEq/L)	-63.07	-0.89

HBS = high bicarbonate and sodium, LBS = low bicarbonate and sodium. PRAL = potential renal acid load according to the formula proposed by Wynn *et al.* [21]. \*\*Phosphate content below detection limit.



**Figure 1.** (a) The pH value of 24-hour urine at the beginning of the study (t<sub>0</sub>), at the interim examination (t<sub>3</sub>), and at the end of the intervention (t<sub>28</sub>). (b) NAE at the beginning of the study (t<sub>0</sub>), at the interim examination (t<sub>3</sub>), and at the end of the intervention (t<sub>28</sub>) [24].

**Table 2.** Urine analysis and fluid consumption at the beginning of the study (t<sub>0</sub>), at the interim examination (t<sub>3</sub>) and at the end of the intervention (t<sub>28</sub>). [24]

Parameter	Group	Time			p value (time × group)*	p value (time)*
		t <sub>0</sub>	t <sub>3</sub>	t <sub>28</sub>		
Fluid consumption (mL)	HBS	2300 (1065) <sup>c</sup>	-	2704 (1100) <sup>c</sup>	0.255	<0.001
	LBS	2260 (920) <sup>c</sup>	-	2605 (822) <sup>c</sup>		
Urine volume (mL)	HBS	2341 (1221) <sup>a, c</sup>	2742 (879) <sup>a</sup>	2687 (1081) <sup>c</sup>	0.176	<0.001
	LBS	2193 (1098) <sup>a, c</sup>	2685 (951) <sup>a</sup>	2704 (1021) <sup>c</sup>		
pH (24-hour urine)	HBS	6.17 (0.66) <sup>a, c</sup>	7.28 (0.22) <sup>a</sup>	7.23 (0.32) <sup>c</sup>	<0.001	<0.001
	LBS	5.98 (0.88)	6.00 (0.66)	5.92 (0.68)		
pH (spontaneous urine)	HBS	5.66 (0.58) <sup>a, c</sup>	7.07 (0.53) <sup>a</sup>	6.90 (0.71) <sup>c</sup>	<0.001	<0.001
	LBS	5.68 (0.99)	5.65 (0.86)	5.53 (0.91)		
HCO <sub>3</sub> <sup>-</sup> (mmol/L)	HBS	8.25 (4.00) <sup>a, c</sup>	24.73 (9.00) <sup>a</sup>	24.50 (12.53) <sup>c</sup>	<0.001	<0.001
	LBS	6.83 (6.15) <sup>a</sup>	6.18 (2.65) <sup>a</sup>	6.18 (2.25)		
NAE (mEq/d)	HBS	22.44 (23.80) <sup>a, c</sup>	-15.40 (11.40) <sup>a</sup>	-14.25 (15.00) <sup>c</sup>	<0.001	<0.001
	LBS	22.28 (19.00) <sup>a</sup>	17.80 (9.65)	18.53 (13.20)		

Data are shown as median (IQR). HBS = high bicarbonate and sodium, LBS = low bicarbonate and sodium. HCO<sub>3</sub><sup>-</sup> = bicarbonate in urine, NAE = net acid excretion. \*Time × group interactions were analyzed using two-way repeated measures ANOVA. \*\*Differences over the intervention time within each group were assessed using repeated measures ANOVA. <sup>a</sup> = sign. Differences between t<sub>0</sub> and t<sub>3</sub> (short term), <sup>b</sup> = sign. Differences between t<sub>3</sub> and t<sub>28</sub> (follow-up), <sup>c</sup> = sign. Differences between t<sub>0</sub> and t<sub>28</sub> (long-term).

However, bicarbonate also carries certain potential risks. Mohebbi [25] and Melamed [26] compared adverse events between bicarbonate and control groups, indicating that its tolerability may be influenced by dosage or formulation. Raphael [27] observed a dose-dependent increase in bicarbonate but a concomitant rise in proteinuria, highlighting the complexity of acid-base interventions in CKD. While bicarbonate can effectively address the biochemical manifestations of metabolic acidosis, its capacity to alter the pathophysiology of CKD may be limited, particularly in advanced stages of the disease. Furthermore, the cost of bicarbonate therapy is also relatively high. Overall, in patients with chronic kidney disease, bicarbonate is indicated to treat metabolic acidosis and slow renal progression, but should be avoided or restricted in those with volume overload, uncontrolled hypertension, or hypercapnia to prevent sodium overload and electrolyte disorders. Similarly, in kidney transplant recipients, low-dose bicarbonate may correct mild acidosis, yet is not recommended in patients with impaired graft function, hypercalcemia, or nephrolithiasis due to increased stone risk. As for dialysis patients, bicarbonate is routinely used to correct chronic acidosis, but high-dose boluses should be avoided to reduce alkalosis, hypokalemia, and hemodynamic instability. By contrast, in athletes, bicarbonate may improve high-intensity performance via buffering lactic acidosis, but is not suitable for those with subclinical renal impairment, gastrointestinal disease, or electrolyte abnormalities due to gastrointestinal distress and alkalosis risk.

## 3.2. Other Alkalinizing Salts

### 3.2.1. Citrate Salts

Citrates act as calcium (Ca) chelators, exerting their anticoagulant effect by reducing the concentration of calcium ions ( $\text{Ca}^{2+}$ ). Citrates have been described as conferring various long-term beneficial effects, including reducing thrombogenesis [28], improving dialysis efficacy [29], mitigating inflammation [30], promoting nutrition [31], enhancing tolerance [32], and controlling acid-base equilibrium by attenuating pre-dialysis acidosis. As citrate is metabolized to  $\text{HCO}_3^-$  in the liver, it provides a gentle, indirect method of raising  $\text{HCO}_3^-$  levels. Alternative buffers such as THAM tris(hydroxymethyl)aminomethane, also known as tromethamine or trometamol) bind  $\text{H}^+$  without generating  $\text{CO}_2$ , and the protonated product is readily cleared by the kidneys [33]. Furthermore, because a portion of THAM is uncharged at physiological pH and is cell-permeable, it can combat intracellular acidosis. Compared to other bases capable of substituting for  $\text{HCO}_3^-$ , such as lactate and acetate [34] [35], research by Patricia *et al.* demonstrated that citrate dialysis more effectively maintains post-dialysis acid-base equilibrium compared to acetate dialysis, thereby reducing or avoiding the occurrence of post-dialysis alkalemia. Citrate plays a crucial role in acid-base equilibrium. It is released from bone during metabolic acidosis and can serve as a potential buffer. As a consequence of its metabolism, citrate also serves as an important source of alkali equivalents. When bone is exposed to an acidic pH and undergoes physicochemical

dissolution, phosphate, calcium, carbonate, and citrate are released from the bone matrix into the systemic circulation [36]. Additionally, metabolic acidosis may increase citrate production in osteoblasts. Chronic metabolic acidosis leads to increased proximal tubular citrate reabsorption, resulting in alkali-retentive hypocitraturia. Combined with acidosis-induced hypercalciuria, this increases the risk of nephrolithiasis.

### 3.2.2. Acetate Salts

Patricia's research revealed that the addition of bicarbonate necessitates the concomitant use of an acid, leading to the implementation of an LD (liquid dialysis concentrate) generation system comprising two concentrates: one containing bicarbonate and the other containing an acid. The acid typically used is acetic acid, with its concentration varying between 3 to 10 mmol/L. During hemodialysis (HD), this trace amount of acid results in acetate transfer to the patient, elevating its concentration in the blood to levels 30 - 40 times higher than the normal physiological range (approximately 0.1 mmol/L). This acetate exposure is further increased with online hemodiafiltration (HDF) techniques due to the larger volume of reinfusate. Among the documented side effects of acetate, its role in contributing to hemodynamic instability during HD is particularly noteworthy. This instability is mediated through vasodilation induced by nitric oxide release and the activation of pro-inflammatory cytokines triggered by hypoxia. Compared to LD containing a low acetate concentration (3 mmol/L), patients dialyzed with acetate-free LD exhibit a lower risk of hemodynamic complications. Consequently, the search for alternative acids to serve as stabilizers in LD formulations has been ongoing for many years [37].

### 3.2.3. Phosphate Salts

Non-bicarbonate buffers, both intracellular and extracellular, include phosphates, hemoglobin, and various proteins [38]. Furthermore, the inorganic components of bone can buffer a substantial amount of  $H^+$  during an acid load. Calcium and phosphate metabolism participate in acid-base homeostasis at several physiological intersections. Phosphate plays a crucial role in defending against metabolic acidosis, serving both as an intra- and extracellular buffer and, through this buffering reaction, facilitating the renal excretion of excess  $H^+$  in the form of urinary titratable acid [39]. In the state of metabolic acidosis, bone acts as an extracellular buffer, as acid-induced dissolution of bone hydroxyapatite releases  $Ca^{2+}$  and phosphate into the extracellular fluid (ECF) [40].

## 4. Conclusions and Outlook

The changes in mineral metabolism that occur in response to acid load and metabolic acidosis to restore acid-base equilibrium are multifaceted. The body's integrated physiological response to acid includes: sequestering  $H^+$  *via* various extracellular and intracellular buffers, increasing carbon dioxide elimination through ventilation, enhancing renal reabsorption of bicarbonate and citrate, and elimi-

nating acid *via* excretion of H<sup>+</sup> carried by ammonia and buffers, including phosphate. Furthermore, the bone matrix undergoes demineralization, leading to the dissolution of bone apatite and the release of phosphate, calcium, carbonate, and citrate into the systemic circulation. Renal handling of calcium, phosphate, and citrate is also altered, resulting in hypercalciuria, hyperphosphaturia, and hypocitraturia. While the primary aim of these adaptive changes is to serve as an evolutionarily conserved defense mechanism against an acid load, the systemic “trade-off” is the emergence of several adverse compromises, such as bone and stone-related complications. The distinction between a “state” and a “disease” depends on the nature, severity, and duration of the acid load, as well as the capacity of the defense mechanisms. Understanding the pathophysiology of mineral complications in acidosis will equip us with the ability to prevent and ameliorate these conditions. Research on the therapeutic importance of acid-base equilibrium continues to garner significant interest from the scientific community and is expected to yield many more effective treatments in the coming years. Future studies should prioritize conducting large-scale, long-term trials to ensure that therapeutic interventions operate within a reasonable range, free of significant drawbacks.

### Conflicts of Interest

The authors declare no conflicts of interest.

### References

- [1] Álvarez-Herms, J. (2024) Summatory Effects of Anaerobic Exercise and a ‘Westernized Athletic Diet’ on Gut Dysbiosis and Chronic Low-Grade Metabolic Acidosis. *Microorganisms*, **12**, Article 1138. <https://doi.org/10.3390/microorganisms12061138>
- [2] Remer, T. (2001) Influence of Nutrition on Acid-Base Balance—Metabolic Aspects. *European Journal of Nutrition*, **40**, 214-220. <https://doi.org/10.1007/s394-001-8348-1>
- [3] Hietavala, E., Stout, J.R., Frassetto, L.A., Puurtinen, R., Pitkänen, H., Selänne, H., *et al.* (2017) Dietary Acid Load and Renal Function Have Varying Effects on Blood Acid-Base Status and Exercise Performance across Age and Sex. *Applied Physiology, Nutrition, and Metabolism*, **42**, 1330-1340. <https://doi.org/10.1139/apnm-2017-0279>
- [4] Putnam, R.W., Filosa, J.A. and Ritucci, N.A. (2004) Cellular Mechanisms Involved in CO<sub>2</sub> and Acid Signaling in Chemosensitive Neurons. *American Journal of Physiology-Cell Physiology*, **287**, C1493-C1526. <https://doi.org/10.1152/ajpcell.00282.2004>
- [5] Lynch, H., Johnston, C. and Wharton, C. (2018) Plant-Based Diets: Considerations for Environmental Impact, Protein Quality, and Exercise Performance. *Nutrients*, **10**, Article 1841. <https://doi.org/10.3390/nu10121841>
- [6] Osuna-Padilla, I.A., Leal-Escobar, G., Garza-García, C.A. and Rodríguez-Castellanos, F.E. (2019) Dietary Acid Load: Mechanisms and Evidence of Its Health Repercussions. *Nefrología*, **39**, 343-354.
- [7] Salcedo-Betancourt, J.D. and Moe, O.W. (2024) The Effects of Acid on Calcium and Phosphate Metabolism. *International Journal of Molecular Sciences*, **25**, Article 2081. <https://doi.org/10.3390/ijms25042081>

- [8] Quade, B.N., Parker, M.D. and Occhipinti, R. (2021) The Therapeutic Importance of Acid-Base Balance. *Biochemical Pharmacology*, **183**, Article 114278. <https://doi.org/10.1016/j.bcp.2020.114278>
- [9] Casimir, G.J., Lefèvre, N., Corazza, F., Duchateau, J. and Chamekh, M. (2018) The Acid-Base Balance and Gender in Inflammation: A Mini-Review. *Frontiers in Immunology*, **9**, Article 475. <https://doi.org/10.3389/fimmu.2018.00475>
- [10] Silva, P.H.I., Camara, N.O. and Wagner, C.A. (2022) Role of Proton-Activated G Protein-Coupled Receptors in Pathophysiology. *American Journal of Physiology-Cell Physiology*, **323**, C400-C414. <https://doi.org/10.1152/ajpcell.00114.2022>
- [11] Suresh, C., Veeraraghavan, V., Jayaraman, S., Gayathri, R. and Kavitha, S. (2022) Awareness about the Significance of Acid-Base Balance of Saliva in Maintaining Oral Health. *Journal of Advanced Pharmaceutical Technology & Research*, **13**, S325-S329. [https://doi.org/10.4103/japtr.japtr\\_402\\_22](https://doi.org/10.4103/japtr.japtr_402_22)
- [12] Carnauba, R., Baptistella, A., Paschoal, V. and Hübscher, G. (2017) Diet-Induced Low-Grade Metabolic Acidosis and Clinical Outcomes: A Review. *Nutrients*, **9**, Article 538. <https://doi.org/10.3390/nu9060538>
- [13] Raphael, K.L. (2019) Metabolic Acidosis in CKD: Core Curriculum 2019. *American Journal of Kidney Diseases*, **74**, 263-275. <https://doi.org/10.1053/j.ajkd.2019.01.036>
- [14] Wesson, D.E. (2021) The Continuum of Acid Stress. *Clinical Journal of the American Society of Nephrology*, **16**, 1292-1299. <https://doi.org/10.2215/cjn.17541120>
- [15] Storz, M.A., Ronco, A.L. and Hannibal, L. (2022) Observational and Clinical Evidence That Plant-Based Nutrition Reduces Dietary Acid Load. *Journal of Nutritional Science*, **11**, e93. <https://doi.org/10.1017/jns.2022.93>
- [16] Cheng, Y.L., Huang, S.C., Ho, M.Y., Li, Y.R., *et al.* (2023) Effect of Sodium Bicarbonate on Cardiovascular Outcome and Mortality in Patients with Advanced Chronic Kidney Disease. *Frontiers in Pharmacology*, **14**, Article 1146668. <https://doi.org/10.3389/fphar.2023.1146668>
- [17] Salman, L.A. and Cohen, D.L. (2021) Chronic Kidney Disease in Adrenal Disorders. *Current Opinion in Endocrinology, Diabetes & Obesity*, **28**, 312-317. <https://doi.org/10.1097/med.0000000000000629>
- [18] Mahmoud Hussein, A.A.A., Shiddo, D., Alla Osman, K.D., Hamad, F., Fadel Yosif, A.S., Mohammed Altieb, H.A., *et al.* (2025) Impact of Sodium Bicarbonate Supplementation on Kidney Function and Acid-Base Balance in Chronic Kidney Disease Patients: A Systematic Review. *Cureus*, **17**, e92586. <https://doi.org/10.7759/cureus.92586>
- [19] Wasserfurth, P., Schneider, I., Ströhle, A., Nebl, J., Bitterlich, N. and Hahn, A. (2019) Effects of Mineral Waters on Acid-Base Status in Healthy Adults: Results of a Randomized Trial. *Food & Nutrition Research*, **63**, 1-11. <https://doi.org/10.29219/fnr.v63.3515>
- [20] Heil, D.P. (2010) Acid-Base Balance and Hydration Status Following Consumption of Mineral-Based Alkaline Bottled Water. *Journal of the International Society of Sports Nutrition*, **7**, Article 29. <https://doi.org/10.1186/1550-2783-7-29>
- [21] Wynn, E., Krieg, M., Aeschlimann, J. and Burckhardt, P. (2009) Alkaline Mineral Water Lowers Bone Resorption Even in Calcium Sufficiency. *Bone*, **44**, 120-124. <https://doi.org/10.1016/j.bone.2008.09.007>
- [22] Koeppen, B.M. (2009) The Kidney and Acid-Base Regulation. *Advances in Physiology Education*, **33**, 275-281. <https://doi.org/10.1152/advan.00054.2009>
- [23] Hamm, L.L., Nakhoul, N. and Hering-Smith, K.S. (2015) Acid-Base Homeostasis.

- Clinical Journal of the American Society of Nephrology*, **10**, 2232-2242.  
<https://doi.org/10.2215/cjn.07400715>
- [24] Mansouri, K., Greupner, T., van de Flierdt, E., Schneider, I. and Hahn, A. (2024) Acid-base Balance in Healthy Adults: Beneficial Effects of Bicarbonate and Sodium-Rich Mineral Water in a Randomized Controlled Trial: The Bicarbwater Study. *Journal of Nutrition and Metabolism*, **2024**, 1-14.  
<https://doi.org/10.1155/2024/3905500>
- [25] Mohebbi, N., Ritter, A., Wiegand, A., Graf, N., Dahdal, S., Sidler, D., *et al.* (2023) Sodium Bicarbonate for Kidney Transplant Recipients with Metabolic Acidosis in Switzerland: A Multicentre, Randomised, Single-Blind, Placebo-Controlled, Phase 3 Trial. *The Lancet*, **401**, 557-567. [https://doi.org/10.1016/s0140-6736\(22\)02606-x](https://doi.org/10.1016/s0140-6736(22)02606-x)
- [26] Witham, M.D., Band, M., Chong, H., Donnan, P.T., Hampson, G., Hu, M.K., *et al.* (2020) Sodium Bicarbonate to Improve Physical Function in Patients over 60 Years with Advanced Chronic Kidney Disease: The BiCARB RCT. *Health Technology Assessment*, **24**, 1-90. <https://doi.org/10.3310/hta24270>
- [27] Raphael, K.L., Isakova, T., Ix, J.H., Raj, D.S., Wolf, M., Fried, L.F., *et al.* (2019) A Randomized Trial Comparing the Safety, Adherence, and Pharmacodynamics Profiles of Two Doses of Sodium Bicarbonate in CKD: The BASE Pilot Trial. *Journal of the American Society of Nephrology*, **31**, 161-174.  
<https://doi.org/10.1681/asn.2019030287>
- [28] Sands, J.J., Kotanko, P., Segal, J.H., Ho, C., Usvat, L., Young, A., *et al.* (2012) Effects of Citrate Acid Concentrate (Citrasate) on Heparin N Requirements and Hemodialysis Adequacy: A Multicenter, Prospective Noninferiority Trial. *Blood Purification*, **33**, 199-204. <https://doi.org/10.1159/000334157>
- [29] Gabutti, L., Lucchini, B., Marone, C., Alberio, L. and Burnier, M. (2009) Citrate- vs. Acetate-Based Dialysate in Bicarbonate Haemodialysis: Consequences on Haemodynamics, Coagulation, Acid-Base Status, and Electrolytes. *BMC Nephrology*, **10**, Article No. 7. <https://doi.org/10.1186/1471-2369-10-7>
- [30] Bryland, A., Wieslander, A., Carlsson, O., Hellmark, T. and Godaly, G. (2012) Citrate Treatment Reduces Endothelial Death and Inflammation under Hyperglycaemic Conditions. *Diabetes and Vascular Disease Research*, **9**, 42-51.  
<https://doi.org/10.1177/1479164111424297>
- [31] Matsuyama, K., Tomo, T. and Kadota, J. (2011) Acetate-Free Blood Purification Can Impact Improved Nutritional Status in Hemodialysis Patients. *Journal of Artificial Organs*, **14**, 112-119. <https://doi.org/10.1007/s10047-010-0551-7>
- [32] Daimon, S., Dan, K. and Kawano, M. (2011) Comparison of Acetate-Free Citrate Hemodialysis and Bicarbonate Hemodialysis Regarding the Effect of Intra-Dialysis Hypotension and Post-Dialysis Malaise. *Therapeutic Apheresis and Dialysis*, **15**, 460-465. <https://doi.org/10.1111/j.1744-9987.2011.00976.x>
- [33] Kallet, R.H., Jasmer, R.M., Luce, J.M., Lin, L.H. and Marks, J.D. (2000) The Treatment of Acidosis in Acute Lung Injury with Tris-Hydroxymethyl Aminomethane (THAM). *American Journal of Respiratory and Critical Care Medicine*, **161**, 1149-1153.  
<https://doi.org/10.1164/ajrccm.161.4.9906031>
- [34] Neavyn, M.J., Boyer, E.W., Bird, S.B. and Babu, K.M. (2013) Sodium Acetate as a Replacement for Sodium Bicarbonate in Medical Toxicology: A Review. *Journal of Medical Toxicology*, **9**, 250-254. <https://doi.org/10.1007/s13181-013-0304-0>
- [35] Schwartz, W.B. and Waters, W.G. (1962) Lactate versus Bicarbonate. A Reconsideration of the Therapy of Metabolic Acidosis. *The American Journal of Medicine*, **32**, 831-834.

- 
- [36] Moe, O.W., Maalouf, N.M., Sakhaee, K. and Lederer, E. (2022) Preclinical and Clinical Evidence of Effect of Acid on Bone Health. *Advances in Chronic Kidney Disease*, **29**, 381-394. <https://doi.org/10.1053/j.ackd.2022.07.007>
- [37] Ortiz, P.D.S., Ramón, M.A., Pérez-García, R., Prats, E.C., Cobo, P.A., Arroyo, R.A., et al. (2015) Efecto agudo del baño con citrato sobre la alcalemia postdiálisis. *Nefrología*, **35**, 164-171. <https://doi.org/10.1016/j.nefro.2014.10.001>
- [38] Clancy, J. and McVicar, A. (2007) Short-Term Regulation of Acid-Base Homeostasis of Body Fluids. *British Journal of Nursing*, **16**, 1016-1021. <https://doi.org/10.12968/bjon.2007.16.16.27082>
- [39] Poupin, N., Calvez, J., Lassale, C., Chesneau, C. and Tomé, D. (2012) Impact of the Diet on Net Endogenous Acid Production and Acid-Base Balance. *Clinical Nutrition*, **31**, 313-321. <https://doi.org/10.1016/j.clnu.2012.01.006>
- [40] Bushinsky, D.A. (2001) Acid-Base Imbalance and the Skeleton. *European Journal of Nutrition*, **40**, 238-244. <https://doi.org/10.1007/s394-001-8351-5>