Cellular States and Secondary Chemical Bonding: A Biochemical View of Major Human Diseases

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ABSTRACT: Nasopharyngeal carcinoma is prevalent in hot and humid areas such as south coastal China and Southeast Asia, but not in the non-coastal southern Chinese Yunnan Province. Secondary chemical bonding may underlie such phenomena. Cancer may be caused by strong acids such as HCl, whereas insoluble and rigid salts such as calcium oxalate are the potential causative factors of heart disease and the Alzheimer disease. The weak organic acids produced by plants counteract strong acids and dissolve insoluble salts, therefore boasting dual roles in disease prevention and treatments. The aforementioned perspective sheds light on the underlying mechanism of human disorders and opens new avenues in the interventions of numerous diseases.

KEYWORDS: Cellular states, major human diseases, calcium oxalate, HCl, secondary chemical bonding, cations

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Secondary chemical bonding is a dominant force in biological systems, yet its impact on cellular pathways and compartments is not fully dissected. The weak non-covalent chemical forces include hydrogen bonding and secondary bonding to non-proton cations. Hydrogen bonding increases water traffic as well as proton traffic which enhances the formation of acids, whereas secondary bonding to divalent cations is prone to generate insoluble salts such as calcium oxalate. The transition between soluble and insoluble states has huge impact on cellular and human physiology. Regarding hydrogen bonding, having loose stools versus soft stools was associated with 2.8-fold increased colorectal cancer risk.[1] In connection with insoluble salts, constipation is a high risk factor for both heart disease and the Alzheimer disease. Heart disease sufferers often developed the Alzheimer disease in their lifetime. A recent hypothesis postulated that the local buildup of strong acids such as HCl, mediated by hydrogen bond donors and acceptors and basic amino acids, triggers carcinogenesis.[2] Nasopharyngeal carcinoma is prevalent in hot and humid areas such as south coastal China and Southeast Asia, but not in non-coastal southern Yunnan Province in China.[3] The high humidity may induce expression of proteins with extensive hydrogen bonding in the inhabitants of these regions, attracting water and protons and enhancing the formation of HCl. The overconsumption of NaCl increases gastric cancer incidences. NaCl-preserved food also confers cancer risks.[2] Red meat is potentially carcinogenic and characterized by the presence of myoglobin which boasts around 21% basic amino acids.[2] The primary pathway and the shunt of the Krebs cycle churn out protons and oxalate, and cancer cells might overproduce organic acids such as oxalate to counteract strong acids.[4] Calcium oxalate causes cell senescence and perhaps human death.[4] Ethanol and acetic acids are structurally similar to oxalate and are beneficial to heart disease and extend lifespan,[4] perhaps by the competitive inhibition of oxalate production. Few cancer cases were reported in Chinese vinegar factories in decades as the volatile acetic acid counteracts HCl and also inhibits oxalate generation.[5] Numerous risk factors of heart disease and the Alzheimer disease possess over 10% to over 20% valine and glycine. Valine and glycine have long C=O bond lengths, enhancing potent secondary chemical bonding of carbonyl oxygen to divalent cations such as calcium. Calcium supplement substantially reduces cancer risks as it neutralizes strong acids, accounting for the mutual protection of neurodegenerative diseases and cancer since insoluble calcium salts and HCl counteract each other. Therefore, secondary chemical bonding plays critical yet not fully characterized roles in major human diseases such as heart diseases. Based on the above scenario, primary heart disease and cancer are also likely to show mutual protections. Secondary chemical bonding is likely to also contribute to diabetes and rheumatoid

arthritis respectively since glucose possesses hydroxyl groups and aldehyde group, and collagen possesses around 20% proline and hydroxyproline with potent hydrogen bonding (GenBank accession nos: AAB59373.1 and AAI16450.1).

As common preventive measures, weak organic acids which are rich in plant-based diet antagonize strong acids and solubilize the insoluble and rigid calcium oxalate. Yogurt contains lactic acid–producing bacteria, helping to establish a beneficial gut microbiome. Dilute acetic acid is favorable since it is similar in structure to oxalate and competitively inhibits the generation of oxalate and counteracts HCl.[4] As white meat such as fish is noncarcinogenic, food of aquatic origin possesses hydrogen bond donors and acceptors which gather protons and help form weak acids capable of solubilizing insoluble salts. The intake of starch-based diet with vitamin supplement for a limited period of time does not give rise to essential amino acids including valine, consequently reducing the levels of the causal factors for heart disease and the Alzheimer disease. Moderate physical exercise is advantageous to major human diseases since it produces lactic acid and other organic acids and directs the protons to the limbs for energy production, consequently lowering proton levels in internal organs and cancer incidences. Heart disease sufferers should be cautious as intensive exercises can lead to the surge of oxalate levels in some susceptible individuals.

In summary, secondary chemical bonding might play critical roles in numerous human diseases. A chemical and biochemical perspective can further our understanding of human disorders.

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Author Contributions

QL contributed to the conception and design of the work. QL, YW, JZ, XL, and YCW contributed to the analysis and interpretation of data for the work. QL and YW drafted the manuscript with input from all authors.

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