



Review Article

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The Medical Importance of Activated Carbon for Detoxing

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To Cite This Article: Leonard Sonnenschein* and Tiberious Etyang, The Medical Importance of Activated Carbon for Detoxing. Am J Biomed Sci & Res. 2024 21(4) AJBSR.MS.ID.002860, DOI: 10.34297/AJBSR.2024.21.002860

Received: 📅: February 12, 2024; Published: 📅: February 16, 2024

Abstract

Modern science has shown that people's health can be improved by improving their nutrition, physical activity, and limiting toxins. There is an extensive array of toxins that we are exposed to, which are a part of our natural diet, while some can be man-made or as a result of environmental exposure. Environmental pollutants that are mostly delivered through food include heavy metals and persistent organic pollutants, whose chronic exposure and accumulation have been linked to non-communicable diseases, such as obesity, diabetes, cancer, cardiovascular diseases, and chronic respiratory disease. The human body already has many safeguards against toxins, and it eliminates toxic substances naturally through the kidneys, liver, skin, and digestive system. However, an efficient detox can help speed up this process and lead to a drastic change in physical and mental wellness within a short amount of time. Appropriate diet can facilitate toxin elimination and weight loss, thereby promoting healthy living and well-being. Activated Carbon (AC) can be used as an adsorbent in the management of diarrhea by attracting toxic particles and liquid materials to its surface, which are then cleared from the body. In chemotherapy-induced diarrhea trials, AC was shown to reduce the severity of diarrhea. AC is also considered a universal antidote for most poisons. AC, a high-purity porous carbon adsorbent, is utilized to adsorb and remove uremic toxins from the gut by excreting toxins from feces. AC, a further processed charcoal, can additionally remove waste products such as urea, indoxyl sulphate and other urinary toxins, and augment the dialysis process. The effects of AC have been primarily attributed to its ability to limit the formation and absorption of indoxyl sulfate and p-cresol sulfate and have been shown to have Cardiovascular Disease and Gut Health Benefits. AC absorbs and geologically binds toxins.

Keywords: Activated Carbon, Toxins, Cancer, Cardiovascular Diseases, Chronic Respiratory Disease, Detox, Dieting, Chemotherapy, Chronic Kidney Disease (CKD), and Dialysis

Abbreviations: AC-Activated Carbon; CKD-Chronic Kidney Disease, CVD-Cardiovascular Diseases

Introduction and Background Information

Metabolism is a multidimensional living equation equivalent to the body. At the cell level, the membrane and cytoplasm are directly affected by diffusion, which affects whole-body function. As fast as one can taste a sip of wine, the body is transformed as cells align to modulate constituent changes. The cells have different metabolic effects. However, with the fusion of fluid and nutritional approaches, a holistic solution based on individual characteristic conditions within a body can be structured to transfer changes at the cell membrane level and begin to unravel the body's toxic memory and rebuild health. As the body ages, there is greater dependence on micronutrients than in young bodies, which often have much more diverse food nutritional invoices and are moved in and out faster due to increased metabolism. As we grow older, metabolites do not en

ter the cell because of less membrane elasticity and more restricted nutritional intake. Modern science has shown that we can improve people's health by improving their nutrition, physical activity and limiting toxins. By paying close attention to the nutritional profile combined with some sort of health state (exercise, sleep, happiness, lack of pain, etc.), we have seen marked improvements in overall human health. Additionally, by providing a detoxification program for the individual, overall improvement has been seen for the cell, cell membrane, organs, and organ functions, progressing towards normal metabolism. Detoxification creates a cascade of processes as metabolism and nutrition improve normal body function. Longevity increases as normal functions reappear. The world is becoming increasingly toxic owing to the worldwide dissemination of industrial chemicals, heavy metals, radioactive elements, and the use



of pesticides that pollute the air and water, contaminate food, and affect health [1,2]. There is an extensive array of toxins to which we are exposed, which are part of our natural diet; some may be man-made or as a result of environmental exposure. Environmental pollutants that are mostly delivered through food include heavy metals and persistent organic pollutants, whose chronic exposure and accumulation have been linked to non-communicable diseases, such as obesity, diabetes, cancer, cardiovascular diseases, and chronic respiratory diseases [3,4]. Most toxins have harmful effects on reproductive, metabolic, and mental health. Many toxins are known to undergo bioaccumulation throughout the food chain, and synergistic effects can occur, whereby the combination of toxins can be more potent than the sum of individual toxins. Several studies have shown that the accumulation of toxic elements in the body is related to metabolic disorders, leading to overweight or obese populations, while also resulting in greater energy intake among individuals with obesity and diabetes [5]. The diets of people with obesity usually lead to an imbalance of trace elements, and the intake of vitamins and minerals has been highly recommended for the management of obesity [6].

Detoxing

Detoxification or a detox can be considered as a specific protocol that has been designed to help people through the cleansing of toxins from their bodies while simultaneously improving their health and well-being. Biochemical pathways that have developed over evolutionary time allow our bodies to cope with a wide range of toxins that we are exposed to on a daily basis. The human body already has many safeguards against toxins, and it eliminates toxic substances naturally through the kidneys, liver, skin, and digestive system. However, a detox can help speed up this process and lead to a drastic change in physical and mental wellness in a short amount of time. Dieting aims to facilitate toxin elimination and weight loss, thereby promoting healthy living and well-being [7]. Detoxing helps to ease these varied and unwanted symptoms, including bloating, fatigue, brain fog, acne, irregular bowel movements, or allergies worse than normal [8]. Detoxing has been demonstrated to help reduce inflammation in the gastrointestinal tract and heal the gut, both of which are essential elements of well-being.

Why Activated Carbon?

The characteristics of carbon that define the adsorption capabilities include Physical Adsorption, which is modulated by van der Waals attractive forces [9,10] and which are based on physical size, in relation to the pore size of the carbon molecule, and Chemical Adsorption capacities [11], which refer to the chemical bonding based on the electron configuration between the interacting substances. AC products are treated using a nanotechnology, rendering the product exponentially more effective than standard charcoal/carbon products, physically changing the pore size of the treated AC, which allows for more thorough and efficient remediation of toxic substances based on physiochemical processes. Additionally, chemically, there are differences between standard carbon and the treated or activated carbon due to its greater buffering capacity and,

therefore, its greater propensity for more efficient chemical-based absorption capabilities [12]. Just as it does in the intestines and stomach, activated charcoal can interact with and absorb a range of toxins, drugs, viruses, bacteria, fungus, and chemicals found in water [13]. AC has also been used in a wide range of application in removal of toxic heavy metals such as Lead [14], Cadmium [15], Mercury [16], Arsenic among others [17].

Role of Activated Carbon in Detoxing

Gastrointestinal decontamination using AC

Gastrointestinal decontamination has been practiced for hundreds of years and is clinically beneficial to patients, as has been demonstrated in recent years. Due to the fact that most potentially toxic ingestions are due to agents that may not necessarily be toxic in quantities consumed. However, the exact circumstances in which decontamination is useful and the mechanisms that are most beneficial in such circumstances require further research [18]. In principle, extreme benefits of decontamination are expected in patients who are presented sooner for medical attention after toxin ingestion. However, many overdose patients present a beneficial response approximately 2 hours after taking AC. This is when most of the toxins have been absorbed or moved well into the intestines beyond the expected reach of gastrointestinal decontamination, and hence, do not contribute to the outcome of such patients, especially those without symptoms. Aspiration, a common complication associated with gastrointestinal decontamination, results from a combination of central nervous system depression, gastrointestinal tract, spontaneous or induced emesis, manipulation of the airway, and loss of protective airway reflexes, which are directly related to the effects of the drug taken, while others are consequences of management choices [19-21]. It has been demonstrated that in cases where absorption is delayed or in events where gastrointestinal mobility is slowed, AC may reduce the final amount of contaminant by absorption. The use of AC is beneficial and is associated with few complications. Buckley, et al. [22] reported that AC intervention spared some acetaminophen-poisoned patients the need for hospitalization and therapy.

Symptomatic Therapy with Activated Carbon

According to Senderovich and Vierhout [23], symptomatic therapy is an intervention that focuses on relieving symptoms despite illness. It is usually implemented in cases where there is a diagnosis that lacks definitive treatment, no response to evidence-based interventions, or when a patient is undergoing evaluation. The use of charcoal in diarrhea management is a pertinent example of this type of medical care.

Diarrhea is the world's third most fatal illness, which is induced by various illnesses and treatments, including irritable bowel syndrome, pancreatic insufficiency, chemotherapy, and antibiotics, among others [24]. AC, an adsorbent, has been used in the management of diarrhea by attracting particles and materials to its surface, which are subsequently cleared from the body. In chemotherapy-induced diarrhea trials, AC reduced the severity of diarrhea.

Diarrhea is one of the most common symptoms in palliative care, and its management has many challenges because most palliative patients require medications that may cause diarrhea, especially chemotherapeutic agents [25]. According to *Pasman, et al.* [26], comfort and symptom management are vital for palliative patients, while *Claessen, et al.* [27] advocate the application of symptomatic therapy in such circumstances because the frequency of bowel movements is reduced while pain usually subsides.

Activated Carbon in Limiting the Progression of Chronic Kidney Disease

Chronic Kidney Disease (CKD) is characterized by unbalanced gut microbiota, impaired kidney function, progressive kidney damage, and disrupted intestinal mucosal barrier function. Damaged intestinal barrier functions mediated mostly by urea allow the influx of toxic products, such as indoxyl sulfate, which leads to systemic inflammation. In CKD, the colon is the main excretory organ that maintains homeostasis. This adaptive mechanism has led to severe concerns regarding the gut environment. Serum urea accumulation during CKD increases urea influx into the intestinal lumen, where urease-producing bacteria hydrolyze urea into ammonia and ammonium hydroxide, subsequently increasing intestinal pH and promoting mucosal irritation and structural alterations in the gut barrier [28]. According to *Lau, et al.* [29] damaged "leaky gut" allows for the translocation of bacteria and toxins into systemic circulation, thus promoting chronic inflammation that drives adverse cardiovascular outcomes and CKD progression. As reported by *Liu et al.* [30], high serum levels of creatinine indoxyl sulfate and p-cresol sulfate are negatively correlated with kidney function and have been considered essential factors in the development of systemic inflammation. Furthermore, indoxyl sulfate accumulation leads to interstitial fibrosis in renal tubular cells. The influx of uremic toxins from the intestine increases and may affect renal function. *Schulman* [31] reported that AC can remove waste products, such as creatinine, urea, indoxyl sulfate, and other urinary toxins, and augment the dialysis process. The effects of AC have primarily been attributed to its ability to limit the formation and absorption of indoxyl sulfate and p-cresol sulfate [32]. AC is considered a universal antidote for most poisons and is a high-purity porous carbon adsorbent utilized to adsorb and remove uremic toxins from the gut by excreting toxins from feces [33]. In addition, the ability of AC to decrease indoxyl sulfate levels is thought to be due to its capacity to ameliorate intestinal barrier disruption, thus blocking the entry of this toxic molecule [34]. Another plausible mechanism for the restoration of intestinal barrier structure by AC is the restoration of *Lactobacillus*, a butyrate-producing microbe. *Lactobacillus* is considered one of the key regulators in maintaining and forming tight junction proteins in the gut [35].

Health Benefits Associated with application of Activated Carbon

Improved Metabolic Function: The AC is exponentially more effective in toxin removal as it is designed to absorb and eliminate toxins from the body, aiding in the restoration of healthy metabolic functions. AC works on the gastric and intestinal mucosal surfaces

for easy and efficient toxin removal through absorption via naturally leaky cell membranes. Support in Cancer Treatment Recovery: It has been shown to assist in the recovery process from cancer treatments, such as chemotherapy and radiation. It can alleviate the toxic side effects associated with these treatments and promote overall health improvements.

Health benefits for Cardiovascular Disease (CVD): AC has been shown to have health benefits in Cardiovascular Disease (CVD). CVD is a complex disorder involving multiple factors such as inflammation, oxidative stress, platelet aggregation, and lipid metabolism [36-39].

Support in Cancer Treatment Recovery: AC attributes assist in the recovery process from cancer treatments like chemotherapy and radiation [40]. According to *Maroun, et al.* [41], activated charcoal has also been seen to be able to target drug metabolites for adsorption such as the case of chemotherapeutic agents. It is safe, fast acting, pleasant and clinically important. It can alleviate the toxic side effects associated with these treatments and promote overall health improvement.

Mechanism of Action

When we are considering a healthy state body, we are looking at cells that have normal metabolism, can transfer out toxins, and are able to grow normally. However, as the cells and body age, metabolism and metabolic changes occur from the intercellular to the extracellular space. These situational changes dramatically alter the ability of cells, which sometimes allows them to multiply at a fast rate (cancerous), slow growth, or atrophy. Occasionally, the immunological characteristics of cells change, and as these changes occur, disease states often follow. Research has shown that the plasticity of the cell membrane in animals and cell walls in plants, as well as the functioning of organelles of the cell, can significantly be improved by removing toxins from the cell and by improving the metabolites available in the cell and in the cell for appropriate metabolic functions. AC absorbs and geologically binds toxins demonstrated using an iron (metal) absorption study as published in "Understanding Cellular Metabolism" with 100% uptake in less than 30 minutes [42].

In the case of diarrhea. The main precursors being bacterial infection and drugs, AC acts in a way to prevent the absorption of the adverse entities by adsorbing them on the surface of its particles. Drugs and bacteria adhere to AC instead of travelling to the intestinal tract. AC ameliorates diarrhea by attacking its primary cause. AC particles are optimally structured with large pores, making this compound an excellent adsorbent [43]. AC is prepared from carbon-containing materials and then broken down into finer granules, resulting in a large surface area that contributes to its adsorbent attributes [44].

Fischer and Singer [45] pointed out that AC has a concrete history of its ability to attract and expel ingested toxins from the gastrointestinal tract. Instances include the use of AC in symptoms management for cholera [46], *Cryptosporidium parvum*, and *Escherichia coli*-induced diarrhea [47,48], demonstrating the effective-

ness of its ability to adsorb bacteria. It has been used to expel excess amounts of drugs from the body and has proven to be more suitable for drug overdose cases. AC has also been seen to be able to target drug metabolites for adsorption such as the case of chemotherapeutic agents. Diarrhea induced by chemotherapy is problematic since its management requires a dosage reduction, delay or cessation of chemotherapeutic treatment [40].

Conclusion

Carbon is one of the most absorptive materials known and its absorptive powers come from its enormous surface area of up to 32,292 square feet (0.75 acre) or more per gram of carbon product. Chemical adsorption and bonding capacities of carbon is based on electron configuration between the interacting substances. By enabling the surface area to become even larger by physically altering the carbon topography the carbon can become even more absorptive exponentially. The nanotechnology treatment actually opens up the micropores, fissures and striations of the carbon molecules creating an even larger surface area of the carbon. The absorbency of the carbon is both chemical and physical. The chemical properties are based on van der Waals forces which can be attractive thereby absorptive. The physical absorbency is based on the amount of porosity of the surface. By optimizing the physical structure of the carbon molecule, a superior product for chemical absorbency is achieved. AC products can be designed to provide absorbency of toxic substances and metals and provide the biochemical basis for health which are key characteristics for its universal therapeutic use.

Acknowledgement

Thanks to Harvey Klein, M.D. for providing valuable medical insights and review to this article.

Conflict of Interest

None.

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