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Food Additives - Risk Factors for Renal Failure

Sivakumar J T Gowder*

College of Applied Medical Sciences, Qassim University, Buraydah, Kingdom of Saudi Arabia

The kidney is an organ of excretion, transport and metabolism. It is a complicated organ, comprising several different cell types and having a sophisticated three dimensional organization [1]. Due to structural complexity, the intact kidney is difficult to employ for adequate study of many biochemical, pharmacological and physiological processes. Cell cultures, either primary cells or established cell lines [2], have provided useful model systems for the study of renal cell functions. Primary cultures of proximal tubule cells have been considered as an appropriate model for the study of proximal tubule cell function or renal intact function [3]. Kidneys are target organs for toxicity and also many diseases and hence initiate systemic pathophysiological processes through their complex functions. Thus, kidney damage and function has been considered as a major public health hazard [4]. In developed countries, lifestyle diseases like diabetes and hypertension are the important causes of renal failure. In developing countries, kidney diseases result from even infectious conditions like cholera, malaria, schistosomiasis and hepatitis B [5,6]. Drugs and toxins are injurious to kidney and increase the risk of progression of renal failure [7]. Smoking, obesity, red meats, sodium, and sugar-sweetened beverages and food additives also cause renal failure [8].

Egyptian records of 5000 years ago describe the brewing of beer from barley. This must be the first recorded use of an additive, yeast, which was soon to be followed by other additives for it was an early practice to put in flavor principles, as hops are put in today [9]. The statutory definition of the term 'food additive' in the Federal Food, Drug and Cosmetic Act exempts any substance "generally recognized, among experts qualified by scientific training and experience to evaluate its safety, as having been adequately shown through scientific procedures to be safe under the conditions of its intended use" [10]. The Codex Alimentarius Commission, acommission which was established to develop a set of food standards to govern international trade, says: 'food additive' means any substance not normally consumed as food by itself and not normally used as a typical ingredient of the food, whether or not it has nutritive value, the addition of which to food for a technological (including organoleptic) purpose in the manufacture, processing, preparation, treatment, packing, packaging, expected to result (directly or indirectly) in it or its by-products becoming a component of or otherwise affecting the characteristics of such foods. The term does not include 'contaminants' or substances added to food for maintaining or improving nutritional qualities [11]. In 1938, Congress passed the Food, Drug, and Cosmetic Act, giving the Food and Drug Administration (FDA), power to remove from foods any chemicals found to be unsafe for human consumption. The Food Additives Amendment of 1958 further broadened that control by requiring the food industry to demonstrate the safety of any new food additives. These ended on a GRAS (Generally Recognized as Safe) list. The FDA is in the process of reevaluating all the additives on this list, to determine whether they are indeed safe [12].

Food additives have been categorized into preservatives, antioxidants, colorants, antioxidants, emulsifiers, flavors, filters and colorants [13]. Toxicological studies on food additives should be made according to necessity and adequacy. If substances belong to a well studied and unexceptionally safe group, carrying a strong initial presumption of safety, toxicological data on each specific substance are generally not needed. But if a substance is consumed at high levels and there is no previous experience with its use or it does not occur naturally in food, more direct toxicological data are essential [10]. The interpretation of toxicological tests requires the determination of a dosage level at which no adverse effects are observed. The limitationssurrounding precise estimation of the no-adverse-effect level have been discussed in an earlier report [14].

Though there are many food additives that exhibit toxicity, this article has been focused on certain widely used additives that have nephrotoxic potential. Monosodium glutamate (MSG) is quite often used in Chinese food items. Recent studies reveal involvement of MSG in distortion of renal cytoarchitecture – that is, cellular proliferation of mesangial cells and infiltration of inflammatory cells [15]. Use of melamine (an additive in milk), results in acute renal failure in thousands of Chinese infants [16]. Potassium bromate ($KBrO_3$), a food additive and also a water disinfection by-product results in kidney damage accompanied by changes in many brush border enzymes [17]. Several studies conclude nephrotoxic potential of common food additives such as cyodax, aluminium chloride, beta-myrcene, tartrazine, borax, Aloe, Sodium nitrite, Aspartame, Diazoaminobenzene, sodium metabisulphite, Methyleugenol, N-nitrosodimethylamine, sodium-o-phenylphenate, d-limonene, thiabendazole, and butylatedhydroxytoluene [18-33].

Due to inadequate data on the nephrotoxicity of the food additive (flavor) cinnamaldehyde, we have designed our study to evaluate the effect of cinnamaldehyde on kidney. The occurrence of cinnamaldehyde is widely noticed in most of the food, medicinal and cosmetic products. Thus, cinnamaldehyde has a high potential for human consumption in the world. Cinnamaldehyde treated rats equivalent to the WHO suggested ADI level (73.5 mg/kg body weight/day) showed many histopathological changes of kidney accompanied by an increased activity of marker enzymes and an imbalance in the antioxidant status [34,35]. We have concluded that cinnamaldehyde induced renal damage, is due to the reactive oxygen species that formed whilein the free radical scavenging reactions [36]. Thus, the toxic food additives may induce oxidative stress and thereby result in renal damage or failure. Antioxidants (vitamins) play a significant role to ameliorate toxicity. Thus, fruits and vegetables in routine diet might protect human health from toxic hazards at certain extent [37].

***Corresponding author:** Sivakumar J T Gowder, College of Applied Medical Sciences, Qassim University, Buraydah 51452, Kingdom of Saudi Arabia, Tel: +966566873969; Fax: +96663802268; E-mail: sivakumargowder@yahoo.com

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