EFFECTS OF PROCESSING ON HEAVY METAL CONTENT OF FOODS

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1. ABSTRACT

Metals occur in all foodstuffs. Of particular concern is the presence of toxic metals, which include lead, cadmium, arsenic and mercury. The toxic metal content of foods is influenced by many factors ranging from environmental conditions during growth to post-harvest handling, processing, preparation and cooking techniques. For example, metal content increases in some commodities grown in contaminated soils or atmospheres while post-harvest handling steps such as washing generally remove metal contaminants. Cooking may reduce metal content although some foods can absorb metals if the cooking water is contaminated. Metals used in food processing equipment or food packaging material may contribute to food contamination. Contamination may also occur during kitchen preparation and storage. This paper will review the effects of processing of foods on toxic metal content. A broad interpretation of processing, to include aspects of food production from growth through cooking, will be taken in discussing the toxic metal content of foods. Specific examples of changes in metal content due to processing will be discussed.

2. INTRODUCTION

Metal contamination of foods, of both plant and animal origin, may occur at various stages of production. These stages include growth, post-harvest handling, in-plant processing, preparation for consumption either in the home or elsewhere, cooking and the act of consumption itself.

Contamination may occur during growth, depending upon the environmental conditions in which a plant or animal is raised. Atmospheric deposition of toxic elements may contribute to the metal content of plant crops. Contamination may occur both through direct deposition on the plant itself or through deposition on soil and subsequent uptake by the plant. Use of sewage sludge as a fertilizer also contributes to the toxic metal content of foods, as does the use of contaminated water for irrigation. Another potential source of contamination is agricultural chemicals, either fertilizers or pesticides. While these products are generally used intentionally to increase crop yields, formulations often contain varying amounts of undesirable contaminants in addition to the active ingredients. Contamination may occur from fragments of harvesting equipment accidentally present in crops. Finally, animal feeds may contribute to increased toxic element levels in animal products. This may occur through the presence of trace contaminants in the feed or through the presence of elements, such as arsenic, used, or misused, as growth promoters in feed.

Post-harvest handling of food products may also lead to the contamination of food products with toxic elements. Storage at the farm after harvest, transportation between farm and processing plant, and storage at the plant all represent stages in the production of foods where additional contamination may occur.

A number of operations which occur at the processing plant itself may potentially lead to metal contamination of food products. Contact with processing equipment may lead to product contamination. Generally, high quality stainless steels, plastics and other materials approved for food contact are used. If care is taken in selecting equipment and contact surface materials, taking into account the nature of the food being processed, there is minimal chance of harmful contamination. However, misuse of equipment or use of materials incompatible with the material being processed may result in contamination. Water used at the plant in washing or rinsing operations as well as that added as an ingredient of the final food product is another potential source of undesirable metals. Water used at the plant must be metal-free to insure that food products are not contaminated. Processed foods often contain additives, used for a variety of purposes in the final product. Trace metal contamination of these additives is another potential source of undesirable toxic elements in foods. Finally, the material in which the finished product is packaged for sale may contribute to contamination of the product. Both aluminum and tin-plate cans may contribute to metal contamination of food. In the past, lead solder used to seal cans was a significant source of lead contamination. As a result, lead solder is no longer approved for food use in the United States.

Food preparation and cooking in the home, or elsewhere, is another potentially significant source of metal contamination. Foods may come in contact with contaminated surfaces such as dirty or dusty kitchen counters, pots and pans, utensils or plates. Materials used in cooking equipment and utensils may also contribute. Use of metal contaminated water in cooking or in preparation of foods and beverages such as soups and drinks, may be another significant source of dietary intake of metals. Non-ideal storage conditions in the home, such as storage of acidic foods in metal pots and pans, rather than transferring to a plastic container, may contribute to metal contamination. In fact, for some segments of the population, it is likely that contamination once the food has reached the home is the most significant source of dietary exposure to toxic metals.

The preceding paragraphs have attempted to outline some of the many potential sources of metal contamination of foods from the farm to the table. While an exhaustive discussion of each of these is beyond the scope of this chapter, several relatively recent books are either entirely devoted to this topic or contain chapters on metal contamination