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Nutritional Support for Detoxification

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ABSTRACT: *Providing nutritional support for the body's detoxification processes is gaining popularity all over the world. Today we recognize that although the body is designed to eliminate toxins, it cannot always handle the overload present in today's environment. Toxin overload can lead to a variety of health problems, such as headaches, muscle and joint pain, chronic fatigue, and allergy or flu-like symptoms. While once widely practiced, fasting is no longer considered to be a healthy form of detoxification. To function optimally, our detoxification processes are dependent upon adequate levels of supporting nutrients, including both macronutrients and micronutrients, that are depleted during fasting programs. Detoxification programs that use a broad-based nutritional approach that supports both Phase I and Phase II detoxification are advantageous for a number of reasons.*

DETOXIFICATION

Why must we be concerned about the body's ability to effectively dispose of toxins? Because now, more than ever, we are exposed to a myriad of foreign chemicals both commercially synthesized and naturally occurring in our environment. The 1989 Kellogg Report[1] stated that 1,000 newly synthesized compounds are introduced each year, which amounts to three new chemicals a day. The current number of known xenobiotics (foreign chemicals) now totals around 100,000 and includes drugs, pesticides, industrial chemicals, food additives, and environmental pollutants.[2]

To provide some real world examples of just how much poison we are exposed to each year, consider the following statistics from the 1989 Toxic Release Inventory National Report, US EPA, Office of Toxic Substances:[3]

- 551,034,696 pounds of industrial chemicals were dumped into public sewage storage.
- 1,180,831,181 pounds of chemicals were released into the ground, threatening our natural aquifers.
- 188,953,884 pounds of chemicals were discharged into surface waters.
- 2,427,061,906 pounds of air emissions were pumped into the atmosphere.

The EPA estimates a grand total of 5,705,670,380 pounds of chemical pollutants were released into the environment in 1989. To put this in perspective, this would fill enough semi-trailers having a cargo capacity of 45,000 pounds each to form a line stretching from downtown Los Angeles to Des Moines, Iowa. And that's just in one year in the U.S. alone!

Toxic chemicals easily find their way into our bodies through the air we breathe, the food we eat, and the water we drink. We also ingest foreign chemicals when taking medicinal or illicit drugs, or when using alcohol or tobacco. Although the body is designed to eliminate toxins, it cannot always handle the overload present in today's environment.

For example, recent estimates suggest that each year there are three million severe pesticide poisonings with 220,000 deaths worldwide. Pesticide-related illnesses in the United States are estimated to occur between 150,000 and 300,000 times a year.[4] Overexposure of the organophosphate class of pesticides has been documented to cause neurological effects which may occur within hours of exposure, or as much as 2 to 3 weeks later. The neurological damage they cause, however, can last a lifetime.

But toxins not only come from external sources (referred to as exotoxins), they are also produced within the body (endotoxins). For example, intestinal bacteria

may release specific metabolic by-products and/or lipopolysaccharide cell wall components that, when absorbed, have toxic effects negatively impacting overall health. Even normal systemic metabolism can produce intermediary metabolites that require detoxification, such as lactic acid, pyruvic acid, urea, and so on. Further compounding the problem, nutritional imbalances and insufficiencies can compromise detoxification pathways, allowing the progressive build-up of toxins to impose a significant, and sometimes overwhelming, burden on the body. Lastly, and quite ironically, the detoxification process *itself* can generate free radicals which are damaging to cellular tissues.

CONSEQUENCES OF TOXICITY

When the body experiences an overload of toxic substances, the consequences can manifest in a number of ways: headache, muscle and joint pain, fatigue, irritability, depression, mental confusion, gastrointestinal tract irregularities, cardiovascular irregularities, flu-like symptoms, or allergic reactions including hives, stuffy or runny nose, sneezing, and coughing.[5]

In addition to these symptoms, it has been suggested that toxic overload may also contribute to more serious conditions such as autoimmune diseases including inflammatory and rheumatoid arthritis,[6,7] and neurological diseases such as Alzheimer's and Parkinson's disease.[8] It is reported that individuals with Parkinson's or Alzheimer's disease may be more susceptible to toxicity,[8,9] seemingly because of a malfunction in xenobiotic elimintion, particularly with sulfur-containing substances. The inability to effectively handle such toxins and the lifetime exposure to them may contribute to the development of these diseases.

THE ROLE OF INTESTINAL PERMEABILITY

The body's ability to protect itself from toxic substances is largely dependent upon the health of its natural barriers (skin, lungs, gastrointestinal tract), and its organs for processing and eliminating wastes (liver and kidney). The gastrointestinal tract functions as a critically important barrier; however, due to our modern day refined diet, medications, exposure to allergens/toxins, and high-stress lifestyles, it is prone to alteration in permeability.

Increased intestinal permeability, or leaky-gut syndrome, are terms used to describe gastrointestinal barrier breakdown. The gut normally allows absorption of a moderate amount of molecules, including some pathogens (toxic microorganisms). Increased intestinal permeability allows passage of larger molecules and more pathogens – and antigens (foreign proteins) – across the gut mucosa and into the systemic circulation. "Leaky gut" has been clinically associated with the etiology of inflammatory joint disease.[6] It has been surmised that the increased burden of pathogenic or toxic substances may lead to an inappropriate immune reaction – the result of a net loss of lymphoid tissue – causing the progression of the disease.[10]

What causes the intestinal mucosa to become more permeable? Permeability changes may occur as a result of irritation of the gut lining, overgrowth or imbalance of intestinal flora, chronic nutritional insufficiency, and exposure to circulating bacterial toxins themselves.[11] The administration of nonsteroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen and aspirin has also been reported to cause gastrointestinal damage.[12] Allison et al. reported an association between the use of NSAIDs and nonspecific ulceration of the small intestine. Ironically, many people who have an inflammatory joint disease are prescribed NSAIDs for inflammation and pain relief, which may exacerbate the problems of both gut permeability and the inflammatory disease itself.

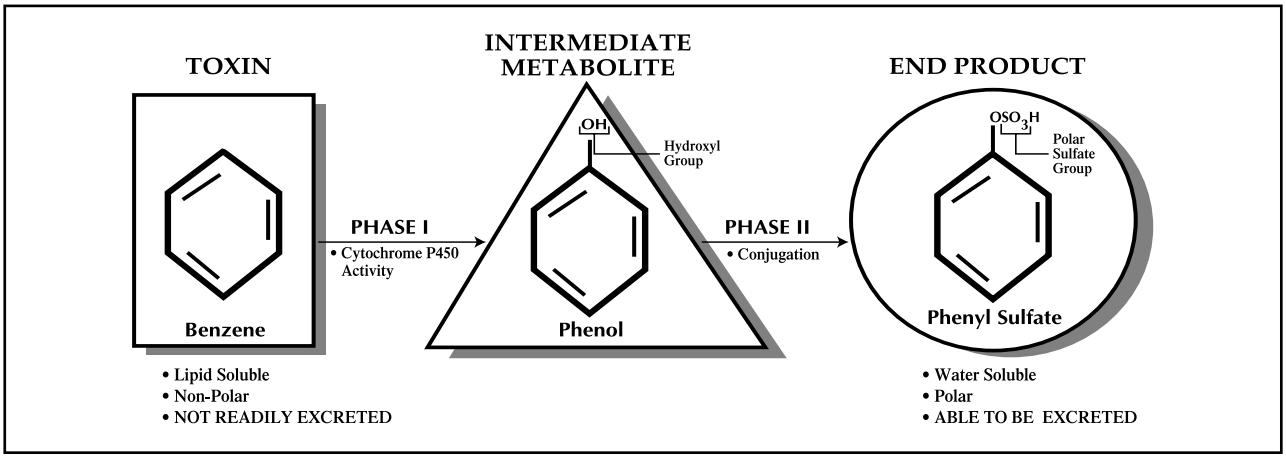
Steps to help preserve the integrity of the gastrointestinal barrier include:

1. Maintaining a proper balance of intestinal microflora.
2. Ensuring adequate digestion of the food we eat (relax before eating, chew all foods to liquid, and augment the diet with digestive enzymes where indicated).
3. Limiting the use of NSAIDs.
4. Providing appropriate nutritional support for the gut.
5. Minimizing exposure to coffee, alcohol, and processed chemical and additive containing foods.
6. Managing stress in general to reduce production of pro-inflammatory eicosanoid hormones and to enhance the production of their anti-inflammatory counterparts.

FOOD INTOLERANCE: ALLERGY OR INTESTINAL DISORDER?

Recently, it has been suggested that specific food intolerances may not be true allergies but, rather, may be related to metabolic toxicity resulting from an intestinal disorder.[13] Hunter proposes that symptoms from apparent food intolerances may result from reduced enzyme concen-

Figure 1: Metabolism of Benzene to Phenyl Sulfate



trations, either inherited or acquired, and from intestinal bacterial endotoxins. According to Hunter, "Specific food residues are broken down by the colonic microflora with the production of chemicals, which, in susceptible individuals with low concentrations of relevant hepatic enzymes, pass into the systemic circulation to produce distant symptoms."

One classic approach to helping the patient with food intolerance is implementing an exclusion diet. Exclusion diets may be effective for migraine, irritable bowel syndrome, Crohn's disease, eczema, hyperactivity, and rheumatoid arthritis.[13] Foods most commonly to blame for aggravating these conditions are gluten containing cereals, dairy products, caffeine, yeast, and citrus fruits. Avoidance of some or all of these foods has lead to a relief of symptoms in some individuals.[14-19]

THE DETOXIFICATION PROCESS

The most difficult toxins for the body to eliminate are the non-polar, lipid-soluble type. These molecules are generally deposited in the less metabolically active adipose tissue, sometimes for a considerable length of time before they are eliminated. For example, DDT, when not effectively detoxified, may stay in the body for years. Detoxification in the liver entails the conversion of these substances into more polar, water-soluble compounds that can then be eliminated. This detoxification process can be divided into two very broad phases.[2] In Phase I, a superfamily of enzymes commonly called the cytochrome P450 system, reduce, oxidize, or hydrolyze the toxin. The intermediate metabolites produced by the Phase I steps are then conjugated in Phase II by other enzymes in the liver to form glucuronides, sulfates, glutathione adducts, and other conjugates. These biotransformed metabolites can then be eliminated in the urine or feces. Figure 1 illustrates the biotransformation of benzene, a carcinogenic compound that has been used in industrial processing.

Proper functioning of *both* of these phases is critically important, because the intermediate metabolites produced during Phase I may actually be more harmful than the original toxins. Phase II must be functioning in balance with Phase I to transform the intermediate metabolites to non-toxic, excretable end-products, thus successfully completing the detoxification process.

In addition, the Phase I process often produces free radicals such as superoxide anion radical, hydroxyl radical, and others. Damage from these free radicals is thought to be the source of much of the endotoxin and exotoxin-related harm. This is one theoretical explanation why some people feel *worse* during a detoxification program: they have successfully up-regulated, or increased the activity of Phase I enzymes, but they had insufficient levels of antioxidants to protect against the free radicals produced when this phase is not balanced by Phase II enzymes.

HOW TO SUPPORT AND FACILITATE THE DETOXIFICATION PROCESS

Detoxification programs are designed to support and facilitate the detoxification process. Such programs may relieve certain chronic health symptoms thought to be of toxic origin.[20]

Frequently used methods of detoxification include the water and juice fast. Methods such as these may do more harm than good, however. These fasts work under the principle that the body will heal itself when the "stress" of digestion and the insulting agents are eliminated. However,

the processes of Phase I and Phase II are not only energy intensive but are dependent upon adequate levels of supporting nutrients. A water fast, being totally devoid of energy sources or supportive nutrients, may in fact suppress detoxification rather than enhance it. A juice fast is better since it provides some carbohydrates and other nutrients, but still may be deficient in rate-limiting vitamins, minerals, or amino acids.

Programs that use a broad-based nutritional approach are advantageous for a number of reasons. The result of one study suggested that these types of programs may support optimum cytochrome P450 activity; help prevent muscle tissue catabolism; help to stabilize blood glucose levels; and may help protect against free radicals liberated as a result of detoxification and normal metabolic functions.[20]

DIETARY REGULATION OF LIVER DETOXIFICATION

- **PROTEIN**

Activation of the cytochrome P450 family of liver enzymes requires adequate dietary protein. Protein deficiency states can often result in decreased liver detoxification of many drugs and other chemicals.[21] Fasting, which involves protein restriction, can result in lowered detoxification ability and actually increase the potential for more active secondary toxins to be produced from the liver. Studies in laboratory animals have shown that protein restriction enhances the toxic effects of some chemicals such as certain pesticides and carcinogens.[22-24] In humans, dietary protein may influence drug metabolism.[21]

Adequate protein, more specifically the ratio between dietary protein and carbohydrate, directly influences the insulin-glucagon hormonal axis. This, in turn, impacts important eicosanoid pathways which produce anti-inflammatory and immune enhancing prostaglandins, such as PGE_1, in the presence of adequate protein and moderate carbohydrate. In the absence of sufficient protein and/or with excessive carbohydrate which can occur with some juice fasts, pro-inflammatory and immune inhibiting prostaglandins (such as PGE_2) and leukotriene production is often increased.

- **CARBOHYDRATE**

For detoxification purposes, a high carbohydrate intake may reduce the ability of the cytochrome P450 enzymes to work effectively.[21] This depression of cytochrome P450 activity by carbohydrate is seen to be more significant with sugar than with longer chain polyglucose sources. It appears that the ratio of dietary protein to carbohydrate may be an important factor in determining the ability of the liver to detoxify certain substances.[21,27] While undergoing a detoxification program, a diet that is higher in well-balanced protein and lower in total carbohydrate may provide optimal activation of cytochrome P450 enzymes.[21,28]

As stated earlier, proper protein-to-carbohydrate ratios may support healing and enhanced immune function on a systemic cellular level.

- **FAT**

The maintenance and induction of cytochrome P450 enzymes may be optimized by proper dietary sources of both mono and polyunsaturated fatty acids.[21] Fatty acids provide energy for cell function and act as substrates for liver energy production necessary for the cytochrome P450 enzyme activity. Medium chain triglycerides are also nutritionally valuable because they provide an excellent source of energy to muscle cells during the detoxification process without stimulating the liver to produce excess triglycerides or cholesterol.[21]

- **ANTIOXIDANTS**

More and more people are becoming aware of the need for antioxidants in the diet. Antioxidants help protect cell membranes from damaging oxygen free radicals generated by both exogenous and endogenous sources. Antioxidants such as flavonoids, vitamin C, vitamin E, and selenium may offer additional assistance to liver detoxification by quenching free radicals produced during the detoxification process. Antioxidant restriction, as during a water fast, allows these free radicals to go unchecked. Furthermore, dietary insufficiencies of vitamins C and E may decrease cytochrome P450 enzyme activity.[21]

- **ADDITIONAL NUTRITIONAL FACTORS**

Additional nutritional factors thought to help in the detoxification process include glutathione, glutamine, and certain minerals and amino acids. Glutathione plays an important role in xenobiotic detoxification because it is both an antioxidant and provides one of the functional groups donated in conjugation (Phase II). Glutamine supplementation may help preserve the integrity of the gut mucosa.[25] Deficiencies in minerals such as zinc, copper, magnesium, and molybdenum may decrease the activity of

the cytochrome P450 enzyme system.[21] The amino acids methionine and cysteine provide sulfur which is utilized during Phase II conjugation. Additionally, fructooligosaccharides may enhance detoxification by supporting the growth of bifidobacteria, so-called friendly bacteria thought to have a lowering effect on the activity of enzymes associated with carcinogenesis.[26]

The intake of sufficient pure water also may serve to enhance the elimination of the end products of liver detoxification pathways.

These dietary variables may alter the rate of liver detoxification and the secondary symptoms that may occur during a detoxification program. Fasting may have some significant adverse effects upon overall safety and effectiveness of clinical detoxification due to the lack of protein, fat, and micronutrient intake, and may result in lowered cytochrome P450 enzyme activity and increased exposure to secondary oxidants.

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