



The Definitive Guide To.

DETOXING YOUR BODY

— with —

• EARTH GROWN NUTRIENTS •



NEED A RESET?

So you've decided you want to clean out your system. Reset it. Get it primed and ready to go for whatever adventure you've got planned. Excellent choice, my friend.

Detoxification is not about getting your organs (including your intestines) squeaky-clean. Instead, it's about giving them the space to do what they are innately capable of to keep your body optimized.

Below is a comprehensive guide to help you detox.

When you do a proper detox, what you're really doing is assisting your organs with the process of repairing toxin-induced damage and recovering optimal functionality. Your goal, to some extent, is to move whatever debris you have in your system. But what you're really looking to do is to make your body efficient at removing toxins.

Car exhaust, industrial factories, coal-burning, BPA-leaching plastic, pesticides/herbicides, and the rest of the toxins associated with modern-day society are a relatively new phenomenon to the human body, and as such, you need to do all you can to give your body a helping hand.



DETOX PHASE I

Adding a Reaction Site to the Toxin

Phase I is known as functionalization and is the first step in turning lipophilic (fat-loving) compounds into something that can be removed from the body in bile or urine.

Many toxins are lipophilic compounds – pharmaceuticals, pollutants, drugs, food constituents like caffeine¹, and xenobiotics. A xenobiotic is any compound that is foreign to an organism; it can be anything from a natural compound from fruits and vegetables, to an air pollutant, to a pharmaceutical. They are classified by their toxic effects on the body. Xenobiotics can mutate cellular DNA, modify the immune or endocrine systems, and inhibit cells from multiplying.

Lipophilic compounds are stored in your fat and are very difficult to remove through ordinary means (sweating and urinating). Your body uses a family of enzymes called Cytochrome P450 (CYP) to add an oxygen molecule to the toxin so a hydrophilic (water-loving) compound can be added. The site of this addition is called the reaction site, which will later be utilized by Phase II enzymes.

CYPs, found mainly in your liver but also in your lungs, kidneys, and brain,² are the first-line of defense against toxic lipophilic compounds. CYPs are also necessary for essential metabolic reactions – conversion of cholesterol to hormones, synthesis and breakdown of unsaturated fatty acids, conversion of vitamins to their active forms, and breakdown of cholesterol to bile acids.³

Often, the actions of these CYPs lead to a safer, less reactive compound that will be neutralized in Phase II. However, this is not always the case. There are a number of compounds converted to reactive oxygen species (ROS) that actually become more damaging than the original toxin. ROS bind irreversibly with DNA, lipids, and proteins, inducing cell death, immune responses, and DNA mutations.⁴ These activations make it all the more important for Phase II enzymes to be in large numbers and ready for action.¹



DETOX PHASE II

Locking Down the Toxin

Phase II is known as conjugation. In this step, lipophilic compounds are removed from the body by attaching a water-soluble group to the reaction site created in Phase I.¹ This step requires specialized sets of enzymes that have very specific mechanisms, yet overlap in their functions.

Glucuronidation: This process turns lipid-soluble molecules into water-soluble molecules. It may account for about 40-70% of all pharmaceutical drugs metabolized during Phase II.⁵ In addition, this pathway metabolizes xenobiotics (chemical carcinogens, dietary compounds, and environmental pollutants). It is also responsible for helping to process endobiotics like bilirubin, fat soluble vitamins (A, D, E, K), hormones, fatty acids, and bile acids.^{5,6}

Glucuronidation not only makes toxins more water soluble for excretion via bile or urine, but it also changes the molecular structure of the original compound, thus changing its function and making it easier for your body to remove.⁶

Glutathionylation: This process is one of the most important Phase II processes as it's involved not only in the metabolism of xenobiotics, but it also plays a large role in protection from oxidative stress caused by free radicals. These enzymes utilize glutathione, the body's most potent antioxidant, to detoxify epoxides formed by exogenous toxins like polycyclic aromatic hydrocarbons (PAH).

Glutathionylation is also responsible for metabolizing endogenous compounds like prostaglandins (inflammatory mediators) and steroids. Most importantly, glutathione is used to neutralize ROS, most of which are created by the CYPs in Phase I.

Sulfation enzymes play a large role in the biotransformation of endogenous compounds like steroids, serotonin, and vitamins A, C, and D. Sulfonation utilizes sulfonates (compounds that donate a sulfur group) to make the toxic compound water-soluble.⁵

Acetylation: These enzymes transfer an acetyl group (donated from acetyl CoA) to make aromatic amines and hydrazines soluble in water and ready for excretion.⁵

Methylation enzymes transfer a methyl group to a toxin. This process is especially important for estrogen metabolism.^{5,7}

DETOX PHASE III

Removing the Toxin

Unlike Phases I and II, Phase III does not involve enzymes but instead uses a transporter protein found largely in your liver, intestines, kidneys, and brain.² This transporter uses ATP (cellular energy) to actively transport Phase II conjugated toxins out of the body.⁸ It also transports xenobiotics entering the system that have not yet gone through detoxification back into the system for processing.

This provides a second chance at breakdown by CYPs, which prevents the toxin from causing harm. Because these actions can prevent pharmaceuticals from entering the system and taking effect, the transporter is often referred to as multi-drug resistant.⁹

DETOXIFICATION ORGANS

Each of the following organs houses subsets of detoxification enzymes, and they each play their own role in the type of detoxification as well as contribute to detoxification dysfunctions.

The **gastrointestinal tract** is like a giant assembly line, breaking down everything that enters our bodies and is comprised of the mouth, esophagus, stomach, liver, gallbladder, pancreas, small intestine, and large intestine. Each acts like a station along that line, contributing to the production of waste.

The **mouth** releases digestive enzymes that start breaking down food, which travels down the esophagus to the stomach. Your **stomach** acts like a washing machine, churning the food and “washing” it in hydrochloric acid (HCl) before food moves into the small intestine. This is where the majority of digestion and absorption takes place.⁷

The **pancreas** is well-known for its insulin secreting duties, but it’s also responsible for releasing the majority of digestive enzymes. After the stomach contents have been moved into the small intestine, the pancreas secretes digestive enzymes into the small intestine to aid in the continued breakdown of food.

Your **small intestine** filters nutrients. Food particles that are toxic or indigestible are moved into the large intestine where they are excreted from your body. Digestive enzymes released from the pancreas and liver bile help break down food, and nutrients are exchanged across intestinal cells.

Your **liver** is where the majority of Phase I and II enzymes are housed. It is also the main filter in the body for detoxification, filtering approximately 1.4 liters of blood per minute, making this organ a filtering powerhouse!

Think of liver detox as an air filter in your home – with a dirty filter, air still goes through but it also carries dirt, pollutants, and toxins. So for optimal filtering, you have to change your filter. Unfortunately, you can’t just get a new, clean liver. Instead, you have to clean it.

The **gallbladder**, while seen in some medical communities as unnecessary, is actually an important component for digestive health. This organ is a storehouse for concentrated bile generated by the liver. Bile is released by the gallbladder into the small intestine to aid in the breakdown of fats.

Often, those that have their **gallbladder** removed will have trouble digesting fats and may see an overgrowth of pathogenic bacteria. This is because acidic bile released by the gallbladder also helps kill harmful bacteria. Individuals without a gallbladder should supplement with fat-digesting enzymes like lipase and a probiotic. (See the Reinoculate section below for more detailed information)

Your **kidneys** filter approximately 1.1L of blood per minute, kicking out water-soluble waste and recycling compounds like glucose, amino acids, and electrolytes. When xenobiotics resemble one of these recyclable compounds, then they too may be reclaimed and recycled back through the body, causing unnecessary damage.²

FACTORS THAT INFLUENCE DETOXIFICATION

Have you ever felt like your brain just wasn't working or that you were a little "slower" on some days? There are a number of things that could contribute to that – lack of sleep, out partying too hard the night before, too much stress, etc.

Knowing you're a little "slower than usual" is easy to detect because it affects your everyday conscious life. But have you ever stopped to think about the biochemical interactions your conscious-self is unaware of?

Sometimes little signals like lightly coughing when inhaling diesel fuel or getting a slight headache from inhaling air freshener are signs that your organs may be a little "slower" than they should be. Only you may not immediately connect the physiological consequence (like coughing) with the external trigger (toxins) because these caustic insults have become a part of everyday life.

The concepts of adaptation, bio individuality, and total body burden (TBB) explain this disconnect.

TBB is the total load of toxins your body is dealing with at any give time – chemicals (heavy metals, pesticides, air pollution), biological (pathogens, mold, food), as well as physical and psychological factors. Your TBB can slowly build up over time, increasing the number of toxins accumulating in your system.

For toxins in the air, being able to detect a scent can serve as a warning, but studies have shown that we adapt with repeated exposure – a definite problem when using everyday household items.

Take for example, a toilet deodorizer. At first, smelling it may cause a minor headache, but repeated use causes your olfactory senses to adapt and the headaches to cease. That's because neurotoxic compounds like paradichlorobenzene (PDCB), infused to mask unpleasant odors, are inhaled, rapidly absorbed, and bioaccumulate, meaning they are stored in fat cells when they cannot be removed from your blood without being detoxified.¹²

Because you adapt to the scent, your body stops warning you, and the toxin levels continually build in your fat cells. The CYP family is the first line of defense against this toxin, and genetic abnormalities causing these enzymes to be dysfunctional increase the amount of PDCB that accumulates, increasing your toxic load.¹²

Phase I CYP detoxification enzymes are like pyromaniacs – sparking little flames in an effort to clean up, which is okay as long as the fires stay small and are put out by our Phase II firefighters. There is a very fine balance between the phases of detoxification – too much activity from Phase I combined with too little activity from Phase II results in infernos of oxidative stress.

Understanding how various sources of toxins, like environmental pollutants, the foods we eat, and natural endogenous compounds modulate the enzymes and organs of detoxification is key to understanding how and why helping your body detoxify is an absolute necessity.

DETOXIFICATION ALTERATIONS



THE ROLE OF GENETICS

Just because we're born with all of the correct organs for proper detoxification, does not mean we're all going to detoxify in exactly the same manner or at the same rates.

CYPs are susceptible to varied functioning via genetic predisposition and/or environmental manipulation (diet, lifestyle, pollution), often resulting in reduced or dysfunctional activity or a deletion of the enzyme altogether.^{1,13}

Genetic changes cause alterations in drug metabolism leading to two metabolic classifications: slow and rapid. Slow metabolizers process lipophilic compounds slower than average and are at increased risk of toxic buildup, whereas rapid metabolizers break down lipophilic compounds faster than average possibly leading to decreased medication efficacy and oxidative damage if Phase II cannot keep up. In other words, there are more fires than firefighters.^{1,3,13}

Phase II enzymes are not exempt from genetic abnormalities that increase the risk of cellular damage. They can also categorize metabolism as fast or slow. Genetic differences in acetylation enzymes (N-acetyltransferases) can cause a person to be considered a slow- or rapid-acetylator, meaning the speed at which carcinogenic aryl- and heterocyclic-amines are processed can greatly vary.

For those who are considered to be slow-acetylators (50-60% of Caucasians), this could mean increased risk of extended exposure to cancer-inducing compounds.¹⁴

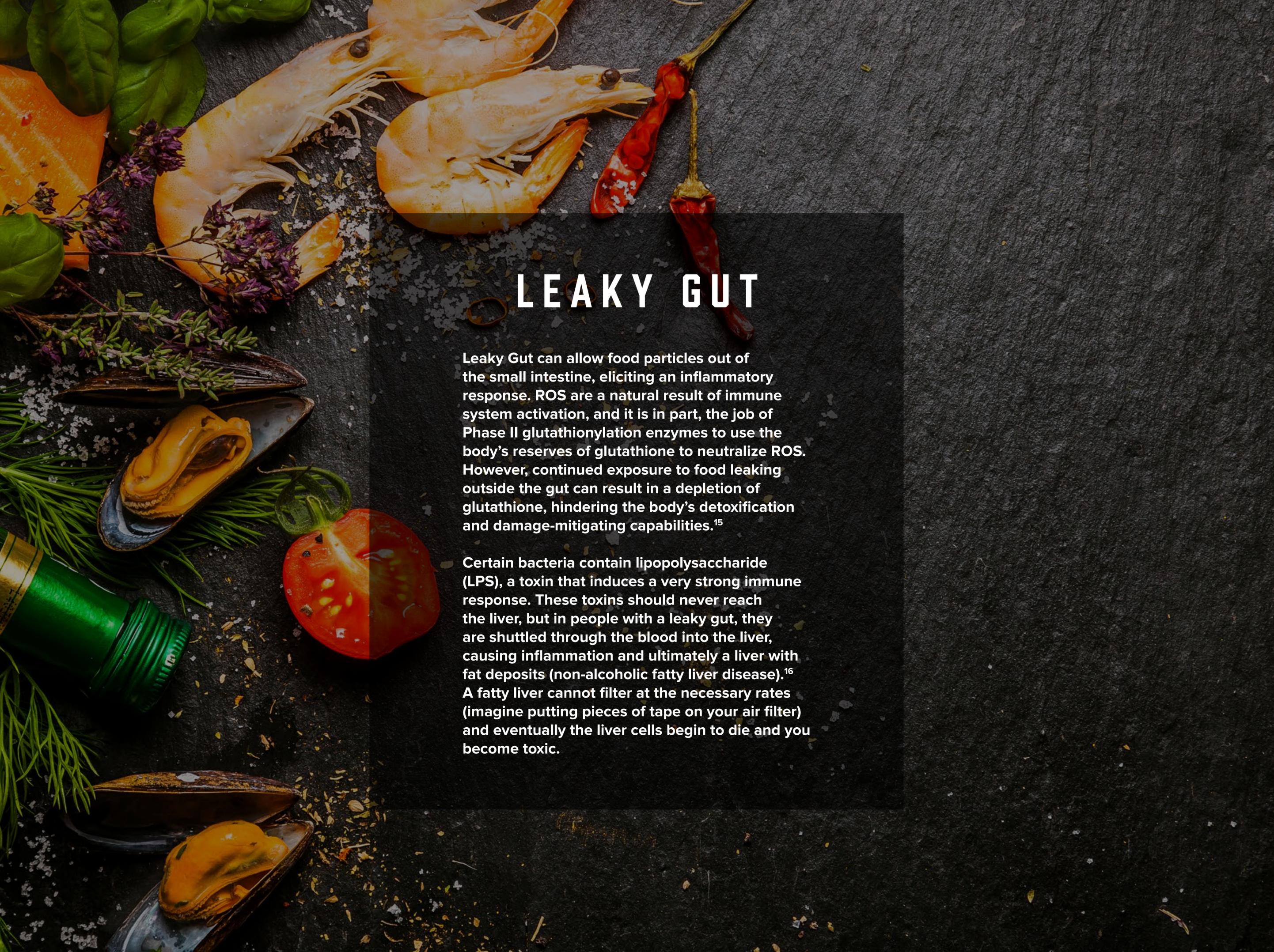
Genes can also be completely deleted, like in the case of the GSTM1 gene, leaving Phase II conjugation by glutathione an impossible feat. Without glutathione to protect from ROS activities, increased cell damage and early cell death are often the result.¹⁴



THE ROLE OF THE MICROBIOTA

In normal situations, the intestinal cell junctions (the glue that holds the cells together) and your liver work as a team to efficiently detoxify blood and work as a barrier against pathogenic microbes. However, in cases of intestinal permeability, more commonly known as leaky gut, the intestinal cell junctions begin to tear apart.

One common factor in leaky gut is an overgrowth of pathogenic bacteria. Toxins are released that loosen cell junctions allowing food and bacteria to leave the confines of the gut and activate an inflammatory response. This common occurrence is implicated in a malfunctioning liver, which as discussed above, is necessary to detoxify properly.



LEAKY GUT

Leaky Gut can allow food particles out of the small intestine, eliciting an inflammatory response. ROS are a natural result of immune system activation, and it is in part, the job of Phase II glutathionylation enzymes to use the body's reserves of glutathione to neutralize ROS. However, continued exposure to food leaking outside the gut can result in a depletion of glutathione, hindering the body's detoxification and damage-mitigating capabilities.¹⁵

Certain bacteria contain lipopolysaccharide (LPS), a toxin that induces a very strong immune response. These toxins should never reach the liver, but in people with a leaky gut, they are shuttled through the blood into the liver, causing inflammation and ultimately a liver with fat deposits (non-alcoholic fatty liver disease).¹⁶ A fatty liver cannot filter at the necessary rates (imagine putting pieces of tape on your air filter) and eventually the liver cells begin to die and you become toxic.

The image shows four distinct bundles of dried herbs, each tied with a string, arranged vertically on a dark, weathered wooden surface. From left to right: the first bundle consists of long, narrow, silvery-green leaves; the second bundle features a mix of green leaves and small yellow flowers; the third bundle has green leaves and several large, light purple flowers with prominent orange centers; the fourth bundle is composed of thin, needle-like green leaves. The text is centered over the middle of the bundles.

**DETOXIFYING WITH THE “4 R’S”
OF FUNCTIONAL MEDICINE**

REMOVE: KNOW THE TOXIN SOURCES

Detoxification starts with complete removal or at the very least, limiting your exposure to toxins. Toxins are a byproduct of the body's metabolic processes, which makes everything entering the body, from food to pollution, a potential toxin. The following are examples of everyday exposures to toxins that should be avoided when possible.

Heterocyclic Aromatic Amines (HAAs) are found in cigarette smoke and also form during a process in cooking called the maillard reaction. This occurs when a reducing sugar (e.g. glucose, lactose, fructose) combines with a protein or fat at high temperatures, forming **Advanced Glycation End-products (AGEs)**.

You'll know when AGEs have been formed in your food because they're the "browning" you see during cooking, like on the outside of decadent pastries, the sear on a gorgeous piece of steak, and the delicious char marks on a thick, juicy, grilled burger.

Hungry?

Well, that's because the maillard reaction is used to alter the flavor, aroma, and colors of foods.^{17,18} Increased temperatures (grilling and frying) and cooking times increase the levels of AGEs, especially in high protein/fat foods like meat.¹⁹ While AGEs may make the food taste better, they are actually HAAs that interfere with your detoxification enzymes.

In some, they inhibit CYPs, while in others they increase CYP activity, turning HAAs into an even more damaging compound that is known to be carcinogenic.²⁰ This latter situation can be even more dangerous for those with slow Phase II acetylation enzymes because it's too slow to keep up with ROS production; leading to increased risk of colon cancer.^{21,22}

You can decrease the risk of AGE accumulation by using cooking processes that decrease AGE production – moist heat (boiling or steaming), low temperatures (dehydration), and the addition of acid (like lemon juice or vinegar) to the cooking process. Try to avoid grilling and frying high protein and fatty foods as much as possible.¹⁸

Heavy metals can be found in our food and water supplies. Lead and mercury are two of the most common heavy metals. These compounds are capable

of not only disturbing the production of Phase I and II enzymes, but also preventing DNA repair enzymes from doing their job. This means that heavy metal accumulation decreases the detoxification abilities at a genetic level while increasing the amount of cells that die due to DNA damage.²³

It is imperative to understand where exposures are common so they can be avoided. Large predator fish can contain high amounts of methylmercury, so it is best to avoid them. Methylmercury binds tightly to and accumulates in the tissues of fish – the larger the fish, the higher the methylmercury content.²⁴ This heavy metal toxin is then passed to whatever eats it, namely, us. Limit your exposure to methylmercury-laden predatory fish like tilefish from the Gulf of Mexico, shark, swordfish, king mackerel, and sushi-grade tuna.²⁵

Phthalates, also known as plasticizers, were found ubiquitously throughout the U.S. populations, according to the CDC's 4th report in 2009. Plasticizers are what make plastic flexible and are found in everything from adhesives, to raincoats, to toys, and even personal care products like shampoo.²⁶

Phthalates are passed to developing infants in toxic form via breast milk² and are endocrine disrupters; meaning they have the ability to act like sex hormones or inhibit the activity of sex hormones in the body.²⁷ Exposure to phthalates should be limited or avoided altogether.

Food preservatives like BHT and BHA are added to pastries to inhibit lipid peroxidation. While considered a good ROS scavenger, their metabolism results in a much more toxic compound that interferes with mitochondrial production, increasing the release of free radicals.²⁰

Dioxins belong to a class of bioaccumulative Persistent Organic Pollutants (POPs), meaning they get stored in fat cells. Dioxins upregulate the activity of Phase I CYPs, disrupting Phase I and II balance, increasing free radical damage.²⁸

90% of dioxin exposure comes from food sources like inorganic meat, dairy,²⁹ and Atlantic farmed salmon.³⁰ These animals are contaminated through their feed.²⁹ POPs encompass toxins belonging to the "dirty dozen", a list stating the "dirtiest" or most heavily infiltrated produce that should be avoided in inorganic forms.^{29,31}

REPLACE: NUTRITION IS EVERYTHING

Cofactors (vitamins and minerals) are required by both Phases I and II for proper functioning. Increased toxin exposures puts both Phases into overdrive and burns through cofactor reserves.³² It's important to replace these nutrients through diet and supplementation:

Phase I: Oxygen, NADPH, vitamin B (2, 3, 6,12, folic acid), amino acids (protein), and flavonoids (fruits and vegetables)¹

Phase II: Antioxidants (vitamins A, C, E; most effective when consumed in whole food plant-based form), selenium, copper, zinc, CoQ10, and glutathione (increased by eating sulfur-rich compounds like garlic, onion, and brassica vegetables)¹

Obviously, as evidenced by the cofactor list, the role of food in detoxification is quite large – influencing every phase of detoxification. For example, grapefruit has an inhibitory effect on the same CYP that metabolizes statins (a type of cholesterol-lowering medication). This means that consuming just one glass of grapefruit juice with statins could prevent the medication from being broken down and could lead to a toxic buildup.³³

NADPH is a cofactor required for multiple activities, including carbohydrate metabolism, fatty acid synthesis, and drug detoxification. Which process NADPH is used for depends upon how much is available. A healthy person in a well-fed state will generate enough to juggle all of these processes. However, a person eating incorrectly will not produce enough, leading to an imbalance.³²

The amount and types of food taken in during the Replace process greatly affects how well a body is able to keep up. A body that cannot meet energy demands simply cannot digest and detoxify optimally.

Digestive enzymes and Betaine Hydrochloride are other agents useful in increasing detoxification. Often, in cases of leaky gut, stomach acid (HCl) is low, which prevents the proper breakdown of foods and release of nutrients like B12, iron, and zinc for absorption. As mentioned above, many of these vitamins are cofactors that are crucial to the phases of detoxification.³⁴

Digestive enzymes like pepsin are released in addition to HCl to further break down food particles for nutrient absorption, and when these are lacking, food is able to stay intact instead of being broken down.

Large particles that escape through a leaky gut substantially contribute to oxidative stress and impaired detoxification.⁷ Lacking digestive enzymes and HCl demonstrate that consuming the proper amounts of nutrients is not the same as absorbing those nutrients, so sometimes supplementation is necessary.

Betaine Hydrochloride is also useful for those that need help preventing another complication leading to increased toxicity – constipation.⁷ Toxins having undergone Phase II, like steroid hormones, are released into the bile where they are removed via the stool. A substantial decrease in bowel transit time leads to increased risk of exposure to and reabsorption of toxins, especially estrogen.³⁵

Consuming or supplementing with adequate amounts of fiber (both soluble and insoluble) reduces transit time and helps to bind toxins like cholesterol and estrogen, increasing the likelihood that it will be successfully removed from the body.³⁵

REINOCULATE: THE ROLE OF GUT FLORANUTRITION IS EVERYTHING

Microflora break down and deactivate or activate compounds for us. This is because each bacterium has its own set of genes and since there are literally trillions of bacteria within us, their genes share some similarity in function to our own. In fact, they're even able to metabolize things we are not.² Sometimes, however, this is not a good thing.

During Phase II, a water-soluble group is added to the toxin so it can be removed in Phase III. Certain bacteria possess the ability to remove this hydrophilic addition, turning the compound back into the original toxin, which can then be reabsorbed and filtered into the blood,² allowing the toxin additional time to wreak havoc in the body.

For example, bisphenol A (BPA) is a plasticizer used to make polycarbonate for plastic items and is used on the inside of food cans; it is a known carcinogen, that according to the CDC, is found in the majority of the U.S. population.²⁶ In a study on rats given BPA, it was shown that increased Phase II glucuronidation was reversed and BPA was reabsorbed.² The same has been shown for estrogen.

Not all bacteria are bad, however. Probiotics are beneficial microbes you want in your gut and are the key to Reinoculation of the gut. These microscopic bacteria provide benefits, like lowering cholesterol, reducing inflammation, modulating the immune system, and outcompeting pathogenic bacteria for both space and food.³⁶

Probiotics have multiple types but Lactobacillus (L.) is one of the largest and most studied forms. L. acidophilus is probably the most well-known probiotic due to its prevalence in cultured dairy products like yogurt.³⁷

This particular strain is able to inhibit the growth of pathogenic bacteria via production of a compound called bacteriocin.³⁸

L. rhamnosus is perhaps the most studied species of lactobacillus. This particular microbe possess the ability to adhere tightly to intestinal walls, allowing it to survive potential unfavorable conditions leading to proliferation that outcompetes pathogenic bacteria.³⁹ According to a recent study performed by the University of Maryland School of Medicine, it may increase the expression of genes that promote the development of other gut bacteria that are beneficial to human health.⁴⁰

L. plantarum has been shown to protect the intestinal barrier by increasing the presence of occludin and zonulin, two proteins that bond intestinal cells, keeping digested contents from leaving the confines of the intestine.⁴¹

L. fermentum offers antimicrobial protection from harmful gut pathogens like E. coli and aids in the detoxification processes of cholesterol breakdown in bile salts.⁴²

Multiple studies have confirmed the beneficial effects of saccharomyces cerevisiae ar. Boulardii, showing it to, among other effects, mitigate the population of pathogenic bacteria and bolster the integrity of the gut barrier.⁴³

Probiotics are available via supplements purchased online, from your local pharmacy, and even from the grocery store. Another viable source is from cultured dairy foods like yogurt or kefir and fermented foods like sauerkraut or kombucha. Just make sure they're not pasteurized because the pasteurization process destroys many of the probiotics.

REPAIR: FIXING, CLEANING, AND BOOSTING

This process pertains mainly to gut health. As mentioned above, leaky gut is the direct cause for a multitude of detoxification malfunctions. After removing the toxins and re-inoculating the system, it is important to repair the damage, which our bodies will naturally do. However, a few things can help optimize these processes.

Colon cleansing has a lot of stigma and misinformation surrounding it. The purpose of colon cleansing is to aid your body's ability to detox – bind toxins like xenobiotics, mercury, and HAAs for removal, increase bile and urine flow, decrease transit time, reduce intestinal inflammation, and provide nutrient cofactors.⁴⁴

Sauna treatments can help you detoxify by sweating out toxins that are tightly bound to tissues like heavy metals or fat-soluble toxins that have accumulated over repeated exposures. Saunas are best used as a supplemental treatment with a detoxification protocol for increased detox speed.⁴⁵ This particular strain is able to inhibit the growth of pathogenic bacteria via production of a compound called bacteriocin.³⁸

ESTROGEN: BRINGING IT ALL TOGETHER

Estrogen is the dominant sex hormone in women but is also an important hormone for men. While necessary for hormonal regulation, because of the powerful effects estrogen has on the body, excess hormone is viewed as a toxin and is broken down in the same manner.⁷ In fact, this hormone is ideal for demonstrating how diet, lifestyle, and genetics affect your ability to detox.

When estrogen is metabolized in Phase I, there are three different CYPs that can break it down, and each produce very different byproducts. Enzyme CYP1A1 produces the preferred metabolite (the other two are carcinogenic) so upregulation of its activity is desired.

Consumption of brassica vegetables (broccoli, cauliflower, kale, brussels sprouts, cabbage, mustard greens) has been known to increase CYP1A1, which is also a reason that brassica vegetables are considered anti-cancerous.⁷ Once run through Phase I, estrogen breakdown continues onto Phase II.

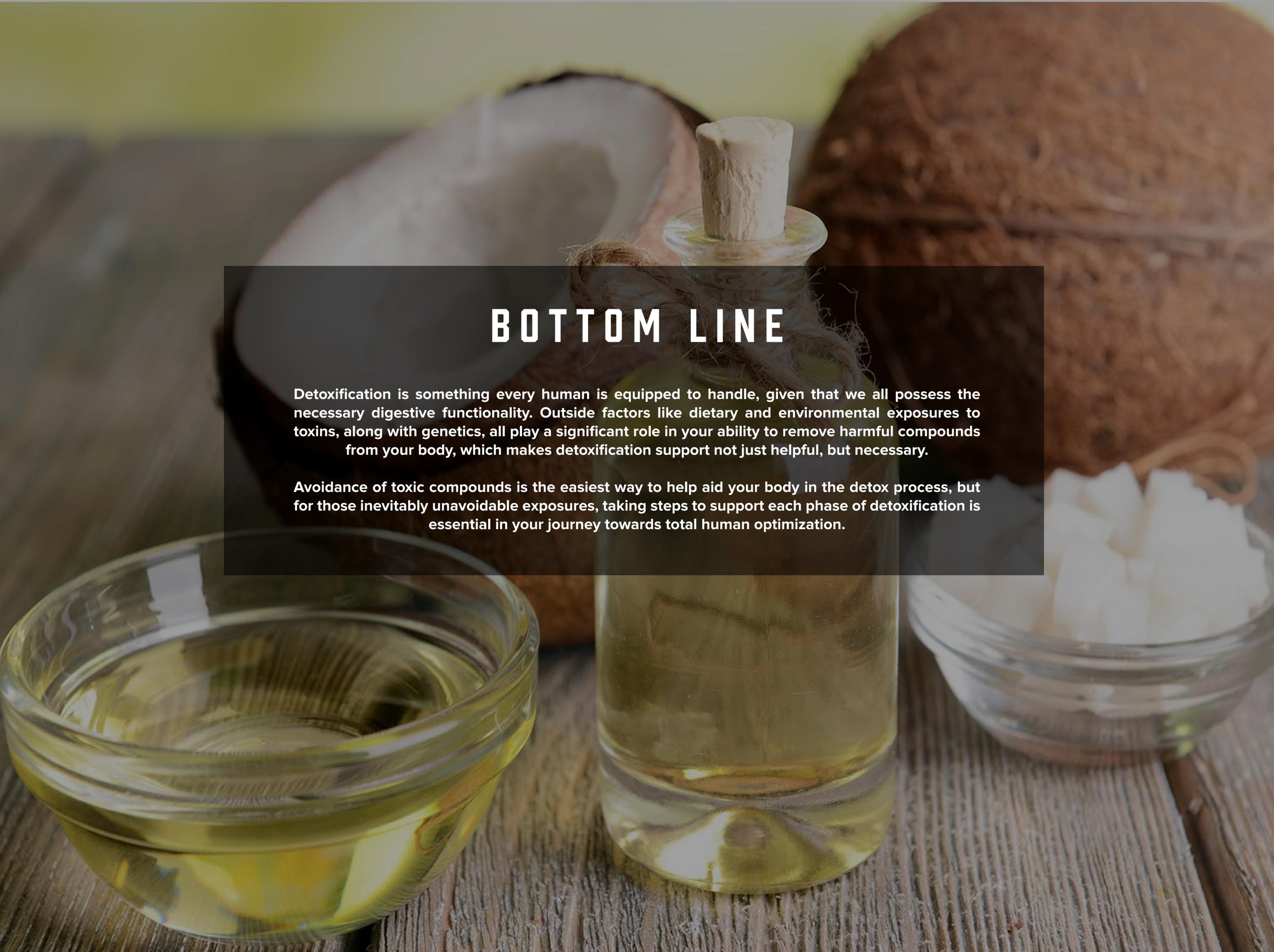
Phase II sulfation enzymes inactivate estrogen by donating a sulfur molecule to it and activate estrogen by removing the sulfur molecule. A sulfur deficient diet could mean there are too many active estrogen metabolites in the body.⁷ A good way to increase dietary sulfur intake is through consumption of sulfur-containing foods like brassica vegetables, onions, and garlic.

Methylation enzymes of Phase II play a protective role against dangerous estrogen byproducts, especially for women, when the preferred estrogen metabolite has a methyl group attached to it. Having too few methyl-donating compounds can lead to increased risk for certain cancers. Evaluating methylation blood markers like homocysteine and methylmalonic acid levels can help indicate if vitamin B12 and methylfolate (crucial to methylation) supplementation is necessary.⁷

Finally, Phase II glucuronidation can be reversed if there is an overload of pathogenic gut bacteria. These bacteria possess the capability of actively removing the water-soluble molecule from the toxin, allowing the toxin to be reabsorbed into the circulation – which is why it's so important to reinoculate your gut with probiotics.

For estrogen, this means a potential toxic load of dangerous metabolites, increasing risk for certain cancers. Consuming enough fiber will help bind up the excess estrogen on its way out of the body.⁷

Balancing gut flora with probiotics will reduce the number of bad bacteria and ultimately the amount of toxins reabsorbed, and consuming foods high in glucuronic acid, like brassica vegetables or certain fruits (oranges, apples, and grapefruit) can decrease these bacterial actions. If food intake is not sufficient, then supplementation with Calcium-D-glucarate may also be an option.⁵²



BOTTOM LINE

Detoxification is something every human is equipped to handle, given that we all possess the necessary digestive functionality. Outside factors like dietary and environmental exposures to toxins, along with genetics, all play a significant role in your ability to remove harmful compounds from your body, which makes detoxification support not just helpful, but necessary.

Avoidance of toxic compounds is the easiest way to help aid your body in the detox process, but for those inevitably unavoidable exposures, taking steps to support each phase of detoxification is essential in your journey towards total human optimization.

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