How the Body Gets Rid of Toxins **by Craig Paardekooper**

When your body wants to get rid of toxins, it does so by converting the toxins into a form that is soluble in water, so that they can be excreted in the urine. The conversion into a soluble form takes place in the liver, and the excretion of the urine takes place in the kidneys.

The Detox Process

The process of conversion into a soluble form involves 2 steps.

Step 1: The first step is usually oxidation of the toxin carried out by **oxidase enzymes** called CYP450 enzymes, and by **reductase enzymes**.

Step 2: The second step is conjugation of the oxidised toxin with polar molecules - including the following groups. These reactions are carried out by **transferase enzymes.**

- Acetyl
- Glycyl
- Glutathione
- Sulphyl
- Methyl
- Glucuronyl

These groups greatly increase the solubility of the toxin.

A Cause of Ageing

When these groups are in short supply, then the toxins in your body cannot be fully eliminated, and will build up - causing **irreversible damage** to tissues.

As we age, our ability to synthesis these groups diminishes, so inevitably our bodies become more toxic, and our health declines. In fact, the damage caused by toxins may turn out to be one of the main factors responsible for ageing, and fixing this may result in a longer and healthier life.

Supplements that Promote Detoxification

Supplementing with the following amino acids boosts the synthesis of the conjugating groups -

- **glycine**
- **methionine**
- **cysteine**

1. Glycine --> Glycyl group
2. Cysteine and Methionine --> Glutathione,
3. Cysteine and Methionine --> Sulphyl group
4. Methionine --> Methyl group
5. Acetyl Cysteine --> Acetyl group

Consequently, taking Glycine and cysteine (also possibly Methionine) as a supplement will greatly boost your bodies ability to remove toxins.

For example - the health services typically use acetyl-cysteine for detoxification of paracetamol overdose

The graphs below show that methionine and cysteine increase the synthesis of Glutathione, and also treble the activity of transferases, oxidases and reductases, which consequently trebles the rate of detox.

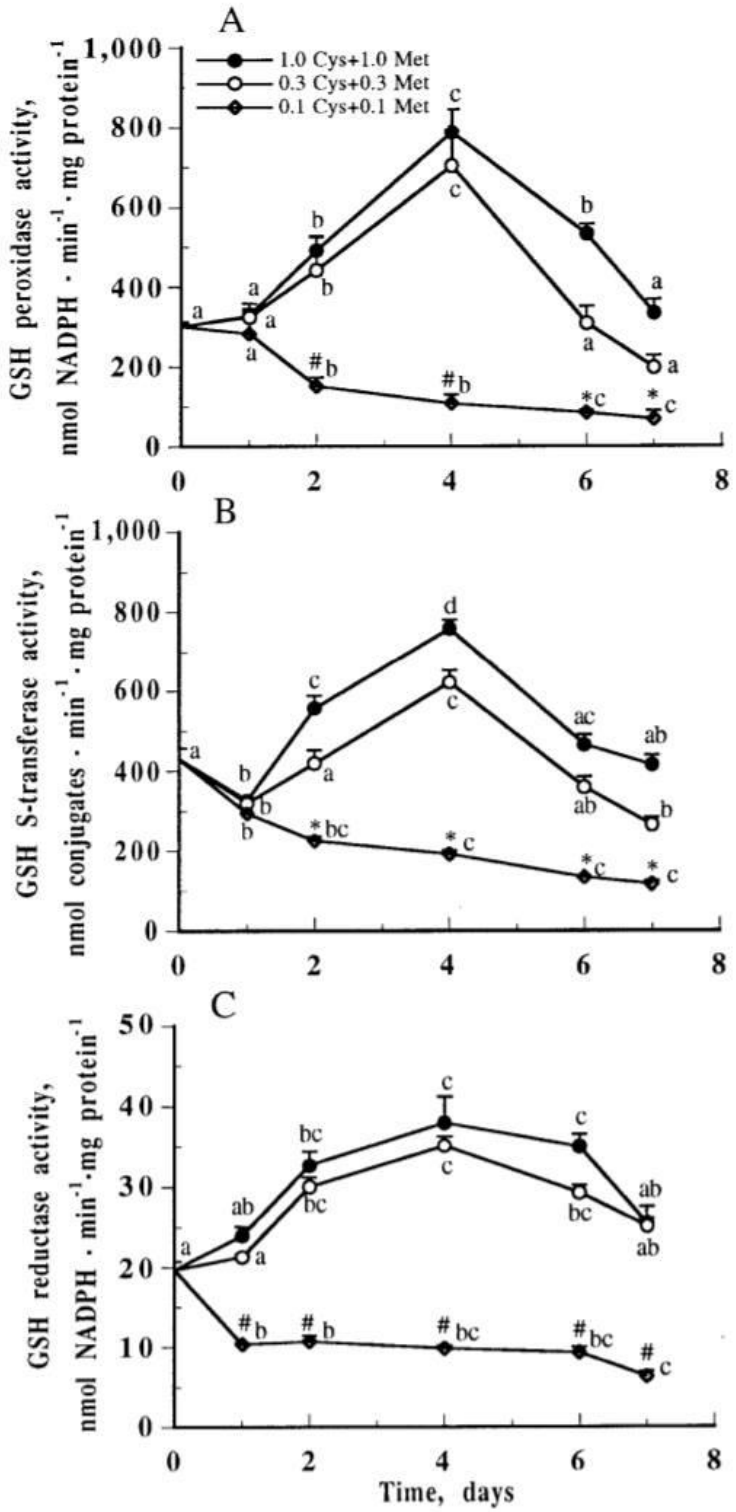

FIGURE 2 Glutathione (GSH) peroxidase (*panel A*), GSH S-transferase (*panel B*), and GSH reductase (*panel C*) activity in rat hepatocytes cultured with different levels of methionine and cysteine for 7 d. Hepatocytes were isolated by collagenase perfusion. After a 4-h attachment period, cells were maintained in a sulfur amino acid–free L-15 medium supplemented with 0.1, 0.3 or 1.0 mmol/L each of methionine and cysteine. Values are means ± SEM, $n = 5$. #Significantly lower ($P < 0.05$) than cells cultured with 0.3 and 1.0 mmol/L at the same time. *Significantly different ($P < 0.05$) among three groups at the same time. [abcd]Treatment means in a medium over time not sharing a letter differ significantly ($P < 0.05$).

Wikipedia – “Cysteine” has this to say –

> *“Due to the ability of thiols to undergo redox reactions, cysteine has antioxidant properties. Its antioxidant properties are typically expressed in the tripeptide glutathione, which occurs in humans and other organisms. The systemic availability of oral glutathione (GSH) is negligible; so it must be biosynthesized from its constituent amino acids, cysteine, glycine, and glutamic acid. While glutamic acid is usually sufficient because amino acid nitrogen is recycled through glutamate as an intermediary, dietary cysteine and glycine supplementation can improve synthesis of glutathione”*

This table shows that GSH (Glutathione) concentration increased by

17 x after 1 day

70 x after 2 days

135 times after 3 days

The greater concentration of Glutathione, and the greater concentration of all the other conjugating groups, together with the tripled activity of the oxidases and transferases, will produce a stronger and more complete detox.

Glutathione (GSH) and oxidized glutathione (GSSG) in rat hepatocytes cultured with different levels of methionine and cysteine[2-1]

Methionine/cysteine, mmol/L	**Day**				
	0	**1**	**2**	**4**	
	nmol/mg protein				
GSH					
0.1/0.1	31.1 ± 2.4^{a}	$1.8 \pm 0.3^{b\#}$	$0.6 \pm 0.2^{c\#}$	$0.5 \pm 0.1^{c\#}$	
0.3/0.3	31.1 ± 2.4^{a}	$17.9 \pm 1.7^{b\ddagger}$	$14.6 \pm 0.9^{bc}*$	$11.3 \pm 1.3^{cd}*$	
0.5/0.5	31.1 ± 2.4^{bc}	25.8 ± 0.9^{cd}	35.6 ± 1.7^{b}	69.1 ± 4.9^{a}	
1.0/1.0	31.1 ± 2.4^{d}	30.6 ± 1.3^{d}	42.3 ± 1.9^{c}	67.7 ± 2.5^{b}	
GSSG 0.1/0.1	0.80 ± 0.04^{a}	$0.40 \pm 0.04^{b}*$	$0.38 \pm 0.04^{b}*$	$0.25 \pm 0.16^{bc\#}$	
0.3/0.3	0.80 ± 0.04^{bc}	0.53 ± 0.07^{cd}	$0.47 \pm 0.07^{d}*$	$0.98 \pm 0.14^{ab}*$	
0.5/0.5	0.80 ± 0.04^{c}	0.68 ± 0.02^{c}	0.89 ± 0.05^{c}	1.56 ± 0.10^{ab}	
1.0/1.0	0.80 ± 0.04^{de}	0.68 ± 0.04^{e}	1.06 ± 0.11^{cd}	1.52 ± 0.21^{ab}	

F2-1 Hepatocytes were isolated from 10-wk-old male Sprague-Dawley rats. After isolation, cells were maintained in sulfur amino acid–free L-15 medium supplemented with 0.1, 0.3, 0.5 or 1.0 mmol/L each of methionine and cysteine for up to 7 d. Values are mean ± SEM for hepatocyte preparations from 5 rats. ^{abcde} Treatment means in a row not sharing a letter differ significantly ($P < 0.05$). $^{\#}$ Significantly lower than groups with 0.3, 0.5 and 1.0 mmol/L of amino acids for the same time period ($P < 0.05$). * Significantly lower than groups with 0.5 and 1.0 mmol/L of amino acids for the same time period ($P < 0.05$). ‡ Significantly lower than groups with 1.0 mmol/L of amino acids for the same time period ($P < 0.05$). ND, nondetectable, <0.02 nmol/mg protein.

References:

1. University lecture notes on Toxicology – Timbrell, “Principles of Toxicology” p304
2. Wikipedia – “Cysteine”
3. “Methionine and Cysteine Affect Glutathione Level, Glutathione-Related Enzyme Activities and the Expression of Glutathione S-Transferase Isozymes in Rat Hepatocytes” https://academic.oup.com/jn/article/127/11/2135/4728653