
Cyanocobalamin vs. Methylcobalamin

Three misleading information to be clarified:

- 1. Cyanocobalamin is toxic.**
- 2. Methylcobalamin is natural.**
- 3. People with methylation problem should take methylcobalamin since supplemental methylcobalamin is the ready-to-work coenzyme (cofactor) form.**

1. Cyanocobalamin is safe, NOT toxic!

- If you eat **ONLY 1 g of almond (1 whole piece)**, you can ingest **15.6 times higher cyanide than taking 1 serving of cyanocobalamin from Shaklee B complex.**¹⁻³
- Most clinical studies **used cyanocobalamin, NOT methylcobalamin**, to solve vitamin B₁₂ deficiencies, **without showing any toxic effects**
- **CDC** indicated following in the section on “How can cyanide affect my health?”⁴
 - **“Vitamin B₁₂, a natural chemical containing cyanide, is beneficial to your body because it prevents anemia. The cyanide binds in vitamin B₁₂ so that it does not serve as a source of cyanide exposure and cannot harm you.”**
- Since cyanocobalamin is NON-toxic, cyanide toxicity is treated by injecting hydroxocobalamin, so that cyanide can bind with the cobalamin to form non-toxic cyanocobalamin in the cell and then to be excreted via urine safely.^{5,6}

1. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3793392/pdf/ISRN_TOXICOLOGY2013-610648.pdf
2. http://www.answers.com/Q/How_many_almonds_are_in_1_gram
3. <http://nordicfoodlab.org/blog/2013/8/hydrogen-cyanide>
4. <http://www.atsdr.cdc.gov/phs/phs.asp?id=70&tid=19>
5. <http://epmonthly.com/article/hydroxocobalamin-turning-cyanide-into-vitamin-b12/>
6. https://www.health.ny.gov/environmental/emergency/chemical_terrorism/cyanide_tech.htm

Cyanide Concentrations in Foods

Common foods contain much higher amount of cyanide than the supplement containing cyanocobalamin which includes 2% of cyanide.^{1,2}

TABLE 1: HCN levels in apricot kernels, sweet, and bitter almond.

		Cyanide content (mg/kg)	Average levels (mg/kg)	Standard error (mg/kg)
Sweet almond	Variety1	27	25.20	8.24
	Variety2	32.40		
	Variety3	16.20		
Bitter almond	Sfax ₁	1053	1062	148.70
	Sfax ₂	1215		
	North	918		
Apricot kernels	Tastour	540	851.04	303.28
	Sfax	583.20		
	Sbiba	804.60		
	Monastir	1134		
	Morneg	1193.40		

Type of product	Cyanide concentration (in mg/kg or mg/L)
Cereal grains and their products	0.001-0.45
Soy protein products	0.07-0.3
Soybean hulls	1.24
Apple seeds	500-700
Apricot pits, wet weight	89-2170
Home-made cherry juice from pitted fruits	5.1
Home-made cherry juice containing 100% crushed pits	23
Commercial fruit juices	
Cherry	4.6
Apricot	2.2
Prune	1.9
Tropical foodstuffs	
Cassava (bitter) - dried root cortex	2360
Cassava (bitter) - whole tubers	380
Cassava (sweet) - whole tubers	445
Sorghum - whole immature plant	2400
Bamboo - immature shoot tip	7700
Lima beans from Java (coloured)	3000
Lima beans from Puerto Rico (black)	2900
Lima beans from Burma (white)	2000

EXPLANATIONS:

- The molecular mass of cyanocobalamin is 1355.38 g/mol whereas that of cyanide is 26.02. Therefore, the percent of cyanide in cyanocobalamin is about **2%** ($26 / 1355 = 0.02$; $0.02 \times 100 = 2\%$).
- Shaklee B complex contains 1.6 mcg of cyanide from 81 mcg of cyanocobalamin.
- The average cyanide content in sweet almonds is 25.20 mg/kg as shown in the Table 1.
- It means there is 25 mcg of cyanide in 1 g of sweet almond (one piece of almond).
- **So, there is 15.6 times higher cyanide in one almond than cyanocobalamin from Shaklee B complex (25/1.6=15.6).**

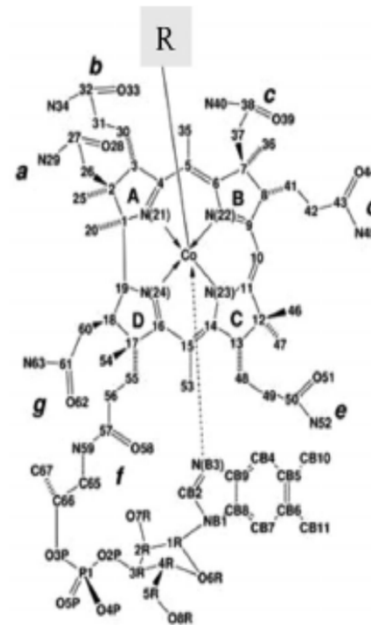
(NOTE: The weight of one almond is about 1 gram and bitter almonds contain a lot higher cyanide.)



Several Forms of Cobalamin

- There are several cobalamin forms of vitamin B12 according to the ligand:

- ✓ **Cyanocobalamin (cyanide group)**
- ✓ Adenosylcobalamin (5'-deoxyadenosyl group)
- ✓ Hydrocobalamin (=aquacobalamin: H₂O)
- ✓ Hydroxocobalamin (=hydroxycobalamin: OH)
- ✓ **Methylcobalamin (methyl group)**



R	Cobalamin form
H ₂ O/ HO	Hydroxycobalamin HOcbl
CH ₃	Methylcobalamin MeCbl
5'-deoxyadenosyl	Adenosylcobalamin AdoCbl
CN	Cyanocobalamin CNCbl

Methylcobalamin that is used in dietary supplements can be **produced by bacteria.**



**5'-deoxyadenosylcobalamin and
methylcobalamin as sources for vitamin B₁₂**

Methylcobalamin

The petitioner indicates that methylcobalamin may be manufactured semi-synthetically following extraction of vitamin B₁₂ from animal material. The petitioner states that alternatively, it may be produced from Genetically Modified Micro-organisms (GMMs).

What is the starting material for chemically synthesized methylcobalamin?

- [Cyanocobalamin or hydroxocobalamin](#)

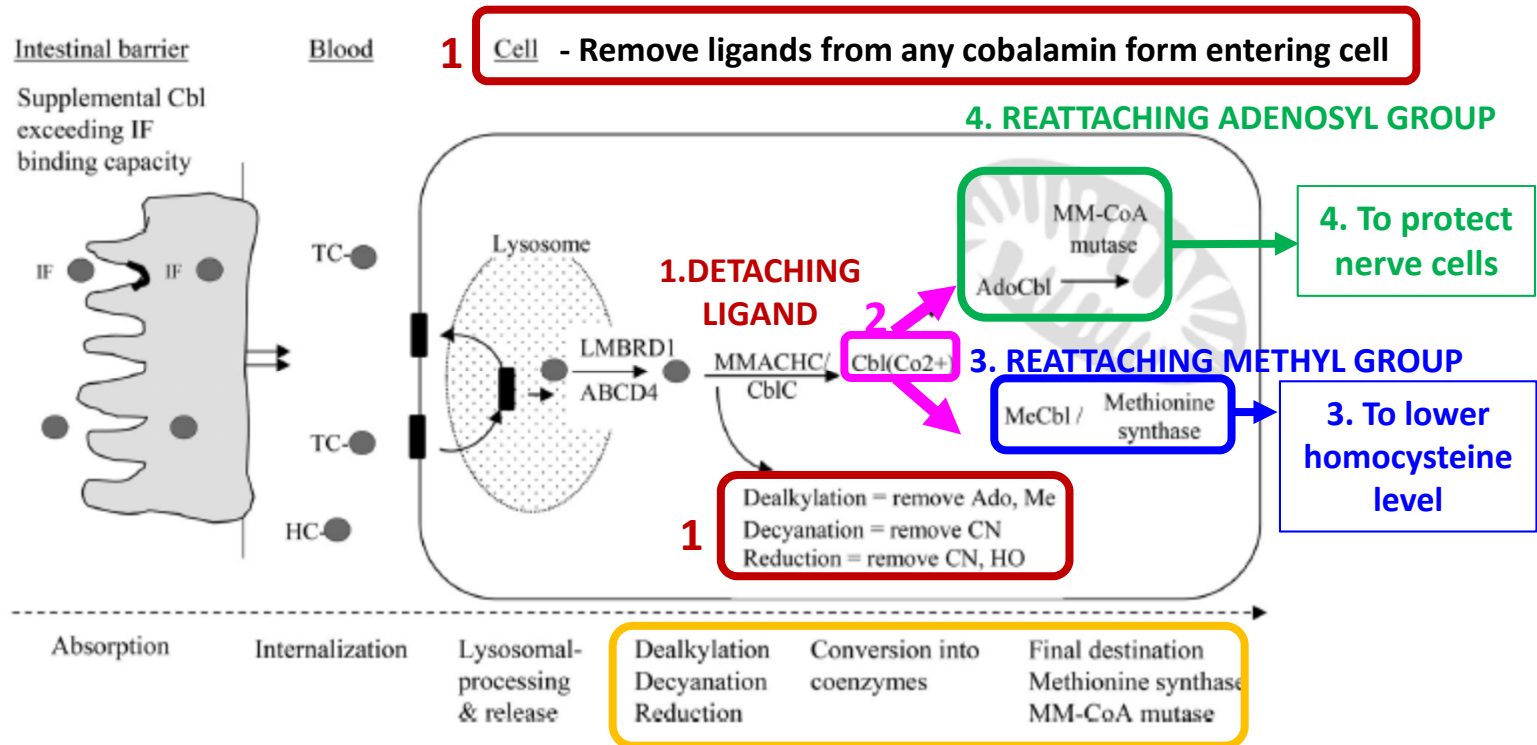
Process for production of methylcobalamin

US 6657057 B2

ABSTRACT

The present invention provides an industrially excellent and novel process for producing methylcobalamin useful as medicines. Namely, it provides a process for producing methylcobalamin, which comprises the step of methylating cyanocobalamin or hydroxocobalamin in the presence of a reducing agent and a water-soluble methylating agent.

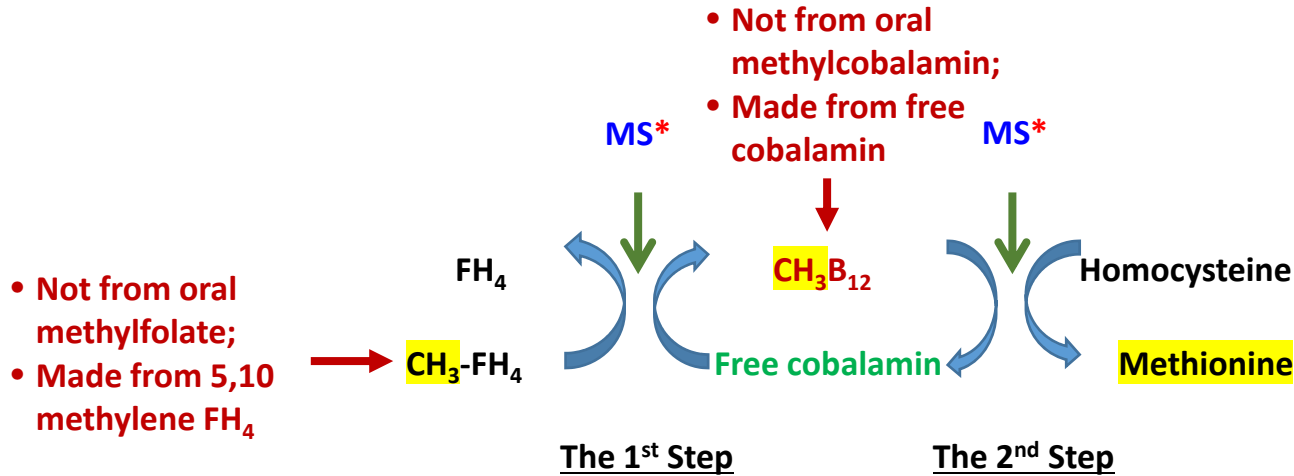
Cobalamin Processing in the Cell:



1. Ligand removal (all ligand to be removed via dealkylation, decyanation, or reduction)
2. Form a free form of cobalamin (Cbl)
3. Reattaching methyl group to be make "methylcobalamin," a cofactor for methionine synthase
4. Reattaching adenosyl group to make "adenosylcobalamin," a cofactor fro Methylmalonyl CoA Mutase

Methylcobalamin

Re-methylation (the 1st step) and De-methylation (the 2nd step) of Cobalamin



The 1st Step: transferring methyl (-CH₃) group from CH₃-FH₄ to free cobalamin to re-synthesize CH₃B₁₂ (methylcobalamin)

The 2nd Step: transferring methyl (-CH₃) group from methylcobalamin (CH₃B₁₂) to Homocysteine to synthesize Methionine, re-generating free-B₁₂

- FH₄: Tetra-hydro-folate
- CH₃-FH₄: Tetra-hydro-methyl-folate (THMF)

- CH₃B₁₂: Methylcobalamin
- Co(I, or II)B₁₂: Free-cobalamin

*MS: Methionine Synthase = homocysteine: methionine methyltransferase

Truth about Methylcobalamin

- Oral methylcobalamin does **NOT** reach the destination as the ready-to-work form because the **cofactor form of methylcobalamin has to be resynthesized (REMETHYLATED) in the cell** from the free cobalamin.
- “Supplementing methylcobalamin (or adenosylcobalamin) is unlikely to be advantageous when compared to cyanocobalamin” **because:**
 - ✓ methylcobalamin (or adenosylcobalamin) follows the same route of intracellular processing as cyanocobalamin **and**
 - ✓ methylcobalamin can be derived from cyanocobalamin

CONCLUSION on Vitamin B12

1. Cyanocobalamin is Safe and the most studied form of B12 (24,475 articles in PubMed).
2. Methylcobalamin is likely produced by bacteria or derived from cyanocobalamin.
3. NO difference between cyanocobalamin and methylcobalamin to function in the body:
 - Supplemental methylcobalamin is NOT the ready-to-use coenzyme form
 - People with methylation defect can utilize cyanocobalamin since cyanocobalamin can be efficiently converted to methyl- or adenosyl-cobalamin.
4. Would it help to take methylcobalamin over cyanocobalamin when told you have a “methylation defect”? → NO
5. There are a lot more cyanide from natural food sources than the cyanide from cyanocobalamin in Shaklee supplements per serving.
6. To detoxify cyanide poisoning, hydroxocobalamin is injected (i.v.) to form cyanocobalamin in the body because:
 - making cyanocobalamin is a way to remove cyanide from the body safely
 - cyanocobalamin is non-toxic and excreted via urine safely



Shaklee Vitamins containing cyanocobalamin are SAFE!

Reference for Vitamin B12

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