Role and Importance of Vitamin $B_{12}$

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Associate Health Ministries Director
General Conference of Seventh-day Adventists
Essential Functions

- Red blood cell formation.
- Neurological function.
- DNA synthesis
- Methyl donor for over 100 hormones, proteins, and lipids.
- Essential in fat and protein metabolism.
A Vital Nutrient

- Made in the colon - but not absorbed
- Calendar studied total vegetarian
  - volunteers in England who had a B$_{12}$ deficiency - megaloblastic anemia, she collected 24 hour stools, made water extracts and fed the extracts back to the volunteers, curing their anemia.
- Demonstrated the patients were producing B$_{12}$ in the large intestines.

BR. J. Hematology, 1962: 8: 230-41
"This vitamin is not found in plant foods in any significant amounts as are other vitamins."  
AJCN. 1988, Vol. 48, P. 852

There is no active source of $B_{12}$ in anything that grows out of the ground.

$B_{12}$ is not produced genetically by plants.

Any plant that may contain $B_{12}$ is the result of bacterial contamination.
“Plant foods do not contain vitamin B\textsubscript{12} except when they are contaminated by microorganisms or have vitamin B\textsubscript{12} added to them.”

Reed Mangels, PhD, RD from Simply Vegan 5th ed.,
Small amounts of $\text{B}_{12}$ may be found in plant food.

Eighty percent of the small amount of $\text{B}_{12}$ found in plant food items is an inactive analog.

Most of the active forms found in plants is also of fecal origin.
Cyanocobalamin is the only biologically active form of $\text{B}_{12}$ for humans.

Humans produce substantial amounts of $\text{B}_{12}$ in the large intestines - but it is not bio-available.

Studies show when human stool is collected every 24 hours for 6 days, the average $\text{B}_{12}$ found was - 5 mcg of Cobolamin and 95 mcg of analogs, in each 24 hour period.

Reabsorption

- It may take between three and twenty years to develop a serious deficiency noticeable to the individuals although proper blood tests will reveal a serum deficiency in less than two years.

AJCN 1980 VR 48 P. 855, 856.
Good Sources

- Meat, fish or poultry may not be the best sources since the $B_{12}$ is bound to protein and may be less available.
- Milk and eggs
- Supplements containing 6 mcg of cobolamin or if over 50, 25 mcg is recommended.
Serum depletion
- Low serum holotrans - coblamine II

Recovery
- Immediately with supplementation
Signs of Deficiency
Stage II

- Cell depletion
  - Low serum red blood cell concentrations
- Recovery
  - In a few days with supplementation
Signs of Deficiency
Stage III

- Biochemical deficiency
  - Slowed DNA synthesis
  - Elevated serum homocysteine
  - Elevated methyl malonate concentrations

- Recovery
  - Within days with B12 supplementation
Signs of Deficiency
Stage IV

- Clinical deficiency anemia
  - Numbness and tingling in the hands, feet and legs.
  - Inability to maintain balance when walking.
  - Excessive fatigue.
  - Irregular menstrual cycle.

- Recovery:
  - weeks: with B12 injections and supplementation.
Signs of Deficiency

Stage IV

- Psychiatric disorders:
  - disorientation
  - depression
  - memory loss
  - dementia
  - paralysis
- Recovery: weeks to months and maybe never, often irreversible
- Death
Three Ways to Become Deficient

1. Inadequate intake via food or supplementation.

2. Defective absorption and utilization
   - Lack of intrinsic factor due to aging
   - Gastritis - gasterectomy, ileal resection
   - Too little hydrochloric acid in the stomach to break the cyano bonds.
   - Some older individuals may need to take synthetic B12 because it is absorbed better.
Three Ways to Become Deficient

3. Increased requirement due to:

- Pregnancy
- Hyperthyroidism
- Increased excretion (alcohol use)
- Increased destruction (mega dose of Vitamin C)
- Aging

AJCN 1994, 59 Supl. P. 12135-12225 *
Risky Practices

- Intake less than 2 mcg daily of active B₁₂.
- Mega doses of vitamin C.
- Continuing intake of inactive form of B₁₂.
- Prolonged iron deficiency.
- Undiagnosed faulty absorption especially in old age.
- Philosophical or religious beliefs.
Excellent Sources for the Lacto-Ovo Vegetarian

<table>
<thead>
<tr>
<th>Food</th>
<th>Quantity</th>
<th>B12 Mcg’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk (8 ounces)</td>
<td>1 cup</td>
<td>.91</td>
</tr>
<tr>
<td>Egg Yolk</td>
<td>1</td>
<td>1.17</td>
</tr>
<tr>
<td>Morning Star Farms Egg Beaters</td>
<td>¼ cup</td>
<td>2.39</td>
</tr>
<tr>
<td>Brewers Yeast (fortified)</td>
<td>2 T</td>
<td>8 mcg</td>
</tr>
<tr>
<td>Cyanocobamin Tablets</td>
<td></td>
<td>25-500 mcg</td>
</tr>
</tbody>
</table>

Recommendations: 2.6 mcg daily
## Fair Sources

<table>
<thead>
<tr>
<th>Food</th>
<th>Quantity</th>
<th>B12 Mcg’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaporate Milk</td>
<td>1 Cup</td>
<td>.64</td>
</tr>
<tr>
<td>Boiled Milk (canned)</td>
<td>1 Cup</td>
<td>.454</td>
</tr>
<tr>
<td>Buttermilk</td>
<td>1 Cup</td>
<td>.540</td>
</tr>
<tr>
<td>Cream</td>
<td>1 Cup</td>
<td>.408</td>
</tr>
<tr>
<td>Butter</td>
<td>1 Tbsp.</td>
<td>.018</td>
</tr>
</tbody>
</table>

Am. J.C.N. 1994, Col. 59 #4 (s) p. 11945; and 1988 #48, p. 858
### Poor Sources

<table>
<thead>
<tr>
<th>Food</th>
<th>Quantity</th>
<th>B12 Mcg’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Eggs</td>
<td>1</td>
<td>.10</td>
</tr>
</tbody>
</table>

Am. J.C.N. 1994, Col. 59 #4 (s) p. 11945; and 1988 #48, p. 858
### Unreliable Sources

<table>
<thead>
<tr>
<th>soy-sauces</th>
<th>Miso’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>shoya</td>
<td>Barley</td>
</tr>
<tr>
<td>Tamari</td>
<td>Rice</td>
</tr>
<tr>
<td>Tempeh</td>
<td>Sauerkraut</td>
</tr>
<tr>
<td>Ame Sake rice</td>
<td>Algae-spirulina, nori</td>
</tr>
<tr>
<td>Sitake mushrooms</td>
<td>Am Boshi prunes</td>
</tr>
</tbody>
</table>
Fortified Foods

- Fortified commercial soymilk
- Fortified Breakfast cereals
- Fortified Red Star Nutritional Support yeast (1T)
- Fortified breakfast cereals
Nori High?

- Is Nori high in Vitamin $B_{12}$?
- If so this is a phenomena of nature or else the culture of seaweed supports the production of $B_{12}$ in plants. This would suggest a complex of plant and animal mix.
Reliable Sources for the Total Vegetarian

- Cyanocobolamin supplements - tablets chewable or sublingual is best.
- Supplemented soy milk (3-4 cups) containing 25% or more of the RDI
- Fortified breakfast cereals.
- Fortified meat analogs.
- Tablets: recommended to take concentrations of no more than 25 mcgs per day
Not all Soy Milks are the Same

- Many products do not contain Vitamin B12. Therefore read the labels.
- Beware of those that do not contain B12 and Calcium at recommended levels.
Examples of Groups Which Seem to Not Get a Deficiency

- Iran: Halsted found they grew their vegetables in night soil (human manure) and did not wash their vegetables or their hands carefully. N. Eng. J. med 1959; 260; 575-80.

- Some groups who also live in rural areas who do not wash their vegetables carefully or who drink water contaminated with fecal matter.
### Example of Deficiency

Weimar Institute, California

<table>
<thead>
<tr>
<th>Tests</th>
<th>Normal</th>
<th>Weimar Normal</th>
<th>Weimar Abnormal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N-19 (68%)</td>
<td>N-9 (32%)</td>
</tr>
<tr>
<td>Years as Total</td>
<td>5.3</td>
<td>8.4</td>
<td></td>
</tr>
<tr>
<td>B-12 Intake vegetarian</td>
<td>2 mcg</td>
<td>Range 1.06-1.42 Mean 1.24</td>
<td>Range .10-.36 Mean 0.23</td>
</tr>
</tbody>
</table>
## Example of Deficiency

Weimar Institute, California

<table>
<thead>
<tr>
<th>SMMA</th>
<th>&lt;150</th>
<th>Range 142-168 Mean 155</th>
<th>Range 462-2689 Mean 1575</th>
</tr>
</thead>
<tbody>
<tr>
<td>STH</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Serum B₁₂ (Pg./ml)</td>
<td>200-900</td>
<td>Range 338-406 Mean 372</td>
<td>Range 243-169 Mean 206</td>
</tr>
</tbody>
</table>

SMMA - Serum Methyl Malonic Acid  
STH - Serum Total Homocysteine  
T.V. - Total Vegetarian  

3 day dietary intake and 24 hour recall success - meat analogs, breakfast cereals, soymilk, B12 supplements

J. Of Nutrition and Medicine 1994; 4:419-430
Testing

- All older individuals past 50, vegetarians or omnivores should have their $B_{12}$ levels tested no less than every five years.

- All individuals, regardless of age who do not use any animal products, should be tested yearly or more often if $B_{12}$ levels are below normal.
Summary

- We all need an exogenous source of B\textsubscript{12}.
- 10-30 percent of individuals over 50 yrs. have compromised Intrinsic factor which is essential for metabolizing B\textsubscript{12}.
- People at risk of Vitamin B\textsubscript{12} deficiency:
  - Total vegetarians
  - Adults over 50
- Supplementation:
  - Dietary
  - Oral or injections
- Read your labels!

U.S. Institute of Medicine  Dietary Reference Intakes, (DRI) 2006 p. 249