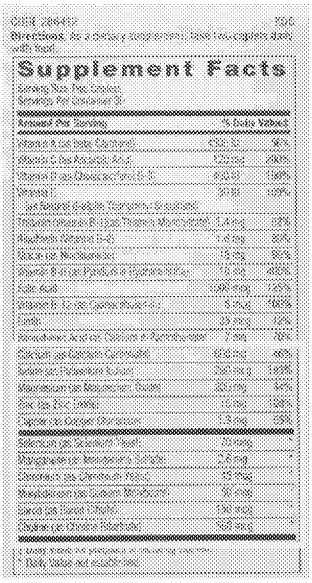
Prenatal Vitamin Ingredients

- Most contain copper, iron, zinc; some also contain chromium, manganese, molybdenum, selenium
- FDA Daily Values
  - Cu = 2 mg
  - Mn = 2 mg
  - Mo = 75 ug
  - Zn = 15 mg
- Detection of these beneficial minerals in meconium is expected

Supplement Facts

Serving size 3 Tablets
Servings per container 64

Amount per serving		%DV for adults	%DV for pregnant women
Vitamin A (80% as beta-carotene from ferment media)	1300 mcg	144%	108%
Vitamin C (as ascorbic acid from ferment media)	75 mg	83%	63%
Vitamin D3 (as cholecalciferol from ferment media)	25 mcg (1000 IU)	125%	167%
Vitamin E (as d-alpha-tocopheryl acetate from ferment media)	20.9 mg	139%	116%
Vitamin K (as phytonadione [K1] from ferment media and as menaquinone-7 [K2] from natto)	80 mcg	79%	98%
Vitamin (as thiamine hydrochloride from ferment media)	1.4 mg	117%	106%
Riboflavin (from ferment media)	1.6 mg	125%	106%
Niacin (as nicotinamide from ferment media)	18 mg	113%	106%
Vitamin B6 (as pyridoxine hydrochloride from ferment media)	5 mg	294%	258%
Folate (as methylfolate, and as 125 mcg folic acid from ferment media)	680 mcg DFE	150%	106%
Vitamin B12 (as cyanocobalamin from ferment media)	3 mcg	125%	107%
Biotin (from ferment media)	35 mcg	117%	106%
Pantothenic Acid	7 mg	140%	106%
Calcium (from algae [*Lithothamnion* [*Lithothamnion calcareum* and *Lithothamnion coralliodes*]])	75 mg	6%	6%
Iron (as ferrous fumarate from ferment media)	27 mg	150%	106%
Iodine (as potassium iodide from ferment media)	150 mcg	100%	52%
Magnesium (as magnesium oxide from ferment media and algae [*Lithothamnion* [*Lithothamnion calcareum* and *Lithothamnion coralliodes*]])	15 mg	4%	4%
Zinc (as zinc oxide from ferment media)	8.5 mg	59%	58%
Selenium (as selenium dioxide from ferment media)	70 mcg	127%	103%
Copper (as copper sulfate anhydrous from ferment media)	0.65 mg	72%	58%
Manganese (as manganese chloride from ferment media)	2.8 mg	113%	106%
Chromium (as chromium chloride from ferment media)	45 mcg	129%	106%
Molybdenum (as sodium molybdate from ferment media)	20 mcg	44%	40%



Expectations for Meconium Mineral Content

- **Canada Maternal-Infant Research on Environmental Chemicals (MIREC) Study (n= 1,591 meconium samples) – Arbuckle et al. (2016)/Ettinger et al. (2017)**
- Aziz et al. (2017), Pakistan study (n = 302)
- Baranowski & Baranowska (1996), Poland study control group (n = 26)
- Haram & Mourabet (1998), New York University Hospital study (n = 32)
- Turker et al. (2013) (n=23)

	Meconium Conc. (ug/g)						
	MIREC (Arbuckle/Ettinger)			Baranowski	Haram	Aziz	Turker
Metal	Median	95th %tile	Maximum	Control Mean	Mean Range by Gestational Age	Mean Range by Location	TBD
Arsenic	NC	0.02	0.55	---	---	---	---
Copper	---	---	---	15.2	90.3 - 113.2	1.6 - 28.7	
Manganese	4.9	15	40	---	9.5 - 35.8	---	---
Molybdenum	---	---	---	---	---	---	---
Lead	NC	0.0085	0.48	0.0047	---	1.2 - 14.4	
Zinc	---	---	---	68	156.4 - 365.4	9.5 - 160.3	

NC = not calculated due to infrequent detection

Lines of Evidence to Support Units Error

- McDermott Table 1 Median Concentrations
  - In most literature studies, meconium concentrations are reported as **ug/g (ppm)** and not ug/kg (ppb)
  - Manganese example *[Median; Min – Max]*
    - Butte = 5.364; 0.388 – 18.120 ug/g
    - Columbia = 0.00325; 0.0002 – 0.01283 ug/g
    - MIREC = 4.9; 0.24 - 40 ug/g
  - Comparison to MIREC study shows…
    - Butte concentrations are within the range of expected MIREC concentrations
    - Columbia concentrations are more than 1,000x lower than expected MIREC concentrations
  - Arsenic and lead concentrations show a similar pattern as manganese

➢ Suggests that the reported units of ug/kg for the Butte dataset are correct in Table 1, but the Columbia dataset is actually ug/g

Lines of Evidence to Support Units Error (cont.)

- McDermott Table 1 Mean Concentrations
  - Copper example
    - Butte = 28.134 ug/g
    - Columbia = 0.01475 ug/g
    - Baranowski Control = 15.2 ug/g
  - Comparison to Baranowski study shows…
    - Butte concentrations are similar to control group concentrations
    - Columbia concentrations are more than 1,000x lower than the control group concentrations
  - Zinc concentrations show a similar pattern as copper

➢ Supports the conclusion the units of ug/kg for the Butte dataset are correct in Table 1, but the Columbia dataset is actually ug/g

Lines of Evidence to Support Units Error (cont.)

- McDermott Table 1 ICP-MS Limits of Detection (LODs)
  - Arsenic example
    - MT Laboratory LOD = 5 ug/kg
    - SC Laboratory LOD = 1.4 ug/kg
    - EPA CLP CRQL = 500 ug/kg
    - MIREC LOD = 200 ug/kg
  - Comparison shows the study laboratories were able to achieve LODs 100x to 300x lower than what EPA requires of the CLP laboratories
  - Canada MIREC study shows the LOD were similar to EPA CLP

➢ Suggests that the reported LOD units of ug/kg for the MT and SC laboratories may actually be ug/g

Lines of Evidence to Support Units Error (cont.)

- McDermott study does not specify if data validation was performed
- McDermott study indicates no inter-laboratory analyses were performed

If Table 1 is corrected to present consistent units for Butte and Columbia (as ug/g)…

Metal	Butte*	Columbia**	Ratio MT:SC
Arsenic	0.032	<LOD	---
Copper	26.311	14.68	1.79
Manganese	5.364	3.25	1.65
Molybdenum	0.059	<LOD	----
Lead	NA (0.005+)	<LOD	----
Zinc	81.642	43.34	1.88

*Table 1 concentrations were converted from ug/kg to ug/g

**If concentrations as reported in Table 1 were assumed to be ug/g (not ug/kg)

+Median not available as only 1 sample was detect; detected concentration is reported.

Observations –

- **Butte levels are within a factor of 2 compared to Columbia**
- **Butte arsenic is similar to MIREC 95th percentile of 0.02 ug/g**
- **Butte manganese is similar to MIREC median of 4.9 ug/g**
- **Only one detect for Butte lead**
- **Butte lead is less than MIREC 95th percentile of 0.0085 ug/g and similar to Baranowski control of 0.0047 ug/g**

What else can influence mineral concentrations in newborns?

- Based on meconium metal concentrations
  - Gestational age (24-28 weeks vs. 38-42 weeks)
    - Cu: 1.3x decrease
    - Mn: 3.8x increase
    - Zn: 2.3x increase
  - Birth Weight (<1,500 g vs. >2,500 g)
- Based on blood metal concentrations
  - Maternal age
  - Infant gender
  - Maternal smoking status
  - Season of sample collection
  - Maternal pre-pregnancy BMI
  - Maternal education level