

# Introduction to Food Science and Engineering

## Food Constituent: Vitamins and Minerals

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# Vitamins and Its Classification

## Vitamins:

- **Vitamins** are organic compounds that are needed by human body for its normal growth and development. Vitamins are considered to be the essential for human body.
- **Vitamins** are required in small quantities for a variety of biochemical function which generally can not be synthesized by the body and must therefore be supplied by the diet.
- There are 13 **vitamins**: 4 fat-soluble (A, D, E, & K) and 9 water-soluble (8 B **vitamins** & 1 C **vitamin**). Each has specific jobs or functions of the body.

**Classification:** Vitamins are of **two types**.

1. **Fat soluble** and
2. **Water soluble**

### 1. **Fat Soluble vitamins are:**

- i. Vitamin A (Retinol,  $\beta$ -carotines)
- ii. Vitamin D (Calciferol)
- iii. Vitamin E (Tocopherols)
- iv. Vitamin K (Phylloquinone ( $K_1$ ), Menaquinone ( $K_2$ ), Menadione ( $K_3$ ))

# Vitamins and Its Classification

**2. Water soluble vitamins are:** Can be categorized into 2 categories

i. **B Complex:**

- Vitamin B<sub>1</sub> Thiamin,
- Vitamin B<sub>2</sub> Riboflavin,
- Vitamin B<sub>3</sub> Niacin,
- Vitamin B<sub>5</sub> Pantothenic acid,
- Vitamin B<sub>6</sub> Pyridoxine, pyridoxamine, pyridoxal are the active coenzyme forms of vitamin B<sub>6</sub> (takes part in protein metabolism)
- Vitamin B<sub>7</sub> Biotin,
- Vitamin B<sub>9</sub> Folates (folic acid),
- Vitamin B<sub>12</sub> Cyanocobalamin, hydroxocobalamin, methylcobalamin,

ii. **Non-B Complex:**

- Vitamin C Ascorbic acid,

**Endogenously synthesized vitamins:**

1. Vitamin D,
2. Vitamin K (by bacterial action in the colon),
3. Vitamin B<sub>12</sub> (Cyanocobalamin is a synthetic form of vitamin B12, C<sub>63</sub>H<sub>88</sub>CoN<sub>14</sub>O<sub>14</sub>P)

# Sources of Vitamins

Vitamin	Animal Sources	Plant Sources	Other sources
A	Retinol: Liver, kidney, egg yolk, cod liver oil., cream butter, milk cheese	B-carotene: Dark & green leafy vegetables, yellow & red fruits (carrots, mangoes, papaya	
D	Fish liver oil & cod liver oil, fatty fish, liver, egg yolk, butter, milk		Sunlight: From 7-dehydrocholesterol by UVirradiation
E	Egg yolk, butter	Vegetables oils, cotton seed, sunflower seed, whole grains cereals, nut,	
K	Milk & dairy products, Cheese, meat, egg yolk & liver	Alfalfa, cabbage, cauliflower, Spinach & other green vegetables	
C	Meat & milk (very small in amount)	Citrus fruits, amloki, lemon, tomato, guava, strawberry, black berry, green leafy vegetables, cabbage, cauliflower, green papers, lettuce	

# Sources of Vitamins

Vitamin	Animal Sources	Plant sources	Other sources
B <sub>1</sub>	Beef, milk, liver, egg, fish	Whole grains, legumes, dried yeast, unmilled cereals, pulses, oil seeds, nut, vegetables, fruits, rice, wheat	
B <sub>2</sub>	Milk, liver, egg, fish, kidney, meat	Green leafy vegetables, most root vegetables, fruits.	
B <sub>3</sub>	Liver, kidney, meat, poultry, fishes	Unrefined grain, cereal, groundnuts.	It can be synthesized from the amino acid tryptophan
B <sub>6</sub>	Egg yolk, liver	Wheat, corn	
B <sub>5</sub>	Meat	Broccoli, avocados	

# Sources of Vitamins

<b>Vitamin</b>	<b>Animal Sources</b>	<b>Plant sources</b>	<b>Other sources</b>
<b>B<sub>7</sub></b>	Raw egg yolk, liver	peanuts, leafy green vegetables	
<b>B<sub>9</sub></b>	liver	Leafy vegetables, pasta, bread, cereal,	
<b>B<sub>12</sub></b>	Milk, liver, egg, oysters, fresh shrimp, chicken		Most of the vitamin required by the humans are synthesized by intestinal bacteria.

# Recommended Dietary Allowance of Vitamins and Diseases Caused due to Their Acute Deficiency

Vitamin	RDA	Acute deficiency symptom
A (retinol)	900 µg	Night blindness, But excess intake causes decreased BMD (bone mineral density) and increases risk of bone fracture
D (Calciferol)	10 µg	Rickets
E (α-Tocopherol)	15 mg	Oxidation of fats and membrane lipids
K (Phylloquinone)	120 µg	Haemorrhage
C (Ascorbic acid)	90 mg	Scurvy, reduced defense against infections
B <sub>1</sub> (Thiamine)	1.5 mg	Beri-beri, neuritis (effect nerves and digestive system)
B <sub>2</sub> (Riboflavin)	1.4 mg	Mouth and tongue lesions
B <sub>3</sub> (Niacin)	16 mg	Pellagra, skin lesions
B <sub>5</sub> (Pantothenic acid)	5.0 mg	Disruption of metabolism
B <sub>6</sub> (Pyridoxal)	2 mg	Atrophy of organs, lack of growth
B <sub>7</sub> (Biotin)	30.0 µg	Acidosis, skin rashes, immune deficiency and neurological problems
B <sub>9</sub> Folic acid (Folates)	400 µg	Megaloblastic anaemia (Megaloblastic anemia is a condition in which the bone marrow produces unusually large, structurally abnormal, immature red blood cells (megaloblasts)).
B <sub>12</sub> (Cyanocobalamin)	2.4 µg	Pernicious anaemia (lack of red blood cells or hemoglobin)

# Biological Functions of Some Trace Elements (Minerals)

<b>Element</b>	<b>Content in human body</b>	<b>Daily requirement</b>	<b>Biological Function</b>
<b>Chromium</b>	6-12 mg	5-200 µg	Part of a glucose tolerance factor
<b>Manganese</b>	10-40 mg	2-18 mg	Cofactor for arginase, superoxide dismutase, glycosyl transferases, pyruvate carboxylase and amino acid peptidase
<b>Iron</b>	4-5 g	1-3 mg/kg	Oxygen transport, enzyme catalyzed red-ox reactions, activation of diatomic oxygen
<b>Cobalt</b>	1-2 mg		DNA synthesis
<b>Copper</b>	100-150 mg	1-1.5 mg	Required for synthesis of haemoglobin, cofactor of cytochrome oxidase, superoxide dismutase, lysyl oxidase, amino oxidase, galactose oxidase, ascorbic acid oxidase and plastocyanin
<b>Zinc</b>	2-4 g	6-20 mg	Cofactor for carbonic anhydrase, carboxypeptidase, several dehydrogenases, superoxide dismutase, RNA and DNA polymerases, alkaline phosphatases and phospholipases.



## Biological Functions of Some Trace Elements, (Minerals)

<b>Element</b>	<b>Content in human body</b>	<b>Daily requirement</b>	<b>Biological Function</b>
<b>Selenium</b>	10-15 mg	0.05-0.1 mg	Cofactor for glutathione peroxidase
<b>molybdenum</b>	8-10 mg	0.3 mg	Cofactor for xanthine oxidase, nitrogenase and sulphite oxidase
<b>Iodine</b>	10 mg	100-200 µg	Part of thyroxine
<b>Fluorine</b>	2-6 g	0.5-1.5 ppm	Increase stability of bones and teeth by substituting for hydroxyl groups on hydroxyapatite
<b>Boron and vanadium</b>	17-45 mg	1-2 mg	Required for growth of plants and rats
<b>Nickel</b>			Activator of a number of enzymes, e.g. alkaline phosphatase, oxaloacetate decarboxylase
<b>Silicon</b>	1 g		Promotes growth
<b>Tin</b>			Promotes growth in rats
<b>Aluminium</b>	50-150 mg	No need	Can affect skeletal mineralization (bad)

# Thanks