

# NATURAL TOXIC COMPOUNDS IN FOODS

- Natural toxins are toxic compounds that are naturally produced by living organisms. These toxins are not harmful to the organisms themselves but they may be toxic to other creatures, including humans, when eaten. These chemical compounds have diverse structures and differ in biological function and toxicity.
- Some toxins are produced by plants as a natural defense mechanism against predators, insects or microorganisms, or as consequence of infestation with microorganisms, such as mould, in response to climate stress (such as drought or extreme humidity).

- **Toxic proteins, Peptids, Amids, Amino Acids:**

The toxic compounds that are common in foods are in these groups

Enzymes that breaking down vitamins

Hemagglutinins

Enzyme inhibitors

Hepatotoxic compounds

Enzyme inhibitors are very common. They affect pancreatic enzymes (tyrpsin, cyhmotyrsin).

Tyrpsin inhibitors exist in soybean and other beans. Besides, they are also found in some legumes, egg White and potatoe.

- In general, using enzyme substrates, they form some complexes that are resistant to protein breakdown. Hence, pancreas works to produce more enzyme and is getting bigger.
- Finally, it was observed the losses of amino acids containing sulphur, and blocking the digestion of amine compounds from intestine.
- These inhibitors are not resistant to heat.
- More than 30 inhibitors have been detected in legumes.
- They accumulate in some parts of the plants. For example, they are more in wheat scab.

Some compounds in this group:

(1) Capsaicin: Responsible for bitterness of Capsicum pepper. Amide structure. It is still bitter or pungent even though diluted by  $1/10^6$ .

(2) Methionine: High doses are toxic on liver and neural system.

(3) Leucine: High doses inhibit NAD synthesis.

(4) MSG: Salt of glutamic acid (e.g. Na-glutamate). It may cause narcosis, vomiting, heart-throb and difficulties in controlling neural system for sensitive people.

### (5) Lectines:

**Lectins** are carbohydrate-binding proteins that are highly specific for sugar groups that are part of other molecules. Most of them are glycoproteins. So, they cause agglutination of particular cells or precipitation of glycoconjugates and polysaccharides. They can be found mostly in legumes (ground nut, soybean, broad bean, lentil and green pea), besides potatoe, banana and wheat germ. Some lectins may be powerful toxins such as ricin and the plants containing them need to be cooked or fermented to reduce lectin content.

They can precipitate red blood cells, therefore they are called as hemagglutinin.

They can be inactivated by with humid heat, however, dry heat is ineffective. Lectine activity losses in the first day of germination by 92%.

MW: 20-110 KDa.

(6) Glucosinolates: Most of them are guatrogen. They cause «goitre» by preventing iodine digesstion in intestine, iodine intake of tyroid gland and tyroxine syntehsis of thyroid.

They are common in some plants of Cruciferae family (cabbage, onion, peppergras, broccoli, cauliflower, radish, turnip. And also, in mustard and rapeseed.

More than 50 glucosinolates have been identified. The main ones: glucobrassicin, gluconapin, progoitrin, sinalbin, sinigrin

Glucosinolates have been removed from rapeseed by breeding and the new crop was named as *Canola* (*The canola varieties are also free from erusic acid, a fatty acid, which was found in abundance in rapeseed*)

- **Oxalates, Phytalates and Other Binders:**

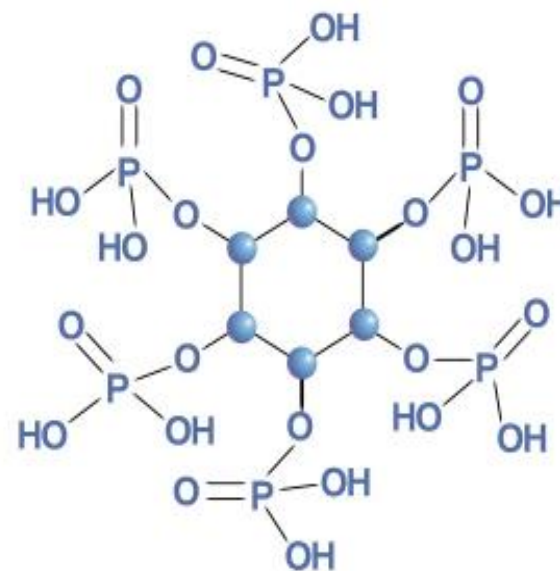
- Oxalic acid or oxalates are very tiny molecules that bind minerals like calcium and form crystals. It is found in a variety of seeds, nuts and many vegetables.
- Spinach has 1% of oxalate. Besides, beet leaf, tea, coffee and mushroom also have it.
- **(1) Oxalate:** Oxalates not only can cause kidney stones (calcium oxalate, not dissolve in water) but also may be responsible for a wide variety of other health problems related to inflammation, auto-immunity, mitochondrial dysfunction, mineral balance, connective tissue integrity, urinary tract issues and poor gut function. When «oxalate/Ca» ratio is more than 1, the Ca is not useful for human body eventhough the food is rich in Ca.

| Food     | Oxalate content. (mg/100g) | Oxalate/Ca |
|----------|----------------------------|------------|
| Purslane | 1294                       | 4,6        |
| Tea      | 1150                       | 1,1        |
| Spinach  | 970                        | 4,3        |
| Cacao    | 700                        | 2,6        |
| Coffee   | 100                        | 3,9        |
| Potato   | 80                         | 1,6        |

(2) **Phytic acid (and salts)**: It contains 6 phosphate in the structure. It is also present in many legumes, cereals, and grains. Phytic acid and phytate have a strong binding affinity to the dietary minerals, calcium, iron, and zinc, inhibiting their absorption in the small intestine.

- Generally, phosphorus and inositol in phytate form are not bioavailable to non-ruminant animals because these animals lack the enzyme phytase required to hydrolyze the inositol-phosphate linkages.
- Table: Phytate content in some foods

| Food       | Phytate (mg/100 g) |
|------------|--------------------|
| Wheat      | 170-280            |
| Rice       | 157-240            |
| White bean | 269                |
| Lentil     | 295                |
| Hazelnut   | 104                |
| Almond     | 189                |
| Pistachio  | 176                |



**Phytic acid**

(3) **Dietary Fiber:** Dietary fiber is a term that is used for plant-based carbohydrates that, unlike other carbohydrates (such as sugars and starch), are not digested in the small intestine and so reaches the large intestine or colon. They can be divided into two according to solubility (fermentable in the colon) and insolubility in water.

- Fibers are pectic substances, hemicelluloses, plant gums, polysaccharides of algae, cellulose and lignin. bulking fiber that retains water as it moves through the digestive system, easing defecation.
- Tannins, non-digestive proteins, plant pigments, waxes and phytic acid can also be in this group.
- They are bulking fibers that retains water as it moves the digestive system, easing defecation. They can bind water up to their 4-6 folds of dry matter. It has been approved that they have protective effect on colon cancer.
- However, excessive consumption may be harmful. They contain so much reactive groups ( $\text{COOH}$ ,  $\text{H}_2\text{PO}_3$ ,  $\text{OH}$ ,  $\text{HSO}_3$ ,  $\text{NH}_2$ ), which can bind metals, amino acids, proteins and even sugars. Binding capacity depends on the pH and ionic structure of the colon.
- Although phytic acid is removed, dietary fiber can also damage the balance of the minerals (Ca, Mg, Zn ve P). Example: Nitrogen absorbtion reduces 8% when diet contains 15% of cellulose.
- Carrageenans reduces  $\text{N}_2$  intake up to 16%.

- **(4) Polyphenols:** Almost all fruits and vegetables contain polyphenols. When excessive consumption, they can combine with proteins and convert them into non-digestible forms. They can also combine with vitamin B12 and reduce its digestibility.
- **(5) Other Binders:**
  - Avidin present in white egg reduces bioavailability of B12,
  - lipoxygenase reduces bioavailability of Vitamin A
  - and polyphosphates reduce bioavailability of some minerals.