



# PHOSPHORUS FACTS

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## FOOD PHOSPHATES

*Phosphates are important components of fertilizers, but they have many other applications. One of them is food processing.*

*This fact sheet explores food phosphates:*

- *what they do*
- *how much is used annually*
- *why they're important*

### *What are Food Phosphates?*

The term food phosphates means, in technical terms, **salts of phosphoric acid**. The most important types are **sodium**, **potassium** and **calcium phosphates**. They are all made from pure phosphoric acid, which is also used in some foodstuffs itself.

Looking at their chemical structure, some salts contain single phosphate units ( $\text{PO}_4^{3-}$ , orthophosphate), while others are made from two or several linked phosphate units. We call these pyrophosphates (two units) and polyphosphates (the longer chains, from three up to hundreds of units).

All these phosphates are white powders. Most are water soluble, but some calcium phosphates are not. The phosphate is the functional part of these compounds, therefore most potassium and sodium phosphates have generally similar properties and applications.

These salts are made from pure phosphoric acid and a source of sodium, potassium or calcium, such as hydroxides or carbonates. Fertilizer grade phosphoric acid, largely available on the world market, contains too many impurities to be used in food. The acid for food applications therefore undergoes rigorous purification in dedicated facilities.

## The Importance of Phosphates in Food Processing

They are used in many types of food processing, typically dosed at less than 1%, and play a large variety of roles. The most important are:



- Polyphosphates are known to sequester ("capture") metal ions from solutions. These metal ions would form crusts and scales, or interfere in some other way with food product quality. An important example is **sodium hexametaphosphate**, which sequesters calcium ions in cheese spread production. It stops casein from forming small lumps, which gives a smooth texture to the cheese spread. Another example is **sodium acid pyrophosphate**, which sequesters iron ions in water used to treat potato cuttings. Iron causes the potato parts to turn blue-purple; the pyrophosphate prevents this by keeping the iron "caught" so the potatoes do not change colour.



- The water soluble phosphates cause water to be acidic, neutral or alkaline, depending on the phosphate. This pH value tends to remain constant even if other ingredients are added to it – the phosphate is a buffer. This is a useful property for treating food in water, because a pH value that is off can cause changes in taste and appearance. In the case of cola beverages, the parent compound of food phosphates, **phosphoric acid**, is added to about 0.04% weight to give the beverage a pleasant tartness, as a balance for its sweetness.



- Phosphates like **sodium acid pyrophosphate** can act as solid acids. This property is used in industrial bakeries, where leavening with natural yeast can take too long and be too unpredictable. A leavening powder is used instead, consisting of a source of carbon dioxide (a carbonate) and an acid. In the dry powder, the two do not react, but in moist dough, carbon dioxide is released in the dough, causing it to rise. By tweaking the acid phosphate composition, very precise leavening can be achieved



- During cooking, meat loses moisture. As an example, in ham, seafood and sausage processing, this loss of moisture needs to be prevented to preserve juiciness in the meat. **Polyphosphates**, added to the cooking liquid, keep the moisture inside the meat.

- Shrimp are easier to peel when cooked in a **polyphosphate containing solution**. The phosphate gives a slight degree of alkalinity to the solution which also aids in loosening the shrimps' shells.

- **Calcium** and **potassium phosphates** can be used instead of sodium phosphates as part of a low sodium food product, or as mineral supplement. Some potassium phosphates are much more soluble than their sodium analogs and are therefore used in applications requiring high solution strength. **Dicalcium phosphate** is used as an abrasive and pigment in toothpaste. **Calcium phosphates** are also widely used as livestock feed supplements.



Food phosphates often perform several roles, e.g. as pH buffering agent and sequesterant, and are generally hard to replace. They are also virtually tasteless, whereas many potential replacements have a distinct taste.

## Food Phosphates Yearly Usage

World use of food phosphates stands at around 1 million tons per year and tends to increase in regions with increased trends towards processed food, such as East Asia. This number includes the use of phosphoric acid in beverages.