

Technical Briefing Replacing phosphates in meat



starches



flours



fibres



proteins

Replacing phosphates in meat

Phosphates are extremely diverse, multifunctional ingredients which go into a wide range of different applications; from dairy and beverages to meat and bakery.

Why is Phosphate Used?

To help improve the texture of meat, various methods (namely injection, tumbling or soaking) are used to add moisture. Phosphates are used to make sure that the meat retains as much water as possible, and therefore produce the most succulent product.

When meat is slaughtered, lactic acid builds up in the muscle lowering the pH of the meat, bringing it towards the meat's isoelectric point (the pH at which a substance is electrically neutral), this is usually around pH 5.1.

When protein carries a charge, it is capable of binding water. This is achieved by either increasing or decreasing the pH away from the protein's isoelectric point; the addition of phosphates to a brine system is one way of achieving this.

Also, at the protein's isoelectric point, it is at its least soluble; therefore it doesn't hold water as well during processing and resulting in a lower yield and less succulent meat. By adding phosphates, the proteins can hold onto more water.

There are several ways in which brines can be adjusted to improve the water binding capacity, such as increasing the pH of the brine. You can see this being utilised with the addition of functional ingredients such as phosphates, salts and citrates for use in meat processing. While these ingredients do all have their unique and beneficial functionalities, some also carry e-numbers which are undesirable in the eyes of the consumer. Hence, why manufacturers are looking to clean and clear label ingredients to tidy up declarations and to mimic the functionality.

So, what are phosphates?

Phosphates function by improving the meat protein's functionality and the water binding capacity of the meat. They do not bind water themselves, they help the meat proteins hold on to water.

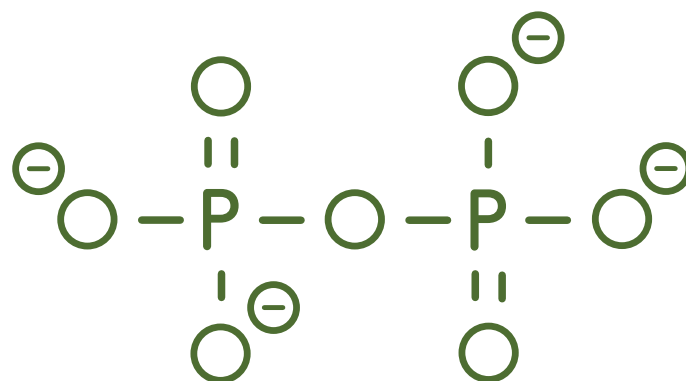


Diagram of diphosphate chemical structures

The phosphates which are significant in meat technology are diphosphate (also known as pyrophosphates) and triphosphates. The usage rate is 0.3% or lower, if they are used between 0.3 – 0.5% then they tend to give an unpleasant bitter, metallic taste to the product. However, this low percentage poses the problem of ensuring proper distribution throughout the product, and sometimes a higher addition rate is required to ensure uniformity.

The three main groups which phosphates will tend to fall into are: diphosphates (E450), triphosphates (E451) and polyphosphates (E452). Manufacturers are then able to get the most out of each type of phosphate as they will work synergistically with each other.

Phosphates have different functionalities and levels of solubility from their varying chain lengths; therefore a blend is often used for any given application. Using a blend ensures the optimum balance between solubility and the functionality required for the meat. In the example of comminuted meats, by including some di and tri phosphates in the blend, as well as the longer polyphosphate chain lengths, this allows for improved solubility while the enzymes in the meats breakdown the polyphosphates – achieving optimum performance.

Due to the chemical structure, triphosphates are more soluble compared to diphosphates, but triphosphates need to be broken down by an enzyme on the meat to diphosphates to improve their functionality. Phosphatase found in meat is responsible for the further hydrolysis of diphosphate for it to be effective.

Functionalities

There are a handful of key functionalities which phosphates give:

- Increased succulence
- Yield improvement
- Emulsification (e.g. in sausages and other comminuted meats)
- Colour stabilisation
- Preservative effects
- Binding chunks of meat together in formed meat products
- pH and protein modification

Because of their wide range of functionalities, it is very hard to find a sole product which is capable of replacing phosphates. Especially when wanting to give a clean label and consumer friendly declaration.

Preservative effects

Phosphates are very good chelating agents (this helps to bind water), as they prevent the proteins from forming cross-bridges which allows the proteins to bind free water by unfolding more readily. This chelating effect also helps in inhibition of fat rancidity by binding to iron found in haemoglobin and myoglobin which are released when the meat is cooked.

Increased succulence, Yield improvement & Emulsification

Moreover, phosphates give synergistic effects when blended and work by improving the functionality of the proteins in meat, rather than binding the water itself. Phosphates can increase the water retention in meat by forcing the proteins apart.

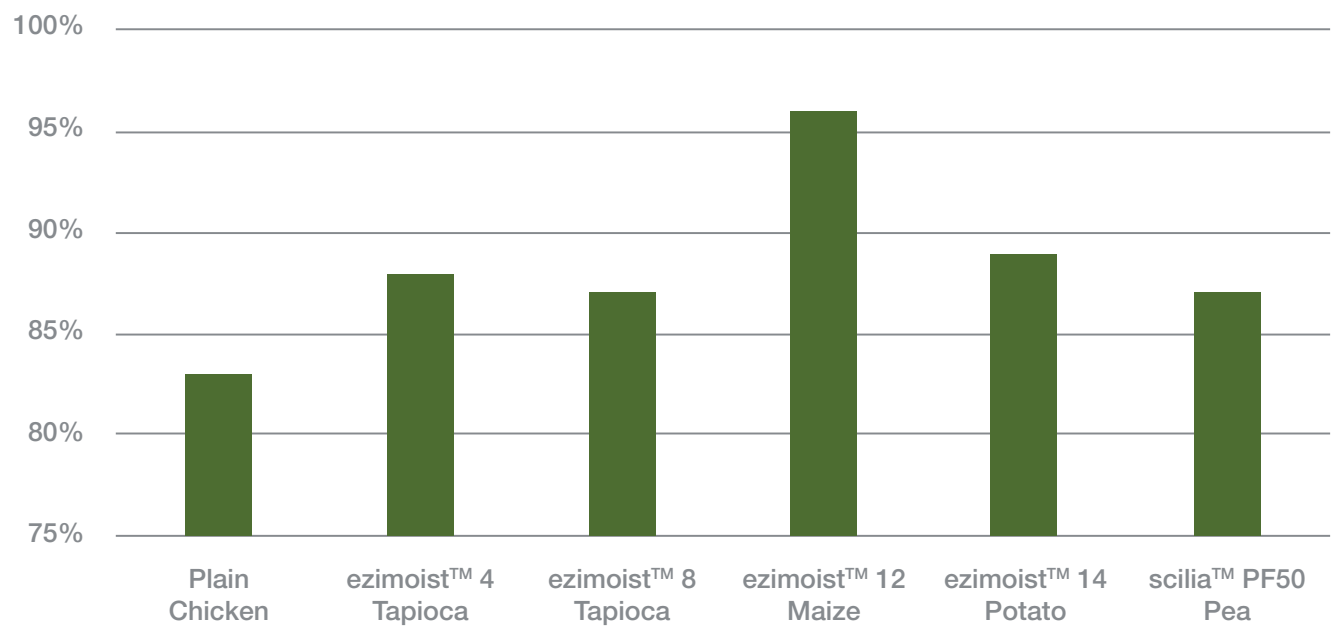
Phosphates also work synergistically with salt to increase yields, give stability and improve the meat's texture. Both salt and phosphates act on the actin and myosin fibres of the meat muscle by interacting with meat fibres, this in turn makes the muscles expand and retain water - increasing the yield.

The addition of salt to a brine results in a less fibrous and softer texture to the meat. Though it may cause issues for solubilising the phosphates if the salt is added to the water before the phosphate.

For fish and seafood applications, triphosphates and polyphosphates are used. Unlike when using phosphates with meat and poultry, these don't need the salt for the phosphates to be functional. Rather the addition of phosphate helps to reduce drip-loss when fish and seafood is stored.

Moisture retention of chicken when cooked

Total Yield (cooked weight/raw weight)



Binding

Phosphates are also used to bind separate bits of meat together. The salt in the meat interacts with the phosphates in such a way that it extracts individual pieces of salt soluble meat, and in doing so acts as a binder. This is often used to produced formed hams.

The functionality of starch in meat – how does it work?

To get the best out of our ingredients, there are some factors to consider. Our starches are derived from different crop bases, and therefore have different amylose and amylopectin levels, granule sizes and gelling temperatures. All of which are important considerations when selecting a starch for tumbling or injecting your meat with.

Firstly, if the product is cooked at a lower temperature it is particularly important to select a starch which gels at a temperature below that which you are cooking to. There is little point tumbling in a starch which won't reach a high enough temperature to gel and retain moisture within the meat.

Moreover, it is critical to select a starch which has an optimum ratio of amylose and amylopectin when developing a phosphate replacer, this gives a product which has the right balance of good texture and process stability.

Generally, starches which ultimately have a higher ratio of amylopectin are better for tumbling meat. The higher ratio of amylopectin results in a lower rate of retrogradation which in turn means that the meat retains more moisture and there is little to no syneresis (water loss). This results in a better quality and more succulent product for the duration of the product's shelf-life.

Our starches are developed for their high water binding capacity; which produces meat with a high yield and improved succulence. Depending on your processing parameters, declaration preferences or cost limitations, we have a variety of products to choose from. Also they are naturally very white which helps with the colour of the poultry, producing a product which is white with no pinking.

Our ingredient range is extensive and each individual ingredient has its' own unique properties. For instance, our scilia™ pea fibre has been developed with process-ability, yielding chicken with improved slicability in mind; whereas the ezimoist™ range has been proven to improve the texture and therefore improve the eating quality of the meat it has been tumbled with or injected into. Some products for injecting have been developed to reduce settlement in the brine tank for easy redispersion when required. The viscosity of the brine remains unaffected when using ezimoist™ so processing remains the same.



Ulrick and Short's phosphate replacement solutions

Here at Ulrick & Short we have a range of clean label starches derived from multiple crop bases. The ezimoist™ range improves the texture, yield and succulence of meat, all without the addition of an E-number.

We have specifically developed the ezimoist™ range to replace phosphates in a variety of different scenarios in meat, poultry and fish. We have specifically designed the range to cater for either tumbling or injecting meat which have been developed for optimum performance and improved functionality in each process. Moreover, the different formulations of the range ensure for no change to your process.

We are experts in functional food ingredients and therefore understand what phosphates do and are best placed to mimic their properties all the while cleaning up label declarations.

As the clean label trend only grows from strength to strength, we will continue developing our range of phosphate replacers to give improved eating experiences in this ever growing sector.





Starches and Flours

Produced from a range of crops including Tapioca, Wheat, Rice, Sweet Potato, Pea and Waxy Maize.

- Available in 'cook up', 'pre-gelatinised' and 'cold water swelling' formats.
- Heat, pH, freeze/thaw stable versions available with a range of viscosity profiles and a whole palette of textures.
- Thickening, stabilising, fat replacement, sugar reduction, phosphate removal and glazing are only a few of the functions possible.
- Simple, clean and consumer friendly declarations in the following key application areas:
 - Bakery
 - Processed meats
 - Sauces
 - Ready meals
 - Desserts
 - Snacks



Fibres

Produced from a range of crops including Wheat, Oat, Bamboo, Flax and Pea.

- Insoluble fibres with high water binding capacity in a range of fibre lengths, giving full control over the desired texture.
- 'Source of' and 'high in' claims for fibre and omega 3 achievable.
- Shear, acid, heat and freeze/thaw stable.
- Key application areas:
 - Bakery
 - Processed meats
 - Sauces
 - Performance foods
 - Sports nutrition
 - Snacks
 - Breakfast cereals



Proteins

Produced from a range of crops including Wheat, Pea and Rice.

- A range and variety of protein content.
- Can be used as effective binders and emulsifiers.
- Nutritionally enhance foods and boost amino acids.
- Easy to apply and use in the following key application areas:
 - Processed meats
 - Bakery
 - Sports nutrition
 - Infant formulas
 - Functional foods



Clean & Clear Label

Starches | Flours | Fibres | Proteins

- ✓ Non-GM
- ✓ Additive free
- ✓ Wide range of crops and functionalities
- ✓ Allergen free options
- ✓ Simple consumer friendly declarations
- ✓ Enhanced nutritional profiles
- ✓ Quality assured from field to fork
- ✓ Fully accredited including BRC, Kosher and Halal approved

All backed up by onsite technical support.



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