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Phosphates replacement with natural alternatives in meat products

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Review Article

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Abstract

The overall quality of meat products is improved by adding phosphates, as it enhances the emulsifying and gelling abilities of meat proteins. The amount of bound water and the intensity of the meat-particle binding in processed meat products are both known to be increased by phosphates. On the other hand, the meat industry is being forced by a number of health hazards associated with dietary phosphate intake to find alternative phosphate replacers and better product formulations (i.e., less phosphate). Developing phosphate-free meat products is a problem for the business due to the current market trend towards additive-free products as well as the health concerns associated with phosphate. Preservative-free, chemical-free, and natural when discussing clean label food goods, all of these words are frequently used, and the meat and poultry category is no exception. Customers still want meat products that are more natural and cleaner. Phosphates are not simple to get rid of, nevertheless. A crucial ingredient in high-yield meat products that are advantageous to both producers and consumers is phosphate. While consumers savor a delicious and juicy meal, producers save money. Food scientists seem to be facing challenges when it comes to substituting natural substances for phosphates in meats.

Keywords: *Meat products, Natural alternatives, Phosphates replacement.*

Introduction

The maintenance of a good state of life depends on consuming sufficient and complete sources of protein, particularly since the world's population is currently living longer than in previous generations **Grasso *et al.* (2021)**. Thus, the need to provide high-protein, healthy food products are growing. Nutrient-dense processed meat products made with natural ingredients could be a good way to meet consumer needs for convenience, flavor, and health **Bohrer (2017); Carvalho *et al.* (2019) and Barone *et al.* (2021).**

Because phosphorus enhances the processing qualities and functional traits of meat and poultry products, it is frequently added to food products. According to **Sebranek (2015),** they help meat products retain onto their water content, prevent lipid oxidation, reduce cooking loss, preserve color, and enhance freeze-thaw stability. Above all, phosphates can enhance the meat products' capacity to retain water and their textural qualities **Long *et al.* (2011); Sebranek (2015); Xiong (2005).** The Food and Drug Administration (FDA) has designated phosphate as a GRAS (Generally Recognized as Safe) substance. According to **USDA-FSIS (2015)**, the final processed meat and poultry products can include up to 0.5% phosphate; however, the meat industry usually uses lower levels, between 0.3 and 0.4% **Sebranek (2009).**

Food phosphates come in several forms (mono -, di-, tri- and polyphosphates) and because of their effects on ionic strength, pH, chelation, and antibacterial activity; they are frequently utilized in the meat business. They satisfy a number of functional requirements for meat products, including high solubility of the meat proteins and depolymerization of the thick and thin filaments (tri- and polyphosphates), as well as good buffering capacity (monophosphates) and the ability to dissociate the meat actomyosin complex (diphosphates) **Long *et al.* (2011); Balestra *et al.* (2019).**

The emulsifying and gelling characteristics of meat proteins can be fully utilized as a result of these actions, which are essential for fat emulsification and water-holding capacity (WHC). Most polyphosphates and diphosphates also help to raise pH and ionic strength, respectively. These processes lead to an increase in electrostatic repulsion between the meat proteins, which in turn create additional space for the binding of water and fat, further enhancing the stability of water and fat. European legislation allows the addition of several forms of phosphate (or blends) to beef products up to a limit of 0.5% (expressed as P2O5) **European Food Safety Authority (2013).**

So, Chronic kidney disease patients should be concerned about phosphorus since high blood phosphorus levels are linked to cardiovascular risk **Savica *et al.* (2016).**

Natural substitutes for chemical synthetic materials are garnering attention as a result of a current rise in customer interest in processed meals with less synthetic ingredients. Since phosphates are artificially manufactured additives used in meat products, meat processors are looking for better and more modern alternatives **Jeong (2016); Sindelar (2015).** Finding synthetic phosphate substitutes has proven to be challenging for numerous researchers and meat processors, as the replacement ingredient needs to preserve the phosphates' natural useful qualities while remaining reasonably priced for the finished product **Sindelar (2015)**. Nevertheless, data indicating that consuming too much synthetic phosphate from processed foods may prevent the body from absorbing calcium and forming bones have prompted researchers to keep searching for novel phosphate substitutes **Virpi *et al.* (2006).** Therefore, efforts to limit or eliminate the usage of synthetic phosphate in meat products have concentrated on natural material replacers **Lee *et al.* (2011); Jarvis *et al.* (2012); Choi *et al.* (2014); Jarvis *et al.* (2015).**

Studies on the potential health concerns associated with using phosphate beyond normal levels have generally been undertaken since the beginning of the 2000s because it is well known that excessive salt consumption has detrimental effects on health. Numerous earlier researches have tried to increase the functions of meat products by using other functional components, like pectin and inulin **Méndez-Zamora *et al.* (2015).**

Pectin is a phosphate substitute that is used in meat products as a coating, emulsifier, gelling agent, and stabilizer. Based on research, pectin works best when combined with other ingredients, such as calcium, to create a gel that is suitable for use as a natural substitute for phosphate. Pectin is therefore beneficial in meat products but shouldn't be utilized exclusively. Instead, in order to achieve the intended effects of a phosphate replacer, a combination of different chemicals should be employed with pectin **Korkmaz (2018).**

Park *et al.* (2008) examined the impact of functional polysaccharides, such as guar gum, κ-carrageenan, alginic acid, and chitosan, as alternatives to inorganic polyphosphate in meat products. They also examined the usage of calcium powders derived from natural sources as an alternative to synthetic phosphates **Bae *et al.* (2017); Cho *et al.* (2017),** protein hydrolyzates **Vann and DeWitt (2007),** amino acids **Kim *et al.* (2014),** mushrooms **Choe *et al.* (2018),** polysaccharide **Meyer (2018); Öztürk -Kerimoğlu and Serdaroğlu (2019)** and dietary fiber **Magalhães *et al.* (2020); Powell *et al.* (2019)** has been tested.

Guar gum is most commonly used in the food business **Dehghani Soltani *et al.* (2021); Herald (2020).** Considerable investigation has been done on GG with respect to processing characteristics that have direct use in the food sector. It is widely used as a food additive in the food industry to thicken, cover, stabilize, bind, and suspend a variety of liquid-solid systems due to its solubility in cold water and

ability to form viscous systems even at low concentrations. Furthermore, in some research, this inexpensive, commonly used gum showed special qualities that make it indispensable for usage in food applications. These characteristics include decreased evaporation rates, enhanced rheological characteristics, increased freezing rates, and improved ice crystal formation **Von Borries-Medrano *et al.* (2016).**

Oyster shell calcium (OSC), egg shell calcium (ESC), marine algal calcium (MAC), and whey calcium (milk calcium, MC) are examples of natural calcium powders that are commonly utilized in the meat industry. Since their fundamental sources of raw materials and production techniques vary, each of these natural calcium powders has distinct physical and chemical qualities as well as distinct sensory attributes. These variations provide them distinct processing qualities when applied to meat products **Cho e*t al.* (2017).** Eggshell powder, often known as ESP, can be a desirable source of calcium for human nutrition because it predominantly consists of calcium, magnesium carbonate (lime), and protein **Gowsika *et al.* (2014).** In an effort to create premium phosphate-free meat products, the impact of various mixes of premixed natural calcium powders on the quality attributes of cooked meat products were examined **Bae *et al.* (2017).** According to **Bae *et al.* (2017),** meat products that were treated with sodium tripolyphosphate had a texture that was similar to that of meat products that had oyster shell calcium (OSC).

Citrus fiber (CF)-treated Bologna sausages showed comparable cooking yields and emulsion stability to those of products that also included sodium tripolyphosphate, according to **Fernández-Ginés *et al.* (2003).** In the same way, **Jarvis *et al.* (2012)** verified that plum powder and plum fiber marinated chicken breast fillets displayed comparable quality attributes to those marinated with sodium tripolyphosphate.

Carrageenan is derived from red sea algae and consists of sulfated linear polysaccharides of D -galactose and 3, 6-anhydro-D galactose. It is utilized in the food business for its gelling, thickening, and stabilizing qualities; it has no nutritional value. Lately, it has also been employed in low fat meat products **Mangione *et al.* (2003).** When carrageenan is added to low-fat meat products, the end product's textural qualities are improved by juiciness and roughness being reduced **Zhang *et al.* (2018).**

As reported by **Munoz (2013)**, chia seeds have a high soluble dietary fiber content, which not only has numerous functional benefits but can also have a good impact on consumers' health. To substitute sodium tripolyphosphate in the process of making bologna sausages, chia mucilage, which is created by soaking chia seeds in water, has been utilized in powder and gelled form at two different concentrations (2 and 4%) **Câmara (2020).**

So, the main objective of this short review is to highlight and summarize the recent studies on the replacement of phosphates in meat products with natural alternatives.

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