

# **Condensed Phosphates and Seafood: Application and Functions**

**Lucina E. Lampila, Ph.D., R.D.  
Associate Professor, Seafood  
Technology  
Louisiana Sea Grant College  
Program  
LSU AgCenter**

## **Food Phosphates**

- **Meet or exceed FCC VI – NANZA**
- **Meet JECFA – 87 Countries**
- **Generally Recognized as Safe (GRAS) – U.S.**
- **Per Codex – internationally**
- **Produced per GMPs**

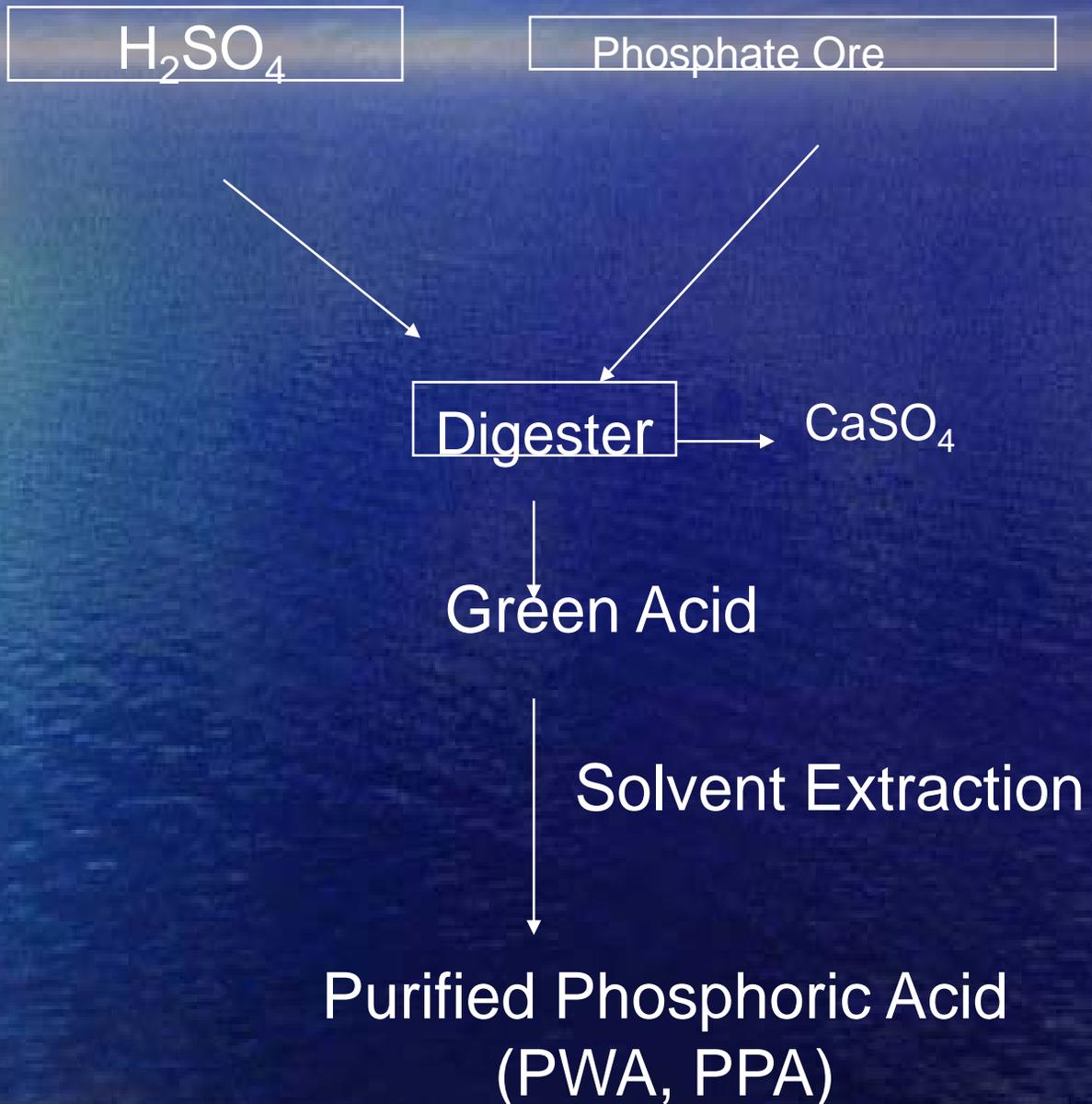
# Allowable Levels of Condensed Phosphate

- U.S. – follows 9CFR424.21 for meat and poultry
- Canada – 0.5% as DSP\*
- Codex – 10 g/kg as  $P_2O_5$  including naturally occurring phosphate
  
- \*Disodium phosphate

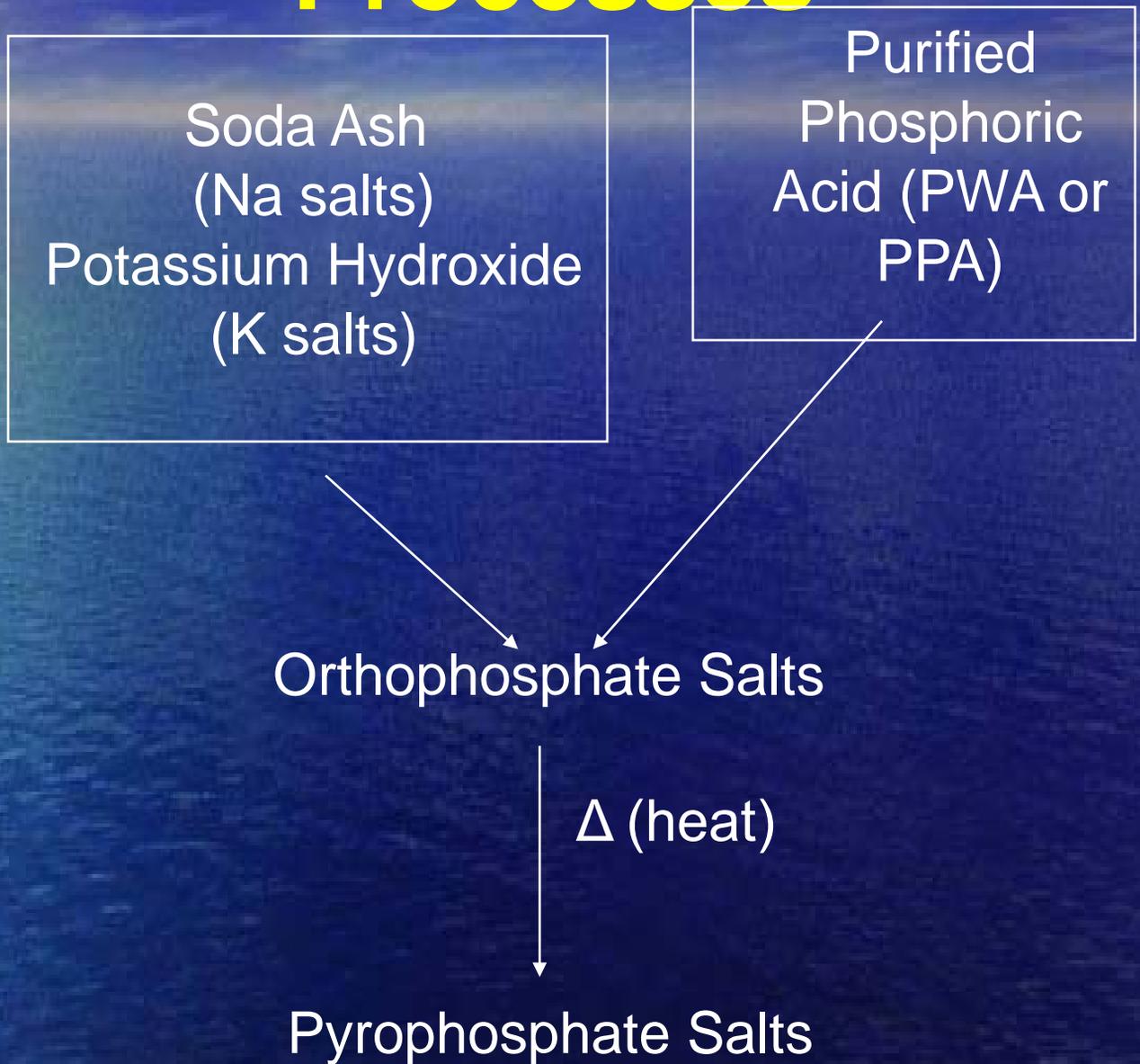
# Permitted Phosphates

- U.S. – any GRAS
- Canada – specific phosphates
- Codex – TSPP, TKPP, KTPP, STPP

# Phosphoric Acid Production (PWA, PPA)



# Phosphate Salt Processes



# Tripolyphosphates

Product	Acro- nym	Formula	Sol. (g/100 ml @ 20 C)	pH (1% sol'n.)
Sodium Tripoly- phosphate	STPP	$\text{Na}_5\text{P}_3\text{O}_{10}$	15	9.5- 10.2
Sodium Potassium Tripoly- phosphate	SKTP	$\text{Na}_3\text{K}_2\text{P}_3\text{O}_{10}$	30	9.8 - 10.2
Potassium Tripoly- phosphate	KTPP	$\text{K}_5\text{P}_3\text{O}_{10}$	180	9.5- 10.2

# Solubility of STPP

- Typically 15% maximum in water at 10 C
- Best to dissolve before adding other ingredients that will compete with available water
- Precipitation may be caused by presence of metal ions or temperature
- Heating solutions may accelerate solubility but initiate hydrolysis

# **Major Phosphates Used in Seafood Applications**

- **Primarily Sodium Phosphates**
- **Sodium Tripolyphosphate**
- **Blends of Phosphates**

# Phosphate Applications in Seafood Products

- Mechanical peeling of (cooked) shrimp
- Frozen raw shrimp
- RTE shrimp
- Frozen fish fillets
- Minced fish & surimi
- Canned seafood
- Pasteurized crab

# Functions of Phosphates In Muscle Food Products

- **In Processing:**
  - Phosphate and NaCl act synergistically
  - Reduce the requirement for NaCl
  - Phosphates compensate for the oxidative effect of NaCl
  - Improved binding of proteins in restructured products
  - Improved water holding capacity, yields and succulence

# Functions of Phosphates in Muscle food Products

- In Distribution and Retail:
  - Protect color
  - Protect proteins during freezing and frozen storage
  - Inhibit lipid oxidation or the development of rancidity
  - Reduce thaw-drip loss
  - Sensory testing has verified that consumers prefer a responsibly treated shrimp over one that has not been treated.

# **In Shrimp Processing, Phosphates Function To:**

- **Solubilize immature collagen to optimize the recovery of edible flesh from the shell during mechanical peeling of shrimp**
- **Reduce thaw-drip loss in frozen, raw shrimp**
- **Reduce cook-cool loss in steam cooked, frozen shrimp**

## The Use of Phosphates To Improve Shrimp Processing And Quality

Shrimp meat is attached to the shell by immature connective tissue or collagen. The connective tissue is broken by treatment with acid (low pH), alkali (high pH) and /or heat.

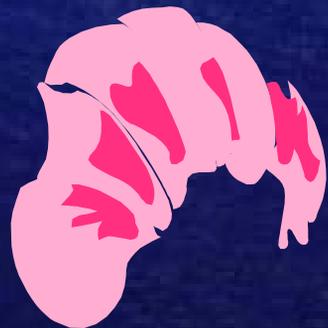
Acid treatment has adverse effects on moisture bound by the meat and texture of the meat.

Alkali treatment helps to break the connective tissue and improve the efficiency of meat separation from the shell. It also aids the meat to form a protective coat of protein which better maintains natural moisture.

# Shrimp



Untreated

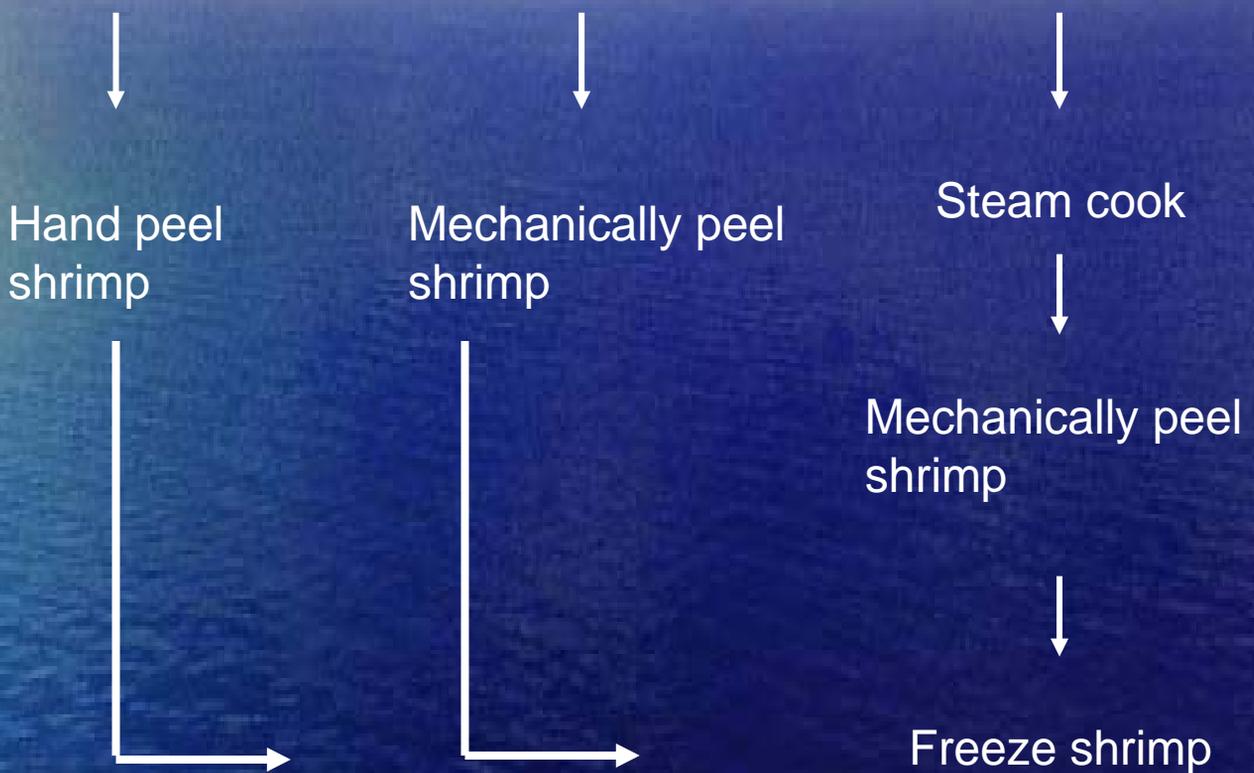


STPP Treated



# Use of STPP to Peel Shrimp

Immerse whole shrimp into a chilled (0.5 to 5.0°C) solution of STPP (3 to 5%) for 5 to 10 minutes.



# Frequently Asked Questions

## Shrimp Processing

**How do you recommend shrimp be treated?**

R: It totally depends upon the type of shrimp and the process protocol.

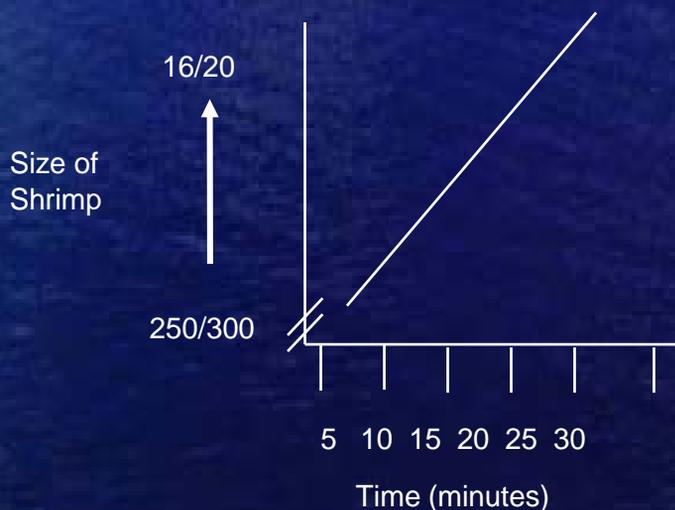
*Example follows:*

**Mechanically peeled (popcorn) shrimp** are given a chilled five (5) minute dip in a 3 to 6% solution of STPP prior to steam cooking and water jet peeling.

**Note:** In areas of moderately hard water, we recommend 90:10 STPP:SHMP.

In areas of very hard water, we recommend 80:20 or 75:25 STPP:SHMP.

**Peeled and deveined shrimp** may be treated as directed in the following table:



Effect of shrimp size on Treatment Time in chilled 4 to 6% STPP solutions.

**36 hrs. in 5% STPP  
at 0.5 °C**



# Steamed Shrimp

## I.T. 140 °F



Ice water, 2 hrs.



Chilled 5% STPP, 2 hrs.

# Frequently Asked Questions

## Shrimp Processing cont.

**Can shrimp be vacuum tumbled?**

R: Yes - if peeled.

Vacuum tumble a solution of STPP with the shrimp. This should be conducted at low temperature. Carefully calculate the amount of phosphate and solution in the end product. **NEVER** tumble in an excess of solution. This extracts rather than retains protein and creates nonessential discharge with high **BOD** (biochemical oxygen demand).

**Can flavors be added to shrimp?**

R: **Yes.** Prepare the marinade solution with careful calculation of end point moisture and phosphate. Vacuum tumble under refrigeration or with CO<sub>2</sub> (carbon dioxide) injection. Do not tumble in an excess of solution (see above).

# Labeling

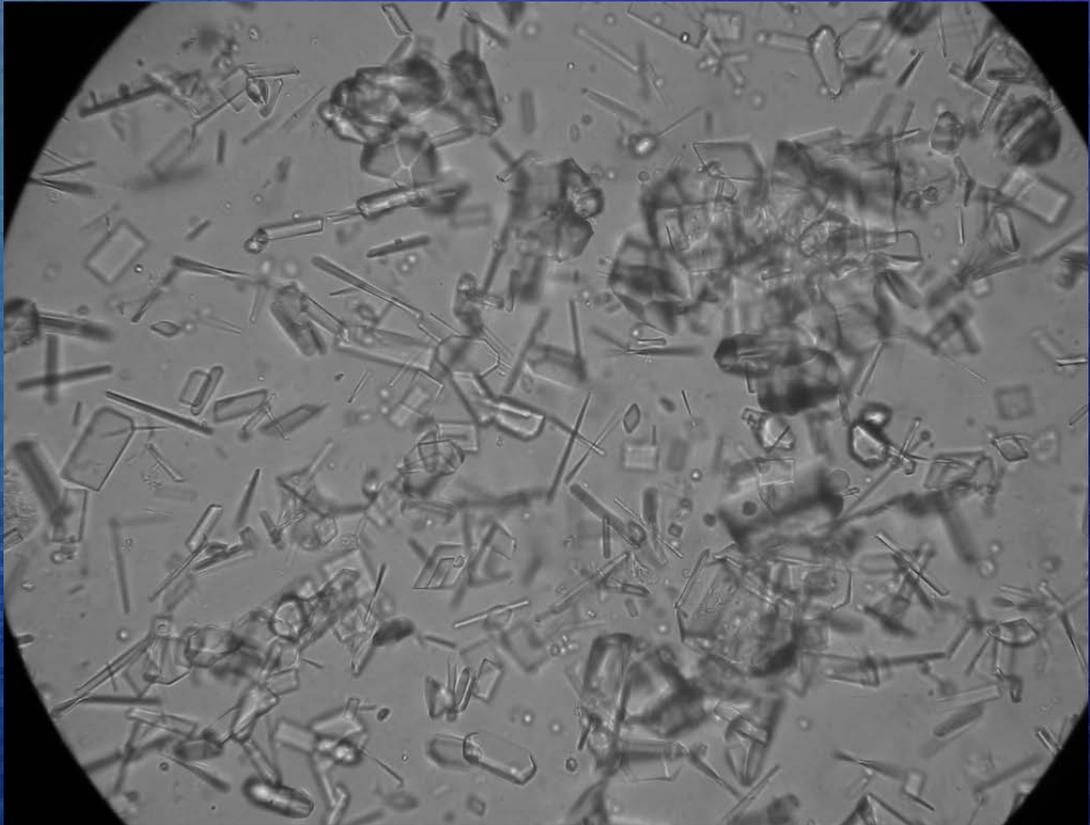
- In the U.S., each component of a blend
- Canada, “sodium phosphates”
- Per Codex Alimentarius, each ingredient

# On Board STPP Use

- In the absence of tap water: not recommended.
- Mineral content of sea and brackish water compete with STPP for available water. The result:



# DSP-6 Crystals



# Thank You

- Questions?