



Abstract

Additives are the substances that are added in food to enhance/improve its freshness, appearance, color, flavor, texture, and test. The chapter includes the topics of food additives, categories of additives, uses of food additives, types of additives (organic and inorganic), numbers or E-numbering system, their active substances, EU approved additives, soaking gain, soaking method, additives in value-added products, etc. The chapter also helps to know the calculation of soaking gain (%) of different types of shrimp products with related exercise.

Keywords

Food additives · Soaking · E-Numbers

4.1 Food Additives

Additives are the substances that are added in food to enhance/improve its freshness, appearance, color, flavor, texture, and test. It also helps to preserve nutrient content, safety requirements, and long-term preservation. Use of food additives in shrimp is a major concern because of potential health effects on the human body. Additives must be approved by the importing countries, and illegal/banned additives are not allowed in foods. International standard and guidelines should be followed strictly during use of additives in food. The Joint FAO/WHO Expert Committee on Food Additives (JECFA) is the international body responsible for evaluating the safety of food additives. The use of additives in food completely depends on the buyer's requirement. There are a variety of additives available in the market. These additives are divided into several categories, i.e., acidity regulators, antioxidants, glazing agents, food preservatives, etc. Some additives are used in specific reasons, but

some additives have more than one function. The following are the categories of food additives.

Acidity regulators:	Acidity regulators are substances that control the acidity or alkalinity of foodstuff.
Antioxidants:	Antioxidants are used as a food to prevent oxidation process.
Emulsifiers:	Use to keep food safer for longer. Emulsifiers allow water and oils to remain mixed together in an emulsion.
Flavor enhancers:	Flavor enhancers used in food to enhance their existing/natural flavors.
Stabilizers:	Help to control physicochemical state of foodstuff and keep the texture firm in shrimp.
Sweeteners:	Sweeteners are added to foods for flavoring agents, also for the taste.
Fortifying agents:	Fortifying agents are used for increasing of nutritional value.
Glazing agents:	Glazing agents are used for the shiny appearance of shrimp. They are also used as a protective coat of shrimp.
Preservatives;	Preservatives are used to prevent or inhibit spoilage of food due to fungi, bacteria, and other microorganisms.

Uses of food additives are common in seafood industries. Stabilizer, emulsifiers, and antioxidants are the most commonly used in shrimp processing industries as per the instruction of the buyers. Uses of others are very low or occasionally.

4.2 Soaking of Shrimp

Soaking means dipping of shrimp into a solution. The solution may contain a mixture of salt, water, and food additives that may help to retain moisture in shrimp and enhance its flavor, color, texture, and test. Different additives are used for different purposes. Soaking is an important part of shrimp processing, but soaking must be in an appropriate way. Percentage of additives, types of additives, soaking procedure, soaking duration, etc. should be followed strictly as per international standard. Uses of additives balance between protein and moisture that result in preferred texture and palatability in tests. Phosphates, non-phosphate, and antioxidants are the most commonly used food additives in shrimp industries. Phosphate and non-phosphate are known as MRAs (moisture retention agents). Fresh seafood with high nutritional value has a limited shelf life, which can be extended by cold storage. Shrimps soaked in food additives have the following functions:

- Help to increase water retention capacity and reduce thaw-drip loss
- Help to increase freezing capacity
- Help to enhance the general appearance and maintain freshness
- Help to improve its consistency, texture, color, and other sensory properties
- Help to improve its taste

- Help to prevent oxidation
- Help to preserve nutrients
- Help to reduce cook and cool losses
- Help to prevent melanosis
- Help to increase weight (weight gain) of shrimp

[Note: Different additives are used for different purposes. Sometimes single additive can perform different functions.]

4.2.1 Soaking Method

The standard soaking method should be maintained properly to ensure quality products. It is essential to handle this stage very carefully. Normally, around 2% additives and 2% salt and water are used for standard soaking (little bit variation may be considerably based on product type and specifications). Chilled water must be confirmed during the soaking process. It's better to maintain the temperature at 4 °C, and soaking duration should be a maximum of 1.5–2 h. Temperature should be checked very carefully and frequently for both soaking water and soaked shrimp itself. Ice should be added if temperature fluctuates during soaking procedure. There are two types of soaking method practiced in shrimp processing industries. These are as follows:

1. Paddler method: Manual process
2. Stirring method: Mechanical process

The following are the images of soaking methods of shrimp (Figs. 4.1, 4.2, and 4.3).

The following parameters should be considered during the soaking of shrimp:

Fig. 4.1 Preparation of additives



Fig. 4.2 Soaking (stirring method)



Fig. 4.3 Soaking (paddler method)



Table 4.1 Permitted food additives currently used in shrimp processing industries

Type of additives	Name of additives	Country of origin
Phosphate (STTP)	Blue sowrd/kdm	China
	Carfosel	Belgium
	Xingfa	China
Non-phosphate (NP)	NP-1 ⁺	Thailand
Antioxidant	Sodium metabisulfite (sulfite)	China

- Size/grade and type of shrimp
- Method of soaking
- Percentage of additives and water
- Duration of soaking
- Temperature of soaking water
- Temperature of soaked shrimp (Table 4.1)

4.2.2 Determination of Soaking Gain (%)

Soaking gain can be calculated by using the following formula:

%of soaking gain

$$= \frac{\text{Weight of shrimp after soaking gain} - \text{Weight of shrimp before soaking}}{\text{Weight of shrimp before soaking}} \times 100$$

Kingwascharapong and Benjakul (2016).

[Note: Weight of shrimp after soaking gain should be taken very carefully; let the shrimp drain out the additives first, and then weight should be taken.]

*Calculate the percentage (%) of soaking gain for BT, PND, raw, 8/12, FC, 20% glaze, 10 × 1 kg shrimp where initial weight (before soaking) of shrimp is 324 g/lb and final weight (after soaking) is 364 g/lb.

$\begin{aligned} \text{\% of soaking gain} &= \frac{\text{Weight of shrimp after soaking gain} - \text{Weight of shrimp before soaking}}{\text{Weight of shrimp before soaking}} \times 100 \\ &= \frac{364 - 324}{324} \times 100 \\ &= 12.3\% \end{aligned}$	Here, Initial weight = 324 g Final weight = 364 g Soaking gain (%) = ?
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Result: Soaking gain of shrimp is 12.3% for BT, PND, raw, 8/12, FC, 20% glaze, 10 × 1 kg products (Table 4.2).

Perform the following exercises

Exercise 1:	Calculate the percentage (%) of soaking gain for BT, PND, raw, 16/20, FC, 20% glaze, 10 × 1 kg shrimp where initial weight (before soaking) of shrimp is 324 g/lb and final weight (after soaking) is 36 g/lb.
Exercise 2:	Calculate the percentage (%) of soaking gain for BT, HLSO-EZP, raw, 13/15, RC, 25% glaze, 10 × 1 kg shrimp where initial weight (before soaking) of shrimp is 445 g/lb and final weight (after soaking) is 458 g/lb.
Exercise 3:	Calculate the percentage (%) of soaking gain for BT, PDTO, raw, 21/25, FC, 25% glaze, 10 × 1 kg shrimp where individual weight (before soaking) of shrimp is 13 g and final weight (after soaking) is 14 g.

Table 4.2 Estimation of soaking gain (%) at different types of frozen product (shrimp)

Parameters	Type of products		
	HLSO	HLSO-EZP	PDTO/PND
Soaking method	Paddler, stirring	Paddler	Stirring
Temperature	6 °C	6 °C	6 °C
Soaking time	1.5–2 h	1.5–2 h	1.5–2 h
Gain	2–4%	4–8%	12–16%
pH	7.0	7.0	7.0
Ingredients	STPP (2%), UV treated water, salt (2%), flake ice, raw materials		

Fig. 4.4 Temp. of soaking water



[Note: Little bit variations are appreciated. Percentage of soaking gain depends on various factors, i.e., size/grade, soaking duration, soaking method, soaking temperature, and types and percentage of additives used.]

The following parameters should be checked and recorded during the soaking process.

- Starting time and ending time
- Soaking method
- Temperature of soaking water
- Temperature of soaked shrimp
- Name of additives
- Origin of additives
- Brand of additives
- % of additive added
- % of soaking gain

The following are the image of different stages of soaking process (Figs. 4.4, 4.5, 4.6, 4.7, 4.8, and 4.9).

• **Precaution of soaking**

- The temperature of soaking water and soaked shrimp can never exceed 6 °C; 4 °C is standard. The temperature should be checked frequently. If the temperature is found higher, ice should be added immediately.
- Additives must be approved by the importers. Banned additives are strictly prohibited.
- The percentage of additives should be added by following international standard or specifications. It must be within the limit. The addition of excess additives is strongly prohibited.
- Soaking duration should be within limit. Generally, 2 h soaking duration is standard but may vary from product to products as per specifications. Oversoaking is strongly prohibited; it's a crime.
- The whole process must be in a hygienic way.

Fig. 4.5 Temp. of soaking of shrimp



Fig. 4.6 Appearance of soaked shrimp



Fig. 4.7 Texture and smell of soaked shrimp



Fig. 4.8 Soaking of shrimp with additives



Fig. 4.9 Soaking of shrimp with additives



4.3 Numbers or E-Numbers

A variety of food additives are available in the market. All additives are assigned under a unique numbering system expressed as “Numbers” or “E-numbers.” This numbering system is now internationally adopted by Codex Alimentarius Commission. In Europe, additives are marked as “E-numbers,” but countries outside Europe marked them by the numbers only. It means same additives are used with the same numbering system in the world, but in Europe they just use “E” prefix before the numbering system, where “E” stands for “Europe.” For example, in Europe people know “diphosphate” as “E450,” but outside Europe people know “diphosphate” as “450.” “E numbers” or “Numbers” are commonly found on food labels. See the following table (Table 4.3) of most commonly used additives in shrimp processing industries.

[Note: Examples are based on EU, because EU is the largest seafood market for shrimp.]

Table 4.3 Most commonly used additives in shrimp processing industries

Treatment	E-Number	Active substances	Purpose	Status
Phosphate	E450	Diphosphates: 1. Disodium diphosphate 2. Trisodium diphosphate 3. Tetrasodium diphosphate 4. Dipotassium diphosphate 5. Tetrapotassium diphosphate 6. Dicalcium diphosphate 7. Calcium dihydrogen diphosphate	Emulsifier	EU Approved
	E451	Triphosphates: 1. Penta sodium triphosphate 2. Penta potassium triphosphate	Emulsifier	
	E452	Polyphosphates: 1. Sodium polyphosphates 2. Potassium polyphosphates 3. Sodium calcium polyphosphate 4. Calcium polyphosphates	Emulsifier	
Non-phosphate	E331	Sodium citrates: 1. Monosodium citrate 2. Disodium citrate 3. Trisodium citrate	Acidity regulator	
	E332	Potassium citrates: 1. Monopotassium citrate 2. Tripotassium citrate	Acidity regulator	
	E333	Calcium citrates: 1. Monocalcium citrate 2. Dicalcium citrate 3. Tricalcium citrate	Acidity regulator, firming agent, sequesterant	
Antioxidant	E223	Sulfites: Sodium metabisulfite	Antimicrobial, antioxidant, food preservative	

Reference

Kingwascharapong P, Benjakul S (2016) Effect of strong alkaline solutions on yield and characteristics of Pacific white shrimp (*Litopenaeus vannamei*). *Int Food Res J* 23(3): 1136–1144