The Science Behind Brining

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StellaCulinary.com/Brine

What is a Brine and How Does it Work?

What is a brine?

Brine is a salt and water solution that food products, (most commonly meats), are soaked in to improve overall quality.

Why Brine?

Texture

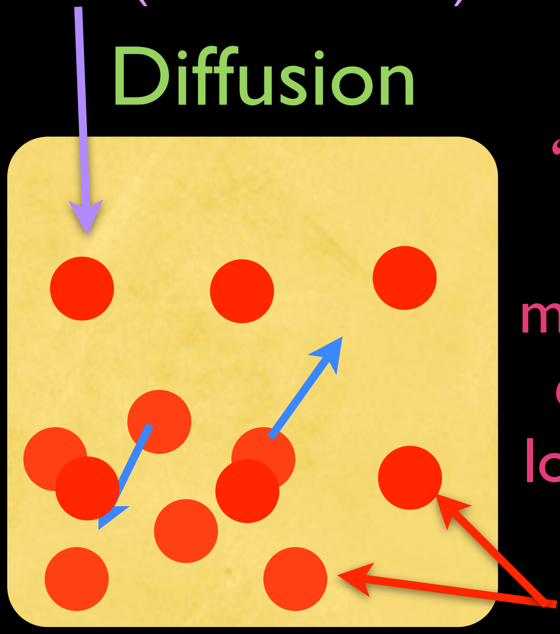
Flavor

Moisture Retention

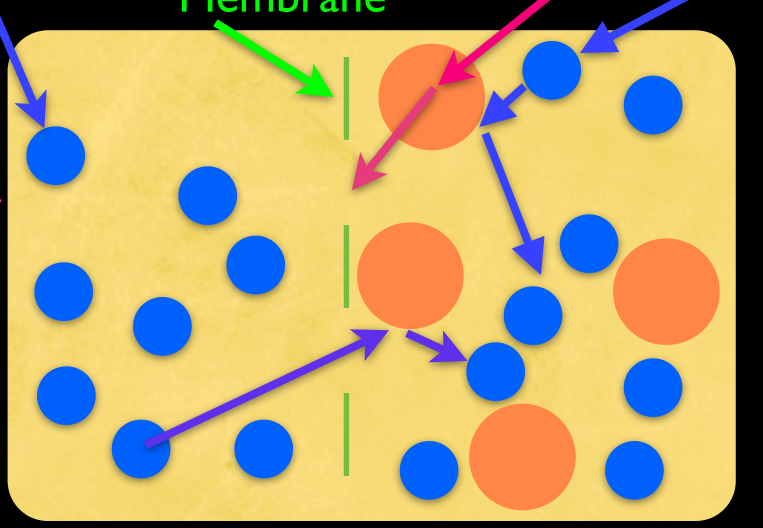
How does a Brine Work?

Most conventional explanations of how brining works describes the movement of salt into the proteins through a process called osmosis.

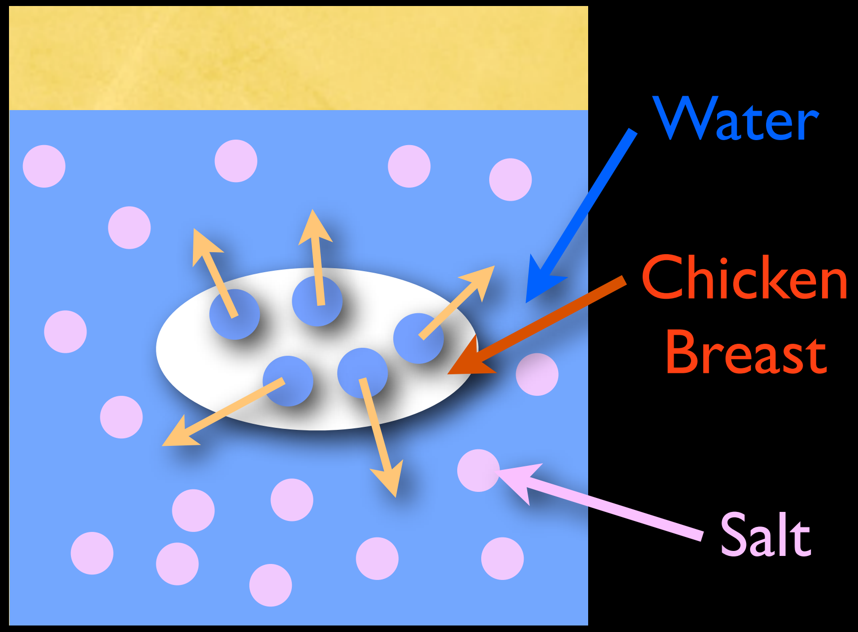
Understanding the Concepts of Osmosis and Diffusion as Applied to Brines



Overtime, the "solute" molecules will equilibrate, moving from a higher concentration to a lower concentration.



Osmosis is the movement of a higher concentration of **water** to a lower concentration of water through a semi-permeable membrane.



What is a Brine and How Does it Work?

What i… …ork?

Brine is a solution that (most comm… soaked in to… quality.

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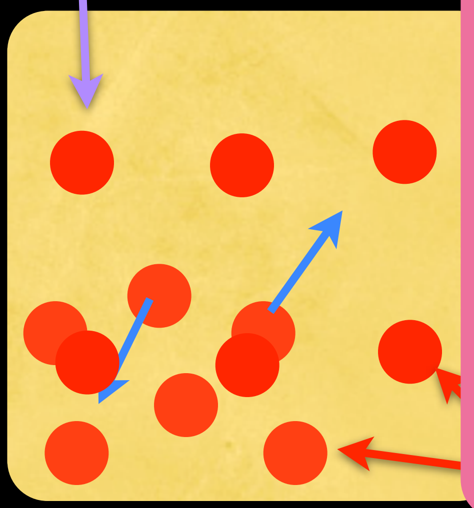
Osmosis deals specifically with the movement of water from an area of higher concentration to that of a lower concentration, through a semi-permeable membrane.

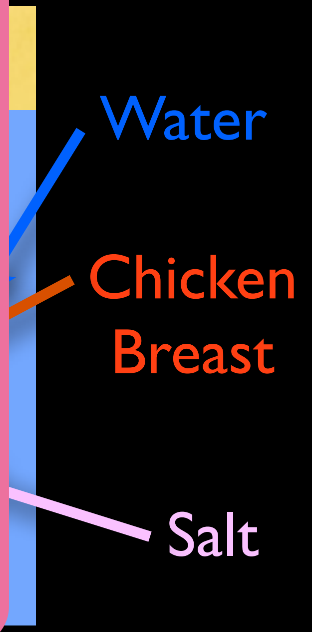
First, whenever you have less of something dissolved into more of something, you have a **solution**.

So a **brine** can actually be thought of as a salt water **solution**, in which the salt is dissolved in the water.

The thing you have more of in a solution, in this case the water, is called the **solvent**, and the thing you have less of, in this case the salt, is called the **solute**.

Under… …ines





What is a Brine and How Does it Work?

If osmosis occurred during the brining process, <u>two things would have to be true:</u>

1. The solute, or the dissolved salt, would have to be too large to penetrate a protein's outer membrane.

We know this is false because the interior of brined meat can obviously become salty.

2. <u>If the salt was actually too big</u> to pass through the protein's outer membrane, then the moisture within the object being brined would actually flow outward into the salt water solution.

We know this isn't true because properly brined proteins are more moist than proteins that haven't been brined.

What is a Brine and How Does it Work?

Now, the natural question is:

Why do we need salt in the first place? If water moves into a protein through diffusion, why can't we just soak a protein in water and have it become juicier?

The answer to this is...technically you can. You can soak a protein in pure water, and it will swell, taking on additional water weight, but not as much as if you added salt to the soaking liquid, and more specifically, proteins will not bind to water as effectively during the cooking process unless salt is present.

Now why this actually occurs is extremely interesting and we'll be discussing this process in more depth, in part two, of this brining video.

How Does a Brine Really Work?

This prevents muscle fibers from shrinking and squeezing out water during the cooking process.

Food products containing more than 1% salt by weight usually taste overly salted.

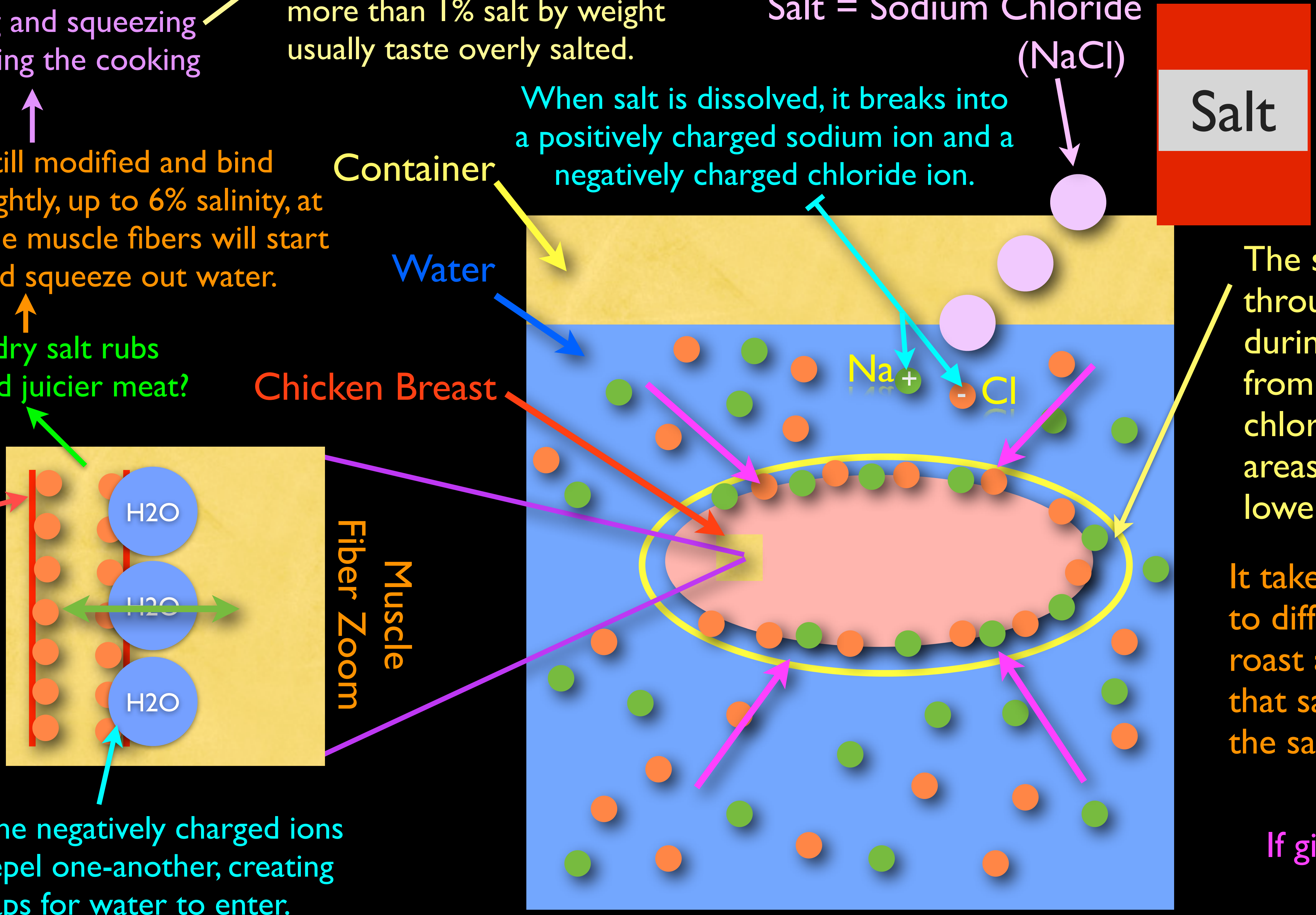
Proteins are still modified and bind water more tightly, up to 6% salinity, at which point the muscle fibers will start to contract and squeeze out water.

Why do both dry salt rubs and brines yield juicier meat?

Negatively charged chloride ions diffuse into muscle fibers.

Salt = Sodium Chloride (NaCl)

When salt is dissolved, it breaks into a positively charged sodium ion and a negatively charged chloride ion.



The negatively charged ions repel one-another, creating gaps for water to enter.

The sodium & chloride ions will diffuse throughout food much like heat does during cooking. Just like heat will flow from hot areas to cold areas, sodium & chloride ions in a brine will flow from areas of higher concentration to areas of lower concentration.

It takes about 100-1,000 times longer for salt to diffuse into food than heat. This is why we roast a pork belly in a matter of hours, but that same pork belly will take 3 months for the salt to transform into pancetta.

If given enough time, the ion content of the brine & food will form an equilibrium, up to a certain point.

Brining Strategies

Dry Rub "Brining"

Salt is mixed with other dry seasonings such as herbs and spices and rubbed onto the surface of the protein.

A good starting point for the amount of salt being used is around 1% based on the proteins weight.

The "salt rub" is left on for a given period of time (anywhere from 4-48 hours) and is then cooked as is, without being rinsed.

Although this method doesn't introduce excess water to be absorbed, the salting does allow the protein to bind moisture more tightly.

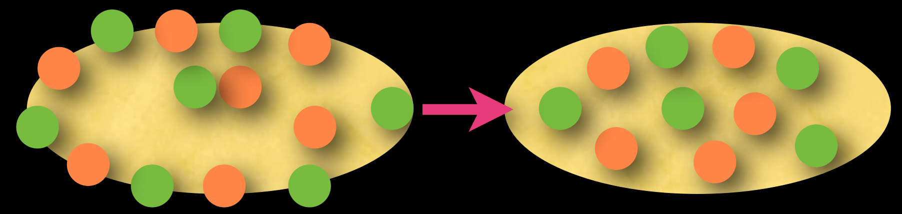
Gradient Brining (Traditional)

Brine usually has 5-10% salt content.

Food is placed in brine for as little as15 minutes and as long as a few days.

The surface of brined food is rinsed under cold water to remove excess sodium from the surface.

During the resting period, the salt gradient is allowed to "equilibrate," or finish diffusing.



Equilibrium Brining (Modernist Cuisine)

Water and food are weighed together (minus any bone weight).

The combined weight of the water and meat are multiplied by the desired finished salt percentage of the brined food (usually .5-1%)

The appropriate amount of salt is dissolved into the water and the food is placed in the brine.

A salinity meter is used to read the salt content in the surrounding brine. When the salinity of the brine reaches equilibrium, you know that your desired finished salinity has been achieved.

Calculating and Making a Brine

Gradient Brining

Added to water.

Desired Brine Salinity X Water Weight = Salt Weight

Usually 5-10% by weight.

Enough water to comfortably cover food.

Ex) 1,000g Water X .05 (5%) = 50g Salt

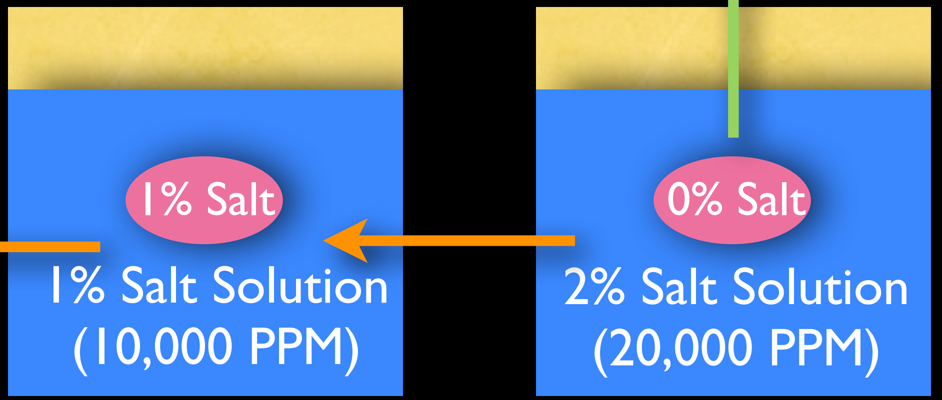
Dissolve salt into water and you're ready to go.

When the PPM drops to half of it's initial reading, you know that a state of equilibrium has been reached and the food is finished brining.

A salt meter will usually read out in PPM not a percentage.

The water will start at a 2% salinity (assuming that equal amounts of water and meat are used by weight).

When equilibrium is reached, the food product is now brined and ready to go.



Equilibrium Brining

Using the same amount of water as food is easiest.

(Water Weight + (Food Weight - Bone Weight)) X Finished Salinity = Salt Weight

Ex) Let's assume that we're brining a whole, bone-in chicken with a total weight of 5 pounds.

Since the average bone weight of a whole chicken is usually around 40%, we'll calculate the weight of the bones as follows:

5 # X .40 = 2# Bone Weight → (5 # - 2# = 3#)

3 # Water + 3# Chicken (meat) = 6# (Total)

6 # X .01 (1% Salt) = 0.06 X 16 = .96oz X 28.3 = 27.1g

Calculating PPM

1 Parts Per Million Equals 1mg / 1,000g. 1g = 1,000mg. So a 1% salt water solution would be 10g (10,000mg) of salt dissolved into 1,000g (or 1,000,000mg) of water, making the salt content 10,000 PPM.

Speeding Up The Brining Process

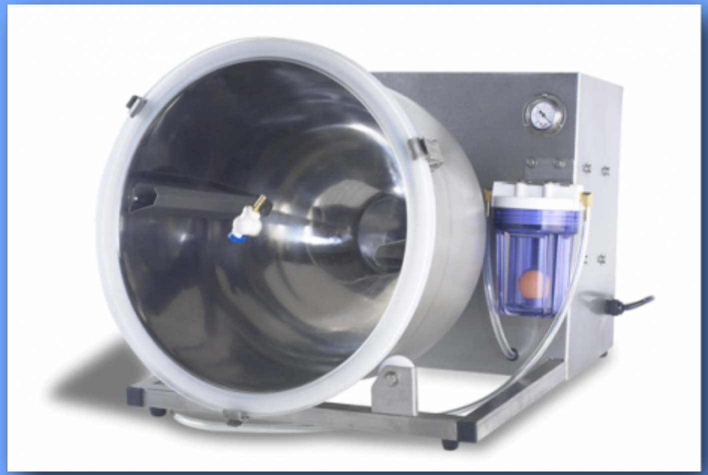
Jaccard

Tenderizes meat by shortening muscle fibers, but also allows for brines and marinades to diffuse quickly throughout the protein.

Injection

Allows brines and marinades to be directly injected into the interior of a protein, speeding up diffusion.

Vacuum Tumbling



Tumbles proteins and liquids (such as brines and marinades) together under vacuum. The combination of low atmospheric pressure (caused by the vacuum) and the tumbling process, can reduce brine durations from hours and days to minutes.

5% Brine Chart

Please Note: The times given here are approximation. Please refer to given recipe for more information.

Item	Brine Time	Rest Time	% Sweetener	Special Notes
Chicken Breast	4-6 Hours	2-4 hours	3% Sugar or 2% Honey	Allow more time for bone in, skin on. Jaccarding is recommended.
Chicken Leg & Thigh	8-12 Hours	3-6 hours	2% Sugar or 1% Honey	Allow more time for bone in, skin on. Jaccarding is recommended.
Whole Chicken	24-48 Hours	8-24 Hours	3% Sugar or 2% Honey	Allow to rest uncovered in refrigerate so that the skin dries out.
Pork Tenderloin	12-16 Hours	2-4 Hours	3% Honey or 100% Cola	Substitute cola for water. Do not mix with curing salts. Could be lethal!
Pork Loin	12-24 Hours	4-8 Hours	3% Honey or 100% Cola	Substitute cola for water. Do not mix with curing salts. Could be lethal!
Pork Chop (Bone In)	2-8 Hours	3 Hours	2% Sugar or 1% Honey	Substitute cola for water. Do not mix with curing salts. Could be lethal!
Fish Fillet	20 min - 2 Hours	2 Hours	3.5% Sugar	Slightly higher sugar content is need to balance brine for delicate fish.
Shrimp/Scallops	20 Minutes	1 Hour	3.5% Sugar	Slightly higher sugar content is need to balance brine for delicate fish.
Lobster	1 Hour	1 Hour	3.5% Sugar	Slightly higher sugar content is need to balance brine for delicate fish.
Beef	N/A (Mostly)	N/A	N/A	Normally beef is not brined; it tends to benefit more from marinades

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