

## Silk Grass Farms Factory Capabilities

Silk Grass Farms built its 130,000-square-foot, state-of-the-art food processing facility in 2022. This factory enables us to process foods from the Silk Grass family of farms as well as partner farms from across Belize, producing the freshest, highest-quality products possible.

Silk Grass Farms invested in this multimillion-dollar facility for a variety of reasons:

- **Commitment to product quality**

We are dedicated to producing the freshest, most flavorful, highest-quality products. This dedication begins with our ecologically aligned sustainable farming practices, which yield healthier, juicier, more delicious foods. Thanks to the high-tech, world-class equipment in our factory, our production processes guarantee that fresh, delicious flavor makes its way from our farm to your tastebuds.

- **Commitment to our workers**

We aim to provide employees, contractors, and visitors a safe and healthy workplace, safeguarding the health, wellness and safety of everyone affected by our operations. Factory employees wear personal protective equipment (PPE) and have access to the appropriate tools necessary to complete their jobs. They receive extensive training and professional development opportunities.

- **Commitment to Belize**

Silk Grass Farms believes the natural abundance of Belize can be a driver of economic sustainability and prosperity for our nation. By partnering with and processing the crops of our fellow Belizean farmers, we hope to use our state-of-the-art processing facility to benefit not just Silk Grass Farms but the entire Belizean agricultural community.

Please read on to learn more about the technical capabilities of the processing facility.

**Interested in speaking directly to someone at Silk Grass Farms about our factory?**

**Contact us today:**

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# Safety + Sustainability

As stated in our Food Safety Policy, “Our primary objective is to manufacture and distribute products of the very highest standards. We will incorporate in [our] manufacturing process a high degree of food safety culture through GMP [Good Manufacturing Practices] and Food Safety training and will ensure that all foods produced are fully complied with regulatory and international standards.”

**Safe Quality Food (SQF) Certification:** SQF demonstrates the highest level of food safety and quality control. Silk Grass Farms’ factory received its SQF certification in 2023.

**Health + Safety:** Silk Grass Farms produces high-quality, ultra-safe food for positive social, economic, and environmental impact. All employees and management are responsible for producing safe products by building a culture of food safety and quality. Our goal is to keep improving our food safety management system to eliminate risks from supplier to customer. [View our Health + Safety Policy.](#)

**Renewable Energy:** We have installed a large-scale (2MW DC/1.5MW AC) solar array to provide power to our processing facility. This array is designed to power 75 to 80% of our operational activities.

## Factory Capacity

Our facility is equipped with three types of equipment capable of neutralizing microbes and food-borne pathogens to produce stable, high quality finished goods.

### This equipment includes:

- **HPP (High Pressure Processing)** – as the name implies, HPP pasteurizes products with pressure. HPP applies up to 87,000 psi of pressure, destroying microbes within the product without damaging proteins and enzymes, while preserving the textures and natural goodness of the product.

The HPP process is a cold-chain, in-package, no-heat food preservation method. This locks in the nutrients and flavor of fresh fruit and vegetables. It also works great with meat and seafood products and ready-to-eat meals. Products in flexible, water-proof packages are loaded into the HPP basket and conveyed into a high-pressure vessel. Water is filled into the HPP vessel and pressurized up to 6,000 bar (~87,000 PSI), which is more pressure than the deepest part of the ocean. It instantaneously and uniformly creates isostatic pressure that does not crush the product or change its consistency. This is because the liquid on the inside of the package and the outside simultaneously adopt uniform pressure so that pressure is equalized around and through the products. HPP dramatically increases shelf-life of refrigerated products (juices up to 120 days; other product shelf-lives vary). Maximum size for HPP: 3–5-gallon pouch or bag-in-box. Must fit into an HPP vessel.

- **Monoblock (Tube-in-Tube Pasteurizer)** – pasteurizes the product with the use of heat. The Monoblock is equipped with a filler at the end, which safely packs the product in aseptic bags.

Our tube-in-tube pasteurizer accommodates liquids that have larger particles (max 5-6 mm) including fruit juices and purees. The equipment utilizes double tubes. The product passes through a tube within a larger tube filled with boiling hot water which heats the juice/puree to kill off microbes and denature enzymes. The speed and temperature at which the product runs through the hot tubes can be controlled for a quick “flash” pasteurization or a longer more intense pasteurization to various specifications. Tube-in-tube pasteurization should not be confused with Ultra-High Temperature (UHT) pasteurization. We do not have UHT capabilities. UHT uses extreme heat and destroys flavor, and is therefore not suitable for high-end products.



The Monoblock also includes a Homogenizer that can be used as part of the heat-pasteurization process or separately as its own function. A Homogenizer acts as a high-tech blender that makes all particles uniform in size and thoroughly mixes the juice/puree for consistency throughout to prevent separation.

- **Retort** – also pasteurizes with heat and pressure but can go to a higher temperature than the Monoblock. The Retort is used for high-heat sterilization of products in their final packaging. It is best for consumer-packaged goods (CPG), not bulk sizes. The product doesn't need to be sterile before packaging. The Retort achieves temperatures up to 230-270 Fahrenheit to kill microbes and sterilize food within its package. We can retort food in glass jars, cans, or pouches.

#### Additional equipment:

- **IceGen** – is used to turn the product into a slurry before freezing. Creating a slurry allows the product to freeze uniformly, which prevents separation and provides for a better-quality product.

This Ice Gen process is a temporary method of keeping bulk, high-end liquid ingredients from spoiling or separating in transit.

Step 1: Juice or puree is transferred into the Ice Gen tank.

Step 2: The IceGen rotates the liquid while freezing it, making a uniform slush that protects the quality of the product that can be lost in a conventional freezing process. For simplicity, it can be thought of as a giant Slurpee machine. It keeps the sugars uniformly mixed throughout and protects the cells from rapid expansion that create an undesirable "frozen and thawed" texture.

Step 3: From the IceGen, the product is stored in drums and kept frozen in cold storage.

Step 4: Drums from cold storage get loaded onto trucks and transported. Juices/purees processed in the Ice Gen can also be pumped directly to IsoTanks for shipment.

## Preservation Options:

- **Aseptic** - Heat Pasteurized and filled in an aseptic environment. Shelf stable until opened. 3 gallon bag-in-box pouches, drums, or bins.
- **Frozen (Ice Gen)** - bulk product which needs to be kept frozen or as a slush.
- **HPP** - ideal for ultra-high-end food service ingredients (e.g. bag-in-box or bottled puree). HPP has a shorter shelf life than aseptic packaging and is cold-chain rather than shelf-stable. Max package size is 3-5 gallons.

## Factory Product Outputs

### Single-Strength Juices

100% pure juice as it is extracted from the fruit. It is not watered down nor is it concentrated in any way.

A key spec for single-strength juice is the degrees brix to test sugar concentration, e.g. ripe oranges approved for juicing have a natural sugar range 11.8-13 degrees brix.

Single-strength juices are commonly called "not from concentrate" because companies that make juice from concentrate need to differentiate their products. We will not be using the phrase "not from concentrate" because it implies that we make concentrate or that our other juice is from concentrate. We use the marketing term "single-strength juices."



### *A Note on Blends:*

We also make single-strength juice blends. That means our juice blends are a mix of single-strength juices of two or more fruits/rhizomes (ginger) / roots(carrot), etc.

Every juice blend recipe has a “base” or “carrier” juice that is the primary ingredient with additional juice(s) added as a flavoring. Because we grow so much citrus—and also because citrus has a low pH which protects juices against Botulism (caused by microbe *Clostridium botulinum* – C.bot)—most of our juice blends will be citrus-based or have citrus as a secondary flavoring blend.

### *A Note on pH and HPP:*

Juices with a pH higher than 4.6 cannot be HPP'd for export to the US unless they are acidified to a pH at or below 4.6 . For juice bases with lower acid (higher pH) such as cucurbits, we make citrus part of the mix as a secondary flavor to lower the pH to <4.6. Lime, lemon, and white grapefruit are good candidates for acidifying other juice bases due to their high acidity and clear/neutral color.

For example:

- Cucumber/Lemon/Mint blend
- Watermelon/Lemon
- Cucumber/Lime/Ginger

HPP destroys bacteria but not spores. C.bot produces spores that die/deactivate in environments with a pH of 4.6 or below or in heat pasteurization but do NOT die under high pressure (HPP). Therefore, alkaline juices need to be acidified.

*Note:* We carried out a validation study with our microfiltration unit to test the effectiveness of the microfiltration to remove C.bot spores. The study proved that the microfiltration does remove C.bot spores.

### *De-activation of enzymes in post-harvest processing*

Sometimes food is spoiled not by microbes, but because of enzymatic reactions that take place post-processing. These reactions can vary based on the chemical properties of the fruit. There are two types of fruit: Climacteric and Non-Climacteric.

Climacteric fruit will continue to ripen after it is picked and produce ethylene gas. Chemical reactions continue taking place within the fruit as it is processed. Unless certain enzymes are denatured (deactivated), fruit juices and purees of climacteric fruits are more likely to change within the packaging and spoil the product (a.k.a. non-pathogenic spoilage/enzymatic degradation).

Enzymes that cause these chemical reactions need to be denatured (deactivated). Thermal deactivation of enzymes ensures that fruit products do not off-gas or alter food chemistry or quality after packaging. HPP cannot deactivate enzymes. Climacteric fruit juices and purees may be flash heat-pasteurized before going through high-pressure processing.

Non-climacteric fruit does not further ripen after it is picked and produces less ethylene gas. That means it must be picked ripe (which makes harvest timing crucial). Non-climacteric fruits also have reduced risk of enzymatic spoilage (non-pathogenic spoilage) in processing and packaging. Non-climacteric fruits are more stable and suited better for 100% cold processing methods because they do not require thermal deactivation of enzymes.



*Climacteric fruit examples (need flash pasteurization to denature enzymes)*

- Soursops
- Papaya
- Mango
- Passionfruit
- Avocado
- Tomato

*Non-climacteric fruit examples (need to be picked ripe)*

- Pineapple
- Watermelons, Cucumbers, Melons
- Most Citrus (all the kinds we grow)
- Dragon fruit (Pitaya)
- Cacao

## **Tropical Fruit Processing**

All our fruits are hand-picked, hand-culled and thoroughly washed before going into the extraction machines.

Subsequently, the fruits are directed into one of the two routes, either citrus fruits (orange, grapefruit, and lime) or other fruits (mango, soursop, pineapple, etc.).

The extracted juice is then sent to the blend tanks for blending or for direct bottling and HPP, pasteurization and storage, or for Ice Gen and storage.

Note: The peels from these fruits (with the exception of citrus) may be converted to biochar or composted and used to augment farm soils. Citrus peels yield valuable citrus oils (see below).

## **Citrus Fruit**

The citrus fruits are carried from washing onto a conveyor to the citrus extractor. The juice is extracted (500 oranges per minute) and the waste product is moved outside of the factory for further processing. The juice that is extracted has a lot of pulp and requires a final finishing process to separate specified amounts of the pulp from the juice. From the blend tank, we then proceed with bottling and HPP, pasteurization, or Ice Gen of the product.

## **Cold-Pressed Citrus Oil (Byproduct that is extracted from the citrus peel):**

Cold-pressed citrus oil is a byproduct of citrus processing. The oil in the skin of citrus is very valuable. We collect it two ways in our process.

When we crush the citrus to extract the juice, some oil from the peel gets into the juice. The juice goes through a de-oiler to extract the citrus oil. The oil is collected as cold-pressed citrus oil.

Citrus oil is also extracted directly from the peels. The juice-extracting machine sprays the citrus peel as it is crushed with a mist of water over it so that the mist and the citrus oil mix to create an emulsion. The emulsion goes to our citrus oil recovery unit where the emulsion is broken and the oil is separated from the water so that a pure, cold pressed citrus oil is left.



The oil from the juice de-oiler and the oil from the oil recovery unit are combined. We produce cold-pressed orange oil, grapefruit oil, lemon oil, lime oil, etc.

*Other notes on cold-pressed citrus oil:*

- Cold-pressed citrus oil must be sold in drums with a special lining or in glass containers.
- Cold-pressed citrus oil is a chemical solvent. It can be used as a cleaner or de-greaser.
- Cold-pressed citrus oil can also be fractionated into valuable fractions in a still. These fractions can be used as edible flavorings, natural scents, perfume, cosmetics, and more.

## Coconut Water

Coconut water is extracted from green coconuts in a facility just outside our main factory and transported in stainless steel totes at a temperature below 40 degrees F. In the main factory it is run through a microfiltration process, which removes spores and other impurities.

The coconut water is then blended for optimal flavor and consistency, ready for bottling and the HPP process.

*Fruits/Vegetable/Rhizomes that we will be processing:*

- Citrus (Lime, lemon, white grapefruit, red grapefruit, oranges, varietal citrus)
- Carrots
- Yellow ginger (turmeric)
- Coconuts
- Pineapple
- Dragon fruit
- Watermelon
- Soursop
- Sugar cane
- Cucumber
- Passionfruit
- Avocado
- White Ginger
- Mango and much more....

## Food Categories

Thanks to the size of the facility and the broad scope of world-class equipment, Silk Grass Farms is positioned to process a vast array of fruits, vegetables and rhizomes into high-quality, nutrient-dense, shelf-stable products. Each product must meet the finished good specification outlined for that particular item. The process to produce these finished goods must be within the guardrails that SQF outlines.

The food categories we are equipped to process include (in alphabetical order):

- Avocado
- Beans
- Carrots
- Citrus (Lime, lemon, grapefruit, oranges, varietal citrus)
- Coconuts
- Cucumber
- Dragon fruit
- Ginger
- Mango
- Meats
- Passionfruit
- Pineapple
- Seafood
- Soursop
- Sugar cane
- Watermelon
- Yellow ginger (turmeric)
- Papaya