

A photograph of three ripe, dark purple plums with a green leaf, set against a white background with a soft shadow.

CULINARY SOLUTIONS FOR CLEAN-LABEL PROTEINS



THE SUNSWEET® ADVANTAGE

Derived from prune plums and packed with sorbitol, antioxidants, and malic acid, Sunsweet Ingredients not only aid in moisture retention but also promote browning and enhance the flavors of meat and poultry.

Sunsweet Ingredients come in a variety of forms—from concentrates and pastes to powders—helping to turn dried plums into functional and versatile solutions for a variety of products.



CONTENTS

I. Sunsweet® Ingredients in Meat and Poultry Processing	3
II. Moisture Retention	4
III. Taste and Appearance Advantages	6
V. Sunsweet® Ingredients on U.S. Labels	9
IV. Sunsweet® Ingredients Product Descriptions	10
Fresh Plum Concentrate	10
Dried Plum Puree	11
Dried Plum Powder	11
IV. Using Sunsweet® Plum Ingredients: Ratios and Guidelines	12
Whole Muscle	12
Sausages	13
Burger Patties	14

I. SUNSWEET® INGREDIENTS IN MEAT AND POULTRY PROCESSING

Propagated since ancient times, prune plums have been cherished for centuries for their rich flavor and functional properties.

When fresh prune plums are dried, they develop a tangy caramel richness from the concentration of sugars and acids. Approximately 50% of the weight of a dried plum is sugar, yet unlike most dried fruit, much of that sugar is sorbitol—a sugar alcohol—which does not spike blood sugar like other sugars. Sorbitol acts as a humectant and is the main vehicle by which plum-based Sunsweet Ingredients attract and hold moisture in meat and poultry.

As the plums dry, most of their sucrose is converted to glucose and fructose—sugars that aid in browning—but the quantity of sorbitol stays the same. Very little sucrose remains once the plum is finished drying. Organic acids, mainly malic but also quinic, comprise roughly 1.5% of the dried plums. These acids can draw out flavors in food in much the same way that a few drops of lemon juice can enliven a soup. Dried plums are also a concentrated source of antioxidant phenolic compounds, which help prevent the formation of warmed-over flavor in meat.

UNIQUE IN NATURE

Sunsweet prune plums are of the Pruneaux La Petite d'Agen variety, a GMO-free stone fruit that originated in France. While the compositions of each Sunsweet Ingredient varies, they all contain several functional components, including sorbitol, fiber, acids, and antioxidants. All Sunsweet Ingredients are free of allergens.

DRIED PLUMS AS FUNCTIONAL INGREDIENTS

In studies, Sunsweet Ingredients have been proven to work in place of phosphates and other binders to bind moisture in meat and poultry, improving both texture and yield. The ingredients also offer a number of culinary advantages. With a subtle caramel flavor and bright, rounded acidity, Sunsweet Ingredients enhance the flavors of the foods, allowing for better-tasting results, often with less sodium, sugar, and spices.

Sunsweet Ingredients also enhance the appearance of both raw and cooked proteins. In addition to preventing off-flavors, the high levels of antioxidants in plums can lengthen the display life of raw protein. Meanwhile, cooked protein achieves an attractive caramelized exterior in place of artificial caramel coloring.

II. MOISTURE RETENTION

One of the biggest issues for poultry and meat producers is moisture loss. Proteins that lack moisture not only taste inferior but also have lower yields. Consequently, applying marinades to protein is necessary to boost moisture levels of raw and cooked meat and poultry products.

PHOSPHATES: THE CONVENTIONAL SOLUTION

To increase moisture through marinades, processors have long turned to phosphates. When muscle converts to meat after slaughter, lactic acid lowers the meat's pH until it reaches the isoelectric point, the point at which the net charge of the protein is zero. In this state, the quantity of water that can be attracted and held by the meat is reduced because the muscle fibrils (where most of the water in meat is stored) are packed together.

Adding phosphates alters the pH of the meat and moves it away from the isoelectric point, thus increasing the meat's water-holding capacity. The change in pH opens up the meat fibers, allowing for space to form between the muscle fibrils and for phosphates to bond with meat molecules. Phosphates also affect protein solubility, dissolving some of the muscle protein that restricts water uptake. (A salt-only brine can dissolve some protein, but not as effectively as a phosphate-salt brine.)

Among phosphate salts, sodium tripolyphosphate (STPP) has long been a favorite for moisture retention. This additive raises the pH of the meat, shaking it out of its isoelectric point and allowing for more pickup of marinade. It also lowers purge and cook loss compared with other phosphate additives, such as sodium acid pyrophosphate (SAPP). Yet STPP can leave behind a soapy flavor and bleached color. Chicken marinated with STPP often does not brown as evenly. Phosphates can also be difficult to dissolve in brine, especially in areas with hard water. These issues, as well as growing health concerns around high phosphate consumption, have led producers to look for alternatives.

HEALTH CONCERNS

Medical researchers are finding that the overuse of phosphates in food processing is impacting consumer health. Our bodies only absorb between 40 to 60% of naturally occurring phosphates in food. Yet when phosphates are added to processed foods, we absorb more than 90%. The prevalence of phosphates in processed food has led to a significant rise in the total phosphorus we absorb daily.

Daily phosphorus intake has risen from 500 mg/day in 1990 to more than 1000 mg/ day in 2010. This can be attributed to the increasing quantity of phosphate additives used in food production.

— *Journal of Renal Nutrition*

Consuming too much phosphate can lead to kidney calcification and kidney damage. While healthy kidneys filter out excess phosphates, nephrologists and patients suffering from kidney failure are well aware of the risk of consuming large amounts of phosphates when kidneys can't do the job. Yet studies are also linking phosphate consumption to adverse effects on cardiovascular health and aging.

Phosphates also impact the environment, stimulating algae growth and causing habitats to degrade when untreated water enters rivers and streams. Concerns about phosphates in water already have led the domestic detergent industry to pull phosphates from products. Increased environmental regulations also often require processors to treat leftover brine containing phosphates before disposing of it.

HOW SUNSWEET® INGREDIENTS WORK IN MOISTURE BINDING

Sunsweet prune plums can be used as an alternative to phosphates in meat and poultry processing. The probable cause is the unique chemical compositions of prune plums, which have high levels of sorbitol and fiber. As a humectant, sorbitol attracts moisture. Meanwhile, fiber absorbs moisture, holding it in place. Unlike phosphates, Sunsweet Ingredients do not dramatically change the pH of the protein. Rather, they attract and hold moisture as the muscle fibers open up during the vacuum tumble and/or injection process or as meat is ground for sausages and patties.

THE ARKANSAS STUDY

The moisture-binding attributes of plum ingredients were tested in a study conducted by the University of Arkansas Fayetteville Food Science Department. Scientists vacuum-tumbled chicken breasts with marinades containing different plum ingredients—Fresh Plum Concentrate, Dried Plum Powder, a dried plum fiber, and a combination of powder and fiber—at different concentrations. One sample group was marinated with STPP while a control sample group had no marinade. In each marinade, salt levels were kept the same.

Sensory evaluations showed that the chicken breasts marinated with plum ingredients had comparable sensory characteristics and levels of moisture when compared with the STPP-marinated samples. The

closest sample to the STPP-marinated chicken was a marinade made with 1.1% Fresh Plum Concentrate. With these findings, the authors of the study concluded that plum ingredients could be used in place of phosphates to enhance the water-holding capacity of poultry.

The Arkansas study also showed that higher usage levels of plum-based ingredients did not necessarily lead to more moisture binding, and marinades with a higher level of concentrate did not outperform marinades with lower levels of concentrate. The Arkansas study found that a marinade with 1.1% Fresh Plum Concentrate had a 10% marinade pickup compared with a marinade concentration of 2.2%, which only had an 8% pickup.

III. TASTE AND APPEARANCE ADVANTAGES

Sunsweet's line of ingredients allows chefs and food scientists to leverage the rich texture- and flavor-enhancing capabilities of prune plums in new applications. Dried Plum Powder and Dried Plum Puree can draw out flavor in subtle ways while Fresh Plum Concentrate's light color and a clean, tangy taste can improve everything from marinades to sauces, braises, and seasoning rubs.

REDUCING SEASONING

The acidity of Fresh Plum Concentrate and Dried Plum Puree accentuate flavor in meat and poultry preparations. This heightened taste level allows formulators to cut back on total spices, possibly reducing the total amount spent on spices and herbs. The flavors of seasonings often come through strong enough that lowering salt and spice levels is necessary to maintain flavor balance. (In some cases, the product will taste too salty if salt isn't reduced.) Removing sugar from marinades is also possible because of plums' natural sweetness.



RICH IN ANTIOXIDANTS

Lipid oxidation is the major cause of quality deterioration in meat and poultry products, especially those that are fully cooked. When the unsaturated fatty acids in meat oxidize, they develop warmed-over flavor. Exposure to air and light are the main causes of lipid oxidation, but iron and salt can trigger it as well. While lipid oxidation can occur before or after meat is cooked, its presence is most noticeable after reheating cooked meat. Meat with a greater amount of unsaturated fat, such as poultry and pork, is more susceptible to warmed-over flavor than beef or lamb.

Synthetic agents, such as butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT), suppress warmed-over flavor. However, antioxidants also prevent the development of off flavors. Studies have shown that the high levels of antioxidant phenolic compounds in prune plums—mainly neochlorogenic and chlorogenic acids—suppress the formation of warmed-over flavor in roast beef and in turkey sausages. These antioxidants are found naturally in Fresh Plum Concentrate and Dried Plum Puree.

Dried prune plums have more than 1800 mg of antioxidant phenolic compounds per 1000 g of fruit. They have more phenolic compounds than fresh prune plums because dehydration concentrates the compounds. Neochlorogenic acid represents 71% of the total phenolics and chlorogenic acid constitutes 24% . Dried prune plums have an ORAC value of more than 8,000 micromoles of Trolox Equivalents per 100 g, according to ORAC values published in 2010 by the USDA.

ENHANCING CARAMELIZATION

In roasted meat and poultry preparations, obtaining a caramelized exterior goes far in improving the appearance and flavor of the dish. This formation of browning compounds—the Maillard reaction—is one of the most important chemical reactions when it comes to imparting flavor on food. Prune plums have small amounts of free amino acids, which are key players in the Maillard reaction. During the fruit's drying process, fructose and glucose sugars react with amino acids and form browning compounds.

These browning compounds are likely what allow plum ingredients to take the place of artificial caramel color in processed meat products. Dried Plum Powder, Dried Plum Puree, and Fresh Plum Concentrate all can boost caramelization in meat and poultry.

IV. PLUM INGREDIENTS ON U.S. MEAT AND POULTRY LABELS

Fresh Plum Concentrate, Dried Plum Powder and Dried Plum Puree are approved for use as binders in meat and poultry processing in the United States. According to the USDA's Table of Safe and Suitable Ingredients for binders, Fresh Plum Concentrate, Dried Plum Powder, and Dried Plum Puree can be added at levels of up to 2% of the total product formulation when used solely for moisture binding. This limit does not apply when the ingredients are instead used as a flavor component.

V. SUNSWEET® INGREDIENTS PRODUCT DESCRIPTIONS

FRESH PLUM CONCENTRATE

Made from the juice of fresh prune plums, this product is the most versatile Sunsweet Ingredient for binding moisture, especially in whole-muscle proteins. Fresh Plum Concentrate blends easily with water and can be used in both vacuum tumbling or injection processes. The product also enhances flavor with bright acidity, allowing manufacturers to reduce the overall quantity of seasonings in a recipe. In addition, its high level of antioxidants suppresses lipid oxidation, helping to extend display life and prevent the formation of off flavors. Alone, the plum-red liquid has the consistency of high-grade maple syrup and carries a tart-cherry flavor.

Suggested Usage Level: .5% to 1.1% to the weight of the meat block

Fiber: 1.54% soluble; .23% insoluble

Titrateable acidity: 1.5 to 2.2% (as malic acid)

Brix: 68°

pH: 3.7-4.2

Sugars: Glucose: 21.18%; Fructose: 13.18%; Sucrose: .25%; Sorbitol: 14.7%



DRIED PLUM PUREE

Made from a blend of dried plums and prune juice concentrate, Dried Plum Puree enhances the juiciness and caramel color of meat and poultry items, particularly sausages. When used in sausage formulas, Dried Plum Puree creates cost saving opportunities by lowering drip and cook loss while imparting a rich mouth feel. Its high level of antioxidants also suppresses lipid oxidation. In sausage making, Dried Plum Puree can be added directly to the meat before grinding or while mixing/emulsifying the meat. Because it is a natural flavor enhancer, it allows for the reduction in seasoning. Dried Plum Puree is a dark purple paste with a tangy flavor similar to molasses.

Suggested Usage Level: 1 to 3% to the weight of the meat block

Fiber: 4.53% soluble; 1.17% insoluble

Titrateable acidity: 1.5 to 2.2% (as malic acid)

Brix: 68°

pH: 3.7-4.2

Sugars: Glucose: 21.18%; Fructose: 13.18%; Sucrose: .25%; Sorbitol: 14.7%



DRIED PLUM POWDER

Ground from whole prunes, this reddish-brown plum powder is very hygroscopic. Its adhesion properties and flavor-enhancing capabilities allow for reductions in overall seasonings. When mixed with seasoning blends, Dried Plum Powder allows the spices and herbs to adhere to the surface of the meat so less of the rub falls off. In addition, it enhances caramelization while staving off lipid oxidation. The powder also absorbs purge. For use in ground meat products, the powder can be added directly to the meat on the first grind. Dried Plum Powder is brownish-purple and slightly tacky, with a mild, toffee-like aroma.

Suggested Usage Level: .5 to .75% to the weight of the meat block

Fiber: 7.3% soluble; 4.5% insoluble

Trace acidity

Sugars: Glucose: 22.28%; Fructose: 13.53%; Sucrose: 1.34%; Sorbitol: 17.65%



VI. USING SUNSWEET® PLUM INGREDIENTS: RATIOS AND GUIDELINES

The following examples are intended to give guidance on formulating products using these ingredients. Because equipment, processes, batch sizes, and raw material vary significantly from company to company, these guidelines are meant to be starting points for experimentation. The size of the needle in an injector, the length of time spent in a vacuum tumbler, or the amount of time the protein rests before being cooked all affect results.

WHOLE MUSCLE

Binding moisture in whole-muscle proteins improves texture and taste, especially in secondary cuts that have a reputation for being tough. This master formula yields juicy meat and can be used as a starting point for benchtop tests. The key ingredient for whole muscle marinades is Fresh Plum Concentrate, which dissolves easily into water. This recipe uses just under 1% concentrate to the weight of the meat block. It can be added in a vacuum tumbler with the protein and/or injected.

MASTER RATIO FOR WHOLE-MUSCLE MEAT OR POULTRY

RAW PROTEIN	10 POUNDS
Fresh Plum Concentrate	.75%
Salt	.4%
Water	15%
Seasonings (vinegar and/or rosemary extract)	2%

PRIMARY EQUIPMENT USED: Vacuum tumbler and a 720 needle (or a pass through a meat tenderizer)

BENCHTOP METHOD: Inject and/or vacuum tumble the protein for 20 to 30 minutes at -27 and 8 rpm with the marinade. Let rest for at least 30 minutes or up to 4 hours before cooking. Mark the meat on a char grill for 2 minutes. Finish in a 375°F oven until the meat reaches an internal temperature of 165°F.

SAUSAGES

The best sausages are juicy, with a fresh, meaty flavor. Sunsweet Ingredients help cut back on drip and cook loss and lower the incidence of warmed-over flavor. There are a few ways to incorporate Sunsweet Ingredients into sausage formulas. The key ingredient is Dried Plum Puree, which aids in moisture binding and emulsification when used about 1.5% to the weight of the meat block. For leaner sausages, however, use up to 3% for a richer mouth-feel. The puree can also be used in hotdogs to improve texture and reduce moisture loss, which is especially helpful when hotdogs are held on roller grills or chafing dishes for extended periods of time. For lighter-colored sausages, use Fresh Plum Concentrate in place of the puree.

For sausages that have a higher percentage of fat, another option is to use .75% Dried Plum Powder with 1% Fresh Plum Concentrate. The powder helps absorb more moisture while imparting flecks that resemble black pepper.

MASTER RATIO FOR BASIC SAUSAGE (RAW OR PRECOOKED)

RAW PROTEIN (27% FAT)	10 POUNDS
Dried Plum Puree	1.5-2%
Ice Water	5%
Salt	1%
Seasonings (vinegar and/or rosemary extract)	2%

METHOD: Add protein to seasoning tumbler and mix with salt and seasoning and grind. Add the Dried Plum Puree and water and blend. Fill casings. Cook according to equipment specifications.

BASIC FRESH SAUSAGE, LIGHTER COLOR

RAW PROTEIN (27% FAT)	10 POUNDS
Fresh Plum Concentrate	1.5%
Ice Water	5%
Salt	1%

METHOD: Add protein to seasoning tumbler and mix with salt and seasoning and grind. Add the Fresh Plum Concentrate and ice water and blend. Fill casings. Cook according to equipment specifications.

BURGER PATTIES

Plum ingredients keep burger patties juicy while lowering the incidence of warmed-over flavor—an important consideration when making pre-cooked ground meat patties. Plum ingredients also aid in browning, taking the place of artificial caramel color.

- For a cooked, lean patty (10% fat), use .75% Dried Plum Powder to the weight of the meat block.
- For a cooked, regular patty (20% fat), use .5% Dried Plum Powder to the weight of the meat block.
- For uncooked patties, the Dried Plum Powder will give the raw meat a speckled appearance. Use .5% Fresh Plum Concentrate to avoid visible specks in the patties.

ⁱRitz, E et al., “Phosphate Additives in Food—a Health Risk,” *Dtsch Arztebl Int* 109 (2012): 49-55

ⁱⁱLeón JB et al., “The Prevalence of Phosphorus-Containing Food Additives in Top-Selling Foods in Grocery Stores,” *Journal of Renal Nutrition* vol 2 issue 4 (2013): 265-270

ⁱⁱⁱSherman, RA et al. “Phosphorus and Potassium Content of Enhanced Meat and Poultry Products: Implications for Patients who Receive Dialysis,” *Clinical Journal of the American Society of Nephrology* (Aug 2009): 1370-1373

^{iv}Dhingra, R et al., “Relations of Serum Phosphorus Levels to Echocardiographic Left Ventricular Mass and Incidence of Heart Failure in the Community,” *European Journal of Heart Failure* (Aug 2010): 812-818

^v“Early Death by Junk Food? High Levels of Phosphate in Sodas and Processed Foods Accelerate the Aging Process in Mice,” *Sciencedaily.com* <http://www.sciencedaily.com/releases/2010/04/100426151636.htm>

^{vi}Stacewicz-Sapuntzakis, M. et.al., “Chemical Composition and Potential Health Effects of Prunes: A Functional Food?” *Critical Reviews in Food Science and Nutrition*, 41 (4) (2001): 251-286

^{vii}Jarvis, N et al., “Dried Plum Produces as a Substitute for Phosphate in Chicken Marinade,” *Journal of Food Science* vol 77 nr 6 (2012): 253-257

^{viii}Min, B et al., “Mechanism of Lipid Peroxidation in Meat and Meat Products—A Review,” *Food Science and Biotechnology* vol 14 no. 1 (2005): 152-163

^{ix}Nuñez de Gonzales, M.T. et al., “Antioxidant Properties of Plum Concentrate and Powder in Precooked Roast Beef to Reduce Lipid Oxidation,” *Meat Science* 80 (2008): 997-1004

^xStacewicz-Sapuntzakis, *Critical Reviews in Food Science and Nutrition*, 251-286

SUNSWEEET® INGREDIENTS AT A GLANCE

	FRESH PLUM CONCENTRATE	DRIED PLUM PUREE	DRIED PLUM POWDER
INGREDIENTS	Concentrated fresh plum juice	Prune juice concentrate, dried plums	Dried plums
CONTAINER SIZE	52 gallon drum	55 gallon drum; 5 gallon pail	40-pound case
APPLICATIONS	Moisture binding, flavor enhancement	Moisture binding (especially for sausages), suppresses warmed-over flavor	Moisture and flavor enhancement, caramel color replacement
CERTIFICATION	Kosher, GMO-free, gluten-free	Kosher, GMO-free, gluten-free	Kosher, GMO-free, gluten-free
PRODUCTION	Juice of fresh plums is extracted and concentrated	Dried plums are pitted and cooked; pulp is concentrated and then blended with prune juice concentrate	Dried plums are chopped/ground, dehydrated, milled, and passed through a screen.
CHEMICAL	Brix: 68° pH: 3.7-4.2 Acidity: 1.5-2.2%	Brix: 68° pH: 3.7-4.2 Acidity: 1.5-2.2%	Trace acidity
PHYSICAL	Plum red with tinges of brown; viscosity similar to maple syrup	Purple-brown paste	Dark amber to brown powder; 95% by weight passes through U.S. standard No. 100 mesh screen
STORAGE	24 months stored at <32°F and <60% humidity	18 months stored at <45 to 55°F and <60% humidity	36 months stored at 50 to 60°F and 40-55% humidity

NOTES

NOTES

NOTES



Amaz!n™ Plums



INGREDIENTS

Sunsweetingredients.com
925.271.9312 · sales@sunsweetingredients.com

2016 © Sunsweet Growers, Inc. Sunsweet® is a trademark or registered trademark of Sunsweet Growers, Inc.