



## *Clearing “Hurdles” with Real Fruit Ingredients*

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### *Extend Shelf Life - Enhance Taste, Texture & Performance*

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**ARTICLE SUMMARY:** Fruit ingredients, from drum-dried powders and flakes to purées and concentrates, can aid and extend shelf life in baking applications and other food systems. Fruit ingredients present formulators with another tool in their arsenal when seeking clean label solutions. The Tree Top, Inc. range of real fruit ingredients offers formulators alternatives to artificial preservatives without compromising food safety while enhancing the organoleptic properties of the food or beverage.

## The Debate

No one can argue that food is vital to survival. And in order to have a safe food supply, capable of feeding millions scattered across a wide geographic area, food must be preserved. However, food preservation methods and ingredient choices have become a public debate between food manufacturers and the consumer. And while flavor or ethnic trends might

*Research studies indicate a continued consumer shift away from artificial and towards more natural or authentic ingredients.*

present a moving target, this desire for more fresh, authentic foods indicates an overall cultural shift across demographic groups, which is likely to grow even stronger in the future. (Hartman Group)

### Consumers want to see product labels with:

- No additives/preservatives
- Real ingredients available from a kitchen cupboard
- Short, clear ingredient lists
- Ingredient names easy to pronounce (or as one research firm put it, to the dismay of xanthan gum

suppliers, consumers dislike ingredients that start with the letter “x”)

- Fresh or minimally processed components

*\*See fig. 1*

Ingredients derived from a natural source and minimally processed — fruit purées, concentrates, juices and drum-dried flakes and powders — can aid in food preparation, keeping in mind best manufacturing processes and following the recommended hurdle technology procedures. When following hurdle technology best practices, fruit ingredients can aid in shelf life extension in a number of applications ranging from proteins to beverages, while boosting fiber and nutrient claims. The baking segment is a primary market for fruit’s functional attributes.

Driven by consumer demand, baking companies are paying close attention to formulating with natural preservatives. Datamonitor consumer research showed that “no preservatives” ranked in the top five for health claims used in new bakery product launches in 2012.

### In an energy bar for example, fruit contributes various functional properties including:

- Controlling water activity ( $a_w$ )\*
- Stability
- Water binding



fig. 1

- Aiding humectancy
- Attaining target pH level
- Adding fruit servings, or soluble and insoluble fiber
- Reaching nutritional targets
- Fruit identity on the label, as a blueberry, apple or mango
- Extended shelf life

\*A water activity level below 0.60 inhibits most microbial growth

## Shelf Life

Successful food preservation leads to increased shelf life, with shelf life defined as the length of time a product will retain its quality and be acceptable to the consumer. Factors limiting shelf life can include staling, oxidation, spoilage caused by microbial growth or loss of key nutrients, among others.

Product taste remains the key driver for consumer purchases and staling and spoilage affect food safety and taste.

A key factor in shelf life is water activity. Water activity, not water content, controls microbial growth because microorganisms such as yeast, mold and bacteria only use the 'available' water in a food system. Total moisture is either in a free or a bound form, with the free water considered available. Designing a product with  $a_w$  below 0.60 is an effective control, although it is not equivalent to a kill step. [Montville, Thomas J, Matthews, Karl R. (2005) *Food Microbiology*, ASM Press, Washington, D.C.].

Air- and drum-dried fruit powders from Tree Top, Inc. can help regulate pH and contain fiber that exhibits hygroscopic properties to help control water activity. Concentrated ingredients such as juice or purées, depending on the level of solids or texture desired, can also help reach targets for soluble and insoluble fiber.

And, Kevin Holland, Ph.D., product developer for Tree Top, Inc. emphasizes there is no single step to extending shelf life and water activity levels are no guarantee of food safety. "There is no 'silver bullet' approach to food safety and shelf life preservation," he says. "And low water activity is no excuse for

abandoning GMPs." Holland stresses the importance of a whole systems approach. *See fig. 2*

Water Activity	Inhibited
0.90	Most bacterial growth
0.85	Most yeasts
0.80	Most fungi and <i>S. aureus</i>
0.60	Extreme yeasts/molds

fig. 2

## Creating High Hurdles

According to Holland, hurdle technology presents one of the best practices to extend shelf life by inhibiting microbial growth. This concept was introduced to the west in the mid-1990s [Leistner, L. (1995) *Principles and applications of hurdle technology*. In G.W. Gould (ED.), *New methods of food preservation* (pp. 1-21). London: Blackie Academic & Professional.] The basic premise of hurdle technology is that it combines multiple approaches to control pathogens. Each control method employed is considered a 'hurdle' that stems the pathogen's proliferation, or at least makes it more difficult for dangerous levels to develop. This helps secure the microbial safety and stability of the system as well as preserving the organoleptic properties of the food or beverage. [Fellows, P.J. (2003) *Food Processing Technology*. 2nd Ed. CRC Press, Boca Raton, FL].

The product developer can manipulate many elements of the food, including pH, water activity, temperature (during processing, storage and shipping), and packaging, or add a final step by using preservatives. *See fig. 3*

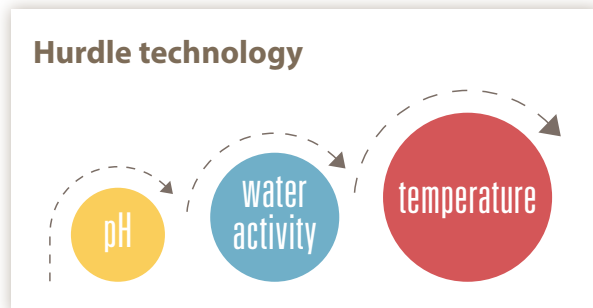


fig. 3

According to Bret Lynch, executive chef, CuliNex, Seattle, Wash., controlling the microbial load towards the beginning of the series of hurdles increases the likelihood the processor will be able to utilize natural preservatives and create a cleaner label. Whereas, if the processor doesn't utilize methods to control microbial load early in the process, this increases the likelihood the final option remaining will be an artificial preservative.

Holland says to achieve the greatest level of success, "When conducting a shelf life study, think of the worst case scenario and develop hurdles accordingly. A slight adjustment in pH for example, can make a dramatic difference."

## Lowering the pH

Microbes require a certain pH level in order to thrive; however environment and microbial type can influence the results. For example, most bacteria grow well at pH 7 while growing poorly or not at all below pH 4. In most foods and beverages a pH level of 3.7 or below helps control most pathogens. "There are still a lot of things that can grow below that pH level," warns Holland. "Just think of wine making. A little yeast or mold and microbial levels can take off." [FDA (2011). Appendix 4: *Bacterial Pathogen Growth and Inactivation*. Table A-1 *Limiting Conditions for Pathogen Growth*]. See fig. 4

### Protect against pathogens by lowering the pH with fruit

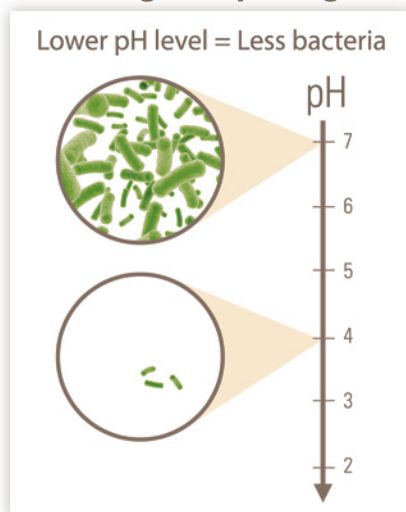


fig. 4

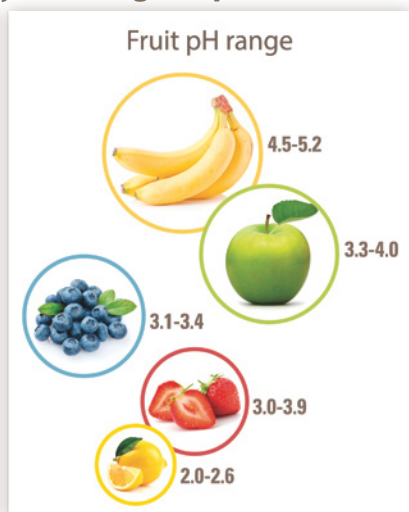


fig. 5

Fruit can help lower the pH of the total formulation. As a side note, pH also affects color. For example, it can help brighten natural reds. Lynch has used a blend of different fruit concentrates with salt in protein injections and this blend helps extend refrigerated shelf life and manage finished product color.

Fruits in the more neutral pH range such as bananas (pH 4.5-5.2) do little to help with microbial control in formulation. However, lemon juice is firmly in the acidic range with pH 2.0-2.6 and used sparingly in certain applications can help lower pH. Blueberries and strawberries are lower in pH as well and apples possess a pH range of 3.3-4.0. See fig. 5

In a beverage application, sucrose syrup as a sweetener would measure approximately pH 7. Adding a fruit concentrate can help lower the pH of the system. Pear, apple and white grape juice are often used as a base in beverages, because they are economical and don't contribute a strong flavor. But to seal the deal, "adding a bit of lemon juice will lower the pH, brighten the colors and give the taste a bit of a pop," says Holland.

## Equilibration Among Components

When considering moisture control or water activity, particularly in a baking application, it is important to note that foods will seek moisture equilibrium with their surroundings and in relationship to other ingredients.

The formulator needs to establish a target  $a_w$  and proper moisture level to reach the shelf life goals, but in order to do this, he or she has to calculate the moisture interactions between ingredients and create accordingly, or select ingredients with matching water activity levels. Holland said that most baking applications have a final water activity level around 0.70 and

Tree Top can help modulate the water activity level of the fruit inclusion provided.

According to Lynch, water activity, texture and flavor are intertwined in equilibration. In a bar, he says, fruits deliver acidity and reduce the moisture level with a focus on achieving a water activity level below 0.60, an important consideration in hurdle

*Tree Top, Inc., supplies fruits in all different varieties, forms and types, from granules to fiber, evaporated pieces, drum-dried flakes and powders, fruit juice concentrates and purées or fruit concentrates both clarified and WONF.*

technology. In addition to pH levels, fruits contribute to brix levels. Combining fig paste for example with strawberry increases brix. Higher brix mean better flavor delivery and a longer shelf life. "It's a balance," says Lynch, "because a certain level of water activity is key for chemical reactions, such as a higher level of water activity for proofing, otherwise the process won't move forward."

In a layered bar for example, with a shortbread base and a glazed topping, the fruit puree in the glaze will have a higher water activity than the base. This could soften the entire bar. The formulator might add a protective layer between them, such as a fat, lecithin or a starch as a coating or even as part of the bar.

The ingredient choice for a protective layer can add its own complications. Higher water activity (above 0.50) also accelerates lipid oxidation. In products that contain fats, such as baked goods, or utilize fat as a protective layer, this can affect the fresh quality of the finished product.

Tree Top drum-dried fruit flakes and powders, says Lynch, pose another solution. "Drum-dried pear flakes would be an excellent choice to help lower

the water activity of a fruit phase. Neutral in flavor, they won't alter the taste of the final product, but when added to a purée, will absorb the extra moisture without altering viscosity." The typical addition of pear flakes could be anywhere from one to 10 percent.

Dried fruits possess a high fiber content for water binding capabilities, but also contribute sorbitol, an important element to maintain humectancy. The sugar level of most dried fruits is 67 percent, and this can add sweetness, aid in humectancy and contribute to surface browning as well as  $a_w$  control. Acids, naturally contained in the fruit, primarily malic acid, contribute to flavor enhancement and microbial inhibition.

Fruit varieties are available as granules or pieces, such as apple bits. Tree Top, Inc. developed a line called Fruit Sensations®, which are fruit bits infused with sugar or juice concentrates. This allows for a softer texture at lower water activity levels. The product was initially developed to help solve the issue of density within a baked good such as a muffin. The infusion helps the ingredient distribute more evenly in the batter instead of rising to the top.

The drum-dried fruit powders can range from 35-mesh to as large as 4-mesh and include varieties such as apples, pears, mangos and berries, although the company can supply any fruit in a drum-dried form with mesh size according to customer specifications. Smaller mesh sizes suit applications that don't desire piece identity, while large sizes work well in an application that benefits from piece identity such as cereal with a fruit flake. Each offers functional benefits and of course nutritional components. The finer the drum-dried fruit powder the more quickly it rehydrates.

Custom and proprietary applications are available. The fully staffed research and development department is ready to help find the right inclusion or natural fruit preservative for your application. Contact Tree Top at (800) 367-6571 ext. 1435 or visit [treetoppingredients.com](http://treetoppingredients.com).

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Extend Shelf Life Naturally With Real Fruit.

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