ENHANCING ANTIOXIDANTS:
SWEET POTATO INGREDIENTS

Carolina Innovative
Food Ingredients, Inc.

Enhancing Antioxidants: Sweet Potato Ingredients

Many consumers demand healthy, functional foods and food ingredients these days, looking to their food products to deliver more than basic calories. The attached article from the Plants for Human Health Institute at North Carolina State University describes how phytochemicals contained in orange and purple sweet potato ingredients can contribute wellness benefits to human diets.

Sweet potato ingredients, depending on the variety of sweet potato employed, contain various phytochemicals that are strong antioxidants. These help with scavenging free radicals and providing anti-inflammatory properties in the body when consumed in a food product. Our sweet potato ingredients contain some of these phytochemicals and can add important functional properties to your food products.

The article describes tests conducted on sweet potato flour and sweet potato juice concentrate, showing that sweet potato ingredients are good sources of phytochemicals. Testing also shows that sweet potato ingredients help stabilize and enhance the phytochemicals in other food ingredients in blends. Finally, sensory evaluations found that sweet potato flours can contribute to appealing applications including baked goods, smoothies, and cereals.

NC STATE UNIVERSITY
Plants for Human Health
INSTITUTE

NEWS RELEASE – October 22, 2015

Media Contact: Megan Bame, Plants for Human Health Institute, Extension Associate, Communications 704-250-5461 or megan_bame@ncsu.edu

Taking Sweet Potatoes Beyond the Thanksgiving Feast

A closer look at the benefits of phytochemicals and the promise of functional food ingredients

KANNAPOLIS, N.C. – Like many other holiday foods, sweet potatoes are available year-round, but mysteriously reserved for seasonal feasts on most American tables. As fall approaches, the color palette of magazine spreads change from bright summer hues to mostly orange, burgundy, deep purple and golden yellow. Mouth-watering photos of sweet potato dishes fill the pages reserved for recipe inspiration; and often, in the corner of the page, is a box of small text, maybe a bulleted list, that reminds the reader that sweet potato is a superfood, full of nutrition and wellness benefits.

Perhaps, this is the very reason sweet potatoes are not a regular part of the menu. Once the holidays are over, the recipes are filed away and our attention moves on to the New Year and setting goals for better health. Wait. Better health? Time to put sweet potatoes back on the grocery list.

Researchers at N.C. State University's Plants for Human Health Institute (PHHI), Kannapolis, NC, recently published results of their work evaluating the phytochemical content of sweet potatoes. The research looked at concentrations of phytochemicals at harvest, after periods of storage and as a functional food ingredient.

Most commonly, fruits and vegetables, including sweet potatoes, are touted for their vitamin content, low calories or, perhaps, high fiber. Phytochemicals are different from all of those nutritional attributes. Phytochemicals have long been recognized as naturally occurring chemical compounds in plants that protect the plant from disease or cellular stress. An emerging body of research is leading to a better understanding of how phytochemicals are biologically active in the human body, conferring disease-preventing properties.

The phytochemical profile of sweet potatoes includes phenolic acids, carotenoids and anthocyanins. The amount of each of these is dependent on the variety of sweet potato with flesh color being a determining factor. While orange varieties are, by far, the most prevalent available in the United States, sweet potato varieties can vary in their flesh tone, from a carotenoid-rich deep orange to a pale yellow and, for a major boost in anthocyanins, there are also purple-flesh varieties.

Fighting Disease with Phytochemicals

Dr. Mary Ann Lila, director of the Plants for Human Health Institute, explains, "Bioactive phytochemicals, or 'phytoactives,' are natural compounds that accumulate inside an edible plant. When a fruit or vegetable is eaten, these natural compounds protect our cells against the ravages of free radicals and provide anti-inflammatory benefits that help to attenuate human disease incidence and progression." Dr. Lila has studied phytoactives in many fruit and vegetable crops, including blueberry, black currant, muscadine grapes, kale and sweet potato. Three classes of phytochemicals found in sweet potato have been extensively evaluated by Dr. Lila's lab.

- Phenolic acids are largely credited with the antioxidant and free radical scavenging ability in the sweet potato.

• Carotenoids, including beta-carotene, confer pro-vitamin A activity that prevents vitamin A deficiencies and night blindness. Beta-carotene has demonstrated antioxidant and anticancer activities and may help offer protection against coronary heart disease.

• Anthocyanins, found in purple sweet potatoes, provide free radical scavenging activity, memory-enhancing effects and protective effects for the liver. Anthocyanins help to cleanse the liver of toxins, curbing inflammation.

A Functional Food Ingredient

Dr. Mary Ann Lila, Director of the Plants for Human Health Institute, and her colleague, Dr. Mary Grace, are interested in the health benefits of sweet potato, but also in its applicability as a component of functional foods. Functional foods are food products that are given an additional health-promoting or disease-preventing function by adding a beneficial ingredient to the original food or food product. In the case of sweet potatoes, Lila's lab looked at sweet potato juice concentrate and sweet potato flour for beneficial health properties. The research included a sensory analysis that led to suggestions for several functional food applications that may add the health benefits of sweet potato phytochemicals to other foods.

Lila's research methods include using a proprietary, novel process that produces stable, dry, powdered ingredient matrices. For example, a protein-rich flour (e.g., soy, hemp or peanut) can be enriched in the lab with concentrated phytochemicals, such as fruit polyphenols. Exploring the possibilities for sweet potato functional ingredients, the Lila lab approached the research from two angles: 1) binding fruit polyphenols to a ground, sweet potato flour, and 2) binding (purple) sweet potato polyphenols to other protein-rich flours.

Both approaches produced promising results, including significantly increased concentrations of total phenolics. Three distinct matrices of sweet potato flour bound to black currant, blueberry and muscadine grape concentrates displayed up to seven times the concentration of total phenolics compared to the original fruit juices. Similarly, the purple sweet potato juice concentrate, bound respectively to defatted soy flour, light roast peanut flour and rice protein concentrate, had at least 10 times more total phenolics. Additional testing assessed stability of the phytonutrients over time finding that polyphenols, as well as the vibrant color of the fortified flours, were preserved for up to 24 weeks.

Purple sweet potato juice concentrate is a dark red color. The anthocyanins (a plant pigment responsible for red, blue and purple color in fruits and vegetables) in sweet potato are present in a form that is more color stable than the form found in most fruit sources (such as blueberries or grapes). As such, the anthocyanins from purple sweet potato have significant potential as a natural food colorant for commercial food products. In addition to replacing a synthetic food colorant, the natural food colorant could potentially introduce additional antioxidant activity to whatever food product is colored with sweet potato anthocyanins.

These innovations capture the health benefits of sweet potato in convenient, stable ingredients that can be incorporated into a wide variety of snack foods, baby foods, military rations, or even food products that stave off malnutrition in developing nations.

From the Lab to the Pantry

Pulling out those recipes and serving sweet potato dishes throughout the year would be an ideal way for individuals to enjoy the many health benefits of this root vegetable. In fact, the North

Carolina Sweet Potato Commission has even made it easy to try a new dish weekly, with their publication, "52 Ways to Love Sweet Potatoes."

However, for many, convenience is key. Sweet potatoes are not exactly a handheld food that is suitable for eating in transit or on-the-go. But that doesn't mean that consumers have to miss out on the myriad health benefits they offer. If whole, fresh or cured sweet potatoes remain relegated to holiday feasts, through the use of functional ingredients, sweet potato's health benefits may still find their way into the pantry and, more importantly, into the hands of a society facing an onslaught of chronic disease that could be ameliorated with better food choices.

As part of the Lila lab's research on sweet potato functional ingredients, the polyphenol-rich sweet potato flours were tested by a sensory evaluation panel that assessed the appearance, flavor and texture of six sweet potato matrices. Based on the sensory analysis, the expert food panel was able to make specific recommendations for products that may best suit the sweet potato flours. For example, the orange sweet potato-blueberry flour might work well in muffins, waffles or grain-based products, while the orange sweet potato-muscadine grape flour could be used in applications where muscadine or white raisin ingredients are suitable, since it had a noticeable grape flavor and aroma. The rice protein concentrate with purple sweet potato was suggested for use in smoothies and cereal bases.

The sweet potato and its phytochemical constituents, consumed as part of a healthy diet, can contribute directly to disease prevention and improved health. Functional ingredients are an innovative solution to advancing human health by conferring the benefits of phytochemicals found in fruits and vegetables without directly consuming the whole food.

Fresh vs. Stored

Another research project evaluated the phytochemical composition in four different varieties of sweet potatoes at harvest, after 4 months of storage, and after 8 months of storage. The results, published in the journal *Food Chemistry*, suggest that, in most cases, the change in the phytochemical profile was variety-dependent, and in some cases, phytochemical concentrations can even increase. The research indicates that the antioxidant and anti-inflammatory activity was retained even after long-term storage. The purple sweet potato variety showed the most antioxidant and anti-inflammatory bioactivity, compared to the orange and yellow varieties, even after eight months of storage.

North Carolina produces 40 percent of the sweet potatoes grown in the United States. The harvest season is September through November, during which time a small percentage of the root crop are sold fresh. Most sweet potatoes undergo a weeklong curing process, which allows the starches to convert to sugar. Cured sweet potatoes, which are sweeter than those fresh-harvested, can be stored for up to 10 months (essentially, until next year's harvest).

Research Cited:

Grace, Mary H., Gad G. Yousef, Sally J. Gustafson, Van-Den Truong, G. Craig Yencho, and Mary Ann Lila, 2014. Phytochemical changes in phenolics, anthocyanins, ascorbic acid, and carotenoids associated with sweetpotato storage and impacts on bioactive properties, Food Chemistry, 145:717-724.

Grace, Mary H. An. N. Truong, Van-Den Truong, Ilya Raskin, and Mary Ann Lila, 2015. Novel value-added uses for sweet potato juice and flour in polyphenol- and protein-enriched functional food ingredients, Food Science & Nutrition, 3(5):415-424.

Lila, Mary Ann and Mary H. Grace, 2015. Analysis of Phenolics in Sweet Potato Juice Concentrate, Report to Carolina Innovative Food Ingredients, Inc. and Micro Thermics, Inc.