Healthy Living: DDG's New Function(role)

Distillers grains may find a new market for extracted protein and fiber to be used in functional foods.

By Luke Geiver | May

New research in the $60 billion functional food industry, coupled with a study from The Boyd Company Inc., a New Jersey-based location consulting firm, points to a promising new role for distillers grains (DDG): improving our health. Though distillers grains today find their way into animal feed, John Boyd Jr., vice president of The Boyd Company, believes the coproduct's potential for improving human health will provide a new function above and beyond what we think the ethanol coproduct can be used for today. Boyd's study, "Functional Food Industry Costs and Ties to Ethanol Coproduct," compares the cost of operating a functional food facility in 35 U.S. and Canadian cities. The study outlines the relationship between DDG and the functional food industry, exploring possible partnerships between the food industry and ethanol producers. "This is a new way for thinking about the ethanol industry," Boyd says, "This is a way to distinguish a market."

A Functional Purpose

The functional food market has existed in countries such as Japan for some time now, according to Boyd. In February 2009, the Functional Food Centre at Oxford Brookes University, in England, began working exclusively with the development, research and promotion of functional foods. "A functional food is a food system that has an advantage to your health, over and beyond the food's normal health contributions," explains center director Jeya Henry. "Take cranberries for example. We didn't always know what amounts of the fruit contributed to our health. We now know the quantity needed for health benefits."

Henry's work utilizes this understanding of the quantities required for a food to aid in health issues such as reducing high cholesterol or in boosting low fiber counts. Henry focuses on using the selective properties of certain foods to make optimal blends with the properties of another, resulting in functional foods with added protein, extra fiber or extracts, all of which boost the food's contribution towards wellness. Although the use and development of functional foods is not new, the use of DDG is. Henry believes the idea is a good one and worthy of support. "Are there things that we can extract to use for more than just feeding pigs and cattle?" Boyd answers in the affirmative. "This is a cutting edge area at the academic level, but people are living longer and want to be healthier," Boyd says. The need to be healthier, however, is only one aspect driving the use of ethanol coproduct in functional foods forward.

Food science researchers at South Dakota State University, Brookings, the "Cadillac" of universities engaging in end-use applications for agricultural materials, as Boyd says, have begun answering the question already. Padu Krishnan, a professor in the department of nutrition, food science and hospitality at SDSU, is developing a functional flour using DDG. Krishnan explains that as feed markets become

saturated, new avenues and markets should be explored for alternative revenue streams. "The use of corn as a food crop is not an alien concept," he says, "However, the use of ethanol residues and byproducts by the food industry has been slow in developing." Krishnan points out the importance of the venture for ethanol producers. "Finding economic value for an underutilized agricultural material will reduce the cost of ethanol production and directly benefit ethanol producers," Krishnan says.

DDG's New Function

Krishnan is working on a higher value use for DDG in a flour blend he's named Alice-DDG. "Alice is a variety of white wheat flour that we produce at SDSU for the Asian noodle market," he says, "but it has tremendous possibilities as a bread wheat also." The promise of Alice-DDG is related directly to the value of important corn components. After the removal of fermentable carbohydrates and the drying process during the ethanol production those components are concentrated, Krishnan says. "The key things in distillers grain are the things that came from the corn to begin with."

The concentration of both protein and fiber in the corn gives the DDG a quality the Boyd study says will be sought after for those producing functional foods, and in the case of the SDSU team, is already being utilized. After grinding the DDG into a fine flour, it is mixed in varying proportions with the wheat flour to create different versions of Alice-DDG. The composition and physical properties of the developed flour were determined through standard laboratory methods. The results showed the product to have very low heavy metal and mycotoxin levels, making the Alice-DDG flour safe for human consumption with its added fiber and protein levels.

Krishnan notes corn is already a food and people should not reject eating a modified food if the added material comes from a pre-existing, food-based substance. "There are many unconventional sources of fiber with various uses in foods like guar gum, xanthan, carrageenan, locust bean gum, etc., but corn-based dietary fiber' has a familiar ring to it," Krishnan says. "Our research is intended to strike a balance between ingredient functionality and aesthetic traits that make a food product desirable." Part of the goal for Krishnan and his team is to create a DDG food ingredient that remains flavor neutral, color neutral, and odor neutral to maintain the ingredient's versatility for introduction into multiple products, something he notes, sawdust can't do.

As the research by the SDSU food science "Cadillac" team continues, Krishnan expects good results. "Our ultimate goal is to use part of the DDG stream in an ethanol plant for the production of wholesome, food-grade DDG that can meet the specifications of a food ingredient."

Boyd expects this goal will be seen sooner than later. He projects a high amount of venture capitalist money to go into the functional food market. "In five years we won't be able to go to a supermarket without seeing other alternatives," he says. "Consumers want it, people want to eat food that promotes healthy living. We project the functional food industry to grow by 25 percent over the next five years." The growth of the ethanol industry supplying food companies with food grade DDG may, however, be much further off, says Scott Kohl, technical director of research and development at ICM Inc. He recognizes the possible partnership between functional food and ethanol coproducts. Kohl has worked

on food production concepts for Lifeline Foods LLC, a joint venture of ICM and AgraMarke Quality Grains, a farmer cooperative. Lifeline utilizes ICM's dry fractionation technology to separate the endosperm, germ and pericarp into usable fractions, with the remaining portion of the endosperm being used for ethanol production. Kohl says there are difficulties with the functional food concept. "It is very unlikely for an ethanol plant to make either a food product or, in this case, a functional product. But, what a plant could do is make raw ingredients that a manufacturer could put into a product." Kohl explains one of the main reasons for the lack of ethanol plants producing food relates directly to regulations in the food industry. "The average ethanol plant can't do any of these things, producing food on site," Kohl says, "because you have to keep the corn in a food grade state. Regulations in the food industry would make this very difficult." He suggests that front-end fractionation may be the best approach to developing functional foods. "Lifeline is a facility that does this," he explains. "The same process could be used to produce DDG for functional food use. Because of sanitation issues and food regulation it would be much easier."

Krishnan explains his approach is to create a food ingredient, and not a food. To produce Alice-DDG, Krishnan addressed the food regulations in the first steps of his process, preparing the DDG by washing it with a variety of food grade solvents and sterilizing the flour in a portion-controlled sealed can in a food-grade steam sterilizer.

As Kohl infers, the idea of an ethanol plant producing food onsite may be unrealistic, but the Boyd study paints a positive outlook for functional foods from DDG. "The massive increase in ethanol production in the U.S. has also resulted in a similar increase in its most valuable coproduct: DDG," the report says, and the future mass production of nutrient rich ingredients from DDG is on the way. Not surprisingly, the Boyd report indicates the best places for food facility operations are located in the highest ethanol-producing Midwestern states with Sioux Falls, S.D., topping the list. The report also lists major food and beverage companies heavily involved in functional food research which include General Mills Inc., ConAgra Inc., PepsiCo, Kraft Foods Inc., and many others. Bioscience firms Syngenta, Monsanto Co., DuPont and others are also involved in researching the concept, according to the report.

Lifeline Foods promotes the idea of "Fueling America, Feeding the World," and Boyd would not disagree. On the future of ethanol plants helping to feed the world and do it in a way that provides added human benefits, Boyd believes that DDG usage and functional food companies are a "perfect marriage." For researchers Henry and Krishnan, using ethanol coproducts for functional foods seems to be a healthy one. EP

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New DDG process could fight world hunger

By Craig A. Johnson | September 15, 2009

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South Dakota State University Food Science graduate student, Sowmya Arra, has developed a process where dried distillers grains (DDGs) can be processed into a low-cost flour rich in fiber and protein. The ethanol coproduct has the potential to fight hunger by serving as a sustainable source of protein for developing countries.

Working in collaboration with mentors and advisers Padu Krishnan and Kurt Rosentrater, Arra's work earned her international recognition this summer when she received first place in the graduate research poster competition at the Institute of Food Technologists Conference, held in Anaheim, Calif., in June. Arra was one of 50 graduate students presenting posters in the product development category at the conference, which drew researchers and technologists from more than 80 countries around the world.

Arra had to create a process of heating, vacuum chamber treatment, grinding and sterilization resulting in a product more wholesome than flour. Post-processed DDG closely resembles wheat flour, and could be used as a flour substitute, according to Arra.

"By making the ingredient as bland, color-neutral and nutrient-enriched as possible, we can offer a product that may have international feeding applications," Arra said. She is a native of Hyderabad, India, and hopes to see her food-grade DDG marketed to Third-World countries for low-cost bread products that could help fight world hunger.

"This award is testimonial to the caliber of Sowmya's work and the significance of the research," said SDSU department of food science professor Padmanaban Krishnan, Arra's adviser. "This puts SDSU and South Dakota on the map for innovative food research."

After completing her advanced degree, Arra hopes to work in research and development for the food industry. She received her bachelor's degree in microbiology and genetics from Osmania University, Hyderabad, and is currently working toward her master's degree in food science at SDSU.

SDSU researcher: Ethanol co-product boosts nutrition in Asian flatbread

Tuesday, August 09, 2011

South Dakota State University research shows a traditional Asian flatbread called chapathi, or chapati, gets a big boost in protein and fiber when fortified with food-grade distillers grains.

SDSU food scientist Padu Krishnan said it is one example of the ways in which distillers dried grains with solubles, or DDGS, can help improve human nutrition worldwide. DDGS is produced as a co-product when processing corn into ethanol, so corn producers from the American Midwest and elsewhere could tap a vast new market if manufacturers begin using it to fortify products in human diets.

Krishnan and his student, Sowmya Arra, worked with Kurt Rosentrater of the USDA Agricultural Research Service's North Central Agricultural Research Laboratory on the project. In lab studies they found that using DDGS to make up 10 percent of the dough in chapathi, an Asian whole wheat unleavened bread eaten in South Asia and East Africa, boosted the fiber from 2.9 percent to 7.8 percent. Using 20 percent DDGS in the dough increased the fiber to 10.3 percent.

Similarly, protein increased from 10.5 to 12.9 percent when they used DDGS to make up 10 percent of the dough in chapathi. Using 20 percent DDGS increased the protein to 15.3 percent.

In the United States, DDGS is most often fed to livestock. But Krishnan, a cereal chemist, has been studying and writing about the possibility of using DDGS in human diets since the early 1990s. Especially now with new state-of-the-art ethanol plants coming online in recent years, Krishnan said, the ethanol industry is well poised to make food-grade DDGS.

DDGS is ideal for including in human diets because it is rich in dietary fiber, at 40 percent, and also in protein, at 36.8 percent.

Krishnan said the results from the SDSU lab studies were enough to catch the attention of the food industry because it suggests a strategy to bolster diets with a bland but highly nutritious ingredient that won't interfere with the taste of foods. Chapathies and naan, another kind of flatbread, made with 20 percent DDG were well accepted by a taste panel.

Krishnan said it's one example of how SDSU's Department of Nutrition, Food Science, and Hospitality is

exploring the use of locally produced South Dakota products such as corn to meet nutritional demands worldwide.

Adding DDGS to the dough did make chapathies significantly darker particularly at the 20 percent substitution, Krishnan notes.

“However, the use of South Dakota white wheats such as ‘Alice’ and ‘Wendy’ in the formulation gives us some leeway when color is the aesthetic criterion,” Krishnan said.

The shelf life of chapathies at room temperature was one week without preservatives and refrigeration, he adds.

Krishnan used flour from white winter wheat developed by South Dakota State University plant breeders in his experiments. He used DDGS supplied by VeraSun Energy, and dough additives from MGP Ingredients Inc. of Atchison, Kan. The project has received support from the South Dakota Agricultural Experiment Station, the North Central Agricultural Research Laboratory of the U.S. Department of Agriculture’s Agricultural Research Service, and the South Dakota Wheat Commission.

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Cereal grains food science professor receives grant to bring corn co-product to market

Thursday, October 23, 2014

Padu Krishnan and students in his new food product development class test run the new cookie depositing unit to demonstrate how new ingredients perform in mass production. New ingredients like food-grade

South Dakota State University food science professor Padmanaban Krishnan received a four-year grant geared toward getting corn co-products to the food market.

With a $576,000 project budget for the Minnesota Corn Growers Association grant, Krishnan will work with the food and ethanol industries with the goal of bringing food-grade dried distiller’s grain (DDG) to the commercial marketplace.

Both industries will need research data on food ingredient quality standards, commercial processing steps, scale-up production and cost-effectiveness.

dried distiller's grain will need to perform well in conventional food processing equipment. Pictured from left to right are Lisa Purcell, nutrition and food science exchange student from the University of Western Sydney; Gatlin Miller, nutrition and food science student from Mitchell; Jigyasha Mishra, graduate research assistant from Nepal; observer and food science professor C.Y. Wang; and food science professor Krishnan.

Regulatory aspects of such an ingredient will also be pursed. Much of the research will focus on providing answers to research questions posed by the industry.

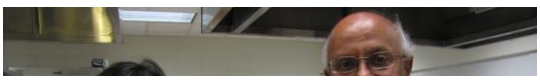
Krishnan's work over the past 20 years laid the pathway for the grant when the concept of DDG use in food received national attention in 2012 and 2013. Following that, the Minnesota Corn Growers Association board of directors invited Krishnan to make a presentation at their meeting. They then invited a proposal from Krishnan.

"There is intrinsic nutritional value in something that is 38 percent protein and 40 percent dietary fiber," said Krishnan. "Everywhere in the world someone needs protein for nutrition and someone needs dietary fiber for health and disease prevention."

According to Krishnan, other grant outcomes will include gaining new knowledge on developing low-glycemic index ingredients in diabetic diets, isolation and recovery of high-value nutraceutical substances from corn pigments, high protein supplements for international feeding programs and gluten-free products.

Krishnan's work is not only in adding health value to baked foods, but also in increasing corn's economic value to farmers and the marketplace.

DDG comes from the ethanol-making process. Currently, one third of the corn bushel, which is 56 pounds, is made into distiller's grain, one third is made into ethanol, and the other third is released into the air as carbon dioxide. This co-product, CO_2, can be trapped and used as a solvent in the processing steps for DDG. Under certain conditions of pressure and temperature, CO_2 becomes a powerful solvent. This phenomenon is called supercritical fluid extraction. "Not different than using spritzer or club soda to remove stains from linen," Krishnan said.



Krishnan wants to create a food-grade product for use in

Jigyasha Mishra, graduate food science student, left, holds a bag of semi-processed dried distiller's grain and Padu Krishnan, right, holds a bag of food-grade DDG, ready for food formulation.

baked food items and ready to eat cereals. Krishnan then grinds the DDG into flour and sterilizes it. The DDG is then food-grade and ready for use in the test kitchen. “There isn’t a food item yet on the market containing DDG, but the research is geared toward getting us there,” said Krishnan.

DDG can then be substituted for flour or added into baked goods, tortillas, pizza crust, noodles and more to increase fiber and protein content, while reducing calories.

“The trick is to add modest amounts in a whole range of foods as opposed to large amounts being added to select foods,” said Krishnan. Flat breads, for example, can easily handle up to 20 percent DDG, while cookies and bread can handle 6 to 10 percent.

Unprocessed dried distiller's grain is shown on the left, and processed DDG is on the right.

When substituting DDG in baked goods, taste is a crucial, along with shelf-stability and sensory characteristics.

Krishnan has baked many different food items using DDG, and the taste-test results almost always come out favorably. He has faith in the science behind it, and plans to produce a nutritional food product that consumers trust and enjoy.

“DDG is currently priced at $95 per ton. It used to be sold at $269 per pound not too long ago,” Krishnan said. “At the current cost of 5 cents per pound for the raw material, it represents a product that shows immense potential for economic improvement.

“We are sitting on gold mines. DDG could be used to solve the world’s food problems as well as increase farmer profitability.”