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Permeate may hold potential to address sodium challenge

By Johanna Nelson

MADISON, Wis. — Fueled by concerns from government officials, medical professionals and a growing number of consumers, sodium reduction has become a hot topic within the food industry.

Finding reduced-sodium alternatives that satisfy food safety, dietary standards and consumer acceptance can be challenging, but researchers have found considerable potential with dried dairy ingredients.

“Earlier this year, when the sodium issue became much more popular, Dairy Management Inc. (DMI) asked if there was anything in the dairy world we could potentially use,” says K.J. Burrington, dairy ingredient applications coordinator, Wisconsin Center for Dairy Research (CDR). “Our answer was yes — we have permeate.”

Deproteinized whey (DPW) is the dried permeate stream left behind when more valuable whey proteins are separated and removed by a filtration process, according to CDR. Permeate also remains behind from the ultrafiltration of milk.

Delactosed permeate (DLP) is the by-product of processing permeate to remove lactose, and has less lactose and more ash than permeate.

CDR first began working with

permeate about 10 years ago, exploring what types of applications permeate could potentially be used in. Burrington says CDR chose to focus on baked products initially because permeate contains a lot of lactose (about 85 percent).

Lactose provides a unique functionality in baked goods because it participates in the Maillard reaction (a chemical reaction between an amino acid and a reducing sugar in the presence of heat), which results in surface browning.

“Intuitively, we thought about browning and similar attributes because we were working with an ingredient with a lot of lactose,” Burrington says. “Baked products benefit from nice browning characteristics.”

CDR began researching pound cake, adding about 5 percent permeate while removing all of the salt.

“We used unsalted butter and had to remove all of the added salt to get the product to taste like a good pound cake should,” says Burrington, noting this was before the “sodium challenge” had begun gaining momentum.

Since CDR conducted its initial research, interest in sodium reduction has grown, and the center has continued to look into applications for permeate, which contains about 0.6 percent sodium. Burrington notes its “salty” flavor really comes from min-

eral salts such as calcium phosphate, magnesium salt and potassium salt.

“You have a combination of mineral salt and non-protein nitrogen compounds,” she adds. “We believe that both of those are working to help enhance the salty taste and overall flavor.”

In addition, CDR notes that recent research published in the *Journal of Biological Chemistry* identifies a role for calcium-sensing receptors in taste perception. According to research, humans can identify five basic tastes: sweet, sour, bitter and umami (savoryness). A variety of substances also enhance these tastes, including calcium, which has been found to invoke what is known as the kokumi taste. While tasteless on its own, the kokumi taste can enhance the umami taste in the presence of other substances.

Building off of these findings, CDR has expanded its focus to include baked goods such as muffins, scones, cookies, snack cakes, bread and pizza crust. Burrington notes pizza crust is a very good application because crust — along with cheese and sauce — all contribute to pizza’s sodium level, making it an area of focus when it comes to reducing sodium.

At the 2010 Dairy Innovation Forum and the Dairy Ingredient Symposium, the center’s Dairy Ingredients group offered attendees samples

of three different formulations of almond apricot muffins: a control muffin, a muffin with DPW and a muffin with DLP. The overwhelming favorite was the muffin with DPW, according to CDR.

“Surprisingly, you can use a significant amount of DPW (5 to 8 percent) in products like muffins, scones and cookies and maintain original quality, or even surpass it,” CDR researchers say. “Permeate improves the surface browning and the crumb texture for these baked goods while providing a clean dairy flavor. However, there is another significant benefit gained from using permeate in these products — you can leave out the salt.”

During the International Food Technologist’s (IFT) annual meeting and food expo earlier this year, CDR introduced a “breakfast bite,” which was featured at DMI’s booth. The product consists of an egg and cheese sandwich enclosed in bread dough vs. some of the commercial-type products that have more of a crisp dough on the outside. Burrington notes these types of products are typically very high in sodium, while CDR’s version has about half the sodium.

“In our outer bread dough, we reduced sodium quite a lot by using permeate,” she says.

In many cases, CDR has been able to achieve 50-percent reduction of sodium, although Burrington notes most companies are probably more interested in about a 25-percent reduction.

In addition, she notes another benefit to using permeate is that it displaces some other ingredients, which are oftentimes more expensive.

“You can very often get a cost reduction because many of the ingredients are quite expensive,” Burrington says. “We’re not necessarily doing a one-to-one replacement of salt in terms of weight, but we usually use a lot

more permeate than salt. It’s very economical, and often reduces cost of the whole formula.”

While the addition of permeate does not have a significant effect on the product’s taste or texture, Burrington notes it sometimes can bump up the calcium content a little bit.

“One thing you may notice is that there are more carbs listed because of lactose content,” she adds. “Otherwise, there’s not a dramatic difference.”

CDR also has been looking into ways to reduce the sodium content of natural and process cheese; however, permeate would not work quite as well in natural cheese as compared to other applications. Burrington says some of the difficulty lies in the fact that sodium is much more important in cheese because it serves a number of different functions.

According to John Jaeggi, coordinator of CDR’s Cheese Industry and Applications Program, salt is relatively cheap, helps with flavor, controls moisture and pH, and helps to control growth of undesirable bacteria in cheese.

Currently, different ingredients are being experimented with to try to address the food safety and flavor challenges posed when sodium is reduced. For example, potassium chloride blends have been added; however this compound is known for its bitterness and stringency. Jaeggi, who discussed current CDR research at an International Cheese Technology Exposition session earlier this year, notes proprietary blends may help, and current work is being done on masking agents.

Additional options include exploring other blends and cultures. For example, CDR has created a low-sodium Cheddar using a thermophilic culture, yeast extract, dairy mineral and 25 percent normal sodium addition. A reduced-sodium, lowfat

Cheddar also has been produced using a thermophilic culture, lipase addition, spice blend and a 70:30 ratio of sodium chloride to potassium chloride. Jaeggi notes the spices may mask the bitterness and astringency of potassium chloride.

Currently, some companies are pursuing reduced-sodium options, including Kraft Foods. Earlier this year, the company announced plans to reduce sodium by an average of 10 percent across its North American portfolio throughout the next two years. The company plans to lower sodium levels in a number of its products including its Easy Mac Cups, which are slated to be reduced by 20 percent.

Sargento Foods, Plymouth, Wis., also has made sodium reduction a focus, introducing 25-percent reduced sodium versions of its slices, shreds and snack cheeses.

And while permeate does not work as well with natural cheese, Burrington says there may be opportunity in the process cheese category. CDR also sees opportunity when it comes to sauces, snack seasonings, soups and processed meats.

Currently, the center has been discussing the potential permeates hold with a number of different food manufacturers. Burrington notes IFT gave the center an opportunity to further disseminate a lot of information to a lot more people.

And although reception has been positive, Burrington says she would be surprised to see anyone producing something before next year.

“It always takes quite a long time when you work with companies that are trying to formulate their own products. They have to go through a lot of work to figure out if it’s going to work,” Burrington says. “We will continue working to expand the types of food products that can use permeate to reduce sodium.” CMN