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Alternative Uses for Surplus Skim Milk and Dairy Operation Byproducts in Vermont (Posted March 14, 2017)

Due to technological innovation, Vermont's dairy farms are producing milk at high rates.¹ In 2008, Vermont cow dairy farms produced 2.57 billion pounds of milk. Vermont cow milk production increased to 2.724 billion in 2016.² The increase in dairy farm milk production has yielded a surplus of dairy operation byproducts, including liquid skim milk. According to the Vermont Senate Committee on Agriculture, the surplus has had a particularly negative impact on non-organic farms housing more than 100 cows.³ Some Vermont dairy farmers without the means to produce additional food products have been forced to dispose of their skim milk surplus. This report explores alternative dairy goods and agricultural uses for skim milk liquid excess and other dairy operation byproducts.⁴

Solutions

Condensed Milk and Milk Powder

Condensed milk and milk powder made from skim milk have a quick production time and can be made with minimal machinery. The equipment needed to create these products consists of an evaporator and a finisher, machinery that some Vermont dairy processors currently have. According to the Director of Operations at the St. Albans Co-Op, it is cost prohibitive to send skim milk surplus out for processing; evaporating and condensing the surplus is the most profitable option at their creamery.⁵ Additionally, these products have a longer shelf life than

¹ Bob Parsons, "Vermont's Dairy Sector: Is There a Sustainable Future for the 800 lb. Gorilla?" *University of Vermont Center for Rural Studies*, Opportunities for Agriculture Working Paper Series 1, no. 4 (2010): 3, accessed March 2, 2017, <http://ageconsearch.umn.edu/bitstream/201256/2/WorkingPaperParsons-web.pdf>.

² Dr. Kristin Haas (Vermont Agency of Agriculture, Food, and Markets), in discussion with authors, February 2, 2017.

³ Senator Robert Starr (Vermont Senate Committee on Agriculture), in discussion with authors, February 2, 2017.

⁴ The Legislature requested information on dairy industry practices in Ireland and New Zealand. Ireland is in the process of a large dairy industry expansion and New Zealand is a major producer of whole milk powder. Nevertheless, there was no credible information related to either country that proved beneficial to the analysis of alternative dairy products and the skim milk surplus in Vermont.

⁵ Rob Hirss (Operations Manager, St. Albans Co-Op, VT), in discussion with authors, February 9, 2017.

fluid milk. Depending on storage conditions, condensed milk has a shelf life between one and two years and milk powder has a shelf life between three and five years.⁶ Milk powder can also be used to create products such as ice cream mix and infant formula.

In 2013, U.S. exports of skim milk powder increased 254 percent compared to the same period in 2012, indicating that there is a large and seemingly growing market for milk powder abroad.⁷ Additionally, the United States Department of Agriculture (USDA) projects that the demand for U.S. skim milk powder will remain strong in 2017, particularly in Mexican and Asian markets.⁸

Ultra-High-Temperature Milk

Ultra-High-Temperature (UHT) milk typically receives a heat treatment of 280°F for two seconds, producing a “nearly ‘sterile’” product that has a shelf life of at least six months and is shelf stable.⁹ In comparison to conventional milk, UHT milk can be transported for longer periods and can be stored without refrigeration; however, the intensity of the heat treatment results in flavor defects and UHT requires high-cost packaging.¹⁰ There is a large market for UHT milk in China; its imports of fluid milk (primarily in the form of UHT) have increased 51 percent from 2015 to 2016.¹¹ A study conducted in 2007 suggested that if UHT production equipment was distributed to rural areas, dairy farms could “simplify deliveries, use simple and cheaper distribution vehicles and eliminate return of unsold products.”¹²

Whey Protein

There are numerous uses for whey protein, a byproduct of cheese production. For instance, whey protein can be used as fertilizer to improve nutrient availability on cropland.¹³ Whey

⁶ “Dried Milk,” *Utah State University Extension*, 2016, accessed February 10, 2017, <http://extension.usu.edu/foodstorage/html/dried-milk>.

⁷ “Dairy: World Markets and Trade,” *United States Department of Agriculture*, December 2013, 7, <http://usda.mannlib.cornell.edu/usda/fas/dairy-market//2010s/2013/dairy-market-12-13-2013.pdf>.

⁸ “Dairy: World Markets and Trade,” *United States Department of Agriculture*, December 2016, 8, <http://usda.mannlib.cornell.edu/usda/fas/dairy-market/2010s/2016/dairy-market-12-16-2016.pdf>; Jim Mulhern, “Dairy Trade in the Trump Era,” *National Milk Producers Federation*, February 2, 2017, <http://www.nmpf.org/latest-news/ceo-corner/feb-2017/dairy-trade-trump-era>. The CEO of the National Milk Producers Federation stated that the Trump administration’s proposed alterations to the North American Free Trade Agreement could harm the dairy trade relationship between Mexico and the United States.

⁹ “Dairy Foods Science Notes,” *Cornell University Department of Food Science*, accessed February 8, 2017, <https://foodsafety.foodscience.cornell.edu/sites/foodsafety.foodscience.cornell.edu/files/shared/documents/CU-DFScience-Notes-Milk-Pasteurization-UltraP-10-10.pdf>.

¹⁰ “Dairy Foods Science Notes,” *Cornell University Department of Food Science*; Kishor Gedam, Rajendra Prasad, and V.K. Vijay, “The Study on UHT Processing of Milk: A Versatile Option for Rural Sector,” *World Journal of Dairy & Food Sciences*, 2007, 53, accessed February 12, 2017, [https://www.idosi.org/wjdfs/wjdfs2\(2\)/2.pdf](https://www.idosi.org/wjdfs/wjdfs2(2)/2.pdf).

¹¹ “Dairy: World Markets and Trade,” *United States Department of Agriculture*, December 2016, 6-7, <http://usda.mannlib.cornell.edu/usda/fas/dairy-market/2010s/2016/dairy-market-12-16-2016.pdf>.

¹² Gedam et al, “The Study on UHT Processing of Milk: A Versatile Option for Rural Sector,” 2007, 49.

¹³ Northeast Organic Farming Association of Vermont, “Vermont Organic Farmers Certification Guidelines 2016,” (2016): 23, accessed February 15, 2017,

protein is also widely used as a supplement to animal feed, as it “has one of the highest quality natural proteins.”¹⁴ According to Agri-Mark, a cooperative with four processing plants in the Northeast Region (New Hampshire, New York, Vermont [2]), whey protein concentrate is either manufactured or shipped to its facility located in Middlebury, Vermont and then distributed internationally.¹⁵

Feed for Animals

The protein and lactose content in dried skim milk can supplement traditional animal feed in a variety of ways. For example, dried skim milk can be used as a milk replacer for calves and an additive to soybeans (a swine feed staple); however, incorporating dried skim milk into the diets of swine and bovine can be expensive.¹⁶ Additionally, consumers have expressed concern that skim milk supplements could increase the chances of microbial growth strains such as *E. coli* and *Lactobacillus*.¹⁷ Despite that, a study conducted in 2004 found no trace levels of microbiota in fecal matter of growing-finishing pigs fed 10 percent dried skim milk added to soybeans.¹⁸ In general, whey protein can be a useful supplement to cattle, swine, and poultry feed at the appropriate levels.

Dairy Cattle

Many different criteria (e.g. age of cow, stress level of cow) affect the determination of the appropriate proportions of whey protein in dairy cattle diets.¹⁹ Moreover, it is important to introduce whey protein in small quantities, as cattle can experience difficulty digesting large quantities of lactose.²⁰

http://nofavt.org/sites/default/files/files/resources/2016_vof_certification_guidelines.pdf; Hirss, interview; “Skim Milk Powder,” *Canadian Dairy Commission*, 2011. The use of whey protein as a fertilizer must be approved by the Northeast Organic Farming Association of Vermont in order to be considered organic.

¹⁴ William Wendorff, “Uses of Whey in the Farmstead Setting,” *Wisconsin Department of Agriculture, Trade, and Consumer Protection*, (September 2008): 10, http://future.aae.wisc.edu/publications/farmstead_whey_use.pdf; Walter Hurley, “Milk Composition: Proteins,” *University of Illinois Department of Animal Sciences*, 2010, accessed February 10, 2017, http://ansci.illinois.edu/static/ansc438/Milkcompsynth/milkcomp_protein.html.

¹⁵ “Our plants,” *Agri-Mark Family Dairy Farms*, 2017, accessed February 10, 2017, https://www.agrimark.net/our_plants/.

¹⁶ “Evaluating Milk Replacer,” *Veal Farmers of Ontario*, 2015, accessed February 10, 2017, <http://calfcare.ca/calf-feeding/evaluating-milk-replacer/>; “Skim Milk Powder,” *Canadian Dairy Commission*, 2011, accessed February 20, 2017, <http://www.milkingredients.ca/index-eng.php?id=192#tphp>; J.T. Yen, J.E. Wells, and D.N. Miller, “Dried Skim Milk as a Replacement for Soybean Meal in Growing-Finishing Diets: Effects on Growth Performance, Apparent Total-Tract Nitrogen Digestibility, Urinary and Fecal Nitrogen Excretion, and Carcass Traits in pigs 1,2,” *Journal of Animal Science* 82, no. 11 (November 2004): 3344, 3338. Many factors must be considered when determining the best skim milk product for calves, including age and fat and protein content. One source called for the U.S. government to subsidize dried skim milk products for agricultural use. See Yen, Wells, and Miller, “Dried Skim Milk,” 3338.

¹⁷ “Evaluating Milk Replacer,” *Veal Farmers of Ontario*, 2015.

¹⁸ Yen, Wells, and Miller, “Dried Skim Milk,” 3338. A growing-finishing pig is a pig whose market weight is between approximately 40 pounds and 200 pounds.

¹⁹ “Skim Milk Powder,” *Canadian Dairy Commission*, 2011.

²⁰ William Wendorff, “Uses of Whey in the Farmstead Setting,” 10.

Beef Cattle

In liquid form, whey protein can be used to promote weight gain in beef cattle.²¹

Swine

Whey protein can be incorporated into the diets of swine that weigh over 60 pounds.²² The suggested amount of additive whey is between 20-30 percent, as some swine experience digestive problems with higher concentrations.²³

Poultry

The consumption of whey protein does not produce significant weight gain in poultry; however, one study concluded that adding a small amount of whey to poultry drinking water caused a decrease in *Salmonella* bacteria.²⁴

Conclusion

Surplus skim milk has a variety of alternative uses and applications in Vermont. Skim milk can be manufactured into condensed milk, milk powder, or UHT milk, all of which are profitable on the global market.²⁵ Additionally, dairy operation byproducts, such as whey protein, can be used as a fertilizer or dietary supplement for livestock.

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Disclaimer: This report has been compiled by undergraduate students at the University of Vermont under the supervision of Professor Anthony Jack Gierzynski, Professor Alec Ewald and Professor Eileen Burgin. The material contained in the report does not reflect the official policy of the University of Vermont.

²¹ William Wendorff, "Uses of Whey in the Farmstead Setting," 11. The USDA has conducted studies indicating the positive outcomes of whey protein in animal feed, particularly in steers and heifers. See, for example, Yen, Wells, and Miller, "Dried Skim Milk," 3338.

²² William Wendorff, "Uses of Whey in the Farmstead Setting," 12.

²³ William Wendorff, "Uses of Whey in the Farmstead Setting," 12; H.W. Modler, "The Use of Whey as Animal Feed and Fertilizer," *Bulletin of the International Dairy Federation* no. 212 (1987): 111–24, accessed February 20, 2017; D.J. Schingoethe, "Whey Utilization in Animal Feeding: A Summary and Evaluation," *Journal of Dairy Science* (1976): 556–70, accessed February 5, 2017.

²⁴ J.R. DeLoach and D.E. Corrier, "Dietary Lactose Reduces Salmonella Concentration and Colonization Poultry" (paper presented at ADPI/CDR Dairy Products Technical Conference, April 25-26, 1990): 109–14.

²⁵ "Dairy: World Markets and Trade," *United States Department of Agriculture*, 2013, 7; "Dairy: World Markets and Trade," *United States Department of Agriculture*, 2016, 6-8.