



UW Dairy Pipeline

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A Technical Update for Dairy Manufacturers

A Word from UW-Extension

by Bill Wendorff, PhD

Since March 1989 I have been the Food Science Extension professor whose primary responsibility is handling issues concerning the cheese industry of our state. Coming from Red Arrow Products Co. in Manitowoc where I worked as technical director, I am pleased to return to the UW where I received my training in dairy and food industries in the 1960's.

During the past several months I have been pleased to find the tremendous resource of individuals committed to serving the needs of the Wisconsin dairy processor and manufacturer. Teaming up with the numerous organizations within and outside the UW, I am confident the myriad of needs and questions facing the industry will be serviced.

One of the tools for working with industry will be this *fact sheet* which will be published cooperatively with the Center for Dairy Research here at the UW. We will publish 3 to 4 times per year depending upon the facts we uncover to pipe out to you. This bulletin is designed so that you can store each issue in a three-ring binder and refer to it as necessary.

We hope to see the dairy expert resources more consolidated thereby making it easier to address your needs. With the Center for Dairy Research I hope to design workshops, seminars, and conferences of interest to you. We will be depending upon feedback from you to make our efforts a success. Please call me or Sarah Quinones at the number below if you have ideas or questions for us to address.

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Landspreading Whey Permeate:

Watch the Parameters

by Bill Wendorff

In 1988, U.S. cheesemakers produced over 6 billion pounds of cheese, including cottage cheese. This resulted in over 53 billion pounds of whey being produced as a byproduct from that cheese production. Of the total whey produced, about 50-60% was processed into edible whey or modified whey products for the food or feed industries. The remaining 40-50% of the whey was disposed of by various methods at a cost to the plant.

One of the major methods for disposal of whey in Wisconsin has been the use of whey on agricultural land. Over 30 years ago, UW soil scientists under the direction of Professor A.E. Peterson investigated the nutrient composition of whey and its effect on soil and plant growth. They found that whey was very effective in increasing yields of corn and hay. From this research, they developed a set of guidelines for whey applications to agricultural land and published those in the University of Wisconsin-Extension Ag Bulletin A3098, "Using Whey on Agricultural Land - A Disposal Alternative." These guidelines served as the basis for Wisconsin Department of Natural Resources regulations covering landspreading whey as outlined in NR 214.

In the past few years, several changes have taken place in the cheese industry that have impacted on this area of landspreading whey. In many cases, cheesemakers are standardizing their milk with additional milk solids to provide for maximum throughput on their cheesemaking systems. This has resulted in wheys with slightly higher solids than normal. The major change that has taken place is the recovery of whey proteins from the whey. As the market for whey protein

concentrate has increased, more cheesemakers have invested in reverse osmosis or ultrafiltration equipment to recover the whey proteins and market those to gain a better return on the milk that they purchased. This process then leaves whey permeate as the by-product which contains only the milk sugar, milk salts, and small amounts of non-protein nitrogen. At the present time, the market for lactose is too low for many of the smaller cheese plants to justify the expense for recovering the lactose from whey permeate. Accordingly, they are deproteinizing their whey and then landspreading the whey permeate. This landspreading of whey permeate is presenting a new problem for the cheese industry.

Whole whey is considered a complete fertilizer, similar to animal manure, since it usually does not require any supplemental fertilizer when it is applied to corn or hay. However, deproteinized whey (whey permeate) has only about one-third the nitrogen of whole whey since 60-65% of the nitrogen is removed with the whey protein concentrate. This creates an imbalance between the lactose and nitrogen in the permeate and may cause a nitrogen deficiency for crops grown on soils landspread with permeate. The soil bacteria will break down the lactose in the permeate and will use up available soil nitrogen for reproduction, thus creating a temporary nitrogen deficiency in the soil. Accordingly, management practices for landspreading whey permeate should be different than with whole whey.

In the past, University of Wisconsin soil scientists have recommended landspreading whole whey at the rate of 1 acre-inch the first year (27,150 gallons), 3/4 acre-inch the second year (20,360 gallons) and 1/2 acre-inch the third and succeeding years (13,600 gallons). Normally, 1 acre-inch of whole whey will provide enough nitrogen, phosphorus, and potassium for high nitrogen demanding crops such as grass or corn. Whey permeate would provide the same level of phosphorus and potassium that whole whey contains but would only have 35-40% of the nitrogen of whole whey. Therefore, when whey permeate is used on corn or grassland, it must be supplemented with additional high nitrogen fertilizer. One acre-inch of whey permeate would provide the following approximate amounts of nutrients: 120 lb. of nitrogen, 110 lb. of phosphorus, 390 lb. of potassium, 80 lb. of calcium, 15 lb. of magnesium, 15 lb. of sodium, and 265 lb. of chlorides.

Whey permeate solids will enhance soil aggregation and tilth. This increases the soil's ability to absorb water and hold nutrients. With this improved soil structure, runoff and soil erosion can be significantly reduced. This is especially beneficial on more heavily textured soils.

Guidelines for Applying Permeate:

We have reviewed the various characteristics of whey permeate with Professor Art Peterson of the UW Soil Science Department and he has given us the following guidelines for applying whey permeate to cropland:

1. Permeate should preferably be applied to low nitrogen-demanding crops, such as legumes. Up to 1/2 acre-inch can be applied to alfalfa in June after the first crop has been harvested. Up to 1/2 acre-inch could also be applied to new seeding in August.
2. Permeate can also be applied to pasture land in spring or fall. If application is to be made to fields from which hay is to be harvested in summer or fall, landspreading should be done after the hay is removed.
3. Whey permeate could be applied to land which will be planted in sweet corn. Up to one acre-inch can be applied in March or April, but soil tests should be run to determine if a supplemental nitrogen fertilizer may also be needed.
4. Care must be exercised to apply the whey permeate at a rate that will permit it to soak into the soil. Maximum daily hydraulic loading should be limited to 1/2 acre-inch.
5. The permeate should be applied in such a manner that it can not run off the surface and into streams. Do not apply permeate where the risk of groundwater or surface water contamination is high.
6. Permeate application should be limited on extremely salt-sensitive crops such as soybeans, green beans, and red clover. Potential salt damage to germinating crops can be decreased by delaying planting in a whey application area for a couple of weeks to allow salt leaching by rainfall. Since legumes, small grains, and grass are sensitive to salt burn,

chlorides should be monitored to ensure that there is not an excessive buildup in the soil.

7. In all cases, annual soil tests should be run on each application area to ensure proper maintenance of soil nutrients for each planned crop. Nitrogen-based fertilizers may need to be supplemented for some crops since whey permeate will normally be lacking in sufficient nitrogen for non-leguminous plants. For assistance in setting up samples for soil tests, contact your local county Cooperative Extension office.

Landspreading of whey and whey permeate is an application procedure designed to use some of the nutrients present in that whey. However, it should not be the primary means of disposing of whey obtained from the cheesemaking process. All efforts should be made to try and use the whey solids for human or animal foods or production of fuels to recover as much revenue as possible from that byproduct.

For additional information:

Kelling, K.A. and A.E. Peterson. 1981. Using whey on agricultural land -- A disposal alternative. UW-Extension bulletin A3098.

Peterson, A.E., W.G. Walker, and K.S. Watson. 1979. Effect of whey applications on chemical properties of soils and crops. *J. Agric. Food Chem.* 27:654-658.

The *UW Dairy Pipeline* is published by UW-Extension and the Center for Dairy Research at UW-Madison. The intent of this fact sheet series is to provide updates on research and technology developments to the Wisconsin cheese industry. We welcome our readers' ideas and questions which we believe will make this a more effective publication.

Please send your correspondence to the editors:

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Upcoming Events:

Wisconsin Cheesemakers Shortcourse:

Two cheesemaker shortcourses, both to be held in Madison, are on the calendar at this time: October 16-20, 1989 and March 19-23, 1990. For more information, call C.E. Johnson or Barb Joppa at 608/263-2013.

Wisconsin Dairy HACCP course:

A Hazard Analysis of Critical Control Points (HACCP) course will be offered in Madison on September 25-26, 1989. For more information, call Barb Joppa at 608/263-2013.

Center for Dairy Research Seminars:

For more information on the following please call Sarah Quinones at 608/262-2217.

H.J. Lee, "Bitter peptide formation with Prt- mutants of *Lactococcus lactis* ML₈ selected by curing of 34 Mdal plasmid." August 17, 1989

M.A. van Boekel, "Milk protein content measurement using infrared spectrophotometry." August 29, 1989

Moursy El-Souda, "Pediococci - Cheese starters for the 21st century?" September, 1989

M.A. van Boekel, "Role of sulphur compounds in Cheddar cheese flavor." September, 1989

Moustafa El-Shenawy, "Anti-listerial effect of the lactoperoxidase system of milk." October, 1989

CDR/ADPI Whey Utilization Conference:

Mark your calendars for CDR's Annual Research Conference which will be held April 25-26, 1990 in Chicago. The conference will focus on whey utilization and dried dairy products, and it will be co-sponsored by the American Dairy Products Institute.