UTAH SCIENCE is a quarterly publication devoted primarily to Experiment Station research in agriculture and related areas. Published by the Utah Agricultural Experiment Station, Utah State University, Logan, Utah 84322-4845.

This publication will be sent free on request in the United States and to libraries and other public institutions in the U.S. Subscriptions mailed to individuals and institutions in other countries cost $35.00 annually which includes shipping and handling. Please include a mailing label from a recent issue of UTAH SCIENCE with any request for change of address.

To avoid overuse of technical terms, sometimes trade names of products or equipment are used. No endorsement of specific products or firms named is intended, nor is criticism implied of those not mentioned.

Articles and information appearing in UTAH SCIENCE become public property upon publication. They may be reprinted provided that no endorsement of a specific commercial product or firm is stated or implied in so doing. Please credit the authors, Utah State University, and UTAH SCIENCE.

Equal Opportunity in employment and education is an essential priority for Utah State University, and one to which the University is deeply committed. In accordance with established laws, discrimination based on race, color, religion, national origin, gender, age, disability, or veteran’s status is prohibited for employees in all aspects of employment and for students in academic programs and activities. Utah State University is dedicated to providing a healthy equal opportunity climate and an environment free from discrimination and harassment.
Despite the fact that a ruminant's diet is about as fibrous as food can get, some livestock don't get enough, or at least not the right kind.

High-grain finishing diets in cattle can cause high rates of acidosis in animals and lead to ulcers in producers trying to eliminate the disorder.

With public scrutiny intensifying farm pollution, agriculture must fertilize its thinking on how to get phosphorus into crop production and out of the environment.

Scientists and government agencies have formed several new alliances designed to get food borne bacteria before they get us.

Although the decline in demand for beef seems to have bottomed out, an industry analyst says producers better toughen their product standards.

Lurking in the demon fat is a friendly acid that will not only help people lose weight, it can reduce cancer risk and stop tumors from growing.
Given that a ruminant's diet is about as fibrous as food can get, surprisingly some livestock don’t get enough, or at least not the right kinds, says Dr. Limin Kung, Jr. from the University of Delaware in Newark.

In a presentation to the 2000 Intermountain Nutrition Conference Kung said that digestion of fiber in the rumen varies greatly and is dependent on a number of different factors often not taken into account by producers.

For example, Kung said, lignin acts as intracellular cement that gives plants rigidity. “Unfortunately, it also has negative effects on fermentability and is associated with reduced digestion.”

Theories that lignin encrusts the fiber or combines with other nutrients or is by itself toxic have been proposed as reasons for negative effects on digestion, he said. Lignification of the plant cell walls generally increases with increasing plant maturity, and within specific forage species increased lignification is associated with reduced digestion.

That's why immature forages generally have more digestible fiber than mature forages and explains why harvesting alfalfa in the late bud or early flower stage is more beneficial than harvesting it in the full bloom stage of maturity, he said.

“Harvesting alfalfa even earlier than in the late bud stage would increase digestibility even more, but total dry matter yield would be reduced,” he said, adding that harvesting forages at optimum stages of maturity is often a compromise between yield and high digestibility.

Fiber is the predominant fraction of the plant cell wall and is primarily comprised of carbohydrates. The primary components of fiber are cellulose, hemicellulose, and lignin. On a chemical basis, cellulose is comprised of linear chains of the sugar glucose. Hemicellulose is closely associated with lignin that has a strong negative influence on fiber digestion.

The rumen is an environment with a diverse population of microorganisms. Bacteria and protozoa dominate the fermentation both in terms of numbers and metabolic processes. Different populations of bacteria will dominate the rumen fermentation depending on the type of diet being fed. Cattle fed diets solely of forage with high fiber will have a ruminal bacterial population that is high in fibrolytic bacteria.
“Simplistically, the fermentation of fiber (cellulose and hemicellulose) results in the production of acetic acid that is used by the cow for energy and is the primary precursor of fat in milk,” Kung said. “In contrast, digestion of sugars and starches yields propionic acid that is converted to glucose in the liver of the cow and used for energy.”

The amount and size of fiber particles in the diets of lactating dairy cows is important to maintaining optimal rumen function. Long fiber in the rumen forms the rumen “mat” where fibers are entangled because they are too long to pass to the lower gut. Fiber from the mat is regurgitated and chewed, a process stimulating secretion of large amounts of saliva that naturally buffers the rumen.

Passage of particles from the rumen is important because without digestion and passage, food would fill the rumen and depress intake, Kung said. There must also be a balance between retention time in the rumen for microbial digestion and passage. In order for a feed particle to pass out of the rumen and into the lower gut, it must attain a size of about one millimeter, he noted.

Grinding fiber to extremely small particles may assist in passage from the rumen, but ruminal digestion of that fiber particle may actually be decreased if it passes too quickly. The normal process of particle size reduction in the rumen leads to increased surface area for microbial attachment and digestion.

That is why timing an alfalfa harvest even earlier than the late bud stage would increase digestibility, he said.

Location, particularly latitude, also has an effect on the fiber of plants, Kung noted. Generally speaking, forages grown in hotter climates such as the Intermountain West have more lignin and are less digestible than forages grown in the Midwest, he said.

In attempts to improve forage quality, forages have been bred to contain lowered concentrations of lignin. Studies at USU and elsewhere have shown that the less lignin in a feed, such as corn silage, allows more fiber digestibility and produces more milk.

Another factor of digestion and fiber with profound effects on the growth of rumen microbes is the pH of the rumen, he said.
A COMPARISON OF THE DIGESTIVE TRACTS OF VARIOUS ANIMALS.
(AA = AMINO ACIDS).

**Dog, human**
Diet \(\rightarrow\) Gastric \(\rightarrow\) Sm. Intestine \(\rightarrow\) Colonic \(\rightarrow\) Feces (AA absorption)

**Horse**
Diet \(\rightarrow\) Gastric \(\rightarrow\) Sm. Intestine \(\rightarrow\) Colonic \(\rightarrow\) Cecal \(\rightarrow\) Feces (fermentation)

**Ruminant**
Diet \(\rightarrow\) Rumen/Reticulum/Omasum (fermentation) \(\downarrow\)
Gastric \(\rightarrow\) Sm. Intestine \(\rightarrow\) Colonic \(\rightarrow\) Cecal \(\rightarrow\) Feces (fermentation)

↓ IF: Lack of fiber or fiber chopped too finely
↓ THEN: Reduced chewing times
↓ THEN: Reduced saliva production
↓ THIS CAUSES: Decrease in ruminal pH
↓ THEN: Fiber digestion in rumen ceases
↓ THIS CAUSES: Acidosis

“Lack of sufficient fiber, or fiber that is chopped too finely, reduces chewing times, and thus reduces saliva production causing a decrease in ruminal pH,” Kung said.

Cows fed a diet with long fiber particles chew for more than 10 hours, ruminate for about six hours, and can produce as much as 50 gallons of saliva per day, he said.

When ruminal pH falls below 5.8-5.9, (a pH of 7 is considered neutral), the rumen is mildly acidic and fiber digestion in the rumen ceases completely. When ruminal pH drops below 5.2 to 5.5 animals can succumb to acidosis with can cause swollen feet and hock, low milkfat tests, loose manure, reduced cud chewing and excess consumption of free choice feeds.

“Any factor that helps maintain ruminal pH above 6.0 is generally beneficial,” Kung said. JT

🔍 MORE INFO

Limin Kung
University of Delaware
lkung@udel.edu
(302) 831-2522
Effective Fiber

Because chemical fiber (what is analyzed for and usually balanced for) does not take into account particle size, the term effective fiber has been used to better define the fiber requirements of dairy cows.

Effective fiber stimulates rumination, chewing, and saliva production. It also maintains a normal fat test, normal rumen pH, and normal rumen mat, Kung said, noting that "balancing diets for effective fiber becomes more important as cows increase their productive levels and therefore require more concentrate and less forage in their diets.

Kung posed a question to attendees of the Intermountain Nutrition Conference in Salt Lake City this past January, which feed they thought would stimulate more chewing and saliva production: a 6-8-inch-long stem of alfalfa hay or a soy hull of about a quarter-inch long.

A summary of 32 experiments showed that forage particle length actually had no relation to chewing time, he said.

"At first thought, this finding does not agree with previous studies that showed reduction in chewing time and salivary flow with forages of smaller particle size," Kung said. "However, this finding is explainable because feedstuffs vary considerably in rate and extent of digestibility, thus confounding the relationship."

In contrast, particle size is related to chewing time within experiments. From a practical view this finding is important, Kung said, because in diets where no or small amounts of by-products are fed, a common fault in effective fiber is the fact that the primary forage sources have been over-processed.

General guidelines have been proposed to maintain adequate effective fiber in the diets for lactating dairy cows, he said. Corn silage and alfalfa silage should be chopped at a theoretical 3/8 inch. For kernal processed corn silage, the theoretical chip length can be increased to an inch.

Some commercial labs offer particle size determinations as an option in their forage analyses. Some county extension agents and nutritionists have separators that can be used. "I believe that the most important time for use of a particle size separator is before harvesting of forage for silage in order that proper settings can be made for chipping. For consulting nutritionists and extension agents separators are good teaching tools when used on farm." JT

### Recommendations for Particle Size of Alfalfa Silages.

<table>
<thead>
<tr>
<th>Forage dry matter from:</th>
<th>Theoretical length of cut</th>
<th>Percent of particles &gt; 1.5 inches long</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% long hay + 50% silage</td>
<td>3/16 inch</td>
<td>&lt; 7</td>
</tr>
<tr>
<td>25% long hay + 75% silage</td>
<td>1/4 inch</td>
<td>7-10</td>
</tr>
<tr>
<td>All silage</td>
<td>5/16-3/8 inch</td>
<td>15-20</td>
</tr>
</tbody>
</table>

Shaver, 1993.
If Fiber Content is Too Low

What can be done if the effective fiber content of your diet is too low and you are stuck with silage that is chopped too finely?

Kung said to first evaluate the ration ADF and NDF content. Use thumb rules to estimate appropriate forage: concentrate rations and NDF from “forage sources.”

Next, determine the amount of nonforage fiber in the diet and assess its contribution to overall NDF. If your balancing program allows you to, calculate an effective fiber value and check for adequacy.

Next, determine if the cause of low effective fiber can be remedied easily. For example, is TMR mixing time too long? Perhaps increasing the chop length of process hay in the TMR will be sufficient. If there is no quick fix for the problem (for example, all the silage was chopped too fine at harvest) replace finely chopped silage with some long dry hay. Three to five pounds may do the trick, but if the diet is extremely fine, eight to ten pounds may be needed, he said.

Sodium bicarbonate also will help to buffer the rumen, he said. There is also some evidence that a small amount of long straw (three to five pounds) may help because of its coarse nature, but this has not been adequately documented in controlled studies.

Kung also advised producers to pay special attention to fiber levels when balancing diets that contain a large proportion of byproduct sources because they are often low in effective fiber.

### Comparison of Fiber Content and Digestion and Energy Density in Feeds

<table>
<thead>
<tr>
<th>Feed</th>
<th>NDF, %</th>
<th>Effective NDF</th>
<th>Rate of fiber digestion, %/hr</th>
<th>NEL, Mcal/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa hay</td>
<td>44</td>
<td>95</td>
<td>0.052 - 0.165</td>
<td>1.32</td>
</tr>
<tr>
<td>Corn silage</td>
<td>45</td>
<td>95</td>
<td>0.029 - 0.082</td>
<td>1.69</td>
</tr>
<tr>
<td>Corn cobs</td>
<td>89</td>
<td>40-80</td>
<td>—</td>
<td>1.91</td>
</tr>
<tr>
<td>Oat hulls</td>
<td>90</td>
<td>80</td>
<td>0.035 - 0.043</td>
<td>1.98</td>
</tr>
<tr>
<td>Cottonseed hulls</td>
<td>78</td>
<td>60</td>
<td>—</td>
<td>1.94</td>
</tr>
<tr>
<td>Wheat middlings</td>
<td>37</td>
<td>50</td>
<td>0.042 - 0.144</td>
<td>1.56</td>
</tr>
<tr>
<td>Soyhulls, fine ground</td>
<td>67</td>
<td>20</td>
<td>0.011 - 0.077</td>
<td>1.94</td>
</tr>
</tbody>
</table>

Adapted from Firkins, 1995.
When a cow’s belly drip, drip, drips excess acid, it often leads to ulcers—not in the cow but in the manager who must constantly deal with acidosis, one of the most important nutritional disorders in feedlot cattle today.

Todd Milton, Extension Feedlot Specialist at the University of Nebraska, said the heavy and intense supply of grain to feedlot cattle these days causes an array of problems for animals and producers. In a presentation to the 2000 Intermountain Nutrition Conference, Milton said grains are digested too fast or animals are simply given too much.

The cattle feeding business in the United States has evolved to an intensively managed system using grains as the primary source of energy, he said. Grain feeding is common throughout the cattle feeding regions of the United States because of the cost per unit of energy is often cheaper with grain compared with other feedstuffs available. In addition, grains are easier to store, handle, process, mix and deliver in rations compared with bulky, lower energy forage-type feed. Not to mention, he said, consumers prefer the taste and flavor of grain-fed beef.

Grains are a relatively foreign addition to the complex digestive systems of ruminants, which evolved consuming large meals of forage that would be digested over time.

“Consumption of these large single meals and subsequent microbial fermentation favored energy and protein utilization of forages by beef cattle. These feeding habits create unique challenges when high-grain finishing diets are fed to beef cattle just prior to slaughter.”

The key challenge is acidosis, Milton said. Acidosis is an array of stresses on the entire digestive system caused by trying to digest high amounts of starch and sugars in grains. The effects aren’t just in the rumen; metabolism is often affected as well. It can reduce food intake, and in severe cases cause death, he said.

Many of the management recommendations that feedlot nutritionists make on a daily basis are to avoid acidosis. When it becomes acute, aside from causing death, some affected cattle wander aimlessly in the pen or cannot stand or appear to have brain damage.

A thiamine injection usually results in a quick recovery for those cattle, Milton said, because
during acute acidosis, the production of thiamine by rumen microbes is impaired.

He added that acute acidosis can have other less obvious effects. Ruminal pH drops to below 5 to 5.3 (normal is 7), and remains there for several hours. During this time, the lining of the rumen wall becomes damaged, and the intestinal linings are severely inflamed. Destruction of the rumen wall results in reduced absorption of nutrients.

“These cattle are often those that are considered ‘poor doers,’” he said. “Additionally, foundered cattle are an indication acute acidosis occurred 40 to 60 days previously in the feeding period.”

Reduced absorption favors the production and accumulation of lactic acid in the ruminal fluid, he said, which has led to the false conclusion that lactic acid is primarily responsible for acidosis in feedlot cattle.

“Although lactic acid may predominate in the ruminal fluid of acutely acidotic animals, it is not the only organic acid involved,” Milton said. “Producers should consider the cumulative effects of all organic acids produced in the rumen.”

Acute acidosis is common and fairly easy to deal with, Milton said. Less severe acidosis—sub-

acute—occurs more frequently and is much more difficult to recognize, a challenge compounded by the fact that cattle are usually fed in large groups of 100 head or more.

The major symptoms of subacute acidosis are reduced feed intake and erratic feeding patterns. Optimum feed intake is very important because daily weight gain is based on the amount of metabolizable energy, he said.

Identifying individual cows with subacute acidosis is almost impossible, Milton said, because other animals will often compensate for a small percentage of the animals that have reduced their feed intake.

Daily observation of feed intake fluctuation of cattle that are ‘on-feed’ is essential in managing subacute acidosis, he said, noting that some animal signs typically associated with it are panting, excessive salivation, kicking at the belly, eating dirt and diarrhea.

Research shows that most animals will experience some degree of acidosis while in the feedlot, and that it actually may be an important step in the transition from forage-based to grain-based diets, Milton said.

**Grains Ranked by Rate of Rumenal Starch Digestion**

**FAST**
- Wheat
- Barley
- High moisture corn (bunker storage; ground or rolled)
- Steam flaked corn, HMC (stored whole)
- Dry rolled corn, steam flaked grain sorghum
- Dry whole corn
- Dry rolled grain sorghum

**SLOW**

*What happened before the cattle on the previous page got their food—the large-scale feed mixing process at Munk's Dairy in Cache Valley, Utah. The mix contains two different silages, grain, cottonseed, nutrients and some French fry grease.*
“We cannot prevent some degree of acidosis during the feeding period, but rather we must manage to prevent cattle from the more severe acidosis challenges.”

That means producers have a tough dilemma, Milton said. Traditionally, roughages added to finishing diets were used as a means of controlling acidosis and adjusting cattle to high-grain diets. However, numerous management challenges exist with roughages such as mixing problems, inventory control and reduced feeding efficiency, he said.

Most feedlots would just as soon eliminate most or all the roughage from the diet, especially if acidosis is not a problem. Adding roughage increases intake, does not affect daily gain, reduces feed efficiency, increases cost of gain and increases the amount of manure to be removed from the pen.

The problem is that more often than not, some roughage is needed in the diet to help control acidosis, Milton said.

There are numerous factors that can be used to help manage acidosis in feedlot cattle. However, regardless of the techniques available, management of acidosis begins with daily bunk management in the feedlot.

“‘The number of philosophies on bunk management probably equals the number of nutritionists,’ Milton said. ‘However, we have learned from experience and research that consistency is one common factor needed to successful bunk management.’

Environmental factors beyond the producer’s control also play a major role as well in managing acidosis, he added. Mud, heat, cold stress, storm fronts all reduce feed intake and alter feed intake patterns.

There is not one simple solution, but rather a continuum of management aspects to be considered, he concluded. Most cattle will recover on their own from subacute acidosis without any medical treatment. However, he said, it remains unknown if repeated bouts have a cumulative effect on an animal’s performance. JT

---

MORE INFO

Todd Milton
University of Nebraska
ancs852@unlum.unl.edu

(402) 472-6402

---

ROUGHAGES—THE PROS AND CONS

PRO

Control acidosis
Adjust cattle to high-grain diets

Mixing problems
Inventory control
Reduced feeding efficiency
(increases intake, does not affect daily gain)
Increased cost of gain
Increased amount of manure in pen

CON

The Utah Agricultural Experiment Station 9
Agriculture has taken, in farmyard terms, a lot of crap about its effect on the environment. The negative environmental impact of agricultural practices is both perceived and real. But because perception is reality, and because public scrutiny is intensifying, the industry must learn how to recycle phosphorus and nitrogen back into crop production.

So said Dr. L.D. Satter, USDA Agricultural Research Service and Dairy Science Department at the University of Wisconsin, Madison, in remarks to the 2000 Intermountain Nutrition Conference this past January.

"The days are numbered for simply disposing of manure," Satter said. "It is likely that in the near future manure application to cropland will be restricted to the amount of nutrients that can be utilized by the crops."

Phosphorus content of manure will likely be the determining factor for the application rate of manure, he said, because the phosphorus-to-nitrogen ratio in manure is approximately twice the ratio needed by crops.

Satter said by reducing dietary phosphorus in dairy herd diets to .38 percent from .48 percent, phosphorus excretion in the manure will be reduced 25-30 percent.

One of the fundamental challenges facing the livestock/feed industries in the immediate future is developing ways to recycle the flow of feed nutrients, particularly phosphorus and nitrogen, from animal operations back to cropland where they can be used again for crop production.

"Anything short of this is not sustainable, and will ultimately be unacceptable to the broader public," Satter said.

Phosphorus is a nonmetallic element that is essential for both animal and vegetable life. Humans get phosphorus by eating vegetables; plants get it from the soil. Most of the phosphorus from dairy cattle gets back into the environment through lactation and as microbial phosphorus sloughed from the intestinal lining into manure.

The key to achieving effective nutrient recycling and minimizing environmental damage is limiting the amount of nutrients applied, which means giving animals and crops only the amount they can utilize, he said.

"Herein lies the rub. Areas with high livestock densities will have to transport manure nutrients..."
over larger distances to avoid over application of nutrients, or alternatively, relocate animals to where cropland is available for manure application.

"Full crediting of manure nutrients will be essential, and switching to a reliable phosphorus standard is inevitable," he said.

Most states now permit manure application in amounts that supply the crop need for nitrogen. Because the phosphorus-to-nitrogen ratio in manure is approximately twice that of the phosphorus-to-nitrogen ratio needed by crops, applying manure to meet nitrogen needs results in a build-up of soil phosphorus levels.

Using multiple research examples in Utah and elsewhere, Satter spent his presentation at the conference debunking the myth that providing dietary phosphorus routinely improves cattle performance.

"It has been shown clearly that under extremely low phosphorus intakes, supplementation can improve reproductive performance and reduce mortality," he said. "But these extreme conditions are seldom encountered with modern husbandry practices."

As far as supplementing it in feedlot cattle, he said, "don’t do it."

The problem is that some of the more economical feedlot ration formulations provide phosphorus far in excess of the animals’ need, resulting in very high concentration of it in manure. Formulating diets to contain less phosphorus is costly, but the higher cost could be offset by lower costs for disposing of manure in an environmentally safe way, he said.

Large amounts of phosphorus are routinely supplemented to dairy cows, Satter said. "We over supplement phosphorus, costing the U.S. dairy industry an unnecessary $100 million annually, as well as increasing risk of environmental damage because phosphorus promotes the growth of algae in lakes and streams.

Most producers follow an industry standard set by recommendations by the National Research Council. Compared to other countries, the NRC recommendation is on the high side, Satter said, adding that caution should be used in placing much faith in any country’s standard because research on phosphorus is both meager and old.

In order to establish a more reliable standard, the persistent question regarding the true digestibility of phosphorus has to be determined, he said, noting that his research strongly indicates that phosphorus is more digestible than previously thought.

Some excellent research in Germany that is largely unknown in the United States established a basis for the recent revision of the German standard for feeding phosphorus to dairy cows,
PHOSPHORUS FEEDING RECOMMENDATIONS

<table>
<thead>
<tr>
<th>1320 lb cow</th>
<th>Estimated Dry Matter Intake</th>
<th>Current NRC Recommendations</th>
<th>Recent German Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.75% milkfat</td>
<td>lbs milk/day</td>
<td>P, g/day</td>
<td>Dietary P%</td>
</tr>
<tr>
<td>22</td>
<td>28.7</td>
<td>36.0</td>
<td>.27</td>
</tr>
<tr>
<td>44</td>
<td>37.3</td>
<td>55.5</td>
<td>.33</td>
</tr>
<tr>
<td>66</td>
<td>44.8</td>
<td>74.5</td>
<td>.37</td>
</tr>
<tr>
<td>88</td>
<td>51.5</td>
<td>93.0</td>
<td>.40</td>
</tr>
<tr>
<td>110</td>
<td>60.1</td>
<td>112.5</td>
<td>.41</td>
</tr>
</tbody>
</table>

1Recommends .48% dietary P during first three weeks of lactation

Satter said. They significantly lowered the ruminant maintenance requirement for phosphorus and linked it to dry matter intake rather than allocating it based on body weight, as is common practice, he added.

Based on a telephone survey of dairy extension specialists, nutrition consultants and feed industry representatives, it appears that dairy producers in the United States are feeding an average of about .48 percent dietary phosphorus, or about 25 percent more than the NRC recommendations, which Satter believes are generally too high.

"Why? Mention has been made of significant uncertainties in the feeding standards, and this has perhaps encouraged feeding extra phosphorus to provide a margin of safety," he said, adding that aggressive marketing of phosphorus supplements has contributed to excesses in the diet.

But perhaps the most important factor responsible for excessive phosphorus supplementation is the notion that it is crucial to maintaining acceptable reproductive performance in dairy cows, he said.

Phosphorus can have an indirect effect on reproductive performance through its effect on digestibility and energy supply when very low phosphorus diets are fed, he explained. "Modern dairy diets, however, never approach the low phosphorus content that can result in impaired function of rumen microbes."

In one highlighted study of a 100-cow dairy operation averaging 20,000 lbs. milk per cow, Satter showed that 3,900 lbs. of phosphorus was imported to the farm, and 2,300 lbs. was exported, or a net buildup of 1,600 lbs. of phosphorus per year on that farm. Just bringing supplemental phosphorus into line with currently recommended standards would reduce by 1,250 lbs. the amount of phosphorus brought to the farm in the first place, he said.

As far as what producers need to do to survive economically, Satter said dairy operations that bring in all of their protein supplement and part of their grain needs will manage only if they eliminate excess phosphorus supplementation to the cows, and eliminate phosphorus fertilizer, which in all probability they will not need.

Dairy operations importing all of their protein and grain, and just producing enough forage to meet their needs, will have to find additional land for manure application he said. "There is no way they will be able to achieve equilibrium in soil phosphorus levels without additional land for manure."

While there is evidence that phosphorus levels actually being fed is .48 percent of diet dry
matter, he said, there is growing indication that some dairy nutrition consultants have started to reduce the amount during the past 18 months.

“There is absolutely no evidence that we should feed more than .38 to .41 percent to even the highest producing herds, including cows that are in the early part of lactation,” he said, adding that because cows mobilize phosphorus along with calcium during the first week of lactation there is no point in supplementing.

“We need to recognize this important source of phosphorus for the early lactation cows,” he added.

The typical dairy diet in the United States prior to phosphorus supplementation contains .36 to .38 percent phosphorus, which poses the overriding question of whether all phosphorus supplements can be eliminated.

Zero supplementation is a reasonable target, he said. “We will not be surprised if this is where we eventually go. In the meantime, our task is to stop feeding the excessive amounts. A strategy for reducing dietary phosphorus levels is a win-win situation for dairy producers because both feed costs, environmental risk and cost of manure disposal will be reduced.”

---

### No Adverse Effects from Lower Phosphorus?

A large experiment was done at USU in 1978 to determine the phosphorus requirements for growth and reproduction of Hereford heifers. Ninety-six seven-month-old heifers were divided into two groups, with one receiving a diet containing .14 percent phosphorus and the other the same diet but supplemented with monosodium phosphate to give .36 percent phosphorus.

The experiment lasted two years. The low phosphorus diet provided about 66 percent of the NRC recommended level of phosphorus and the high phosphorus diet about 174 percent of the recommended level.

The average daily weight gain was .99 lb. per day for both groups, and feed efficiency was similar for the two groups. The low phosphorus group had a 96 percent pregnancy rate with 91 percent live calves. The high phosphorus group had corresponding values of 100 and 93 percent, respectively.

These differences were not significant. After nine months on trial at approximately 16 months of age, no differences were discernible in rib bone structure based on bone microradiographs.

---

<table>
<thead>
<tr>
<th></th>
<th>High Phosphorus Diet</th>
<th>Low Phosphorus Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Daily Weight Gain</td>
<td>.99 lbs</td>
<td>.99 lbs</td>
</tr>
<tr>
<td>Feed Efficiency</td>
<td>Similar</td>
<td>Similar</td>
</tr>
<tr>
<td>Pregnancy Rate</td>
<td>100%</td>
<td>96%</td>
</tr>
<tr>
<td>Live Calve Rate</td>
<td>93%</td>
<td>91%</td>
</tr>
<tr>
<td>Rib Bone Structure</td>
<td>No difference</td>
<td>No difference</td>
</tr>
</tbody>
</table>
WILDERNESS AS INCOME BOOSTER

If designating land as wilderness has a detrimental effect on the West's economy, two USU economists can find no evidence of it.

Marca Hagenstad and Donald Snyder report after examining 205 counties in the West, no decreases in incomes could be attributed to the presence of wilderness areas.

In fact, incomes in Utah, Colorado, Arizona, and Idaho increased in the presence of wilderness areas, their study shows. In addition, incomes in all states increased with increases in revenues from tourist-related employment.

Most of the wilderness areas in the study are located on U.S. Forest Service lands, with some located on BLM, U.S. Fish and Wildlife Service and National Park lands.

Forestry in the next 100 years

Most rural communities in the western world will still rely on forests and natural resources in the next hundred years as much as they did in the 19th and 20th centuries, according to a new assessment of rural development.

Although western world understanding, values and management of forests and community development are considerably different now than in earlier centuries, forests and other resources will still form the social and economic foundations of rural and developing communities, says USU Forest Resources Professor James Kennedy.

Kennedy, along with colleagues at universities in Montana and Vienna, say the economy and the identity of rural communities will continue to depend on natural resources. They assert that forest managers, local communities and the general public must find ways to share resources and balance conservation values. "Otherwise sociopolitical conflict could become the major constraint to healthy, sustainable forest ecosystems and to rural community development in the 21st century."

More info

Don Snyder
dsnyder@b202.usu.edu
(435) 797-2383

James Kennedy
jkennedy@cc.usu.edu
(435) 797-2573
Widespread concern that a transplanted shrub will invade and eliminate native plant populations in 10 western states is largely unfounded, according to a detailed study of 151 plantings just released by the USDA Agricultural Research Service and the Utah Agricultural Experiment Station.

"Immigrant" forage kochia has been seeded on approximately 150,000 acres in the West. Many scientists and rangeland managers consider it a prime candidate for use in range rehabilitation and fire prevention. Immigrant appears to have a competitive advantage over many other species because of its temporal and spatial capacity for water uptake.

Although there have been sites where Immigrant has spread, and although some uncertainty is always associated with the introduction of new plants, "only a few of the thousands of the purposefully introduced plants have ever become major problems," the report states.

Forage kochia, originally from Russia and first planted in the United States in 1968, is a long-lived, semi-evergreen half shrub that averages 1 to 3 feet high at maturity. Individual plants may live 10 to 15 years. It develops an extensive fibrous root system with a taproot that may extend to a depth of 16 feet.

More info

Deane Harrison
(435) 797-3066

Jerry Chatterton
(435) 797-2249

njchatt@cc.usu.edu

The entire report, Forage Kochia: Its Compatibility and Potential Aggressiveness on Intermountain Rangelands, can be found on-line at http://agx.usu.edu/agx/special_research_frameset.html

UAES WEBSITE REDESIGNED

Early in 2000, the Utah Agricultural Experiment Station website was redesigned and updated thanks to Craig McLaughlin. The new streamlined site contains a news section and has a site search engine. It can be found at http://agx.usu.edu/agx/

It also contains a section of other agricultural links to help you find related sites.
**RECENT GRANTS AND CONTRACTS**

**Philip Rasmussen** continues to lead regional sustainable agriculture training programs with support from the USDA's Cooperative State Research, Education and Extension Service (CSREES).

**Daryll DeWald**, associate professor of biology, is investigating a mechanism in cells which may be involved in the spread of some cancers. His study, *Phosphoinositide-4-kinase Regulation of Secretion*, is supported by the American Cancer Society.

**Allen Rasmussen**, associate professor, Rangeland Resources, is studying the effects of goats on plant communities to help prevent or reduce wildland fires damage where wildlands and urban areas meet. His research is funded by the U.S. Department of Interior, Bureau of Land Management.

**Edward Evans**, received funding from the USDA/CSREES for his study, “Predator Sharing Among Insect Pests: Increase or Decrease in Predator Pressure.”

**Donald Snyder**, professor, Economics, is investigating identification and development of plants to improve dryland and irrigated pastures.

**Thomas Bunch**, professor, Animal, Dairy and Veterinary Sciences, is studying the effects of locoweed on embryo growth and development with support from the USDA/Agricultural Research Service.

**Tilak Dhiman**, assistant professor, Animal, Dairy and Veterinary Sciences, received funding from Insta-Pro for his investigation of the influence of soybean meal processing techniques on yield response of cows.

**Shiquan Wang**, research assistant professor, Animal Dairy and Veterinary Sciences, is investigating the toxicity of locoweed on reproductive performance of sheep and cattle with funding from the Utah Department of Agriculture.

**Daren Cornforth**, associate professor, Nutrition and Food Sciences, is evaluating the effects of carbon monoxide treatments to increase the color stability of fresh beef, and **Charles Carpenter** is studying the effects of consumer bias for beef color and packaging on eating satisfaction. Both projects are supported with funding from the National Cattlemen's Association.

**NEW FACULTY**

**Howard Bingham** has joined the Animal, Dairy and Veterinary Sciences Department faculty as a clinical assistant professor. He has a bachelor's degree in animal science from Brigham Young University and a doctorate in veterinary medicine from Washington State University. He has a doctorate in epidemiology, bovine respiratory disease and biostatistics from The Ohio State University, where he worked as a clinical veterinarian and was a graduate research associate in the Department of Veterinary Preventative Medicine.
The United States has a second FBI. It combines five separate government agencies and involves day and night surveillance. Although it isn’t part of the legal system, it deals with zillions of little criminals committing countless random acts of violence against humans, making millions of people sick and even killing some every year.

The FBI in this case is food-borne illness, the most widely discussed public health concern in recent years and a national rallying point for the humans that host the disease-causing pathogens. The government is fighting back by assigning some agencies with famous acronyms to do something about FBI. There’s the FDA, (Food and Drug Administration), the CDC (Centers for Disease Control), the FSIS (Food Safety and Inspection Service), the USDA (U.S. Dept. of Agriculture), and the NIH (the National Institutes of Health).

USU is also involved. Food scientist Bart Weimer, director of the Center for Microbe Detection and Physiology here, told scientists gathered at the 2000 Intermountain Nutrition Conference in Salt Lake City that the increase in food production in the United States has been matched by an increase in bacteria-caused infections.

*Salmonella* and *E. coli* 0157 are the most famous bugs, but others, *Campylobacter, Vibrio parahaemolyticus, Cryptosporidium*, make up the top five. One other, *Listeria*, does not cause as many cases of infection, but leads to more hospitalizations than other diseases.

New detection methods, new disease surveillance sites and a new genetic fingerprint method to track outbreaks from a single organism are helping control the pathogens and reduce cases, Weimer said.

However, bacteria are always evolving, he said, noting that there are 20 different strains of *E. coli* that are disease causing but haven’t had outbreaks similar to the infamous 0157.

FoodNet, a new disease monitoring network linking seven states—California, Connecticut, Georgia, Maryland, Minnesota, New York and Oregon—shows infections fluctuate by state, type and time of year for specific pathogens. The incidence of disease varies, and while some are not new they are persistent, Weimer said.

The newest bacteria, known by its full name as *Escherichia coli* 0157:H7, first appeared in 1982. It
causes hemorrhagic colitis, and less than 1 cfu (colony forming unit) per 25 grams of ground beef is dangerous for human health. Illness is caused by fecal material entering the bloodstream, usually by mouth. About 20,000 cases occur a year, and the number is increasing, according to FoodNet figures. About 5 percent of the patients develop more serious health problems such as hemolytic anemia and kidney failure of a type that is most difficult for children to survive.

_E. coli_ 0157 is a concern to the food industry because it causes serious illness and because it appears to be increasing. It is found in the environment and is prevalent in domestic farm animals, and has been isolated from calves, cattle, and sheep, Weimer said.

Thus potential cross contamination at the farm or in commercial meat processing plants can lead to infections of food, Weimer said, adding that other contaminated foods have been identified—apple juice, apple cider, raw apples, milk, ground beef, radish sprouts, salami, tomatoes and lettuce.

Other documented outbreaks involve swimming pool and drinking water.

Cross contamination is an emerging issue for food associated disease. For example, _E. coli_ 0157 is found in meat, fruit and vegetable foods. A common link between each food type seems to be animal waste. Further work is needed to define the exact mechanism of contamination issues. FoodNet may offer a chance to link causes that seem to be independent, Weimer said.

Another single outbreak was the highly infectious and often lethal _Listeria_. FoodNet reported that _Listeria_ infections had the highest hospitalization rate and caused nearly half of the reported deaths. The organism is associated with dairy and meat products. FoodNet will conduct additional studies of _Listeria_ infections to identify food sources and potential control points in 1999.

Weimer, who has focused his research on rapid screening for microbes, said detection of any FBI is difficult. During the past several years, rapid detection methods have developed for _E. coli_ 0157:H7. All still require at least six hours of
VARIATION IN THE NUMBER OF CASES FROM A SPECIFIC ORGANISM BY SEASON.

Detection of a E. coli 0157:H7 cell captured with the GlycoBind detection system and imaged with confocal microscopy.

pre-enrichment before detection is possible, and most methods require at least 24 to 96 hours before detection and identification are finished.

Enzyme-linked immunosorbent assays (ELISA) for detection of E. coli 0157:H7 were developed to meet the need for faster detection, Weimer says. His own lab has detection time down to about six minutes. Together with various enrichment methods and ELISA-based detection methods, the analysis time and sensitivity has improved to less than 24 hours.

"The need to develop faster and more sensitive methods is apparent," Weimer said. "Our research group has focused on developing a biosensor that is more sensitive than 100 cells per milliliter, regardless of sample size."

Weimer's patented ImmunoFlow method can easily be adapted for detection and identification of other pathogenic foodborne bacteria such as Salmonella and Listeria.

MORE INFO

Bart Weimer
milkbugs@cc.usu.edu (435) 797-3356

Dr. Bart Weimer using the system developed by his research group for detection and identification of pathogenic foodborne bacteria such as E. coli 0157, Salmonella, and Listeria.
One of the stated goals of the annual convention of the National Cattlemen’s Beef Association a year ago was to stabilize beef demand by the year 2000.

Demand for beef has indeed stabilized in the past year—it’s the lowest ever and is staying there.

CattleFax reports that market share spending on beef has decreased by 13.7 percent in the past 10 years. The beef industry analyst also reports that almost all of the loss was attributable to increased consumer demand for chicken, which was 16 percent of market share in 1980 and about 30 percent last year.

In 1991, when the beef industry first realized that it must do something to tackle the decline in market share spending, a group of scientists, economists, and beef producers concluded that beef must be produced more efficiently so it can be sold at lower prices.

Dr. J. Brad Morgan of Oklahoma State University, in assessing the beef market at the Intermountain Nutrition Conference 2000 in January, said that the objective of making beef cheaper could be considered unAmerican. Morgan pointed out that Harley-Davidson motorcycles, OreIda potatoes, and the American automobile industry—which had been going through a similar phase of decreased demand—did not lower the price of their products, “they fought back by improving quality and consistency.”

The beef industry should do the same thing, Morgan said. While improvements have been made recently, many have been geared toward customers, not consumers, Morgan said. “They aren’t the same thing.”

Citing an article by Dr. Gary Smith of Colorado State University, Morgan said that a feedlot operator can say he is “producing for demand” by producing the most marketable carcass when that carcass fits a packer’s version of quality.

“But you have to realize that when feedlot operators hit the carcass grid of their customer—the packer—this does not necessarily mean that they are satisfying the consumer.”

In order to satisfy them, the industry must recognize who consumers are, Morgan said, noting that consumers have a long list of demands: taste, tenderness, attractiveness, storage

When feedlot operators produce the most marketable carcass for the packer it does not necessarily mean that they are satisfying the consumer.
stability, simplicity, convenience, safety, consistency.

The need for such traits in beef products is justified and essential because beef's prime competitor—chicken—has changed the form in which it is marketed, from 7 percent further-processed products in 1975 to 43 percent in 1998.

The industry must also understand the facts of the consumer's lifestyle, Morgan said:

- 70 percent of women are in the U.S. workforce; 28-58 percent of both women and men say they have "lack of time" or have schedules "too busy" to cook.
- Two-thirds of all dinner decisions are made the same day; of those 73 percent of the dinner preparers don't know at 4:30 p.m. what they're going to have for dinner.
- Simplicity and convenience are the most important factors driving meal preparation decisions.
- 41 percent of consumers under the age of 25, and 50 percent of those 26 to 35, say their lack of cooking knowledge keeps them from buying certain cuts of beef.
- During the typical workweek, 40 percent of households spend less than 30 minutes on meal preparation while 78 percent of households spend less than 45 minutes on meal preparation.

"Cattle producers can no longer just produce what they individually or collectively think is best or easiest or most economical and expect the world to come begging for more," Morgan said. "Rather, it means that at each critical juncture in the beef production sequence consideration must be given to what the consumer wants and is willing to buy."

In the year 2000, what the consumer appears to want can be rendered down to one word: assurance. Morgan said that means that domestic and international consumers want bacteriologically and chemically safe, healthful, high quality and consistently palatable beef that was produced without compromising the environment or the animal's welfare.

In order to meet that expectation, producers must be able to assure consumers of where the beef comes from and how quality was measured, monitored and managed.

Morgan said producers must form alliances to increase both quality assurance for consumers and profitability for themselves. He listed several advantages to alliances:

- Participants are full partners, not share croppers or tenant farmers.
Participants need not have an island mentality.

Costs of changes in genetics, production practices and technology can be recovered, i.e., costs of better seedstock, vaccinations programs, vitamin E or D supplementation and bacterial decontamination technology.

Packers and processors will have supplies guaranteed to be high quality so they can focus on making beef more convenient to use.

Beef is produced that is consistent and safe and comes from people who care and want to be accountable to consumers.

A 1998 study by the Food Marketing Institute found supermarket shoppers consider taste, nutrition, product safety, price and storability as “very important” factors in making food selections.

“Americans in fact are much more concerned about the safety of food than in its nutritional content,” Morgan said, citing an article in USA Weekend in which Americans ranked things they were most afraid of:

1. Being in a car crash
2. Having cancer
3. Inadequate Social Security
4. Not enough money for retirement
5. Food poisoning from meat.

Morgan said he believes that the reason food is in the top five fears among Americans is in part due to the high number of stories in the news media on food safety, which he said invariably have a large picture of a hamburger. Unmentioned is the fact that most hospitalizations and illness from food are caused by vegetable contamination, he said.

He said the beef industry “shoots itself in the foot” by not doing enough to point out steps being taken to reduce the probability of contamination.

One system used by packers follows a multi-step process involving steam, pre-washing, acetic acid rinsing and high-temperature washing.

Morgan said the chances of finding E. coli 0157:H7 on the surface of a beef carcass that had gone through multiple hurdle processing is 1 in 500,000 rather than 1 in 500 expected at most traditional packing plants.

The sight/touch/smell concepts of federal and state meat inspection have identified unaesthetic and diseased meat, but are of little use for lessening occurrence of food borne pathogens on beef or chemical residues in beef, Morgan said.

“Consumers, both domestic and internationally, will be much more comfortable about the safety of beef if we can provide assurance through
source verification and USDA process verification that everything possible is being done to assure the bacteriological and chemical safety of specific beef products.

Several pork packers announced in late 1998 that they will purchase hogs for harvest only from swine producers who qualify for the most stringent on-farm pork safety standards, Morgan said. He noted that the largest supermarket chain in Australia announced in April 1998 that it will now purchase beef only from ranches that qualify for the "CattleCare" farm safety designation.

"It seems highly probable that similar things will happen in the U.S. industry," he said.

Morgan, who has worked closely with the world's biggest beef consumer—McDonald's—said the hamburger giant is not waiting for producers to adopt tougher standards but imposes its own strict quality assurances. He said company inspectors will regularly and randomly stage unannounced visits—called Mac Attacks—at individual franchises. If the conditions do not meet their standards, varying types and degrees of responses will occur, up to and including, taking a franchise away, he said.

While safety is very important to consumers, tenderness is a close second, Morgan said. Since the outbreak of *E. coli* 0157:H7 in the Pacific Northwest in 1993, U.S. consumers have preferred meat cooked more well-done. That in turn makes the most affordable cuts of beef often dry and tough.

Morgan said one possible way of improving beef tenderness is devising a version of what most U.S. pork packers offer—"Enhanced Pork." Those products have been pumped with solutions of sodium tripolyphosphate in water. Other tenderizers and other methods of assuring tenderness are being investigated, he said.

"The main reason people eat beef is taste," Morgan said. "They like it. They don't have to put a lot of coatings on it or deep fry it to get the flavor." Morgan said a recent study shows that 40 percent of consumers said they would pay an extra 50 cents per pound for guaranteed-tender beef; 36 percent said they would buy more beef and less pork and poultry if the beef they buy is truly tender.

If it is true that the U.S. beef industry is changing from being production-driven to becoming consumer-driven, it is imperative that beef producers accept the challenge of making such changes, gradually in an evolutionary rather than revolutionary manner, Morgan said.

"Those changes have to occur gradually because otherwise producers could lose economic viability while chasing someone's ideal of what consumers want and not being rewarded for achieving a new standard."

---

**MORE INFO**

Brad Morgan
Oklahoma State University
bmorgan@okstate.edu

The Utah Agricultural Experiment Station 23
Intake of fat has been demonized for so long, that a review of what humans might be without it is in order. First and foremost, we simply wouldn't be. Second, we'd be a cleverly assembled collection of sticks in a sack with the consistency of brown paper bag. We wouldn't think straight or be able to reproduce.

And now it turns out that the fat we fear so actually works to help keep us thin, and maybe even reduces cancer risk.

At least that is what research by USU animal, dairy and veterinary scientist Tilak Dhiman is clearly indicating. Dhiman told the 2000 Intermountain Nutrition Conference that a nutrient available principally in those infamous high-fat dairy products like ice cream and meat like steak has significant benefits to human health.

Conjugated linoleic acid, found in the richest supplies in milk, has numerous potential health benefits, Dhiman said. Feeding as little as 0.05 grams of the fatty acid per 100 grams of food to rats caused a reduction in the number of mammary tumors. The acid reduced blood fats and early aortic atherosclerosis in hamsters and rabbits with high cholesterol, and it has been shown to normalize impaired glucose tolerance in diabetic rats.

While CLA has been shown to actually increase lean muscle tissue in humans (see *Utah Science*, Vol. 58, No. 3), its anticancer properties are just now being recognized, Dhiman said. A study conducted in Finland has suggested that CLA in milk is a possible factor for the inverse relationship between milk consumption and risk of breast cancer. Another study in France using 360 patients with breast cancer reported an inverse relationship between CLA levels in breast adipose tissues and risk of breast cancer. Patients with higher levels of CLA in adipose tissues had less tumor growth.

CLA is unusual among anticancer compounds because it reduces the incidences of cancer and also suppresses the growth of existing cancers, Dhiman said, adding that the mechanisms by which CLA influences cancer growth are not well understood.
The presence of CLA in milk was first observed in 1935 in research that reported that milk fat from cows grazing pastures in summer showed an increase absorption compared with milk fat made during the winter months from the same cows.

Milk fat is the richest natural dietary source of CLA. Whole milk contains an average 4.5 milligrams of CLA per gram of fat. In humans, one serving of whole milk (8 oz.) and one serving of cheese (30 grams) can provide 81 milligrams of CLA, or a daily dietary intake of CLA that is only 25 percent of lowest dose shown to reduce incidences of cancer in laboratory rats.

"Therefore, the intake of CLA can be increased either by increasing the consumption of foods of ruminant origin, or by increasing the CLA content of milk and meat," Dhiman said, "The latter approach is more practical."

Dhiman's research shows that diets fed to ruminants have a major influence on CLA content of milk. Cows grazing natural permanent pasture, for example, had 500 percent higher CLA content in milk compared to cows fed typical dairy diets containing preserved forage and grain in a 50:50 ratio.

Other research concurs. Cows grazing on pasture containing predominately perennial ryegrass have been shown to have significantly higher CLA in milk compared to periods when they were being fed dry hay.

Dhiman's research shows that CLA content in milk can be increased by feeding plant oils such as soybean, sunflower, peanut and linseed to dairy cows. Feeding full fat extruded soybeans and full fat extruded cottonseed to dairy cows doubled the CLA content of milk and cheese. (Feeding raw cracked soybeans had no effect on CLA content of milk.)

However, feeding heat-treated cracked soybeans doubled the CLA content, he said. Interestingly, feeding 4 percent soybean oil resulted in milk CLA contents close to the CLA in milk from grazing cows, suggesting that cows grazing lush green pasture with 60 percent less fat intake were more effective in enhancing CLA content of milk compared to cows fed soybean oil.

In trying to increase CLA content, producers should keep in mind that the amount will vary from cow to cow, even on the same diet, Dhiman said.

A study in 1996 found it to range from 2.5 to 17.7 milligrams per gram of fat no matter what the diet was.

Age of the animal can also be a factor, Dhiman said, noting that cows fed grass-based diets in lactations greater than four produced more CLA in milk fat than cows in two to four lactations. In another study, older cows had higher CLA in milk than younger cows.

One serving of whole milk (8 oz.) or one serving of cheese (30 grams) can provide 81 milligrams of CLA. This is 25% of the lowest dose shown to reduce the incidence of cancer in laboratory rats. Researcher Tilak Dhiman is trying to increase the CLA content of milk, milk products and meat.
Dhiman said that some researchers have tried to enhance the CLA content of milk by infusing synthetic CLA. Results showed that milk fat content decreased. Feeding synthetic CLA may not be an efficient way to increase the CLA content of milk because of the significant drop in milk fat content, he said.

In contrast to research on the CLA content of milk, studies of the dietary factors affecting the CLA content of meat are limited. The CLA content of beef in North America varies between 3.5 to 5.5 milligrams per gram of fat, about the same as milk, but several times less than cheese.

The few studies that have been done on meat show that, similar to dairy cows, feeding high forage diets to cattle increased the CLA content of beef. Dhiman also noted that neither variable cooking methods—frying, baking, broiling or microwaving—nor degree of doneness altered the CLA content in cuts of beef, indicating that CLA in meat is a stable compound under normal cooking and storage conditions.

Dhiman said that recent technology allowing scientists to analyze different chemical compounds of CLA is improving the ability to demonstrate the biological role of those individual compounds.

"The animal industry has a unique opportunity to enhance the image of dairy and meat with consumers by demonstrating the health benefits of CLA in humans."
After two years of gathering information about the diets of elderly Utahns, Heidi Wengreen is anxious to start working with data. But the people behind those anonymous case numbers will always be in her mind.

Wengreen is part of a research team led by associate professor Ron Munger that is studying the role nutrition may play in the incidence of hip fractures among the elderly. Wengreen's research involves gathering additional information from 200 of the 1,700 people participating in the study, and will help assess its validity and reliability.

Wengreen likes the work, meeting people and number crunching, and anticipates that information the team discovers will be very valuable.

"There are real holes in the data we have about the elderly population," she said. "Working on the study has been a good experience and the things we learn will be very valuable, especially as our population ages. Hip fractures are a much bigger problem than most people think. They are debilitating and depressing, and are often the big physical downturn for many people."

Participants in the study have supplied detailed information about their food preferences, how often they eat specific foods, their level of physical activity, and their family and personal medical histories.

Wengreen explained that over the past two years she has called each person in her study six times to get a report on exactly what they ate the day before. The surprise calls help reduce the chances that people will alter their usual diet in an effort to appear more nutrition conscious. She also makes home visits with people in the study.

"All the information is confidential and kept anonymous, but I feel I know these people," she said. "The scary thing is that someday we'll all be there and some of these people are so lonely. You finish with your questions and they don't want you to leave."

In addition to the hours spent interviewing people, Wengreen helped build the database researchers are using to assess the foods people report eating. While a lot of nutrition information was already available there were some notable exceptions. For example, people who reported eating cereal were asked to name specific types. But to fill in blanks in the available data Wengreen spent hours recording information from the labels of hundreds of cereal boxes.

Wengreen earned her bachelor's degree in USU's coordinated dietetics program in 1997 and jumped right into her graduate program, anxious to get more involved in nutritional epidemiology.

"I liked the one-on-one consulting dieticians do, but just didn't see myself working at a hospital and doing that every day," she said. "I really like working on studies with larger populations. It's like putting together a puzzle and the things we learn can help so many people. I'm just one small part of this very large study and I've learned so much working with Dr. Munger and the great people doing the study."

Wengreen has found the research so appealing that she plans to finish her master's degree and then complete a Ph.D.

"All with the support of the Clay Wengreen scholarship fund," she said joking but appreciatively of the financial and moral support her husband has unfailingly provided. "He's always been very supportive of my plans and really encouraged me to get my doctorate. I like working with the elderly population and I really look forward to devising my own studies, writing my own grant proposals, discovering more information that can help people. And I'd like to teach. I've enjoyed being a teaching assistant and have a new respect for teachers. It requires so much preparation and working with students isn't always easy."

*Heidi Wengreen, left, practices with her grandmother.*
EDITOR'S FOOTNOTE

It's such a rare occurrence that you can't help but notice when the national news media take notice of farmers. The New York Times, arguably the nation's most influential newspaper, took notice in a big way on Sunday, April 2, with a front-page story on small farmers around the country being driven off the farm at a time when the food supply has never been more abundant and agriculture never more efficient.

"With the failure of American farm policy, no one has much of a plan anymore, even though the present course appears unsustainable," the article states.

"The growing cost of federal farm programs, the replacement of small family farms with huge factory farms, the fading of rural hamlets—all these point to historic changes under way in American agriculture. Yet the changes are happening without anyone guiding them or the nation paying them much heed."

No heed indeed. Why should there be? The country, even the world, is brimming with grain, milk, poultry, beef and pork despite the fact that only 1.5 percent of the American population lives on farms and ranches. In 1900, 42 percent of the population lived on farms.

The story points out that "for many years, the agricultural equivalent of the four-minute mile has been the yield of 400 bushels of corn per acre." The average is about 150 bushels, but last year an Iowa farmer, Francis R. Childs, achieved celebrity by producing 394 bushels under tight monitoring.

And with more and more practical uses of biotechnology, agricultural efficiency could actually be in its infancy.

Other highlights in the article:

• The average poultry farmer raises 240,000 birds a year and earns just $12,000 for his labor.

• More and more livestock and crops will be produced under contract to large food companies. The farmer in those contracts is somewhere between a businessman and a laborer, and closer to laborer.

• The average American farm has gone from 139 acres in 1910 to 435 acres today.

• Direct federal payments to farmers last year rose to a record $23 billion, more than the federal government spent on elementary and secondary education, school lunches and Head Start programs combined.

• Congress talks about saving the family farm, but it pours the money disproportionately to larger farmers.

I read the story with interest because I grew up on a small dairy farm in Southern Utah that wasn't very efficient or very big and is no more. Those farmers with farms my father's size and era are also no more. Those who have survived have done so by getting bigger.

No doubt, the corporate model works for corporations, but the question is, does it work for anything else, such as raising a family. There's a lot of talk about the corporate farm and its effect on the quality of soil, water and the food it produces. But the quality of the farmers life doesn't often get considered.

"What always hurt us was when we're at the table trying to figure out how to make a land payment, and the kids are seeing us crying as we wonder what happens if we can't make the payment," Mike Abel, a Nebraska ranchers says in the article. Echoing many of his fellow farmers in Utah, he adds, "We'd always hoped this would be a family operation. But why should my son, Tyler, struggle and make money only two out of five years when he could get a good-paying job in the city somewhere?"

PHOTOQUIZ

Clue: A simple little gadget used in preventing "hardware" disease in cows.

James Thalman (JT), Editor
(435) 797-2189
jamest@cc.usu.edu

Answer to last issue's photoquiz (left): This is a hydrometer for determining the texture (sand, silt, clay content) of soils.
Utah Science is on line.
Check out our Web page at:
http://agx.usu.edu/agx/

FEATURED RESEARCHERS

Bart Weimer  Tilak Dhiman