Study Pinpoints Sustainability of Jersey Milk Production

With over 40% of milk produced in the United States utilized in the manufacture of cheese, using nutrient-dense milk produced by smaller Jersey cattle results in substantial reductions in water and land usage, fuel consumption, waste output, and greenhouse gas emissions compared to using Holstein milk.

Per unit of cheese, the Jersey carbon footprint *(total CO_2-equivalents)* is 20% less than that of Holsteins.

These were the key findings from a life-cycle assessment study presented by Dr. Jude Capper of Washington State University on July 13, 2010 at the Joint Association Meetings of five North American scientific societies for animal agriculture, including the American Dairy Science Association and the American Society of Animal Science.

"Not only does the Jersey population conserve finite resources needed for cheese production," Capper observed, "the total environmental impact is lower."

Conclusions were based on a year of herd performance information from nearly two million dairy cows in over 13,000 herds in 45 states.

New science probes environmental impacts of milk produced by the two major breeds related to greatest utilization—making cheese

Study Parameters

Capper and coauthor Dr. Roger Cady (Elanco Animal Health) broke new ground with this study by analyzing farm milk production required for the annual manufacture of 500,000 metric tons (1.1 billion pounds) of Cheddar cheese.

They compared two production systems, one using the large breed Holstein cow (average mature bodyweight, 1,500 lbs.) and the other the smaller Jersey cow (1,000 lbs.). Characteristically, the Jersey produces less milk measured by volume, but containing substantially higher fat and protein content. For the manufacture of Cheddar cheese, expected yields are 12.5 lbs. cheese per hundredweight (cwt.) from Jersey milk compared to 10.1 lbs./cwt. from Holstein milk.

Capper and Cady quantified the environmental impacts of producing Cheddar cheese from these different milks. The production system model included all primary crop and milk production practices up through and including milk harvest. It did not include transportation to the manufacturing plant, production and sales systems.

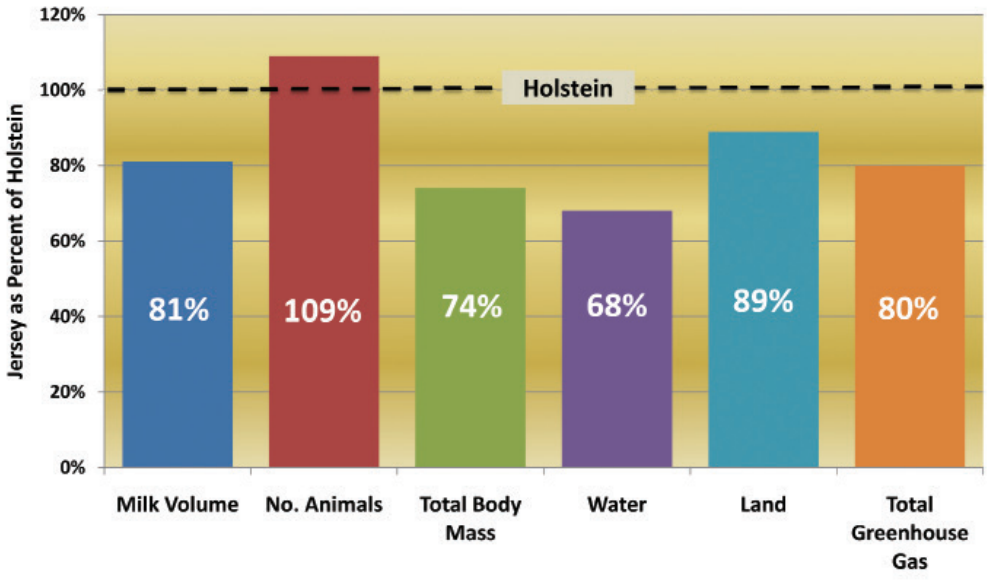

Fig. 1 Resources used and environmental impact per unit of cheese manufactured, comparing Jersey to Holstein milk production

Key Findings

To produce 500,000 metric tons of Cheddar cheese (1.1 billion pounds):

- 8.8 billion pounds of Jersey milk was needed, which was 19% less than the required amount of Holstein milk (10.9 billion pounds).
  - More Jerseys (91,460 animals) were needed to produce the same amount of cheese as Holsteins. That represents just 0.5% of the total U.S. dairy cattle population.
  - Despite the greater number of animals, the total body mass of the Jersey population was 26% smaller (276 million fewer total pounds) compared to the Holstein population.
- Total feed consumption decreased by 1.75 million tons with Jerseys, and Jerseys produced 2.5 million tons less manure compared to Holsteins.
- Water use was reduced by 32% with Jerseys, conserving 66.5 billion gallons of water, equivalent to the needs of 657,889 U.S. households.
- The land requirement dropped by 240,798 acres (376 sq. miles), which was 11% less than that required to support cheese production from Holsteins.
- The Jersey system used less fossil fuels than the Holstein system. The savings of 517,602 million BTUs in fossil fuel consumption is equivalent to

freeing up the energy necessary to heat 6,335 U.S. homes per year.

- The 20% reduction in the carbon footprint for the Jersey system is equivalent to removing 443,900 cars from the road annually.

Cheese production from Jersey milk conserves resources and reduces environmental impact. The two-fold advantage that the Jersey has is that they weigh so much less and the milk they produce is a more nutrient-dense product.

Jude L. Capper
Washington State University

Jerseys Reduce and Dilute Maintenance Overhead

The study's findings are explained by Jersey breed-specific characteristics that both reduce and dilute maintenance overhead in the production system. The lower total body mass of the Jersey system reduces maintenance costs per animal, and the greater nutrient density of Jersey milk dilutes maintenance resource requirements, especially for water, over more units of cheese.

"Water use in Jerseys comes down because there is more fat and protein in milk," Capper noted. "The savings is not just water intake for the smaller animals, but will carry through in transport and processing the milk into cheese.

"This study demonstrates that the number of animals in a population is not a good proxy for body mass," Capper added.

"In previous work, we assumed that the number of animals in a system equaled bodyweight. More animals meant greater bodyweight and thus greater environmental impact.

"In this study, because Jerseys weigh so much less than Holsteins, even though more animals are needed to produce the same amount of cheese, the total body mass comes down," she said. "Going forward, we need to account for differences in body size among animals.

"To produce the same amount of cheese, you need more Jersey animals," concluded Capper. "Holsteins do have an advantage in milk yield per animal.

"That is overcome by the two-fold advantage that the Jersey has. The animals weigh so much less and the milk they produce is a more nutrient-dense product."

A detailed research report is in preparation for submission to a peer-reviewed scientific journal.

Funding for this research was provided by National All-Jersey Inc., formed in 1957 to promote the increased production and sale of Jersey milk and milk products. For more information, call 614/861-3636 or email naj@usjersey.com.

Table 1. Milk production, cheese yield and herd dynamics for Jersey and Holstein production systems evaluated

	Holstein	Jersey
Daily milk yield *(lb)*	62	46
Fat *(%)*	3.8	4.8
Protein *(%)*	3.1	3.7
Cheese yield *(lb/cwt)**	10.1	12.5
Calving interval *(mo)*	14.1	13.7
Annual herd turnover *(%)*	34.5	30.0
Expected number of lactations*	2.54	3.00
Age at first calving *(mo.)*	26.1	25.3
Heifer:cow ratio*	0.86	0.83
Mature cow body weight *(lb)*	1,500	1,000

* Estimated as functions of data accessed
Source: DRMS, DairyMetrics™, accessed November 9, 2009

Breed has significant implications for nutrient management, CAFO permitting

A recently published report in the *Journal of Dairy Science* documents the differences in manure and nitrogen excreted by Jersey and Holstein cows—differences large enough, the study's authors say, to merit consideration in nutrient management plans and CAFO permitting.

With the changes in the definition of concentrated animal feeding operations and the inclusion of smaller farms, nutrient management planning is a priority. The standard estimates for manure and nutrient excretion used by engineers and regulatory agencies are, however, based only on Holstein studies.

The research team included Katharine Knowlton, associate professor at Virginia Tech; Vic Wilkerson, formerly at the ARS Nutrient Conservation and Metabolism Laboratory and now with Land O'Lakes Purina Feed LLC; David Casper, previously a USDA research scientist at Beltsville, Md., and now vice-president of nutrition with Agri-King; and David Mertens of the U.S. Dairy Forage Research Center. They analyzed nutrient excretion data from Jersey and Holstein cows collected at the former Energy Metabolism Unit within the USDA-Agricultural Research Service facility at Beltsville.

Data were obtained from Jersey and Holstein cows at 49, 154 and 271 days in milk in open-circuit respiration chambers allowing for collection and precise measurement of feed intake, feed refusals, milk, feces and urine. All cows had had at least two calves. Average daily production was 51 lbs. fat-corrected milk for Jerseys, and 69 lbs. for Holsteins. Average bodyweight was 940 lbs. for Jerseys, 1,385 lbs. for Holsteins.

Jersey cows consumed less dry matter (71% of Holstein intake) and less water (62% of Holsteins). Dry matter intake per unit of bodyweight was not significantly different, nor was there a breed difference in dry matter digestibility.

Manure excretion was lower in Jersey cows and generally proportional to changes in feed intake. Jersey cows excreted 33% less wet manure (total of wet feces and urine). Total nitrogen excretion was lower by 29%.

"The effect of breed on manure and nutrient excretion has significant nutrient management implications," the authors wrote. "The revised federal CAFO regulations (and the CAFO permitting programs of many states) define CAFO by a specified number of cows, making no distinction among breeds or cow size." The differences between Jerseys and Holsteins, they suggest, are "large enough to merit consideration in nutrient management planning and CAFO permitting. Accounting for breed differences in manure excretion will support more effective nutrient management planning on dairy farms."

Funds for this research were provided by the AJCC Research Foundation.

Knowlton, K.A., V.A. Wilkerson, D.P. Casper, and D.R. Mertens. 2010. Manure nutrient excretion by Jersey and Holstein cows. J. Dairy Science. 93:407-412.