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Comparisons of milk quality on North Carolina organic and conventional dairies

K. A. E. Mullen,* L. G. Sparks,† R. L. Lyman,† S. P. Washburn,* and K. L. Anderson†[1]
*Department of Animal Science, and
†Department of Population Health and Pathobiology, North Carolina State University, Raleigh 27695

ABSTRACT

The organic dairy industry is growing rapidly across the United States and has recently expanded into the southeastern states. To date, no published comparisons of milk quality exist between organic and conventional dairies in the Southeastern United States. Maintaining high milk quality is challenging in this region due to the longer periods of high heat and humidity. The objective of this observational study was to compare milk quality on organic and conventional dairies in North Carolina during the warm summer months of the year. Data were compared from 7 organically and 7 conventionally managed herds in North Carolina. To assess milk quality, milk samples were aseptically collected from each functional quarter of each cow in the milking herds at the time of sampling and linear somatic cell scores (SCS) were obtained for individual cows. A total of 4,793 quarter milk samples (2,526 conventional and 2,267 organic) were collected from 1,247 cows (652 conventional and 595 organic). Milk samples were cultured and bacterial growth was identified using protocols consistent with those of the National Mastitis Council (Verona, WI). Subclinical mastitis was defined as the presence of SCS $\geq$4 and also a microbiological infection in at least 1 quarter. The proportion of cows with subclinical mastitis did not differ between conventional (20.8%) and organic (23.3%) herds. No significant difference was observed between herd management types in the proportion of cows without microbiological growth in milk samples. Also, no significant differences were observed between organic and conventional herds for cow-level prevalence of *Staphylococcus aureus*, coagulase-negative *Staphylococcus* spp., *Streptococcus* spp., or *Corynebacterium* spp. Two of the organic herds had a notably higher prevalence of *Corynebacterium* spp. and higher SCS. Coliforms were found in 5 of 7 conventional herds and in only 1 of 7 organic herds. Mean SCS did not differ between conventional (3.3 $\pm$ 0.2) and organic (3.5 $\pm$ 0.2) herds. Despite differences in herd management, milk quality was remarkably similar between the organic and conventional dairies compared for this study.

Key words: organic, milk quality, mastitis, somatic cell score

INTRODUCTION

The organic industry of the United States is growing steadily due to increasing consumer demand. In 2010, organic food sales reached $28.6 billion, representing 4.0% of the total United States food market. Organic dairy products are the second-largest category of organic foods and sales in 2010 were $3.9 billion, representing almost 6% of all marketed dairy products in the United States (Organic Trade Association, 2011). The growth of the United States organic dairy industry is fueled by the willingness of some consumers in the United States to pay more for dairy products produced without the use of antibiotics and with documented pasture access for dairy cattle (Olynk et al., 2010).

Mastitis, or mammary inflammation, represents a significant economic challenge to the dairy industry. Mastitis management is potentially more difficult on organic farms in the United States because certified organic dairy farms in the United States are prohibited from using antibiotics in their cattle. However, treatment cannot be withheld from a sick animal, and if an animal is treated with antibiotics, it cannot return to the organic herd and products from it cannot be sold as organic (USDA National Organic Program, 2013). Organic regulations in the United States emphasize prevention rather than treatment of disease. Organic cattle must also have year-round access to the outdoors, at least a 120-d grazing season on organic pastures, and obtain at least 30% of their DMI from those pastures during the grazing season (USDA National Organic Program, 2013).

Few studies have compared milk quality in organic and conventional production systems in the United States. Most of those studies have been performed in Wisconsin (Sato et al., 2005; Pol and Ruegg, 2007b) or other northern states (Zwald et al., 2004; Stiglbauer et

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[1]Corresponding author: kevin_anderson@ncsu.edu

al., 2013). No studies comparing organic and conventional dairy production in the southeastern states have been published. The heat and humidity of the southeast provide favorable conditions for the growth of environmental bacteria and increase the risk of mastitis. Heat stress compromises the udder's defense mechanisms (Giesecke, 1985) and increases SCS in Holstein and Jersey cattle (Smith et al., 2013). The southeast United States also faces significant challenges with regard to meeting lower SCC limits (Norman et al., 2000).

Mastitis is a challenge for many southeast dairy producers, particularly in summer, and the limited availability of effective treatments for mastitis in organic dairy cattle raises questions about the ability to maintain high-quality milk in organic herds in the region. Currently, 6 certified organic dairy herds produce milk in North Carolina. One pasture-based research herd manages half of its cattle using organic health care standards, whereas the other half of the herd is managed conventionally. The objective of the current study was to compare milk quality in organic versus conventional dairies in North Carolina during the warm months.

MATERIALS AND METHODS

Regulatory Compliance

All sample collections from cows were performed in accordance with the North Carolina State University Institutional Animal Care and Use Committee (Raleigh) approved protocol 11-029-A.

Farm Selection and Surveys

In 2010, owners of all certified organic dairy farms in North Carolina (n = 6) were contacted and all agreed to participate in the study. Six conventionally managed dairy farms of similar size and geographical locations were recruited by personal contact of the authors. Also, a pasture-based research farm was included in this study. That research herd in North Carolina has managed half of its herd using organic health standards since 2009 and those organic cattle graze in transitioned pastures that can be certified organic. The other half of the herd is managed with conventional disease treatments, including antibiotic therapy at dry off and antibiotic treatment of mastitis. All cows in the research herd meet the 30% of DMI organic pasture requirement but they did receive supplemental concentrates that were not organically produced. Both management groups are milked in the same parlor, but otherwise do not have contact with each other. The research herd was considered as 2 separate herds in the analysis.

A written survey was developed by one of the authors (L. G. Sparks) to evaluate herd health management practices related to milk quality. Questions included basic farm demographics, milking protocols, fly control, and detection and treatments of subclinical and clinical mastitis. Farm demographics included breed(s) of cattle, number of lactating cattle, number of people milking cows, number of years certified organic, and the most recent bulk tank SCC. Surveys were given to farmers to fill out during farm visits while samples were being collected. Farmers were not compensated for participating in the study, but they were provided all milk culture results from cows in their respective herds.

Sample Collection

Milk samples were aseptically collected once from each functional quarter of all lactating cows in each herd between May and October of 2010. The average temperature during those months was 23°C (74°F) with an average of 70% relative humidity, with temperatures ranging from 17.9 to 27.4°C (64.3 to 81.3°F) and relative humidity ranging from 40 to 101% (State Climate Office of North Carolina, 2013). Only those cows that contributed milk to the bulk tank were sampled, as cows with clinical mastitis were not part of the protocol for the current study. Briefly, teats were predipped with the teat germicide used on the farm and wiped dry using the normal milking preparation procedure of the farm being sampled; 2 to 4 streams of foremilk were expressed and then teat ends were cleaned using cotton balls soaked in 70% isopropanol. Samples were collected into 12-mL vials, cooled, and then frozen overnight before milk culture. Linear SCS were obtained for individual cows within the sampled herds from the most recent monthly DHIA test if they participated in monthly testing. In those herds not on a monthly testing schedule with DHIA (n = 4), milk samples were collected from each cow, taking an equal amount of milk from each functional teat into a tube containing a bronopol tablet preservative. The samples were shipped to the United DHIA Laboratory (Blacksburg, VA) for SCC analysis. Monthly test data were given as SCS and thus results here are presented as SCS. The SCS was calculated using the formula $\log_2\left(\frac{\text{SCC}}{100,000}\right)+3$ to obtain the base 2 logarithmic transformation as recommended by Shook (1982).

Milk Culture

Microbiological analysis was performed in the Milk Quality and Mastitis Laboratory at the College of Veterinary Medicine at North Carolina State Univer-