Milk hygiene quality and clinical mastitis incidence on UK conventional and organic dairy farms

Ellis, K.A.[1], Mihm, M.[2], Innocent, G.[1], Cripps, P.[3], McLean, W.G.[4], Howard, C.V.[5] and Grove-White, D.G[3]
[1]Division of Animal Production and Public Health (E-mail: k.ellis@vet.gla.ac.uk) and [2]Division of Cell Sciences, Faculty of Veterinary Medicine, University of Glasgow. [3]Division of Livestock Health and Welfare, University of Liverpool Faculty of Veterinary Medicine. [4]Department of Pharmacology & Therapeutics, School of Biomedical Sciences, University of Liverpool. [5]Centre for Molecular Biosciences, University of Ulster.

Abstract

Dairy farms (17 organic and 19 conventional) were visited monthly for one year. The monthly BTSCC, BS count and incidence of clinical mastitis in both lactating and dry cows were compared between organic and conventional farms over the 12-month period by means of a generalised linear mixed modelling (GLMM) approach. Organic farms had a higher geometric mean BTSCC (227,000 cells/ml) compared to conventional farms (172,000 cells/ml). On all farms, a seasonal effect was observed, where BTSCC increased in the summer months to peak in September. Although there was no difference between farming system in the mean BS count, there was also a seasonal change in BS, which increased in the winter months (November-February) compared to the summer. Organic farms reported a lower mean monthly clinical mastitis case rate in the lactating cows (2.5 cases/100 cows/month) compared to conventional farms (5 cases/100 cows/month). The monthly mastitis case rate increased over the winter (November-February) on all farms. There was no difference in the dry cow clinical mastitis incidence between farming systems, although dry cow mastitis cases on organic farms represented 7% of all mastitis cases compared to 3.5% on conventional farms. As organic farms are less likely to use antibiotic therapy and may, therefore report fewer cases, these results may not reflect true differences in disease incidence.

Introduction

A number of mainly cross-sectional, small-scale studies of milk hygiene and mastitis incidence in organic dairy farm production in Europe have been published which indicate differences in comparison to conventional farms (Busato *et al*, 2000; Hovi and Roderick 2000; Weller and Bowling 2000; Hovi *et a.*, 2001; Byström *et al.* 2002; Hamilton *et al*, 2002; Toledo *et al.* 2002; Bennedsgaard *et al.* 2003). The study described in this paper investigated milk hygiene quality and clinical mastitis incidence on a larger number of farms in the UK over a 12-month period.

Methods

Conventional (n=19) and organic (n=17) dairy farms located in the north-west of England and in Wales were recruited for a longitudinal study. All farms enrolled in the study were visited monthly for 12 months from May 2003 to April 2004. All visits to each farm included completion of a short interview questionnaire to collect data on the previous month's milk production quality and the herd management. Data were analysed using Microsoft Excel and MINITAB software (MINITAB 13.20, Minitab Inc.). For analysis of bulk tank somatic cell count (BTSCC) and Bactoscan (BS) data, log transformations of the data were performed. To compare the BTSCC and BS content of milk from organic and conventional farms over the 12-months of the study, a GLMM approach was adopted;

$$MV_{ijk} = \mu + F_i(T_j) + T_j + M_k + \bullet_{ijk}$$

Where MV_{ijk} is the milk variable of interest (BTSCC, or BS), F_i is the individual farm, T_j is the farm type (organic or conventional), M_k is the month and $\bullet_{ijk}$ is the residual error term. Individual farm identity was included as a random factor and month was included as a fixed effect. The effect of month, individual farm or farm type was considered significant if the F-test for this effect was

significant ($p<0.05$). Post-hoc pair-wise tests were performed using a Bonferroni comparison to compare the different levels of significant factors, with significance levels of $p<0.05$.

The monthly incidence of clinical mastitis in both lactating and dry cows was calculated per 100 cows in milk or dry as appropriate. These case rate data showed over-dispersion, therefore, the data were transformed to a gamma distribution. Analysis was conducted in SAS (SAS Institute, US) using the PROC MIXED function to enable a GLMM to be constructed as described above, with the outcome of interest as mastitis case rate. Interactions between farm type and month were examined in all models. Additionally, the annual clinical mastitis rate/100 cows was estimated for the herds in both systems.

Results

Both farm type ($p<0.01$) and month ($p<0.01$) affected the mean BTSCC (Figure 1). The mean organic BTSCC of 227,000 cells/ml was higher than the mean conventional BTSCC of 172,000 cells/ml. The BTSCC on both farm types increased through the summer to reach a peak in September and then dropped through the autumn to a low point in the winter in January ($p<0.05$). Individual farm 12-month geometric mean BTSCCs showed a wide range on both farm types: 143,000 to 362,000 cells/ml on organic farms and 89,000 to 309,000 cells/ml on conventional farms. There was no difference in variance between organic and conventional herd BTSCC results (Levene's test, $p=0.86$). There was no effect of farm type on BS count (mean values of 30,000 /ml in organic and 28,000 cells/ml in conventional farms). Month was significant ($p<0.01$), with BS counts increasing in both systems in the winter (Figure 2), with lower counts in June and August compared to the winter months of November to February ($p<0.01$). However, there was fluctuation in this pattern, with BS counts increasing in May. Individual farm 12-month geometric mean BS counts, ranged between 13,000 /ml to 69,000 /ml on organic farms and 9,000 /ml to 60,000 /ml on conventional farms. There was no difference in variance between organic and conventional herd BS results (Levene's test $p=0.45$).

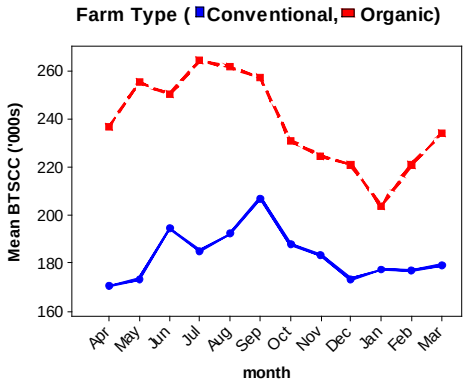

Figure 1 Mean 12-mo BTSCCs

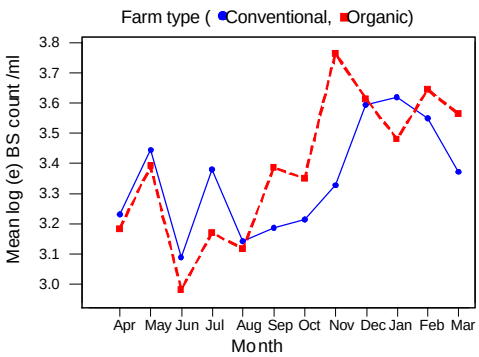

Figure 2 Mean 12-mo (log) BS

Monthly clinical mastitis case rate differed between organic and conventional farms ($p<0.05$) where mean case rates were 5 and 2.5 cases/100 cows/month respectively. There was also a highly significant effect of month ($p<0.01$), where case rate increased in the autumn to peak in November. The mean (SD) annual clinical case rate per 100 cows in milk was 25 (11.5) on organic farms and 41 (21.2) on conventional farms. There was a highly significant effect of month on dry cow clinical mastitis cases ($p<0.01$), with a peak case rate in August, although there was no difference between the two farming systems ($p=0.27$), where the mean monthly case rate was 1.4 and 1.7 cases/100 cows/month on conventional and organic farms respectively. There was a higher dry cow case rate in organic farms in July and November compared to conventionally managed farms. The mean (SD) annual clinical case rate per 100 dry cows was 2.5 (3.9) on organic farms and 0.86 (1.8) on

conventional farms, which was not significantly different. However, dry cow mastitis cases contributed 7% of the total cases in organic and 3.4 % of total cases on conventional farms.

Discussion

Both month and farm type significantly affected the BTSCC, with organic farms having a higher mean BTSCC compared to conventional farms. The mean organic BTSCC was similar to values from previous UK studies of 244,000 cells/ml (Weller and Davies 1996) and 246,000 cells/ml (Weller and Bowling 2000). In both systems, the BTSCC increased through the summer to reach a peak in September and then dropped to a low point in January. Higher BTSCCs on organic farms are probably a reflection of a combined effect of less frequent treatment of clinical mastitis cases with antibiotics and a reduction in the use of antimicrobial dry-cow therapy. Additionally, there is less direct financial pressure to control BTSCCs compared to conventional farming in UK organic systems, where the organic milk BTSCC must be below the EU threshold of 400,000 cells/ml with few other BTSCC payment bands.

Organic farms reported a lower monthly clinical mastitis case rate compared to conventional farms. There was a highly significant effect of month overall, with an increase in cases reported in the winter months of November to February. With respect to dry cow mastitis, there was a highly significant effect of month on the case rate, although there was no difference between the two farming systems. There are a number of limitations to these mastitis data: first, these are data based on farm records of clinical cases and, in most cases, this was only a record of cases that were treated; second, there was no gold-standard definition of a clinical case, (the study was reliant on farmer observation and reporting); third, these are cow cases rather than quarter cases. Farms utilising a policy of allowing self resolution of cases may not be recording all cases. Organic farmers are less likely to use antimicrobial therapy at the first sign of mastitis compared to conventional farms, therefore case reporting is likely to be lower if cases represent only those treated with antibiotics. However, the mean annual estimated clinical cow case rate in this study of 41 cases/100 cows/year on conventional farms is comparable with other studies of UK dairy farms (Whitaker *et al.* 2004). The mean case rate of 25 cases/100 cows/year on organic farms was lower than previous studies of UK organic farms which reported 35-46 cases/100 cows/year (Weller and Cooper 1996; Hovi and Roderick 2000; Weller and Bowling 2000). A different mastitis pattern on organic farms has been reported (Hovi and Roderick, 2000; Weller and Bowling 2000), with a greater percentage of cases attributable to dry cow cases compared to conventional farms. This was confirmed in the current study, where there was higher percentage of cases in organic herds in the dry period. There was great variation between herd case rates across all herds in the dry period, which may reflect genuine variation or poor case detection in cows which are observed less frequently compared to lactating counterparts which are presented through the parlour twice daily.

References

Bennedsgaard, T. W., Thamsborg, S M, Vaarst, M, and Enevoldsen, C (2003) Eleven years of organic dairy production in Denmark: herd health and production related to time of conversion and compared to conventional production. Livestock Production Science 80 [1-2] 121-131.

Busato, A., Trachsel, P, Schällibaum, M, and Blum, J W (2000) Udder health and risk factors for subclinical mastitis in organic dairy farms in Switzerland. Preventive Veterinary Medicine 44 205-220.

Byström, S., Jonsson, S, and Martinsson, K (2002) Organic versus conventional dairy farming - studies from the Öjebyn Project. Proceedings of the Colloquium of Organic Researchers Conference, 2002 179-184.

Hamilton, C., Hansson, I, Ekman, T, Emanuelson, U, and Jonsson, S (2002) Health of cows, calves and young stock on 26 organic dairy herds in Sweden. Veterinary Record 150 503-508.

Hovi, M. and Roderick, S (2000) Mastitis and Mastitis Control Strategies in Organic Milk. Cattle Practice 8 [3] 259-264.

Toledo, P., Andrén, A, and Björck, L (2002) Composition of raw milk from sustainable production systems. International Dairy Journal 12 75-80.

Weller, R. F. and Bowling, P J (2000) Health status of dairy herds in organic farming. Veterinary Record 146 [3] 80-81.

Whitaker, D. A., Macrae, A I, and Burrough, E (2004) Disposal and disease rates in British dairy herds between April 1998 and March 2002. Veterinary Record 155 43-47.

Acknowledgements

The farmers who participated in this study, the University of Liverpool Farm Animal Practice and Professors David Taylor and Mike Stear (University of Glasgow). This work was funded by the Organic Milk Suppliers Co-operative.