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Evaluation of food safety and quality in organic beef cattle in NW Spain; a comparison with intensive and conventional systems

I. Blanco-Penedo[1], M., López-Alonso[1], R.F. Shore[2], M. Miranda[3], C. Castillo[1], J. Hernández[1] and J.L. Benedito[1]

[1]Universidade de Santiago de Compostela, Departamento de Patoloxía Animal, Facultade de Veterinaria, 27002 Lugo, Spain.
[2]NERC Centre for Ecology & Hydrology, Lancaster Environment Centre, Library Avenue, Bailrigg, Lancaster LA1 4AP, UK.
[3]Universidade de Santiago de Compostela, Departamento de Ciencias Clínicas Veterinarias, Facultade de Veterinaria, 27002 Lugo, Spain.
e-mail: isabel.blanco.penedo@usc.es

Abstract. The objective of this study was to analyse how beef-cattle farming in NW Spain on organic farms compares with intensive and conventional systems in terms of impacts on the safety and quality of cattle products. Data on the hygiene and quality of 244, 2596 and 3021 carcasses of calves from organic, intensive and conventional farms, respectively, were collected at the slaughterhouse. Organic calves generally had fewer condemnations for liver, kidney and heart pathologies. Liver parasitic infections were 2 fold higher in organic calves than those from other types of farm. Farm processes and resultant food product quality are linked through the health of the animal and its disease status. Overall better health status was not reflected by carcass performance as this was significantly lower for organic calves than for calves from conventional and intensive farms. Carcass performance seemed to be more determined by dietary component than by health status in the animals in our study.

Key words: organic, beef cattle, animal health, food quality

INTRODUCTION

The standards associated with organic farming do not per se ensure either high levels of animal health and welfare or safe livestock food products (Vaarst et al., 2006; Fall et al., 2008). The benefits of organic systems are primarily related to environmentally-friendly production and to animal welfare, whereas issues pertaining to animal health and product quality are more influenced by the specific farm management than by the production method (Sundrum, 2001; Vaarst et al., 2006).

In beef farming, it is known that, to improve meat quality, it is necessary to examine the whole production chain from breeding to meat processing. Farm processes and resultant food product quality are linked through the health of the animal and its disease status. It is necessary to remark that specially in organic farming meat quality is a major factor and this production system emphasises product quality rather than

quantity (Hermansen & Zervas, 2004), thereby meeting the requirements of consumers (Sundrum, 2001) who tend to be wary of intensive production systems that have been associated with food crises. The importance and characteristics of organic beef production vary widely between European countries. In Spain, 97% of organic cattle livestock production is for beef cattle (MAPA, 2007) and, in the north-west, beef-cattle production is the most important form of agriculture, accounting for 15.2% of total national production (MAPA, 2005). In this region, cattle were traditionally reared on small farms that were dependent on local fodder crops. In the 1980s, calves began to be produced on indoor intensive farms where they were fed purchased concentrate to promote their growth. In recent years, however, there has been an increase in the number of organic farms in this region. These have mostly been conventional farms that have adapted to the broad standards required of organic systems (1804/1999/EEC). To date, there has been no assessment of the impact such changes in farming practice have made to resultant quality of meat in Spain.

The objective of this study was to analyse how organic beef-cattle farming in NW Spain compares with intensive and conventional systems in terms of impacts on the safety and quality of the cattle products at the slaughterhouse.

MATERIALS AND METHODS

Data for 244 calves from organic farms (representing 84% of all certified organic calves slaughtered from this area during the whole of 2007), 2596 calves from intensive farms and 3021 calves from conventional farms were collected from the same slaughterhouse. The total of calves (5861) represents the global annual work of this slaughterhouse. The remaining 16% of certified organic calves were slaughtered at two different slaughterhouses and were not included in this study to avoid variability in hygiene control and carcass quality criteria. Mean±SD age at slaughter was 286±31, 295±52 and 246±64 days for intensive, organic and conventional calves, respectively. Data on pathological findings and condemnations at the post-mortem inspection by official veterinarians from the slaughterhouse were retrieved from the Official Inspector's Veterinary Record Book. Data on classification of carcass quality was a visual evaluation of the carcass (according to sex) using the SEUROP system (grades from S: superior to P: poor) and a visual fatness score (5 grades from 1: lean to 5: fat) (103/2006/EEC). These assessments were conducted by graders at the slaughterhouse.

All statistical analyses were done using the program SPSS for Windows (v.15.0). Variables that were normally distributed were analysed by Student's t test or Analysis of Variance (ANOVA). Variables that were not normally distributed, even after data transformation, or that did not meet the underlying assumptions of the ANOVA, were analysed by the non-parametric Kruskal-Wallis test. In all analyses, statistical significance was taken to be indicated by $P < 0.05$.

RESULTS

The results from the post-mortem inspections of calves from organic, conventional and intensive farms are presented in Table 1. In all, 25.7% of all animals had at least one recorded pathological abnormality.

Table 1. Analysis of post-mortem condemnations (expressed as number and % of the total animals) in different viscera/body areas of organic, conventional and intensive reared calves. Pathological findings for each viscera/body area are presented as a percentage of animals condemned.

	Organic (n=244)	Conventional (n=3021)	Intensive (n=2596)	Coefficient	p
Liver					
N	26 (10.7%)	374 (12.4%)	435 (16.8%)	H_2=24.57	0.000
Abscesses	42.3%	66.1%	71.9%		
Parasites infection	23.1%	10.6%	3.94%		
*Degenerative proc.**	11.5%	13.8%	12.8%		
*Inflammatory proc.***	0%	0.54%	0.46%		
Other causes	23.1%	8.9%	10.9%		
Lung					
N	58 (35.2%)	535 (17.7%)	915 (35.2%)	H_2=225.2	0.000
Pneumonia	94.9%	97.6%	99.2%		
Inflammatory proc.	0%	0%	0.32%		
Other causes	5.08%	2.23%	0.43%		
Kidney					
N	9 (3.7%)	362 (12.0%)	290 (11.2%)	H_2=15.56	0.000
Kidney abscesses	0%	0.27%	0%		
Degenerative proc.	10%	0.27%	0.68%		
Inflammatory proc.	0%	0%	1.03%		
Other causes	90%	99.4%	97.9%		
Digestive tract					
N	78 (32.0%)	49 (1.60%)	211 (8.10%)	H_2=430.5	0.000
Inflammatory proc.	94.8%	97.9%	98.6%		
Other causes	5.19%	2%	1.42%		
Heart					
N	1 (0.40%)	17 (0.60%)	12 (0.50%)	H_2=0.328	0.849
Pneumonia	0%	7.1%	8.3%		
Degenerative proc.	0%	14.3%	8.3%		
Inflammatory proc.	100%	42.9%	8.3%		
Malformation	0%	14.3%	16.7%		
Other causes	0%	21.4%	58.3%		
Legs					
N	2 (0.80%)	5 (0.10%)	3 (0.20%)	H_2=6.503	0.039
Inflammatory proc.	50%	20%	0%		
Traumatic injuries	50%	60%	33.3%		
Malformation	0%	0%	33.3%		
Other causes	0%	20%	33.3%		
Drug residues	0 (0%)	0 (0%)	1(0.03%)	H_2=1.207	0.272

* Degenerative proc. = Degenerative processes. ** Inflammatory proc= Inflammatory processes.

Common abnormality between some viscera was also observed. The highest proportion of condemnations was due to pathologies observed in the liver, lung and digestive tract. There were significant differences between calves from the different farm systems in the proportion of condemnations due to pathologies in all viscera and body areas studied, except for the heart. Organically reared calves had the lowest proportions of condemnations in the liver (10.7%), kidney (3.7%) and heart (0.40%) compared with calves from conventional and intensive farms, but the highest incidence of pathologies was in the digestive tract (32.0%). Notably, there was a high incidence of lung condemnations amongst intensively reared calves (35.2%).

When analysing in detail the condemnations for each viscera/body area, the percentage of the different pathological findings were very similar in the three groups of calves for the main condemnations, except for liver abscesses which occurred at a lower frequency in organically reared calves (42.3%) than in calves from conventional (66.1%) and intensive (71.9%) farms. In contrast, the incidence of liver parasitic infections was higher (>2 fold) in calves from organic farms (Table 1). In relation to condemnations for drug residues, only one positive animal was detected and this came from an intensive farm.

With regards the assessment of the performance of beef production, statistically significant differences were found for carcass weight ($F_{2, 5860}$= 468.6, $P \leq 0.001$), with calves from intensive farms having a higher mean (± SD) carcass weight (210 ± 36 kg) than organically (173 ± 49 kg) and conventionally reared calves (178 ± 44 kg). Furthermore, the carcass weight of calves from intensive farms was less variable than that of calves from conventional and especially from organic farms (coefficients of variation: 17.2, 24.4 and 28.2 respectively). There were also significant differences between farming systems for the fatness score (H_2 = 4.738, P = 0.030), calves from intensive farms being the fattiest group, but not for carcass conformation (H_2 = 0.136, P = 0.712).

DISCUSSION

The hygiene and quality control record of the animal at slaughter can be used to evaluate the impact of husbandry practices on the health of animals. The higher frequency of liver abscesses detected at slaughter in calves from intensive and conventional farms may be related to the feeding practices of these farming systems. Unlike many conventional and all intensive farms, organic farms provide only a low fraction of concentrate in the feed ration and this can prevent rumen acidosis and liver disorders (Owens et al., 1998). It has also been reported that calves which competed for feed in crowded pens (as might be most likely to occur on intensive farms), had twice as many instances of abscessed livers and this could reduce farmer's income by 3–5% (Welfare Quality, 2008). In contrast, Jorgensen et al. (2005) observed marginally higher frequencies of liver abscesses in organic dairy cows than in conventional herds (8% *vs.* 5%), but the organic cattle were more exposed to rumen acidosis and liver abscesses because of higher dietary starch levels and unbalanced feeding strategies (which were strongly seasonal dependent).

Although liver abscesses were less prevalent in organic calves in our study, the percentage of parasitic infections in the liver in organic and intensively managed calves

were relatively high and low, respectively. This may be related to the grazing management on organic farms and the permanent indoor conditions and standardized parasites-prophylaxis on intensive farms. A higher incidence of parasitic lesions in organic than conventional cattle has likewise been reported previously (Hansson et al., 2000) and was related to the level of hygiene in predominantly outdoor organic management systems. Conversely, the high incidence in our study of lung condemnations at slaughter caused by pneumonia in intensive calves may be explained by the permanent indoor conditions which may have been over-crowded and/or poorly ventilated (Grandin, 1997). Similar results were observed in intensively reared pigs compared with free range (Seifert et al., 2002) and organically reared animals (Hansson et al., 2001; Baumgartner et al., 2003). Finally, the high incidence of inflammatory digestive lesions detected at slaughter in organically reared calves in our study is notable. These results probably indicate that digestive tract infections in organically reared calves have a predominantly sub-clinical pattern and may be associated with diarrhoea or mucosa lesions that are related to feeding behaviour and supply in outdoor systems (Vaarst & Hovi, 2004).

Slaughterhouse records can also be used to evaluate the impact that farming systems have on final beef performance (Vaarst & Hovi, 2004). There are conflicting views with regards the quality of meat products from organically reared calves: the general consumer believes organically certified meat is better, this is not always the opinion among practising veterinarians and conventional farmers (Hansson et al., 2000). Our study has demonstrated that the generally promoted view that organic farming concentrates more on product quality than quantity (Hermansen & Zervas, 2004) may not be completely true. Although, in our study, the percentage of condemnations in organically reared calves was generally lower than for calves from conventional and intensive systems (perhaps reflecting better overall health status of calves on organic farms), neither carcass conformation nor fatness scores were superior in organically reared calves. Sundrum (2001) likewise reported that there was little evidence of any impact of organic production on product quality. The heaviest carcasses in our study were for calves from intensive farms and the lowest, although more variable, were for organically reared calves. The high proportion of concentrate, and hence energy, in the feed ration of intensively reared animals leads to higher fat deposition and energy retention (Galyean & Rivera, 2003) compared with animals from organic farms where forage is the main dietary component; it is well known that herbivores fed with a higher proportion of roughage but few concentrates need more time to fatten (Nielsen & Thamsborg, 2005).

The difference between the mean carcass weights of intensively reared and conventionally reared calves are also likely to be related to the higher age at slaughter of animals from intensive farms. Carcass weight was also most homogenous for intensively reared animals and this is possibly partly related to low breed diversity common on intensive farms. Homogenous carcass weights may also be due to standardized husbandry and management indoor practices on intensive farms, together with a low dependence on local feed and little influence of seasonal and environmental conditions. In contrast, all these factors are likely to exert a maximal (and potentially adverse) effect on weight gain in organically reared calves, and the diversity of diverse rustic breeds on organic farms in NW Spain is also likely to lead to heterogeneity in slaughter weights. Furthermore, the higher sub-clinical parasitic infections in organic

calves in our study, indicated by the high prevalence of liver parasites and inflammatory digestive lesions at slaughter, could also be a contributory cause to low carcass weights. Indirect losses through decreased live-weight gains, lower feed-conversion efficiencies and more liver condemnations due to the presence of parasitic lesions, have been reported elsewhere (Murrell, 1986), and growth performance greatly improves when animals are treated with antihelmintics (Stromberg et al., 1997). Dimander et al. (2000) reported that, depending on pasture management, an average of 30 kg reduction of live weight was found between organically-managed calves and young cattle prophylactically given anti-parasitical drugs treatments.

CONCLUSIONS

Compared with animals from conventional and intensive farms, cattle from organic farms had fewer condemnations at slaughter. However, this better health status was not reflected by carcass performance, which seems to be determined more by dietary component. Furthermore, the suspected higher prevalence of parasitosis in the organic herd compared with cattle from intensive and conventional systems may decrease beef performance. Evaluation of condemnations at slaughter could be a useful tool as a feedback mechanism to establish appropriate control measures on farms in order to reduce the high prevalence of sub-clinical disorders that are mainly related to parasitosis. Further investigations into fattening feed strategies for organic beef are needed to improve product quality and thereby meet the specific requirement of consumers of organic products.

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