Carcass Quality in Certified Organic Production Compared with Conventional Livestock Production

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With 3 tables and 7 figures

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Summary

By studying carcass quality, expressed as affection, pathological findings, slaughter-weight and evaluation, a picture of an animal’s health and potential as high quality food is achieved. This study compares the carcass quality in Swedish certified organic meat production with that of conventional meat production slaughtered during 1997. The study involves 3.9 million pigs, about 570 000 cattle and 190 000 sheep, all reared conventionally and 3483 pigs, 4949 cattle and 4997 sheep reared according to organic standards. Pathological and additional findings are registered by meat inspectors from the Swedish National Food Administration at the post-mortem inspection. There was a significant difference at the post-mortem inspection of growing-fattening pigs; 28 % of conventionally and 17 % of the organically reared pigs had one or more registered lesion. The carcass evaluation of swine shows a higher meat percentage in conventional swine production. The total rate of registered abnormalities in cattle was systems around 28 % from organic and 27 % from conventionally reared herds. Carcass evaluation of cattle from organic herds gave higher classification in the EUROP system, whereas the fat content was lower than that of conventionally reared cattle. Sheep, reared both organically and conventionally, showed a lower rate of registered abnormalities than swine and cattle.

Introduction

One of the purposes of organic agriculture systems is to produce food of high quality from healthy animals. The animals should be reared according to present ethical and environmental standards aimed at a sustainable system. There are differing opinions concerning animals and food from organically certified systems. The general public think that those from organically certified systems are better, however, this is not the opinion among practising veterinarians and conventional farmers. The Swedish government is committed to an increase in organic production, with the goal of at least 10 % of the total agricultural production by the end of this century. Livestock farming is still far less than 10 %. In 1997 around 3.9 million pigs were slaughtered in Sweden, of which about 0.1 % were reared in organically certified herds. Out of about 570 000 slaughtered cattle, 1.5–2 % came from organically certified herds. Approximately 2.5–3 % of 190 000 slaughtered sheep, and only 0.06 % of the 63 million chickens were reared in certified organic systems (KRAV, 1998; Statistics Sweden, 1998).

The meat inspection at the abattoir is carried out in order to guarantee the quality and safety of the meat. The reporting and the results of post-mortem abnormalities and additional findings registered during inspections differ between countries. In Denmark approximately 0.6 % of the swine carcasses were totally condemned in 1997 and about 25 % of the

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slaughtered swine had a partial condemnation (Hermansen, 1998). The most common cause of partial condemnation was respiratory diseases (Hermansen, 1998). In Norway, about 0.4% of the cattle and 1.0% of the pig carcasses were condemned in 1997 (Nordbr, 1998). In Finland, approximately 1% of the cattle and 0.6% of the pig carcasses were totally condemned in 1997, the most common cause of partial condemnation in pigs being arthritis (Mangs, 1998).

Antibiotic feed additives are not allowed in any type of livestock production in Sweden. Veterinary treatment with chemotherapeutics or antiparasitic drugs routinely or for preventive purposes is not allowed in Swedish organically certified systems (KRAV, 1997). Other anti-parasite strategies, such as rotational grazing and other means of grazing management have to be implemented. However, animals showing signs of illness may be given pharmaceutical therapy when that is considered the best choice. The qualifying period for milk delivery is double the withdrawal period in conventionally reared dairy herds. For meat to qualify as certified organic, the qualifying period is 6 months.

Livestock farmers who wish to sell their product as certified organic have to adhere to the standards of KRAV, the Swedish certifying organization of organic production. KRAV was formed 1985 and is an association with delegates from the farmers’ organizations, processing industry, distributors, retailers, consumer co-operation, and the environmental movement. KRAV is also a member of IFOAM, the International Federation of Organic Agriculture Movements. In the organic agricultural system the animals must be able to express normal social behaviour, i.e. pigs may root in the soil, and a calf may suckle the cow for the first few days. The standards of the certifying organization state that ‘animals showing signs of poor welfare at the ante-mortem inspection cannot be certified’. A severely contaminated hide or emaciated animals at the ante-mortem inspection would be such signs.

According to the standards of the certifying organization at least 95% of the annual feed intake for ruminants must be organically produced, for swine 85%. At least half of the feed must be produced on the farm. For dairy cows, roughage must make up at least 50% of the daily dry matter intake, for other cattle not less than 70% must consist of roughage (KRAV, 1997).

The purpose of this study was to find out in what way the rules stipulated by the certifying organization affect animal health and carcass quality. The result are discussed in relation to the influence of the two systems on the health of the animals.

**Materials and Methods**

Meat inspection at all abattoirs in Sweden is organized and carried out by the Meat Inspection Organization which is a part of the National Food Administration. All meat inspections in Sweden are done according to the ordinance on slaughter of domestic animals and farmed game (The National Food Administration, 1996). At the ante-mortem inspection a severely soiled animal will be registered by the meat inspection veterinarian as a contaminated hide, and at the post-mortem any pathological and additional findings are registered.

Raw data on the pathological findings and condemnations of conventionally reared animals were collected on an individual basis from the Swedish Board of Agriculture, where the data are sorted into groups of species of animals, findings at the inspection (which may be one to four lesions), and the number of animals with this combination of lesions. These data were compiled and analysed by use of Matlab software (Matlab, 1993). Data on livestock from certified organic herds slaughtered during 1997 were collected on an individual basis from 29 abattoirs. These animals were all reared according to KRAV standards, but not all meat was sold as organically produced meat.

Classification of the carcass is carried out after the post-mortem inspection, just before the carcass is put into cold-storage. The classification is carried out according to the directions of classification of carcasses (The Swedish Board and Agriculture, 1991). The classification data on conventionally reared cattle and sheep slaughtered in Sweden in 1997 was retrieved from the Swedish Board of Agriculture (Jonsson, 1998). The classification of cattle and sheep gives a description of the relationship between muscular tissue, fat tissue and bone of the carcass and its suitability for use. Classification of sheep and cattle is a visual assessment made by a trained evaluator and entails three steps: (1) classification according to the animal’s sex and age group; (2) assessing meat content according to the EUROP system where E stands for extremely well developed with bulging muscle, down the scale to P which stand for very poorly developed muscle; (3) evaluation of fatness score, 10 grades from 02, lean, to 25, fat.
The classification of swine is an estimation of the meat content of the carcass without the head, described in meat-percentage and is carried out at most of the slaughterhouses with the Hennessy Growing probe. The classification data on conventionally reared swine slaughtered in Sweden in 1997 were retrieved from Ingemar Hansson, Department of Food Science, Swedish University of Agriculture Sciences. The mean slaughter weights of conventionally reared swine were retrieved from Yearbook of Agriculture Statistics 1998.

The pathological findings are presented as a percentage of slaughtered animals and the statistical significance was determined by the chi-square test (Wonnacott and Wonnacott, 1984). One animal may have more than one pathological finding registered. It is assumed that condemnations and classifications were assigned independently of the animal’s origin.

**Results**

**Ante-mortem affections**

The incidence of contaminated hide (Table 1) was higher in conventionally reared bulls and steers than in those from the organic systems. In cows and heifers no significant difference was found between the two systems.

**Post-mortem affections**

The results from the post-mortem inspections in growing-fattening pigs are shown in Table 2. There was a significant difference between swine from organic systems and pigs reared in conventional rearing systems with regard to most of the pathological findings at the post-mortem inspection. In conventionally reared herds approximately 28% of the swine had at least one affection registered at the post-mortem inspection, whereas in the organic herds 17% of the pigs had one or more such finding. The most common pathological finding in conventionally reared swine was pleuritis, which was found in 7.4% of the slaughtered conventionally reared pigs. Among organically reared pigs the corresponding figure was 1.8% (Table 2). The second most common pathological finding in conventionally reared pigs was ascaris (5.6%), whereas in organic pigs it was the most common (4.1%). The results of post-

<table>
<thead>
<tr>
<th>Lesions in 1932 organic and 256781 conventionally reared cows and heifers, 2482 organic and 261141 conventionally reared bulls and steers slaughtered in 1997</th>
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<tbody>
<tr>
<td>Cows and heifers</td>
</tr>
<tr>
<td>Organic (%)</td>
</tr>
<tr>
<td>Onchocerciasis</td>
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<tr>
<td>Peritonitis</td>
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<tr>
<td>Abscesses</td>
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<tr>
<td>Arthritis</td>
</tr>
<tr>
<td>Eosinophilic myositis</td>
</tr>
<tr>
<td>Parafilariosis</td>
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<tr>
<td>Pneumonia</td>
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<tr>
<td>Pleuritis</td>
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<td>Lungworm</td>
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<td>Fasiosiasis</td>
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<td>Dicroceliasis</td>
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<td>Liver abscesses</td>
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<td>Other liver diseases</td>
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<tr>
<td>Mastitis</td>
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<td>Contaminated hide</td>
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</tbody>
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* Statistical significance, *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$. 
Table 2. Lesions in 3464 organic and 3963 799 conventionally reared growing-fattening pigs slaughtered 1997

<table>
<thead>
<tr>
<th>Lesion</th>
<th>Organic (%)</th>
<th>Conventional (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumours</td>
<td>0.1**</td>
<td>0</td>
</tr>
<tr>
<td>Abscesses</td>
<td>0.5 ***</td>
<td>1.4</td>
</tr>
<tr>
<td>Arthritis</td>
<td>2.1***</td>
<td>1.3</td>
</tr>
<tr>
<td>Arthrosis</td>
<td>1.5***</td>
<td>0.4</td>
</tr>
<tr>
<td>Tail biting</td>
<td>0.5***</td>
<td>1.4</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>0.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Pleuritis</td>
<td>1.8 ***</td>
<td>7.4</td>
</tr>
<tr>
<td>Ascariasis in the liver</td>
<td>4.1 ***</td>
<td>5.6</td>
</tr>
<tr>
<td>Other liver diseases</td>
<td>2.2</td>
<td>2.2</td>
</tr>
</tbody>
</table>

* Statistical significance, *P < 0.05, **P < 0.01, ***P < 0.001.

mortem inspections indicated a higher rate of pleuritis, abscesses, tailbiting and ascaris in the liver in conventionally reared pigs than in pigs from certified organic systems. The incidence of joint diseases such as arthritis and arthrosis was higher in organically reared pigs (Table 2).

The incidence of post-mortem abnormalities and additional findings registered during inspections of cattle are presented in Table 1. In conventionally reared cattle approximately 27% had at least one pathological finding registered at the post-mortem inspection, whereas in the organically reared cattle, 28% had one or more such finding. The most common pathological finding in cows was lipidosis, which is registered among other liver diseases. Lipidosis were more common in female than in male cattle (Table 1). More than 10% of the livers from conventionally reared cows and heifers were condemned due to liver diseases. Cows and heifers from certified organic herds showed a significantly lower incidence of abscesses, arthritis, mastitis and liver diseases such as lipidosis. Parasitic affections such as dicrocoeliasis, parafilariosis and onchocerciasis were more prevalent in certified organic herds, in cows and heifers as well as bulls and steers. Eosinophilic myositis also showed a significantly higher prevalence in organically reared cattle. There were no significant differences found in cows and heifers concerning peritonitis, fascioliasis and parasitic liver affections except dicrocoeliasis. In bulls and steers no significant differences were found concerning peritonitis, abscesses, arthritis, pneumonia, pleuritis, fascioliasis and liver abscesses (Table 1).

The pathological findings at the post-mortem inspections of sheep are shown in Table 3. The result show a low number of abnormalities at the post-mortem inspections of sheep in both conventionally reared (10%) and certified organic sheep (9%). The most common pathological finding in sheep was liver damage caused by Dicrocoelium dendriticum, which was

Table 3. Lesions at 4724 organic and 185 059 conventionally reared sheep slaughtered 1997

<table>
<thead>
<tr>
<th>Lesion</th>
<th>Organic (%)</th>
<th>Conventional (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abscesses</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Lungworm</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td>Pleuritis</td>
<td>0.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Dicrocoeliasis</td>
<td>5.4*</td>
<td>4.9</td>
</tr>
<tr>
<td>Parasitic affections of the liver</td>
<td>1.7*</td>
<td>1.3</td>
</tr>
<tr>
<td>Other liver diseases</td>
<td>0.3*</td>
<td>0.5</td>
</tr>
</tbody>
</table>

*Statistical significance, *P < 0.05, **P < 0.01, ***P < 0.001.
Carcass Quality in Certified Organic Production

Fig. 1. Classification in meat percentage at 3464 organically and 3559 conventionally reared growing-fattening pigs. Shaded bars, organically reared; white bars, conventionally reared.

registered in 5.4% of the organic and 4.9% of the conventionally reared animals. There was a significantly higher rate of parasitic affections of the livers in sheep from certified organic herds (Table 3) whereas other liver diseases were lower in organically reared animals.

Carcass classification

Swine from certified organic herds showed greater variation in meat percentage than conventionally reared swine (Fig. 1). The mean meat percentage in growing-fattening pigs from certified organic herds was 59.5%, and in conventionally reared swine 60.1%. The mean slaughter weight of growing-fattening pigs from certified organic herds was 82.5 kg. Pigs from conventionally reared herds had a mean slaughter weight of 84.1 kg. The incidence of emaciated swine was below 0.1% in both of the groups.

The fatness score was lower in young bulls reared according to the KRAV standards (Fig. 2). They had a more developed carcass with a higher meat content that gave them a better classification in the EUROP system (Fig. 3). The fatness score in cows from organic systems showed a greater variation, compared with conventionally reared cows (Fig. 4). The organic cows had a more developed carcass, and were therefore better classified in the EUROP system (Fig. 5). The incidence of emaciated cattle was 0.1% in both of the groups.

Fig. 2. Fatness score; O2, lean and 25, fat, in 2242 organically and 249145 conventionally reared young bulls. Shaded bars, organically reared; white bars, conventionally reared.
Carcass classification results of sheep did not follow the same pattern as the cattle. The fatness score was higher in lambs from certified organic herds than in lambs from conventionally reared herds.
reared herds (Fig. 6). Lambs from conventionally reared herds had values that were more frequently in the lower classes, O-, P+ and P (Fig. 7). The incidence of emaciated sheep was 0.2% in conventionally reared sheep but below 0.1% in those organically reared.

Discussion

The present study involved all of the conventionally reared animals slaughtered and approximately 80–85% of all certified organic animals slaughtered. The remaining animals from organic farms could not be collected. One reason for not achieving 100% of the certified organic animals is that commonly the farmer sends the stock to a nearby abattoir even though it is not approved by the certifying organization. This is because the premium paid for certified organic meat is not high enough to compensate for the longer wait at, and journey to, the approved slaughterhouse. Another reason could be for instance that animals were slaughtered before the certifying organization’s qualifying time had been fulfilled. In this study, most of the animals are registered as organic but some of them might have been registered as conventionally reared at the slaughterhouses. This might cause lower numbers of pathological findings at the post-mortem inspection of organically certified animals.

Findings at the ante-mortem inspection

There was a lower incidence of contaminated hide in bulls and steers from certified organic systems. The principal cause of contaminated hide could be lack of bedding, aggravated by high

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Fig. 6. Fatness score; O2, lean and 25, fat, in 4821 organically and 158,273 conventionally reared lambs. Shaded bars, organically reared; white bars, conventionally reared.

Fig. 7. Classification of 4821 organically and 158,273 conventionally reared lambs. Shaded bars, organically reared; white bars, conventionally reared.
stocking densities, poor ventilation causing condensation, poor drainage, inadequate floor
gradients and infrequent removal of slurry (Gracey, 1981). In conventional rearing systems,
young stock, particularly bulls and steers, are usually sold as young calves to special beef
production units. In these operations the bulls are most commonly either tied up or housed in
box stalls with slatted floors. This system is not applied under organic standards. The certified
organic farm has fewer animals, only the young stock that were born on the farm. The animals
must not be tied under the age of 6 months, and they must have access to a bedded area.
During the summer months they must be pastured. Consequently within the organic system
there are no large numbers of animals tied up or on slatted floors without adequate bedding
over long periods of time, which probably explains why organically reared bulls and steers have
a lower incidence of contaminated hide. For cows and heifers there was no difference in the
incidence of contaminated hide, and there are no major differences in housing systems for this
group of animals, between organic and conventional farms.

Findings at the post-mortem inspection

One of the major problems of indoor intensive systems in conventional swine production
is diseases of the respiratory system. Enzootic pneumonia of pigs is an infectious disease, but
one that is greatly affected by management factors such as crowding, ammonia levels, relative
humidity, temperature fluctuations, and mixing of stock from various sources (Yates, 1988).
The findings at meat inspection indicate a significantly higher rate of pleuritis in conventionally
reared pigs compared with those from organically certified herds (Table 2), which are kept
partly outdoors, in smaller herds and without the mixing of stock.

Solitary infected joints and solitary abscesses cause condemnation of the affected parts of
the carcass. In the microbiological examinations *Erysipelothrix rhusiopathiae* was the most common
organism isolated from the joints (Friede and Segall, 1986, Hariharan et al., 1992). *Erysipelothrix
rhusiopathiae* can gain entry to the body by a variety of routes. Infection through ingestion of
contaminated feed and water is considered a common mode (Wood, 1986). The bacteria can
also be found in the soil of swine pens (Wood, 1986) and has been isolated from 25.6% of
samples of soil where swine have been kept (Acha and Szyfres, 1989). It may imply a greater
problem when pigs are kept outdoors. There are significantly higher incidences of arthritis and
arthrosis in pigs kept in an organic systems. Vaccination against *Erysipelothrix rhusiopathiae* is
allowed in certified organic herds but vaccination has not been widely practised among organic
farmers.

The incidence of abscesses in pigs was higher in conventionally kept animals (Table 2).
The reason for this might be that the pigs in certified organic herds are usually kept in
smaller groups with more available space and do not suffer from stress to the same extent as
conventionally reared pigs. The lower level of stress prevents tail biting and hence injuries that
might lead to formation of abscesses. Abscesses might also be secondary to wounds caused by
a rough floor surface without sufficient bedding material. A third route of entry may be an
injection site. In organic herds preventive medication such as routine deworming is not practised
and the overall sickness prevalence seems to be lower than in conventionally reared herds.
Consequently organic pigs would have, as a group, fewer injection sites where pathogens may
be introduced and lead to the formation of abscesses.

Factors involved in parasitic diseases are, for example, the volume and intensity of grazing,
grazing habits, and the immunological and nutritional status of the animal. Treatment with
antiparasitic drugs routinely or for preventive purposes is not allowed in certified organic
systems. These farms have to rely on alternative antiparasite strategies, such as rotational grazing
and other means of grazing management. This may lead to an insufficient supply of grazing
and a higher population density on available land. It may also cause an increased use of marginal
pasture-land, such as wooded or swampy areas where parasite vectors may be more abundant.
This is probably one of the reasons that condemnation of the liver because of the liver fluke
*Dicrocoelium dendriticum* was more frequent in certified organic herds of cattle (Table 1) and sheep
(Table 3) than in conventionally reared herds. In general, adult and well-nourished animals are
less susceptible to the effects of liver fluke, and maintenance of a good plane of nutrition may
help to reduce its severity (Radostitis et al., 1994). There was a significantly higher incidence of parasitic findings such as onchocerciasis and parafilariosis in the organic herds. The major reason for the difference among young bulls was probably that bulls and steers in conventionally reared herds are generally never let outdoors. For cows and heifers, it may be caused by the lack of bug-repellent ear tags that are not allowed by organic standards.

Migration of ascarid larvae through the liver, lungs and other organs may provide entry sites for pathogenic micro-organisms and cause lesions resulting in condemnation at slaughter. The onslaught of many larvae in the liver destroys parenchyma and results in white spot in the liver. Older pigs withstand worm burdens better and inhibit larval migration, thus they are free of infection or are asymptotic carriers of low-grade infections due to prior exposure (Corwin et al., 1986). Signs of parasitic affections of the liver, mainly ascarisis, in the postmortem were more prevalent in swine from conventionally reared herds (Table 2). This may be because swine in conventional rearing systems are kept in larger herds and in a confined area, which may lead to a higher risk of infection. It is, however, more likely that, because the organic pigs do not grow as fast and are therefore older at the time of slaughter, some of their parasitic lesions will have healed (Corwin et al., 1986).

The higher incidence of pathological findings like mastitis and lipidosis and other liver diseases in conventionally reared cattle may be production-related. Mean milk production in the organic herds is at 85 % of the conventionally maintained herds. Fatty liver is seen in conjunction with other periparturient diseases, although its pathogenesis is still not clear (Radostitis et al., 1994). It is an interesting finding that in this material cows in organic herds show a lower incidence of this ailment. It may be that fatty liver is secondary to other diseases, from which the organic cows are less likely to suffer.

**Carcass classification**

Organically reared pigs are usually older at the time of slaughter, as evidenced by a higher bone density, but they do not have a higher slaughter-weight. The meat percentage of growing-fattening pigs was higher in swine from conventionally reared herds than from organic herds. This may be because organic pigs use more energy when moving around outdoors.

The general effects of the level of nutrition on the growth of meat animals are reflected in the composition of individual muscles. On a high level of nutrition, a greater proportion of fat is synthesized (Lawrie, 1985). There is an indication that the percentage of fat tissue in the carcasses is lower in cattle from organic systems than in those from conventional systems (Figs 2 and 4). They are better classified in the EUROP system (Table 3 and Fig. 5). As mentioned above, there are a number of restrictions with regard to the feed in the organic standards. There is a potential risk that forage may be of lower nutritive value or provide an insufficient yield as chemical fertilizers are not permitted.

Young bulls and steers classify better in the EUROP system, possibly because of different breeds being more common in different systems. Cattle from dairy herds still make up approximately 70–80 % (Statistics Sweden, 1998) of Swedish meat. The main reason for the better classification of organic cattle is probably that 59 % of the cows are dairy cows (KRAV, 1998), compared with 74 % of conventionally reared cows (Statistics Sweden, 1998). There is, thus, a larger share of beef breeds on the organic side and these animals will generally classify better.

Another important factor that may contribute to better classification is the freedom from mixing of stock from different sources, which is a common method in conventional rearing systems. In conventional beef-rearing units, slatted floors without bedding material are common, and a high stocking density is the rule. This is most likely a stressful environment for bulls. In organic herds, the calves may also get off to a better start as they receive whole milk for as long as 10 weeks, in many cases by nursing.

Sheep are housed and managed in much the same manner whether they are reared organically or conventionally in Sweden. Carcass classification is better in lambs from the certified organic system and they also have a higher fatness score (Figs 6 and 7), possibly because organic sheep are kept in smaller flocks and the animal densities at pasture are not as high as in some of the conventionally reared flocks.
Acknowledgements

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References


