Effect of some factors of variability on carcass weight of organically reared beef

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SUMMARY

Introduction - During the last few years, organic production has showed an increasing trend. This trend is mainly due to the EU supporting policy, in order to guarantee food security and sustainable productions for the future. In addition, since the nineties, producers and consumers have shown a growing interest towards organic production and the market have been developed. Moreover in Tuscany, a lot of farmers which own marginal land and/or forested areas have decided to turn to organic livestock, both for the ethical value of their products and for the greater bargaining power that the goods have on the market.

Aim - The aim of this research was to study the effects of some variability factors on carcass weight.

Materials and methods - Breed, slaughtering age, sex, season of birth, interactions year x management, breed x age and sex x age on carcass weight of 457 cattle slaughtered during the period 2001-2011 were evaluated. The animals were Chianina, Maremmana, Limousine and crossbreed Maremmana x Limousine veals and were raised in the same farm in Tuscany. The animals received the same feed and were slaughtered at an average age of 18/24 months, depending on the breed and sex. Data were stratified on the basis of the slaughtering age (five levels), then a statistical analysis was performed.

Results and discussion - Chianina and crossbreed Limousine x Maremmana gave heavier carcasses: 389.3±6.39 and 323.4±5.41 kg, respectively. In general the farming system (conventional or organic) did not affect carcass weight. Chianina cattle showed a wide range of slaughtering weights. Moreover in the farm, the larger number of Chianina beef was slaughtered between 22 and 26 months like Limousine and crossbreeds, whereas Maremmana was slaughtered between 18-22 months.

Males had heavier carcass than female: 353.2±4.35 vs 299.4±5.85 respectively but the differences between sexes were significant only after 18 months. The management system (conventional/organic) and the season of birth did not affect the carcass weight of cattle.

Conclusion - The management system (conventional/organic) do not seem to influence the productivity, indeed it does not affect the carcass weight of beef cattle. On the other hands the choices of management play an important roles on productivity as demonstrated by the effects of the slaughter age and the breed on the carcass weight.

KEY WORDS

Beef, carcass weight, organic system, variability factors.

INTRODUCTION

During the last few years, organic production has showed an increasing trend. This trend is mainly due to the EU supporting policy, in order to guarantee food security and sustainable productions for the future. In addition, since the nineties, producers and consumers have shown a growing interest, organic production and market have been developed. Although in Italy organic farming has been regulated later with respect to the other European countries, nowadays it is well established and reached a certain stability¹. Unlike organic crops, organic livestock chain is mainly related to the development of specific market segments. For its characteristics organic livestock is expected will guarantee a certain market stability and will make the market not linked to EU Community founds in the coming years.

In the last ten years in Tuscany, a lot of farmers which own marginal land and/or forested areas decided to turn from conventional to organic livestock, both for the ethical value of their products and for the greater bargaining power that the goods have on the market. Regarding beef production, organic breeders have turned their attention to typical Tuscan breeds, characterised by a good rusticity and good live performances.

The present study aims to evaluate the effect of some factors on carcass weight of Maremmana, Chianina, Limousine and crossbreed Maremmana x Limousine beef raised in a farm in the province of Grosseto, during the period from 2001 to 2011.

MATERIALS AND METHODS

The trial was carried out in a farm located in the heart of Maremmana (Tuscany); it covers an area of 1,500 hectares, of which 1,100 of woods and 400 of agricultural land. The
herds were kept in the wild, particularly in the woods, using the cow-calf breeding system. In the farm about 100 Maremmana, Chianina and Limousine beef were reared in the wild; the calves that were not chosen for the turnover were used as fattening cattle. For this reason, they were recovered in pens with outdoor area until the age of slaughtering. The slaughtering occurs at about 18/24 months of age, depending on the breed and sex. The composition of feed did not differ between the breeds and consisted in herbage silage, hay, cereal (barley and oats) and legume (faba bean and protein pea) meals that were produced in the farm; feed was given ad libitum and in the evening it was supplemented with additional meal (a mix of cereal and legume meals in a 50:50 ratio) on the basis of the animal weight. In particular meal was given daily from a minimum of 0.8 kg/100 kg of live weight for raising animal up to a maximum of 1 kg/100 kg of live weight for finishing animals. Data from management programs, invoices, shipping documents during the years 2001-2011 were analysed. The collected data refers to: registration number, breed, sex, date of birth, slaughtering age and carcass weight of 457 animals (100 Chianina, 63 Limousine, 37 Maremmana and 257 crosses Maremmana x Limousine). Thus, the subjects were grouped according to slaughtering age, as follows:
- Level 1: slaughtering age under 14 months,
- Level 2: slaughtering age between 14 and 18 months,
- Level 3: slaughtering age between 18 and 22 months,
- Level 4: slaughtering age between 22 and 26 months,
- Level 5: slaughtering age over 26 months.
Levels 1 and 5 were excluded from statistical analysis for the few number of subjects. The data from level 2, 3 and 4 (for a total of 437) were analysed using a statistical model in which the effect of year of slaughter, breed, age, sex, season of birth, interactions year x management (in 2004 the farm change the rearing system from conventional to organic) and the interactions between age x breed and age x sex were tested. The not significant interactions were excluded from the model:

\[ y_{ijklmn} = \mu + P_i + A_j + B_k + S_l + D_m + G_n + (A_j * B_k) + (G_n * P_i) + (A_j * S_l) + \varepsilon_{ijklmn} \]

where:
- \( y_{ijklmn} \) = studied parameters;
- \( \mu \) = overall mean;
- \( P_i \) = fixed effect of \( i \)th years (\( i = 2001, \ldots, 2011 \));
- \( A_j \) = fixed effect \( j \)th breed (\( j = \) Limousine, Chianina, Maremmana, Limousine x Maremmana cross);
- \( B_k \) = fixed effect of \( k \)th slaughtering age (\( k = 14-18, 18-22, 22-26 \));
- \( S_l \) = fixed effect of \( l \)th sex (\( l = \) male, female);
- \( D_m \) = fixed effect of \( m \)th birth season (\( m = \) spring, summer, autumn, winter);
- \( G_n \) = fixed effect of \( n \)th management (\( n = \) organic, conventional);
- \( (A_j * B_k) \) = effect of age x breed interaction
- \( (G_n * P_i) \) = effect of management x years interaction
- \( (A_j * S_l) \) = effect of age x sex interaction
- \( \varepsilon_{ijklmn} \) = residual effect.

RESULTS AND DISCUSSION

Among the factors that affected carcass weight, slaughtering age is obviously very important, as already reported in the literature in a study carried out on Chianina. Indeed, it is known that there is a gradual increase in weight with the increasing of the slaughtering age. As shown by the number of the animal slaughtered for age class (Table 1) the farm usually delayed the age of slaughtering in order to have heavier weights, and therefore a greater profitability.

The increase in body weight as a function of age is represented by an equation of the third degree: the growth curve has a self-accelerating trend up to 13-14 months, then slow down gradually until the weight of about 370 kg. Therefore, in our study the beefs had a weight reflecting the normal somatic development of their species. Obviously, the breed affected the carcass weight (Table 2). Chianina beef, for example, grows absolutely more than other breeds, and had significantly heavier carcasses (\( P \leq 0.01 \)). Even if the difference is not significant, Maremmana x Limousine crosses led to the production of heavier carcasses if compared to the pure breeds. This result is in agreement with the findings of other authors. Moreover an improving effect was found in all crossbreed between Maremmana and the other breeds.

In Table 3 the interaction effects between farming system (conventional and organic) and the year of slaughtering are shown. The farming system did not affect carcass weight, with the exception of year 2003 (Conventional system), when highest slaughter weights were registered. Furthermore the results in year 2003 were similar to the findings in years 2007 and 2008 (both Organic system). These observations are probably due to business decisions: in fact, during the years 2003, 2007 and 2008 a larger number of older animals, and males - typically heavier than females - was slaughtered. In addition, in the same period the farmer decided to stop the raising of Chianina breed, thus a larger number of Chianina - known for somatic gigantism - were slaughtered. Moreover, Table 3 reports normal oscillations probably not only due to the factors investigated, but also to other factors not considered in this study.

These results seem to confirm other findings: in France, some authors have compared animals extensively reared ac-

| Table 1 - Effect of the slaughtering age on carcass weight. |
|----------------|----------------|----------------|
| Age (months)   | 14-18          | 18-22          |
| N               | 51             | 160            |
| Mean (kg)      | 269.6b         | 326.3a         |
| s.e.            | 10.54          | 5.89           |
| A, B, C: P ≤ 0.01 |

<table>
<thead>
<tr>
<th>Breed</th>
<th>Chianina</th>
<th>Limousine</th>
<th>Maremmana</th>
<th>Crossbreed</th>
</tr>
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<tbody>
<tr>
<td>N</td>
<td>86</td>
<td>62</td>
<td>34</td>
<td>255</td>
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<tr>
<td>Mean (kg)</td>
<td>389.3b</td>
<td>302.1a</td>
<td>312.8a</td>
<td>323.4a</td>
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<td>s.e.</td>
<td>6.39</td>
<td>8.35</td>
<td>10.81</td>
<td>5.41</td>
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<tr>
<td>A, B: P ≤ 0.01</td>
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</table>
despite some authors have reported that the best age for slaughtering Maremmana calves is between 16-18 months. Nevertheless, Maremmana cattle give excellent meat even at older age and with pasture-based farming systems.

In this study, some Maremmana veals were slaughtered between 14 and 18 months. However, Maremmana has a certain somatic precocity and in spite of a late sexual maturity it is not advisable to anticipate the slaughter age too much.

Also the sex affected significantly carcass weight ($P <0.001$) (Table 5).

As reported in the literature, the differences in size and shape between sexes are due to the different development of tissues and organs.

In the light of our results on the breed and age level, the differences between males and females were significant ($P <0.01$) only after 18 months, for all the considered breeds (Table 6).

Since animals were raised according to the cow-calf system, the effects of the season of birth was tested. In fact, the results of the analysis of the interactions between breed and slaughtering age are reported in Table 4. Chianina cattle showed a wide range of slaughtering weights. Moreover in the farm, the larger number of Chianina beef was slaughtered between 22 and 26 months. Otherwise two trends were generally found in literature: the first one is the slaughtering at a relatively younger age and live weights around 600 kg and the second is the slaughter at an older age and live weights from 750 kg.

Although some authors stated that the optimal slaughtering age is around 18 months for Limousine breed, in our study a large number of cattle slaughtered at older ages was registered.

Regarding Maremmana, the largest number of subjects were slaughtered between 18 and 22 months as shown in Table 4, despite some authors have reported that the best age for slaughtering Maremmana calves is between 16-18 months. Nevertheless, Maremmana cattle give excellent meat even at older age and with pasture-based farming systems.

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lity of the pasture is known to depend on the period and could have affected the calves growth and the carcass weight (Table 7).

Our findings show that carcass weight was not affected by season. Probably this result is linked to the ability of the animal to balance the lack of growth with the age. Furthermore, the season of birth has been reported to have a different impact on the health of cows, on their milk production and on the growth of calves in the early period of life\(^\text{12}\).

**CONCLUSIONS**

The interaction “management system x year of slaughtering” do not seem to influence the productivity, in fact it does not affect the carcass weight of beef cattle. Therefore this production has good potential also given the interest of market and of the consumers, their awareness of the ethical value of organic farming and their perception of organic foods as safer, healthier products.

On the other hands the choices of management play an important roles on productivity as demonstrated by the effects of the slaughter age and the breed on the carcass weight.

**ACKNOWLEDGEMENTS**

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**References**


<table>
<thead>
<tr>
<th>Season</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
<th>Winter</th>
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<tbody>
<tr>
<td>N°</td>
<td>118</td>
<td>117</td>
<td>108</td>
<td>94</td>
</tr>
<tr>
<td>Mean (kg)</td>
<td>334.6</td>
<td>339.5</td>
<td>325.6</td>
<td>339.7</td>
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<tr>
<td>s.e.</td>
<td>7.22</td>
<td>7.40</td>
<td>7.40</td>
<td>8.09</td>
</tr>
</tbody>
</table>

**Table 7** - Effect of season of birth on carcass weight.