Effects of testicular status and feeding diets containing date palm by-product on the sensory attributes of Omani lamb meat

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Abstract

The effects of testicular status and diet on the tenderness and flavour intensity of Omani lamb meat were evaluated. Thirty male lambs were divided into three testicular status treatments shortly after birth, entire, castrated or induced to cryptorchidism. The animals were fed a maize and soya bean meal based diet, isocalorically supplemented with either palm fronds or Rhodesgrass hay. The animals were slaughtered at an average age of 161 days and weight of 27.6 kg. Sensory evaluation of meat for tenderness and intensity of flavour were undertaken using descriptive analysis with unstructured scales. Meat from New Zealand lambs was also evaluated for comparison. Meat from castrated lambs tended to be more tender than meat from either entire or cryptorchid lambs. This effect was related to the significantly lower daily weight gains, lower carcass weight and lower intermuscular fat content of castrated lambs. The effect of induced cryptorchidism or inclusion of date frond was not significant on tenderness, nor flavour of the lamb meat. Meat from New Zealand lambs was significantly more tender, but similar in flavour compared to Omani lambs. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

Consumers have identified tenderness and flavour as the most important factors regarding lamb meat quality, preferring tender as opposed to tough (Lawrie, 1991), and mild flavoured as opposed to strong flavoured lamb (Melton, 1991). These sensory attributes depend on factors that may include diet and management practices. Management practices examined in the present study are male fertility control.

Unlike temperate areas, desert climates do not have abundant grazing land for ruminants. Sources of roughage, like Rhodesgrass, must be grown under irrigation, at considerable cost. Alternate sources of roughage would be economically desirable. In Oman, some 14,000 tonnes dry weight of palm frond prunings are produced from approximately eight million date palm trees each year (Myhara et al., 1999), most of which are disposed of by burning. Palm frond, used in experimental diets, were shown to be inferior to Rhodesgrass hay as a source of roughage, but were economically viable given the latter’s high cost of production (Mahgoub et al., 1998). The effect of feeding palm frond upon the lamb meat quality had not been evaluated.

Lamb meat tenderness, in general, is not significantly affected by diet. Fahmy et al. (1992) found that diet did not significantly affect meat tenderness from...
lambs slaughtered at ages ranging from 198 to 243 days.

Lawrie (1991) reported that post-mortem handling conditions such as chilling rate have a profound effect upon the ultimate pH of meat. Generally, the closer the ultimate pH is to the isoelectric point of the meat proteins, the less tender the resultant meat becomes. The significance of diet on lamb meat flavour has not been determined with certainty. Cramer et al. (1967), Park and Thomas (1973) and Field et al. (1983), found feed source to significantly affect the flavour of lamb meat, however, Paul et al. (1964) and Ford and Park (1980) failed to show significant dietary effects. Certainly dietary factors could quite possibly affect meat flavour, especially so as the animals age.

Raising entire males can introduce management problems related to breeding programs, so castration is a common means of fertility control that could Mahgoub et al. (1998) found that castration of male Omani lambs resulted in lower daily growth rates, carcass weights and intermuscular fat content. Induced cryptorchidism, an alternative to castration, controls fertility (Chesworth et al., 1996) but does not significantly decrease growth rate, average slaughter weight or intermuscular fat content (Mahgoub et al., 1998).

In the present study, a trained sensory panel assessed the tenderness and flavour intensity of entire, cryptorchid or castrated Omani lambs fed either Rhodesgrass or palm frond.

2. Methods and materials

2.1. Animals

Thirty Omani male lambs, born at the Sultan Qaboos University Experimental Station, were used in the study. After birth, 10 randomly chosen lambs were induced to cryptorchidism and 10 were left entire. Two weeks after birth the remaining lambs were castrated. The lambs were castrated or induced to cryptorchidism, (the scrotum was shortened by an elastrator rubber band after the testes were manually manipulated back into the body cavity). From birth until weaning (on average 76 days), the lambs were fed and housed castrated or induced to cryptorchidism as described by Mahgoub et al. (1998).

2.2. Feeding treatments

The base diet, was composed of milled maize (≈38% w/w), and milled soya-bean meal (≈11%) (Mahgoub et al., 1998). Each weaned animal was fed this base diet isocalorically supplemented with either 42% dried palm fronds or Rhodesgrass hay. The compositional and nutritional values of the two diets are shown in Table 1. Feeds were analyzed for proximate and chemical composition according to the methods of the AOAC (1990). Each of the three testicular treatments (castrate, induced cryptorchid and entire) was fed one of the two experimental diets (palm frond or Rhodesgrass hay) in a 3×2 arrangement.

2.3. Post-mortem

Animals were slaughtered over a two-day period, on-site, when they attained an average live weight of 28 kg. The eviscerated carcasses were split in the middle and held in a chiller (4°C) for 48 h. Carcasses were divided into wholesale cuts following the methods of Gerrard and Mallion (1977). The resultant wholesale cuts were immediately frozen and stored at −20°C in vacuum pouches.

<table>
<thead>
<tr>
<th>Component (%)</th>
<th>Palm frond diet</th>
<th>Rhodesgrass diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground palm frond</td>
<td>42.4</td>
<td>0</td>
</tr>
<tr>
<td>Ground Rhodesgrass hay</td>
<td>0</td>
<td>42.7</td>
</tr>
<tr>
<td>Maize</td>
<td>37.7</td>
<td>38.0</td>
</tr>
<tr>
<td>Soya bean meal</td>
<td>11.3</td>
<td>11.4</td>
</tr>
<tr>
<td>Palm oil</td>
<td>4.71</td>
<td>4.70</td>
</tr>
<tr>
<td>Urea</td>
<td>1.41</td>
<td>0.80</td>
</tr>
<tr>
<td>Ground limestone</td>
<td>1.04</td>
<td>1.00</td>
</tr>
<tr>
<td>Monocalcium phosphate</td>
<td>0.24</td>
<td>0.20</td>
</tr>
<tr>
<td>Mineral vitamin mix</td>
<td>0.38</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Chemical analysisa

<table>
<thead>
<tr>
<th>Component</th>
<th>Palm frond diet</th>
<th>Rhodesgrass diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter (%)</td>
<td>92.0</td>
<td>92.0</td>
</tr>
<tr>
<td>Metabolizable energy (MJ/kg)</td>
<td>11.9</td>
<td>12.4</td>
</tr>
<tr>
<td>Crude protein (%)</td>
<td>15.7</td>
<td>14.9</td>
</tr>
<tr>
<td>Acid detergent fibre (%)</td>
<td>17.9</td>
<td>21.0</td>
</tr>
<tr>
<td>Lipid (ether extract) (%)</td>
<td>9.30</td>
<td>8.58</td>
</tr>
<tr>
<td>Calcium (%)</td>
<td>0.54</td>
<td>0.74</td>
</tr>
<tr>
<td>Phosphorus (%)</td>
<td>0.30</td>
<td>0.37</td>
</tr>
</tbody>
</table>

a Percent dry matter basis.
2.4. Sensory evaluation

Sensory evaluation was completed 30 days after slaughter. A total of five loin pairs from each overall treatment were available for sensory evaluation. One vacuum packed frozen loin from each of the individual treatments was randomly chosen and thawed at 8°C for 12 h. After thawing, the complete Longissimus dorsi muscles were excised from the loins. Muscles were wrapped in one layer of aluminum foil and cooked in a gas-fired oven to an internal temperature of 70°C. A copper-constantan thermocouple was placed in the center of each muscle and the temperature was recorded using a digital recording thermometer (Model #CMC821, Ellab Instruments, Denmark). Cooked L. dorsi muscles were kept warm for 10 min in an insulated container and then cut into 2.54×2.54×1.25 cm pieces at room temperature.

2.5. Training

An eight member sensory panel consisting of faculty members and technicians was trained in three separate 1 h sessions. During training sessions, the panelists were asked to evaluate the tenderness and the intensity of flavour of standard meat samples. Young lamb loins, purchased from a local retailer, provided a tender textured mild flavoured standard. Mature Merino sheep loins, also purchased from a local retailer, provided a tougher textured stronger flavoured older mutton standard. The samples were prepared as previously described. In each training session, samples were presented to each of the eight panelists in an open round-table format. The panel was asked to establish anchor points, describing the young lamb standards as very tender and very mild in flavour, while describing the older sheep standards as very tough with a very strong mutton-like flavour. During the training sessions the panel was encouraged to talk openly about the anchor points and the wording of the questionnaire form.

2.6. Sensory panels

Following the training sessions, the panel was asked to sit for three sessions, once per week. Panelists were presented with three portions of each of the six treatments under study (six sample sets). A seventh sample set consisting of frozen vacuum-packed New Zealand lamb loins, prepared as previously described, was included for comparison. Each of the sample sets was labeled with randomly selected three digit codes so that panelists were unaware of their origin. Panelists were isolated from each other and were not allowed to communicate with each other. Water at room temperature and unsalted crackers were provided to help remove residual flavours from the mouth between samples.

Panelists evaluated the sample sets for tenderness and flavour. Individual questionnaires labeled with the appropriate code, contained a 15 cm unstructured line scale (Larmond, 1977). Numerical values were given to the ratings by measuring from the left end of the 15 cm line, the distance of the panelists marks in units of 0.25 cm. The anchor points were from left to right; very tender to very tough, and very mild to very strong.

2.7. Data analysis

The three testicular treatments and the two diets were examined for effects on tenderness and flavour by two-way analysis of variance. Main effects and interactions between testicular treatments and diet were determined. Significant differences between individual interaction means were detected using the least significant difference (LSD).

The means for the Omani lamb and the New Zealand lamb were compared using a two-tailed independent t-test. The purpose of this comparison was to simply determine whether significant differences existed between Omani lamb and New Zealand lamb for flavour and tenderness. The statistical analysis package Statistica (Release 5.0 StatSoft Inc. Tulsa, OK, USA) was used for data analysis.

3. Results and discussion

Since Omani sheep are small in stature, average live weight of the lambs after 161 days was 27.6 kg which is slightly more than half the live weight of western-bred sheep raised for about the same length of time (Notter et al., 1991). Traditionally, Omani lambs are slaughtered at low live weights (≈28 kg.), and at younger ages (≈161 days), than in western farming systems (Fahmy et al., 1992).
3.1. Tenderness

Neither testicular status nor diet had effects on the tenderness of Omani lambs ($P > 0.05$) (Table 2). However, the meat from cryptorchid Omani lambs fed palm frond (4.43) and castrated Omani lambs fed Rhodesgrass (4.56) had lower tenderness scores than meat from entire Omani lambs fed palm frond (7.15) ($P \leq 0.05$). Castrate lambs in this study had significantly lower daily weight gains, lower carcass weights and less intermuscular fat than either entire or cryptorchid lambs (Mahgoub et al., 1998). Although the final pH of the tissues were not measured in this study, it is conceivable that the smaller leaner lamb carcasses may have cooled faster in the chiller, thus affecting the ultimate pH of the muscles tissues. Lawrie (1991) has shown that the ultimate pH of the muscles tissues has a profound effect upon the tenderness of meat.

The effect of induced cryptorchidism on the tenderness of meat was not clear, with cryptorchid animals scoring both low and high scores. In this study, neither entire nor cryptorchid lambs showed significant differences in daily weight gain, carcass weight or intermuscular fat content. Further research into the effect of low levels of sex hormone on meat tenderness and the overall efficacy of inducing cryptorchidism in Oman are desirable.

The effect of diet on the tenderness of the meat was inconsistent. Palm frond and Rhodesgrass diets produced both tender and tough meat. These results support the findings of Fahmy et al. (1992), that diet does not significantly influence meat tenderness. Although lambs fed palm frond had significantly lower daily weight gains than those fed Rhodesgrass, slaughter weights and intermuscular fat content were not significantly different. Consequently, feeding palm frond does not appear to affect the tenderness of the meat significantly.

New Zealand lamb meat samples scored significantly lower mean tenderness scores (3.01) than meat from Omani lambs (5.55). New Zealand post-mortem practices may include electrical stimulation, and accelerated aging. These factors may be responsible for the significant difference in tenderness scores found for New Zealand lamb meat.

3.2. Flavour

Neither testicular status nor diet had affects on the flavour of Omani lambs ($P > 0.05$) (Table 2). Flavour changes due to testicular status and hormone levels could, however, become significant for animals older than six months of age or more than 55 kg in live weight (Field, 1971; Siedeman et al., 1982).

Cramer et al. (1967), Park and Thomas (1973), Field et al. (1983), and Shahidi and Rubin (1986) found feed source to be a significant environmental factor affecting the flavour of meat. The results of this study, however, support the results of Paul et al. (1964) and Ford and Park (1980) who found that feed source had no significant impact upon lamb flavour.

There were no significant flavour differences between Omani lamb samples (6.12) and those of New Zealand lamb (7.32) ($P > 0.05$).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Tenderness means&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Flavour means&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire Palm frond</td>
<td>7.15 ± 0.99</td>
<td>6.29 ± 0.78</td>
</tr>
<tr>
<td>Entire Rhodesgrass hay</td>
<td>5.71 ± 0.81</td>
<td>5.88 ± 0.75</td>
</tr>
<tr>
<td>Induced cryptorchid Palm frond</td>
<td>4.43 ± 0.81</td>
<td>6.68 ± 0.80</td>
</tr>
<tr>
<td>Induced cryptorchid Rhodesgrass hay</td>
<td>6.29 ± 1.00</td>
<td>6.50 ± 0.76</td>
</tr>
<tr>
<td>Castrate Palm frond</td>
<td>5.17 ± 0.87</td>
<td>6.60 ± 0.75</td>
</tr>
<tr>
<td>Castrate Rhodesgrass hay</td>
<td>4.56 ± 0.64</td>
<td>4.74 ± 0.58</td>
</tr>
</tbody>
</table>

<sup>a</sup> Means of panelist’s scores (0–15 cm line scores) ± standard error. Means in the same column having similar letters are not different ($P > 0.05$).
4. Conclusion

Although the inclusion of milled palm frond did reduce the daily growth rate of lambs, it did not adversely affect the lamb meat quality. Given that date palm frond, a by-product of intensive date fruit production, is essentially a free source of roughage, it would follow that it is an economically viable alternative to special irrigated crops such as Rhodesgrass.

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References