Productive characteristics of precocious or super precocious cattle confined

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Abstract

The aim of this research was to characterize studies on production of super precocious and precocious cattle by meta-analytical approach associated with data mining, using articles published between 2002 and 2012. The selected research was intended to address the production of male bovines, receiving the same level of concentrate during all experimental period, receiving as roughage, exclusively corn silage. Data were classified as super precocious for cattle until 18 months of age at the end of the experiment; and precocious, for bovines with aged between 19 and 30 months to the finishing of the experiment. The classification accuracy was 89% with accuracies from 89% for super precocious and 92% for precocious. The built model showed the number of days confined as root node, which is the primary node in the decision tree. System production of super precocious steers require greater confinement period with high share of food with low fiber and high energy level of the diet. The exploitation of results through the decision tree model features easy viewing and interpretation, with good implementation capacity in animal production.

Key-words: Confinement days, Data mining, Decision tree, Meta-analysis

Introduction

The use of confinement is widespread among producers of beef cattle. In the Brazilian cattle industry, the feedlot grew 62% over the last five years, being that about 11% of the cattle production from the confinement system (Anualpec, 2014). Among the advantages of finishing feedlot cattle are: the possibility of intensive farming on small areas; livestock production in between harvesting; faster return of invested working capital for fattening; reduced age for slaughtering; and improvement of meat quality. Kuss et al. (2010) assess the organoleptic characteristics of meat from cattle slaughtered at the age of 16 months (super young) and 26 months (young) and observed that the meat is better softness in super young category.

The technical and economic efficiency of the confinement system depends on quality and cost of the roughage used in the cattle diet (Neumann et al., 2004). In Brazil, corn is the most widely used plant for silage (Guaresci et al., 2010), which is well accepted by the animals and has good energetic value. It has also the advantage of high productivity, ease to cultivation (in the country), and ease fermentation inside the silo.

There is little characterization of cattle slaughter categories based on age, mainly given the difficulty of gathering these peculiarities in the same study, what makes the meta-analytical approach essential in
this case. Data mining seeks to obtain, through filtering, consistent patterns in the data set, allowing interpretation of results to be based only on the relevant data. The decision tree is a graphical method of classification view that allows to obtain a precise and accurate classifier model within different data sets (Im and Jensen, 2005).

Data mining and fuzzy logic, among other tools directed to decision-making and more specific actions, have contributed to the progress and speed of research in animal production (Perissinotto et al., 2009). This technique has been employed in different areas of animal production, such as dairy cattle (Nääs et al., 2008) and birds (Ferreira et al., 2013; Lima and Rodrigues, 2010), but it has been underexplored in beef cattle production. Our objective was to characterize studies on the production of super early and early cattle by meta-analytical approach to mining exploration.

Material and methods

This study was based on the data presented in the articles published between 2002 and 2012 in the following journals Revista Brasileira de Zootecnia; Pesquisa Agropecuária Brasileira; Arquivo Brasileiro de Medicina Veterinária e Zootecnia; Ciência Rural; Semina: Ciências Agrárias; Acta Scientiarum. Animal Science; Ciência Animal Brasileira; Archives of Veterinary Science; Revista Brasileira de Agrociência; Revista de Ciência Agronômica e Boletim de Indústria Animal. Among them, 63 articles were selected, from which we removed the zootechnical variables, nutrition data and the production system.

The selected studies included data on production of male bovines, castrated or uncastrated, confined receiving from initial to final of evaluating, the same level of concentrate in diet, getting as bulky, exclusively corn silage. Information about the methodology, and the data from animal performance, as well as the chemical composition of the diets used in study were tabulated in spreadsheet. Later, the data were grouped for the separation of animals into categories: SUPER PRECOCIOUS for cattle less than 18 months old at the end of the experiment; and PRECOCIOUS for cattle between 19 and 30 months old at the end of the experiment.

Table 1. Parameters of the variables collected for modeling

<table>
<thead>
<tr>
<th>Variable</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Average</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulky feed on diet, %</td>
<td>20</td>
<td>88</td>
<td>52.11</td>
<td>15.2</td>
</tr>
<tr>
<td>Concentrate feed on diet, %</td>
<td>12</td>
<td>80</td>
<td>47.9</td>
<td>15.5</td>
</tr>
<tr>
<td>Days of confinement</td>
<td>30</td>
<td>210</td>
<td>115</td>
<td>33.9</td>
</tr>
<tr>
<td>Dry matter on diet, %</td>
<td>39.2</td>
<td>74.3</td>
<td>58.9</td>
<td>10.8</td>
</tr>
<tr>
<td>Organic matter on diet, %</td>
<td>65.1</td>
<td>95.6</td>
<td>85.9</td>
<td>13.7</td>
</tr>
<tr>
<td>Crude protein on diet, %</td>
<td>9.89</td>
<td>16.2</td>
<td>12.6</td>
<td>1.21</td>
</tr>
<tr>
<td>Ether extract on diet, %</td>
<td>2.18</td>
<td>7.30</td>
<td>3.98</td>
<td>1.46</td>
</tr>
<tr>
<td>Acid detergent fiber diet, %</td>
<td>27</td>
<td>58.3</td>
<td>42.2</td>
<td>10.0</td>
</tr>
<tr>
<td>Digestible energy diet</td>
<td>2.25</td>
<td>3.27</td>
<td>2.91</td>
<td>0.26</td>
</tr>
<tr>
<td>Total digestible nutrients diet, %</td>
<td>64</td>
<td>82.7</td>
<td>72.1</td>
<td>4.62</td>
</tr>
<tr>
<td>Initial weight, kg</td>
<td>165.7</td>
<td>441.8</td>
<td>299.5</td>
<td>63.0</td>
</tr>
<tr>
<td>Final weight, kg</td>
<td>224.7</td>
<td>578.4</td>
<td>438.6</td>
<td>54.4</td>
</tr>
<tr>
<td>Dry matter intake, kg</td>
<td>3.35</td>
<td>12.6</td>
<td>8.21</td>
<td>1.79</td>
</tr>
<tr>
<td>Average daily gain weight, kg</td>
<td>0.52</td>
<td>2.11</td>
<td>1.31</td>
<td>0.27</td>
</tr>
<tr>
<td>Food conversion</td>
<td>4.46</td>
<td>9.69</td>
<td>6.25</td>
<td>1.32</td>
</tr>
<tr>
<td>Hot carcass weight, kg</td>
<td>182.8</td>
<td>340.1</td>
<td>253.9</td>
<td>25.7</td>
</tr>
<tr>
<td>Hot carcass yield, %</td>
<td>50.4</td>
<td>60</td>
<td>55.7</td>
<td>2.00</td>
</tr>
<tr>
<td>Cold carcass weight, kg</td>
<td>178.3</td>
<td>296</td>
<td>238.0</td>
<td>27.1</td>
</tr>
</tbody>
</table>
Data were analyzed by data mining techniques, applying a classification task based on the software algorithm J48 Weka®, version 3.6 for tree decision construction. The algorithm creates a model of rules using the minimum necessary information for classification, building a graph in the form of an inverted tree with the root node, being this the first attribute with higher power rating, dividing and classifying the object in semantic rules on body shape (variables or classification attributes) and head (class as a consequent). The tree is divided into branches that represent the semantic conditionals AND and OR, following the logic of classification to the leaves (generally up) in a classification. Each branch of the tree represents a classification rule in the IF form (variable x) AND (y connectors between variables z ... if any) THEN (consequent or class). The accuracy of the model was calculated and the accuracy verified the sensitivity and specificity from the contingency matrix. In Table 1 shows the variables that were collected for the realization of the modeling.

**Results and discussion**

The model elaborated for the classification of cattle in age classes showed the number of days that the animals were confined as the root node, variable with higher power rating, forming two branches, which were dependent of the concentrate level used in the diet (Fig. 1: Precision = 89%, accuracy = 89% for super precocious class and 92% for the precocious class).

The determination of days in confinement as the root node demonstrates the relevance of confinement time to classify the production system in super precocious class, requiring longer 145 days period of feedlot. This result is closely linked to the economic assessment of beef cattle production. Vittori et al.
(2007) found that the animals with longer confinement period had higher production costs since it requires more food. Shorter period for termination in confinement implies higher profitability, as it generates lower feed costs and allows for the increase in the number of finished animals (Pacheco et al., 2006). Pacheco et al. (2005) observed that young steers were confined for 35 days, whereas animals of precocious production super category required confinement for a period of 142 days.

When the feeding period was less than 145 days to produce super precocious steers for 18 months of age slaughtering, the concentrate level had to exceed 69% and required a diet of at least 71% NDT. This conditional classification affects directly the production costs of feedlot finished cattle. When disregarding the animal purchase price, food represents 70% of total production costs, requiring reduction of the cost of concentrate mainly (Pacheco et al., 2006; Restle et al., 2007), justifying the consistency of the classification rule of this research. Gottschall et al. (2007) observed that the termination period was shorter for the production of super precocious steers than for the precocious steers. However, the authors observed that the profit was lower in the super precocious system, which the authors attributed to the need of a high energy and protein content diet on the concentrates.

According to Menezes et al. (2005), many studies have been conducted to assess the optimum roughage: concentrate ratio in cattle diet, but the results are contradictory. Some studies showed that increase on concentrate participation in diet improves the carcass yield (Silva et al., 2002) and the commercial cuts (Ribeiro et al., 2001), increases the thickness of fat cover (Costa et al., 2005) and reduces confinement period (Missio et al., 2009).

Two other rules have defined the condition of super precocious in the model presented in Figure 1, on the left branches of the tree. When the concentrate participation was less than 69% and the bulky feed, in the form of corn silage, minor than 60% of the total diet and the initial weight of cattle feedlot was less than 230 kg, were classified as super precocious. This difference in weight is related to the age at which animals have to enter the period of confinement, being that in this stage, close in age to two years, the animals showed more bone and muscle development that animals the lower age.

Metz et al. (2009) observed that by confining animals with mild initial weight, 362.7 kg, and steers with heavy initial weight of 441.8 kg, both receiving 60% of corn silage in the diet, the confinement period was 30 days for the group of animals with higher weight and 94 days for the animals with lower initial weight. As presented in Fig. 1, it was possible to get super precocious cattle when the share of bulky in the diet was over 60%, resulting in a confinement period between 85 and 103 days. The remaining cases were classified into the precocious class.

According to Rodrigues et al. (2013) the decision tree is an easy platform to understand from introductory knowledge, which enables the use of this system for possible measurements by producers who are interested in simulating some field conditions. Perissinotto and Moura (2007) point out that the data mining helps in decision making, and can be used in making appropriate strategic decisions by providing support cattle breeder in information management. The data mining application in the meta-analytic process proved satisfactory and able to summarize knowledge in bibliographic databases.

Conclusion

The production of super precocious steers in confinement requires more use of concentrate feed on diet in combination with a high energy diet. It also requires higher confinement period when compared to precocious cattle.

The meta-analysis by data mining with association analysis and exploitation of results through decision tree model proved to be an easy method for viewing and interpreting the results, which can be of good implementation capacity in animal production.

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