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The farm-to-table continuum as an innovative trade-off approach for optimal management decisions in the beef sector: flavour clustering of young bull meat cuts.

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Take home message Powerfulness of decision trees for beef flavour categorization using rearing factors and carcass data.

Introduction Consumer studies had shown that once variation in beef tenderness is controlled, flavour becomes the most important driver of eating satisfaction (Killinger *et al.,* 2004). However, most of the studies have focused mainly on tenderness and little has been done on flavour. Accordingly, we hypothesise that a more thorough understanding of the farm-to-table continuum leads to produce consistent flavourful beef. Thus, this study on young bulls aims to use both machine learning and decision tools to predict and cluster beef flavour using rearing factors and carcass traits.

Materials & methods A total of 308 young bulls from the main French beef breeds were used in this trial. Data of animal characteristics [Age at slaughter], fattening period [Duration (days), Initial body weight (BW, kg), Final BW, %Forage, %Concentrate, dry matter intake (DMI) (kg DM/day), Energy intake (Mcal/day), BW gain (kg/d) and Feed efficiency (kg/kg DM)] and carcass characteristics [%Dressing, Carcass weight (kg), Carcass fat weight (kg), Carcass muscle weight (kg), EUROP conformation score and Fatness carcass score (1 – 5 scale)] were recorded (Soulat *et al*., 2016; Gagaoua *et al*., 2017). Meat samples aged for 14 days were assessed for beef flavour (0 – 10) using a sensory panel (Gagaoua *et al*., 2016). For the identification of flavour classes, unsupervised learning methods (k-means and hierarchical cluster analysis (HCA)) were performed. Among them and based on Silhouette widths (*Si*), HCA gave the best results and lead to 3 clusters that were named flavourful (FLAV+), medium (FLAV=) and less flavourful (FLAV–). Then, the frequently used decision tree algorithms (C&RT, CHAID and QUEST) were performed to categorize the beef cuts using carcass and rearing factors based on HCA clusters. The best decision tree was obtained by Chi-squared Automatic Interaction Detection (CHAID) method.

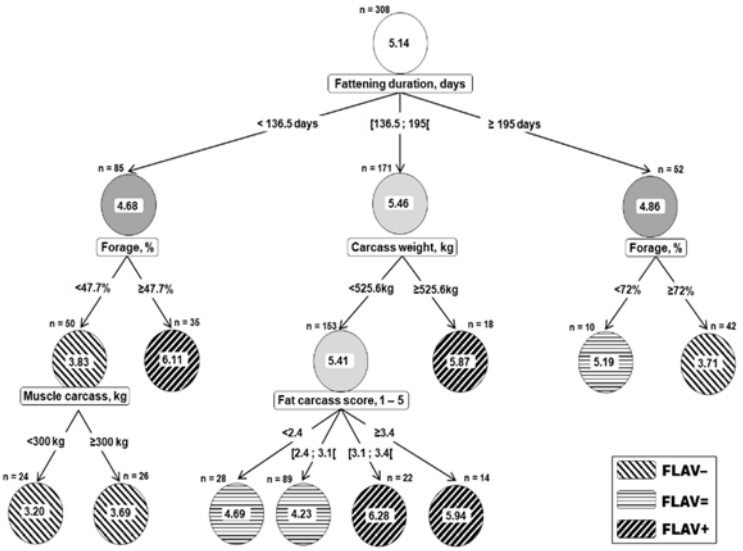

Figure 1 Best decision tree built using both carcass and rearing factors, which predicted 79.54% the HCA flavour's classes.

Results & discussion The prediction accuracy was 79.54% by retaining 5 variables: Fattening duration, %Forage, Carcass weight, fat carcass score and muscle carcass (Figure 1). In line to our results, recent studies showed that fattening duration has significant role in beef qualities (Soulat *et al.,* 2016; Picard *et al.,* 2017). The use of fattening duration combined with forage amount or with carcass weight are likely to categorize FLAV–, FLAV= and FLAV+ clusters and allows the identification of 54 FLAV+ cuts. Then, carcass weight <525.6kg with fatness scores greater than 3.1 identify the remaining 36 FLAV+. These results indicate the possibility to achieve the desirable beef flavour, using different strategies and combinations of both rearing factors and carcass characteristics. By doing so, decision trees would be easily implemented to categorize beef cuts for their flavour and propose strategies at the farm and slaughterhouse levels.

Conclusion These results showed the possibility to properly cluster young bulls' carcasses for their flavour potential using carcass characteristics and rearing practices factors. This would be beneficial at both the economic and consumer levels.

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