# BIOMARKERS OF TENDERNESS AND INTRAMUSCULAR FAT IN FIVE MUSCLES FROM FRENCH PDO MAINE ANJOU 2 – PREDICTION OF GROUPS OF QUALITY

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**Abstract – This paper reports the prediction of tenderness and intramuscular fat content (IMF) of the French Protected Designation of Origin (PDO) Maine Anjou by the measure of the relative abundance of accurate candidate biomarkers of these traits. One muscle among the five studied *Longissimus thoracis* (LT), *Rectus abdominis* (RA), *Semimembranosus* (SM), *Semitendinosus* (ST), *Triceps brachii* (TB) was selected for the measure of the abundance of biomarkers used to predict the tenderness and IMF of the others. The results showed that the abundance of 4 proteins of the TB muscle combined with data on slaughter age and finishing period duration, allowed an accurate prediction of the affiliation group of tenderness and IMF.**

**Key Words – proteins, proteomics, bovine, meat quality, adiposity, equations of prediction**

## I. INTRODUCTION

Meat tenderness and lipid content are two major criteria determining the sensory quality of the meat. For beef, tenderness characterized by a large uncontrolled variability is the first quality sought by consumers. In order to control and predict this quality, over the past decade, functional genomics studies have been undertaken to identify proteins considered as biomarkers of tenderness. Thus, a list of predictive proteins has been established [1, 2]. The aim of the present study was to complete this and to extend the approach to the search for biomarkers of intramuscular fat content (IMF). A second objective was to choose a muscle on which these biomarkers could be measured to predict the tenderness and IMF of a set of carcass pieces.

## II. MATERIALS AND METHODS

The study involved 101 cattle from Maine Anjou PDO slaughtered in an industrial slaughterhouse. Samples of 5 muscles were taken: *Longissimus thoracis* (LT), *Semimembranosus* (SM), *Rectus abdominis* (RA), *Triceps brachii* (TB) and *Semitendinosus* (ST) for biomarker analyses, IMF content and Warner-Bratzler shear force (WB) measurement [3]. The relative abundance of 20 protein biomarkers of tenderness and/or IMF content was measured by the Reverse Phase Protein Array technique (RPPA) [4]. This technique allows the simultaneous analysis of 500 samples for 20 proteins using specific antibodies. A weighted average WB (WBwa) taking into account the WB values of each of the 5 muscles was calculated using the following formula: 3xWBLT + 2xWBSM + 2xWBRA + WBTB + WBST. From the WBwa values, 3 tenderness groups were created according to our expertise and to the information available in the literature: tender (WBwa<42 N/cm$^2$), tough (WBwa>50 N/cm$^2$), medium (42<WBwa<50 N/cm$^2$). The prediction of belonging to one of the 3 groups was carried out by applying decision trees using the software XLSTAT v.2009.1.01. Finally, among tender carcasses, another decision tree distinguished tender lean (LIM <2.5%) and tender fat meat (LIM> 2.5%).

## III. RESULTS AND DISCUSSION

The proposed strategy for carcass classification was composed of 3 steps allowing the classification into 4 groups: though, tender, very tender lean and very tender fat in order to optimize their assignment and industrial processing. The results obtained showed that it is possible to classify the WBwa in these groups with an accuracy of 70 to 100% depending on the case (not shown). For each muscle, the number of proteins involved in the decision trees (among the 20 measured) varies from 2 to 6. In some cases the prediction was improved by taking into account factors such as

carcass weight, slaughter age or finishing period duration. The choice of the muscle to be retained among the 5 for a future use in a prediction tool usable at the slaughterhouse, was made on the basis of the following criteria: the use of the lowest number of proteins for a good classification, tolerance of zero tough predicted in the tender group. Considering these criteria, we proposed the TB muscle using only 4 proteins and information on animal: age at slaughter and finishing period duration, to predict the different classes (Fig. 1). It allowed a classification of tough meat with an accuracy of 93%, and of tender and medium with an accuracy of 73% for each. The tender fat class was well predicted at 85% and the tender lean one at 60%.

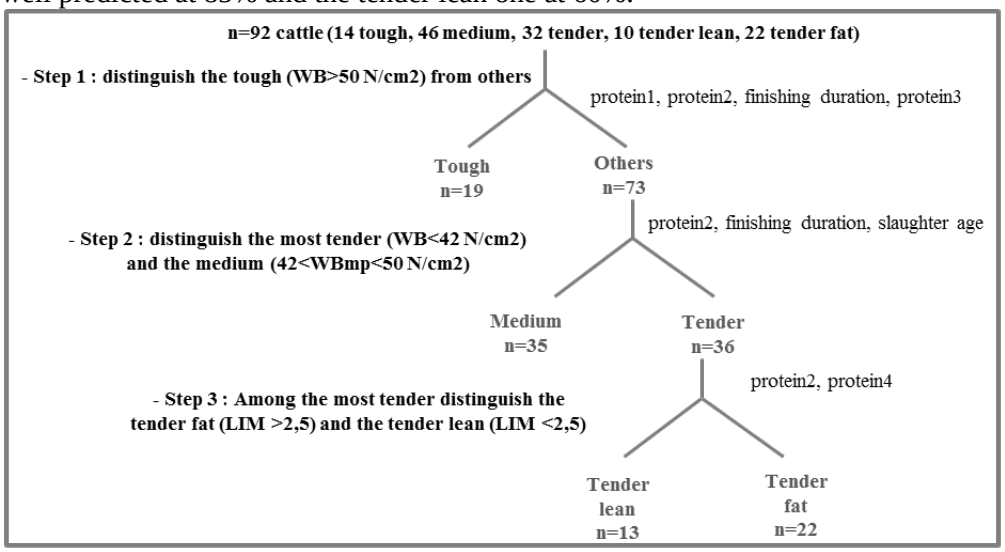


Figure 1. Different steps of the decision trees for the prediction of the groups of tenderness and adiposity with *Triceps brachii* biomarkers. Two cattle were not classified at step2.

## IV. CONCLUSION

These results showed that it is possible to properly classify the carcasses of PDO Maine Anjou according to their tenderness and adiposity from 4 protein biomarkers measured on samples of TB muscle taken at slaughter and with information on the age at slaughter and duration of the finishing period. These first results now require to be validated on new datasets from high numbers of cattle and to be refined to further improve the levels of predictions obtained.

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