EFFECTS OF LOW TEMPERATURE COOKING METHOD ON ROASTS BEEF REMOVED FROM FIVE DIFFERENT MUSCLES

P. Tribot Laspière[1], I. Legrand[2]

[1] Institut de l'Elevage, route d'Epinay, 14310 Villers Bocage, France

[2] Institut de l'Elevage, Boulevard des Arcades, 87060 Limoges Cedex 2, France

Abstract – Low Temperature Cooking method is not enough used in institutional catering to prepare roasts beef. However compared to the Conventional Cooking method it presents several advantages: the ease to control the cooking level according to the roasts size, the ease to control the temperature during the service and, as it is shown in this present study, the tenderness improvement on 4 muscles from 5 studied. But unfortunately, this method reduces systematically meat juiciness. When the consumer eats roast beef, does he prefer to have a slice tender and dry or tough and juicy? This question remains and needs to be studied.

Key Words – Beef meat, Juiciness, Low temperature cooking, Roast, Tenderizing, Tenderness

I. INTRODUCTION

In meat industry, if oven Low Temperature Cooking method (LTC) is widely used, in institutional catering, at least in France, it is not the case even if the oven cooking is used. The purpose of cooking is to make meat palatable, digestible and microbiologically safe (Torneberg, 2005). Cooking methods affect meat qualities, especially shear force (Lawrence, King, Obuz, Yancey & Dikeman, 2001; Kerth et al., 2003; McKenna et al., 2003). LTC method is known for improving beef meat tenderness. Further more if this cookery method is widely used, it would be interesting to be carried out in institutional catering context. First, this cooking method allows a better control of the roasts beef cooking level, by a better control of the internal temperature whatever the roasts size. Secondly, this treatment enables to bring under control the temperature of the roast slices during the service. Finally, this cooking method is supposed to improve meat tenderness. This cooking method would enable the consumer to taste a good meat quality either coming from good quality muscles or from less good quality muscles improved by this cooking method, and then with reduced prices. This study suggests comparing different cooking methods applied on different muscles.

II. MATERIALS AND METHODS

2.1 Muscles selection

Five beef muscles, *Vastus lateralis* (VL) *Semimembranosus* (SM), *Semitendinosus* (ST), *Biceps femoris* (BF), and *Triceps brachii* (TB) were obtained from 24 dairy cows. These muscles removed from carcasses at 24 hours post mortem, were vacuum packed and aged for 8 additional days at 2°C. Muscles were cut in order to obtain 0.9 kg (+/- 50g) weight and 20x10x6cm size pieces.

2.2 Cooking methods

2.21 Oven Conventional Cooking (CC)

Each face of roasts beef were browned on a grill (T°C = 270°C) during 15 seconds. Then they were cooked in an electric convection oven at 180°C for 30 minutes, followed by a 20-minute rest outside from the oven in order to obtain 56°C as the internal temperature.

2.22 Low Temperature Cooking (LTC)

Each face of roasts beef were browned on a grill (T°C = 270°C) during 35 seconds. Then they were cooked in an electric steam convection oven at 56°C during 16 hours.

2.23 Low Temperature Vacuum Cooking (LTVC)

Each face of roasts beef were browned on a grill (T°C = 270°C) during 35 seconds. Then they were vacuum packed, cooked in an electric steam convection oven at 56°C during 16 hours and they were chilled at 0/+1°C for 12 hours. Before the sensory evaluation, roasts beef were reheated, during 3 hours and a quarter, by immersion in water bath at 56°C, in order to obtain this same temperature as the internal temperature.

The aim is to obtain the same cooking level (rare) whatever the three cooking methods.

2.3 Sensory evaluation

A selected and trained panel of 12 experts performed the sensory analysis.

For the 1st part of the study (12 animals), the samples (2 in each plate) were served to the assessors who compared and scored them for tenderness and juiciness on a scale from 0 (low) to 100 (high). Each plate contained 2 samples coming from the same carcass and the same muscle, and cooked according to 2 methods (Conventional *vs* Low Temperature method).

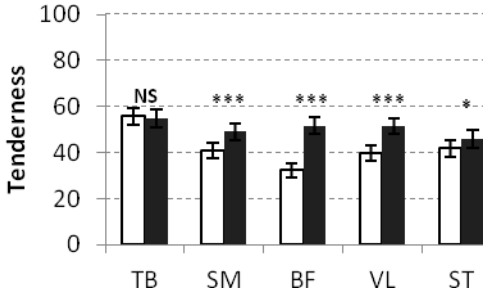
For the 2nd part of the study (12 other animals), the samples (3 in each plate) were served to the assessors who compared and scored them, as before, for tenderness and juiciness. Each plate contained 3 samples coming from the same carcass and the same muscle: 2 corresponding to 2 Low Temperature Cooking methods (LTC and LTVC) and 1 corresponding to the CC method applied on the TB muscle (control).

2.4 Statistical analysis

All data were analyzed by using analysis of variance (procedure mixed in SAS).

3 RESULTS AND DISCUSSION

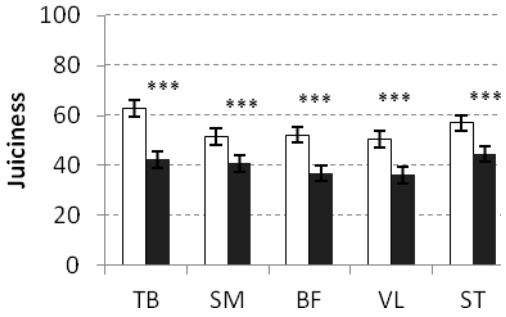
As expected, compared to the CC method, LTC improves tenderness (cf. fig. 1). But the efficiency depends on the muscles studied: it is very efficient for 3 of them (SM, BF and VL), it is slightly efficient for one of them (ST) and we notice no difference between the 2 cooking methods studied for the last muscle (TB).



NS: Non significant, * = P<0.05, *** = P<0.001

Figure 1: Two cooking methods effect on different muscles tende□ess (C■ and LTC).

On the other hand, we see, whatever the muscle tested, LTC method impairs the juiciness of roasts beef, compared to the CC method (cf. fig. 2).

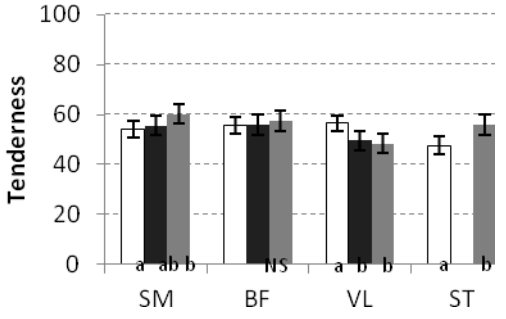


*** = P<0.001

Figure 2: Two cooking methods effect on different muscles jui□ness (■C and LTC).

In the 2nd part of this study, the aim was to assess if benefit gained by the LTC method could enable roasts beef from intermediate quality muscles to be replaced by roasts beef provided from less quality muscles. Then we had to analyze if there were any sensory differences between TB cooked conventionally and others muscles (SM, BF, VL and ST) cooked by low temperature (with vacuum bag or without).

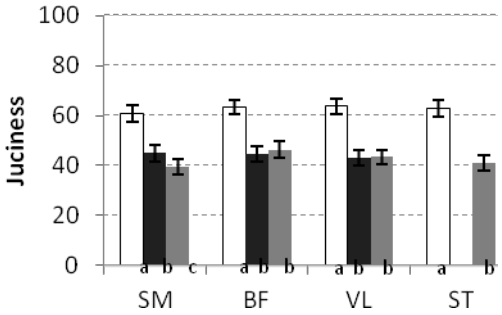
In terms of tenderness, it depends on the muscle studied (cf. fig. 3). SM and ST are tenderer when cooked by LTC method compared to TB cooked with CC method. Moreover, there is no difference between BF cooked by LTC method compared to TB with CC method. And VL cooked by LTC method is tougher than TB cooked with CC method. These results suggest it is possible, without any decline in terms of tenderness, to replace TB muscle by SM, ST and even BF, when LTC method is used.



NS: Non significant; a, b for the same muscle, bars with no super script in common differ significantly (P<0.05)

Figure 3: Three cooking methods effect on different muscles tenderness□ C■ LTC an■ LTCV).

Although we noted the efficiency of the LTC on tenderness, we notice at the same time (cf. fig. 4) the effect of LTC method on juiciness. First, whatever the muscles studied here, LTC method damages the juiciness. Secondly, vacuum technique does not preserve meat juiciness when LTC method is applied. Juiciness of roasts beef cooked by LTC are similar whether vacuum is used or not (cf. fig. 4).



a, b, c for the same muscle, bars with no super script in common differ significantly ($P<0.05$)

Figure 4: Three cooking methods effect on different muscles juicines□(C■, LTC a□ LTCV).

4 CONCLUSION

The LTC method tenderizes most of the muscles studied, and reduces systematically juiciness, compared to the CC. Is this effect on juiciness too much penalizing to discourage the consumer from eating meat again? Does he prefer a slice of roast beef tender and dry or tough and juicy? This question remains and should be examined through an additional work implying sensory analysis with a consumer panel.

ACKNOWLEDGEMENTS

This work was supported by INTERBEV and FranceAgriMer.

REFERENCES

1. Lawrence, T. E., King, D. A., Obuz, E., Yancey, E. J., & Dikeman, M. E. (2001). Evaluation of electricbelt-grill, forced-air convection oven and electric broiler cookery methods for beef tenderness research. Meat Science 58: 239-246.
2. McKenna, D., King, D. A., & Savell, J. W. (2003). Comparison of clam-shell cookers and electric broilers and their effects on cooking traits and repeatability of Warner-Bratzler shear force values. Meat Science 66: 225-229.
3. Yancey, J. W. S., Wharton, M. D., Apple, J. K. (2011). Cookery method and end-point temperature can affect the Warner-Bratzler shear force, cooking loss, and internal cooked color of beef *longissumus* steaks. Meat Science 88: 1-7.
4. Torneberg, E. (2005). Effects of heat on meat proteins – Implications on structure and quality of meat products. Meat Science 70: 493-508.