

EXTENDED DRY AGING OF BEEF IN FRENCH BUTCHER SHOPS

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I. INTRODUCTION

Aging is of major importance for meat tenderizing and flavor evolution [1]. In France, it is usually limited to 2-3 weeks before deboning, or carried-out under vacuum, which may limit the expression of eating qualities. French beef industry is interested in a long-term dry aging, without any package, that have been widely talked about over the last years. In this respect, the French butcher Confederation (CFBCT) encourage the study analysing this aging meat way compared to the traditional practices in an artisanal background. Thus, a long-term beef dry aging was tested within butcher shops. The aim was to investigate its potential risks and benefits, by exploring its commercial, microbiological, sensory consequences and those linked to meat yields under butcher shops real conditions.

II. MATERIALS AND METHODS

Three dry aging practices were compared on bone-in ribeyes: 2 weeks in the butchers' cold rooms as usual way, 8 weeks in the same conditions or 8 weeks in an aging cellar. The cellar was set at 2°C and relative humidity (RH) 80% based on several publications [2, 3] and current practices in France. Comparison was made within animal and repeated 10 times, namely on 2 animals in 5 different butcher shops. Environmental temperature and RH were continuously recorded during aging. Different tests were carried out concerning meat yields, commercial quality, microbiological contamination, and sensory qualities perceived by 100 naïve consumers after 0, 2, and/or 8 weeks of aging.

Statistical analyses were performed with 9.4 SAS software version (SAS Institute, USA) using MEANS and FREQ procedures and analysis of variance techniques (MIXED and GLIMMIX procedures) with correction of the multiplicity of tests by Turkey-Kramer method.

III. RESULTS AND DISCUSSION

In the butcher cold rooms, mean temperatures varied between 0.1 and 3.6°C and mean RH between 89.5 and 99.0%, depending on the shop. RH was quite different in the cellar with a mean of 75%, less than desired, the mean temperature being 1.7°C. Saleable meat yields were reduced on average by 6 to 8% or 9 to 10% after 8 weeks of aging, respectively to provide bone-in and boneless ribeyes. This was mainly due to color alterations, surface desiccations and/or mucous coatings and molds developments, which increased meat losses (Table 1). However, using a cellar limited mucous coatings and molds levels. Spoilage microflora (*Pseudomonas spp.*, *Enterobacteriaceae* family) didn't develop much more for 8 weeks than for 2 weeks before deboning (Table 1). The aging cellar allowed to reduce the microflora loads, but it remained sometimes high (5-6 log CFU/g). Trimming reduced significantly the aerobic mesophilic flora and *Pseudomonas spp.* levels, the most limiting flora, but not *Enterobacteriaceae* family levels. Recently, Gowda *et al.* [4] also showed that trimming allowed to reduce microbial levels of dry aged meats before commercialization. Meat sensory evaluation performed by 100 consumers at the end of the aging period did not lead to different appreciations between the 3 aging ways before tasting (odor and global aspect). In contrast, meat aged 8 weeks were more tender ($P < 0,01$) and it slightly improved consumers' global satisfaction (Table 1). This observation aligns with Laster *et al.* [5] results who found that "overall like" consumer scores improved through 35 days of dry aging. Meat aged 8 weeks in the cellar got the best place after consumption, with the most appreciated flavor intensity. After 8 weeks in the butchers' cold rooms, beef was sometimes penalised by "putrid" off-flavors. Finally, compared to a cold room, the aging cellar reduced

commercial and microbiological degradations and moderately enhanced tasting satisfaction, with variations between butchers.
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Table 1 Results from 3 dry-aging ways for beef cuts (Least squares means \pm standard error of the mean, SEM)

Quantitative trait (or similar)	2 weeks in butchers' cold rooms	8 weeks in butchers' cold rooms	8 weeks in aging cellar	SEM	P>F
Retail yield to provide bone-in ribeye (%)	90.5 ^a	82.8 ^b	84.3 ^b	1.90	<0.0001
Retail yield to provide boneless ribeye (%)	78.9 ^a	66.8 ^b	68.0 ^b	6.09	0.0021
Odor (1 = deterioration to 5 = perfection)	3.85 ^a	4.50 ^b	5.00 ^b	0.45	0.0017
Surface color (<i>idem</i> :1 to 5)	2.60 ^a	1.10 ^b	1.15 ^b	0.41	<0.0001
Surface desiccation (<i>idem</i> :1 to 5)	2.70 ^a	1.18 ^b	1.00 ^b	0.54	0.0002
Mold (surface %)	13.8 ^a	77.5 ^b	21.9 ^a	15.6	<0.0001
Mucous coating (surface %)	32.5 ^a	29.4 ^a	7.5 ^b	12.6	0.0024
Total aerobic mesophilic count (log CFU/g)	6.16 ^{ab}	6.29 ^a	5.32 ^b	0.91	0.0133
<i>Pseudomonas spp.</i> (log CFU/g)	5.78 ^a	5.94 ^a	4.91 ^b	0.96	0.0052
<i>Enterobacteriaceae</i> family (log CFU/g)	2.06 ^{ab}	2.43 ^a	1.55 ^b	1.16	0.0485
Global eating satisfaction (0 = bad to 10 = best)	6.65 ^a	6.74 ^a	7.19 ^a	1.64	0.0525

^{a, b} Means in the same line with different superscripts differ significantly at P<0.05.

IV. CONCLUSION

This study provided original results in the context of French traditional butcher shops. Even if most of the beef consumed in France is wet aged or shortly dry aged, extended dry aging time is increasingly applied due to high communication on its benefits. Thus, it has been important to quantify its consequences when applied in small butcher shops with or without specific equipment investment, in comparison with common dry aging practices. Overall, the data indicate that butchers should use an aging cellar to preserve qualities of dry aged meat far beyond the traditional time of 2-3 weeks. However, the cellar may not minimize the yield losses. Although a cellar appears to reduce slightly spoilage microflora, a current study is ongoing on long-term dry aged beef on a sanitary point of view: additional references are indeed needed to provide safe products to consumers in France.

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