Production and characterization of 6-month-old calves, 8-month-old calves and older animals produced in France

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Abstract— **Objectives - European regulations have recently set the veal calf maximum age at slaughter to 8 months. Older calves such as the "Veaux d'Aveyron et du Ségala" in France are exceptionally allowed. The aim of this study was firstly to define the constraints to product older calves than the French "standard" 6 month-old animals, secondly to know the technical and economical interests, and finally to check if the product quality still suits the consumer.**

Material and Methods - Two trials of 56 Prim'Holstein male veal calves were run in research station in order to compare French pre-ruminant veal calves of 6 and 8 months. The "Veaux d'Aveyron et du Ségala" were integrated into the study as the oldest animals marketed as veal in France.

Results - On the zootechnical level, the 8-month-old calves grew up as good as 6-month-old calves. Cold carcasses weights reached 130-135 kg for the control group, and 165-175 kg for the 8-month-old calves. The oldest carcasses tended to be more coloured, fatter and better conformed. The economic result was very unfavourable within the 2008 context, and because of the meat colour degradation. The 2-month extension of the fattening length did not lead to major changes in meat characteristics other than the colour. "Veaux d'Aveyron et du Ségala" meats often positioned themselves differently.

Conclusions - On a technical point of view the pre-ruminant 8-month-old veal calves production could be possible without major meat quality degradation; however problems linked to carcass redness and breeding buildings organization arose.

Keywords— **Veal calves, Age, Meat quality**

I. INTRODUCTION

Recent European regulation [1, 2] applied since July 2008 defined at last the veal calf maximum age at slaughter as 8 months in the European Community. However older calves are exceptionally allowed by each country, such as the "Veaux d'Aveyron et du Ségala" in France, because of his Protected Geographical Identification. In order to answer to French professional and public organizations, two trials were led by Institut de l'Elevage (French Livestock Institute) to study the production of older calves than classical 6 month-old animals.

The aim of this work [3] which lasted more than 2 years was (a) to compare zootechnical and economical performances, carcass and meat qualities of calves at 6 or 8 months (b) to compare their carcass and meat qualities to those of "Veaux d'Aveyron et du Ségala" (9-month-old) and even of very young bulls or heifers intended to be exported (10 to 11-month-old). Meat quality was studied on commercial, nutritional and organoleptic aspects.

II. MATERIAL AND METHODS

A. Animal origin

The 6 and 8-month-old calves were reared in the Institut de l'Elevage research station in Le Rheu, and then slaughtered by the industrial meat company Tendriade, both located in the western part of France.

The "Veaux d'Aveyron et du Ségala" Label Rouge (French official quality brand [4]) and very young bulls and heifers were chosen at random among those slaughtered in the Bigard abattoir located in Castres, in the production area of such specific animals (south part of France). These veal meats are placed between white (veal) and red (beef) bovine meats indeed.

B. Breeding conditions at the station

The study was made up of 2 consecutive experimental trials, each one aimed at comparing two groups of 28 Prim'Holstein male veal calves:

- the control group of about 6-month-old animals, considered as the archetype of the current French production, fattened for 23 weeks with a carcass weight objective of 130-135 kg,
- another group of about 8-month-old animals which is the higher limit of the new veal generic name (except for PGI), reared during 32 weeks, with an estimated carcass weight objective of 170-180 kg.

All in all, 112 calves were housed in collective 5-animal pens on slatted floor (1,8 m^2 per calf). They were fed with a milk replacer as follows:
- from day 1 to day 48: starter feed including 50% powdered skimmed milk,
- from day 49 to slaughter: milk substitute grower-finisher feed without powdered skimmed milk.

Grain-based diet was once or twice a day manually supplied from bucket to reach daily intakes over 250 g.

C. Controls

Controls firstly concerned *zootechnical parameters* for calves bred *at the research station*:
- every 4 weeks weighing and hematocrit,
- individually and daily recording of milk replacer intakes, as well as disease symptoms and possible treatments.

Slaughterhouse registrations relative to these animals included:
- carcass weighing and grading (colour assessed at the end of the slaughter line by an Institut de l'Elevage trained technician according to a 4-point scale),
- at the same time, *m. rectus abdominis* colour measurement with a Minolta Chromameter CR-310.

And possible issues concerning 8-month-old veal calves from their breeding to meat marketing were noticed.

Other animal types carcasses were characterized according to the following criteria:
- slaughterhouse carcass features for the 18 "Veaux d'Aveyron et du Ségala" studied in the second trial,
- data collect on a large scale regarding the "Veaux d'Aveyron et du Ségala" and very young bulls/heifers intended to be exported. The aim was to deepen our knowledge through a realistic photograph of these two populations. This survey was conducted within the Castres slaughterhouse for 6 weeks of the first 2009 half-year (from mid-February to mid-June).

Finally *meat characterization* compared the 2 station-animal groups for the first trial and 3 animal groups for the second one (including the "Veaux d'Aveyron et du Ségala"). Each group consisted of 10 to 18 calves, depending on the meat studied parameters:
- *m. rectus abdominis* heme iron and total iron content assay,
- strip loin (*m. longissimus dorsi*) ultimate pH measurement and colour evaluation (sensory and instrumentally) after 5 days of aging,
- strip loin roast comparative eating quality assessment by a 12-member trained panel in order to describe tenderness, juiciness and flavour,
- veal cutlet lipid content and fatty acids composition based on the *m. longissimus dorsi* intramuscular and inter-muscular relative fat contents.

D. Statistical analysis

Data analysis was conducted to characterize and compare each animal group in pairs. Every trial was individually processed. Variables were analysed by using the MEANS and MIXED procedures of SAS software. An exploratory approach was chosen, as statistical tests were not adjusted for the test multiplicity. 2 various letters on the same line within a trial mean a statistical significant difference between 2 animal groups ($P < 0.05$).

III. RESULTS

A. Main fattening results (Table 1)

The extension of the fattening length until 8 months rose the final live weight compared to the control group. The average daily gains ranged between 1,150 and 1,235 g/day didn't differ significantly between animal groups, whatever the trial. Milk replacer consumption reached the expectations; the whole diet was ingested. 8-month-old calves real feed efficiencies showed large differences between the two trials: lower than the control ones in the first trial and upper in the second one. Anaemia evolution didn't reach the final target of 23 hematocrit value for the 8-month-old calves first trial (+ 3 points); but it was quite achieved for both second trial groups.

Table 1 Effects of calves fattening length extension on fattening performances and carcass characteristics

	Trial 1		Trial 2	
	6 months	8 months	6 months	8 months
Initial live weight (kg)	49.3 a	45.1 a	48.6 a	48.0 a
Final live weight (kg)	234.6 a	318.4 a	246.3 a	312.4 a
Global ADG (g/j)	1150 a	1220 a	1235 a	1180 a
Cold carc. weight (kg)	130.8 a	173.7 b	133.7 a	167.5 b
Ing. milk replac (kg/calf)	313.0 a	433.3 a	314.9 a	430.6 a
Ing. solid diet (kg/calf)	62 a	132 a	62 a	132 a
Real CI (milk+solid diet)	1.77 a	1.72 a	1.66 a	1.77 b
Final hematocrit (%)	25.0 a	27.1 a	23.5 a	24.5 a
Dressing percentage (%)	55.7 a	54.6 b	54.3 a	53.8 a
Visual colour (1to 4)	2.35 a	3.47 b	2.33 a	2.57 a
Conformation (1 to 18)	7.89 a	8.25 a	7.96 a	8.43 b
Fatness (1 to 4)	2.85 a	3.05 b	2.83 a	3.05 a

For each trial, cold carcass weights hierarchy between animal groups was the same as for the live weights: between 130-135 kg for the control group and 167-173 kg for the older one. However, 6-month-old calves were unlike 8-month-old ones for colour (lighter), conformation (less conformed) and fatness (thinner).

B. Economical approach (Table 2)

Starting from the mean carcass characteristics and French market prices similar for both trials, the balance sheet showed positive raw margins for both 6-month-old calves groups, but negative ones for the 8-month-old. Therefore, 2008 economical context (8 October quotation) was not favourable to lengthen the fattening period.

On the slaughter line and in the boning room carcass length made some steps more difficult (end of bleeding, dressing, carcass splitting, vacuum packaging of some cuts), but was not insurmountable.

Only square ribs and veal loin implied marketing issues because of the weight and cost of individual consumer units. Meat colour remains a sensitive criterion which must be under control for raw meat marketing such as escalopes, grilled meats, cutlets…

Table 2 Annual raw margins according to the veal calf type

	Trial 1		Trial 2	
	6 months	8 months	6 months	8 months
Market price (€/kg, quotation 08/10/08)	4.75	3.85	4.81	4.67
Cost price (€/kg)	4.59	4.56	4.51	4.71
Margin /carcass (€)	21	-124	40	-7
Rotations/year (pens kept empty for 21 days)	2.01	1.48	2.01	1.48
Marge/carcass/year (€)	42	-184	81	-11

C. « Veaux d'Aveyron et du Ségala » Label Rouge and very young bulls/heifers carcass characteristics

Approximately 1,200 « Veaux d'Aveyron et du Ségala » and more than 800 very young bulls/heifers intended to export were observed in Castres slaughterhouse. These animals including males and females were beef or dairy/beef crossed animals. Meat genetics showed through a carcass dressing percentage of around 62%, a carcass grading mainly equal to U for conformation and 2 for fatness. These bovines mostly reared by cow calf and finishing breeders were unlike 6 and 8-month-old station veal calves. Otherwise, the Castres slaughter line observations showed the important pigmentation of the "Veaux d'Aveyron et du Ségala" meat, according to a colour grading around 4-/4=. On this point, the later are close to export young animals (colour grading equal to 4).

D. Meat Qualities

Meat colour (Table 3): Sensory evaluations, instrumental measurements and iron content assay showed a clear effect of animal group on meat colour.

Table 3 Effects of the fattening length extension on meat colour and main eating characteristics

	Trial 1		Trial 2		
	6 months	8 months	6 months	8 months	"Aveyron"
Rectus abdominis L* (lightness 0-100)	47.92 a	43.00 b	46.81 a	44.25 b	41.38 c
Rectus abdominis heme iron (mg/100g)	0.45 a	0.55 b	0.37 a	0.46 b	0.73 c
Strip loin visual colour (1-4)	2.10 a	2.76 b	1.96 a	2.52 b	3.74 c
Tenderness (0-100)	71.3 a	61.9 a	68.8 a	69.1 a	38.3 b
Juiciness (0-100)	60.9 a	57.6 a	46.4 a	50.5 a	38.5 b
Flavour intensity (0-100)	55.8 a	53.5 a	42.5 a	45.9 a	40.3 a

Table 4 Effects of the fattening length extension on veal cutlet fat content and composition

	Trial 1		Trial 2		
	6 months	8 months	6 months	8 months	"Aveyron"
Lipid content (%)	5.4 a	7.2 b	5.3 a	4.3 a	4.8 a
Saturated fatty acids (mg/100 g)	2075 a	2725 a	2078 a	1686 a	2084 a
Polyinsaturated fatty acids (mg/100 g)	364 a	482 b	369 a	318 a	228 b
C18:2 n-6 / C18:3 n-3	21.97 a	23.41 a	15.83 a	16.30 a	7.79 b

Slaughter age is mainly responsible for the difference between 6 and 8-month-old veal calves, but feed nature is also involved for the "Veaux d'Aveyron et du Ségala" which showed darker meat very close to young bulls/heifers one [5]. This intense colour is a commercial disadvantage, but of nutritional value with a bigger heme iron content, highly bio available.

Eating qualities (Table 3): Whatever the trial, roast strip loin comparative sensory testing didn't bring out noticeable difference between 6 and 8-month-old calves: dairy 8-month-old veal calf meat still seemed to belong to "white meat universe". On the other hand, the "Veaux d'Aveyron et du Ségala" were clearly distinguished by the trained panellists as much for the raw appearance as for eating qualities: their darker meat seemed very specific, probably partially due to an inappropriate cooking method.

Lipids composition (Table 4): 6 and 8-month-old calf veal cutlets get similar lipid contents and fatty acids profiles (intra and intermuscular fats). 8-month-old calves didn't show a major and systematic nutritional disadvantage. Both animal types gave typical veal calf meats: lean, with relatively few saturated fats but badly adjusted polyunsaturated fatty acids with too many omega-6. So C18:2 n-6/C18:3 n-3 ratio ranged between 15 and 24.

The "Veaux d'Aveyron et du Ségala" clearly differed for their fatty acid profile due to the diet relative importance of solid and liquid feeds and to the ingested fat nature, especially coming from the milk. Their meats showed less PUFA than the other ones but a better composition with higher contents of profitable rumenic acid and long chain omega-3 fatty acids. So the previous ratio reaching hardly 8 was not far from the human health advice (less than 5).

IV. CONCLUSIONS

On a zootechnical point of view, extension of the fattening length up to 8 months is technically possible, but deteriorates carcass characteristics (colour, fatness) and worsens the economical result.

The veal calves collective pens appeared unsuitable to this type of rearing (1.8 m²/calf). Except for the colour, this study didn't show major veal meat quality changes: eating qualities, intra and intermuscular fat contents and compositions were both alike for 6- and 8-month-old veal calves. The "Veaux d'Aveyron et du Ségala" had a more coloured meat, with nutritional assets, although an inappropriate cooking may have skewed the sensory testing.

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