UCT OF PREGNANCY AND CALVING ON MUSCLE CHARACTERISTICS IN CATTLE

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MARY

nty-two Limousin females (12 heifers: H and 10 first calf heifers: FCH) were slaughtered at 36 months of age weighing 668 kg and 645 spectively, (31 days after calving). Heifers were raised in identical conditions after weaning (290 kg LW), wintered on maize silage and ed during summer periods, to achieve the same average daily gain until artificial insemination at 26 months. At the end of the grazing on, they were finished indoors on a maize silage diet for 71 days before slaugther. Calves were weaned from first calf heifers 3 to 5 days calving. Empty body, hot carcass and offal weights were determinated at slaughter. The right side of carcasses (2 x 7) was dissected muscle, fat and bone. Dry matter, pH, lipids, pigments (myoglobin), total collagen content and heat-labile collagen content were ated on *Longissimus thoracis* (LT), *Rectus abdominis* (RA) and *Triceps brachii* (TB). Protein and DNA concentration, lactate ogenase activity were determined on the *Semitendinosus*, LT, RA and TB. Fiber type was determined using an immunological mination (ELISA) with monoclonal antibodies against slow myosin heavy chain isoform. At days 1 and 8 after slaughter reflectance es for colour measurement were obtained on a cross-section of the LT and TB. The ageing of meat was studied on LT and TB, surements were made at days 1, 4 and 14 *post mortem*.

ers produced heavier carcasses than first calf heifers (+ 11 kg). Anatomical carcass composition remained unaltered by calving. rtheless, first calf heifers had less internal fat and a higher dressing percentage. Calving produced no consistent differences in nitrogen, and collagen content or collagen heat-labile collagen in the different muscles. Oxidative activity of muscle and fiber type seemed to be ted by calving. Further, after 8-day storage, differences in heme pigment concentration, colour characteristics and metmyoglobin ent were not observed. Also, there was no significant difference in *post mortem* ageing of meat between the two groups. Therefore, gnancy and calving followed by a 30-day finishing period have no major effect on carcase composition and muscle characteristics of ale beef cattle.

TRODUCTION

production of meat from heifers that have produced a calf has been suggested as a method to increase the efficiency of beef production ard *et al*, 1992). A first calf heifers system before slaughter combines reproduction and meat production into one system. Performance, ass composition and eating quality results have been reported by Dumont *et al* (1987), Waggoner *et al* (1990) and Vincent *et al* (1991). le is known about the effects of parturition and calving on biological characteristics of muscles and meat quality (composition, colour, *m mortem* ageing). Our objectives were to evaluate the effects of pregnancy and calving on muscles characteristics and meat quality of calf heifers system in an important study on aging, pregnancy, parturition and lactation with female beef cattle.

TERIALS AND METHODS

perimental design and slaughter measurements

chased heifers were purchased (n = 72) from suckler herds after weaning in Limousin area of France. The heifers were 9 mth old and eighed 290 kg at the time of purchase for the experiment. On the experimental farm (INRA-Le Pin au Haras) they were assigned to six lots h twelve heifers per lot to equalize birthdate, initial liveweight and body measurements (conformation score and skeletal development). ups were randomly assigned to treatments. The six treatments were for the heifers slaughter at 24, 32, 36 or 43 mo of age and, for the n calf heifers slaughter at 36 mo of age just after calving or at 43 mo of age after suckling of the calf. This paper involved with the group heifers (H n=12) and the group of first calf heifers (FCH n=10) slaughtered at 36 mo of age.

ifers were raised in identical conditions after weaning, wintered on maize silage and grazed during summer periods, to achieve the same rage daily gain (386 g/d) until artificial insemination at 26 months. At the end of the last grazing season, they were finished indoors on a ze silage diet for 71 days before slaugther. Calves were weaned from first calf heifers 3 to 5 days after calving. First calf heifers were ughtered 31 days on average after calving.

slaughter, the empty body weight, the hot carcass weight, the weight of fat depots in the 5th quarter were measured. The carcases were ntained at 15°C for 6 h and then were cooled at +2°C until 24 h post-mortem. The right side of carcasses of 7 animals per group was ced into muscle, fat and bone to determine the anatomical composition of carcass.

scle characteristics determination

er slaughter, *Longissimus thoracis* (LT), *Rectus abdominis* (RA), *Triceps brachii caput longum* (TB) and a sample of *Semitendinosus*) were excised at day D1.

pH and composition of the muscle: The following measurements were carried out on a section of LT, RA and TB. The pH was measured at D1 with a glass electrode. Dry matter content was measured by oven-drying at 105°C during 24 h. Total pigments (myoglobin) content e determined by the method of Hornsey (1956). Collagen content was assesed throught the determination of the hydroxyproline content

according to the method of Bergman and Loxley (1963). Collagen solubility was determined after a 2 h–heat treatment in water at 9 subsequent measurement of the residual insoluble collagen content. Solubility was expressed as the percentage of heat–soluble (total minus residual) in total collagen. Total lipids content was determined by refractometry according to the procedure of Arneth (1 Protein (Lowry *et al*, 1951), DNA concentrations (Labarca and Paigen, 1980), lactate dehydrogenase activity (Ansay, 1974) were det on the LT, RA, TB and ST. Fiber type was determined using an immunological determination (ELISA) with monoclonal antibodies slow myosin heavy chain isoform (Picard *et al*, 1992).

–*Colour measurements*: The steak was layed down on a fibreboard tray and overwrapped with PVC meat grade film. Reflectance were obtained with a Uvikon 860 spectrocolorimeter. Colour coordinates were calculated in the CIE 1931 system, at D1 then after during 9 days *post mortem* (or day D9) at 3°C. The results were expressed as lightness (L*) and redness (a*) in the CIELAB (1976) colour space. Metmyoglobin content was mesured according to Krzywicki (1979).

–*Determination of post mortem ageing: 1) Muscles*. LT and TB muscles were removed 1h after slaughter, divided into 3 parts, packed and immediatly stored in water bath at 15°C for 10 h, then at 2°C. *2) Mechanical Measurements*. The myofibrillar strength meat was determined in compression using the method of LEPETIT and SALE 1985. For that , meat samples (L = 1.5 cm, w = 1 cm cm) were submitted to a 20 % compression at a 10 Hz frequency. The applied strain was perpendicular to muscle fibres and the fre occured in the direction of muscle fibres. Mean values of the maximum stress were obtained from 10–12 determinations. Measur were made at days 1,4,14 *post mortem.*

Statistical analysis of data: The results of empty body weight, carcass composition and muscle characteristics were subjected to a co analysis of variance by GLM procedure (SAS, 1987). Least significant difference values were used to test the significance of the differ between the mean treatment values.

RESULTS AND DISCUSSION

Empty body and carcass composition. The heifers were slaughtered at 36 mo of age at 668 kg liveweight for heifers group (H) and at 9 for first calf heifers group (FCH) after a 71 day finishing period (Table 1). Dressing percentage and carcass weight were not sig between the two groups according to slaughter weights. Empty body fat was similar H=18.2 % EBW *vs* FCH=17.9 % EBW. However group showed a lower, but no significant, proportion of carcass fat (19.9 vs 20.3 % carcass wt) and a higher proportion of five quarter (4.7 vs 4.0 % EBW) than FCH group. Pregnancy have slighty reduced final live weigth, carcass weight and muscle weight (– 4 without modified significantly the body and carcass composition. These results agree with others studies (Vincent *et al*, 1991) conc that once–calved heifers can produce carcasses of similar composition than those from nonpregnant heifers.

Table 1: Effect of pregnancy and calving on slaughter characteristics and carcass composition

Treatment	Heifers	First calf heifers
Number of animals	12	10
Slaughter		
Slaughter age (mo)	36.0[a] (1.0)	35.8 (1.4)
Liveweight (kg)	668 (37)	645 (45)
Empty body weight (kg)	588 (31)	566 (43)
Hot carcass weight (kg)	400 (21)	389 (30)
Body and carcass composition		
Carcass muscle (kg)	272 (14)	263 (18)
Carcass fat (kg)	79.5 (10.4)	78.9 (13.6)
Carcass bone (kg)	47.8 (3.4)	46.5 (3.7)
Five quarter fat (kg)	27.6 (4.4)	22.5 (5.3)
Empty body fat (kg)	107.1 (12.8)	101.4 (17.9)

[a] group means (standard error).

PH and chemical composition of muscles (Table 2). The pH at day D1, the contents in dry matter, myoglobin, hydroxyproline and lipids, and the collagen heat solubility were not significantly different between the two groups of heifers in the muscles LT, RA and TB. lack of any consistent effect of pregnancy and calving on muscle proximate composition is consistent with the findings of Dumont (1987) and Bailey *et al*. (1991) in maiden and once–calved heifers compared at the same age.

Table 2. Effect of pregnancy and calving on pH, chemical composition and colour characteristics of beef heifers

Treatment	Heifers	First–calf heifers	P
pH			
Longissimus thoracis	5.5 (0.1)	5.5 (0.1)	NS
Rectus abdominis	5.7 (0.0)	5.7 (0.1)	NS
Dry matter (%)			
Longissimus thoracis	26.3 (0.5)	26.1 (0.7)	NS
Rectus abdominis	26.1 (0.5)	25.8 (0.5)	NS
Myoglobin (mg/g)			
Longissimus thoracis	5.98 (0.41)	6.09 (0.32)	NS
Rectus abdominis	5.40 (0.30)	5.40 (0.42)	NS
Triceps *brachii*	6.68 (0.83)	6.71 (0.77)	NS

Table 2 (continued)

Hydroxyproline (mg/g)			
Longissimus thoracis	427 (58)	395 (46)	NS
Rectus abdominis	563 (68)	602 (72)	NS
Collagen heat solubility (%)			
Longissimus thoracis	20 (10)	18 (8)	NS
Rectus abdominis	16 (4)	17 (6)	NS
Total lipids (%)			
Longissimus thoracis	3.7 (0.7)	3.0 (0.8)	NS
Redness coefficient D1			
Longissimus thoracis	15.4(1.9)	15.8(2.3)	NS
Triceps brachii	14.5 (1.3)	14.6(1.7)	NS
Redness coefficient D9			
Longissimus thoracis	15.8(1.7)	16.4(1.3)	NS
Triceps brachii	12.2(1.5)	12.0(0.6)	NS
Metmyoglobin percentage D1			
Longissimus thoracis	17.3(1.4)	17.4(1.9)	NS
Triceps brachii	19.7(2.0)	19.9(2.4)	NS
Metmyoglobin percentage D9			
Longissimus thoracis	24.6(2.9)	25.1(1.1)	NS
Triceps brachii	30.6(4.2)	31.3(3.3)	NS

…ein and DNA concentrations and fiber type. (Table 3). Fist calf heifers had a higher protein concentration (P< 0.05) than heifers in LT, … and TB. DNA concentration in muscles of FCH group was smaller than those of H group. So, the ration Proteins/DNA was significantly …er (P<0.05) in FCH than in H group for the four muscles. Lactate dehydrogenase activity in FCH muscles appeared to be smaller than in …scles especially in ST (P<0.05). Muscles of FCH had a smaller proportion of slow myosin heavy chain than muscles of H group. …en seemed to have a higher glycolytic metabolism but also a higher proportion of slow myosin. This can be explained by a relative …er proportion of IIa than IIb fiber type in FCH muscles. These results desagreeded with those of Young and Foote (1984) which reported …fferences in fiber type between cows and heifers. Our study suggests modifications of protein content and metabolic activity of muscle …s with pregnancy and calving.

Table 3: Effect of pregnancy and calving on protein content, DNA concentration and fiber type of muscles.

Treatment	Heifers	First calf heifers	*P*
Proteins (mg/g of muscle)			
Longissimus thoracis	203a (16)	215 (10)	0.05
Rectus abdominis	196 (12)	218 (14)	0.001
Triceps brachii	193 (6)	214 (13)	0.001
Semitendinosus	204 (18)	202 (23)	NS
DNA concentration (mg/g of muscle)			
Longissimus thoracis	437a (59)	355 (70)	0.001
Rectus abdominis	482 (86)	397 (92)	0.05
Triceps brachii	464 (73)	418 (86)	NS
Semitendinosus	440 (79)	364 (62)	0.05
Lactate Dehydrogenase activity (nkat/mg of muscle)			
Longissimus thoracis	145a (7)	143 (18)	NS
Rectus abdominis	135 (12)	128 (13)	NS
Triceps brachii	145 (26)	130 (14)	NS
Semitendinosus	156 (20)	139 (16)	0.05
Slow myosin % total myosin heavy chains			
Longissimus thoracis	39a (13)	31 (7)	NS
Rectus abdominis	40 (9)	35 (5)	NS
Triceps brachii	32 (9)	31 (7)	NS
Semitendinosus	11 (3)	10 (2)	NS

a group means (standard error).

…lour. (Table 2). It was shown that TB was richer in pigment content than LT (P<0.05) for H as for FCH, this result agreed with previous …rvations (Renerre, 1984). No difference in pigment content was observed between F and FCH. Meat colour stability during storage …uld be appreciated by the decrease in redness and the increase in metmyoglobin percentage. For redness coefficient, between D1 and D9, it …s observed a highly significant decrease for TB (P<0.001) and no decrease for LT. At D9, the metmyoglobin percentage was higher in TB …n in LT (P<0.001). TB is more oxidative and more colour labile than LT (Renerre, 1984). However and whatever the examinated colour …acteristic, no difference was noted between heifers and first calf heifers.

Determination of post mortem ageing. There were no differences in the myofibrillar strength between heifers and first calf heifers whatever the muscle and the time *post mortem* considered (Table 4). As fully aged meat have given values of strength about 10 N/cm2, LT muscles were nearly aged after 14 days at 2°C wheras TB muscles were not aged in the same conditions.

Table 4 : Effect of pregnancy and calving on the myofibrillar strength of raw meat

Treatment	Heifers	First calf heifers	P
Myofibrillar strength (N/cm2)			
Longissimus thoracis			
Day 1	33 (7)	34 (5)	NS
Day 4	25 (7)	23 (6)	NS
Day 14	14 (2)	12 (2)	NS
Triceps brachii			
Day 1	42 (4)	44 (3)	NS
Day 4	37 (2)	39 (1)	NS
Day 14	18 (4)	20 (2)	NS

CONCLUSION

It was concluded that first calf heifers produced the same carcass weights than those of heifers with the similar composition. PH, dry matter, myoglobin and lipids contents of muscles revealed no differences between first calf heifers and heifers. The most important differences were the higher protein content of muscles and the more oxidative activity of fibers from first calf heifers group. No differences appeared on colour characteristics and on *post mortem* ageing of muscles.

The results support the conclusion that first calf heifers produce carcasses and meat of a similar quality to that produced by heifers. The results will be reported further with the effects of aging of heifers and calf suckling. They allow to precise what are the biological characteristics of muscles which are related to the high quality meat in beef. They will also quantify the technical and economical advantages of the various beef production systems from females. Lastly, they will contribute to the improvement of the predictive relationships of meat qualities.

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