EFFECT OF GENOTYPE ON PIGMENT, LIPID AND COLLAGEN CONTENT OF THE LONGISSIMUS DORSI MUSCLE IN YOUNG BULLS

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Retail and consumer requirements should be the main considerations of a selection system for future beef production and for maintaining or improving meat consumption levels.

With the increase of prepackaged meat on the market consummer no longer benefit from traditional butchers recommandations, and thus use their own criteria for judging quality. Among criteria generally used are : color, then tenderness and flavor, which are mainly sought. Because of the technological condition of meat preparations, these characteristics are varied but they originate in three important components of the muscle : myoglobin, collagen and intramuscular lipids. What are the biological variations of these characteristics and what are the selection possibilities between breeds or crossbreeds to change and to standardize their level ?

A study of variation in meat characteristics was undertaken to consider the main breeds or strains available in France crossed with the French Friesian.

The different strains used were :

- large-sized French beef breed
  - 2 types of Charollais CH 1 and CH 2
  - 2 types of Limousin LI 1 and LI 2
  - Blonde d'Aquitaine BA
- late-maturing beef breed
  - CHIANINA CIA
- early-maturing English beef breed
  - Hereford British type HE B
  - Hereford American type HE A
- dual purpose breed
  - MAINE ANJOU M.A.
  - Pie Rouge de l'Est P.R.
- strain selected for rate of growth and breeding value
  - from Charollais : INRA type 2 IN 2
- selected for muscle hypertrophy
  - Belgian blanc bleue BB
  - PIEMONTESE PI
    from Blonde d'Aquitaine :
  - COPELSO CO
    and from Charollais :
  - INRA 1 IN 1
- dairy type
  - Friesian F

The animals were slaughtered as entire males in the 14th or 17th month. On the chilled carcasses a slice of the longissimus dorsi at the level of the rib was taken and frozen.

After thawing the peripheral connective tissue and discolored meat were removed from each sample of muscle and parallelipedic probes 1 cm wide, 0.5 to 1 cm thick and 3 to 5 cm long were cut from an area as near to the muscle centre as possible and parallel to the fiber axis. The rest was homogeneized with a vertical robot cutter and thoroughly mixed. Part of this mixture was used to determine pigment content (HORNSEY, 1956). The rest was freeze-dried then pulverised in a ball mill.

The total nitrogen and the hydroxyproline were determined in the powdered sample and expressed by the ratio of nitrogen of Hypro to the total nitrogen (BOCCARD, 1968). The lipid content was also determined in the dry powder by nuclear magnetic resonance.

Tables 1, 2 and 3 presents results. For each characteristic, the different crossbreeds were classified by order decreasing value. In figure 1, the statistical significance of differences between crossbreeds are listed.

1/ The pigment content of the longissimus dorsi shows variation between the compared crossbreeds. The pure Fresian is placed in the middle of the scale. All crossbreeds with a lower content can be considered as obtained with late-maturing breeds. The Copelso strain and to a less extent the Belgian Blanc Bleue and the Chianina are the less early types asfar as meat pigment development is concerned.

The well-established breed differences are certainly reduced by crossing with Friesians which are generally considered to have well-coloured meat.

2/ For lipid content, the order of cross-breed classification is largely changed from the pigment order with the exception of Maine Anjou, the fattest, as well as copelso strain and Blanc Bleue breeds the leanest.

In the muscle of the 2 latter and the Blonde d'Aquitaine, a significant difference in lipid content is found between the majority of cross-breeds used. They do not reach the content given by panel to be the optimal flavour level (GOUTEFONGEA, VALIN, 1978).

3/ Among the three characteristics considered, collagen content seems to be most affected genetically. The value order is completely different from the other except for the richest (Maine Anjou X Friesian) and the poorest (Copelso).

The values obtain in this set of longissimus dorsi from different cross-breeds agree with the values given by BOCCARD (1978) for the same muscle from normal charollais bulls but are higher than results obtained with South African Friesland by BOCCARD et al. (1979) who stressed the influence of breed on the collagen content of four out of five muscles they considered. The differences in amount of connective tissue observed could be greater if we used a muscle containing a higher amount of connective tissue instead of LD. From the comparison of values obtained from Copelso and INRA type, both selected for muscular hypertrophy with the pure Friesian values and the value in collagen obtained from homozygotous double-muscle animals (BOCCARD, 1978), it would appear that meat collagen content can be decreased by selective crossbreeding.

The sampling age remains to be determined. According to different sources and BOCCARD (1978) the most favorable period would be from 5 to 8 months of age when collagen is nearly constant in the different muscles.

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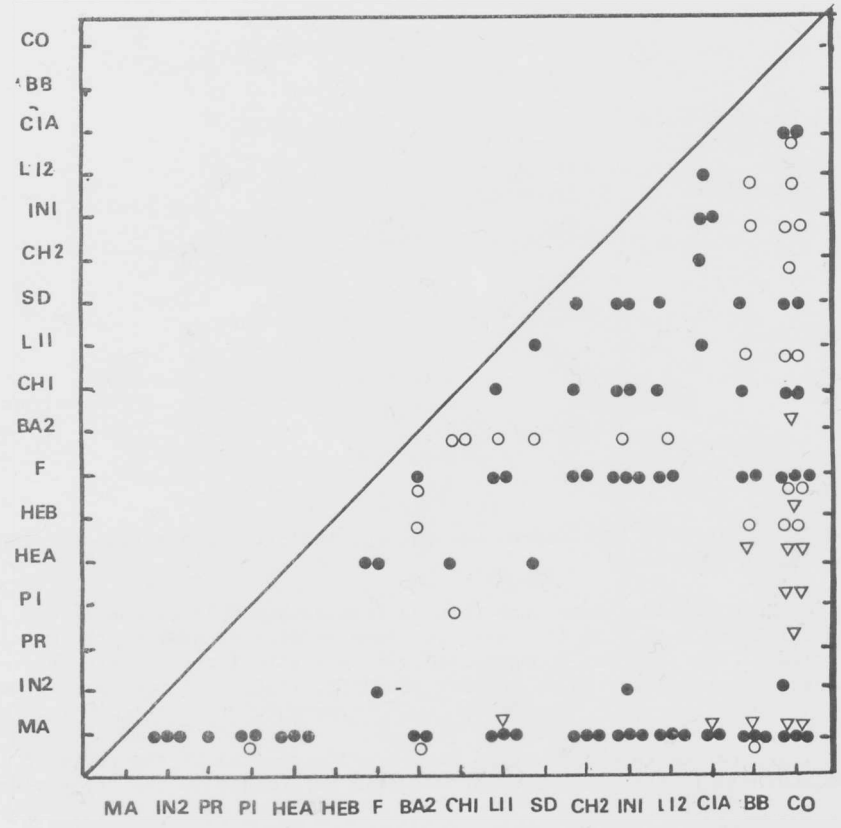

Figure 1 : SIGNIFICANCE OF THE DIFFERENCES BETWEEN CROSS-BREEDS FOR THE THREE CHARACTERISTICS STUDIED IN THE LONGISSIMUS DORSI

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cross-breed	N	mean	Standard deviation
M.A.	11	15.2	2.4
IN 2	13	14.6	2.7
PR	10	14.6	2.1
PI	11	14.6	1.9
HEA	13	14.4	1.4
HEB	12	14.1	1.8
F	12	14.0	1.6
B.A.	13	13.8	1.5
CH 1	11	13.4	1.8
LI 1	12	13.4	1.3
S.P.	8	13.2	2.0
CH 2	13	13.2	2.5
IN 1	13	13.1	2.6
LI 2	13	13.1	2.7
CIA	12	13.0	2.2
BB	12	12.9	2.2
CO	12	12.1	2.3

Table 1 : LONGISSIMUS DORSI PIGMENT CONTENT (IN HAEMINIC IRON) OF THE DIFFERENT CROSS-BREEDS (μg/g fresh basis)

cross-breed	N	mean	standard deviation
MA	11	2.84	0.71
IN 1	13	2.78	0.80
LI 1	12	2.75	0.75
SD	8	2.74	0.61
LI 2	13	2.73	0.81
HEB	12	2.72	0.62
F	12	2.68	0.55
CH 1	11	2.64	0.32
CIA	12	2.62	0.72
CH 2	13	2.53	0.57
IN 2	13	2.52	0.49
HEA	13	2.47	1.00
PR	10	2.37	0.34
PI	12	2.22	0.60
BA	13	2.19	0.41
BB	12	2.09	0.61
CO	12	1.97	0.55

Table 2 : LONGISSIMUS DORSI INTRA MUSCULAR LIPID CONTENT OF THE DIFFERENT CROSS-BREEDS (g/100 g fresh basis)

cross-breed	N	mean	standard deviation
M.A.	11	2.74	0.35
S.D.	8	2.62	0.48
F	12	2.51	0.26
CH 1	11	2.47	0.28
HEB	12	2.42	0.73
CIA	12	2.35	0.16
P.R.	10	2.34	0.36
IN 2	13	2.33	0.15
PI	12	2.30	0.30
B.A.	13	2.29	0.25
HEA	13	2.26	0.18
LI 1	12	2.22	0.16
CH 2	13	2.20	0.18
B.B.	12	2.19	0.28
LI 2	13	2.17	0.27
IN 1	13	2.12	0.22
CO	12	2.08	0.28

Table 3 : LONGISSIMUS DORSI COLLAGEN CONTENT OF THE DIFFERENT CROSS-BREEDS

$$\left(\frac{\text{N Hypro}}{\text{N total}} \times 10^3 \right)$$