Cellularity and Enzyme Activity in Adipose Tissue from Angus, Hereford and Brahman Crossbreeds Produced in Extensive Grass System

Margaria, C. A.; Pensel, N. A.; Morales, D. A. and Garcia P. T.
Instituto de Tecnologia de Alimentos, CICV, INTA. CC 77 (1708) Moron, Buenos Aires, Argentina.

Keywords: Cellularity, fat deposition, adipose tissue, enzymatic activity, beef.

Introduction

Beef fat deposition has been widely studied because of its importance in human health and animal production. It is known that fat deposition affected by genetics and it is possible to select different lines with substantial differences in fat content (LeClerq et al., 1980; Sharp et al, 19 Asante et al., 1989). Since NADPH is essential for *de novo* synthesis of fatty acids, it is possible to study fat deposition from the point of of NADPH-generating enzymes (Muller, 1986; Asante et al. 1989). Because *Bos taurus* and *Bos indicus* cross-breeds had been frequently used in our country in the past years, the aim of this paper was to study the cellularity and enzymatic activity of adipose tissue cross-breed and pure breed steers produced on an extensive grass system in Argentina, to know more about fat deposition process and influence of genetics on it.

Materials and Methods

Sixty steers, ten of each pure breed and ten of each cross-breed BrahmanxAngus (BA) and BrahmanxHereford (BH) ¼ and 3/8, and pure breed Angus (A) and Hereford (H). The steers were raised on extensive pasture systems in Argentina's pampas region (North-east of Buenos Aires Province). The end point for each breed was determined by ecographic backfat measurements and the judge of a trained panel of members. After slaughter, samples of subcutaneous adipose tissue were obtained from the 10th - 12nd rib area. Adipocites were isolated from the tissue by the collagenase technique. Adipose Isocitrate dehydrogenase (ICDH) and Glucose 6-P dehydrogenase (G6PDH) activity were determined by a cinetic technique (NADPH formation) at 340nm (Bowers, 1959; Kornberg, A. and Horecker, B. L. 1955), from a supernatant of 105,000xG centrifugation (60min at 4°C) of an homogenate obtained from adipose tissue (Ultraturrax, at 0°C), filtered and centrifugated at 1,000rpm 2min at 4°C. Cell number was determined into a Nageotte cell count chamber and cell diameter of isolated adipocites was determined digitizing and measuring microphotographies.

Results and Discussion

When cellular profiles obtained were compared, it can be noted differences among cross-breeds and pure-breeds. Angus steers adipocites shown a bi-modal profile of adipocite diameters with bigger cells (122±32µm) than the other breeds, in which cell diameter distributions were unimodal (cell diameters ranged between 39 and 43±3µm). Angus cell size and amount are about the same of those found by Mills et al. (1989).

Angus steers presented the lowest ICDH activity related to cell size (9.83±5.24µmol/h/µm), while Hereford had the highest (45.94±17.52µmol/h/µm), as can be seen in FIGURE 1. Their crossbreeds had intermediate activities, ascending as Brahman percentage increased in Angus; and descending as Brahman percentage increased in Hereford. When enzymatic activity was analyzed related to cell count, pure-breeds had the highest activities. G6PDH activity in the extract increased as cell count increased (FIGURE 2), G6PDH activity presented the lowest values in Angus steers and the highest in Hereford steers (FIGURE 3), while cell diameter had a variable effect, as can be seen in FIGURES 4 (a to f) and 5 (a to f), for G6PDH and ICDH respectively.

Conclusions

These results show a genetic effect in cellularity and enzymatic activity in bovine adipose tissue, and suggest a differential enzymatic activity related to cell diameter, that might also be explained for different "maturity" (metabolic) stages during cell growth.

Bibliogaphy

Asante, E. A., Hill, W. G. and Bulfield G. 1989. Analysis of lines of mice selected for fat content. 1. Correlated responses in the activities of NADPH-generating enzymes. Genet. Res. 54:155-160.

Bowers, G. N. Jr. 1959. Measurement of isocitric dehydrogenase activity in body fluids. Clin. Chem. 5:509-513.

Kornberg, A. and Horecker, B. L. 1955. Glucose-6-Phosphate Dehydrogenase. In Methods in Enzymology (eds. Colowick, S. P. and Kaplan N. O.). Academic Press: New York. Vol. 1, pp 353.

LeClerq, B., Blum, J. C. and Boyer, J. P. 1980. Selecting broilers for low or high abdominal fat: initial observations. British Poultry Sci. 21:107-113.

Mills, S. E.; Lemenager, R. P. and Hortsman, L. A.. 1989. Adipose Tissue Lipogenesis in Growing Steers Adapted to Different Levels of Feed Intake. J. Anim. Sci. 67:3011-3017.

Muller, E. 1986. Physiological and biochemical indicators pf growth and composition. In Exploiting New Technologies in Animal Breeding Genetic Developments (ed. C. Smith, J. W., B. King and J. C. McKay), pp 132-139. Oxford Science Publications.

Sharp, G, L., Hill, W.G. and Robertson, A. 1984. Effects of selection on growth, body composition and food intake in mice. 1. Responses in selected traits. Genet. Res. 43:75-92.

Figure 1

ICDH Activity vs. Cross-breed

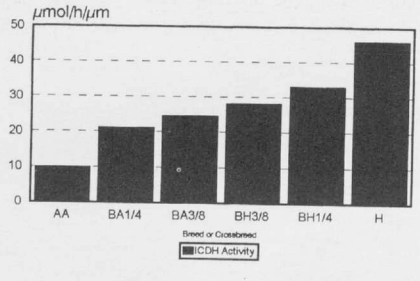


Figure 2

G6PDH Activity vs Cell Count

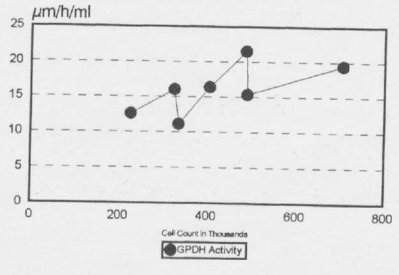
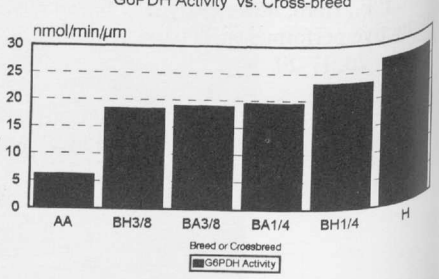


Figure 3

G6PDH Activity vs. Cross-breed



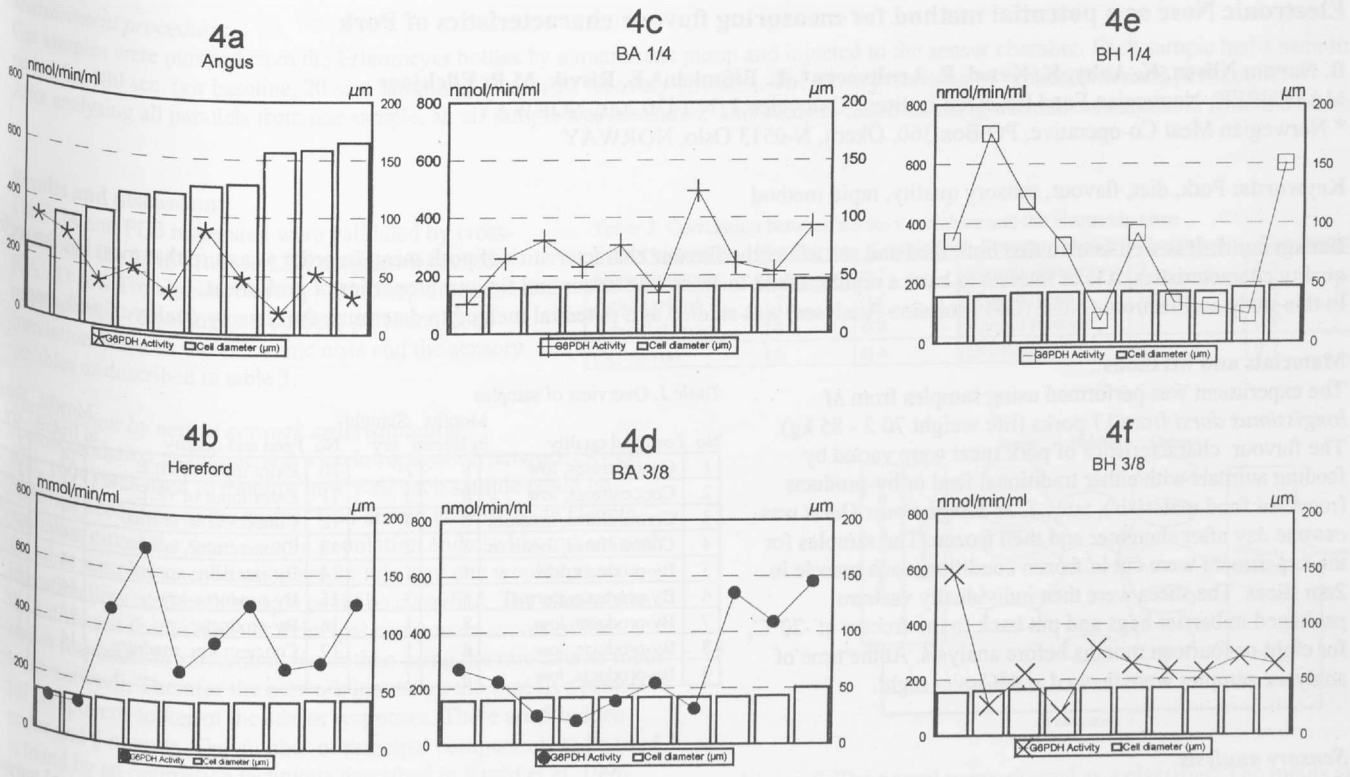


Figure 4
G6PDH Activity vs Cell Size
for each Animal in each Breed

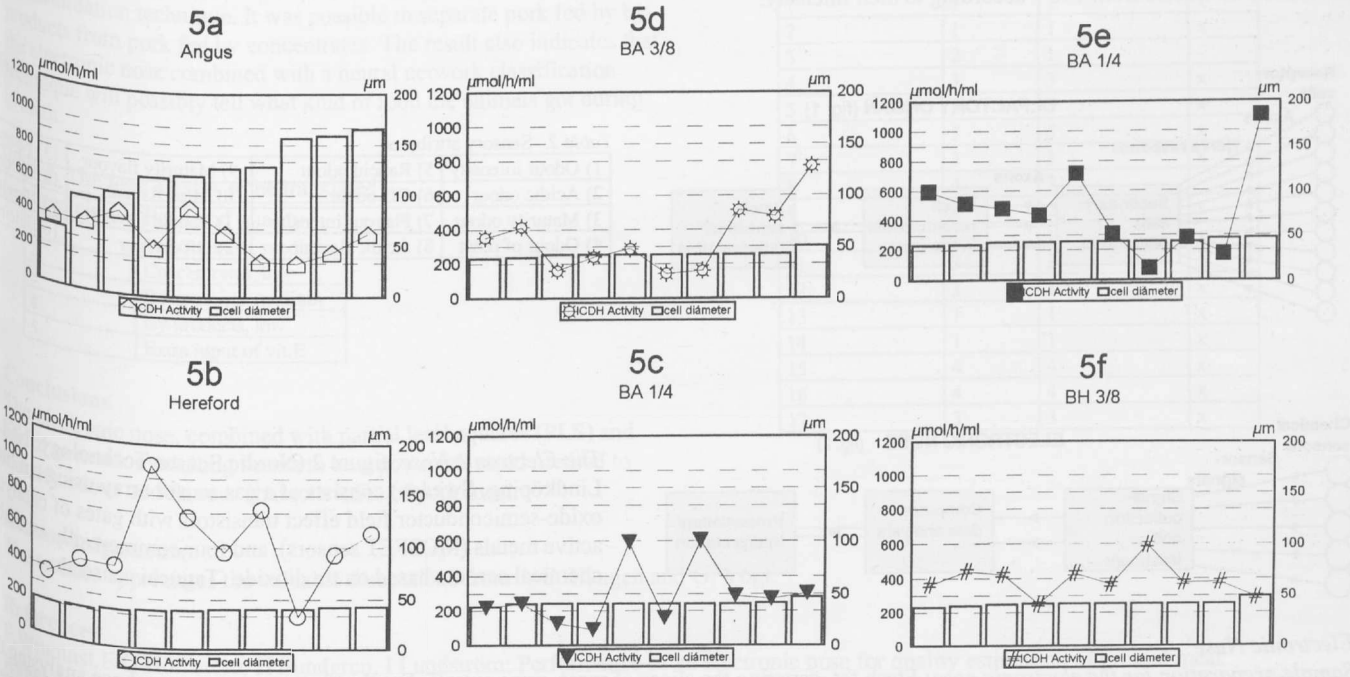


Figure 5
ICDH Activity vs Cell Size for
each Animal in each Breed