ON FARM EFFECTS ON LEAN BEEF MEAT YIELD PREDICTION

V. Schindler, L. Pruzzo, H. Avila, D. Colombatto. N. Abbiati, L. Santa Coloma.

Facultad de Agronomía, Universidad de Buenos Aires, Av. San Martín 4454, Buenos Aires, Argentina. Convenio SENASA - AACREA - DZ FAUBA. Project TG23, JICA (Japan International Cooperation Agency)

Background

The yield of edible meat has become restricted to those muscles that can be separated, due to the progressive increase of fat trimming of the retail cuts (Savell *et al* 1991). Processors measure the daily production of a wide range of products, but find it difficult to relate them to the yield of the primary product, that they receive from different origins, because it loses its identity during processing. They use kill-out yield and conformation measurements that confuse muscle yield with fat yield. Fat covering and principally seam fat or retail fat trimmings (invisible) also round out the carcass (Everett *et al* 1966) Moreover in Argentina different carcass fat dressing are practised. According to Shackelford *et al* (1995) at that date no equations had been published for predicting the yield of clean cuts (closely de- fated and de-boned).

The level of fatness is the principal factor for determining the meat yield. All authors coincide on this matter, and in all the equations calculated for estimating it, one or several measurements of carcass fatness are used, in most cases the dorsal fat thickness measured on the rib-eye after quartering the cold carcass (Abraham *et al* 1968).

Internal fats (kph), even when visually estimated, are the 2nd factor in importance for determining the yield, even more important that the rib eye and slightly less important than dorsal fat (subcutaneous). (Kempster *et al* 1976). The age and breed affect the distribution of internal fats. For example, British breeds deposit in proportion more *subcutaneous* fat than dairy breeds (Johnson *et al* 1972) and older animals more than younger ones (Charles *et al* 1976). In a previous analysis with the same data, sex and grazing or feed lot system have not a significative effect ($p<0,05$) (Santa Coloma *et al* 1998).

Some authors, as Johnson *et al* (1997) use the proportion of defeated round for estimating the proportion of lean meat. Crouse *et al.* (1976) sustains that the Round and Rump and Loin added together are the best indicator for determining the yield of partially defeated retail cuts. The pistol (a similar concept), is an obligatory step in the quartering of carcasses in the River Plate, so as to separate the rib cage and flank that processors sell immediately for roasting consumption, keeping the fore quarters and Pistols for further processing. No further literature was found where the proportion of internal fats weight, or the proportion of pistol, were used for predicting the yield of totally defated cuts.

Objective

To evaluate the influence of the Breed Type and Age Group on the prediction of carcass lean meat yield, using the proportion of Internal Fats, weight at slaughter, or the proportion of Pistol, both referred to the hot carcass weight before removing dressing fats.

Methods

Commercial crosses steers grouped according to their different biotypes as British (**BB**), Continental Crosses (**CB**), Bos Indicus Crosses (**ZB**), and Friesian (**HH**) and aged grouped according to different adult teeth and carcass weight as: (**0 D**) up to 118 kg half carcass; (**<4 D**) with more than 118 kg half carcass; (**4 D**) and (**>4 D**) more than 4 adult teeth. Breed and tooth were classified at slaughter floor observing round conformation hump, ears and hide colour spots before skimming. For all carcasses the right half weight was determined, separating and weighing the warm kidney and pelvic fats. The cold Pistol was weighed with 4 ribs (9^{th} lumbar vertebra). Some totally de-boned and de-fated (100%) retail cuts from the round were weighed: (100% VL) Eye of Round (171 C of NAMP classification), Knuckle (167 A), Flat (171 B), Top Cap off (169 A) and Top Cap (169 b) of 530 carcasses.

Statistical Analysis: A linear model was used for the % of lean cuts using as fixed factors the breed and age nested on the following co-variables: % of internal fats or % of Pistol. The SAS-GLM procedure for unbalanced data was used. The mean levels of each factor was compared with the Tuckey test and the LS means were calculated. The analysis was performed at the University of Buenos Aires Agronomy Faculty's Computer Services Center.

Results And Discussion

The predictive model with the proportion of internal fats had a CV of 6,7 and R^2 of 0,41. All the factors considered in the model were highly significant ($p< 0,0001$). One can see (Table 1) that the average yield of the Continental is generally higher than that of the Bos Indicus and Friesian crosses and they were all greater than the British breeds at all ages (Table 2). These differences according to breed were significant ($p< 0.005$), except between the Continental and Bos Indicus crosses. The majority of the comparisons found in the half carcasses are referred to retail cuts with the fat estimates intercepts (a) and linear regression coefficients (b). With a careful separation Callow *et al* (1961) and Keane *et al* (1990) found differences of 4 and 9 % between Continental and Friesian with British crosses.

The predictive equations, based on the % of Internal fats (Table 3) show a similar effect: the intercepts had a lower value as age. The intercept is much greater in Continental crosses than the Bos Indicus, Friesian and British breeds, in that order, and the (negative) regression slope on the graph for each is in the same order. Abraham *et al* (1968) and Koch *et al* (1979) coincides with the need for adjusting according to breed and age. For the same % of internal fats, British breeds has a greater amount of other fats, that reduce the yield of lean meat.

The predictive model based on the % of Pistol has a CV of 5,9 and R^2 of 0,67. Al factors included in the model were highly significant ($p<0.001$). This greater predictive effect is explained by the results of Keane *et al* (1994), who shows that the Pistol, that is more than half the carcass, has only one third of the total fat (or even less if we add k.p.h.), and that this fat is proportionally more intramuscular and therefore varies less according to age and breed. In the predictive equations we observe that the intercepts values follow the same order as the positives regression slopes: the Continental crosses are superior to the Bos Indicus and Friesian, and they are all greater than the British breeds. The intercepts values of age effect are less than in those of internal fats.

In another similar analysis with the same data but with all the cuts from the Pistol (some without trimming off the fat), an R^2 of 0.79 was obtained for the % of internal fats and 0.91 for the % of Pistol. On the other hand, for predicting only one muscle, Eye of Round, from 2.453 carcasses only a much lower R^2 was obtained 0.45 and 0.44 with the same predictive variables (Santa Coloma, 1998). In this sample of carcasses the differences of lean meat yield predicted between the extremes according to breed and age reached 12%, and within breeds 5%. These differences are double if we consider that the bone and fat have no value.

Conclusions

Just with an additional scale before trimming off fat at slaughter one can get a reasonable prediction of the yield of lean meat cuts from a carcass. Greater precision can be reached later on after quartering, with the % of pistol and trazability.

In both cases it is necessary to record the age group by tooting and the breed type, either by the hump, the ears, the hide, the round conformation and the weight of the carcass. These predictions would permit quality control of purchases and a guide for the beef farmers.

Pertinent Literature

ABRAHAM, H. C., CARPENTER, Z. L., KING, G. T., BUTLER, O. D. (1968). Relationships of carcass weight, conformation and carcass measurements and their use in predicting beef carcass cutability - J. Animal Sci. 27:604-610

CHARLES, D. D., JOHNSON, E. R. (1976). Breed differences in amount and distribution of bovine carcass dissectible fat - J. Animal Sci. 42:332-341

CROUSE, J. D., DIKEMAN, M. E. (1976). Determinates of retail product of carcass beef - J. Animal Sci. 42:584-591

EVERETT L. M., WALTERS, L. E., WHITEMAN, J. V. (1966). Association of beef carcass conformation with thick and thin muscle yields - J. Animal Sci. 25:682-687

JOHNSON, E. R., BUTTERFIELD, R. M., PRYOR, W. J. (1972). Studies of fat distribution in the bovine carcass - I. The partition of fatty tissues between depots - J. Agr. Res. 23:281

JOHNSON, D. D., ROGERS, A. L. (1997). Predicting the yield and composition for mature cows carcasses - J. Animal Sci. 75:1831-1836.

KEANE, M. G. (1994). Productivity and carcass composition of Friesian, Meuse-Rhine-Issel (M.R.I.) x Friesian and Belgian Blue X Friesian steers - Animal Production 59:197-208

KEMPSTER, A. J., CUTHBERSTON, A., HARRINGTON, G. (1976). Fat distribution in steers carcasses of different breed and crosses - 1. Distribution between depots - Animal Production 23:25

KOCH, R. M., DIKEMAN, M. E., LIPSEY, R. J., ALLEN, D. M., CROUSE, J. D. (1979). Characterisation of biological types of cattle (cycle II).III. Carcass composition, quality and palatability - J. Animal Sci. 49:448-460

SANTA COLOMA, L., AVILA, H. (1998). Evaluation of beef carcass retail yields. SENASA. http://wwsenasa.mecon.gov.ar

SAVELL, J. W HARRIS, J. J., CROSS, H. R., HALE, D. S., BEASLEY, L. C. (1991). National Beef Market Survey - J. Animal Sci. 69:2883-2893.

SHACKELFORD, S. D., CUNDIFF, L. V., GREGORY, K. E., KOOHMARAIE, M. (1995). Predicting beef carcass cutability - J. Animal Sci. 73:406-413

LEAN RETAIL CUTS YIELD MEANS

TABLE 1 - BREED TYPE MEANS

	n	$\bar{x}$
BB	296	11,0
CB	76	12,0
HB	45	10,6
ZB	113	11,9

TABLE 2 - AGE GROUP AND BREED TYPE MEANS

	0 D <118 kg		>118 kg <4D		4 D		>4 D	
	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$	n	$\bar{x}$
BB	55	11,03	197	11,10	14	10,63	30	10,77
CB			76	11,96				
HB					11	11,34	34	10,32
ZB			60	12,12	32	11,83	21	11,44

LEAN RETAILS CUTS YIELD PREDICTIVE EQUATIONS

TABLE 3 - BY % PISTOL / CARCASS WEGHT

BREED TYPE	AGE							
	0 D <118 kg		>118 kg <4D		4 D		>4 D	
	A	b	a	b	a	b	a	b
BB	-7,03	0,45	-7,11	0,45	-8,62	0,51	-0,42	0,30
CB			-12,46	0,60				
HB					-6,10	0,46	-6,61	0,46
ZB			-7,28	0,47	-4,44	0,40	1,20	0,26

TABLE 4 - BY % INTERNAL FAT/ CARCASS WEGHT

BREED TYPE	AGE							
	0 D <118 kg		>118 kg <4D		4 D		>4 D	
	a	b	a	b	a	b	a	b
BB	11,41	-0,29	11,65	-0,36	11,78	-0,40	11,83	-0,40
CB			13,17	-0,66				
HB					12,65	-0,40	12,12	-0,46
ZB			12,99	-0,58	12,32	-0,34	11,50	-0,02

BB: British Breeds, CB: Continental -British crosses, ZB Zebú-British crosses, HB Friesian-British Crosses.
Age group = Number of adult teeth. and half carcass weight: less/more < / >. a= intercept, b= coefficient of linear regression.