DRIP LOSSES IN MEAT OF YOUNG BULLS

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Introduction

Cross-striated muscle, from which comes the meat we eat, contains about 75% of water, most of which is present in the myofibrils in the spaces between thick and thin filaments. Losses of water occurr in different ways first during carcass chilling, then at carcass jointing, when joints are cut up into steak or chops, during storage and finally during cooking. Fresh meat exudes a fluid, called "drip", because the rigor causes volume changes of myofibrils; as a result of their shrinkage the fluid accumulates between fibre bundles and, when a muscle is cut, it will drain from the surface under gravity (Barton-Gade *et al.*, 1994). The quantity of drip that oozes from the meat therefore affects the weight retention during storage and display, that is the final weight of the product. Furthermore, it affects the nutritive value of meat, because it contains 80-160 mg of protein/ml and it tends to be discarded by the butcher and the consumer. Lastly, the presence of a pool of red fluid around the meat affects negatively the visual appraisal and the consumer appeal of the product (Offer and Knight, 1988).The formation of drip from meat can be influenced by primary factors of production and by several post-slaughtering factors (Smulders *et al.*, 1991).

The aim of the present study was to examine the influence of some factors (i.e. ethnic group, muscle, length of storage, weight of sample) on drip losses of meat of young bulls.

Material and Methods

Twenty-four young bulls, of which 6 hypertrophied Piemontese (H), 6 normal Piemontese (N), 6 hypertrophied Piemontese x Friesian crossbred (H x F), 6 Friesian (F) were slaughtered at live weights convenient from a commercial point of view.

The pH of *longissimus* (LTL) and *infraspinatus* (In) were measured at 45 minutes, 3h and 24h *post mortem*. At 1 day *p.m.*, In and LTL (6th thoracic-last lumbar verthebra) were excised from the right side of each carcass, transversely cutted in parts, each assigned at random to different periods of storage (1, 3, 7, 14 days *p.m.* for LTL; 1, 7, 14 for In).

Each muscular portion was weighed (W1), vacuum packaged and stored at 0-2°C. The weights were different in relation to the muscle (means value for LTL = 1504 g; In = 796 g) and the ethnic group (H = 1571; N = 1329; H x F = 1101; F = 882 g); the latter differences depended on the weight at slaughter and, most of all, on the muscular development, which is obviously influenced by the presence of the muscular hypertrophy. At the fixed days, the samples of meat were taken from the plastic bag and, after gently drying, reweighed (Wd, being d = 3 or 7 or 14 for LTL; 7 or 14 for In). We expressed the drip loss as 100 * (W1 - Wd) / W1. Water, protein and ether extract content were performed using AOAC procedures on subsamples of the muscular portion assigned to day 7.

Statistical analysis: the variance analysis for drip losses data was performed by GLM procedures (SAS), by adopting the type III of SS. The model included two fixed effects: the ethnic group (4 levels), the muscle (2 levels) and their interaction, as well as 2 covariates: the initial weight of the muscular portion (W1, in g) and the length of storage (d, in days *p.m.*). For the other data, one-way analysis of variance was performed with SPSS/PC.

Results and Discussion

Live weight and dressing percentage were significantly affected by the ethnic group (table 1), confirming what is known about the favourable effect of hypertrophy on dressing percentage. Also on chemical composition of each muscle there were differences among the ethnic groups, depending on weights at slaughter, on later maturity of Piemontese breed *vs* Friesian breed, and, above all, on the presence of double-muscling, its most remarkable effect being the reduction in fat content of meat (Barge *et al.* 1993).

Regarding the drip losses, the results of the variance analysis are reported in table 2, while the least squares means, adjusted to equal initial weight of the meat samples (=1221 g) and at equal length of storage (9 days *p.m.*), are reported in table 3. The overall F test is significant, that is the model as a whole accounts for a significant portion (60%) of the variability in the drip losses.

The muscle influenced the drip loss in a very significant way (P=0.0001). We can see that, at the above-mentioned conditions, the muscular portion of LTL lost 3.01% of its initial weight, while the drip losses were definitely more reduced in muscle In (1.37%). Honikel and Potthast (1991), studying the influence of age, sex and feeding regimes on biochemical changes *p. m.* and water-holding capacity of 4 muscles in cattle, showed that the main differences were due to the muscle. With regard to the drip losses, sex and age had no influence, whereas the muscle significantly affected the percentage of drip losses: the highest were in *semitendinosus*, the lowest in *supraspinam*, in between lied *longissimus dorsi* and *psoas major*. Also in the study of Destefanis *et al.* (1994) the muscle influenced the drip losses of a slice during a period of 48 hours. Once again *semitendinosus* exhibited the highest drip losses (3.67%), followed by *longissimus* (2.59%), *supraspinatus* (1.92%), and *pectoralis profundus*, which had the lowest (1.35%).

The ethnic group also had a significant influence on drip losses, being P<0.05. The least squares means showed that the meat of young bulls H had a higher drip loss (2.73%) than the meat of subjects belonging to the other groups, though not significatively different from that of H x F (2.33%). Group F exhibited the lowest drip losses (1.72%), close to that of N group (1.99%). These results suggest that the effect of ethnic group was attributable not to the breed, but rather to the muscular hypertrophy, in accordance with the results of Destefanis *et al.* (1994) on the same ethnic groups and the results obtained by Uytterhaegen *et al.* (1994) on normal and double muscled Belgian Blue-White bulls.

Muscle by ethnic group interaction was not significant. Nevertheless, we can observe that in group H the drip losses of In (2.14%) represented 65% of those of LTL (3.31%), whereas they represented only 28% in F (0.75 *vs* 2.70%); the other groups lied in between, the drip losses of In being about 43% of those of LTL. As a consequence, the differences among the ethnic groups seem rather negligible in LTL (2.70 ÷ 3.31%) whereas they were more remarkable for In (0.75 ÷ 2.14%). These results not seem due to the differences in chemical composition - in fact less drip is lost by In, richer in water and poorer in protein content than LTL - but rather to the pH values (table 1). These were rather similar in the two muscles at 45' (LTL: 6.58 ÷ 6.75; In: 6.66 ÷ 6.73) and at 3h (LTL from 6.10 to 6.37; In from 6.11 to 6.29), whereas at 24h the pH values for In were higher than those of LTL in all groups. This difference was lowest in H (5.55 *vs* 5.47), highest in F (5.74 *vs* 5.51). The correspondence to the above remark on the drip losses of the two muscles in the various ethnic groups proves the importance of the final pH on drip losses (Offer and Knight, 1988).

The length of storage of the muscular portion, measured in days *p.m.*, influenced the drip losses in a very significant way. The value of b resulted equal to 0.20897 (table 2). Therefore, other conditions (muscle, ethnic group, weight of sample of meat) considered equal, whitin two weeks *p.m.*, each day more (or less) than the mean, results in an increase (or decrease) of the drip losses of 0.21. This value can be better evaluated if we consider that a range equal to 1.01 (2.73 ÷ 1.72) included all the means of the ethnic group.

The weight of the meat sample at day 1 had a significant effect ($P<0.05$) on the percentage of drip. Its coefficient had a negative sign, i.e. a heavier muscular portion corresponds to a minor drip loss. The value of b shows that each 100 g more (or less) than the mean value results in a decrease (or increase) of the percentage of drip equal to 0.0566. On this subject we observe that the weight of the sample does not allow to know its size in an exhaustive way. In the study of Zarate and Zaritzky (1985), the percentage drip loss, measured on cilindrical samples of beef *semitendinosus* muscle, was proportional to the volume of meat. Other aspects of the sample can be important (Offer and Knight, 1988) such as the geometry of the meat piece, the cut surface and the distance between the cut ends.

Conclusions

Muscle influenced the drip loss percentage of the meat of young bulls, being definitely more reduced in In than in LTL, though the magnitude of the difference (1.37 *vs* 3.01%) could be to some extent due to the ultimate pH. The muscle affected also the results of the comparison among the ethnic groups: in fact the tendency of subjects with muscular hypertrophy to higher drip losses was clear in *infraspinatus*, but rather negligible in *longissimus*. The lenght of the storage period had a very remarkable effect on drip losses, showing that the exact indication of the initial and final days of the analysis is necessary. At least with our procedure, the weight of the muscular portion seems to have a not too considerable effect on drip losses, except for a very large deviation from the mean value. On the other hand, the use of equal weight samples in different muscles or in the same muscle of animals with different muscular development, may involve disadvantageous changes on the geometrical aspects of the samples.

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Table 1. Live weight at slaughter, dressing percentage; pH and proximate analysis (%) of *longissimus* and *infraspinatus* from young bulls of different ethnic groups.

	Ethnic group			
	H	N	HxF	F
live weight (kg)	552 bc	582 c	504 a	529 ab
dressing (%)	65.55 c	61.48 b	57.76 a	55.83 a
LTL pH 45min	6.68	6.58	6.66	6.75
pH 3h	6.10	6.28	6.37	6.28
pH 24h	5.47	5.50	5.51	5.51
In pH 45min	6.71	6.66	6.68	6.73
pH 3h	6.28	6.11	6.28	6.29
pH 24h	5.55 a	5.67 b	5.70 b	5.74 b
LTL water	75.62	74.94	75.23	74.54
protein	22.26 b	21.83 b	21.82 b	21.24 a
ether extract	0.33 a	1.55 b	1.27 b	2.49 c
In water	77.16	76.84	77.10	76.68
protein	20.33 b	20.31 b	19.78 ab	19.16 a
ether extract	0.59 a	1.25 ab	1.51 b	2.45 c

a, b, c: means in the same row with different letters differ ($P<0.05$)

Table 2. Drip losses (%): ANOVA using the GLM procedure of SAS.

Source of var.	D F	S S	M S	F value	Pr>F
Model	9	124.9091	13.8787	18.41	0.0001
Error	110	82.9107	0.7537		
Source of var.	D F	Type III S S	M S	F value	Pr>F
Ethnic group (E)	3	12.1776	4.0592	5.39	0.0017
Muscle (M)	1	32.9509	32.9509	43.72	0.0001
E x M	3	2.5647	0.8549	1.13	0.3385
Days (§)	1	89.8017	89.8017	119.14	0.0001
Weight (#)	1	3.4708	3.4708	4.60	0.0341

R-Square = 0.6010

(§) Linear regression of days *p.m.*

(#) Linear regression of weight of muscular portion

b (days) = 0.20897;

b (weight) = - 0.0005660;

Table 3. Drip losses (%): least squares means.

	Ethnic group				
Muscle	H	N	HxF	F	mean
LTL	3.31	2.77	3.26	2.70	3.01 a
In	2.14	1.21	1.39	0.75	1.37 b
mean	2.73 a	1.99 bc	2.33 ab	1.72 c	

a, b, c: means in the same row or column with different letters differ ($P<0.05$)