COOKING EFFECT ON CHEMICAL AND PHYSICAL QUALITY OF FROZEN *LONGISSIMUS DORSI* ON LAMBS.

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Background: Meat is usually cooked before consumption, this process changes its structure and eating quality characteristics. The effect of different cooking methods, temperatures and times on tenderness and juiciness has been the subject of considerable researches as reported in Casales et al., 1988, particularly on beef muscles.
The experiments on sheep and on the cooking effect on chemical quality of the meat are limited (Bouton et al., 1978; Solomon et al., 1980; Rhee et a., 1990).
Generally, the protein unfold with the cooking at 65°C, followed by partial denaturation with corresponding expulsion of water and low percentage of fat, protein and ash (Solomon et al., 1980).
Furthermore, meat qualitative characteristics are affected by slaughtered age and breed (Bouton et al., 1978; Mendenhall and Ercanbrack, 1979; Solomon et al., 1990).

Objectives: The experiment aim is to study qualitative changes in *longissimus dorsi* muscle of different male lambs according to the cooking and to value the water holding capacity of the frozen and cooked muscle.
Furthermore, slaughter age and typical characteristic qualitative of meat in local breed are evaluated.

Methods: The experiment was carried out on 119 *longissimus dorsi* muscle samples of male lambs. The animals Pinzirita (Pi) and Comisana (CO) and their crossbreeds with Barbaresca (Ba*Pi and Ba*Co) were slaughtered at two different ages (100 and 180 days). The Pinzirita, Comisana and Barbaresca are typical Sicilian breeds. The first two have principally aptitude to produce milk the other meat as reported in Lanza et al, 1983.
The lambs were fed on maternal milk and weaned at 60d, then fed on leguminous hay (*hedysarum coronarum*) and concentrate. *In vita* and at slaughter data were referred by Bonanno et al., 1993, Leto et al., 1994.
The samples were placed in polyethylene bags, frozen at -20°C and kept for about 4 months, then they were thawed for 24 h at 4°C.
Weights of frozen and thawed meat to thaw loss determination and pH were recorded.
They were cut in two sub samples, one was wrapped in polyethylene bags and heated, totally immersed in a constant temperature water bath, until the internal temperature of meat reached 75°C and then was cooled in cold running water for 30 minutes and dried with paper towels. Both weights before and after cooking to determine moisture loss were recorded.
These two samples (raw and cooked meat) were cut in 3 cylinder of ½ inch parallel to the grain and the Warner- Bratzel Shear force with a Instron 1011, with a cross head speed of 100 mm/min was recorded.
Raw and cooked meat were immediately homogenized and, after dry matter determination at 65°C, the remaining part of sample was lyophilised for chemical analysis.
On lyophilised samples, fat, extracted with petroleum ether in Soxhlet apparatus and ash at 540°C were determined, at last protein for difference was obtained.
Chemical composition on raw and cooked meat was referred to unfrozen sample weight.
The data were analysed by analysis of variance, using GLM procedure of SAS package (SAS, 1985).
The analysis included test for differences between genotypes (GT) (with contrast test for Pi *versus* Co, Ba*Pi *versus* Ba*Co and Pi with Ba*Pi *versus* Co with Ba*Co) and ages (A) for pH, water losses on thaw and cooked meat, while, it considered also the type of meat (B) (raw and cooked) for qualitative analysis, according to following model:

$$Y_{ijkc} = \mu + GT_i + A_j + B_k + (GT*A)_{ij} + (GT*B)_{ik} + (A*B)_{jk} + E_{ijkc}$$

Results And Discussion: The thaw meat pH was lower (5.71 on the average) compared to unfrozen meat (5.94), because the pH decreased during freezing by time and temperature (Dransfield and Failla, 1995).
Meat pH (table 1) was affected by genotype, between pure-breeds (+1.4% Pi vs Co) and crossbreeds (+1.2% Ba*Pi vs Ba*Co). There was not significant differences between Pi *versus* Ba*Pi and Co *versus* Ba*Co. Thaw loss, negatively correlated with pH (Thee et al., 1990), showed higher values in Pi meat compared with Co meat (+3.34%) and in Ba*Pi compared with Ba*Co (+4.88%).
If the meat lost a lot of water at thaw, then it losses water at cooking. The cooked losses were complementary with thaw losses in Ba*Pi and Ba*Co, which showed higher values compared with pure-breed (19.07% vs 17.36% with $P<0.001$) , probably due to greater muscle size (Solomon et al., 1980). In fact the Ba*Co, that is the genotypes with more somatic development (Leto et al. 1994), lost more water (19.76%).
The slaughter ages showed significant differences in all considered parameters (Solomon et al., 1980). The meat pH was higher in younger animals (+3.2%) and on the contrary the thaw loss was lower (-1.51%) and cooked loss was + 2.97%.
Generally, freezing of meat increase to amount of drip moisture when the meat is thawed, because with making of ice in the muscles the water is transferred across the cell membrane into extracellular spaces and lost with some chemical constituent (mineral and protein)(Bhattacharya et al., 1988).
The meat dry matter (table 2) was significantly higher in Co and Ba*Co *versus* others two genotypes (24.20% vs 23.28 %), the protein and ash had the some trend (20.23% vs 19.35% for the first and 0.87% vs 0.82% for the second). This characteristic composition of Co and Ba*Co was linked with lower thaw losses (Bhattacharya et al., 1988). The fat showed significant differences only between pure

breeds(-0.27% Co *versus* Pi). The Pi in fact is a more precocious breed compared with Co as reported in Lanza et al., 1983 and furthermore, showed more fat on carcass and on meat. Similar composition we noticed in Micari et al., 1991, on Pinzirita breed.
The 100d animals had higher dry matter (+0.99%), probably due to thaw loss of water and chemical substance. The other chemical parameters derived from percentage of dry matter therefore in younger animals higher percentages in protein (+0.61%), fat (+0.35%) and ash (+0.03%) were checked.
The meat lost with cooking 1.23% of dry matter (41.5% protein, 46.3% fat and 12.2% ash). Furthermore, comparing the losses with meat chemical composition, (82.30% protein, 12.29% fat and 3.58% ash) more fat and ash and relatively few protein, probably with low biological value (soluble collagen) were lost (Casales et al., 1988).
The genotypes had little effect on hardness. Considering the interaction with age the shear force values were lower in Co at 180d compared with the other genotypes at same age. The hardness showed significant difference in the slaughter age (+25% for older lambs) and after cooking the hardness value increased, due to both twitch and limited solubility of collagen depending on low temperature and time of treatment (Bouton and al., 1978).
Generally the hardness values reported in literature were higher compared with our data, probably for different genotypes involved. (Rhee et al., 1990; Mendenhall and Ercanbrack, 1979 Solomon et al., 1980).

Conclusions: Cooking and frozen effects on *longissimus dorsi* of lambs are very important . The cooking principally affects the meat fat and hardness improving the quality, while the frozen effect is unfavourable on the water holding capacity , increasing the dry matter loss, protein and ash while the values in hardness and fat do not change. Therefore, it is important to study the effects, that the common cooking type have on meat dietetic-nutritional value and it is necessary to test the adapt frozen way to reduce the thaw loss.

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Table 1 - Water holding capacity on thawed and cooked meat.

	Genetic types									Slaughter ages			MSE
	Pi	Co		Ba*Pi	Ba*Co		Pi Ba*Pi	Co Ba*Co		100d	180d		
N	27	25		44	23		71	48		51	68		
pH	5.71	5.79	**	5.69	5.76	**	5.70	5.78	***	5.83	5.64	***	0.088
Thaw loss %	13.55	10.21	***	12.99	8.11	***	13.27	9.16	***	10.46	11.97	***	2.527
Cooked loss %	17.66	17.06	**	18.38	19.76	**	18.02	17.91	ns	19.45	16.48	***	1.975

Table 2 -Chemical composition and hardness on *longissimus dorsi* muscle.

	Genetic types									Slaughter age			Meat types			MSE
	Pi	Co		Ba*Pi	Ba*Co		Pi Ba*Pi	Co Ba*Co		100d	180d		raw	cooked		
DM %	23.49	24.01	*	23.10	24.40	***	23.28	24.20	***	24.24	23.25	***	24.36	23.13	***	1.193
Protein%	19.49	20.24	***	19.23	20.22	***	19.35	20.23	***	20.70	19.49	***	20.10	19.54	***	0.913
Fat %	3.16	2.90	*	3.06	3.31	ns	3.11	3.09	ns	3.28	2.93	***	3.39	2.82	***	0.669
Ash %	0.84	0.87	**	0.81	0.87	***	0.82	0.87	***	0.86	0.83	***	0.92	0.77	***	0.060
Hardness Kg/cm^2	2.30	2.12	ns	2.26	2.23	ns	2.29	2.17	ns	1.91	2.55	***	2.08	2.38	***	0.553