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IMPLICATIONS OF FASTING AND OF TRANSPORTATION FOR A HIGH QUALITY RABBIT MEAT PRODUCT.

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I T A L Y

ABSTRACT. In one trial (april 1991) on 36 NZW male rabbits fed ad libitum with a commercial diet till to 95 days (2,6 kg) it was tested the effect of the 24 h solid fasting or/and two hours car transportation. The control group (C) not fasted nor transported represented the half of the experiment (#18) while six rabbits were allocated to fasted (F), transported (T) and fasted and transported (FT) groups. After the usual recovery of body and carcass components, the 24 h chilled carcasses were axially splitted (left regions identified by a thread) and then cut at the 7-8th TV and at 6-7th LV: from the six pieces a randomized carcass was then reassembled for a family paired panel test for preference where one (unknown) half portion was a standard rabbit from the C group so that 486 valid trimodal global preferences (+/-/=) were expressed, pooled within rabbit and computed as marginal ratios; this panel was also pooled within group-between rabbit and elaborated as trinomial distribution by a log-linear model (proc Catmod).
The loss of liveweight was strongly affected by fasting of some 136 g (-5%) in the F group and 97 (-3.9%) in the FT group, but when also a transportation occur in only two hours the rabbits further lost 43 g (-1.8%). In the transported not prefasted (T) (the real case) the weight loss was near 60 g (-2.2%). Nevertheless the crude differential effect of fasting, including the miss mark due to the last day's growth, was 164 g (***). Hot dressing percentage interacted with the two factors, being the maximum in the F group. A strong decrease of liver was related to fasting, thus the reference carcass percentage was conversely higher (+1.6% **) in F and FT groups. In these groups the fat condition score of carcasses was insignificantly decreased.
Panel test showed significant preference for meat derived from fasted rabbits (in the ratio 2.29+ / 1-), while transported were not prefered (1.81- / 1+). These two effects were added in the FT group (1.21+ / 1-).
Lumbar final pH was favourably decreased by fasting (-0.18, *), but strongly increased by transportation (+0,53,***). This parameter was not exhaustive of consumer test variation and the response varied according preslaughter fasting condition.
High quality rabbit meat product must to be compromised to selling weight : skip feeding in the last day decrease body mass due to the specific high maintenance needs. Prolonged soft salutary stress as fasting was beneficial to meat acceptability, while consistent transportation effects decreased the sensory quality at the consumer level.

Key Words: Rabbits, Fasting, Transportation, Dressing percentage, Meat preference, muscular pH.

Introduction

Preslaughter treatments are important studied factors in many domestic species (Tarrant P., 1982; Baudonnet-Lefant et al, 1991) . Rabbit is commonly trucked from herds to the slaughterhouses (Crimella et al, 1991) and sometimes it is previously fasted (Lukefahr and Ozimba, 1991). Bate-Smith and Bendale (cited by Lawrie, 1979) observed abnormal raising of final pH of Psoas muscle from 5.9 to 6.5 after a very long starvation period of 2 or 3 days. Also Ouhayoun (1989) reported abnormally high muscular pH at 3 h from slaughter after a prolonged transportation.
Mass factors connected to preslaughter treatments are mainly economic because they involve reduction of live weight (paid to the producers) and changes in the carcasses (sold by the butchers). This work aims to confirm previous informations (Lebas, 1969; Cheeke et al., 1987; Coppings et al., 1989), but particularly it points to the not understood qualitative implications for the product.

Material and Methods

A total of 36 young New Zealand male rabbits, having received a commercial diet till to 95 days were randomly allocated to four groups: the control group (C), not fasted nor transported, included the half of the experiment (#18); the transported (T, #=6) group tested the effect of a two hours car transportation; the fasted (F, #=6) group tested the effect of a solid 24 hours fasting period; the fasted and transported (FT, #=6) tested the double effect.
The rabbits were sudden stunned and immediately bleeded. After the usual recovery of body and carcass components and final pH (portable instrument equipped by an electrode Orion 8163) according to the procedures described in Blasco et al, 1990, the carcasses chilled at 2 °C for 24 h were axially splitted (left regions identified by a series of threads) and then cut at the 7-8th TV and at 6-7th LV: from the six pieces a randomized carcass was then reassembled for a family paired panel test where one (unknown) half portion was a standard rabbit from the C group. In total 486 valid trimodal global preferences (+/-/=) were expressed, pooled within rabbit and computed as marginal ratios. This panel was also pooled within-group between rabbit and elaborated as trinomial distribution by a log-linear model (proc Catmod). Linear models were computed by GLM of SAS System (1987). The model involved two fixed effects (F, T) as well as their interaction. Pre-planned contrasts for main effects evaluation were calculated by Lsmeans differences, and precisely: Fast (F+FT-C-T) and Transportation (T+FT-C-F). An explorative analysis according to the Partial Least Squares (PLS1) method was then conducted by using the program UNSCRAMBLER II (by CAMO, 1991) on the individual results preference of panel test (Y) regressed over design plus other eight individual variables (X: 2 pH of Long. dorsi plus 6 noted in table 1).

Table 1 - Variations of live weight, and body and carcass components.

	groups				Int. Fasting		Transportation	
	C	T	F	FT	(F+FT-C-T)/2		(T+FT-C-F)/2	RSD
N°	18	6	6	6				
Start_Liveweight, g								
W	2640	2597	2706	2545	(7.0)		(-101.0)	264.0
Variation 0-24h, before transportation								
W	40a	54a	-136b	-97b	-164.3	***	(26.5)	50.0
%SW -U	1.5a	2.2a	-5b	-3.9b	-6.25	***	(0.9)	2.0
Variation 24h-slaughtering, after transportation								
W	6a	-56b	0a	-43b	3.6		-53.5	*** 23.1
%SW -U	0.2a	-2.2b	0a	-1.8b	0.1		-2.1	*** 0.9
Hot carcass, g								
W	1686a	1650ab	1664ab	1494b	-89.0		-103.6	167.7
Hot dressing %								
%SW	62.9	63.6	64.7	62.2	* 0.1		0.9	2.2
Gastro intestinal tract								
W	417a	376ab	349b	345b	-49.0	+	-22.6	75.7
%SW -U	15.4a	14.4a	13.5b	14.3a	1.0		-0.1	1.8
Blood,								
W	68.1	73.9	66.5	61.8	-6.9		0.5	12.6
%SW	2.5	2.8	2.6	2.6	-0.1		0.1	0.4
Skin %								
W	481	466	470	461	-7.0		-12.0	61.6
%SW -U	17.9	17.9	18.3	19.1	0.8		0.4	1.5
Liver								
W	77.9a	80.4a	61.2b	51.8b	-22.7	***	-2.7	14.2
%CC -U	4,7a	5.0a	3.8b	3.5b	-1.1	***	0.0	0.6
Perirenal fat								
W	45	43.7	38.6	35	-7.5		-2.5	12.9
%CC -U	2.7	2.7	2.4	2.4	-0.3		0.0	0.8
Scapular fat								
W	11.4	11.4	9.9	9	-2.0		-0.4	4.0
%CC	0.7	0.7	0.6	0.6	-0.1		0.0	0.2
Kidneys								
W	15.9a	15.0ab	15.3ab	13.6b	-1.0		-1.2	1.8
%CC	0.97	0.94	0.96	0.93	0.0		0.0	0.1
Heart, lungs								
W	28.5	26.7	25.1	25.8	-2.2		-0.5	4.9
%CC	1.74	1.66	1.56	1.76	0.0		0.1	0.3
Reference carcass %								
W	1458	1426	1461	1333	-45.0		-80.0	139.6
%CC	89.1b	89.1b	90.7a	90.8a	1.6	**	0.0	1.3

a>b>c;P<0.05; +P<0.1; *P<0.05; **P<0.01; ***P<0.001 -U:included in PLS model.
W= Weight (g); SW=Slaughter Weight; CC= Cold commercial Carcass.

Table 2 - pH of longissimus dorsi muscle (T_7 and L_6) at 24h.

	Groups				Int. Fasting		Transportation		
	C	T	F	FT	(F+FT-C-T)/2		(T+FT-C-F)/2		sd_E
T_7	6.27b	6.51a	6.26b	6.55a	0.01		0.26	***	0.20
L_6	6.01b	6.58a	5.89b	6.34a	-0.18	*	0.53	***	0.24

a>b>c; P<0.05 Int.= Interaction Fasting x Transportation

Table 3 - Family's panel test of paired samples.

	groups				Int. Fasting	Transportation
	C	T	F	FT	(F+FT-C-T)/2	(T+FT-C-F)/2
					P< P<	P<
class	Frequencies		TRIMODAL DISTRIBUTION (CATMOD by SAS)			
+	103	27	48	40		
-	117	49	21	33		
					3.22	-0.88
=	24	10	7	7	0.8 0.0004	0.0465
total	244	86	76	80		
marg.ratio	-1.14	-1.81	2.29	1.21		

Preference	LINEAR MODEL (GLM by SAS; weight = 1/ni)				
-1.23s	-2.07s	2.65r	0.5lrs	3.23	-1.48
r>s; P<0.09			Prob.->0.7	0.075	0.403	1.34

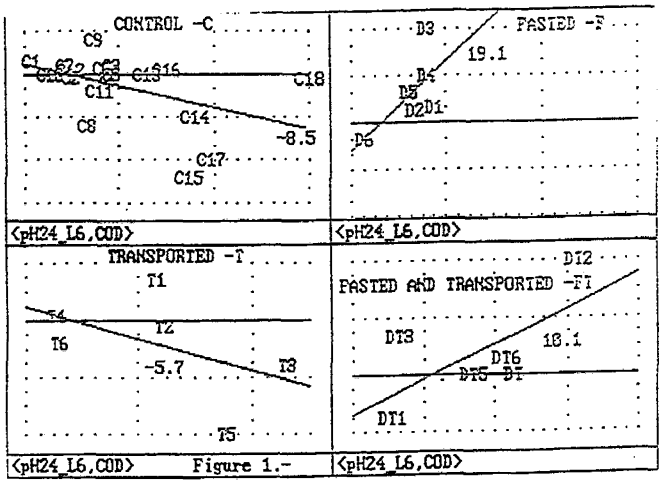

Figure 1 - Regressive plots of Preference on the pH_24h (Long. dorsi loin) by groups. (D => F)

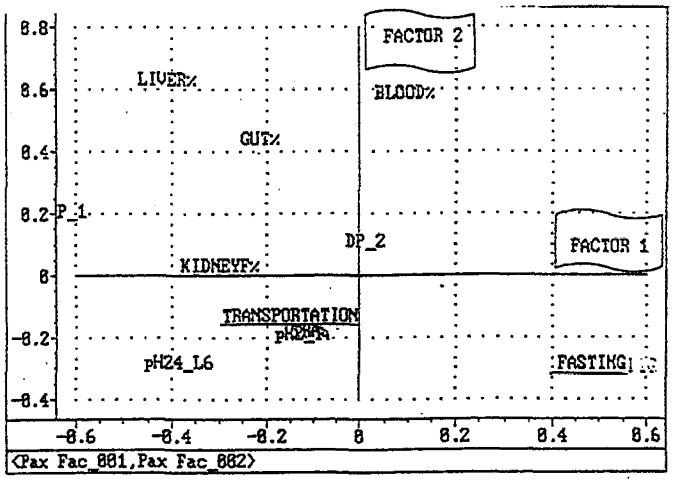

Figure 2 - Loadings of 10 independent standardized variables on Preference.

Results and Discussion

Liveweight and body components. Pretreatment live weight did not vary significantly among the four groups on trial (table 1.). During the next 24 hours the rabbits normally fed gained 40-54 grams, an appreciable value in spite of the age and of the warm season: manipulation of animals for weighting was not an apparent stressor. Coppings et al. (1989) reported higher gains in the control (80 g), when rabbits weighted 2 kg; nevertheless in a subsequent trial their control group lost 9 grams during the last day. At the end of the fasting period the live body weight of animals was decreased of 5 % and of 3.9 % respectively in the F and in the FT groups. Equivalent figures from the previous AA were slightly higher (-6.3 and -6.6 %). Nevertheless the crude differential effect of fasting, including the miss mark due to the last day's growth, was 164 g (***).

Transportation occurred on subsequent two hours. The body weight losses were then similar in both the conventional and in fasted condition. (-2.2 and -1.8 %). However, the rate of weight decreasing was accelerated about five times as respect to the fasting in cage. Equivalent changes were assessed by Crimella et al. (1991) in large scale trucking operation : -1.9 % after two hours.

Differences in warm carcass weights were displayed in FT (1494 g) vs C(1686 g); this was accounted for by the pretreatment sampling (-95 g liveweight) and by the miss mark of growth in the last day (-97 g) and by the trucking decrease (-43 g).

Concerning hot dressing % a significant interaction opposed the two factors: transportation tended to increase the dressings in the conventional not fasted condition (62.9 to 63.6) while it tended to decrease them after the preslaughter 24 h fasting (64.7 to 62.2). These results confirmed Coppings et al. (1989) about the best results in F group. They confirmed also opinion of Lebas (1969) about a greater effect of T against carcass weight when animals were previously fasted. Regarding to the distribution of live weight reduction between the chief components as offal (visceral, blood, skin) and hot commercial carcass, estimated by % incidences in the C group, the calculated figures were respectively:

-40 and -17 g for T; -82 and -38 g for F ; -44 and -106 g for FT

The supposed differences between FT and F groups about offal and carcass losses were surprising: number of rabbits was low, variability in excretion (urine) may be important to compensate offal with carcass.

Weights and percentage losses of edible internal organs concerned fasting effects. Liver was strongly decreased (-22.7 g = -1.1 %) and consequently incidence of the reference carcass on the commercial carcass increased of 1.6 %. Other signals of body mobilisation were indicated in fat depots losses, but statistical evidence was difficult to reach because of high invidual reaction. Losses in liver weight were problably mainly due to glycogen, water and also protein mobilisation (Davidson et al., 1968)

Transportation effects did not appear, nor in liver weight nor in other internal organs. In piglets, 42 % of the live weigth lost after two hours of trucking was accounted for by excretory products, while 58 % was attributed to evaporative losses and respiratory exchange (Dantzer and Mormede , 1983).

Muscular pH. Ultimate muscular pH (table 2) was strongly increased as direct consequence of transportation. The raise was 1/2 unit in loin region and 1/4 unit in thoracic part. Differences in the type of fibres present in the two regions of muscle (Ouhayoun and Delmas , 1988) explain the modulated response. All this was due to a strong glycogen muscle breakdown caused by beta adrenergic during the trucking. The rabbits appear to be quite

different from lambs, who can restore muscle glycogen reserves in severe trucking (Monin and Giret, 1980). Excessive reduction in acidity of the muscle could involue towards DFD defects, but it did not seem univocal. In effect, at sensory level (fig 1.) raise of pH produced sparse responses in preference: the rejection risk strongly increased for rabbit from non fasted groups, control included, while a positive trend was evident in fasted groups. From the figure 1 it was also evident a lack of interactive effects: transportation and pre-transportation fasting seems to be additive and contrasted each other.
On the contrary - and this is very important - fasting decreased significantly of 0.18 units the pH of loin. The lack of solid feed started mobilisation of glycogen and also a gluconeogenesis process from the liver to muscles (Fausch et al.1968).
Panel test. The palatability responses (+,-,=) were submitted to a log-linear model (table 3) and revealed strong differences between factors. The **F** effect was positive and strong while **T** was negative and weaker, as regard to the high quality rabbit meat product. The two factors did not interact. Thus the best choice was for tastes derived from rabbits fasted but not transported , who were 2.3 times preferred to the **C**. On the contrary the rabbits transported without preslaughter fasting were clearly rejected in the average ratio -1.8 to 1 versus the **C**. The rabbits transported and fasted were on the average superior to the control group.
Further analyses were conducted on the individual observations expressed as a consensus variable by the ratio of positives to negatives -or minus the inverse-, and centred to zero. The Ordinary Least Squares analysis (GLM) gave significant response for fasting effects but at a lower level of probability, while the response to transportation did not appear significant. The means of the two models well agreed: the control was lowered because of the strong effect of fasted group. One only discrepancy regarded the **FT** group where the average of the individual ratios (subtracted 1 or added 1) was lower than the ratio of the sums. Thus transportation apparently lost significance.
The findings on transportation partially disagreed with analogous study of Becker et al (1989) about fasted and transported pigs. Originality of the work were the negative consequences for meat from animals transported and not fasted, who was the normal condition in rabbit while it is forbidden, and thus not studied, in pigs.
Multivariate analysis of standardized variables (Partial Least Squares of selected 8 X independent variables) was relatively unable to predict individual preference: the variance explained was 22 % keeping 3 factor. However the value of the loadings was more informative about etiology of preference (Fig. 2). The component 1 separated fasting and blood % (positive) against weight losses during the fasting and the pH24 of loin. The component 2 distinguished positively liver % and also blood % against pH24 of loin. However a clear net contribution in the preference of the panelists involved negatively the pH of loin (mainly for the not fasted individuals, as seen in Fig. 1, left part) and transportation, while blood % contributed in positive.

Conclusions

Fasting rabbits in preslaughter period could be a simple tool for improving quality. Salutary effects of fasting on the organisms could be involved by a soft stress. Rabbits put in starvation are more anxious than full fed ones and mobilize glycogen from liver. This condition probably well arrange the trucking and the final stresses.

Opposition of quality needs to weighting losses, as well as economic, must to be specifically studied in the varied field conditions.
Further researches need in this field specially concerning pre-slaughter treatments associated with a possible fasting after that a transportation has occurred. Nevertheless qualitative consequences of inevitable handling and transportation could be considered even from scientist who aim to apply and extend their researches.

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