EFFECT OF THE COMBINATION OF FASTING TIME AND DIETARY GLYCAEMIC INDEX ON DRIP LOSS AND COLOUR OF PORK

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Abstract – The combined effect of fasting time previous to slaughter and the dietary treatment based in different glycaemic index (GI) formulation on drip loss and colour of pork (muscle *longissimus lumborum*) were studied. One hundred and twenty pigs were distributed into two groups and fed either a diet with low or high GI (starch and sugar content 45.3 % vs. 50.6%, respectively) for 28 days. At the time of slaughter three different fasting periods were followed (17, 19 and 22 h). Meat from pigs that had the lowest fasting time and were fed the low GI diet showed the highest water losses, whereas, those groups that received a high GI diet and had a medium or high fasting time had the lowest drip losses. Moreover, meat from pigs under the high-fasting showed lower luminosity (P=0.0001), lower yellowness (P=0.0001), saturation of the colour (P=0.0001) and greater content of pigments (P=0.0001) when compared to the other groups. Results of colour changes were in turn with those observed for drip loss, so a long-fasting period in combination with a high GI diet (which result in lower glycolytic potential) was the combination that improved pork quality characteristics.

Key Words – feeding formulation, meat quality, pre-slaughter management.

I. INTRODUCTION

Pre-slaughter management and feed formulation are important factors affecting meat quality. Among management practices, withholding feed previous to slaughter has been shown to affect pork quality by reducing muscle glycogen levels leading to a higher ultimate pH and lower drip loss [1]. A prolonged fasting period has also been reported to improve colour and other characteristics such as firmness [1]. However, there is not consistent information of these pre-slaughter procedures on pork quality, and these effects seem to be dependent on other factors like the duration of the withdrawal feeding period or pre-slaughter feed management [2]. The use of diets with different glycaemic indexes and different rate of starch digestion affects the postprandial glucose availability and energy utilization [3], being this response directly related to the glycolytic potential of muscle [4]. Consequently, both fasting and the glycaemic index (GI) of diets would modify glycogen stores and pork quality.

The objective of the present research was to study the combined effect of fasting time previous to slaughter and the dietary treatment based in different GI formulation on drip loss and colour of pork (muscle *longissimus lumborum*).

II. MATERIALS AND METHODS

One hundred and twenty male and female pigs (PIC x L337) (RN and halothane negative) were randomly selected and distributed into two groups that were fed different diets. Diets were isoenergetic and isoproteic and were formulated in order to provide two different GI. High-GI diet (**H**) contained 44.7% starch, 50.6% starch+sugar, 5.4% fat, and 12.4% NDF, whereas low-GI diet (**L**) contained 41.3% starch, 45.3% starch+sugar, 5.3% fat and 13% NDF. At the end of the experimental period (28 days), pigs were sent to a commercial slaughterhouse (Incarlopsa, Tarancón, Cuenca, Spain) stunned with CO_2 and slaughtered after three different fasting periods (17, 19 and 22 h.) (**Lf, Mf, Hf**). Electrical conductivity and pH were measured by means of a LFStar conductivity meter (Mattahäus Ingenieurbüro, Klausa, DE) and a portable pH meter pH*K21 (NWK Binar, Puergen, DE), respectively. Samples of approximately 15 cm in size were taken from the *longissimus lumborum* muscle at the level of the last rib for analysis (n=120). To determine

weight loss during storage, approximately 1 cm^3 of sample (weighing around 10 g) was taken, weighed and placed under refrigerated conditions at 4°C in a saturated atmosphere. Samples were weighed again after 96 hours of storage. The difference between initial and final weights was used to calculate drip loss, which was expressed as a percentage of the initial weight [5]. Colour measurement and pigment concentrations were assessed in 2-cm-thick muscle samples placed on trays and kept at 4ºC for 1, 4, 6 and 8 days. Muscle colour was evaluated by means of a Chroma Meter (CM 2002, Minolta, Camera, Osaka, Japan) previously calibrated against a white title in accordance with the manufacturer's recommendations [6] and using the illuminant D_{65}. The average of three random readings was used to measure lightness (L*), redness (a*) and yellowness (b*). Meat pigments (oxymyoglobin, deoxymyoglobin and metmyoglobin) were calculated by the isobestic wavelengths measured by means of the Chroma Meter. Oxymyoglobin was calculated as the ratio of measurement at 610/525 nm, deoxymyoglobin as the ratio at 474/525 nm and metmyoglobin as the ratio at 572/525 nm [7].
Data were analyzed using the general linear model procedure in SAS 9 [8] to study the effects of the dietary treatment and fasting time.

III. RESULTS AND DISCUSSION

The effect of the dietary GI and the fasting time previous to slaughter on drip loss is presented in Figure 1. Both fasting time and GI of diets affected on water losses of pork (P=0.0004 and P=0.0001, respectively). Other authors reported that a fasting of 16 h did not reduce drip loss, whereas a prolonged fasting of 24 hours decreased water losses [1]. A recent meta-analysis carried out by Salmi et al. [9] showed that fasting time had a significant effect on drip loss measured in *longissimus dorsi*. Concerning the effect of diet formulation, previous studies reported [10] that diets with higher GI may result in lower glycolityc potential due to a higher hyperinsulinemia and earlier increase in the rate of glucose disappearance from blood to tissues [4, 10]. However, other authors reported no changes in the glycogen content by a low starch diet when compared to a high starch diet. According to the present results meat from pigs that had the lowest fasting time and were fed the low GI diet (Lf-L) showed the highest water losses. Whereas, those groups that received a high GI diet and had a medium or high fasting time had the lowest drip losses. Intermedium values of water loss were found in groups Lf-H, Mf-L and Hf-L.

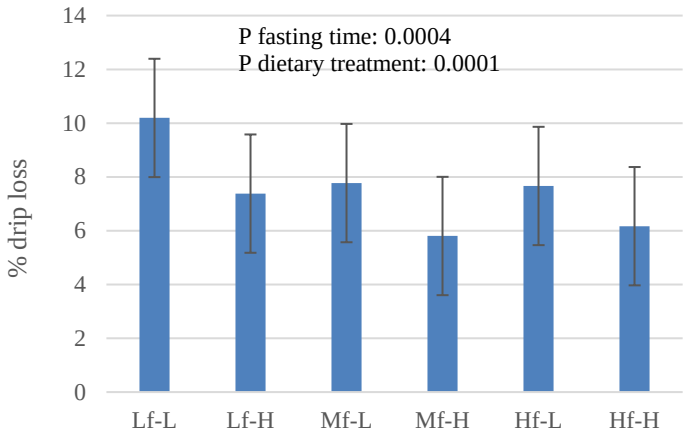

Figure 1. Effect of fasting time previous to slaughter (low: Lf, medium: Mf, high: Hf) and glycemic index (low: L, high: H) of diets on drip loss

Consequently, a long-fasting time seems to improve water losses of pork at 72 hours of refrigerate storage and the combination effect of diet formulation allows a higher manipulation of this parameter.

The effect of fasting time and GI on colour parameters were also studied (Table 1). Fasting period had a significant effect on pork colour. Hence, meat from animals that had a long fasting time showed lower luminosity (L*, P= 0.0001), lower yellowness (b*, P=0.0001) and saturation of the colour (chroma, P=0.0001) when compared to the other groups. Meat from the high-fasting period pigs, also showed greater content of pigments (oxymyoglobin, deoxymyoglobin and metmyoglobin, P=0.0001). Other authors found similar reduction of muscle lightness by fasting periods of 16 or 24 h [1] or 48 h [2]. However, the effect of the GI of diet was much lighter, being the luminosity (L*) of the meat the only parameter that tended to be higher in those samples from pigs fed the low GI of diet (P=0.055). Previous studies based in the administration of different GI reported effects on colour [10], while others did not find differences [11]. Moreover, it has been reported a direct relationship between luminosity and drip loss, similarly as observed in the present study [10]. Results of colour changes were in turn with those observed for drip loss, so a long-fasting period in combination with a high GI (which results in lower glycolytic potential) was the combination that improves pork quality characteristics.

Table 1. Effect of fasting time previous to slaughter (low: Lf, medium: Mf, high: Hf) and glycemic index (low: L, high: H) of diets on colour parameters[2]

	GI				Fasting						RMSE[1]	GI	Fasting	GI*Fasting
	Low		High		Low		Medium		High					
L* D65	54.66	a	53.59	b	54.69	a	54.96	a	52.90	b	3.945	**0.0555**	**<.0001**	0.6827
a* D65	0.74		0.56		0.50		0.72		0.85		1.447	0.3227	0.4546	0.7375
b* D65	10.71		10.68		11.07	a	11.02	a	10.06	b	1.321	0.3445	**<.0001**	0.1826
chroma	10.88		10.78		10.94	a	11.17	a	10.22	b	1.374	0.5668	**0.0001**	0.1002
ratio_630/580	1.56		1.58		1.56	b	1.54	b	1.60	a	0.141	0.0783	**0.001**	0.8848
a*/b*	0.06		0.05		0.04		0.06		0.07		0.134	0.414	0.5442	0.4282
OxyMb	5.14		5.24		4.63	b	4.50	b	6.60	a	2.927	0.7153	**<.0001**	0.1335
DeoxyMb	1.14	b	1.16	a	1.15	a	1.13	b	1.15	a	0.038	0.9654	**0.0001**	**0.0111**
MetMb	9.53		9.60		8.60	b	8.22	b	12.16	a	5.314	0.8687	**0.0001**	0.1460

[1]RMSE: Root of the mean square error of treatments effect

[2]Means with different superscripts were statistically different (P<0.05)

IV. CONCLUSION

The combined effect of fasting time previous to slaughter and the GI of diets as factors that modify glycolytic potential of muscle is an interesting strategy to improve pork quality characteristics.

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