EFFECT OF GENOTYPE AND SEX ON PH OF BICEPS FEMORIS AND LONGISSIMUS DORSI MUSCLES IN RABBIT CARCASSES

BARRÒN G., ROSAS G., SANDOVAL CH., BONILLA O., REYES G., RICO P., CARDONA L., ZAMORA F.

Medicina Veterinaria y Zootecnia. Universidad Nacional Autónoma de México. Facultad de Estudios Superiores Cuautitlán, Km. 2.5 Carretera Cuautitlán-Teoloyucán, Cuautitlán Izcalli, Estado de México. CP 54740 – MÉXICO.
marybarron68@hotmail.com

ABSTRACT

The effect of genotype and sex on pH variation of the muscles *Biceps femoris* (BF) and *Longissimus dorsi* (LD) in rabbits carcasses was determined. Two hundred eight rabbits 70 days old were slaughtered, having 52 animals for every single genotype (New Zealand, California, Chinchilla and a Synthetic line). Significant differences (P<0.01) were observed between genotypes, New Zealand showed the highest value of $pH_{24\ h}$ in LD muscle and Chinchilla and New Zealand showed the highest values of pH_{20min} and pH_{24h} in BF muscle. In the muscle LD, males exhibited the highest pH_{20min} values (P<0.01).

Key words: rabbits, genotype, sex, muscle, pH.

INTRODUCTION

Some characteristics of rabbit meat may be known if muscle pH is considered, due to the fact that this parameter affects the structure of tissue proteins as well as water retention capacity, this fact could modify the sensorial quality of meat mainly color and tenderness. Grade and decreasing speed of muscle pH after slaughter are the most important cause of the variation in meat quality (HULOT and OUHAYOUN, 1999).

There are different factors that are closely related with a particular muscular pH such as genotype, sex, age, weight, food, technological considerations, pre slaughter conditions and cooling systems (DALLE ZOTTE, 2002). Meat features become important when consumer satisfaction is looked for, and this is even more important in Mexico because not many studies on this subject have been made to determine the effect of genotype and sex on pH variation and its relationship with meat quality in this particular animal specie (MACIAS *et al.* 1998; ORTIZ and RUBIO 2001).

The objective of this research was to determine the effect of genotype and sex on muscle pH variation in rabbits.

MATERIALS AND METHODS

Research was performed in the rabbit development module, slaughter house and Biochemistry–Genetics laboratory at MVZ Department in FESC. Two hundred eight rabbits were slaughtered from June to September 2003 at 70 days old, having 52 animals for every genotype (New Zealand, California, Chinchilla and a Synthetic line), having 26 female and 26 male animals in every group. Animals were kept in metallic cages and fed with a balanced commercial diet with 17 % of raw protein, 15 % of raw fiber, 2% of raw fat, 12% humidity, 8% ash and 46% of nitrogen free extracts. The carcasses were separated following BLASCO *et al*. (1993) method.

The pH measurement of *Biceps femoris* (BF) and *Longissimus dorsi (LD)* muscles was done in situ, in the LD muscle a 3 mm deep wound cut was made at 5^{th} lumbar vertebra level. The pH was recorded with a pH meter electrode Hg/Hg_2Cl_2 of 159 mm (Cole Parmer E 05998-21).

The measurements were done at 20 minutes, 3, 6 and 24 hours after slaughter. Twenty minutes *post mortem* the carcasses were kept under refrigeration conditions (4° C). The date were analyzed by Least square means procedure of the General Linear Model Program of SAS (1996), following a fixed effect model that included genotype, sex and their interaction, using body weight at slaughter as a covariable. The means were compared by the minimum significant difference (DMS).

RESULTS AND DISCUSSION

Least square means and belonging standard errors are shown in tables 1 and 2. Significant differences (P<0.01) among genotypes were found with respect to values of pH_{20min} and pH_{24h} *post-mortem*. New Zealand showed the highest value of pH_{24h} *post mortem* in LD muscle and Chinchilla and New Zealand genotypes showed the highest values of pH_{20min} and pH_{24h} *post mortem* in BF muscle. California genotype had the lowest pH at 20 minutes in LD muscle, and lowest values of pH_{20min} and pH_{24h} in BF muscle.

Sex influenced significantly (P<0.01) only the pH_{20min} in LD muscle, which were highest in males.

The pH values at 15 minutes and 24h *post mortem* are relatively high in comparison with those reported by other authors (OUHAYOUN and DELMAS, 1988; BLASCO and PILES, 1990; PLA *et al*., 1996; TROCINO *et al*., 2003).

Our data are quite similar to those found by MACIAS *et al*. (1998), DAL BOSCO *et al*. (1997, 2000) who also reported high pH_{24h} values, mentioning that factors such as transportation, loading and unloading of animals, population density, handling and fast cooling of the carcass are important variability factors. LÓPEZ *et al*. (2001) assure that high muscle pH values in carcasses may be caused by previous slaughtering handling

Table 1.Least square means adjusted[1] and standard error of pH in *Longissimus dorsi* muscle in New Zealand (NZ), California (CAL), Chinchilla (CHIN) and Synthetic line (SL)

	pH_{20min}	pH_{3h}	pH_{6h}	pH_{24h}
GENOTYPE				
New Zealand	7.2 ± 0.05^{A}	6.5 ± 0.13^{A}	6.1 ± 0.09^{A}	6.3 ± 0.11^{A}
California	6.9 ± 0.05^{AB}	6.4 ± 0.13^{A}	6.3 ± 0.09^{A}	5.8 ± 0.11^{B}
Chinchilla	7.1 ± 0.05^{A}	6.5 ± 0.13^{A}	6.2 ± 0.09^{A}	6.0 ± 0.11^{AB}
Synthetic line	7.1 ± 0.05^{A}	6.6 ± 0.13^{A}	6.1 ± 0.09^{A}	5.9 ± 0.11^{B}
SEX				
Females	7.0 ± 0.03^{A}	6.5 ± 0.09^{A}	6.2 ± 0.06^{A}	6.1 ± 0.07^{A}
Males	7.2 ± 0.03^{B}	6.5 ± 0.09^{A}	6.3 ± 0.06^{A}	6.3 ± 0.07^{A}
GENOTYPE x SEX				
NZ: Females	7.1 ± 0.07^{AB}	6.6 ± 0.17^{A}	6.2 ± 0.13^{A}	6.0 ± 0.15^{B}
Males	7.2 ± 0.07^{A}	6.7 ± 0.17^{A}	6.4 ± 0.13^{A}	6.6 ± 0.15^{A}
CAL: Females	6.9 ± 0.07^{B}	6.5 ± 0.17^{A}	6.2 ± 0.13^{A}	5.8 ± 0.15^{B}
Males	7.0 ± 0.07^{B}	6.6 ± 0.18^{A}	6.3 ± 0.13^{A}	5.9 ± 0.15^{B}
CHIN: Females	7.0 ± 0.07^{B}	6.6 ± 0.17^{A}	6.2 ± 0.13^{A}	5.9 ± 0.15^{B}
Males	7.2 ± 0.07^{A}	6.6 ± 0.18^{A}	6.2 ± 0.13^{A}	6.0 ± 0.15^{B}
SL: Females	7.0 ± 0.07^{B}	6.8 ± 0.18^{A}	6.1 ± 0.14^{A}	5.8 ± 0.16^{B}
Males	7.2 ± 0.07^{A}	6.7 ± 0.17^{A}	6.1 ± 0.13^{A}	5.9 ± 0.15^{B}

[1]Body weight at slaughter of 2149 g

Same letters in a column indicates statistically non different values (DMS, P<0.01)

Table 2. Least square means adjusted[1] and standard error of pH in *Biceps femoris* muscle in New Zealand (NZ), California (CAL), Chinchilla (CHIN) and Synthetic line (SL)

	pH_{20min}	PH_{3h}	pH_{6h}	pH_{24h}
GENOTYPE				
New Zealand	7.3 ± 0.05^{A}	6.7 ± 0.12^{A}	6.3 ± 0.08^{A}	6.2 ± 0.04^{A}
California	7.1 ± 0.05^{B}	6.6 ± 0.12^{A}	6.2 ± 0.08^{A}	5.9 ± 0.04^{B}
Chinchilla	7.3 ± 0.05^{A}	6.6 ± 0.12^{A}	6.3 ± 0.08^{A}	6.1 ± 0.04^{A}
Synthetic line	7.2 ± 0.05^{AB}	6.8 ± 0.13	6.2 ± 0.08^{A}	6.0 ± 0.04^{AB}
SEX				
Females	7.2 ± 0.04^{A}	6.7 ± 0.09^{A}	6.2 ± 0.06^{A}	6.0 ± 0.03^{A}
Males	7.3 ± 0.04^{A}	6.6 ± 0.09^{A}	6.3 ± 0.06^{A}	6.1 ± 0.03^{A}
GENOTYPE x SEX				
NZ: Females	7.2 ± 0.07^{A}	6.6 ± 0.17^{A}	6.3 ± 0.12^{A}	6.1 ± 0.05^{A}
Males	7.4 ± 0.07^{A}	6.7 ± 0.17^{A}	6.4 ± 0.12^{A}	6.2 ± 0.05^{A}
CAL: Females	7.1 ± 0.07^{AB}	6.5 ± 0.17^{A}	6.2 ± 0.12^{A}	5.9 ± 0.05^{B}
Males	7.0 ± 0.07^{B}	6.6 ± 0.18^{A}	6.3 ± 0.12^{A}	6.0 ± 0.05^{B}
CHIN: Females	7.2 ± 0.07^{A}	6.6 ± 0.17^{A}	6.2 ± 0.12^{A}	6.1 ± 0.05^{A}
Males	7.4 ± 0.07^{A}	6.6 ± 0.18^{A}	6.4 ± 0.12^{A}	6.1 ± 0.05^{A}
SL: Females	7.0 ± 0.07^{B}	6.8 ± 0.18^{A}	6.2 ± 0.12^{A}	5.9 ± 0.06^{B}
Males	7.3 ± 0.07^{A}	6.7 ± 0.17^{A}	6.2 ± 0.12^{A}	6.0 ± 0.05^{AB}

[1]Body weight at slaughter of 2149 g

Same letters in a column indicates statistically non different values (DMS, P<0.01)

factors, covering also environment and animal comfort ones, since when animals are exposed to stress situations, plasmatic cortisol concentration increases and consequently gluconeogenesis increase appears. On the other hand, the depletion of glucose reserves determines a high final pH in meat, due to the reduced lactate synthesis.

Descent velocity of pH observed in the 4 genotypes seems to be gradual in the first 6 hours in BF muscle. The BF muscle showed the highest post mortem pH compared to LD muscle, this means a low glicolytic potential in the first one, and as well a differentiated metabolic rate behavior, relating this with its function and fiber type composition.

CONCLUSIONS

The effect of genotype on muscular pH was evident at 24 hours in New Zealand who showed the highest value of pH_{24h} *post mortem* in LD muscle and Chinchilla and New Zealand genotypes showed the highest values pH_{24h} *post mortem* in BF muscle. California genotype had the lowest pH at 20 minutes in LD muscle, and lowest values of pH_{20min} and pH_{24h} in BF muscle.

Studying pH kinetic, New Zealand and Chinchilla showed the lowest pH decrease during 24 h while New Zealand genotype showed the fastest decrease up to 6 h *post mortem* and the slowest at 24 h.

Different results in initial pH between sexes may be further taken in consideration for the subsequent meat storage and processing.

REFERENCES

BLASCO A., OUHAYOUN J., MASOERO G. 1993. Harmonization of criteria terminology in rabbit meat research. *World Rabbit Sci.,* **I**, 3-10.

BLASCO P., PILES M. 1990. Muscular pH of the rabbit. *Ann. Zootech*., **39**:123-136.

DAL BOSCO A., CASTELLINI C., BERNARDINI M. 1997. Effect of transportation and stunning method on some characteristics of rabbit carcasses and meat. *World Rabbit Sci.,* **5(3):**115-119.

DAL BOSCO A., CASTELLINI C., BERNARDINI M. 2000. Productive performance and carcass and meat characteristics of cage-or pen-raised rabbits. *In: Proc. 7th World Rabbit Congress, Valencia, Spain, 4-7 July,* 579-583.

DALLE ZOTTE A. 2002. Perception of rabbit meat quality and major factors influencing the rabbit carcass and meat quality. *Livest. Prod. Sci*., **75**:11-32.

HULOT F., OUHAYOUN J. 1999. Muscular pH and related traits in rabbits: a review. *World Rabbit Sci.,* **7(1**):15-36.

LÓPEZ M., MARTÍNEZ G.,ROS B. 2001. Evaluación del bienestar animal en mataderos y su relación con la calidad de la carne en las especies animales. ITEA., **97(3):** 165-179.

MACÍAS G., RUBIO M., MONTIEL A. 1998. Calidad de la carne de conejos de las razas Chinchilla y Nueva Zelanda con diferentes tratamientos de congelación y maduración. *In. Proc. Primer Congreso de Cunicultura de las Américas. Colegio de Postgraduados. México.10-11 de Septiembre,*12-15

ORTIZ H., RUBIO L. 2001. Effect of breed and sex on rabbits carcass yield and meat quality. *World Rabbit Sci.,* **9(2)**:51-56.

OUHAYOUN J., DELMAS D. 1988. Meat Quality of rabbit. I. Differences between muscle in post mortem pH. *In:Proc. 4th World Rabbit Congress. Budapest 10-14 October,* 412-418.

PLA M., HERNÁNDEZ P., BLASCO A. 1996. Carcass composition and meat characteristics of two rabbit breeds of different degrees of maturity. *Meat Sci.,* **44(1-2)**:85-92.

SAS. 1996. SAS/STAT User's guide. (Release 6.12). SAS Institute Inc., Cary NC. USA.

TROCINO A., XICATO G., QUEAQUE P., SARTORI A. 2003. Effect of transport duration and gender on rabbit carcass and meat quality. *World Rabbit Sci*,. **11(1**): 23-32.