Abanico Veterinario. January-December 2020; 10:1-8. http://dx.doi.org/10.21929/abavet2020.19
Short communication. Received: 02/03/2020. Accepted: 10/07/2020. Published: 28/07/2020. Code:2020-5

Sampling time and age at sacrifice over pH and meat color in hair sheep

Edad de sacrificio y tiempo de muestreo sobre pH y color de la carne de ovinos de pelo

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ABSTRACT

The objective of the present work was to evaluate the age at slaughter, carcass and muscle sampling time on the pH and meat color in lambs and sheep. The 25 sheep, 14 females and 11 males, weighing 41.06 ± 0.064 kg and 28.244 ± 2.435, respectively, were used. The age of the females was 2.32 years, and the males younger than 1 year, of undefined hair phenotypes. They sacrificed themselves by the disgorging method. After evisceration, the first pH reading was taken, as well as the color of the meat, then a sample of the *Femoral* muscle was taken, 24 h later, the second pH and color reading was taken in this muscle. The data obtained was analyzed with a completely randomized block design. The sampling time affected the pH (P <0.01) at zero time was 6,081 ± 0.057 vs 5,264 ± 0.017. For color there was no effect (P> 0.05) of age for, L*, a* and b*. However, the sampling time affected the L * and b * values (P <0.01). Age did not affect the pH and color of the meat, however, the sampling time affected both variables.

Keywords: time-sampling, color, pH.

RESUMEN

El objetivo del presente trabajo fue evaluar la edad al sacrificio, hora de muestreo de la canal y músculo sobre el pH y color de la carne en corderos y ovejas. Se utilizaron 25 ovinos, 14 hembras y 11 machos, con un peso de 41.06±0.064 kg y 28.244±2.435, respectivamente. La edad de las hembras fue de 2.32 años y los machos menores de 1 año, de fenotipos de pelo indefinidos. Se sacrificaron por el método del degüelle. Después de la evisceración se realizó la primera lectura de pH, así como el color de la carne, posteriormente se tomó una muestra del músculo *Femoral*, 24 h después se realizó la segunda lectura del pH y color en este músculo. Los datos obtenidos se analizaron con un diseño de bloques completamente al azar. El tiempo de muestreo afecto el pH (P<0.01) al tiempo cero fue de 6.081±0.057 *vs* 5.264±0.017. Para el color no hubo efecto (P> 0.05) de la edad para, L*, a* y b*. Sin embargo, el tiempo de muestreo afecto los valores de L* y b* (P<0.01). La edad no afecto el pH y el color de la carne, sin embargo, la hora de muestreo afecto ambas variables.

Palabras claves: tiempo de muestreo, color, pH.

INTRODUCTION

The production in Mexico of sheep in 2016 was approximately 118 thousand tons, of which were destined for carcass meat; 60,300 ton. The 95% of the lamb meat in Mexico is in the form of barbecue consumed and only 5% is in another way consumed; which includes the fine cuts. Sheep production only covers 70% of national demand; the remaining 30% is imported from Australia, New Zealand and the USA (SAGARPA, 2017).

The color of the meat is decisive to choose or reject at the time of purchase by consumers. Consumer preferences for a certain aspect of muscle color, pink or red meats, vary depending on the type of consumer, as well as the custom of the local market. The color of the meat is due to the concentration of pigments (myoglobin), its chemical state and the properties of light scattering in the meat (Alberti and Ripoll, 2010; Calnan *et al.*, 2014).

The color of fresh ruminant meat is determined by endogenous and exogenous factors; as well as the complexity of the interactions between them (AMS, 2012; Neethling *et al.,* 2017). Among the endogenous factors are the species, race, age at slaughter and the muscle where the samples are taken. Among the most important exogenous factors is the feeding system (extensive vs. intensive) Rodrigues *et al.* (2011), and stress *ante morten* Neethling *et al. (*2017).
The color of the meat is affected by nutrition, cooling speed of the carcass, muscle, location of the sample within the muscle, pH of the muscle, temperature, post morten storage time, oxygen exposure time and myoglobin concentration (AMS, 2012; Neethling *et al.,* 2017).

Studies carried out by Pascual-Alonso *et al*. (2015), who evaluated the color in suckling lambs and ternasco lambs, slaughtered at a weight of 10.97 ± 0.3 kg and 30 days of age and lambs, slaughtered at a weight of 16 ± 0.72 kg and 60 days of age. Meat color was lighter with less pigments in suckling lambs, with luminosity values (L*) 47.82 ± 0.98 vs 43.6 ± 0.9 and for redness (a*) of 13.91 ± 0.53 vs 15.35 ± 0.53, respectively. Guerrero *et al*. (2013), evaluated the weight and age of ternasco lambs and lambs at slaughter, in relation to the color of the meat, 21.9 vs 26.5 kg and 93 and 133 days, found that the lamb meat is darker.
This leads to the conclusion that in lambs as the slaughter weight increases, the red color is more intense (Marichal *et al.,* 2003; Žgur *et al*., 2003; Calnan *et al.*, 2014). On the other hand, an effect of the lamb and young goat's genotype on the color of the meat has been reported (Rodrigues *et al.,* 2011; Fernandes *et al*., 2013).

Animals fed in extensive systems perform a great physical activity in comparison to animals fed intensive systems. It results that the meat of extensive systems contains a smaller number of contractile fibers, a high oxidative metabolic potential. This increases

the proportion of oxidative red fibers, making the meat appear darker than those raised in intensive systems (Alberti and Ripoll, 2010; Rodrigues *et al.,* 2011; Neethling *et al.,* 2017). The addition of zilpaterol in the sheep diet decreases the redness index (a*) in meat (Partida *et al.,* 2015).

The color of sheep meat in Mexico has been mainly determined in lambs; however, in Chihuahua State there is no information available for adult females, so it is important to generate information in this regard.

Another important physical quality characteristic that affects sheep meat is the pH, because it has been shown to affect shelf life, tenderness and meat color; the ideal value should be between a pH of 5.5 to 5.8 (Taruman, *et al*., 2018). The pH is affected by the breed of sheep (Young *et al*., 1993), effects on the phenotype have also been reported in kids (Rodrigues *et al.,* 2011), but it is not affected by sex (Craigie *et al*., 2012) or by feeding time (Rezende *et al*., 2017).

The pH is affected, by stress *ante morten*. A relationship between the transport time and the number of bruises in lambs has been demonstrated, when measuring the pH in the *Longissimus Thoracis* muscle was from 5.8 to 6.3, and when measured in the leg in the *Semitendinosus* and *Biceps femoris* muscles, it was more stable pH <5.8 (Taruman *et al*., 2018). In Mexico, there is little information on the pH and color of the meat of sheep with hair. In Chihuahua state, the information is even less and there is a lack of information for sheep.
The objective of the present work was to evaluate the age at slaughter, sampling time and sex on the pH and color of meat in hair sheep.

MATERIAL AND METHODS

The work was carried out in the Ruminant Feeding area, of the Department of Veterinary Sciences of the Institute of Biomedical Sciences, of the Autonomous University of Ciudad Juárez, in Chihuahua State, Mexico. The experiment was carried out during the period from September 3 to November 12, 2017; 25 sheep were used, 14 females of an age of 2.32 years, and weighing 41,064 ± 1,744 kg and 11 males less than one year of age, and weighing 28,244 ± 2,435 kg.

The phenotype was undefined, since there were animals in which the Dorper breed predominated, in others Pelibuey, Panza Negra, Rambouillet and the crosses between these breeds; as well as creole sheep. The animals were fed with hay-fed alfalfa and native grasses. The sheep were purchased on the day of slaughter on the farms on the outskirts of Ciudad Juárez, at 6:00 a.m.

Sheep were weighed before slaughter using a Detecto brand digital scale, model CN 20; they were slaughtered at 8:00 in the morning by the disgorging method, based on the official Mexican standard (NOM-033-ZOO-1995), on humane slaughter of animals, after evisceration and skinning of animals. The pH and color of the meat were determined at time 0; then a sample of the *Femoral* muscle was taken, identified, and kept in refrigeration at 2 °C, for 24 h, to perform the second determination of color and pH. The *Femoral* muscle sample was taken, because the pH is more stable, in this muscle (Taruman *et al*., 2018).

The pH of the meat was determined after evisceration (time 0), in the Femoral muscle; a meat penetration potentiometer (Hanna HI 99163) was used, which was calibrated with a 7.0 buffer. After a sample of the *Femoral* muscle was taken, it was refrigerated at 2 ° C. The second reading was at 24 h made, after the sample was taken. Each of the readings was in triplicate done.

For color, a colorimeter (Konica Minolta CR 400) was used, with which the L* clarity was evaluated, the positive values of a* correspond to red and the positive values of b* correspond to yellow (Alberti and Ripoll, 2010). Two *femoral* muscle readings were, at time 0 and at 24 h made. Each of the readings was with three repetitions performed. The data obtained was analyzed with a completely randomized block design, where the independent variables were: reading time (0 and 24 h), age at slaughter (2.32 years and less than 1 year) and sex (females and males); the dependent variables were meat color and pH. It was analyzed for the use of the statistical package SPSS version 25 for Windows, 2017.

RESULTS AND DISCUSSION

The results obtained are presented in Table 1, where the mean value and standard error are shown, for age, sampling time and sex. No effect of age and sex was found on pH and color (P> 0.05); but the sampling time was highly significant (P <0.01), higher values of L* and b * were recorded at 24 h; however, the pH was lower at 24 h *post morten*.

Alberti and Ripoll, (2010) reported values of L* 48.3, for a* 10.3 and b* 11.2, which are completely different from those found in this work. These differences may be due to the feeding system, since animals fattened in pastures tend to produce meat with less light, due to an increase in exercise, which favors an increase in the proportion of oxidative red fibers (Rodríguez *et al*., 2011; Neething *et al.*, 2017). No effect of age was found on meat color, these results differ from those reported by Guerrero *et al*., (2013), who sacrificed lambs at 93 and 133 days. They found that the older the sacrifice, the meat is darker. This difference may be because in the present study the lambs were 1 year old and the sheep of 2.32.

Table 1. Color and pH of meat in hair sheep

	Color			pH
	L	a	b	
Age at slaughter				
2.32 years	36.095±0.477	16.082±0.299	6.853±0.349	5.74±0.075
<1 year	35.323±0.474	15.378±0.294	7.544±0.270	5.629±0.057
	ns	ns	ns	ns
Sampling time				
0 hours	34.279^{a}±0.352	16.23±0.270ns	5.724^{a}±0.250	6.081^{b}±0.057**
24 hours	36.971^{b}±0.352**	15.069±0.310	8.823^{b}±0.243**	5.264^{a}±0.017
	**	ns	**	**
Sex				
Females	35.323±0.474	15.37±0.294	7.54±0.270	5.629±0.057
Males	36.095±0.477	16.02±0.290	6.53±0.394	5.74±0.075
	ns	ns	ns	ns

ns = not significant; ** = (P<0.01)

The effect of the meat color reading hour did have differences (P <0.01). The L* and b* values at the time of slaughter and measured at 24 h later were 34.28 and 36.97; 5.72 and 8.82 respectively; for a* there were no differences (P> 0.05). The difference may be due to the maturing process of the meat; as well as the decrease in pH. (Taruman, *et al*., 2018). Alberti and Ripoll, (2010), recommend that the measurement of the color of the meat should start 24 hours after slaughter.

Sex had no differences (P> 0.05) on meat color, the L* value was 35.32 and 36.07, for females and males; however, Žgur *et al*. (2003) reported L* values of 39.02 and 41.48, for females and males. This difference is attributed to the growth of males, since they grow faster than females.

It is important to mention that in this study, females were older than males, and what was observed by Žgur *et al*. (2003), may not have been demonstrated. On the other hand, Bianchi (2006), found no effect of sex when analyzing the color of lamb meat; the L*, a* and b* values for females and males were 40.4 and 39.8; 17.6 and 17.4 and 10.3 and 10.3. These values differ from those found in the present work, which were 35.32 and 36.06; 15.37 and 16.06; 7.54 and 6.53 respectively for L*, a* and b*. Differences may be due to feeding control; since in the present work it was not controlled; the animals were bought from farms on the outskirts of the city.
Slaughter age did not affect the pH of the meat. These results are similar to those reported by Rezende *et al*. (2017), who reported pH values of 5.7 and 5.5, for lambs slaughtered at 140 and 182 days.

The pH measured at 0 and 24 h was 6,081 and 5,264, which was similar to that reported by Rezende *et al*. (2017), who reported pH values between 6.0 and 5.7. The decrease in pH is due to anaerobic glycolysis in muscle, which increases shelf life and improves the organoleptic characteristics of meat; Craigie *et al*. (2012) reported pH values of 5.58. For

the pH of meat, McGeehin (2001) found no effect of sex on this variable, the pH measured at 24 h *post morten*, for females and males, was 5.69 and 5.62. These values are very similar to those reported in this work, which were 5.63 and 5.74 for females and males. Bianchi, 2006 reported values of 5.6 and 5.7 for females and males. The following authors reported similar values (Fernandes *et al*., 2013; Marichal *et al.,* 2003; Žgur *et al*., 2003).

CONCLUSION

No effect of age or sex was on the color and pH of the meat found; however, the sampling time did affect the previous variables.

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