# Effects of Origin on Carcass and Meat Characteristics of Donkey

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## ABSTRACT

The aim of this study was to evaluate the effect of origin on carcass characteristics, non-carcass components, and meat and fat color of donkeys (Equus africanus asinus). A total of 189 animals were used, with different origin (United States of America and Mexico). The donkeys from the USA had greater ($P<0.05$) carcass weight, carcass dressing and pH of the longissimus muscle, compared to Mexican ones, but similar ($P> 0.05$) cooling loss, non-carcass components and color of muscle and fat.

## INTRODUCTION

Donkeys (Equus africanus asinus) belong to the Equidae family, and were domesticated around 4,000 BC. They work as pack animals and saddle mounts in arid climates (Aganga et al., 2003), but also provide milk (Monti et al., 2006) and meat for human consumption (Lorenzo et al., 2014). Global consumption of equine meat is mainly concentrated in some European countries such as Italy, France, and Belgium, as part of their traditional food (Stanciu, 2015). According to the FAO data, Mexico is the largest producer and exporter of equine meat (from donkeys or horses) in the American continent and participates with 11% of total world production (FAO, 2017). It is difficult to estimate with precision the consumption per capita (Gill, 2005), but it was calculated in approximately 0.10 kg by Belaunzaran et al. (2015).

Most of donkey meat comes from animals that have finished their productive life (Lorenzo and Carballo, 2015). Despite Mexico is the second largest exporter of equine meat to Europe and Asia, to date there are no scientific reports about origin on carcass composition and meat characteristics affecting this industry. Thus, the aim of this study was to evaluate and compare the effect of origin on carcass characteristics, non-carcass components, and color of muscle and fat of donkeys, from the USA and Mexico.

***Table 1.*** *Least square means for carcass characteristics, non-carcass components1 and color (L*, a*, b*)2 of the semitendinosus muscle, subcutaneous and abdominal fat in donkeys according to their origin*

| | Origin | | |
|---|---|---|---|
| Item | Mexico | U.S.A. | SEM |
| Carcass characteristics | | | |
| Hot carcass weight, kg | 63.6[b] | 86.6[a] | 19.4 |
| 24 h cold carcass weight, kg | 61.2[b] | 83.5[a] | 19.4 |
| 24 h cooling loss, % | 4.1 | 3.9 | 1.9 |
| Hot carcass dressing, % | 44.5[b] | 51.4[a] | 3.7 |
| Cold carcass dressing, % | 42.7[b] | 49.5[a] | 3.7 |
| 45 min postmortem pH | 6.2[b] | 7.1[a] | 0.4 |
| Non-carcass components, % | | | |
| Head | 5.4 | 5.1 | 1.2 |
| Skin | 8.0 | 8.4 | 1.3 |
| Small intestine | 1.5 | 1.6 | 0.7 |
| Large intestine | 0.7 | 0.6 | 0.3 |
| Caecum | 0.7 | 0.6 | 0.2 |
| Spleen | 0.2 | 0.4 | 0.2 |
| Heart | 0.6 | 0.7 | 0.3 |
| Lungs | 1.1 | 1.2 | 0.7 |
| Liver | 3.1 | 4.1 | 0.8 |
| Color | | | |
| *Semitendinosus* muscle | | | |
| *L** | 35.5 | 36.0 | 1.2 |
| *a** | 17.1 | 17.2 | 1.2 |
| *b** | 4.3 | 5.1 | 0.3 |
| Abdominal fat | | | |
| *L** | 78.5 | 77.6 | 0.7 |
| *a** | 2.8 | 2.8 | 0.1 |
| *b** | 14.9 | 14.0 | 1.1 |
| Subcutaneous fat | | | |
| *L** | 64.3 | 65.0 | 0.9 |
| *a** | 10.8 | 11.2 | 0.8 |
| *b** | 22.6 | 22.0 | 1.8 |

*[ab] Different superscript letters in a row are different (P<0.05).*
*[1] Non-carcass components are expressed as percentage of empty BW.*
*[2] Color scale: L* = lightness (0 = black, 100 = white); a* = red to green (positive values = red, negative values = green); b* = yellow to blue (positive values = yellow, negative values = blue).*

## MATERIALS AND METHODS

The study was carried out at the meat packing plant "Empacadora de Carnes Fresnillo S.A. de C.V.", Federal Inspection Type plant E42, located in the State of Zacatecas, Mexico. One hundred and eighty-nine donkeys were slaughtered from April to June 2014, being 119 from the USA (72 females and 47 males) and 70 from Mexican origin (47 females and 23 males). Animals were classified according to their country of origin (Mexico or USA). The animals were slaughtered in accordance with the provisions of the Official Mexican Standard of methods for killing domestic and wild animals (NOM-033-SAG/ZOO-2014).

After slaughter, hot carcass weight was registered and the head, legs, and skin were removed and weighed individually using an electronic scale (EQB 100/200, Torrey, Mexico). The gastrointestinal content was weighed and subtracted to SW to obtain the empty BW. The carcasses were chilled for 24 h at 2 °C and 98% of relative humidity, and then were weighed to obtain the cold carcass weight. Hot carcass dressing ([hot carcass

weight/empty BW] × 100), cold carcass dressing ([cold carcass weight/empty BW] × 100), and cooling loss (hot carcass weight - cold carcass weight/hot carcass weight) were calculated.

The non-carcass components (head, skin, stomach, small intestine, large intestine, and cecum, heart, lungs, liver and spleen) were weighed from each animal separately using an electronic scale (EQB 100/200, Torrey, México), and yields of these organs were calculated from empty BW. The pH was measured in the longissimus thoracis muscle at 45 min post-mortem using a pH meter equipped with a penetration electrode and thermometer (Hanna Instruments, HI-9025, Woonsocket, RI). The semitendinosus muscle and fat (subcutaneous and abdominal) color (L*, a*, b*) were measured directly on the carcass at 45 min post-mortem using a portable spectrophotometer (CR-400, Konica Minolta Sensing Inc., Japan).

Data were analyzed as a completely randomized design, considering the fixed effect of origin. Analysis of variance was performed using the PROC GLM procedure of SAS version University Edition (SAS Inst. Inc., Cary, NC). When significant effects for the variables evaluated were observed, a comparison of means was performed using the Tukey method with the LSMEANS instruction. The differences were considered significant when $P<0.05$.

**Results and Discussion**

Donkeys from USA had greater ($P<0.05$) carcass weight, carcass dressing and pH of the longissimus muscle, compared to Mexican ones (Table 1). However, cooling loss, the non-carcass components and the color of muscle and fat were similar ($P> 0.05$) between donkeys from USA or Mexican origin (Table 1).

Aganga et al. (2003) reported that African donkeys had greater hot carcass dressing (59%) and cold carcass dressing (51%) than those observed in this study (lower than 50%). Moreover, Sarriés and Beriain (2006), Franco et al. (2011) and Nivia et al. (2014) mentioned a range from 50 to 70% for hot carcass dressing of horses. It can be expected that carcass yields of horses will be greater because there are specialized breeds in meat production unlike donkeys. Cooling loss might be influenced by either the stress, the transport, or the slaughter process (Rosenvold and Andersen, 2003; Andres et al., 2007).

It has also been reported an effect of the production system and the time of year on cooling loss of cattle, in very broad parameters ranging from 5.6, to 10.1 depending on the production system where the animals came (Rodríguez et al., 2013). Meanwhile, Mamani-Linares and Gallo (2011) reported values for cooling loss of 1.37% in Llamas, 2.44% in cattle and 2.50% in horses. Similarly, Furtado et al. (2010) observed cooling loss ranging from 2 to 2.5% in equine meat, which are lower than those observed in the present study. Based on the previous research data and on the results obtained in this study, it can be considered that donkey meat has high values of cooling loss when compared to meat from other farm species.

The pH is an important measurement related to meat quality (Reis and Rosenvold, 2014). The pH values of the longissimus muscle obtained in this study were similar to those reported for other red meats, including equine (Juarez et al., 2009; Polidori et al., 2015). However, the pH differences between carcasses from USA and Mexican donkeys, could be explained by the stressful effect of the transport prior to slaughter (Amtmann et al., 2006), because the ante-mortem stress level reduces the muscle glycogen stores and then impact on the amount of lactic acid produced in the post-mortem period (Amtmann et al., 2006), which is essential to reach an optimum pH value in the carcass (Warris, 2000). The donkeys from the USA used in this study were transported for 12 to 14 hours from the USA border to the slaughter plant in Mexico. Additionally, to transportation, climatic factors and waiting times before slaughter represent other stressors that affect the pH in muscle and, therefore,

the carcass quality (Gallo et al., 2003).

The meat color reported in this study is consistent with those observed by Sarries and Beriain (2006) whom did not observe interactions between systems of rearing and meat color. However, it was observed an effect of the production system on the color of cattle meat, being generally darker in animals grazing compared with those on feedlot (Yang et al., 2002).

## CONCLUSION

The donkeys from USA resulted with greater carcass weight and dressing compared to Mexican donkeys, although the latter may be due to a handling problem and can be improved.

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