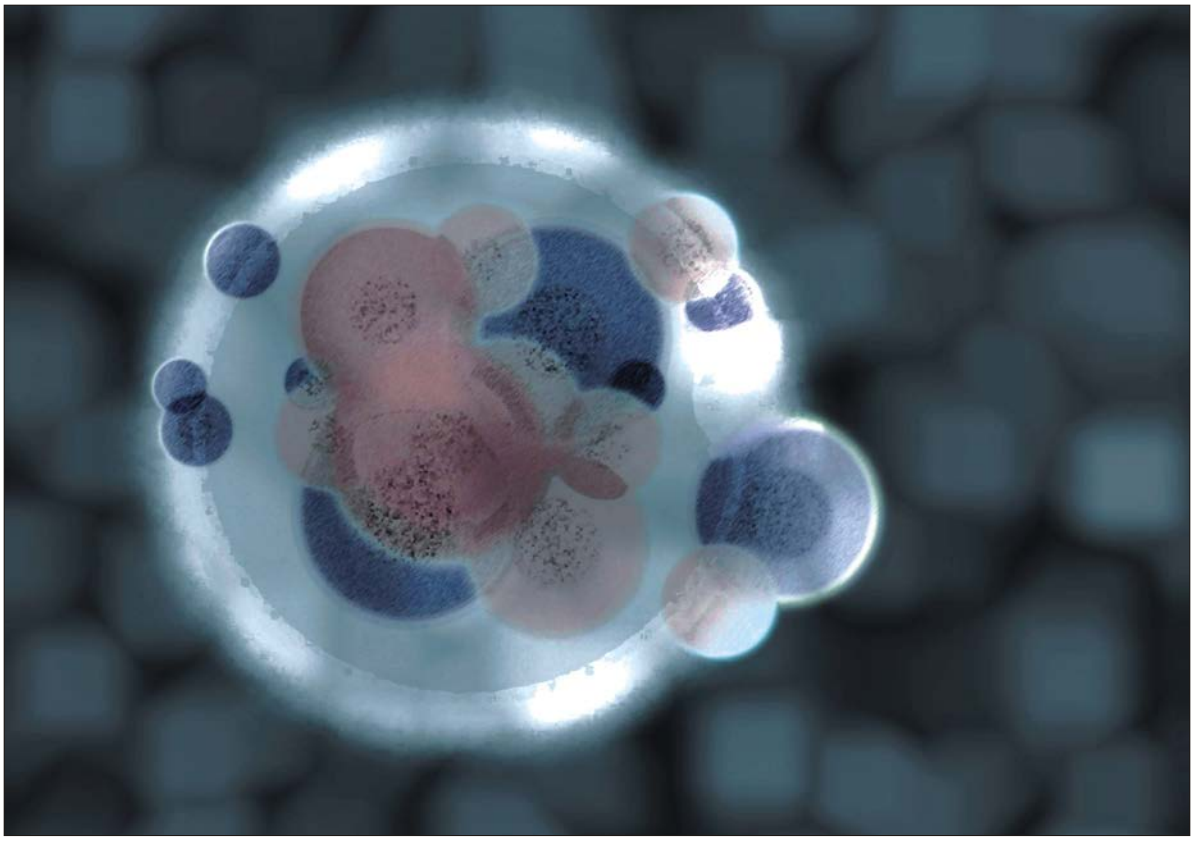

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Equine Carcasses: Nutritional Analysis, Shrinkage and Cutting Performance

[1]M. Becerril-Herrera, [2]M. Zermeño, [2]D. Mota-Rojas, [2]G.H. González, [3]C. Casas-García,
[3]J. Toca-Ramírez, [2]R. Ramírez-Necoechea, J.A. Toca-Ramírez, [4]C. Lemus-Flores and [2]M. Alonso-Spilsbury
[1]EIAH-Benemérita Universidad Autónoma de Puebla, Domicilio conocido,
San Juan Acateno. Municipio Teziutlán, Puebla. México.
[2]Departmento de Producción Agrícola y Animal, Universidad Autónoma Metropolitana-Xochimilco,
Calzada del Hueso 1100, Col. Villa Quietud, México D.F., C.P. 04960. México
[3]Facultad de Medicina Veterinaria y Zootecnia. Universidad Juárez del Estado de Durango
Carretera Durango-Mezquital Km. 11.5. México
[4]Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma de Nayarit,
Cd. de la Cultura Amado Nervo. Nayarit. 63190, Mexico

Abstract: Ten equine carcasses from creole horses were used, distributed by sex: 5 females and 5 males. Animals were identified with a mark in their posterior limbs using indelible ink in order to follow the carcass up to the butchery. Each cut was weighed in order to characterize the shrinkage percentage and carcass yield. Samples of the *Longissimus dorsi* muscle at the level of the tenth rib were taken at the butchery in order to carry out a proximal chemical analysis. The average percentage of protein was 18.6, which turned out to be 7.5% lower than the one reported by others authors. In adult animals gaskins, shoulder blades, ribs and flanks (spare meat for fillets) corresponded to 30.0, 21.3, 31.2 and 16.5%, respectively, of the total carcass. In young animals gaskins represented 29.5%, shoulder blades 19.6%, ribs 31.3% and flanks, 12.5% of the total carcass. We conclude that horse meat can be an excellent alternative for consumption for its high content in proteins and low levels of fat. It is also worth mentioning the higher losses for shrinkage due to the high content of humidity as well as the characterization of the yield at cutting.

Key words: Equine carcass, cutting performance, shrinkage losses

INTRODUCTION

In Mexico, equine use for meat production is not commonly found; the highest percentage of equine meat that can be possibly consumed comes mostly from culled animals (injured and old donkeys and horses mostly), from different towns, circuses or auctions and is destined to feed dogs or carnivorous animals at zoos (Gonzaléz *et al*., 2006). Historically horses have been of great importance for men; formerly this animal was one of the few means of transport and cargo and was used also as an important source during combat. At present, the consumption of horse meat has dramatically decreased due to a major commercial consumption of meat from other domestic species such as pork, beef and chicken. Furthermore, to raise horses for slaughter is not a profitable business for cattleman since it is much more expensive to produce horse meat rather than bovine, swine or ovine meats, also because these species show faster growth and better weight gains than horses (Sanz, 1948; Abadia and Fúnez, 1997).

Approximately 87,200 horses were processed for human consumption at US slaughter facilities in 1997 and the resultant meat products were marketed for export. Horses tend to travel longer distances to slaughter than other livestock, because there is a limited number of equine slaughterhouses (Stull, 1999).

Nowadays, most of the horse meat consumed in Mexico comes from injured, sick and old donkeys, or horses from different towns, circuses or auctions, mostly. The transportation method and handling before slaughtering is the main cause of injuries, stress and bites of these animals that are destined for provisioning (Grandin *et al*., 1999; Reece *et al*., 2000). Furthermore, in Mexico equine use for meat production is not commonly found as in some European countries like France, for example, since this specie would be in disadvantage with other domestic ruminants for two very important reasons:

Corresponding Author: Dr. Daniel Mota Rojas,. Departamento de Producción Agrícola y Animal, Universidad Autónoma Metropolitana-Xochimilco. México D. F., C.P 04960. México Tel/FAx: (525) 55 54837535

first, Mexicans consider horses as pets, companion and sporting performance animals; therefore, the habit to consume horse meat is not widely accepted; and second, this species have a feed conversion of 10-11 kg of high quality food, to gain 1 kg of live weight, whereas bovines need 7 kg of food to produce 1 kg of live weight, consequently this activity is not economically profitable (Abadía and Fúnez, 1997; Domínguez, 1995). For this reason, horses slaughtered in Mexico for meat production arrive to the abattoir as culled animals, when they have finished their productive life in diverse activities.

The purpose of this study was to know the nutritional analysis and test the effect of gender on carcass yield cutting, shrinkage losses and fat content in creole (serrano) horses meat.

MATERIALS AND METHODS

The study was carried out at an equine slaughterhouse, located in the State of Mexico, during October and November 2004. Ten equine carcasses from creole horses (Fig. 1) were used, distributed by sex: 5 females and 5 males (Table 1).

Animals were evaluated as follows:

- Slaughter weight was determined in 10 equine carcasses, which came from different places and had similar weights.
- Animals were identified with a mark in their posterior limbs using indelible ink in order to follow the carcass up to the butchery. Carcasses are shown in Fig. 2.

Table 1: Group distribution

Group 1	Group 2
4 adult females	3 adult males
1 yearling filly	2 foals

Fig. 1: Creole horses used in this study

- The typical cutting was observed at the butcher shop, where four primary cuts were obtained as follows:

a) Rib: consisted on the spine length, with ribs stick and no abdominal and *Longissimus dorsi* muscles.
b) Gaskin: a perpendicular cut was done on the 4th and 5th sacral vertebras as shown in Fig. 3.
c) Shoulder blade: ripping the natural conjunctive tissue located below the scapula.
d) Flank (meat for fillets): included the abdominal muscles (*serratus* and interior and exterior *obliques*), *Longissimus dorsi* and diaphragm.

Fig. 2: Creole horses carcasses. Compared to bovine carcasses color, these are darker

Fig. 3: Gaskins from creole horses (30% of the carcass weight)

Each cut was weighed in order to characterize the shrinkage percentage and carcass yield.

- Samples of the *Longissimus dorsi* muscle at the level of the tenth rib were taken at the butchery in order to carry out a proximal chemical analysis. Humidity, protein, fat and ashes were determined according to Flores (1981) method.

Statistical analysis: The Proc Univariate command of the SAS program was used to obtain a descriptive analysis for all measured variables. Variable results at cutting were analyzed at random with a co-variable (hot carcass yield) using the following mathematical model:

$$Y_{ij} = \mu + \iota_i + \beta(\times_{ij} - \bar{x}) + \xi_{ij}$$

I = Groups 1, 2 j = 1, 2, 3....Repetitions

Where:

Y_{ij} = Variable result
μ = General mean
ι_i = Effect of the group (sex)
β = Regressive coefficient
$\times_{ij}$ = Independent variable or covariable (hot carcass weight)
$\bar{x}$ = General mean of the covariable
ξ_{ij} = Random error

The Tukey test was used ($p<0.05$) to determine significant differences between group means.

RESULTS

The results obtained in the proximal chemical analysis in Table 2 shown that . The average percentage of protein was 18.6%. With regard to fat percentage, higher values were obtained.

Table 3 shows the descriptive statistics for the measured variables during cutting in adult animals. Two different hot carcass weights were obtained, the first one (HCW) is equivalent to the average weight of the half carcass and the second (THCW) is similar to the weight of the complete carcass. Gaskins, shoulder blades, ribs and flanks (spare meat for fillets) corresponded to 30.0, 21.3, 31.2 and 16.5%, respectively, of the total carcass. The water loss percentage due to shrinkage was 6.4%, which is equivalent to 5.32 kg. With regard to the variation coefficients, the highest deviation corresponded to shrinkage losses, due to the use of males and females in this study; females presented higher water retention as a consequence of a major fat tissue deposition. The remaining variation coefficients are classified as moderate.

In order to decrease the variation coefficients in the variables at cutting, animals were splitted in two groups according to their age. Table 4 shows the descriptive statistics for the variables at cutting in young animals (foals). In these animals gaskins represented 29.5%, shoulder blades 19.6%, ribs 31.3% and flanks, 12.5%, of the total carcass. In young animals shrinkage losses were 6.7%.

Table 2: Proximal chemical analysis results

Sample	Dry matter (%)	Ashes (%)	Protein (%)	Fat (%)
1	27.61	1.124	18.700	7.322
2	28.51	0.902	20.024	6.374
3	23.82	1.012	18.846	1.663
4	27.38	1.016	17.840	5.568
5	24.77	1.091	18.850	5.079
6	28.26	0.920	18.287	7.599
7	26.57	1.006	18.070	2.484

Table 3: Descriptive statistics for the cutting variables in adult horses (kg)

Statistic	HCW	HCTW	GW	SBW	RW	Flank	MTTW	Shrinkage	Shrinkage % loss
Median	84.85	169.71	26.00	18.14	26.57	14.00	79.53	5.32	6.42
Mode	81.00	138.00	23.00	14.00	26.00	7.00	77.00	4.00	5.00
Standard deviation	17.95	35.45	5.65	5.00	6.04	2.16	17.13	1.56	2.10
Minimum	66.00	138.00	21.00	13.00	18.00	5.00	58.00	4.00	4.90
Maximum	130.00	240.00	40.00	30.00	41.00	13.00	122.00	8.00	13.10
Number	14.00	7.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
Variance coefficient	21.15	20.88	21.75	27.58	14.00	24.51	21.54	29.39	32.75

HCW: Hot Carcass Mean % Weight; HCTW: Hot Carcass Total Weight; GW: Gaskin Weight; SBW: Shoulder Blade Weight; RW: Rib Weight; MTTW: Meat Trimmings Total Weight

Table 4: Descriptive statistics for the cutting variables in young horses (kg)

Statistic	HCW	HCTW	GW	SBW	RW	Flank	MTTW	Shrinkage	Shrinkage % loss
Median	54.16	108.33	16.00	10.66	17.00	6.83	50.50	3.66	6.70
Mode	46.00	96.00	15.00	10.00	13.00	5.00	48.00	2.00	4.00
Standard deviation	8.95	18.00	0.89	1.21	3.63	3.31	8.04	1.63	2.63
Minimum	46.00	96.00	15.00	9.00	13.00	4.00	43.00	2.00	4.00
Maximum	70.00	129.00	17.00	12.00	23.00	12.00	64.00	6.00	10.50
Number	6.00	3.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Variance coefficient	16.52	16.62	5.59	11.35	21.37	48.46	15.92	44.53	39.29

HCW: Hot Carcass Mean % Weight; HCTW: Hot Carcass Total Weight; GW: Gaskin Weight; SBW: Shoulder Blade Weight; RW: Rib Weight; MTTW: Meat Trimmings Total Weight

Table 5: Median and standard error (SE) of the mean, adjusted to the covariable of the cutting variables by sex effect

Variables	Treatment 1 (Females) n = 5	Treatment 2 (Males) n = 5
Total hot carcass weight (kg)	150.78 ±1.70	51.81±1.70
Gaskin weight (kg)	22.32 ±0.56	23.67±0.56
Shoulder blade weight (kg)	15.78±0.44	16.01±0.44
Rib weight (kg)	23.78 ±0.78	23.61 ±0.78
Flank weight (kg)	9.04 ±0.65	7.40 ±0.65
Trimming weight (kg)	70.94±0.45	70.70 ±0.45
Shrinkage (kg)	4.70±0.45	4.94 ±0.45
Shrinkage % loss	6.21±0.76	6.80±0.76

Not significant differences were found

The higher variation coefficients were obtained in flanks, shrinkage losses and shrinkage losses percentages as a consequence of a major content of lean tissue compared with that from bone and fat tissues. The remaining variation coefficients are classified as light to moderate. With the purpose of comparing the effect of gender at cutting, an analysis of the measured variables was carried out during this process. A covariable, hot carcass weight was included at random, since it is an uneven (not uniform) variable because the animals were of different ages and therefore of different weight.

Table 5 includes the mean and the standard error of the mean, corrected by the covariable hot carcass weight of the different variables during the cutting process. Lower values were found in females, except for flank weight. In case these data does not fit the covariable hot carcass weight, significant differences would be observed between genders and females would present the highest value.

DISCUSSION

The average percentage of protein was 18.6, which turned out to be 7.5% lower than the one reported by Buxadé (1996) and 15.9% according to Magras *et al.* (1997). The explanation to these differences reflects the productive system used for horses in Mexico. In European countries advanced confined technological production systems are used and the animals feed is highly specialized, taking into account the productive stage of the animal. Moreover, it is important to point out that handling programs as castration, increase the weight gain as well as the meat tenderness (Buxadé, 1996).

With regard to fat percentage, higher values were obtained compared to those reported by Magras *et al.* (1997) and lower to those described by Buxadé (1996). This is certainly due to the influence of intrinsic factors as genetics and extrinsic factors as the production system. In Mexico slaughtered horses do not have a defined genetic line and they are maintained under extensive conditions. No differences were found in ashes and humidity percentages compared to the values obtained by the above-mentioned studies.

Magras *et al.* (1997), observed that protein content in bovine meat is 17 to 22%, (an average of 18%), which is less than the one obtained in equine meat (22%); however, the protein value of equine meat determined in this study was 18.65%, which is inferior to the values reported by several authors (López, 1970; Buxadé, 1996). This is explained by the fact that genetics in these horses was not well defined and their diet was not based in a nutritious regime, since they were not meant for production and they were culled animals.

Regarding the percentage of humidity content in the horse meat, this was higher compared with those from other species (70.9%), 3% more than the one reported by Abadía and Fúnez (1997). For this reason shrinkage losses are higher, although meat quality did not affect significantly its characteristics.

The nutritional value of horse meat is not inferior than that from other species. With regard to lipids, equine meat has less content compared to other domestic species; according to Abadía and Fúnez (1997), it contains 9%, whereas in the present study 5.1% of fat was determined, therefore more lean meat was obtained.

Abadía and Fúnez (1997), found that females showed better yield, which was closely related to the adipose tissue weight rather than to muscles weight; however, in general they appreciated a better development in females that in males, this information agrees with the data obtained in the present study. On the other hand, Rosset (1983), found that neck muscles are less developed in females that in males and on the contrary, abdominal, thigh or leg muscles are more developed in females. If the values that were not corrected by the covariable hot carcass weight were considered, significant differences ($p<0.05$) could be found at cutting, both in males and females, the latter registered the highest weights in the different primary cuts.

Abadía and Fúnez (1997), reported in horses' gaskins an average weight of 300 kg of live weight, which represented 39% of the total hot carcass weight. The values obtained in the present study were 9.5% lower. This can be due to the animals' carcass weight which was low because the phenotype characteristic of this breed is not for meat production.

As for carcass yield Abadía and Fúnez (1997), found that live weight and carcass weight were directly proportional; the higher value for live weight, the higher values were also determined in carcass weights and vice versa. However, in the present study these values did not follow the same pattern; the lower live weight was obtained, the better yields were determined. The reason

for this is that younger animals show less proportional live weight, their digestive system is less developed than that of adult animals that also have higher live weight. The mature animals had a percentage in similar hot carcass to the foals and these ones showed a higher loss to the cutting due to shrinkage as consequence of low fatty tissues.

We conclude that due to its high content in proteins and low levels of fat, horse meat can be an excellent alternative for consumption. Worth mentioning are also, the higher losses for shrinkage due to the high content of humidity as well as the characterization of the yield at cutting.

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