

## Research Note

# Carcass fabrication: non-domesticated neotropical mammals vs. selected domesticated livestock

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This study compared the various meat cuts and fabricated parts of selected domesticated and non-domesticated neotropical mammals. The domesticated animals utilized were eight chicken (*Gallus domesticus*) and eight rabbits (*Oryctolagus cuniculus*), whilst the non-domesticated species were eight agoutis (*Dasyprocta leporina*) and three manicoes (*Didelphis marsupialis insularis*). The carcasses were processed in two ways; four carcasses were singed and the other four carcasses were processed by removing the skin with a knife. The manicoes' carcasses were only singed. They were captured by hunters in comparison to the chickens, rabbits and agoutis which were reared in captivity. The agoutis were fed local crops and vegetables and were supplemented with commercial ration (Mastermix<sup>®</sup>). However, for the chickens and the rabbits, the majority of their diets consisted of commercial ration (Mastermix<sup>®</sup>). The chickens and rabbits had the greater live weights in comparison to the agoutis. The chickens had the highest live weight ( $3725 \pm 167$  g), the agoutis had the lowest live weight ( $2614 \pm 354$  g) and the rabbits had a live weight of  $2691 \pm 283$  g, between that obtained from the chickens and agoutis. The agoutis and manicoes also had less hot carcass weights in comparison to the chickens and rabbits. There were no live weights recorded for manicoes, due to the fact that the manicoes were collected by hunters in the forests. The hunters only recorded the carcass weights after the animals were eviscerated. The manicoes and the agoutis produced less carcass weight and meat in comparison to the domesticated species, but were considered more sustainable because they can be fed crop and agricultural by-products, which are not fit for human consumption, and convert them into animal protein for human consumption. Further work must be done on the non-domesticated species to attain the growth rates and the most economical time period for market.

**Keywords:** Agouti (*Dasyprocta leporine*), rabbit (*Oryctolagus cuniculus*), manicoe (*Didelphis marsupialis insularis*), chicken (*Gallus domesticus*), integrated production

In a resource-depleting world non-conventional sources of animal protein for human consumption are becoming more popular. One such non-conventional protein source is 'bush meat' or 'wild meat' of neotropical origin. In the neotropics there are non-domesticated animals which are reared in captivity for meat consumption. These animals include the agouti (*Dasyprocta leporina*), lappe (*Agouti paca*), manicoe (*Didelphis marsupialis insularis*), red brocket deer (*Mazama americana*), capybara (*Hydrochoerus hydrochaeris*) and collared peccary (*Tayassu tajacu*) (Brown-Uddenberg et al. 2004; Nogueira and Nogueira-Filho 2011; Saadoun et al. 2014). These wild meat species are extremely important in neotropical

regions as a source of protein and to provide some economic relief.

Wild meat consumption and trade have been influenced by a number of factors. In some instances, the introduction of roads and increased transport into areas that were inaccessible have increased the consumption and trade of wild meat species (Suarez et al. 2009). In neotropical regions, such as the Guyana Amazon, church affiliations have placed taboos on specific meat of neotropical origin. In these cases, the followers have decreased consumption of the forbidden meats and thus a decrease in the hunting of these species occurred, which aids in conservation efforts (Luzar et al. 2012). Some authors have found that decreasing the price of alternative

domestic meat sources has caused a decrease in the consumption of wild meat (Apaza et al. 2002), but other authors were in disagreement showing that the increased price of domesticated meat did not cause a decrease in wild meat consumption (Chaves et al. 2018). That study stated that domesticated meat was not considered a substitute, as most local persons desired the taste of wild meat instead of domestic meat.

In the Guyana Amazon, wild meat serves as an irreplaceable source of income as well as food. It has been projected that if the quantity of wild meat consumed by local people, was converted into the equivalent quantity of beef cattle consumed, a large proportion of forest lands would have to be converted into agricultural lands, which would have a devastating impact on the neotropical flora and fauna. In addition, the native people would have to use most of their income to purchase meat required to maintain adequate nutritional levels for their families (Nunes et al. 2019b). Wild meat also plays an important social role in rural villages in the neotropics, as some of the wild animals that are captured, are given as gifts to neighbours. This act of wild meat sharing also decreases food insecurity in these villages (Nunes et al. 2019a).

In rural areas, wild meat consumption is driven by the ease of access and the relatively cheap cost in comparison to domesticated meat (Chaves et al. 2019; El Bizri et al. 2020a). In some cases, wild meat consumption is driven by preference, yield and perceived health benefits (Chaves et al. 2019). It was found that occupation also affects wild meat consumption, with farmers and fishers consuming more wild meat. However, as wealth increased, the consumption of wild meat and domesticated meat increased by 25% and 60% respectively (Chaves et al. 2019). Chaves et al. (2017) showed that an increase in market access to rural communities led to an increase in domestic meat consumption and a decrease in wild meat consumption. This shows that market access can play an important role in conservation of hunted wild meat mammals. Recently, Chaves et al. (2020)

showed that rural to urban migration and generational change in meat preference led to a decrease in wild meat consumption and an increase in domestic meat consumption. In contrast, some researchers found that in urban areas wild meat consumption is highly prevalent causing hunters to remove animals from the forest for commerce. This has led to the illegal trade of wild meat for commercial value and not for subsistence (Chaves et al. 2010; Estrada-Cely et al. 2014; El Bizri et al. 2020b).

Wild meat trade in the neotropics is driven by price, with mammals being traded from US\$1.58-\$11.80/kg (Suarez et al. 2009; Chaves et al. 2010; Chaves et al. 2019; van Vleit et al. 2017; El Bizri et al. 2020a, 2020b). In rural areas, wild meat is sold relatively cheap but the price can be doubled when it is sold in urban markets (Suarez et al. 2009). Wild meat is also hunted for luxurious restaurants serving tourists, and for illegal export to other neotropical locations which attract high prices (von Halle 2002).

Wild meat has high consumption and trade within the neotropics, but there is a dearth of information on the fabricated parts of the carcass of wild neotropical mammals. Some work has been documented on the capybara, collared peccary and lappe. To the authors' knowledge there has not been any documented information in the literature on the fabricated parts of agouti and manicou. Therefore, the objective of this research was to investigate the fabricated carcass of two non-domestic neotropical mammals; the agouti and the manicou and compare it to two domesticated animals; the chicken and rabbit.

## **Materials and methods**

### *Ethical approval*

All applicable international, national, and/or institutional guidelines for the care and use of animals were followed. The research site was overseen by veterinarians to ensure that animals were kept healthy. Field and laboratory protocols were approved by the

Ethics Committee of The University of the West Indies, Faculty of Food and Agriculture, The University of the West Indies, St. Augustine campus (ref no. CEC546/03/20).

### *Sources of animals*

#### *Agouti (Dasyprocta leporina)*

Eight male agoutis, approximately 12 months of age, were obtained from the Wildlife Unit at The University of the West Indies Field Station. This unit is located in Valsayn, Trinidad, West Indies. Agoutis used in this experiment were born in captivity and reared in cages or on concrete floors. These animals were clinically healthy and their diet consisted of fresh fruits such as bananas (*Musa* spp.), pawpaw (*Carica papaya*) and guava (*Psidium guajava*); vegetables such as cassava (*Manihot esculenta*); forages (*Trichanthera gigantea*) and commercial rabbit ration (Mastermix<sup>®</sup>) which contains approximately 17% crude protein (CP). Agoutis were given water *ad libitum*.

#### *Rabbit (Oryctolagus cuniculus)*

Eight male rabbits, approximately 3 months old, were obtained from the rabbitry at the Sugarcane Feed Centre, Longdenville, Trinidad, West Indies. All animals had been reared intensively and fed a diet that consisted of forages (*Trichanthera gigantea*) and Mastermix<sup>®</sup> rabbit ration (17% CP). The rabbits had access to water *ad libitum*.

#### *Chicken (Gallus domesticus)*

Eight commercially grown broiler chickens, approximately 6 weeks old, were obtained from the Corinth Campus of the University of Trinidad and Tobago, Trinidad, West Indies. Broilers had been reared on broiler starter ration (Mastermix<sup>®</sup>) for 2 weeks and broiler grower ration (Mastermix<sup>®</sup>) for 4 weeks. Chickens had access to water *ad libitum* throughout the entire grow-out period.

#### *Manicou (Didelphis marsupialis insularis)*

Three manicous were caught by hunters in the Northern Range of Trinidad and Tobago. The manicous' hot carcass weights were recorded, but not the sex of the animals. The diets of these animals could not be determined because they lived in the wild. The hunters removed the entire viscera from the carcasses to avoid spoilage and the carcasses were stored at 4 °C.

### *Animal processing*

All animals were slaughtered humanely through cervical dislocation. Once cervical dislocation was done or the animals were shot (as in the case of the manicous), animals were bled via the jugular vein. The carcasses were then divided into two random groups to be processed with skin and hair/feathers intact (to be singed) or the skin and feathers were removed. In the case of the manicous, the three carcasses were processed with skin and hair intact (singed).

Four animals of each group (agouti, rabbit, chicken), which had their skin and hair/feathers intact before processing were singed with a blow torch. The remaining four animals from each group had the skin and feathers removed with a knife. Carcasses were then eviscerated and the weight of the organs was recorded. The hot carcass weights were recorded by the researchers, once the manicous were obtained from the hunters. Subsequent to the removal of the thoracic and abdominal viscera, the head and feet were removed and then weighed. Commercial cuts of all animals (agouti, chicken, rabbit, manicou) were then made and the respective weights taken for comparison among the different species (agouti, chicken, rabbit, manicou). With the exception of the manicous, the other animals were fasted and live weights were taken prior to slaughtering.

### Statistical analysis

The weights obtained from the animals were analyzed using Microsoft Excel®. The means and standard deviations were obtained for each treatment.

## Results

The fabricated parts of the agouti (*D. leporina*), rabbit (*O. cuniculus*), chicken (*G. domesticus*) and manicou (*D. m. insularis*) are described in Table 1. The live weights of the individual species showed some variation, with the chicken having the highest live weight ( $3725 \pm 167$  g), the agouti having the lowest live weight ( $2614 \pm 354$  g) and the rabbit ( $2691 \pm 283$  g) having an intermediary live weight. The manicous were eviscerated by the hunters when captured, and the eviscerated carcasses were given to researchers, so live weights were not obtained.

The hot carcass weights of the singed carcasses were heavier in comparison to the non-singed groups for all animals. The carcass yield (dressing percentage) was also greater for singed carcasses, in comparison to the non-singed group.

The chicken carcasses gave the greatest quantity of deboned meat per carcass ( $1602 \pm 118.6$  g). The rabbit had the least deboned meat per carcass ( $1072.8 \pm 794.8$  g), with the agouti ( $1212.4 \pm 177.5$  g) having intermediary values. Chickens produced higher weights for specific cuts of meat such as the leg and thigh, ribs and back and wings in comparison to all other animal groups. The visceral organs (lungs, heart, liver, kidneys) of all animals had similar weights.

The dressing percentages of the agoutis, rabbits and chickens are presented in Table 2. The broiler chickens had the highest dressing percentage compared to the rabbits and the agoutis. The broiler chickens that were not singed, had a dressing percentage of 63.6% and the singed broilers had a dressing percentage of 82.1%. The rabbits had the lowest dressing percentage, with the agoutis having an intermediary value. Generally, singed carcasses had a higher dressing percentage compared to the non-singed carcass. The result showed that the chickens had the highest dressing percentage and deboned meat. The dressing percentage of the manicous was not obtained, due to the fact that the live weights of the animals were not recorded by the hunters when they were captured.

Table 1: Weight of various organs and cuts from selected non-domesticated neotropical animals and domesticated animals (mean  $\pm$  SD)

Parameters (g)	Agouti ( <i>D. leporina</i> )		Rabbit ( <i>O. cuniculus</i> )		Broiler chicken ( <i>G. domesticus</i> )		Manicou ( <i>D. m insularis</i> )
	WS	S	WS	S	WS	S	S
Live weight	2535 $\pm$ 228	2692 $\pm$ 479	2704 $\pm$ 375	2677 $\pm$ 390	3975 $\pm$ 126	3475 $\pm$ 206	-
Hot carcass weight	1459 $\pm$ 108	2029 $\pm$ 367	1335 $\pm$ 100	1574 $\pm$ 234	2528 $\pm$ 96	2852 $\pm$ 389	705.7 $\pm$ 58.2
Forelimbs/ wings	198.4 $\pm$ 15.4	151.4 $\pm$ 20.8	131.6 $\pm$ 70.5	116.3 $\pm$ 15.6	221.4 $\pm$ 4.9	249.9 $\pm$ 27.3	74.2 $\pm$ 3.4
Thigh and legs	416.9 $\pm$ 33.4	460.3 $\pm$ 51.6	357.0 $\pm$ 58.9	-	647.0 $\pm$ 37.9	604.7 $\pm$ 103.9	134.4 $\pm$ 18.3
Ribs/ ribs and back	235.7 $\pm$ 26.7	399.6 $\pm$ 85.8	302.8 $\pm$ 74.3	229.3 $\pm$ 49.2	387.1 $\pm$ 35.3	553.0 $\pm$ 113.1	163.5 $\pm$ 10.7
Breast	-	-	-	-	1057.0 $\pm$ 41.4	1093.2 $\pm$ 131.6	-
Saddle	605.8 $\pm$ 54.3	758.9 $\pm$ 181.6	452.1 $\pm$ 53.5	515.4 $\pm$ 117.5	-	-	81.3 $\pm$ 10.7
Head	253.5 $\pm$ 14.1	250.2 $\pm$ 19.7	242.9 $\pm$ 31.2	193.72 $\pm$ 21.5	64.2 $\pm$ 1.5	64.7 $\pm$ 5.1	115.5 $\pm$ 8.2
Skin and hair/ feathers	307.7 $\pm$ 29.2	-	276.6 $\pm$ 23.5	-	564.0 $\pm$ 108.9	-	-
Heart	16.5 $\pm$ 2.5	18.9 $\pm$ 2.1	6.35 $\pm$ 0.7	5.7 $\pm$ 1.5	14.5 $\pm$ 1.6	14.8 $\pm$ 1.3	-
Lungs	22.9 $\pm$ 2.0	29.5 $\pm$ 6.2	14.5 $\pm$ 1.5	19.9 $\pm$ 2.6	12.9 $\pm$ 0.9	12.9 $\pm$ 0.6	-
Liver	73.5 $\pm$ 8.8	89.9 $\pm$ 29.0	102.4 $\pm$ 19.6	90.0 $\pm$ 24.7	58.86 $\pm$ 3.9	50.9 $\pm$ 15.0	-
Kidneys	19.1 $\pm$ 1.4	27.1 $\pm$ 12.5	16.9 $\pm$ 0.9	14.2 $\pm$ 3.0	-	-	-
Feet	71.0 $\pm$ 4.2	58.2 $\pm$ 9.0	88.5 $\pm$ 10.3	61.3 $\pm$ 7.3	98.0 $\pm$ 6.3	106.7 $\pm$ 7.8	25.0 $\pm$ 2.0
Reproductive organs	65.0 $\pm$ 3.8	69.9 $\pm$ 17.0	17.7 $\pm$ 0.7	14.9 $\pm$ 3.9	-	-	-
Gastrointestinal tract	141.3 $\pm$ 23.5	200.1 $\pm$ 43.3	167.1 $\pm$ 29.5	204.5 $\pm$ 46.9	156.4 $\pm$ 4.6	132.3 $\pm$ 22.43	-
Deboned meat	1001.8 $\pm$ 26.3	1422.9 $\pm$ 328.1	895.9 $\pm$ 37.7	1249.7 $\pm$ 238.5	1697.0 $\pm$ 113.7	1507.3 $\pm$ 123.4	-
Bones	451.6 $\pm$ 19.3	426.3 $\pm$ 78.8	423.5 $\pm$ 32.2	371.3 $\pm$ 68.7	873.5 $\pm$ 0.25	1230.7 $\pm$ 129.5	-

WS - without singeing; S - singeing

Table 2: Dressing percentage of domestic and non-domestic livestock (mean  $\pm$  SD)

Animal species	Dressing percentage
Agouti (WS)	57.6 $\pm$ 3.4
Agouti (S)	75.4 $\pm$ 4.0
Rabbit (WS)	49.8 $\pm$ 4.7
Rabbit (S)	58.8 $\pm$ 1.1
Broiler chicken (WS)	63.6 $\pm$ 1.9
Broiler chicken (S)	82.1 $\pm$ 8.0

WS - without singeing; S - singeing

## Discussion

This study showed that broiler chickens had the highest dressing percentage and boneless meat in comparison to the agoutis and rabbits. The diets of domesticated animals, such as chickens and rabbits, are mainly grain-based, which could be used for human consumption. In a resource-depleting world, mini-livestock or micro-livestock, such as agouti and manioc, provide animal protein to rural villages (Hardouin et al. 2003; Govino and Fielding 2001). The agouti can utilize local feed resources and by-products and convert them into animal protein (John and Jones 2020). Non-domesticated neotropical animals are more sustainable for meat protein for human consumption in comparison to domesticated livestock species. The agouti is an omnivore and can consume both plant and animal by-products, which cannot be utilized by humans (Guimaraes-Silva et al. 2020, Jones et al. 2019; Lall et al. 2018).

Domesticated species such as chickens and rabbits have shorter grow-out periods under intensive production systems, when compared to the agouti and the manioc. In this study, the chickens and rabbits reached market weights at 6 weeks and 3 months respectively. This was in contrast to the time taken for the agouti to reach market weight, which was approximately 1 year. Some studies have also stated that the meat from a non-domesticated rodent such as the capybara (*Hydrochoerus hydrochaeris*), is more nutritious for human consumption than that of domesticated

animals. The capybara meat is higher in protein, lower in fat and higher in polyunsaturated fatty acids (Ali and Jones 2020). There is no information on the chemical properties of the meat of the agouti, but because the capybara and the agouti are both hystricomorphic rodents, there may be similarities in their meat composition.

The carcasses that were singed, had greater dressing percentages in comparison to non-singed carcasses. Therefore, in areas where animal protein is limited, the singeing of animal carcasses will provide a larger quantity of animal mass for human consumption. However, in some cases when the animal was singed, the subcutaneous tissue remains, providing a greater amount of fat.

In the rural areas, the neotropical intensive production of non-domesticated animals may provide greater returns in comparison to the production of domesticated livestock. Rearing domesticated animals require more capital output on feed and infrastructure in comparison to non-domesticated animals (Nunes et al. 2019b). Persons living in rural communities, have little income to buy grain-based animal feed, but can feed agoutis and manioc refuse from the kitchen and agricultural crops.

Agouti and manioc meats are very popular with high consumption rates in both the urban and rural areas (Brown-Uddenberg et al. 2004). Intensive production systems for these animals can aid in poverty reduction, improve food security and decrease hunting pressures (Brown-Uddenberg et al. 2004; Nogueira and Nogueira-Filho 2011).

## Conclusion

Chickens and rabbits produced larger quantities of meat in a smaller grow-out period in comparison to agoutis. Chickens at 6 weeks old, had a live weight of 3725 g, rabbits at 3 months of age weighed 2691 g and the 1-year-old agouti weighed 2614 g. However, for sustainability, the agouti may be the best

option, because it can utilize crop refuse and agricultural by-products to produce animal protein. Chickens and rabbits require grain-based feed in their diets, grains that are used by humans for food.

Singed carcasses had higher dressing percentages in comparison to non-singed carcasses.

It is recommended that further work be conducted on the non-domesticated species to determine its growth rates and the most economical time to market.

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