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Research article

CARCASS TRAITS OF AMAZON TURTLES (*PODOCNEMIS EXPANSA*) REARED IN CAPTIVITY IN BRAZIL

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ABSTRACT: Forty Amazon Turtles raised in captivity in Goias and Para States, Brazil underwent complete carcass dissection to determine parameters for carcass traits. The effects of sex, origin and live weight were investigated on actual weight and proportions of the various body parts. Mean liveweight was 2.19kg. Viscera made up 11.87% of the carcass, while the plastron accounted for 7.91%, meat and bone 34.66%, carapace 25.31% and fat 5.54%. Live weight affected the weights of different digestive tract parts (duodenum, cecum, colon). When weights proportional to live weight were investigated the live weight affected significantly the proportion of blood, head, fat and carapace, heavier animals having less blood and more head, fat and carapace. The means of sectioning the head for bleeding the carcass did not affect the amount of blood released. Males presented significantly more blood, heart, plastron, carapace, shell and liver and smaller head, stomach and intestines in terms of live weight and less blood. Females had larger head, plastron, liver, heart, carapace and shell when proportions were compared. Correlations were in general high and positive between traits except for those with stomach and intestine proportions. Principal component analysis defined different types of animals, including those who were heavy for all traits and those that were heavy for carcass traits but had light intestine and organ weights which would be of interest for breeding these animals for slaughter. These results can be used as the basis for further studies on this species.
Key words: carapace, meat, proportion, viscera, weight

INTRODUCTION

Many traditional production systems are suffering a decline in profit margins due to the "price-cost" squeeze, foreign imports as well as subsidies paid in importing countries. Some farmers are turning to farming non-traditional animals in both developed [9] and developing [5, 6] countries in an attempt to improve farm receipts. The products and subproducts from these systems are sold at higher prices, frequently as "health" foods. In many cases little or no information on the feeding, genetics, health or slaughter of these animals exists. In Brazil the production of non-conventional animals in farms has been gathering interest as a method of sustainable exploration of natural genetic resources and a means of saving these animals from uncontrolled exploitation and possible extinction due to disappearance of their natural habitats. All wild animals are considered property of the Brazilian government and it is a crime to pursue, capture or maintain these animals captive. This law also permits the rearing of these animals for commercial purposes, controlled by the Brazilian Institute for the Environment and Natural Renewable Resources (IBAMA). The meats to be found include capybara, paca, deer, as well as alligator. These meats were to be found in the diets of primitive peoples in the country [4]. The rearing of the Amazon Turtle (*Podocnemis expansa*) was regulated in December 1992 (White paper 142/1992) but only for communities where these of chelonians naturally occur. The interest in rearing these animals has also been influenced by the increased demand for exotic meats in urban centers, as well as the increase in number and rigour in laws against clandestine capture of these animals.

At present there are over 800 farms rearing wild animals in Brazil, with the Amazon Turtle having the largest number (98), followed by capybara (69) and alligator (61). The number of animals in captivity is over 3.38 million. The interest in rearing *Podocnemis expansa* and *Podocnemis unifilis* is due to their size, high breeding rate, rusticity as well as high demand and price paid for the meat and sub products [14].

Turtle meat is a delicacy in many parts of the world [8, 13], but frequently can be found mixed with other cheaper meats at the point of sale [13] and in several cases the demand can affect the survival of the local species [1]. In Brazil, turtle meat was preferred by the consumer over other game meats [10].

This study aimed to define some basic carcass parameters as well as sanitary guidelines for *Podocnemis expansa* reared in captivity in Brazil as none currently are available.

MATERIAL AND METHODS

Forty turtles from three commercial farms (Para and Goias states) were slaughtered in a licensed fish abattoir in the Federal district, Brazil. Only one farm sent both sexes. In all cases the animals were over 1.5kg (permitted slaughter weight). The animals from Goias state were transported approximately 500km by road while from Para came by plane. Food was withdrawn for at least 48 hours before slaughter. In the *ante-mortum* rest period the animals were kept in a tank with 10cm of running water.

Evaluations included: Weight immediately before slaughter on an electronic scale with 1g precision. This weight was later used as the standard weight to calculate relative weights of carcass parts.

After washing and desensitization the animals were hung by their hind legs. The throats were slit and animals were bled for 15 minutes. This time was chosen after it was noted that dripping after 12 minutes was very small. Two types of cuts were tested – complete and partial. No stimulus was given to increase dripping rate. Blood was collected in pre-weighed beakers.

After bleeding the lower level of the bridge was sawn using a manual electric saw with a 2 inch disc at 3000 rpm. The disc was positioned at a tangent to the plastron. After sawing the bone bridges of the plastron were cut using trenchant scissors. The animals were again hung by the hind members and plastron dislocated from the musculature using a knife and manual traction. The head was then removed by continuing the cut at the base f the throat used for bleeding, between the axis and 1st thoracic vertebrae. The plastron and head were then weighted.

The viscera were removed as a whole in the cranium-caudal direction. They were then separated into intestines (stomach, duodenum, jejunum, ileum, cecum and colon), pancreas, heart, liver, lungs and genital-urinal tract. These were weighed together and separately.

The amazon turtle has two types of skin. An anterior type which covers front feet and neck and is attached to the anterior borders of the plastron, bridge and carapace as well as the crown of the head. The other is at the posterior of the animal covering anterior feet, tail and cloaca and inserted in the posterior border of the plastron, bridge and carapace. These were removed using a small knife, around the insertions in the shell and with circular cuts around the feet which were later removed. These skins were weighed together.

Anterior and posterior members were sectioned at the carpal/metacarpal articulations using trenchant scissors. The remaining parts of the carcass and weighed. These included the carapace, part of the bridge, meat and apendicular bones. The carcass was weighed and washed.

Meat and fat were obtained after carapace removal. Meat included remaining musculature and apendicular bones. These include part of carpal and metacarpal bones, scapula, humerus, radius, tibia, tarsus, cervical vertebrae and part of the basal bones. The bones of the vertebral column and part of the spleen bones were fused with the carapace. Meat and fat were removed using a knife in the cranial-caudal direction beginning by removal of the cervical musculature.

Fat was seen as adipose masses distributed in various parts of the meat and carapace. Not all animals had adipose bodies. When possible (visible to the eye) these were removed and weighed separately. In the internal face of the carapace, in the angle formed by the bridge and carapace some quite large bodies of adipose tissue were found in some animals. These were weighed along with fat found in the musculature. Carapace is defined as the carapace as well as the bridges, part of coxis and fused thoracic and lumbar vertebrae.

After weighing, relative weights were calculated by dividing by the original weight of the animal before slaughter.
Data were analyzed using General Linear Model (GLM), regression (REG) and correlation (CORR) and principal components (PRINCOMP) procedures of SAS v. 9.3 (Cary, North Carolina). Fixed effects included in the model included sex, state and farm of origin. Weight was included as a covariable. Transformations (logs with absolute weights and arcsin with relative weights) were carried out where necessary to stabilize the variance.

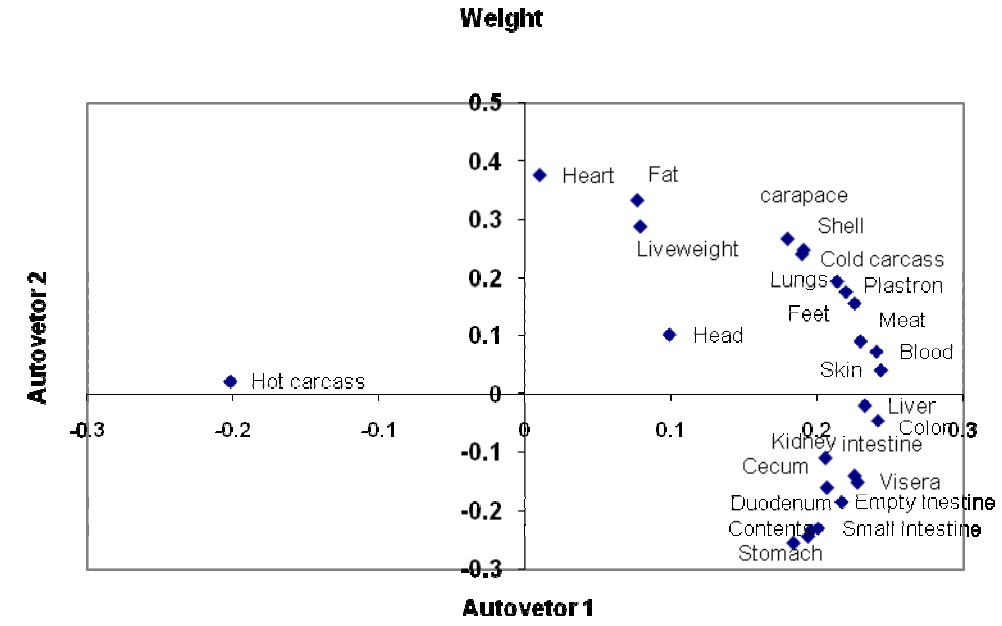
RESULTS

Table 1 has means and standard deviations for absolute weights and percentages of carcass components relative to liveweight before slaughter. Variance coefficients for proportions were in general much lower than absolute weights. This is attributed to the large variance in weights between farms.
The turtles weighed between 1165g and 3858g with a variance coefficient of 40%. Of this 795g was meat and 170.6g fat. The hot carcass was 60% of the weight of the animal, while the carapace was 25% of slaughter weight.
The summary of the analysis of variance of percentages and weights is shown in Table 2. There was a large difference in weight between the animals from Goias and Para States. Weight was shown to be a significant source of variation for weights of full and empty intestines as well as intestine contents, duodenum, cecum and colon. For the percentages, weight had a significant influence on the percentages of blood, head, fat and carapace. Heavier animals had less blood and proportionally larger heads, fat and carapace. The type of head section did not affect the percentage or quantity of blood taken from the body.

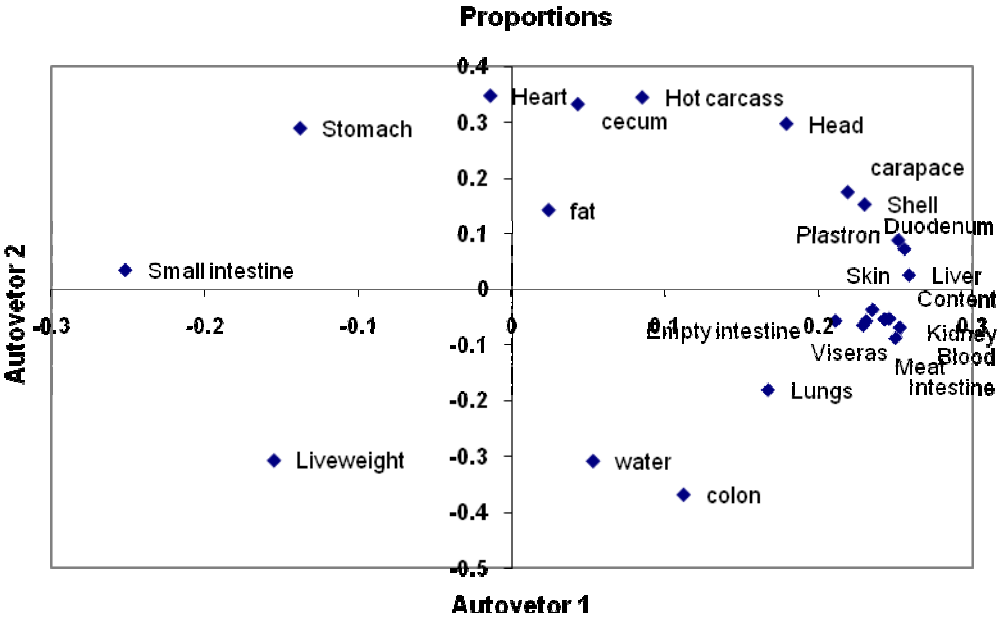
Table 1. Summary of absolute weights and percentages of carcass traits in Amazon Turtles

	Weight (g)			Percentage of Slaughter weight (%)		
Trait	Mean (g)	Sd	CV	Mean	Sd	CV
Slaughter	2191.64	882.051	40.246			
Blood	61.718	33.51	54.295	2.709	0.708	26.148
Head	72.84	17.745	24.362	3.028	0.636	20.998
Plastron	181.667	64.34	35.417	7.907	1.049	13.261
Viscera	282.074	97.54	34.58	11.867	2.527	21.292
Intestines	174.679	62.835	35.972	7.777	2.61	33.562
Liver	62.867	32.237	51.278	2.54	0.48	18.911
Kidney	5.828	2.377	40.78	0.245	0.038	15.593
Heart	6.857	3.159	46.068	0.275	0.043	15.57
Lungs	26.69	9.827	36.821	1.137	0.152	13.371
Empty Intestines	62.625	13.783	22.009	3.319	1.001	30.158
Intestine contents	97	43.085	44.417	5.019	2.229	44.413
Skin	87.3	33.423	38.286	2.423	0.231	9.547
Feet	60.92	19.706	32.347			
Hot Carcass	1343.17	575.745	42.865	60.364	5.079	8.415
Cold carcass	1420.28	617.588	43.484			
Meat	795.313	327.823	41.219	34.661	4.406	12.711
Fat	170.6	108.237	63.445	5.535	2.628	47.476
Stomach*	34.182	9.745	28.509	50.796	2.874	5.657
Small Intestine*	16.818	6.129	36.442	25.242	1.706	6.76
Duodenum*	6	1.944	32.394	9.236	1.541	16.684
Cecum*	4.5	1.179	26.189	7.581	0.953	12.57
Colon*	3.667	2.55	69.532	5.851	2.85	48.705
Carapace	574.313	211.867	36.89	25.311	1.874	7.404
Shell	770.067	274.372	35.63	33.24	2.884	8.675
water				8.053	9.941	123.441

* expressed as percentage of empty intestine weight



(a)



(b)

Figure 1. First two autovectors for weights and percentages of carcass parts of Amazon turtle

The means per sex and farm are in table 3 for weights and percentages. The males had more blood, heavier heart, plastron, carapace, shell and liver but lighter head, stomach and intestine than the females. In percentage terms females had significantly less blood but more head, plastron, heart, carapace and shell than the males. All animals from farm 1 were from Para state and had been significantly heavier than those from farms 2 and 3 which were from Goias state. They were approximately 2.5 years old. Those from farms 2 and 3 were also of the same age. This difference may be genetic and or environmental. The shell represented 33.23 $\pm$1.03% of the liveweight, with the carapace accounting for 25.3 $\pm$0.65% and plastron 7.9 $\pm$0.37%, while the carcass was 60.98$\pm$1.13 % of the liveweight. No significant differences in carcass weight were found between males and females.

Animals from farms 2 and 3 did not present discrete fat bodies. Meat free from fat was 34.47±1.54%. No significant difference was found between meat production from farms 2 and 3 or between males and females. Correlations between the weight traits and their percentages measured are in table 4 and 5 respectively. Slaughter weight was positively correlated to the weights of the plastron, carapace and shell, as well as cold carcass which was 0.80.

Table 2. Summary of variance analysis for weights and percentages of carcass components of the Amazon Turtle

	Blood	Head	Plastron	Viscera	Intestine	Liver	Kidney	Heart	Lungs	Empty Intestine	Intestine Contents	Skin	Feet	Hot Carcass	Cold Carcass	Stomach	Intestine	Duodenum	Cecum	Colon	carapace	Shell
	Weights																					
Sex	*	P<0,10	***	ns	ns	*	ns	*	ns	ns	ns	ns	ns	ns	ns	**	*	ns	ns	ns	P<0,10	*
Farm	***	ns	ns	ns	ns	ns	ns	ns	P<0,10	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Weight	***	***	***	***	ns	***	***	***	***	ns	ns	***	***	***	***	**	**	ns	ns	ns	***	***
R^2	0.864	0.845	0.944	0.679	0.309	0.922	0.894	0.906	0.887	0.730	0.376	0.917	0.912	0.943	0.974	0.918	0.911	0.585	0.744	0.303	0.967	0.963
Cv	21.17	10.24	8.786	20.81	31.69	15.10	14.08	14.90	13.06	15.10	46.39	11.58	9.90	10.70	7.37	9.73	12.98	25.53	16.21	73.34	7.12	7.17
	Percentages																					
Sex	*	P<0,10	***	ns	ns	*	ns	*	ns	ns	ns	ns		ns		ns	ns	ns	ns	ns	P<0,10	*
Farm	**	*	ns	ns	ns	**	ns	ns	***	ns	ns	ns		ns			ns	ns	ns	ns	ns	ns
Weight	*	**	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns		ns		ns	ns	ns	ns	ns	***	ns
R^2	0.537	0.825	0.648	0.341	0.471	0.593	0.08	0.357	0.386	0.893	0.326	0.249		0.128		0.073	0.596	0.481	0.34	0.183	0.448	0.541
Cv	18.79	9,38	8.29	18.41	25.92	12.75	15.77	13.24	11.08	13.06	47.86	8.84		8.458		7.70	5.67	15.89	13.49	58.20	5.88	6.20

* P<0.05; **P<0.01; ***P<0.001; ns-not significant; R2 – coefficient of determination; cv – coefficient of variation

Table 3. Means weights per sex and farm for the Amazon Turtle.

	Weights (g)					Percentage (%) of slaughter weight				
	Sex		Farm			Sex		Farm		
	M	F	1	2	3	M	F	1	2	3
Slaughter Weight	2,747.13	2,048.29	2,894.50	1,296.10	1,624.78					
Blood	77.38	57.68	89.50	27.70	37.78	2.8	2.7	3.1	2.1	2.4
Head	72.00	73.24	78.90	48.60	.	2.7	3.2	2.8	4.1	.
Plastron	184.13	180.77	215.05	114.90	.	6.7	8.3	7.4	8.9	.
Viscera	286.75	280.11	319.30	175.71	.	10.5	12.4	11.1	14.0	.
Intestine	173.63	175.10	191.90	131.63	.	6.4	8.3	6.7	10.4	.
Liver	69.38	60.50	80.70	27.20	.	2.5	2.5	2.8	2.1	.
Kidney	6.25	5.67	7.00	3.22	.	0.2	0.3	0.2	0.3	.
Heart	7.25	6.70	8.35	3.13	.	0.3	0.3	0.3	0.2	.
Lung	30.25	25.33	31.35	16.33	.	1.1	1.2	1.1	1.3	.
Empty Intestine	62.33	62.80	69.20	51.67	.	2.4	3.9	2.7	4.3	.
Intestine Contents	106.33	91.40	113.80	69.00	.	4.0	5.6	4.5	5.8	.
Skin	101.25	82.23	106.25	49.40	.	2.4	2.4	2.4	2.6	.
Feet	64.88	59.06	68.35	31.20	.					
Cold Carcass	1,590.50	1,253.23	1,717.11	791.00	738.50	57.9	61.3	60.2	60.9	59.2
Hot Carcass	1,784.38	1,326.32	1,906.45	844.70	979.44	65.0	64.8	65.9	65.2	60.3
Meat	957.13	741.38	992.40	453.20	535.00	34.8	34.6	34.4	34.9	36.4
Fat	140.38	190.75	170.60	.	.	5.0	5.9	5.5	.	.
Stomach	31.00	35.38	39.00	28.40	.	50.2	51.6	50.8	.	.
Intestines	16.33	17.00	20.33	12.60	.	26.3	24.6	26.1	23.8	.
Duodenum	5.33	6.29	6.67	5.00	.	8.5	9.7	8.6	10.3	.
Cecum	5.00	4.29	5.40	3.60	.	8.1	7.3	7.9	7.1	.
Colon	4.67	3.17	4.80	2.25	.	6.9	5.2	6.6	4.6	.
Carapace	652.25	548.33	708.20	348.80	363.00	23.8	25.8	24.5	26.9	25.1
Shell	836.38	745.96	923.25	463.70	.	30.6	34.2	32.0	35.8	.
Water	374.57	123.37	257.09	91.67	89.30	13.6	6.0	8.9	7.1	5.5

In both cases the first three autovectors explain 100% of the variation between the traits measured. In terms of weight, the first autovector shows an animal with higher liveweight has a tendency to have higher weights for all the other traits as expected. This variation explains 63% of all variation between traits.

There are also heavy animals with light viscera and this is of interest for selection programs (Figure 1). In terms of percentages, the first autovector was similar (59% of total variation) where a higher percentage of one part of the carcass meant higher parts for the others except viscera. The second distinguishes between fat animals with heavy carcasses but with little meat. Hot carcass weight was lower (0.12).

Table 4. Correlations between weights of carcass parts in the Amazon Turtle

	Live weight	Blood	Head	Plastron	Viscera	Intestine	Liver	Kidney	Heart	Lungs	Empty Intestine	Intestine contents	Skin	feet	Hot carcass	Cold carcass	meat	fat	Stomach	Small intestine	Duodenum	cecum	Colon	carapace
Blood	0.39																							
Head	-0.20	0.53																						
Plastron	0.62	0.96	0.47																					
Viscera	0.00	0.84	0.30	0.66																				
Intestine	-0.14	0.68	0.14	0.47	0.97																			
Liver	0.08	0.95	0.65	0.82	0.90	0.78																		
Kidney	0.35	0.72	-0.15	0.63	0.86	0.86	0.65																	
Heart	0.89	0.19	0.01	0.47	-0.33	-0.51	-0.10	-0.09																
Lung	0.60	0.95	0.54	1.00	0.62	0.42	0.82	0.56	0.49															
Empty Inestine	0.00	0.76	0.15	0.58	0.99	0.99	0.82	0.91	-0.38	0.53														
Intestine contents	-0.19	0.65	0.14	0.43	0.96	1.00	0.77	0.84	-0.55	0.38	0.98													
Skin	0.35	1.00	0.50	0.93	0.88	0.74	0.96	0.76	0.12	0.92	0.81	0.71												
Feet	0.55	0.98	0.52	1.00	0.70	0.51	0.87	0.63	0.40	0.99	0.62	0.48	0.95											
Hot carcass	0.12	-0.84	-0.82	-0.70	-0.80	-0.68	-0.96	-0.43	0.19	-0.72	-0.69	-0.67	-0.85	-0.76										
Cold carcass	0.80	0.85	0.32	0.97	0.48	0.28	0.65	0.56	0.67	0.96	0.41	0.23	0.82	0.94	-0.50									
Meat	0.63	0.93	0.20	0.94	0.77	0.64	0.78	0.85	0.34	0.90	0.74	0.60	0.93	0.93	-0.60	0.91								
Fat	0.47	0.50	0.72	0.65	-0.02	-0.26	0.39	-0.17	0.70	0.72	-0.16	-0.29	0.43	0.65	-0.45	0.69	0.37							
Stomach	-0.13	0.59	-0.01	0.38	0.93	0.99	0.68	0.88	-0.54	0.32	0.97	0.99	0.66	0.42	-0.55	0.21	0.59	-0.39						
Ismall intestine	0.15	0.81	0.12	0.67	0.98	0.96	0.82	0.95	-0.24	0.61	0.99	0.94	0.86	0.69	-0.67	0.52	0.83	-0.09	0.94					
Duodenum	-0.26	0.68	0.29	0.44	0.96	0.98	0.82	0.76	-0.57	0.41	0.96	0.99	0.74	0.50	-0.76	0.23	0.57	-0.19	0.95	0.91				
Cecum	-0.24	0.78	0.56	0.57	0.94	0.90	0.93	0.64	-0.45	0.56	0.89	0.90	0.82	0.63	-0.92	0.34	0.59	0.08	0.82	0.84	0.95			
Colon	0.32	0.93	0.24	0.83	0.95	0.87	0.89	0.92	-0.03	0.79	0.93	0.85	0.95	0.85	-0.73	0.71	0.93	0.15	0.83	0.97	0.83	0.82		
Carapace	0.72	0.84	0.49	0.96	0.42	0.20	0.67	0.42	0.68	0.97	0.32	0.16	0.80	0.94	-0.57	0.98	0.84	0.81	0.10	0.43	0.18	0.35	0.64	
Shell	0.71	0.88	0.49	0.98	0.48	0.26	0.70	0.47	0.63	0.98	0.38	0.22	0.83	0.96	-0.60	0.98	0.87	0.78	0.17	0.49	0.24	0.40	0.69	1.00

Table 5. Correlations between carcass percentages in the amazon turtle

	Blood	Head	Plastron	Viscera	Intestines	Liver	Kidney	Heart	Lungs	Empty Intestine	Intestine contents	Skin	Hot carcass	water	Meat	fat	Stomach	Small intestine	Duodenum	cecum	Colon	carapace
Head	0.57																					
Plastron	0.93	0.83																				
Viscera	0.90	0.53	0.85																			
Intestines	0.82	0.46	0.78	0.99																		
Liver	0.97	0.74	0.99	0.92	0.85																	
Kidney	0.73	0.39	0.69	0.95	0.99	0.77																
Heart	-0.11	0.63	0.20	-0.32	-0.40	0.03	-0.47															
Lungs	0.80	0.20	0.61	0.48	0.36	0.65	0.22	-0.06														
Empty Intestine	0.83	0.51	0.80	0.99	1.00	0.87	0.98	-0.35	0.36													
Intestine contents	0.82	0.44	0.77	0.99	1.00	0.84	0.99	-0.42	0.36	1.00												
Skin	0.98	0.59	0.92	0.81	0.71	0.94	0.59	0.02	0.86	0.72	0.70											
Hot carcass	0.11	0.77	0.44	0.34	0.37	0.35	0.40	0.44	-0.43	0.41	0.36	0.05										
Water	0.42	-0.32	0.12	0.10	0.01	0.20	-0.09	-0.29	0.86	-0.01	0.02	0.50	-0.84									
Meat	0.95	0.49	0.87	0.99	0.96	0.94	0.90	-0.32	0.61	0.96	0.96	0.88	0.21	0.25								
Fat	0.18	0.42	0.28	-0.23	-0.37	0.17	-0.50	0.79	0.50	-0.34	-0.38	0.35	-0.10	0.35	-0.13							
Stomach	-0.71	0.08	-0.43	-0.45	-0.36	-0.52	-0.25	0.35	-0.95	-0.34	-0.37	-0.75	0.62	-0.93	-0.58	-0.26						
Small Intestine	-0.93	-0.58	-0.90	-1.00	-0.97	-0.95	-0.92	0.24	-0.52	-0.98	-0.97	-0.85	-0.35	-0.12	-0.99	0.14	0.47					
Duodenum	0.94	0.81	1.00	0.90	0.83	0.99	0.75	0.12	0.58	0.86	0.82	0.91	0.45	0.10	0.90	0.19	-0.42	-0.93				
Cecum	0.12	0.76	0.40	-0.11	-0.21	0.25	-0.30	0.97	0.11	-0.16	-0.23	0.24	0.47	-0.20	-0.10	0.83	0.20	0.03	0.33			
Colon	0.59	-0.32	0.25	0.47	0.44	0.38	0.38	-0.68	0.77	0.40	0.45	0.57	-0.67	0.85	0.58	-0.12	-0.93	-0.46	0.28	-0.55		
Carapace	0.80	0.92	0.95	0.65	0.55	0.89	0.44	0.49	0.56	0.59	0.53	0.84	0.48	0.06	0.67	0.53	-0.31	-0.71	0.92	0.67	0.04	
Shell	0.84	0.91	0.97	0.71	0.62	0.92	0.51	0.41	0.58	0.65	0.60	0.87	0.47	0.08	0.73	0.47	-0.35	-0.77	0.95	0.60	0.10	1.00

This can be explained by the loss of liquid during the chilling process. Slaughter weight did not show significant correlations with viscera weights. In terms of percentages, hot carcass was highly correlated with head (0.77) as were the correlations of meat, liver and intestines (>0.90). Also proportionally more plastron meant more meat (0.87). Percentages of plastron, carapace and shell have high correlations as expected and the percentage of blood was highly correlated with these traits

DISCUSSION

The turtles had 5% fat compared with 16-25% in cattle [19, 20] and up to 30% in pigs [24]. This should be interpreted with care as the animals from farms 2 and 3 did not present visible fat bodies, possibly because the animals were very small. Almost 37% of the carcass was meat. Although all the animals in this study were of the same species, those from farm 1 were caught in the Xingu River Basin in para State while those from farms 2 and 3 came from the Araguaia River in Goias State, two separate river systems. All animals arrived on the farms at about 40 days of age weighing 20g.

Animals from farms 1 had significantly more meat + fat than those from farm 2 39.54$\pm$0.85% vs 34.93$\pm$0.48%. The animals from farm 1 presented discrete fat bodies while those from farm 2 did not. Food and temperature may affect the deposit of these bodies. An economic analysis as well as physiological analysis is necessary to determine whether these animals were economically viable. Growth rates in turtles vary depending on age [15, 3], but not necessarily sex [2] although some authors observed this effect [21]. One possible cause of the difference in weights may be the environmental temperature in the two distinct States in Brazil. Reptiles are pecilothermic, i.e. body temperature varies with environmental temperature. Proteins and principally enzyme activity are influenced by temperature. Energetic and protein metabolism involved in digestion and muscular anabolism is therefore affected by temperature. This includes air and water temperature as well as microclimate in the rearing habitat. Constant temperature in artificial incubation experiments had a significant effect on hatching but differences disappeared by one month of age as the smaller hatchlings grew faster in the same environment [18].

The diet between the farms was also different. In Goias state the animals were fed a commercial fish ration and by products from the farm (corn, roots, vegetables, etc). Those from Para state were fed a ration specific for turtles with 45% protein. [12], in experiments with 18, 21, 24, 27 and 30% gross protein, observed that those animals receiving 27 and 30% protein grew faster and those that had protein from an animal source grew even faster.

Differences between individual's growth rates per age depend on diet and reproduction [16]. [11] Showed a general increase in turtle weight with increase in protein over a six week period. Feed conversion was also between in those that received 45% protein compared with those receiving 30-35% protein but not significantly different from those receiving 55%.

During bleeding the turtles lost on average 2.71$\pm$0.08% of their liveweight. It was shown that those from farm 1 lost significantly more blood than those from farms 2 and 3. As well as possible weight influences a parasitic infestation was noted in the animals from farms 2 and 3. These were haemo-parasitic as well as vectors of a *Hemogregarina* sp. Protozoária. This may cause a lower haemocrit and affect the quantity of blood expelled. More blood was expelled by the females than males (3.32$\pm$0.06% vs 2.82$\pm$0.15% respectively).

Little data is available on the Amazon turtle in the literature. [7] Studied the use of the meat of this animal. They found that after bone removal the meat was 30% of the carcass compared with 34% in this study. Protein and lipid content were 17.39 and 1.83%, respectively with low calorie content (86.03 kcal/100 g meat). Studies in China showed the protein and lipid content in muscle from *Chinese soft-shelled turtles (Trionyx sinensis*) were 18.21 and 1.23% respectively and lipid content of the fat block was [25]. Principal component analyses showed distinct types of animals, those with liveweight related to meat production but also a subgroup of heavy animals with light intestine and organ weights, which could be useful for breeding purposes as more energy is directed to meat production.

CONCLUSIONS

The results presented can be used for comparison with future studies. Different types of animals were defined, including those who were heavy for all traits and those that were heavy for carcass traits but had light intestine and organ weights which would be of interest for breeding these animals for slaughter.

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