Thai J. Agric. Sci. *23* (January 1990): 5-18

CARCASS CHARACTERISTICS OF THAI NATIVE MALE GOATS

By

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Received June 1988

ABSTRACT:- This paper presents results from a study of the body and carcass composition of Thai native male goats of fasted liveweight (FLW) ranging 8.8 to 21.6 kg. Two groups of goats of different management history but similar mean liveweights were used in this study. The first group (village) of goats (n = 10) were chosen on the basis of age (mean fasted liveweight = 15.1 kg, mean age 331 d) from a random selection of village herds in the Songkhla province of southern Thailand and brought to the university for slaughter. The second group (n = 23) were raised from birth at the university campus farm under controlled management conditions (mean FLW = 15.3 kg, mean age 212 d).

When compared at the same FLW, there were no significant differences between the two groups in dressing percentage (45.5 %), saleable percentage (71.2 %), edible meat (muscle + fat) to bone ratio (4.31) or individual organ weights expressed as a percentage of FLW. However farm goats had significantly higher percentage of carcass fat (8.38 v. 5.07 %), but lower percentages of muscle (68.38 v. 70.65 %) and connective tissue (5.04 v. 6.31) when compared with the village animals. The fat content of the carcass was significantly correlated (r = 0.79) with FLW only for the farm goats.

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Prediction equations for both the farm and the village goats were developed relating FLW to some linear measurements and carcass components to liveweight and carcass weight.

Heart-girth circumference was significantly correlated with FLW, carcass weight and saleable weight for both groups of goats. It is proposed that these relationships may be of practical use for the prediction of liveweight and for estimating the economic value of goats where weighing facilities are not available.

INTRODUCTION

According to the 1978 Agricultural Census Report presented by the National Statistical Office 73,979 goats, or 87.6 % of total goat population, were found in southern Thailand with the remainder scattered over parts of the country. Thai native goats are similar in size and conformation to Malaysian goats and play an important role in the cultural and economic life of Muslim farmers in the south of Thailand. Although goat meat realises higher prices than most other sources of meat, it is only recently that detailed studies of goat productivity in Thailand have been initiated (Saithanoo et al. 1985). In the region village goats are raised in a variety of farming systems with few management inputs (Saithanoo and Milton 1988). As a consequence growth is often slow and mortality high. There is little information available on the potential of these goats to respond to improved management or on the carcass and body composition.

The production levels such as livewight are markedly increased under improved conditions (Sathanoo and Milton 1988). Therefore, it is needed to be studied how the weight influenced meat production.

Wilson (1960) working with the indigenous goats of East Africa found that male goats (6.7 kg carcass weight) had muscle, fat, bone and edible meat (muscle + fat) to bone ratios of 63.4, 10.7, 25.9 and 3.5 %, respectively. Comparable values for male Botswana goats (7.3 kg carcass weight) were 59.8, 6.7, 25.3 and 2.6 % respectively (Owen et al. 1978). High edible meat to bone ratio (MBR) is a desirable trait in the selection of meat goats and appears to vary widely (2.5 to 4.1) with different goat breeds at similar carcass weights (Ash 1986). Since MBR increases with liveweight larger goats within the same breed will have higher MBR. Devendra (1980) has reported that improved nutritional management of Katjang goats in Malaysia increased carcass weight, dressing percentage and MBR from 4.1 to 4.9. Although there are few similar

studies with crossbred goats, it would seem that substantial improvements in meat production from goats can be made simply by improved nutrition. There is no comparable information available for the body composition of Thai native goats.

The present experiment was designed to study the body and carcass composition of Thai native male goats raised to the same weight under village and improved management conditions. The relationships between linear measurements, liveweight, carcass weight and carcass composition for these goats was also investigated with a view to development of prediction equations that might be used in future village goat production studies.

MATERIALS AND METHODS

Animals and their management

Two groups of entire male goats raised under different management conditions were used. The first group of 23 goats was raised from birth at the Prince of Songkla University campus farm under controlled management conditions. At slaughter, fasted liveweights ranged from 8.8 and 21.6 kg (mean 15.1 kg). All goats grazed improved pastures and were offered concentrate supplements as required and were maintained relatively free of external and internal parasites. These management procedures have been reported previously (Milton et al. 1987). The second group comprised 10 goats chosen on the basis of age and weight from randomly selected herds in villages in Songkhla province, southern Thailand. Mean liveweight was 15.2 kg with a range of 9.3 to 21.6 kg. The major industries in these villages were fishing, rice and rubber production. These goats were raised from birth under village management conditions grazing natural pastures and browse with the consumption of some household scraps. Some goats, especially the younger ones had also been offered cooked rice. The ages of these goats were estimated to the nearest month by questioning the owners on the date of birth and all were less than 15 months old.

Slaughter procedures

Groups of two or three goats taken from the villages were weighed individually and transported to the University. Similarly groups of four or five goats at the University farm were held in a pen overnight without feed or water. On the following morning each goat was weighed (fasted liveweight FLW) and the following linear measurements (mm) made: heart-girth circumference, height at withers, length (withers to the tip of the tail), cannon bone

(metacarpus) length and testicular circumference. All goats were slaughtered by exsanguination and reweighed after bleeding. All organs were weighed to the nearest gram in the following order: head, fore and hind feet, skin, tail, testicles, penis, full intestinal tract, empty intestinal tract (oesophagus, reticulo-rumen, omasum, abomasum, pancreas, small intestine, caecum, large intestine, rectum and bladder), liver, lungs and trachea, heart, kidneys, diaphragm and carcass. The carcass was longitudinally divided into two and the right half weighed (hot carcass weight). Following chilling overnight (2°C), the right half of the carcass was again weighed (cold carcass weight) and dissected taking care to minimize water loss. Fifteen farm goats and 10 village goats were dissected into muscle, fat, bone and connective tissue. During dissection carcass fat was separated into subcutaneous, intermuscular, perinephric (kidney) and pelvic fat. Dressing percentage was calculated by expressing hot carcass weight as a percentage of fasted liveweight. However in Thailand, many components other than the carcass are sold for consumption and a more useful measure of economic productivity is given by the production of the goat that is saleable. Saleable percentage was calculated as follows:

$$100\ (\text{FLW} - \text{head} - \text{feet} - \text{penis} - \text{gut contents})/\text{FLW}$$

Statistical analysis

Liveweight and carcass characteristics of the two groups were firstly compared by t-test. Co-variance analyses were then used to examine the differences between groups in carcass characteristics using either carcass weight or liveweight as a covariable.

For the development of prediction equations, liveweight and carcass weight were treated as dependent variables since the component measurements collectively constitute total carcass or liveweight. The form of the equations was therefore:

$$Y = a + bX$$

where Y is dependent variable (carcass or liveweight), X is carcass or liveweight component (muscle, fat), a is intercept value ($X = 0$) and b is the regression coefficient.

Although Sokal and Rohlf (1981) suggest that the relevant prediction equations can then be calculated by inversion by a and b ($X = 1/b\ Y - a/b$), there appears to be no methods for calculating the errors of prediction from this equation. The equations presented are therefore in two forms, those representing the original form of the equation with their relevent error terms and inverted forms without errors for use in prediction.

The effects of management history on body conformation

Table 1 shows mean values with standard errors (SE) for the liveweight, carcass weight, organ weights and linear measurements of goats raised under different management regimes. Apart from liver weight which was significantly differences between the two groups in any other measurement.

The effects of management history on carcass composition

Table 2 shows least squares means with SE (corrected for differences in cold carcass weight) for the percentages of muscle, bone, fat and connective tissue in the carcasses of goats from the different groups. At the same carcass weight, farm goats had significantly ($P<0.05$) lower percentages of muscle and connective tissue, but significantly ($P<0.05$) higher proportions of carcass fat than did village goats. The farm goats also had significantly ($P<0.05$) higher percentages of intermuscular, pelvic and kidney fat when compared with the village goats. There were no significant differences between the two groups for muscle to bone and edible meat (muscle + fat) to bone ratios.

Table 3 shows the simple correlation coefficients for the relationships between fasted liveweight, heart-girth circumference, height, body length and dressing percentage for male Thai goats raised under farm and village management systems. Heart-girth circumference was significantly ($P<0.05$) correlated with fasted liveweight for both groups of goats over the liveweight range of 8 to 22 kg. Other linear measurements (height and length) were also significantly correlated with fasted liveweight but only for goats raised under farm conditions.

An analysis of covariance of the relationship between heart-girth circumference and fasted liveweight showed that there was no significant difference between groups in fasted liveweight after adjustment for differences in girth measurement nor was there a significant difference in their regression coefficients. The combined regression equation ($n = 33$) with correlation coefficient (r) and residual standard deviation (RSD) was:

$$FLW = 0.074\,G - 26.3, \quad r = 0.93, \quad RSD = +/- 1.26$$

where FLW is fasted liveweight (kg) and G is heart-girth circumference (mm).

RESULTS

Table 1. Mean values with SE for fasted liveweights, carcass weights, body components and linear measurements of Thai male goats.

	Farm goats		Village goats	
	Mean	SE	Mean	SE
No. of goats	23		10	
Age (days)	212	11.7	331	19.0
Fasted liveweight (kg)	15.1	0.8	15.3	1.2
Gut contents (%)	16.7	0.9	16.8	1.2
Hot carcass weight (kg)	6.9	0.5	6.9	0.7
Body components (%)				
Head	8.3	0.1	8.4	0.2
Hide	8.4	0.1	8.2	0.2
Intestinal tract	7.8	0.2	8.4	0.3
Blood	4.0	0.2	3.8	0.3
Feet	2.7	0.1	3.1	0.1
Liver	1.59	0.04	1.76*	0.05
Lungs + trachea	1.16	0.03	1.23	0.05
Omental fat	0.95	0.08	0.39	0.11
Testes + penis	0.90	0.02	0.82	0.02
Spleen	0.69	0.05	0.89	0.08
Heart	0.43	0.01	0.43	0.02
Diaphragm	0.36	0.02	0.34	0.02
Kidneys	0.29	0.01	0.32	0.01
Linear measurements (mm)				
Girth	580	10.7	575	16.2
Height	491	10.0	510	18.1
Length	480	9.8	478	14.9
Cannon bone length	119	2.8	122	4.2
Testicular circumference	200	4.3	199	6.6
Dressing %	45.7	0.8	45.1	1.0
Saleable %	71.4	0.8	70.9	1.1

* Significance level $P < 0.05$

Table 2. Least squares means with SE (corrected for difference in cold carcass weight) for the muscle, bone, fat and connective tissue contents (%) of carcasses from goats.

Carcass component	Farm goats		Village goats		Significance of difference
	Mean	SE	Mean	SE	
No. of goats	15		10		
% Muscle	68.38	0.59	70.65	0.72	*
% Connective tissue	5.04	0.27	6.31	0.33	**
% Bone	18.20	0.40	17.97	0.48	ns
% Total fat	8.38	0.61	5.07	0.75	**
% Subcutaneous fat	1.29	0.22	0.74	0.27	ns
% Intermuscular fat	5.57	0.33	3.62	0.41	**
% Pelvic fat	0.35	0.04	0.19	0.05	*
% Kidney fat	1.17	0.15	0.51	0.18	*
Muscle : bone ratio	3.84	0.09	4.00	0.11	ns
Edible meat : bone ratio	4.33	0.10	4.29	0.12	ns

* $P < 0.05$, ** $P < 0.01$

Table 3. Simple correlation coefficients for the relationships between fasted liveweight (FLW), heart-girth circumference, height, body length and dressing percentage of Thai male goats.

Trait	System	Girth (mm)	Height (mm)	Length (mm)	Dressing %
FLW (kg)	Farm	0.95*	0.95*	0.71*	0.88*
	Village	0.95*	0.52	0.71*	0.39
Girth (mm)	Farm		0.93*	0.67*	0.79*
	Village		0.55	0.78*	0.29
Height (mm)	Farm			0.70*	0.86*
	Village			0.68*	−0.06
Length (mm)	Farm				0.78*
	Village				0.08

* Significance level = $P<0.05$

The relationship between liveweight and carcass composition

Table 4 shows the simple correlation coefficients relating liveweight (LW) , empty body weight (EBW), carcass weight (CW) and heart-girth circumference to muscle, fat, edible meat, saleable components, dressing percentage and saleable percentage. There were no significant correlations for liveweight and carcass weight with fat content, dressing percentage or salaeble percentage for goats raised in villages but these correlations were significant for farm goats. The relationships of major interest in this study were those that predicted body composition most accurately from external measurements. There were significant correlations between fasted liveweight and carcass weight and saleable weight for both the village and farm goats. Analysis of covariance showed that for each relationship there was no significant difference between management groups and the combined regression equations with their complementary prediction equations were:

$$FLW = 1.78\,CW + 2.79,\ n = 29,\ RSD = +/- 3.01,\ r = 0.99$$

$$CW = 0.562\,FLW - 1.56$$

$$FLW = 1.28\,SW + 1.49,\ n = 25,\ RSD = +/- 2.29,\ r = 0.99$$

$$SW = 0.781\,FLW - 1.16$$

where FLW is fasted liveweight (kg), CW is hot carcass weight (kg) and SW is saleable weight (kg).

Girth circumference was also highly correlated with both carcass and saleable weight for both farm and village goats. An analysis of covariance showed that the individual regression equations for each relationship for these groups were not significantly different from each other. The combined regression equations were:

$$CW = 0.037\,G - 14.44,\ n = 29,\ RSD = +/- 1.26,\ r = 0.93$$

$$SW = 0.051\,G - 18.60,\ n = 25,\ RSD = +/- 0.96,\ r = 0.93$$

where CW is hot carcass weight (kg), SW is saleable weight (kg) and G is heart girth circumference (mm).

Table 4. Simple correlation coefficients for the relationships between fasted liveweight (FLW), empty body weight (EBW), carcass weight (CW), girth and carcass composition of Thai native goats raised under farm (F) and village (V) management systems.

Trait	System	LW (kg)	EBW (kg)	CW (kg)	Girth (mm)
EBW (kg)	F	0.99*	-	-	
	V	0.99*	-	-	-
CW (kg)	F	0.99*	0.72*	-	-
	V	0.99*	0.72*	-	-
Girth (mm)	F	0.95*	0.91*	0.91*	-
	V	0.95*	0.94*	0.92*	-
Muscle (kg)	F	0.98*	0.99*	0.99*	0.89*
	V	0.99*	0.99*	0.99*	0.93*
Fat (kg)	F	0.79*	0.92*	0.78*	0.72*
	V	−0.03	−0.01	0.01	−0.17
Carcass meat (kg)	F	0.98*	0.99*	0.99*	0.90*
	V	0.99*	0.99*	0.99*	0.91*
Saleable wt. (kg)	F	0.99*	0.99*	0.99*	0.90*
	V	0.99*	0.99*	0.99*	0.92*
Dressing %	F	0.91*	0.95*	0.95*	0.79*
	V	0.39	0.48	0.51	0.29
Saleable %	F	0.69*	0.69*	0.69*	0.45
	V	−0.10	−0.01	0.03	−0.20

* Significance level = $P < 0.01$

DISCUSSION

The effect management system on body and carcass composition

The Thai native goats used in this study were chosen from village herds so that they would be comparable in liveweight to those raised under improved management conditions. Since the village goats were on average four months older at the same liveweight as farm goats, it was apparent that farm goats had higher rates of growth than did village goats. At similar liveweights (15 kg) there were no differences between the groups for either linear body measurements

or weights of organs and body components. However farm goats had higher fat contents (8.4 %) in their carcasses than did village goats (5.1 %). Village goats also had higher connective tissue contents than did farm goats. It was also observed that with farm goats the fat content of the carcass increased with increasing liveweight, but this relationship was not significant for village goats. The low and highly variable fat reserves in village goats are possibly a reflection of the poor and variable nutritional regimes often experienced by village goats during their active growth phase. It was clear from this study that body weight alone was a poor predicter of carcass fat content confirming observations made by other workers with goats (Ash 1986), sheep (Black 1974) and cattle (Lloyd-Davies 1977) that body composition of ruminants can be modified by the nutritional regime independent of body weight.

The goats in this study appear to have a low propensity for fattening when compared with other goat breeds. Australian feral goats (Ash and Norton 1987) and Boer goats (Naude and Hofmeyer 1981) contain approximately 15 % fat whilst New Zealand feral goats (Kirton 1970) and Alpine goats (Fehr et al. 1976) have lower but similar fat contents (5-8 %) at comparable carcass weights to goats used in the present study. Although there are no fixed standards, high contents of fat in the carcass are probably not a desirable attribute of goat meat quality in Thailand. If improved management is going to increase both the growth rate and fat content of goats then there is a need to determine the minimum and maximum fat content of carcasses which will meet the requirements of the Thai consumer.

Comparative characteristics of Thai native goats

There is presently much interest in crossbreeding schemes to improve the productivity of the Thai goat. These schemes have been usually conceived without information on either the inherent productivity of goats under village conditions or on their response to improved management and nutrition. Milton et al. (1987) have demonstrated the extent to which improved management can increase the productivity of Thai goats. The present study provides baseline data on the phenotypic characteristics of Thai goats in relation to other goat breeds. Since Thai goats are principally raised for meat, their characteristics as meat producers should be examined. Carcass weight as a percentage of liveweight (dressing percentage) in our goats (45.9 %) was similar to that found for goats in Northern Thailand (Falvey and Hengmichai 1979). This value is generally higher than that found for other goat breeds of similar liveweight. The dressing percentage for Philippine native goats with an average 19 kg slaughter weight (8.3 chilled carcass weight) and for Malaysian

Katjang goats (18.6 kg liveweight) was only 43 and 44 % (Argayosa et al. 1977; Devendra 1980), respectively. Dressing percentage usually increases with liveweight (Devendra and Owen 1983), but in the present study this was only significant for the farm goats. Similar observations were made for saleable percentage and neither of these values were useful predictors of carcass or saleable weight from liveweight. If breeding objectives are to be set for meat goats then these should perhaps be in terms of the meat/bone ratio (MBR) at particular carcass weights. This ratio increases with carcass weight and for Australian feral goats varies from 2.4 for a carcass weight of 4.9 kg to 5.0 at maturity (carcass weight 19.5 kg). Females have higher ratios than males at the same carcass weight (Ash 1986). Goats with high ratios will be more desirable as meat breeds than those with low ratios. Thai male goats at 15.2 kg liveweight (6.9 kg carcass weight) had a mean MBR of 4.3. MBR increased from a value of 3.0 (8.8 kg FLW) to 5.2 (21.6 kg FLW). There was no significant effect of management system on this ratio, suggesting this trait is liveweight dependent. At similar carcass weights, MBR in Thai male goats compares favourably with those for male East African goats (3.5, Wilson 1960), male Botswana goats (2.6, Owen et al. 1978) and Alpine goats (2.8, Fehr et al. 1976). It would seem that Thai goats have desirable attributes as meat goats and care needs to be taken these characteristics are not lost in crossbreeding programs with introduced milch goats.

The proportion of the whole goat which is saleable will vary with locality. Devendra (1980) reported that Katjang goats in Malaysia had 96.2 % of total commercially saleable parts. In the present study, this value was only 70.3 % because head, feet, testes and penis were excluded from the calculation. In fact, some parts of these organs may be consumed such as brain, tongue and also the reproductive organs, but they were not separately dissected.

Prediction of liveweight and carcass composition

Goats in Thailand are usually sold on a price per head basis and this varies considerably from place to place. Goat meat is sold on a weight basis and is more expensive than meat from cattle, buffaloes, pigs and poultry (Saithanoo et al. 1988). The present studies show that both carcass meat (muscle + fat) and saleable weight increase with liveweight and therefore producers would obtain a better return for their goats if they were sold on a weight basis rather than a per head basis. Two problems exist that may prevent this system operating. Firstly the need to sell may be determined by economic circumstances of the farmer in which case the price will be determined by the trader and not the farmer. There is little that be done about

this circumstance. Secondly, goat farmers usually have no means to weigh their animals, and therefore are unable to bargain in relation to the market price of the meat. Our studies have shown a close relationship between girth circumference and fasted liveweight, carcass meat and total saleable weight. These relationship could be used in two ways. Firstly the measurement of girth would allow the prediction of liveweight which may then be used to gain information on the patterns of liveweight change in village goats in different seasons and locations. The range of liveweights covered in our study was limited (9 to 22 kg), and further information needs to be collected for goats outside this range and for females over the whole weight range. Secondly these relationships could be used by farmers to translate these commercial traits (carcass and saleable weight) into economic value for individual goats. It is proposed that a tape measure could be developed using our prediction equations which interpreted girth circumference directly to either carcass weight, carcass meat or saleable weight which in turn could be converted by the farmer into an economic value from his knowledge of the present market price of these respective components. It is suggested that such a scheme might return a more equitable proportion of goat sales to the poor farmer and perhaps provide a more realistic basis for bargaining than now exists.

CONCLUSION

The information presented in this paper provides baseline data on the body and carcass composition of Thai native male goats raised under improved management conditions (farm) and village goats which were raised by traditional methods. Farm goats had faster growth rates and higher fat contents than did village goats. There was no effect of management treatment on carcass weight and saleable weight when goats from the two groups were compared at the same liveweight. Liveweight, carcass weight and saleable weight were significantly correlated with heart-girth circumference and it is suggested that girth measurement may provide an accurate field method for the prediction of liveweight and carcass composition in the absence of suitable weighing facilities.

ACKNOWLEDGEMENTS

We wish to thank Mrs. W. Rakswong, Mr. C. Bupharanoo, Mr. K. Lumnuan, Mr. P. Khrongyot, and Mr. L. Charoenrungwattana, graduate assistants of Goats Research and Development in Southern Region of Thailand, for assistance given to the experiment. This study was funded by the

Thai-Australian Prince of Songkla University Project and we are grateful to both Professor Sujin Jinahyon and Professor T.R. Paton for their encouragement during this program.

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