MORPHOMETRIC CHARACTERISTICS OF ETAWAH GRADE GOAT AS A FEMALE POPULATION OF CROSSED SAPERA DAIRY GOAT AT IRIAP

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ABSTRACT

Morphometric is an essential characteristics of a breed of livestock. Morphometrics can be used to direct to an ideal dairy goat type. Etawah Grade (EG) does has been functioned as a female population in the crossing to Saanen bucks to improve its genetic milk yield. This study was aimed to describe body weight and some body measurements as well as to predict body weight from body measurements of EG goat as a female parent population of the crossed sapera goat at IRIAP, Indonesian Research Institute for Animal Production, Bogor, West Java. Goat samples were at the age ranges of 1.5 to 6 years old for a total of 44 hds, consisting of 34 females and 10 males. Body weight and body measurements were classified by sex and age (1.5 - 2, 3 - 4, 5 and 6 years). Body weight was estimated from body sizes by linear and quadratic regressions. EG males generally had larger body sizes than females. By the aging animals, the differences tended to increase. At 1.5 - 2, 3 - 4, and 5 years old, EG females had body weight by 37.7±1.9, 44.2±2.6, and 46. ±4.1 kg; whereas for males were 45.3±4.7, 47.2±0, and 56.7±6.1 kg respectively. At those respective ages, EG females had chest girth of 75.7±0.6, 83.6±3.5, and 85.6±3.3 cm, while for males were 81.5±3.5, 83.0±0, and 89.0±2.7 cm. Chest Girth and hip height by using simple linear regression could be quit good predictors for estimating body weights at various ages of EG goat.

Keywords: dairy goat, morphometric, body weight, and body measurement.

INTRODUCTION

Fresh milk in the country is mostly supplied by Holstein Friesian dairy cows. Milk yield from dairy goat has still contributed small part to the national fresh milk. Recently demand on milk from dairy goat by the community has significantly increased, leading to faster growing dairy goat farms. By the growing dairy goat businesses promises income opportunities to dairy goat farmers, as dairy goat cultivation only require small capital investment and can be raised in a limited land (Astuti and Sudarman, 2012). To make profitable in dairy goat agribusiness requires dairy goat breeding stocks with high high milking ability. Dairy goat breeding stocks can be produced by the crossing between local dairy goats to exotic ones.

Etawah Grade (EG) goat is a dual purposes of local dairy goat that can serve to produce milk and meat. EG goat is the result of the cross breeding between local kacang goat to Etawah goat and has adapted in a long time in various local environments. This goat can produce a quit high milk yield under

good management in tropical climate. EG goats that were raised under an intensive management at IRIAP (Indonesian Research Institute for Animal Production) produced milk around 129.0 - 508.9 L lac^{-1} by the average of 158.2 L lac^{-1}; while daily production was around 0.2 - 2.9 L lac^{-1} by the average of 0.82 L lac^{-1}. Lactation length was between 55-316 days by the average of 193 days. However, the ability of this goat in producing milk has varied widely, due to among others was no planned selection on milk production. Saanen is known as a temperate dairy goat with excellent genetic milking ability in temperate regions. Saanen goat is originally from Switzerland and has been improved for newly saanen breed, such as British Saanen, USA Saanen, French Saanen, Australian Saanen and NZ Saanen. In those countries, milk production produced by Saanen goats is excellent around 3.0 - 5.2 L lac^{-1}.

Genetic improvement of milk production in EG goat can be done by crossing EG does to exotic dairy goat bucks of having good genetic transferring milk ability. Crossing to exotic dairy goat is one good alternative to improve genetic ability in producing milk of local dairy goat as carried out by a number of countries both in temperate zones (Aziz, 2010) or some tropical countries (Devendra, 2012). High milk production in Saanen goat can be used to increase genetic potential of milk production in local dual purpose EG goat. Crossing EG females to Saanen bucks was done for several years at IRIAP to produce the crossed dairy goat offsprings named as Sapera. Body measurements can be used as an early indicator for estimating whether a female dairy goat will have good milking ability. Body weight is an important factor in identifying dairy goats to be considered as candidates of breeding stocks. Body weight can be estimated from a number of body sizes of whose high correlation between the two. A simple statistical model that can be used to estimate body weight from any body size with a high accuracy can be useful for identifying candidates of breeding stocks under field conditions (Mahmud *et al.*, 2014).

This study was aimed to determine body weight and body measurements as well as to develop simple regression equation for estimating body weight from body sizes. Information on body weight, body measurement, and estimated body weight from some individual body sizes will be useful to direct into an ideal dairy goat conformation and to make easier of availability of body weight data of EG goat as female parent population of Sapera goat at IRIAP.

MATERIALS AND METHODS

Research Location

This research was done by using Etawah Grade (EG) dual purpose goat raised at a dairy goat station at IRIAP (Indonesian Research Institute for Animal Production), Ciawi Subdistrict, Bogor, West Java. IRIAP was located in an area of about 23 ha in Banjar Waru Village, Ciawi Subdistrict, Bogor Regency, at an altitude of 450 to 500 m asl with rainfall between 3,500 to 4,000 mm per year.

Materials

Etawah Grade (EG) goat used as animal research in this study was EG females that were crossed mating to Saanen bucks to produce Sapera dairy goat at IRIAP. The observed EG goats were for females at the age ranges between 1.5 - 6 years old and for male between 2 – 5 years old. Ages were determined on the base on kidding dates and dentish change information. A goat of still having

milk teeth (temporer) was determined less or one year old. For a goat having 1, 2, 3, and 4 pairs of permanent teeth were determined respectively at the ages of 2, 3, 4, and 5 years old. If a goat experienced 1 or more pairs of erosion teeth was considered > 5 years old.

Body weight (kg) data were weighed and body sizes were measured providing both linear and non linear (cm) measurements, namely chest girth, chest depth, body length, shoulder height, hip height, hip width. For head was measured face length, face width, ear length, and ear width. Foot was measured front length leg and hind leg length. as well as for tail length and tail width.

Management

Many forages were fed to EG goat providing grases and legumes. Grasses were fed for king grass or *Pennisetum purpureum*, while for legumes were gamal leaf or *Gliricidia maculata* and *Caliandra calothyrsus*. Lactation does were fed forages by 2.5 - 3 kg/hd/d, while young goats were fed by 2-2.5 kg/hd/d. Concentrate was feed for lactation does by 800 gr/hd/d, while that for young females were by 600 gr/hd/d.

Data Analysis

Data of body weight and body measurements were classified by sex, namely males and females, and four age groups, namely 1.5 - 2, 3 - 4, 5, and 6 years old. Data were calculated for average and standard deviation values and mean test by sex were done for EG goat at the same ages. Estimation of body weight from individual body size was developed by linear and quadratic regression equations for each age classification within sex. Coefficient of determination (R^2) value was used to know level of accuracy of regression equation in estimating body weight from individual body measurement. Some body sizes used to predict body weight were body length, chest girth, chest depth, shoulder height, and hip height.

RESULTS AND DISCUSSION

Body Weights

Body weight reflects the level of efficiency of livestock in converting feed into meat and muscle tissues. Body weight is a good indicator in knowing growth, cell tissue composition, body condition and carcass quality of livestock (Lambe *et. al.*, 2008). T From this study, the number of the observed female EG goats that were classified into 4 ages of 1.5-2, 3-4, 5, and 6 years old were 3, 10, 14 and 7 heads respectively. While the number of male EG goats classified into 3 age groups, namely 1.5-2, 3-4, 5 years old, were 2, 1, and 3 heads respectively. Average and standard deviation of body weight and body sizes of the observed EG goats for the respective sex and ages are presented in Table 1.

Averages of body weights of EG goats in both sexes increased by the aging animals. EG males had higher body weights than females at the respective ages. For the ages of 1.5 - 2, 3 - 4, and 5 years old, males were heavier to females by 7.9, 6.8, and 21.4 % respectively. A similar pattern was found for body weights of this EG goat by pooled sex. Higher body weights of males against females might be due to male hormonal influences to anabolic process and also the ability of males to eat more than females.

Table 1. Average and standar deviation of body weight of EG goats by sex and age

Age (year)	Female		Male		Both	
	Goat (head)	X ± Sd (kg)	Goat (head)	X ± Sd (kg)	Goat (head)	X ± Sd (kg)
1.5-2	3	37.7±1.9[a]	2	45.3±4.7[c]	5	40.7±35.6
3-4	10	44.2±2.6[a]	1	47.2[b]	11	44.4±40.3
5	14	46.7±4.1[a]	3	56.7±6.1[c]	17	48.5±41.6
6	7	60.4±8.7			7	60.4±45.5

Description: letters by sex at the same row showed significant different (P<0.05)

Male goats had heavier body weights than females were also reported in many previous studies. Gebreyowhens and Kumar (2017) in characterizing local Maefur goat from Nigeria, as an example, reported males were heavier than females (P <0.01) for each age groups of 4-12, 13-18, 19-24, and 35-36 months. Body weights at these ages for males were successively 20.5 ± 3.3, 28.5 ± 3.1, 31.2 ± 2.9, and 42.8 ± 6.6 kg; while those for females were respectively 18.5 ± 4.4, 26.4 ± 2.9, 27.9 ± 4.6, and 32.7 ± 5.4 kg. Males against females for the respective ages thus had heavier body weights by 10.8, 8.0, 11.8, and 30.9 %. Birteeb *et al.* (2015) by observing growth traits of WAD (West Africant Dwarf) goats during earlier ages old, from birth to weaning, also gained higher growth rates and higher body weights of males to females (P<0.05), namely 32.4 g d^{-1} and 5.3 kg vs. 31.8 gr d^{-1} and 5.2 kg.

A different results was found for local Terai goats from Eastern Nepal of which different sex had similar growth rates and body weights during preweaning ages of animals. By the adding ages (up to 8 months), however, males grew faster and achieving heavier body weights than females (Bhattarai & Sapkota, 2012). Further Rani *et al.* (2010) reported that sex did not give significant effect (P> 0.05) on body weight at the classified ages between <1 month-9 months of Malabari goat in northern Karala. Averages of body weights for the ages of <1, 3, 6, and 9 months were succesively 2.4±0.1, 9.5±1.1, 16.1±0.1, and 21.2±0.3 kg; while those at the same ages for females were 2.4 ± 0.1 kg , 9.6 ± 0.2 kg, 16.2 ± 0.4 kg, and 22.2 ± 0.5 kg.

Body Measurements

Morphometrics of body reflect development of conformation and body frame. Body weights and skeletons become important variables of selection activities, such as to identify well-developed livestock individuals who will be considered as candidates of breeding stocks seed (Gilbert *et al.*, 1993). In dairy goats, body measurements reflect the growth of the skeleton. The linkage of growths between skeletons can be a consideration for addressing appropriate dairy goat conformations. Goat dairy type is expected when approaching the posture of dairy cows. Mean and standard deviation values of various EG goat sizes classified by sex and age are presented in Table 2.

For a number of major body sizes of EG goats, sex was not significantly affected (P>0.05) when animals were at younger ages. However, by increasing the ages significant differences in some body size were found between males and females. Male EG goats have longer body sizes than females (P <0.05). These body sizes were chest depth, shoulder height, and hip height. At the age of 1.5-2, 3-4, and 5 years, EG male goats had larger sizes in in chest depth by 2.8%,

2.7%, and 1.8%; shoulder height by 1.5%, 0.1%, and 0.9%; as well as hip height by 0.8%, 0.01% and 0.6% respectively. By comparing hip pelvic width of EG male and female goats at the same ages showed that males were higher about 9.6%, 0.1%, and 1.5%. Some body sizes were not affected by sex, namely chest width and body length.

Table 2. Average of body measurement of EG goats by sex and age

Age	Female	Male	Both	Female	Male	Both
	X ± Sd	X ± Sd	X ± Sd	X ± Sd	X ± Sd	X ± Sd
	Face Length			Face Width		
1.5-2	22.0±2.0[a]	27.0±0.0[b]	24.0±3.1	16.0±1.0[a]	20.5±0.7[b]	17.8±2.6
3-4	24.1±1.7[a]	28.0[a]	25.5±2.0	17.6±1.2[a]	20.0[a]	17.8±1.3
5	24.1±0.5[a]	27.7±2.1[c]	24.8±2.2	18.0±1.3[a]	21.0±1.0[c]	18.7±2.0
6	23.1±0.5		23.1±1.3	19.6±1.8		19.6±15.0
	Ear Length			Ear Width		
1.5-2	30.0±1.0[a]	36.0±2.8[b]	32.4±3.7	11.7±1.2[a]	11.0±0.0[a]	11.4±1.2
3-4	33.8±1.9[a]	32.0[a]	33.6±1.9	11.7±1.6[a]	12.0[a]	11.7±1.5
5	31.8±1.9[a]	35.3±0.6[a]	32.4±2.2	11.1±0.9[a]	12.2±1.3[a]	11.3±1.0
6	33.6±3.5		33.6±3.5	12.1±1.5		12.1±1.5
	Chest Girth			Chest Depth		
1.5-2	75.7±0.6[a]	81.5±3.5[a]	78.0±3.7	18.0±2.7[a]	23.0±0.0[a]	20.0±3.3
3-4	83.6±3.5[a]	83.0[a]	87.5±3.4	20.5±1.3[a]	26.0[c]	21.0±2.0
5	85.6±3.3[a]	89.0±2.7[a]	86.2±3.4	20.6±2.3[a]	24.3±1.5[b]	21.3±2.6
6	88.9±5.3		88.9±5.3	22.0±1.0		22.0±2.5
	Body Length			Shoulder Height		
1.5-2	72.2±1.6[a]	75.0±2.8[a]	73.3±2.4	72.8±10.2[a]	83.5±3.5[a]	77.1±9.5
3-4	73.5±2.1[a]	73.5[a]	73.5±2.0	82.5±7.0[a]	83.0[a]	82.5±3.1
5	75.6±3.8[a]	79.0±3.0[a]	76.0±3.8	82.0±2.9[a]	89.0±6.9[b]	83.2±4.5
6	83.1±5.2		83.1±5.1	84.7±4.8		84.7±4.8
	Hip Height			Hip Width		
1.5-2	80.0±4.0[a]	86.5±3.5[a]	82.6±4.9	78.0±2.0[a]	85.5±2.1[b]	81.0±4.5
3-4	82.9±7.0[a]	84.0[a]	83.0±3.0	84.4±4.3[a]	85.0[a]	85.9±4.4
5	83.9±2.5[a]	88.6±2.7[b]	84.6±2.9	86.7±6.3[a]	88.0±1.00[a]	86.9±5.7
6	86.7±4.7		86.7±4.7	94.9±4.5		94.9±4.5
	Front Leg Length			Hind Leg Length		
1.5-2	50.3±2.1[a]	52.3±1.8[a]	51.1±2.0	56.7±2.1[a]	54.0±4.3[a]	55.6±3.0
3-4	51.6±2.8[a]	54.0[a]	51.8±2.8	56.2±1.9[a]	57.0[a]	56.3±1.8
5	50.1±2.1[a]	55.0±3.0[c]	51.9±2.9	55.0±3.2[a]	60.7±3.1[b]	56.0±3.8
6	52.7±4.1		52.7±4.1	58.3±6.4		58.3±6.4
	Tail Length			Tail Width		
1.5-2	18.1±1.0[a]	20.5±0.7[a]	19.0±1.6	5.8±1.3[a]	6.8±1.1[a]	6.2±1.2
3-4	17.9±1.7[a]	21.0[a]	18.2±1.9	6.2±1.0[a]	7.0[a]	6.3±1.0
5	18.6±1.5[a]	21.5±2.7[b]	19.0±1.9	5.1±0.6[a]	6.5±1.3[c]	5.4±0.9
6	18.4±1.3		18.4±1.3	5.3±0.8		5.3±0.8

Description: letters by sex at the same row showed significant different (P<0.05)

Gebreyowhens and Kumar (2017) who observed Maefur local goat from northern Nigeria reported sex affecting all goat body sizes for every age observed. At the age ranges of 4-12, 13-18, 19-24, and 35-36 months showed males compared to females had greater chist girth by 3.3%, 0.2%, 5.5%, and 1.2%; wither height by 6.3%, 2.9%, 7.8%, and 13.6%; rumpth height by 7.8%, 1.0%, 4.6%, and 9.9%; and chest depth by 3.2%, 2.3%, 7.3%, and 12.4%. Rani *et al*. (2010) in observing Malabari local goat in Karala also gained

significant effects of sex (P>0.05) on body sizes for <1, 3, 6, and 9 months of ages of animals. For those respective age ranges were obtained chest circumference, paunch girth, body length and shoulder height for males were 31.5±0.2, 32.5±0.3, 28.9±0.3, and 32.1 ± 0.2 cm respectively; whereas in females were 31.4±0.2, 32.5±0.3, 30.1±0.3, and 32.2±0.3 cm respectively. Study in Black Bengal goat from Bangladesh by Paul *et al.* (2011) at birth, 3, 6, 9, and 12 months og ages showed that males had very significant body sizes than anothers (P<0.05). Rahman (2007) also reported differences in face length and width for both sex in this goat. At birth 3, 6, 9, and 12 months of ages, males with face length (8.6, 12.1, 14.4, 15.4, and 16.7 cm) was longer than females (7.0, 7.9, 11.5, 11.7 and 12.1 cm).

Estimation of Body Weight from Body Measurements

Many studies have developed statistical equation to estimated body weight based on a number of body sizes, both linear and non-linear bodies. Simple statistical equations with a good accuracy in estimating body weight from body sizes will be very helpful in developing data of body weight of livestock in difficult conditions of weighing especially in the fields. Since the body measurements had high correlation with the body weight of gotas, so these variables may be used as selection criteria to identify good breeding stocks (Khan *et al*., 2006).

Some body measurements usually used as body weight predictors are body length, chist girth, chist depth, sholuder height, and hip height. Relationship between body weight and individual body size of EG goats for the classified 4 age groups in this study was developed using linear and quadratic regressions as presented in Table 3.

To estimate body weight from individual body size by pooling sex in the observed EG goat resulted different levels of accuracy among different classifies ages of 1.5-2, 3 - 4, and 5 - 6 years old. Based on the coefficient of determination (R^2) values showed that linear and quadratic regressions with the highest accuracy for predicting body weight at young ages (1.5 - 2 years) were chest girth, namely with R^2 Lin. = 95.8% and R^2 Qua. = 97.2%. Hip height was found as the second predictor (R^2 Lin. = 70.7%, R^2 Qua. = 93.4%). Thiruvenkadan (2005) suggested the existence of high association of body weight with chest girth in relating to growths of bones, muscles and viscera. A regression coefficient of heart girth measurement against body weight of 0.895 showing a strong relationship between the two variables. Measurement of heart girth therefore can be used in developing a tape measure to assist farmers in getting body weights and for the better management purposes (de Villiers *et al*., 2009)

For the 3-4 years old of EG goats, chest depth was obtained as the best body weight estimator (R^2 Lin. = 42.5%, R2 Qua. = 50.7%). Entering the 5 years old so body weight could be accurately estimated by three body sizes, namely chest depth (R^2 Lin. = 54.7%, R^2 Qua. = 69.7%), hip height (R^2 Lin. = 40.4%, R^2 Qua. = 46.4%), and chest girth (R^2 Lin. = 40.1%, R^2 Qua. = 42.6%.) Further by the mature age (6 years) only chest girth was as the best predictor of body weight (R^2 Lin.= 81.2%, R^2 Qua. = 81.2%). However, by improving linear regression to quadratic regression to estimate body weight of the observed EG goat had only relatively small accuracy increases of only about 2.5 to 15.0%). Even to estimate body weight from chest girth of adult (6 years) EG goat, by developing linear regression to quadratic regression gave no any increasing

accuracy. Based on these results, therefore it can be stated that body weight of the observed EG goat can be estimated fairly by simple linier regression from individual body size considered.

Table 3. Estimation of body weight from body sizes by linear and quadratic regressions by age in EG goat

Body size		Regression Equation	R^2	Prob.
		1.5 – 2 years old		
Body Length	Lin.	BW = -65.76 + 1.453 BL	48.6	0.191
	Qua.	BW = 3005 – 81.60 BL + 0.5610 BL^2	72.3	0.128
Chest Girth	Lin.	BW = -63.28 + 1.333 CG	95.8	0.002
	Qua.	BW = -283.8 + 6.89 CG – 0.03487 CG^2	97.2	0.028
Chest Depth	Lin.	BW = 21.45 + 0.9636 CD	41.2	0.243
	Qua.	BW = 126.0 – 10.22 CD + 0.2915 CD^2	65.5	0.345
Shoulder Height	Lin.	BW = 15.20 + 0.3311 SH	39.5	0.256
	Qua.	BW = 324.4 – 8.305 SH + 0.05928 SH^2	96.9	0.034
Hip Height	Lin.	BW = -30.11 + 0.8576 HH	70.7	0.008
	Qua.	BW = 728.1 – 17.60 HW + 0.1120 HW^2	93.4	0.066
		3 – 4 years old		
Body Length	Lin.	BW = 19.29 + 0.3420 BL	7.0	0.432
	Qua.	BW = -159 + 5.20 BL – 0.0331 BL^2	7.3	0.740
Chest Girth	Lin.	BW = 9.99 + 0.4124 CG	28.3	0.092
	Qua.	BW = 75.6 – 1.163 CG + 0.0094 CG^2	28.6	0.260
Chest Depth	Lin.	BW = 26.98 + 0.8310 CD	42.8	0.029
	Qua.	BW = -30.75 + 6.116 CD – 0.1197 CD^2	50.7	0.059
Shoulder Height	Lin.	BW = 15.20 + 0.3311 SH	25.8	0.110
	Qua.	BW = 324.4 – 8.305 SH + 0.05928 SH^2	28.9	0.256
Hip Height	Lin.	BW = -30.11 + 0.8576 HH	17.4	0.202
	Qua.	BW = 728.1 – 17.60 HW + 0.1120 HW^2	19.4	0.422
		5 years old		
Body Length	Lin.	BW = 6.77 + 0.5466 BL	12.8	0.159
	Qua.	BW = 91.9 – 1.67 BL + 0.0144 BL^2	12.9	0.380
Chest Girth	Lin.	BW = -45.39 + 1.088 CG	40.1	0.006
	Qua.	BW = 388.5 – 9.03 CG + 0.05894 CG^2	42.0	0.022
Chest Depth	Lin.	BW = 13.44 + 1.646 CD	54.7	0.001
	Qua.	BW = 89.13 – 6.015 CD + 0.19002 CD^2	69.7	0.000
Shoulder Height	Lin.	BW = 16.86 + 0.7846 SH	37.6	0.009
	Qua.	BW = 240.6 – 5.293 SH + 0.3575 SH^2	39.2	0.026
Hip Height	Lin.	BW = -61.26 + 1.297 HH	43.4	0.004
	Qua.	BW = 544.8 – 13.09 HW + 0.08530 HW^2	46.4	0.013
		6 years old		
Body Length	Lin.	BW = -20.34 + 0.9722 BL	32.4	0.182
	Qua.	BW = 1.266 – 29.84 BL + 0.1840 BL^2		0.373
Chest Girth	Lin.	BW = -72.05 + 1.491 CG	81.2	0.006
	Qua.	BW = -83.7 + 1.76 CG – 0.00152 CG^2	81.2	0.035
Chest Depth	Lin.	BW = 38.76 + 0.984 CD	18.1	0.535
	Qua.	BW = 240.0 – 17.45 CD + 0.4175 CD^2	20.6	0.637
Shoulder Height	Lin.	BW = -49.15 + 1.293 SH	51.5	0.069
	Qua.	BW = 239 – 5.51 SH + 0.0400 SH^2	51.5	0.069
Hip Height	Lin.	BW = -76.15 + 1.575 HH	73.1	0.014
	Qua.	BW = 233.4 – 5.47 HH + 0.0400 HH^2	73.9	0.063

Description: BW was body weight, Lin. was linier regression, Qua. was quadratic regression, R^2 was coefficient determination, and Prob. was probability

Das *et al.* (1990) by simple regression equations to estimate body weight in Barbari and Jamunapari goats by pooling sex reported at age 3 mo. old chest girth gave a good accuracy. At the age of 6 mo. olds therefore chest girth and wither height contributed greatly. Further at 9 mo. old so chest girth became the best predictor of body weight, but at one years old chest girth and paunch girth were as the best predictors. Estimated body weight from body measurements in Hararghe highland goat breed by Segaye *et al.* (2013) through regression analysis resulted highest and significant correlation ($p < 0.01$) between body weight and heart girth, both for male ($r = 0.96$ and $r = 0.82$) and female ($r = 0.93$ and $r = 0.73$). In regarding to Tsegaye *et al.* (2013) body weight of goats can be predicted from heart girth, body condition, rump length, wither height and pelvic width with coefficient of 0.95 for males and 0.90 for females.

CONCLUSION

Body weights and body sizes of the observed EG goat at the ages of 1.5-2, 3-4, and 5 years old, of males were heavier against females by 7.9, 6.8, and 21.4% respectively. Those differences from body weights and body sizes become higher by the increasing ages within and between sex of EG goat. Body weight of EG goats can be predicted with good accuracy from a number of body sizes using simple linear regression. The information obtained from this study can be used to determine body weight and body sizes of the observed EG goat ant to direct their conformation toward an ideal dairy goat type.

REFERENCES

Astuti, D.A., A. Sudarman. 2012. Dairy goats in indonesia: potential, opportunities and challenges. E-Proceedings First Asia Dairy Goat Conference. 9-12 April 2012. UPM, Kuala Lumpur, Malaysia. Page: 47 – 51.

Aziz, M.A. 2010. Present status of the world goat populations and their productivity. Lohmann Information. Vol. 45 (2), Oct. 2010, Page 42-52.

Bhattarai, N., Sapkota. 2012. Effect of non genetic factors on weight traits of local Tarai goats under farmers' managed condition. Nepal J. of Science and Technology. 12(2011):51-54.

Birteeb, P.T., B.A. Danquah, S.S. Abdul-Rahaman. 2015. Growth performance of west african dwarf goats reared in the transitional zone of Ghana. Asian J. of Animal Sciences. 9(6):370-378.

Das, N., H.B. Joshi, G.S. Bisht. 1990. Prediction of body weight from body measurements in Barbari and Jamnapari goats reared under intensive management system. Indian Vet. J. 67:347-351.

de Villiers, J.F., S.T. Gcumisa, S.A. Gumede, S.P. Thusi, T.J. Dugmore, M. Cole, J.F. du Toit, A.F. Vatta, C. Stevens. 2009. Estimation of live body weight from the heart girth measurement in KwaZulu-Natal goats. Appl. Anim. Husb. Rural Develop. 1:1-8.

Devendra, C. 2012. Dairy Goats in Asia: Multifunctional Relevance and Contribution to Food and Nutrition Security. E-Proceedings First Asia Dairy Goat Conference. 9-12 April 2012. UPM, Kuala Lumpur, Malaysia.

Gebreyowhens, W., R. Kumar. 2017. Phenotypic characterization of indigenous Maefur goat population in Tigray, Northern Ethiopia. International J. of Biodiversity and Conservation. 9(5):130-145.

Gilbert. R.P., D.R.C. Bailey, N.H. Shannon. 1993. Body dimensions and carcass measurements of cattle selected for post-weaning gain fed two different diets. J. Anim. Sci. 71:1688–1698.

Khan, H., F. Muhammad, R. Ahmad, G. Nawaz, Rahimullah, M. Z. Khan. 2006. Relationship of body weight with linear body measurements in goats. J. of Agricultural and Biological Sci. 1(3):51-54.

Mahmud, M.A., P. Shaba, U.Y. Zubairu. 2014. Live body weight estimation in small ruminants-A Review. Global J. of Animal Scientific Research. 2(2):102-108.

Paul, S., M.A.M.Y. Khandoker, M.A. Moinuddin, R.C. Paul. 2011. Characterization of Black Bengal goat. J. Bangladesh Agril. Univ. 9(1):61–66.

Rani, A., K.C. Raghavan, K.A. Mercey. 2010. Prediction of body weight of Malabari goats from body measurements under field conditions. J. Vet. Animal Sci. 41:21-27.

Tsegaye, D., B. Belay, A. Haile. 2013. Linear body measurements as predictor of body weight in Hararghe Highland Goats under farmers environment: Ethiopia. Global Veterinaria. 11(5):649-656.