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Response to phenotypic screening of Mubende meat goats

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Abstract

Sixty-two mature goats of the Mubende breed sampled from the field on the basis of heart girth were used in a study to estimate the contribution of parental phenotype to body weight gain at different ages in indigenous goats. Four mating groups were formulated on the basis of weight and heart girth of the does and bucks. At birth, kids from the elite mating group were heavier ($P<0.05$) than those of the controls. Kids born to elite bucks though not significantly heavier from kids born to ordinary ones at birth, were progressively heavier with time, 8 weeks ($P<0.01$), weaning ($P<0.01$) and at one year ($P<0.05$). Average kid birth weights were 2.34, 2.12, 2.28, 2.11 kg for elite, reciprocal I, reciprocal II and control, respectively. Male kids were significantly heavier ($P<0.001$) at birth and all subsequent ages up to 40 weeks, and showed a faster growth rate ($P<0.01$) to 52 weeks of age, than female kids. Kids from single birth weighed an average of 2.29 kg at birth compared to 2.05 kg for kids born as twins. The differences in birth weight were significant ($P<0.001$) and persisted up to 44 weeks of age. Post weaning kid diet had a significant influence on body weight gain with animals weaned on a diet of 25% crude protein (CP) gaining at a faster rate than those fed a 15 % CP diet.

Key words: Birth weight, genetic response, selection, weaning weight

Introduction

Goats along with sheep form the second most important livestock in the agricultural production systems in Uganda (Kiwuwa, 1996). Livestock contributes 17% of the Ugandan agricultural GDP (MFPED, 2000). The livestock population has been rising consistently and was estimated at 5.7, 1.0, 5.1 and 1.4 million goats, sheep, cattle and pigs respectively (MAAIF, 1996). Little reliable information is available on the performance of indigenous Ugandan goats and the consequences of genetic selection for increased rates of production. Work done on the reproductive performance of Uganda meat is scanty. Indigenous goat breeds (the Mubende, the Small East African and the Kigezi) comprise up to 95% of the Uganda goat population (Nsubuga, 1996). Low growth rate is one of the major limiting factors in goat production and results from low genetic potential. The present investigation was conducted to estimate the contribution of parental phenotype to body weight gain at different ages in indigenous goats, and to determine the effects of non-genetic factors on kid performance.

Materials and methods

Experimental treatments were constituted by four mating groups based on body weight and heart girth measurements as follows: ordinary buck x ordinary doe (control); large buck x large doe (elite); large buck x ordinary doe (reciprocal I) and ordinary buck x large doe (reciprocal II). Random mating was done within each group. Does were synchronised for eostrus using intra-muscular injections of prostaglandin PGF_{2} (Sanofi Sante Nutrition Animale, France) hormones. Body weight of kids was taken on a weekly basis from birth to twelve months of age. At weaning, kids from each treatment were

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Data were subjected to analysis of variance of General Linear Models of SAS (SAS, 1993) procedures using a fixed model. Fixed effects were the mating groups, buck size, doe size, kid sex, litter size, kidding season, and diet treatments. The models used were:

$$Y_{ijklmn} = \mu + B_i + D_j + S_k + L_l + P_m + (BD)_{ij} + (SL)_{kl} + (LP)_{lm} + e_{ijklmn} \quad N(0, \sigma_e^2) \quad \text{(i)}$$

Where:

Y_{ijklmn} = Live weight of the n^{th} kid born of the i^{th} buck size and j^{th} doe size, k^{th} sex, in the l^{th} litter size and during the m^{th} season of birth;

μ = general mean of the kid herd;

B_i = effect of the buck size (i = 1,2);

D_j = effect of the doe size (j = 1,2);

S_k = effect of kid sex (k = 1,2);

L_l = effect of litter size (l = 1,2);

P_m = effect of season of birth (m = 1,2);

$(BD)_{ij}$ = effect of interaction between buck size and doe size (ij = 1,2,3,4);

$(SL)_{kl}$ = effect of interaction between kid sex and litter size;

$(LP)_{lm}$ = effect of interaction between litter size and season of birth;

e_{ijklmn} = random error term that is associated with the kid record.

The above model was used in the preliminary analysis. Due to the finding that the buck group by dam group interaction effect $(BD)_{ij}$, the effect of kid sex and litter size interaction $(SL)_{kl}$ and the effect of interaction between litter size and season of birth $(LP)_{lm}$ did not significantly affect performance of kids and they were eliminated from the model. subsequently, two new models were used as shown below.

$$Y_{ijklmn} = \mu + B_i + D_j + S_k + L_l + P_m + e_{ijklmn} \quad N(0, \sigma_e^2) \quad \text{(ii)}$$

$$Y_{ijklmno} = \mu + B_i + D_j + S_k + L_l + P_m + F_n + e_{ijklmn} \quad N(0, \sigma_e^2) \quad \text{(iii)}$$

Where F_n is the supplementary ration used post weaning (n = 1,2)

Results and discussion

Effects of buck size, doe size and kid sex

Average kid birth weights were 2.34, 2.12, 2.28, 2.11 kg for elite, reciprocal I, reciprocal II and control, respectively. Kids born to elite bucks were significantly heavier ($P<0.05$) than those of control bucks from birth and at all subsequent ages up to one year (Tables 1 and 2, Fig.1). The growth rate of kids sired by elite bucks were faster than those of the controls in the first eight weeks, and though the former remained superior in weight gain up to weaning, subsequent differences in growth rates were not significant (Table 1). The average daily gain of all the kid categories during the pre-weaning period was found to be 69.67 g, which was higher than 50.80 g reported by Oluka (1999), but less than 75.70 g reported by Okello (1993). The weight of weaners sired by elite bucks were significantly higher than

Table 1. Means for kid body weight from birth to 24 weeks..

Factors	Birth weight	4 weeks	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks
Sire groups							
Elite (EB)	2.19+0.05	4.84+0.20	6.63+0.33^{c}	7.99+0.40^{a}	9.18+0.64^{a}	11.28+0.51^{c}	13.64+0.77^{c}
Control (CB)	2.14+0.05	4.44+0.20	5.48+0.33^{d}	6.37+0.41^{b}	7.52+0.60^{b}	9.63+0.51^{d}	10.83+0.77^{d}
Dam group							
Elite (ED)	2.18+0.07	4.72+0.20	6.30+0.32	7.48+0.40	8.76+0.55	10.89+0.50	12.25+0.53
Control (CD)	2.13+0.06	4.56+0.20	5.81+0.32	6.89+0.40	7.94+0.62	10.02+0.50	11.43+0.55

abcd For each age and grouping class along the column means with different superscripts differ significantly (P<0.05); (P<0.01).

Table 2. Means of kid body weight from 32 to 52 months of age.

Factors /effects	32 weeks	40 weeks	48 weeks	52 weeks
Sire groups				
Elite (EB)	15.22±0.66^{a}	17.23±0.68^{a}	19.28±0.67^{a}	19.84±0.83^{a}
Control (CB)	13.27±0.67^{b}	15.30±0.76^{b}	15.71±1.23^{b}	16.58±1.51^{b}
Dam groups				
Elite (ED)	14.90±0.63	17.67±0.69^{c}	18.65±1.11	19.35±1.16
Control (CD)	13.59±0.70	14.86±0.71^{d}	16.34±0.88	17.07±1.29

ab, cd For each age and grouping class along the column, means with different superscripts differ significantly (P<0.05); P<0.01).

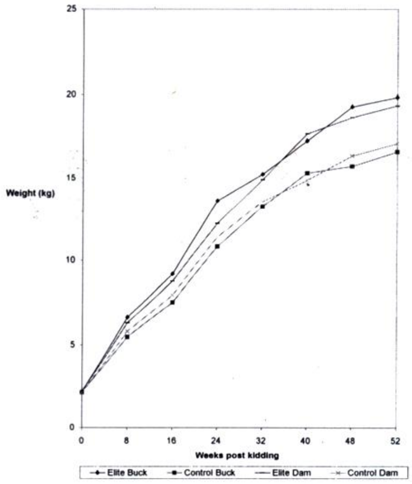

Figure 1. Growth curves of Mubende kids by buck and dam group.

those of controls at 16 (P<0.01), 20 (P<0.001) and at 24 weeks (P<0.001) (Table 1). Kids born to control does had lower growth rates than those of elite does up to weaning.

The mean live weights of offspring from elite bucks at 32 weeks was significantly superior (P<0.05) to the control buck kids. This advantage was maintained up to 52 weeks of age (P<0.05) (Table 2). These results show that large size among bucks was highly genetic. The contribution of buck size to kid weight increased with age because maternal effects present in early stages waned and true genetic effects took over. After six months, kids from smaller sires started compensatory weight gain, but remained inferior to those from elite bucks.

Kids mothered by elite does had significantly higher weight than those of control does at 28 weeks (P<0.05) and 40 weeks (P<0.01) (Table 2) only. The growth rate of kids weaned from elite does was superior by an average of 23.3 g/day over the control progeny during the 28-week period. The inferiority in growth rates during pre-weaning stages was not significant contrary to expectation. Elite mothers should have given birth to much heavier kids because of better uterine nutrient provisions than small does. During lactation, elite dams are expected to give more milk and hence, better weaning weights for their kids. This is not withstanding the findings that kids of elite dams survived better in the pre-weaning period implying that they acquired substantial immunoglobulins from their mothers.

Sex was found to have a significant (P<0.001) effect on weight at birth, four weeks (P<0.01), and at 12 weeks (P<0.05) (Table 3). The average birth weight of males and females was 2.28 and 2.06 kg, respectively. These observations are similar to findings of Oluka (1999) who reported that males weighed 2.04 while females weighed 1.9 kg among Mubende goats. Male kids gained up to 15.3% faster than females during the pre-weaning period, smaller than 25% reported by Louca *et al.* (1977), but significantly larger than 5% reported by Gebrelul *et al.* (1994). Over the entire 16 weeks, males had a highly significant (P<0.01) faster growth rate averaging 39.1 g/day over the females (Table 4). These results are attributed to male hormones which positively influence growth.

During the post-weaning period, males were significantly heavier than females at 24 (P<0.001), 32 (P<0.01), 40 (P<0.01) and 44 weeks (P<0.01) of age (Table 5). Though males grew faster than females in most quarters, the average daily weight gains were not significantly different, and were similar to results obtained by Das *et al.* (1996), and Oluka (1999). Male goats had higher mean weight than their female counterparts throughout the six – month period (Table 5, Fig.2). These results agree with those reported by Siddiqui *et al.* (1981) and Wilson (1983).

Effects of non-genetic factors on kid performance

Pre-weaning weights as affected by litter size and season of birth are shown in Table 3. Litter size was found to have a highly significant effect (P<0.05) on live weight at birth through to weaning (Fig. 2).

Table 3. Means of kid body weight from birth to weaning.

Factors / effects	Birth weight	4 weeks	8 weeks	12 weeks	16 weeks
Sex					
Male	2.28 ± 0.05^{e}	4.99 ± 0.17^{c}	6.48 ± 0.27^{a}	7.74 ± 0.35^{a}	8.90 ± 0.50
Female	2.06 ± 0.06^{f}	4.30 ± 0.22^{d}	5.63 ± 0.36^{b}	6.62 ± 0.44^{b}	7.80 ± 0.67
Litter size					
Single kids	2.29 ± 0.06^{e}	5.39 ± 0.24^{e}	7.27 ± 0.38^{e}	8.32 ± 0.45^{e}	9.85 ± 0.66^{e}
Twin kids	2.05 ± 0.04^{f}	3.89 ± 0.11^{f}	4.84 ± 0.28^{f}	6.04 ± 0.38^{f}	6.85 ± 0.57^{f}
Season of birth					
Wet	2.23 ± 0.06^{a}	4.60 ± 0.25^{c}	5.77 ± 0.39	7.02 ± 0.48^{c}	9.29 ± 0.52^{a}
Dry	2.14 ± 0.08^{a}	4.21 ± 0.33^{d}	5.34 ± 0.52	5.72 ± 0.62^{d}	8.79 ± 1.63^{b}

$^{ab,\ cd,\ ef}$ For each age and grouping class along the column, means with different superscripts differ significantly (P<0.05); (P<0.01); (P<0.001).

Single kids were heavier than twins by 240 g, at birth (P<0.001), 1.5 kg at 4 weeks (P<0.001), and 2.4 kg at two months (P<0.001) (Table 3). These results corroborate with those of Oluka (1999) who reported that the mean live body weight of single Mubende kids at birth, 2 months and weaning was 2.04, 5.88 and 8.79 kg, respectively. Sacker and Trail (1966) reported 2.1±0.05, 7.4±0.18 and 11.9±0.27 kg for birth, 2 months and weaning at five months among single male Mubende kids, respectively. In addition, single kids were found to have a higher average daily gain than twins.

The superior weight and average daily gain of singles over twins could be explained by the higher nutrient uptake per kid expected for singly born kids. It is probable that single kids consume more colostrum and milk, and hence more immunoglobulins than twins or triplets. This implies that resistance to disease is stronger in single kids and hence the better growth rate and live body weight. Over 16 weeks period, single kids had gained an average of 85 g/day (Table 4). This was not significantly differently different from the 73.8 g/day for the twins over the same period.

Kids born during the wet season had significantly higher weights (P<0.05) at all pre-weaning ages except at birth and two months. This is attributed to the provision of lush forage for the dams translating into more milk. The season effect reduced towards weaning because by 16 weeks, kids start browsing and originally small ones have compensatory growth. During this study, the does were synchronised

Table 4. Means of kid growth rates for various growth periods.

Factors/ effects	Growth rate (g/day) in various growth periods (weeks)				
	0- 4	4 - 8	8 - 12	12 – 16	0 – 16
Sex					
Male	96.5±6.7^{c}	89.9±19.4	87.4±21.3	33.9±9.8	98.9±10.1^{c}
Female	78.8±8.4^{d}	60.3±8.2	42.9±8.9	36.8±4.1	59.8±10.2^{d}
Litter size					
Single kids	110.4±8.7^{e}	80.0±20.7	65.3±39.3	51.8±6.2^{a}	85.0±10.8
Twin kids	64.9±7.1^{f}	70.1±12.3	35.1±17.3	19.0±9.5^{b}	73.8±10.3

ab, cd, ef For each age and grouping class along the column, means with different superscripts differ significantly (P<0.05); (P<0.01); (P<0.001).

Table 5. Means of kid body weight from 24 weeks to one year.

Factors/ effects	24 weeks	32 weeks	40 weeks	48 weeks	52 weeks
Sex					
Male	12.96±0.46^{e}	15.36±0.54^{c}	17.69±0.60^{a}	18.53±0.97	19.17±1.27
Female	10.72±0.60^{f}	13.13±0.73^{d}	14.84±0.82 ^{b}	16.46±0.86	17.25±1.12
Litter size					
Single	13.51±0.63^{e}	15.88±0.76^{c}	18.36±0.75^{e}	18.97±1.05	19.83±1.03
Twin	10.17±0.51^{f}	12.61±0.60^{d}	14.17±0.68^{f}	16.02±1.01	16.59±1.42
Trial diets					
25% CP	12.64±0.55^{a}	15.48±0.65	17.07±0.69	17.67±0.99	18.49±1.04
15% CP	11.04±0.51^{b}	13.01±0.59	15.47±0.66	17.31±0.76	17.93±1.17

ab, cd, ef For each age and grouping class along the column, means with different superscripts differ significantly (P<0.05); (P<0.01); (P<0.001).

to ensure birth in the same season. Some does did not respond while others recycled and had to be remated. This led to staggered births and hence was the major limitation in this study. Poor response to synchronisation could be due to dosage levels.

During the post-weaning period, litter size continued to have a significant effect on live weight with single kids weighing heavier than those that were born twin at 28 ($P<0.001$), 32 ($P<0.01$), 36 ($P<0.01$), and 40 weeks ($P<0.001$). The significant effect of litter size on live weight during the post weaning period has previously been reported by siddiqui *et al.* (1981), Wilson (1987) and Roy *et al.* (1989), who reported that singly born kids grow faster than twins. Twin kids had lower growth rates compared to single kids and this had a long term effect on the live body weight of the goats. Oluka (1999) also working with Mubende goats reported that the single birth superiority over multiple births was not significant.

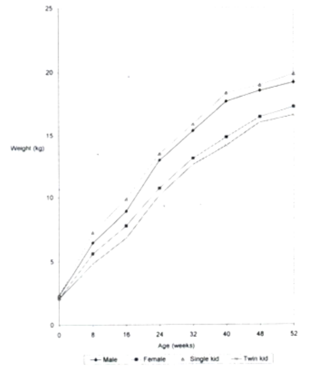

Figure 2. Growth curves of Mubende kids by sex and litter size.

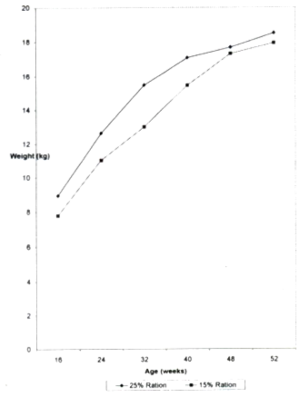

Figure 3. Growth curves of Mubende kids by post weaning ration.

Goats fed on the 25% CP ration (diet I) had a significantly higher mean weight than those fed a 15% CP ration (diet II) throughout the 8-week post weaning feeding trial period (Fig. 3). The superiority of diet I began to show at 18 weeks ($P<0.05$). The superiority was also observed at 20 ($P<0.01$), 22 ($P<0.05$), and 24 weeks ($P<0.05$) of age. Under both diets, the mean body weight increased in the entire herd, even after the supplementation was stopped.

During the post feeding trial period, animals originally under diet I were significantly superior in weight over their counterparts at 28 ($P<0.01$), 32 ($P<0.05$) and 44 weeks of age ($P<0.001$) (Table 5). These findings agree with those reported by Morand-Fehr (1981) who used sunflower cake supplements to goats. The growth rates for the goats under both diets were however, not significantly different ($P>0.05$).

The body weight gain of kids under diet I of 66.5 ± 10.0 g/day was significant ($P<0.01$) over those on diet II (37.5 ± 10.0 g/d) during the 8-week feeding trial period. From the results of the proximate analysis conducted on the pasture samples, the nutrient content of the pastures was rather low compared to that used by other workers. Secondly, it is probable that the weaned goats ate a lot of the poor quality forage to satiety and hence the overall concentrate diet intake later on was very low. Results also showed that weaners under 15% diet had a fairly high average daily gain up to 24 weeks of age, and hence is reliable in raising weaned goats. However, the overall average daily gain superiority of goats under diet I over those on diet II (29 g/day) is substantial and could be higher if the basal diet, supplementation time and regime factors are addressed.

Conclusion

There was an indication of genetic response to phenotypic screening of goats using live body weight. This implies that goats can be selected for breeding on the basis of their body size. A superior buck when mated with an inferior doe gives heavier and faster growing progeny than the reciprocal cross. Findings also revealed that maternal effects contributed to birth weight, and that kids sired by small bucks but fed on high protein diets may not grow faster than those from elite bucks fed on a low protein diet. The season when the kids are born, their sex, the type of their birth (whether single or twin), had a significant effect on their birth weight and, or, the live weight and growth rate at and by the subsequent pre- and post-weaning ages. The seasonal factor can be controlled by ensuring controlled and synchronised mating such that kidding coincides with good forage availability. Further research in hormone doses for Mubende goats should be conducted to overcome shortcomings of this study.

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