PGF2α induced estrus characteristics and reproductive performance of goats under traditional husbandry system in Benishangul-Gumuz region

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Abstract

PGF2α induced estrus characteristics and reproductive performance of free ranging goats were studied in six districts of Assosa and Metekel zones of the Benishangul-Gumuz region, Ethiopia. Structured questionnaire and a field survey were applied on a total of 200 randomly selected households. The entire goats (n=1073) owned by the households were clinically examined for the presence of any health problem. Records of animal identification, parameters of reproductive performance such as weaning age and age at puberty, litter size, kidding interval (KI), the type of management practice and clinical parameters were taken on pre-designed format. Further, 40 cycling local breed does were selected and randomly assigned into PGF2α treatment (n=20) and control (n=20) groups to study estrus characteristics. Age at puberty was 6.5±1.22 and 6.7±1.22 months for male and female goats, respectively. The mean (±sd) kidding interval was 252.35±31.46 days with a mean (±sd) litter size of 1.6±0.3. Annual reproductive rate was found to be 2.2 kids/year. The mean (±sd) weaning age was 4.74±0.7 months. The major production constraints as perceived by the goat producers were health problems (53%), poor genetic potential (20.43%) and shortage of feed (20.32%). Gynecological examination of 461 animals revealed 16.1% prevalence of reproductive diseases. In the experiment, estrus response after PGF2α injection was over 80% on Day 3 post injection, while the time to onset of estrus and duration of estrus were 48.6±4.3hrs and 47.9±4.5 hrs, respectively. Major signs of estrus included restlessness, inappetence, mounting, slight edema of the vulva and hyperaemia of its mucosa, tail

twitching, and frequent bleating. Management, especially health management and feeding regime were found to be the primary factors significantly affecting the reproductive parameters of goats. Kidding interval and weaning age were the most affected.

Key words: Estrus characteristics, Goat, Reproductive performance, Traditional husbandry

Introduction

Africa has a population of 374.8 million goats representing approximately 37.0% of the world total (FAOSTAT, 2014). The distributions of small ruminants vary widely, with a higher concentration found in dry areas than in humid areas. These animals serve primarily as sources of meat, but also provide milk, skins and manure. African small ruminant produce only 14% of the world's milk and 7.5% of the world's skin. In Ethiopia, there are about 29.33 million goats (CSA, 2015) and based on their phenotypic features, 14 goat types are identified (FARM-Africa, 1996). The total goat population of Benishangul-Gumuz region is 440,719 (CSA, 2015). They are known to inhabit both the arid and semi-arid parts where rainfall is erratic and the availability of feed is not uniform. Improvement of productivity is fundamentally based on careful performance evaluations of the genetic potential of the indigenous goat breeds and designing appropriate breeding methods (Jansen and Burg, 2002; Bourdon, 2000; Wiener, 1994). Because of the wide geographical and agro-ecological distribution of goats in Ethiopia, it is necessary to characterize and identify the types and breeds and the environment to which they are adapted (FAO, 1993). Under traditional husbandry system breeding is uncontrolled, housing is, in some instances, nonexistent, and feeding is primarily based on natural pasture, which in turn dependent on season (Bourdon, 2000). In arid zones goats are allowed to range freely, while in the mixed smallholder farming system of the semi-arid and sub-humid zones they are kept under more controlled conditions, particularly during the growing season to avoid crop damage (Nigatu Alemayehu, 1994).

Inadequate management at critical times of production especially at weaning and pregnancy represents one of the major economic losses due to poor husbandry Nigatu Alemayehu, (1994) and harsh climate exacerbate pre- and postnatal reproductive wastage, mortality and morbidity (Tamirat Degefa, 1993). Culling non-productive animals are not practiced and the sale of pregnant goat

for meat is common. Keeping and grazing animals by mixing age, sex and with other species gives little opportunity for controlled mating and maintenance of improved genotype (Odeoye, 1995).

Goats have been considered, and still are by many, as having very little or even negative value in contributing to human welfare and having no role in sustainable production systems. In this regard, so far no study has ever been conducted in Benishangul region to determine the performance of goats under the prevailing production system. To optimize reproduction estrus synchronization and ovulation in goats has been extensively evaluated. The objectives of this study were to describe goat husbandry system, determine the reproductive performance and characterize estrus after PGF2α injection.

Materials and Methods

Study area

This study was conducted in Benishangul-Gumuz region located between 90 30' N to 110 39'N Latitude and 340 20'E to 360 30'E longitude. Benishangul-Gumuz Regional State has three administrative zones (Assosa, Kamashi and Metekel zones), 20 districts (woredas) and one special woreda (BGRS, 1999). The study was conducted in Metekel and Asosa zones.The altitude ranges between 600-2731 meters above sea level (m.a.s.l.). The region is generally characterized by semi-arid and sub humid climate. The rainfall is monomodal occurring for 6-7 months, between May and October. The average annual precipitation is 1000 mm. The mean minimum and maximum temperatures are 17°C and 32°C, respectively (BGRS, 1999). The agro-climatic zones (ACZ) of the region are classified as lowland (Kola, 74%), Midland (Woyenadega, 25%) and (Dega, 1%) highland (CSA, 2005).

Study animals

Goats reared in Assosa and Metekel zones of the region were targeted. The goat breeds have been characterized as Small East African (SEA) known for their relative significance of surviving in harsh environments (FARM-Africa, 1996; Ranjahan, 2004). The predominant production system across the region is a mixed farming system and pastoralist in few marginal areas across the Sudan border. The most common livestock system is traditional. Intensive productions, to any extent, are apparently absent in the region.

Study design

Questionnaire survey

The sample size for this study was determined adopting the formula described in Markos Tibbo, (2000). Accordingly, 200 households owning a total of 1073 goats were randomly selected from the six districts: Wembera, Guba and Dangur of Metekel zone; and Asosa, Menge and Sherkole of Asosa zone. Households in each peasant association were first randomly selected and identified. A pre-tested structured questionnaire was used to characterize goat production based on interview of goat breeders on different production parameters such as housing, feeding, breeding and health management, and reproductive parameters such as age at puberty, kidding interval and kidding rate (Romano, 1997).

Field clinical survey

Goats owned by households previously identified for questionnaire survey were monitored during the study period through a follow-up study. All animals (n=1073) owned by the breeder were clinically examined. Records of animal identification, parameters of reproductive performance such as weaning age and age at puberty, litter size, kidding interval, and the type of management practice were recorded. The type of management was measured from conditions of housing (absence or presence), feeding (presence or absence of supplementation), and health. Information related to goat production constraints were also obtained by interviewing goat breeders and ranking them according to their priority. The management conditions were categorized according to Ranjhan, (2004) as "Good" when owners provided feed supplementation, housing and regular veterinary services is accessible. "Moderate" when owners provided at least two of the three husbandry practices mentioned above, and "Poor" when the owners didn't provide any specific husbandry practices. Litter size was calculated from the number of kids born to each doe at each birth Devendera, (1993) while KI was defined as the number of days between two successive kidding (Wilson, 1999). The annual kidding rate was computed as a ratio of the number of doe of reproductive age to the number that are kidding per year (Zarkawi *et al.,* 1999).

Experimental study on estrus characteristics of does after PGF2α injection

The purpose of this experiment was to study estrus characteristics of goats particularly after induction with PGF2α for a potential use in estrus synchronization program. Forty cycling local breed does aged between 2 to 4 years were randomly assigned into two groups; PGF2α treatment (n=20) and control (n=20). The mean body weight of the does (n=40) was 29.5 kg. The animals were allowed to graze on natural pastures during the day (7:00–12.00 h) and restricted indoors at night. All does were allowed free access to mineral salts and *ad lib* water. The treatments comprised of an injection of 7.5 mg PGF2α (Lutalyse, the Upjohn Company, England). The does were teased twice daily with four intact teaser buck and observed for signs of estrus for 5 days after the treatment. Does were considered to be in estrus when they were showing behavioral manifestation of estrus including standing to be mounted. Estrus signs exhibited, estrus response rate, interval from treatment to estrus and duration of estrus manifestation were recorded.

Data analysis

Data was analyzed using statistical package, SPSS 15.0 for windows 2006 version. Management parameters (housing, feeding and health) and reproductive performance indices (weaning age and age at puberty, litter size, kidding rate, and kidding interval) were illustrated using descriptive statistics. Characteristics of estrus after PFG induction was also depicted using descriptive statistics. ANOVA and Chi square were applied to study the effect of management on reproductive performance taking level of management (Poor, Moderate, and Good) and district as a fixed independent factor in the model. P value of <0.05 was used to determine the level of significance in statistical differences.

Results

Questionnaire survey

The prevailing traditional system of goat husbandry in the study area was found to be the mixed farming. Households usually keep one or more types of livestock and have a small plot of land for cropping cereals. Accordingly, a household in the study area consist of a mean number of 3 cattle, 6.6 goats (3 does, 1.5 bucks and 2.1 kids), and 0.5 sheep and 1 ha of land. Goats generally make the largest proportion of the whole of domestic ruminants. Of all the

households, 64% had a large goat herd size (>5), while the remaining 36% had small flock size. Among the household interviewed (68%) kept goats as a source of income, while 6% are kept as a source of meat and 26% as a source of the combination of the above two.

Feeding and watering

According to the present survey, the major feed resource was found to be based on grazing/browsing of natural pasture at communal grazing together with other livestock. Only 43% of goat breeders do provide supplementation that constitutes grain, kitchen waste or mill byproducts, the remaining 57% farmers do not provide any supplement to their goat. In addition, many farmers also provide tilled crop residue from crop field and such feed was known to make a significant contribution to goats feed. Availability of feed was found to be seasonal in all study sites often increasing with increasing level of precipitation. Water, in all cases, was abundant and accessed for all breeders with no seasonal limitation. There was a significant difference ($p<0.05$) in KI and weaning age between animals with and without feed supplementation (Table 1).

Table 1. The reproductive performance of goats under two feeding systems, with and without concentrate supplementation

Reproductive performance	Supplemented	N	Mean (±SD)	X^2	P
Age at Puberty Male [Month]	No	719	6.53±1.29	4.98	0.418
	Yes	354	6.53±1.08		
Age at Puberty Female [Month]	No	719	6.63±1.24	1.83	0.766
	Yes	354	6.55±1.20		
Kidding Interval [Days]	No	719	263.10±26.39	88.93	0.000
	Yes	354	230.53±29.72		
Litter Size	No	719	1.53±0.29	2.48	0.981
	Yes	354	1.51±0.26		
Weaning Age [Month]	No	719	4.81±0.62	14.57	0.009
	Yes	354	4.59±0.76		

Housing practices

Out of the 200 households, only 48.5% of goat breeders in the study area house their goats properly; the remaining 51.5% keep their goats in an open-air fence near the house. Young animals were always kept around the homestead until

weaning usually to avoid walking long distances in search of feed and water and to minimize exposure to predators. Housing system did not significantly affect any of the reproductive performance.

Health management

According to the survey, about 47% of respondents rarely received veterinary service while 53% received veterinary service from the nearest veterinary clinic/post of the districts. Overall, 85% the households reported the presence of one or more types of diseases affecting their goats. Internal and external parasitism was known to be 80.7% and 23.2%, respectively. Parasitism was rated to be the primary cause of morbidity and mortality in goats of both study zones. Out of 461 clinically examined animals, the prevalence of reproductive diseases was 16.1%. Comparison of the reproductive performance between goats receiving veterinary services and those that are not getting veterinary services showed the presence of a significant difference ($p<0.05$) in the mean age of weaning and KI.

Reproductive performance of goats

The mean (±SD) weaning age and the mean age at puberty were in the order of 4.74±0.68 months, and 6.53±1.22 and 6.61±1.23 months for male and female, respectively. The overall annual reproductive rate was 2.2 kids per doe. The reproductive performance of goats under the current traditional system of husbandry in the study area is summarized in (Table 2).

Table 2. Overall reproductive performance of goats in the study area (n=1073)

Reproductive performance parameters	Mean	SD	Range
Goat herd size	5.19	1.89	1-9
Age at Puberty, Male [Month]	6.53	1.22	5-10
Age at Puberty, Female [Month]	6.61	1.23	5-9
Kidding Interval [Days]	252.35	31.46	185-315
Litter Size	1.53	0.28	1.2-3
Weaning Age [Month]	4.74	0.68	3-6

Puberty in the female was usually recognized by the presence of frequent bleating, vaginal discharge, restlessness, and courting of others. Heat in the doe included constant bleating, vaginal discharge, and restlessness, frequent tail twitching, and riding of others and standing to be mounted.

Goat breeders usually assess the reproductive performance or fertility of the goats by observation of the condition of the genital organs, libido, the number of kids born to the doe and body condition. Males are usually selected based on their body size, size of testicle and strength of their libido. Animals found to be poor in their reproductive performance will end up in market for sale. Pregnant animals receive no special care except in rare cases of a separate housing.

Characteristics of estrus after PGF2α injection

Major signs of estrus were restlessness, courting, in appetence, mounting, edema of the vulva and hyperemia, vaginal discharge, tail twitching, frequent bleating and standing to be mounted. The rate of estrous response was 80% at Day 3 post injection (Figure 1). By Day 4, over 95% of the does have showed marked estrus following cessation of their respective treatments.

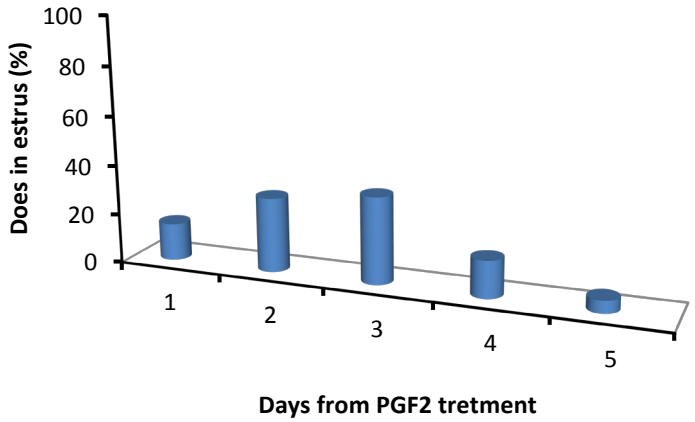

Figure 1. Frequency distribution of estrus response in does after end of treatment with natural PGF2α (n=20).

The time to onset of estrus was 48.6 h and, the mean observed duration of the induced estrous period was 47.9 h. None of the does in the control group exhibited estrus in the 5-day post-injection observation period.

Effect of management on reproductive performance

Descriptive statistical results of the reproductive performances of goats are summarized for Assosa and Metekel Zones. Comparison of reproductive perfor-

mances between the two study sites showed no statistical difference for most parameters. KI was statistically significant ($p<0.05$) among the different level of management. KI was relatively shorter in animals under good management, while animals under poor management weaned earlier than those under moderate or good management systems (Table 3). The rest of the reproductive parameters were not statistically significant among the different levels of management in both study sites.

Table 3. Reproductive performance of goats at different level of management (n=1073)

Reproductive performance	Level of Management	N	Mean (±SD)
Age at Puberty Male [Month]	Good	86	6.69±1.20
	Moderate	354	6.47±1.14
	Poor	633	6.54±1.28
Age at Puberty Female [Month]	Good	86	6.56±1.15
	Moderate	354	6.56±1.37
	Poor	633	6.64±1.16
Kidding Interval [Days]	Good	86	*234.38±27.32
	Moderate	354	250.91±35.68
	Poor	633	255.59±28.71
Litter Size	Good	86	1.52±0.28
	Moderate	354	1.52±0.31
	Poor	633	1.53±0.26
Weaning Age [Month]	Good	86	4.75±0.77
	Moderate	354	4.83±0.74
	Poor	633	4.63±118

* Value significantly different at $p<0.05$.

Discussion

The major goat feed resource in Ethiopia include natural pasture, browse and bushes, fodder plants in current study agree with previous reports (Tamirat Degefa, 1993, *Berhanu* Gebremedhin *et al.,* 2002 and Yoseph Mekasha, 2007). But Nigatu Alemayehu, (1994) reported that feed resource availabilities fluctuates with the season under tropical condition particularly in Africa, strongly affecting the efficiency of reproduction, however, in the present study, the results disagree with the previous report with no significant difference between

animals grazing only natural pasture and those that received supplement. A marked seasonal variation in the quantity and quality of feed supply and the acute problem of feed supply during dry season found in this study is in agreement with (Berhanu Gebremedhin *et al.,* 2002).

The housing system of goats found in the current study is similar with the housing systems in previous reports (Yoseph Mekasha, 2007; Tamirat Degefa, 1993; Inshwar and Pandey, 1990). Although, housing is known to have a more direct effect on reproductive performance (Romano, 1997), the result of the current study does not prove this. This could be attributed to the type of house constructed where there is basically not much different than no house due to the following major reasons such that constructed houses are rudimentary and do not have concrete floor, ventilation system, enough space per animal and, as well as they are inadequate to manage different category of animals.

Goat owners rated parasitic diseases as the main cause of mortality and these were reported as the most prevalent flock health threats across all the sites. The results in this study are in good agreement with the result of previous study by (Tamirat Degefa, 1993) for goats in Benshangule-Gumuz region. According to (Otte and Chilonda, 2002) infectious diseases cause considerable morbidity and mortality in goats under traditional husbandry system of Debre Berhan area.

The overall reproductive performance in the current study is higher than previous reports by Payne and Wilson (1999) who indicated KI to be 210-230 days in West African goats under traditional production systems. Another report by Otte and Chilonda, (2002) revealed that for most small east Africa goats (SEA) the KI range varies from 238 to 265 days. The result obtained in the current study is within the range of the previous report in West Africa for West African Dwarf goats (Wilson, 1981). Animals whose breeding is not controlled and where goats mate at the first opportunity, KI is primarily affected by intrinsic factor rather than failure of proper breeding management (Kosgey, 2004).

The average litter size in the present study was lower than previous reports for Alpine goats (Silva *et al*., 1998; Song *et al*., 2006; Payne and Wilson, 1999 and Seabo *et al*., 1994). The average litter size reported in these studies was 1.69±0.05, 1.69±0.03, 1.78±0.16 and 1.46; respectively. On the other hand, the finding in the current study agrees with reports of Odeoye (1995) litter size 1.53. Litter size is generally affected by breed and age (Song *et al*., 2006; Silva

et al., 1998 and the minor difference found in the study could be attributed to difference in breed rather than husbandry system conversely, since breeding is not controlled under traditional system young animals that are bred at the first opportunity will have lower litter size (Song *et al*., 2006). According to Joe *et al* (2004), the weaning age of goats is 5-7 and 3-5 months for female and male, respectively. Tesfaye Alemu *et al* (2000) reported weaning age of 3.18 month for Boran Somali and 3.3 month for Mid Rift Valley goats, a finding which is similar to the present study. Payne and Wilson (1999) reported tropical male goats reach sexual maturity at 4.12 months. These two reports showed slightly lower interval compared with the present result. Litter size, weaning age and kidding rate are all affected by level of nutrition and breed. In this regard, nutrition seems to be the most important factor to directly influence these parameters in this particular study.

The respondents reported that health problem was a leading constraint including parasites, infectious, reproductive disease followed by feeding and marketing constraints. This is in agreement with previous reports by Merma and Rannobe (1994) and Ademosun (1988). KI and weaning age was affected significantly by the overall management practice prevailing in the study area. The present study is in agreement with the result reported by (Pandey *et al.,* 1985) and (Devendera, 1993). The rest of the parameters were not affected by the management practice which varies from previous authors. Though, herd size is known to be highly correlated with resource; in this particular instance, since animals were all dependent on natural grazing/browsing effect was uniformly for all herd size category.

Estrus signs exhibited are in line with previous reports (Merk, 2000; Adugna Tolera *et al*., 2000; CSA, 2005). Although double injection of PGF2α, 11 days apart is known to be efficient methods for estrous synchronization in cycling indigenous does a single injection can also effectively induce estrus in does. Similar estrus response rate generally falling between 87 and 100% have been reported (Inshwar and Pandey 1990; Baril *et al.,* 1993; Ahmed *et al.*, 1998; Joe *et al*., 2004; Akusu and Egbunine, 1984). However, the time to onset of estrus found in the present study is much higher compared the previous reports of 33±3.7h by (Baril *et al*., 1993), 41±5.2h by (Ademosun, 1988; Inshwar and Pandey, 1990; Mellado *et al.,* 2006) and (49±8.5h) by (Greyling and Van Niekerk, 1991). Majority of the does had a delayed response probably because of the poor management that did also influence the nutritional status nevertheless this result confirm that PGF2α injection is a promising estrus induction agent,

which is effective for the purpose targeted by causing luteolysis of the corpus luteum.

Conclusion

The reproductive performance of goats in this particular study area is found to be relatively good. The prevailing housing system in the study area is generally rudimentary and they are not divided to allow different category of goats in order to manage easily and keep their hygiene properly. Generally, reproductive performance of goats was affected by the management. Particularly, the feeding system, and health management are the major factors that are significantly associated with the reproductive performances. Kidding interval and weaning age were among the performance parameters that were the most affected by traditional husbandry. The experimental study, however confirmed that there is a potential for control of breeding by application of reproductive biotechnology such as estrus synchronization that can improve the reproductive performance easing management.

Improvements of the current management system particularly breeding, feeding and health service are very important. Optimum utilization of the seasonally available feeds through preservation of crop residues and agricultural byproducts and strategic supplementation with low cost farm byproducts and household wastes is vital to balance the seasonal lack of feed supply and nutritional required for improved reproductive performance.

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