

## Milk production, kidding interval and kid growth of indigenous goats of southern Mexico

### Producción de leche, intervalo entre partos y crecimiento de cabritos de cabras criollas del sur de México

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**ABSTRACT.** Milk production, kidding intervals and kid growth were evaluated in 20 multiparous indigenous goats of southern Mexico, grazing on a tropical forest. The association between milk production and kid growth rate was also assessed. The total average milk yield was  $26.9 \pm 9.3$  kg, in lactations of  $108 \pm 13$  d. Average daily weight gain of kids was  $67 \pm 27$  g. Considering the entire lactation, daily milk yield accounted for less than 1 % of the known variation in kid weight gain. It was concluded that, due to the high energy investment in reproduction (mean kidding interval of these goats was  $195 \pm 8$  d), low genetic merit for milk production, low adult body weight ( $28.7 \pm 3.3$  kg), and sub-optimum nutrition (6 h daily grazing), the lactation performance of the indigenous goats of southern Mexico was very poor, which forces kids to depend upon native forage at an early age.

**Key words:** Body weight, calving interval, grazing, growth traits

**RESUMEN.** Se registró la producción de leche, el intervalo entre partos y el crecimiento de los cabritos de cabras criollas del sur de México en pastoreo en bosque tropical. La producción de leche por lactancia (108 d) fue de  $26.9 \pm 9.3$  kg. La ganancia diaria de peso de los cabritos fue de  $67 \pm 27$  g. La producción diaria de leche explicó que la variación de la ganancia de peso de los cabritos fuera menor a 1 %. Se concluyó que, debido a la alta inversión energética en la reproducción (intervalo entre partos de  $195 \pm 8$  d), el bajo mérito genético para la producción de leche, su bajo peso corporal ( $28.7 \pm 3.3$  kg) y la sub-óptima nutrición (sólo 6 h diarias de pastoreo), la producción de leche de las cabras criollas del sur de México es muy pobre, lo cual obliga a sus cabritos a depender del forraje nativo a una edad muy temprana.

**Keywords:** Kidding interval, reproduction, body weight, lactation length

### INTRODUCTION

Kid growth is of great economic importance to the low-input production systems in southern Mexico, because goat industry in this zone is based exclusively on the supply of goat meat. Native goats are raised in this area for meat production. For centuries these goats have never been milked, thus, the milk potential of this breed is unknown. Growth rate of kids under pasture conditions is directly related to the amount and quality of forage available for consumption (Papadopoulos *et al.* 2001). In

lambs (Mekoya *et al.* 2009) and kids (Sangare and Pandey, 2000), weight gain is also influenced by milk production of the dam. Knowledge of the milk yield of dams and growth patterns of kids should be helpful for a proper management of goats in these grazing systems. The objectives of this study were to estimate the milk production of native meat goats of southern Mexico, and to establish the relationship between milk yield and growth of the suckling kids. An additional objective was to assess the kidding interval of these native goats.

## MATERIALS AND METHODS

The study was carried out in southern Mexico (San Pedro Totomachapan, District of Zimatlan de Alvarez, Oaxaca), between latitude 16° 50' N and longitude 97° 08' W, with a mean annual precipitation of 950 mm. The study site has a mean annual temperature of 19 °C and an altitude of 2 200 m above sea level. The climate is temperate with vegetation composed primarily of pine-oak. Common species in this area are *Weinmannia pinnata*, *Liquidambar stryaciflua*, *Hediosmum mexicanum*, and *Meliosma dentate*. There is a moderate cover of shrubs, and a dense cover of native grasses and herbs in deforested areas.

Twenty multiparous native goats, animals of Spanish origin introduced in Mexico in the XVI century, were used in the present study. All goats had a single kid and grazed on native vegetation in the surrounding areas of the village for 6 h (from 11:00 to 17:00) per day. Kids grazed with their dams for the entire suckling period until they were sold. A barnyard made of stems and branches of shrubs was provided in the immediate vicinity of the farmer's home. Goats did not receive veterinary assistance or supplementary feeding; only plain salt was provided occasionally throughout the year. There were no attempts to control reproduction. Mating occurred randomly whenever a female came in estrus and young bucks fecundated them, because older castrated bucks were slaughtered. Births occurred in a 7 d period (middle of October) and lactation ended in February 2007. Most goats were in estrus approximately 5 weeks postpartum, therefore the majority of goats were pregnant for the most part of lactation. Kidding dates were recorded and kidding interval was calculated as the difference (in days) between two sequential kiddings.

Kids weight was recorded within 24 h of birth using suspended scales weighing from 0 to 20 kg in 20 g increments; weights were recorded every 2 weeks thereafter. Milk production was also recorded every 2 weeks. The milk yield of goats at pasture was estimated by the kid-suckling technique (Abd-Allah et al. 2011). Briefly, kids were isolated

from their mothers in the evening (17:00) preceding milk assessment. The next day kids were allowed to suckle, individually, for half an hour (10:00). Milk yield was estimated as the difference between kid's weight before and after suckling. Total milk yield was calculated by multiplying the average between successive milk measurements by the number of day milk recordings, and adding the products. It is worth mentioning that milk yield corresponded to 17 h of milk yield only, and that one suckling does not give accurate milk yield estimation. However, the trial was performed under the conditions established by farmers in this region, which prevented keeping the kids away from the dam during 24 h, as well as double suckling during the day. Even with these limitations it was considered pertinent to discern the approximate milk yield capacity of these local goats.

Body weight of adult goats was recorded monthly, using a platform scale weighing from 0 to 100 kg (in 100 g increments) in the morning, before goats went on pasture for herbage intake. Correlations between milk yield at different stages of lactation and kids' daily average gain (ADG) were determined using correlation (PROC CORR procedure of SAS) and regression analysis (PROC REG).

## RESULTS AND DISCUSSION

Indigenous goats in this study had an extremely low lactational performance. Daily milk yield was  $246 \pm 78$  g (mean  $\pm$  SD) in lactations of  $108 \pm 13$  days. The average milk yield per lactation was  $26.9 \pm 9.3$  kg. These results are in good agreement with those obtained by other researchers with indigenous goats in tropical environments (Ahamefule et al. 2007, Mahmudul-Hassan et al. 2007, Odoemelam et al. 2013). Curves for milk production peaked at 55 d (Figure 1), and a drastic decline was noted thereafter, with less than 100 ml per day after day 97 postpartum. Lactation length in this flock of indigenous goats was within the range for goats in tropical environments (Mahmudul-Hassan et al. 2007). However, milk yield was much lower than other indigenous goats

with Hispanic background in tropical areas of southern Mexico (Martínez-Rojero *et al.* 2014). Low milk production by this tropical meat goats was due to a low dairy merit, small size (28 kg adult BW), substandard level of feeding (goats grazed only 6 h per day) and the fact that lactation and gestation ran concurrently. A major factor influencing the low milk yield of these goats in this tropical environment is inadequate nutrition, due to lack of any kind of feeding supplementation throughout the year, and the fact that tropical forages eaten by goats present high levels of secondary metabolites (De Deus *et al.* 2013, León-Castro *et al.* 2015).

For centuries, goats of this region have been reared only for meat, thus, apart from fertility and prolificacy, milk yield is not considered an important trait. Research work to improve productive traits of this breed has never been undertaken. Thus, the uncontrolled breeding at farmers' level has prevented the improvement of the genetic potential for meat and milk of this well-adapted indigenous breed.

These results suggest that native goats of southern Mexico optimize reproductive effort, which implies a reduction in resources available to other allocation categories, such as milk yield for their current offspring, in order to set resources aside for the next gestation.

**Table 1.** Regression equations of kids' daily weight gain on estimated daily milk production, with corresponding coefficients of correlation.

Days postpartum	Regression equation	r
28	Y= 162.3 - 0.005X	-0.008
58	Y= 38.8 - 0.02X	-0.30
73	Y= -173.8 + 0.96X	0.73*
88	Y= 67.5 - 0.03X	-0.10
103	Y= 24.3 - 0.00006X	-0.0004
118	Y= 24.9 + 0.02X	0.14
133	Y = 38.1 - 0.04X	-0.15
Total lactation	Y= 63.8 + 0.009X	0.05

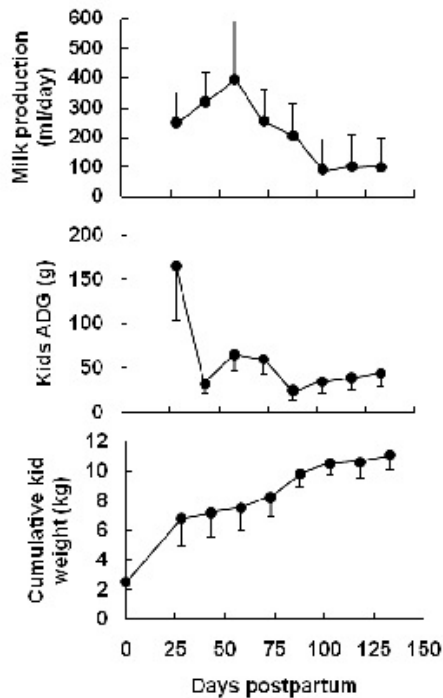
\*P<0.05.

The mean  $\pm$  SD kidding interval of these goats was 195  $\pm$  8 d, a figure close to that observed in other native goats in tropical areas (Mahmudul-Hassan *et al.* 2007), which indicates that pregnancy started approximately 45 d postpartum, which imposed additional energetic cost on the mother.

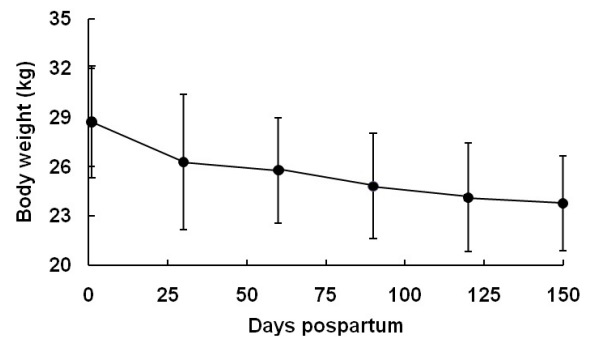
The considerable investment in reproductive efforts in these goats has been also reported by others (Martínez-Rojero *et al.* 2014), who observed that 20 % of Oaxaca's native goats kidded twice a year under natural grazing, but 62 % of the goats had two litters per year with feeding supplementation. Thus, the strategy employed by these goats appears to be a limited nutrient investment (short lactation) in the current offspring, in order to start allocating nutrients for the next one.

Mean daily growth rates of kids during a 125 d period were 67  $\pm$  27 g (Figure 1). This figure is close to that recorded for native breeds of goats under village conditions in tropical and subtropical countries of Africa (Mahmudul-Hassan *et al.* 2007), Asia (Das and Ghosh 2007, Singh *et al.* 2007) and America (Alexandre *et al.* 1999). A possible explanation for the low ADG of kids might be the low growth genetic potential of these animals. Under intensive conditions (Ivey *et al.* 2000) or grazing in semi-arid regions (Maia *et al.* 2012), growth rate of native goats of Spanish origin is under 80 g d<sup>-1</sup>. Regression equations to predict kid weight gain from milk production at different stages of lactation are presented in Table 1. Correlation coefficients increased until day 73 of lactation and then presented an undefined trend. Except for the 73 d of lactation, we did not find a significant correlation between milk production and kid ADG. Significant correlation between milk yield and kid weight gain at 69 days postpartum reflexes the residual effect of peak milk production. For the entire lactation, daily kid weight gain practically did not increase with additional milk yield of dams, and daily milk yield accounted for less than 1 % of the known variation in kid weight gain. These results suggest a high dependence of kids upon forage for their energy and protein needs from early age.

Goats lost weight throughout lactation (-3.5 kg, Figure 2), which is typical of native goats reared on pasture (Ortega-Jiménez *et al.* 2005). Dietary restriction of goats during lactation explain the reduced milk yield per lactation, but weight loss did not hamper early return to estrus, which is a common feature of indigenous goats



**Figure 1.** Goats milk production, kids average daily gain (adg) and cumulative kid weight for indigenous goats of southern Mexico under village conditions. Bars are SD of the means.



**Figure 2.** Body weight change after parturition of indigenous goats of southern Mexico. Bars are SD of the means.

under harsh conditions (Zarazaga *et al.* 2005; Rosales *et al.* 2006). For most of the lactation, kids' growth seems to be independent of milk yield of dams, which indicates a high dependency of kids upon pasture plants from early age.

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