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MILK PRODUCTION OF THE WEST AFRICAN DWARF GOAT IN SOUTHERN OF BENIN FROM 5 TO 90 DAYS: YIELD, EFFECTS OF PARITY, LITTER SIZE AND POST-PARTUM WEIGHT

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ABSTRACT

This study aims to evaluate the daily milk yield of WAD goat in southern of Benin and to estimate the effect of parity, litter size and postpartum weight on the milk yield. Twenty-four goats in an advanced state of pregnancy were grouped together and taken to the station. Their milk yield was measured every ten (10) days up to 90 days postpartum by the technique of double weighing before and after suckling the kids combined with milking under oxytocin. The Generalized Linear Models (Proc GLM) procedure of SAS (Statistical Analysis System, 9.2) was applied to the data, with fixed effects consisting of litter size, lactation number and postpartum weight of the doe. The results indicate the initial yield obtained on D5 is 285.03±12.51 g. The average daily peak milk yield is 443.23±51.17g and the average peak day is 14.67±0.93. The average daily milk yields are respectively 348.35±31.17g/d, 298.82±25.40g/d, 247.68±21.09 g/d, 215.36±18.10 g/d, 127.99±10.91 g/d for the periods D5 to D30, D5 to D60, D5 to D90, D30 to D60 and D60 to D90. Only litter size has a significant effect on milk production, which however increases with litter size, postpartum weight and parity (up to parity 4). The milk yield of the WAD goat will be improved by taking into account these influencing factors.

Keywords: Goat, Milk, Benin, Wad.

1. INTRODUCTION

Benin is characterized by a dynamic agricultural sector contributing 32.5% to GDP (INSAE, 2012). Livestock farming occupies a preponderant place with a contribution to agricultural GDP sometimes reaching 44% (MAEP, 2011). Its importance is all the more marked as animal production contributes to the maintenance of activity in rural areas, to the quality of the environment as well as to the fight against poverty (Gbangboché *et al.*, 2005). This challenge cannot be met without the implementation of a policy to intensify bovine milk production, but also the development and promotion of other dairy species. Among these species with potential are goats, whose numbers were estimated at 1,605,000 head in 2010 (DE, 2011). They are widespread in Benin and raised by more than 90% of agricultural households (Essou, 1991). The importance of this species in the production of milk and meat has been mentioned by several authors (Adamu, 2021; Alabi et al., 2013; Riskó and Csapó, 2019). This importance is all the

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more marked in rural areas (Haenlein, 2004) as the goat is usually referred to as "the poor man's cow". Also, goat's milk enjoys a certain nutritional interest because of its composition of caseins and fats which are more digestible than those of cow's milk (Hossaini-Hilali, 1995). It contains many vitamins and minerals in satisfactory concentrations to cover certain daily needs (Desjeux, 1993). In Benin, the goat herd is mainly made up of the WAD or West African dwarf goat and Sahelian breeds, with a marked predominance of the WAD breed. They are characterized by low milk productivity. Several authors have reported interesting productions, ranging from 280 to 570 kg per day (Ba Dio *and al.*, 2010; LRVZ de Farcha, 1998). The factors influencing this milk production, although low, are highlighted by many authors (Ahamefule, 2012; Zahraddeen et al., 2009, Odoemelam, 2013) in neighboring Nigeria where the WAD breed is also widespread. But no study in Benin has focused on the evaluation of the milk production of local WAD goats in our climatic conditions. The present work fills this lack of scientific information by setting itself the objective of evaluating the milk yield of the WAD goat in southern Benin, in the commune of Kétou. It is part of a series of studies aimed at quantitatively and qualitatively evaluating the milk production of three goat genetic groups in Benin; this with the aim of identifying the prospects for intensification and genetic improvement, the basis for the creation of a dairy goat sector.

2. MATERIALS AND METHODS

2.1 Study environment

This study was conducted in the commune of Kétou. It is located at the northern end of the Plateau department between latitudes 7°10 and 7°41'17" North on the one hand and longitudes 2°24'24" and 2°47'40" East on the one hand. The climate of the municipality of Kétou has a bimodal rainfall regime: long rainy season (March to July), short dry season (August), short rainy season (September to October), and long dry season (November to February). The annual amount of rainfall is about 1,073mm in 65 days. The average annual temperature of 25°C, with the minimum and maximum located around 24°C (the coolest month) and 37 °C in February (the hottest month).

Animals

Twenty-four (24) WAD goats at 03 and 04 months of gestation were made available by the breeders of the commune and grouped together on an experimental site. Throughout the duration of the study, the animals were kept in permanent confinement with trough feeding consisting of Panicum maximum C1, Moringa oleifera and mangifera indicate. A concentrate (60% corn, 36% soybean meal and 4% vitamin mineral complex). All animals were vaccinated against PPR at the start of the experiment. Internal and external deworming is carried out every two months. Animals showing signs of mastitis or other infections receive injections of 20% tetracycline for 3 days.

Collection of data

Milk checks take place every 10 days. The first milk recording takes place on D5 in order to allow the kid to consume the colostrum. A total of 169 daily production data were recorded from D5 to D97. The method of double weighing the kid before and after suckling (Cissé et al, 1993) combined with milking under oxytocin (Coombe et al., 1960; Gnanda et al., 2016) is used. The young are separated from the mother the day before milk recording in the evening at 6 p.m. The

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next day, three (03) supervised feedings are organized respectively at 8 a.m., 12 p.m. and 4 p.m. The kids are weighed before and after each feeding. The weight difference is recorded. Two (02) hours after the last feeding, the full milking of the female is organized. An injection of 5 IU of oxytocin is made in the jugular vein and the goat is milked immediately afterwards. Fifteen (15) minutes after the first injection, another intravenous injection of 2.5 IU of oxytocin is given followed by a second complete milking. The quantities of milk milked are immediately weighed and fed to the kids using a syringe.

Ultimately, the saved parameters are as follows:
Initial yield : The milk yield on day 5 *post partum*
Maximum return (Peak yield) : The highest daily milk yield recorded during successive milk checks
The peak day (Peak day) : The lactation day when the maximum yield was recorded
Average daily milk yield from D5 to D30 postpartum (Dmyield 5-30d): average of the daily milk yields obtained during milk checks carried out between D5 and D30.
Average daily milk yield from D5 to D60 postpartum (Dmyield 5-60d) : average of the daily milk yields obtained during milk checks carried out between D5 and D60
Average daily milk yield from D5 to D90 postpartum (Dmyield 5-90d): average of the daily milk yields obtained during milk checks carried out between D5 and D90
Average daily milk yield from D30 to D60 postpartum (Dmyield 30-60d) : average of the daily milk yields obtained during milk checks carried out between D30 and D60
Average daily milk yield from D60 to D90 postpartum (Dmyield 60-90d) : average of the daily milk yields obtained during milk checks carried out between D30 and D90

Statistical analyzes

The Generalized Linear Models (Proc GLM) procedure of the SAS (Statistical Analysis System, 9.2, 2008) was applied to the data. The fixed effects consist of parity (1, 2, 3, 4, 5+), postpartum weight ([14; 18[, [18; 22[, [22; 26[) of the goat and the litter size (1, 2, 3). This model looks like this:

$Yijkl = \mu + R_i + L_j + M_{k+} eijkl$ with

Yijkl : The estimated parameter for each goat of parity *i*, whose litter size is *j* and postpartum weight *k*

μ : the value of the general average;

R_i : fixed effect of the month of parity (1, 2, 3, 4, 5+);

L_j : fixed effect of litter size (1, 2, 3)

M_k : fixed effect of postpartum weight: 3 classes *([14; 18[kg, [18; 22[kg, [22; 26[kg))*

eijkl : random residual effect

The different means were compared using the Student's t test at the 5% level.

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3.RESULTS

Figure 1 presents the curve of daily milk production of the WAD goats object of the study. The production curve presents a normal pace with an ascending phase which goes from D5 to the peak around D15. The plateau is circumscribed around D15 and the descending phase goes from D15 to D90. Table 1 presents the average values of the main quantitative parameters milk production from 5 to 90 days. The initial yield obtained on D5 is 285.03±12.51g. The average daily peak milk yield is 443.23±51.17g and the average peak day is 14.67±0.93. The average daily milk yields are respectively 348.35±31.17g/d, 298.82±25.40g/d, 247.68±21.09 g/d, 215.36±18.10 g/d, 127.99±10.91 g/d for the periods D5 to D30, D5 to D60, D5 to D90, D30 to D60 and D60 to D90. Table 2 presents the average daily milk yield by parity, litter size and postpartum weight in the WAD goat reared in southern Benin. Parity and postpartum weight have no significant effect on any of the milk parameters studied. The size of the litter has on the other hand a significant effect on the daily milk yield at the peak and the average daily milk production of the first thirty (30) days of lactation. Daily milk yields are positively correlated with parity. But the daily milk yields for the periods D5 to D30, D5 to D60 and D5 to D90 increase up to parity 4. The latest peak, i.e. 18.6±1.60 d is obtained at parity 2. The yield at the highest peak, i.e. 686.99±166.62g/d is obtained at parity 4. Regarding litter size, the highest milk yields are observed in goats whose litter size is 2 and the lowest yields in single litter goats. In terms of postpartum weight, it is the heaviest goats (weight between 22 and 26 kg) that have the best daily milk yields and an early peak at 13.5 days. But the highest peak yield is obtained in goats with a postpartum weight of between 18 and 22 kg.

4.DISCUSSION

The average daily milk production obtained for the first two (02) months of lactation is close to the highest value mentioned by Odoemelam (2013), i.e. 298.66g/d, for the same breed. Ahamefule (2012) reports a daily milk yield of 92.5 g/day for primiparous WAD goats aged 10 to 12 months. This yield is significantly lower than that obtained at parity 1 in the present study. Olawoye et al. (2020) also records in the WAD breed in Nigeria, a low yield of 125.31ml/day or 129.07g/day corresponding to a drop of 47.88% compared to the daily average obtained between 5 and 90 days postpartum of lactation in our WAD goats. In Burundi, the East African small goat shows better performance with a daily milk yield of 440±167g/day and a peak yield of 350g/day and 650g/day respectively for single litter and double litter goats (Mbayahaga et al., 1994). Zahraddeen et al. (2009) noted in WAD goats kept on station in Nigeria, an average daily milk production of 168.63±1.27ml, or 173.69±1.31g, which is below the daily productivity obtained in our study. However, it should be noted that this evaluation was done without injection of oxytocin and could have given higher yields otherwise. The average peak yield is below the values mentioned by Egwu (1995) which are between 600 and 700g of milk per day but higher than that of 260.74±2.10 observed by Zahraddeen et al. (2009) for the WAD breed. Regarding the average day of peak lactation, our results are similar to those of Zahraddeen et al. (2009) and James and Osinowo (2004) who record it in the third week for the breed. Butswat et al. (2002) observed a later peak in Sahelian goats and Red Sokoto at the fourth week.

Parity has no significant effect on most of the production parameters studied, contrary to the observations of several authors (Kala and Prakash, 1990; Salah et al., 1991; Akpa et al., 2002; Zahraddeen et al., 2009). Even if parity is one of the factors that affect milk production according to Midau et al., 2010, this author does not find any significant effect on parity in the

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Red Sokoto goat in Nigeria. In fact, milk yield is lower in primiparous goats than in multiparous goats. Among the three indigenous breeds of goat, Red Sokoto, Sahelian goat and WAD goat, Zahraddeen et al. (2009) observed an increase in daily milk yield from parity 1 to 3. The same observation was made by Butswat et al. (2002) in Sahelian goats and Red Sokoto which show a significant increase in milk production up to the third parity and a decrease thereafter. Zeng and Escobar, (1995) and Carnicella et al., (2008) also report an increase up to parity 3 or 4. This dynamic could be explained by the fact that older goats have a larger udder volume than primiparas. Indeed, the mammary alveoli developed during previous lactations do not entirely regress and are supplemented by those developed during subsequent lactations, thereby increasing the secretory parenchyma (Knight and Peaker, 1982).

The significant influence of litter size on milk yield in goats is highlighted by several authors (Browning et al., 1995; Carnicella et al., 2008; Delgado -Pertínez et al., 2009; Zahraddeen et al., al., 2009) as obtained for peak yield and yield from 5 to 30 days. Milk yield increases with litter size. Akpa et al. (2002) recorded a growth of 62.83% between the average daily milk yield of single litter goats and those with 3 kids against 27.18% in our study for WAD goats. According to Zahraddeen et al., 2009, this difference in yield related to litter size could be due to the additional pressure or stimulation on the mammary gland as a result of the additional suckling of the second or even third kid. Browning et al., (1995) add that placental lactogen stimulates mammary gland development and therefore higher milk production in goats. However, Rai and Chorey (1965) believe that the increase in milk yield from multiple births depends on the number of kids suckled and not on the number of kids born.

The absence of a significant effect of pasturm weight observed in our study is confirmed by the results of Constantinou (1989) in the alpine goat. The author specifies the importance of this parameter for the milk yield because it best reflects the physical condition of the goat. The positive correlation observed between daily milk yield and postpartum weight is confirmed by Mavrogenis and Papachristoforou (2000) in Damascus goats in Cyprus and Devendra and Burns (1983). Lipid mobilization in heavier goats is very important for goat milk production. The lipid reserves of the body constitute an energy reserve to improve the milk yield of the goat (Morand-Fehr and Sauvant, 1978).

5.CONCLUSION

The study made it possible to evaluate the milk yield of the WAD goats taken to the station over a period of 90 days. The milk production performances obtained, although low, are close to or even superior to most of the performances recorded for the breed in the West African sub-region. The effects of the reproductive factors (litter size, parity rank and postpartum weight) described in this article make it possible to propose avenues for genetic improvement of the milk production of the WAD goat through selection. Thus, the heaviest and most prolific goats produce more milk and should be selected for this purpose. The highest milk yields are obtained in goats of parity 3 and 4. Other studies will have to look into the evaluation of the level of milk production in real environment as well as the effects of other non-genetic factors such as the season farrowing, feeding and health status on the level of production of the WAD goat.

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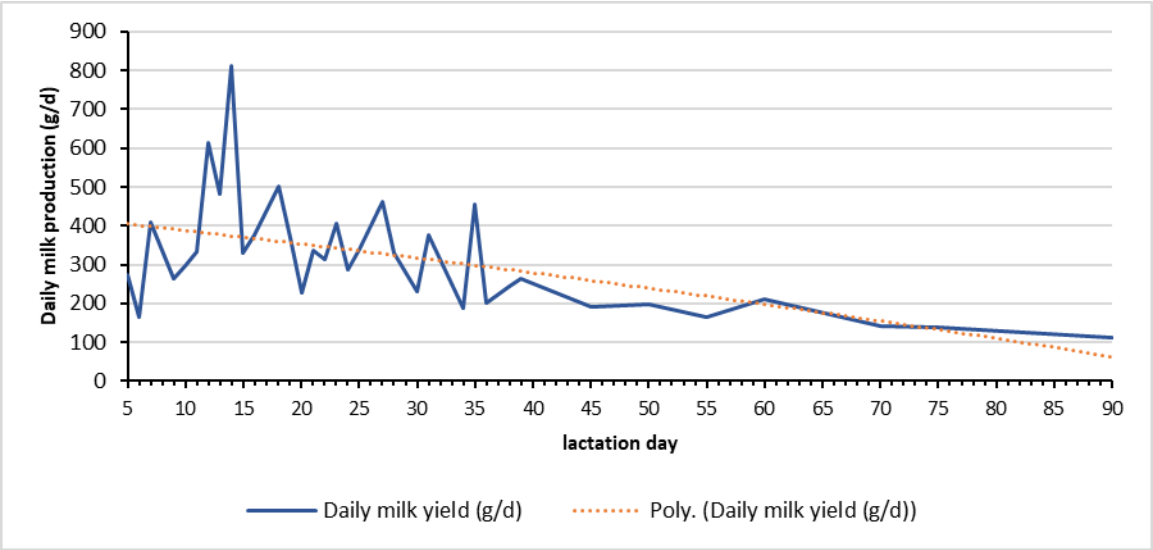

Figure 1: Lactation curve of WAD goats taken to a station in southern Benin

Table 1: Averages of some milk production parameters in the WAD goat

Parameters	Means (N=24)	Minimum	Maximum	Standard Error	Coeff of variation
Initial yield (g)	285.03	122.2	560.4	12.51	42.28
Peak yield (g)	443.23	180.74	1321.59	51.17	56.56
Peak day (days)	14.67	5.00	23.00	0.93	30.93
Dmyield 5-30d (g)	348.35	139.74	661.39	31.17	43.84
Dmyield 5-60d (g)	298.82	113.28	513.47	25.40	41.64
Dmyield 5-90d (g)	247.68	96.49	400.44	21.09	41.71
Dmyield 30-60d (g)	215.36	72.19	359.20	18.10	41.16
Dmyield 60-90d (g)	127.99	54.53	251.34	10.91	41.74

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Table II : Distribution of least squares means (±standard error) of daily milk production and effect of parity, postpartum goat weight and litter size in the WAD goat in southern Benin.

Factors	Modalities	NOT	Initial yield	Peak yield	Peak day	Dmyield 5-30d	Dmyield 5-60d	Dmyield 5-90d	Dmyield 30-60d	Dmyield 60-90d
Global		24	285.03 ±100.89	443.23 ±172.85	14.67 ±3.5	348.35 ±123.33	298.82 ±104.35	247.68 ±89.09	215.36 ±76.38	127.99 ±44.93
Parity			ns	ns	ns	ns	ns	ns	ns	ns
	1	4	157.49± 20.37b	219.78± 26.79b	13.00± 2.35A	172.55± 24.18b	144.87± 22.09b	123.66± 18.75b	103.35± 19.07b	70.62 ±10.45c
	2	5	243.22± 59.45ab	369.30± 88.43ab	18.60 ±1.60a	296.70± 67.62ab	258.83 ±55.33ab	217.90± 45.07ab	183.47± 32.07ab	100.37± 13.68bc
	3	5	334.37± 64.76a	430.62± 91.07ab	15.00± 2.05A	371.65± 75.60a	316.25± 57.30a	261.64± 43.77a	225.00 ±37.26ab	113.49± 22.23bc
	4	5	282.05± 40.87ab	686.99± 166.62a	15.60 ±0.98A	455.65± 66.34a	381.75± 45.85a	316.47± 34.24a	270.88± 34.44A	153.29± 10.98ab
	5+	5	382.50± 19.43a	464.79± 40.10ab	10.80± 2.06A	410.07± 31.08a	361.62 ±33.81a	293.94± 43.32a	271.71± 29.41a	190.72± 19.24A
Litter size			ns	*	ns	*	ns	ns	ns	ns
	1	13	210.92± 23.43b	336.33± 43.39a	15.92± 1.28A	269.52± 33.51a	237.11± 30.27a	199.44± 24.91a	183.33± 26.95a	99.68 ±12.69b
	2	9	378.92± 35.48a	595.03± 103.42a	13.78 ±1.15A	453.58± 47.75a	379.10± 35.34a	316.05± 26.47a	255.80± 19.49a	157.90± 14.14a
	3	2	344.22± 2.25A	455.02± 113.04a	10.50± 5.50a	387.26± 82.40a	338.70± 79.27a	253.66± 113.49a	241.59± 73.00a	177.44± 37.27a
Postpartum weight (kg)			ns	ns	ns	ns	ns	ns	ns	ns
	[14; 18[	8	238.20± 44.84a	327.19± 63.02a	15.13± 1.54A	264.74± 51.41a	228.18± 43.89b	193.44± 36.50b	160.57 ±27.95b	96.02± 13.82b
	[18; 22[	12	296.29± 33.75a	504.12± 89.03a	14.75± 1.41A	381.47± 46.50a	322.83± 35.24ab	261.41± 29.09ab	230.34± 25.45ab	128.57 ±12.78b
	[22; 26[	4	344.89± 56.02a	492.64± 35.24A	13.50± 2.40A	416.22± 35.86a	368.08± 38.97a	315.00 ±35.61a	280.02± 26.02a	190.20±28.47