International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 38 No. 2 Dec. 2022, pp. 443-453

http://www.ijias.issr-journals.org/

Effect of level of feeding on the preweaning growth performance of kids

Nourou Abdou[1], Ousseini Mahaman Malam Mouctari[2], Abdoulaye Soumana Gouro[2], and Ignatius Verla Nsahlai[3]

[1]Department of Animal Production, National Institute for Agricultural Research, Niamey, Niger

[2]Department of Animal Production, Faculty of Agronomy, University Abdou Moumouni, Niamey, Niger

[3]Department of Animal and Poultry Science, University of KwaZulu-Natal, Pietermaritzburg, South Africa

ABSTRACT: Red Maradi goats from Caprine Centre of Maradi in South of Niger were used during two subsequent lactations from 2 weeks post kidding to 13 weeks (91 days) to evaluate to determine the effect of previous level of feeding on production performance of dams and their kids. For the first lactation, sixty goats were placed into six groups of 10, and randomly assigned to six treatments (T1, T2, T3, T4, T5, and T6) with four levels of feeding (g/kg DM): T1=842, T2=T5=T6=934, T3=1079 and T4=1300 corresponding to 200 g, 400g, 600g and 800g of milk production, respectively. During the subsequent lactation, 35 lactating does and 17 kids were used. All does were given one dietary treatment (T4) to determine the effect of previous levels of feeding on preweaning performance of kids and determine the potential milk production of Red Maradi goat. At the 1st lactation, the linear effect of level of feeding increased ($P<0.001$) dry matter intake, ME intake and milk yield of dams. During the 2nd lactation the previous levels of feeding did not affect these parameters; however, previous levels of feeding affected ($P<0.001$) final liveweight and live weight change of dams. During 1st kids' ME intakes increased ($P<0.001$) linearly with levels of feeding and kids' final weight also increased linearly with feeding level of does. During the 2nd lactation, the daily ME intake of dams, and daily milk yield (mean milk yield of 367 g/day) were not affected by previous level of feeding.

KEYWORDS: Red Maradi goat, preweaning performance, feeding levels, metabolisable energy, kids.

1 INTRODUCTION

The Red Maradi (Sokoto) goat is known as multipurpose breed because it produces meat, milk and good quality skin throughout West Africa; these skins are exported to Europe. Goats play an important role in generating income, capital storage and improving household nutrition [1]. Being small in size, they do not require large housing space per head compared to cattle and can easily be handled and managed by women and children. Goats play an important role in the national economy of Niger where they contribute about 51.61% of live animal exports and 59.38% of total hide and skin [2]. Red Maradi goat is more dominant in Southern Niger and represent the most important goat breed reared by smallholder farmers due to its prolificacy and milk production [3]. In the semi-arid areas, goats are the most important animal species for milk production next to cows for smallholder farmers, and on live weight basis, goat is a more efficient milk producer than the cattle and sheep [4]. It was also reported that 61% of households raise at least 1 to 5 goats and goats are the most common animals sold by rural households for immediate cash income used to purchase food items [5]. However, the livestock system in this area is characterised by an acute shortage of feed supply where animals graze only poor natural pastures in the dry season and were offered cut-and-carry grass and shrubs in the rainy season. Studies on phenotypic and zootechnical characterization and then on diet of red Maradi goat in a controlled environment, refer to improving its performance [6], [7]. Nowadays, it appears that Red Maradi goat has undergone a dilution which influences negatively some production attributes namely birth and weaning weights, growth rate and body condition. Among numerous productions constraints, the nutritional factor constitutes the most crucial as most of the others can be manipulated by their improvement [8]. Dietary protein deficiency was highlighted as a major limiting factor to small ruminant production in tropical Africa and suggested the use of agro-industrial by-products as feed supplements to alleviate this constraint [9]. Thus, adequate nutrition and the improvement of dietary protein and energy intake may influence does to express their genetic potential for self-production and production performance of its kids. The preweaning performance of kids is the most important trait for successful animal production but very little is known about this trait for Red Maradi goat although some authors by evaluating effect of weaning age of kids on quantity and composition of milk resulted in an average milk production per lactation of 120 days which amounts to 75.5 kg, with a fat content average of 4.59% and an average protein level of 3.51% [10]. The amounts of fat and protein are respectively 3.50 kg and 2.59 kg. Therefore, the present study intended to determine the effect of previous levels of feeding on production performance of dams and kids during three months post kidding corresponding to weaning period.

2 Materials And Methods

2.1 Study Site

The study took place in the Caprine Centre of Maradi (1850 ha and 893 animals in 2012) which is located at East of Maradi. It is located in the sahelo-sudanian zone of Niger with a mean annual rain fall of 350-600 mm, latitude $13^0 30'$N, longitude $7^0 6'$E and an altitude of 347 m above sea level. The climate is relatively dry and the rainy season occurs between June and September. The dry season begins around the 15th October with dry and cold weather from November to February. Hot weather occurs from March to June. The mean min/max temperature is 22/36°C with a peak in April-May (>40°C); heat decreases when the rains begin. The relative humidity from October to June is < 20% and July to September is > 80%. The natural vegetation is Sahelo-Sudanian woodland dominated by various *Acacia* species, with sparse ground regenerating shrubs and perennial or annual grasses.

2.2 Animal And Housing

Sixty (60) lactating does with their seventy three (73) kids were used in this experiment from 14 days post kidding until weaning (at 3 months) at the first kidding while 35 lactating does with seventeen (17) kids were used at the second kidding. Kids were kept together with dams in individual pens where they ate the same diets and suckled their dams until weaned at 3 months of age. Kid survival rate was 78% at the first kidding and 47% at the second kidding. Kids' mortality was due to lack of milk yield and infectious diseases (Pasteurollosis; see Appendix A) mostly.

2.3 Feeds And Feeding Management

Feed troughs were made by cutting a barrel in three parts each of which became a feed trough. Untreated and urea treated millet stover, groundnut haulms, wheat bran and cottonseed cake were used as feed ingredients. During the 1st lactation, diets were formulated using milled (10mm) urea treated or untreated and uncrushed millet stover (MS), crushed groundnut haulms (GH), cottonseed cake (CSC) and wheat bran (WB). Table 1 shows that treatments T1, T2, T3 and T4 were derived from diet 1. Treatment T5 was derived from diet 2 and treatment T6 was derived from diet 3. During the 2nd experiment (lactation), only T4 was offered to all does to determine the effect of previous levels of feeding. Every day, diet offered and orts in plastic bags were measured with an electronic balance (Santorin 6100g d=0.1 g) the previous day in the afternoon just to facilitate the feeding process and measuring intake. Diets were offered in the morning at 8: 00 h and refusals were collected the following day between 7: 00 h to 8: 00 h. Mineral lick was hung in individual pen permanently per animal as supplementary ingredient. Tap water was offered *ad libitum* in a 10-liter basin. Representative diets and refusals were collected daily and dried (for DM determination) in an oven at 65°C for 48h. An electronic balance and a scale were used for measurements. At the end of the week a composite sample (5%) of diets and refusals were taken and stored and at the end of the experiment, representative samples (5%) of diets offered and refusals were collected for chemical analyses.

Table 1. Ingredient and chemical composition of diets

Ingredient (g of DM)	Diet 1				Diet 2	Diet 3
	T1	T2	T3	T4	T5	T6
CUTMS	385	384	385	385	-	-
CMS	-	-	-	-	384	-
MS	-	-	-	-	-	384
GH	308	307	308	308	307	307
WB	230	231	231	231	231	231
CSC	77	77	77	77	77	77
Total	1000	1000	1000	1000	1000	1000
Chemical composition						
N (g/kg DM)	16.93	16.93	16.93	16.93	16.52	16.52
ME of diet (MJ/kg DM)	9.24	9.24	9.24	9.24	8.8	8.8
Rationing						
Target milk production (g)	200	400	600	800	400	400
Rationing level (g/day)	842	934	1079	1300	934	934
Feeding level	0.65	0.72	0.83	1	0.72	0.72

MS: millet stover; CMS: crushed millet stover; CUTMS: crushed and urea treated millet stover; GH: groundnut haulms; WB: wheat bran; CSC: cottonseed cake; ME: metabolisable energy.

2.4 Experimental Design

The six (6) treatments (T1, T2, T3, T4, T5 and T6) allocated to dams were also available to their kids. Sixty animals were blocked according to weight, parity and litter size into groups of 10 animals each, which were randomly allocated to six (6) dietary treatments, making a total of ten (10) animals per treatment. The six dietary treatments were offered to lactating does from 14 days to 3 months post kidding. After weaning, these animals continued on the same diet until the next kidding. After the 2nd kidding, all animal were fed one dietary treatment (T4) to determine the effect of previous feeding levels. Each dams and its kid (s) stayed together in the same pen, except during test days. On a test day, a dam and its kids were separated and milk yield measured from 18: 00 h to 18: 00 h the next day.

2.5 Measurements

At the beginning (evening of day 14 and morning of day 15) and end (evening of day 90 and morning of day 91) of each experiment, body weights of kids and dams were taken during two consecutive days after starvation for 12 hours from 18: 00 h to 06: 00 h. The live weight of each dam or its kid (s) corresponded to an empty live weight. Empty kids' weights were recorded weekly from 14 days after kidding until weaning (91 days after kidding). Empty body weights of dams were recorded every two weeks from 14 days after kidding.

Milk intake of kids was recorded weekly until weaning. From 14 days post-partum, milk yield was collected weekly until at the end of the experiment after week 13. Feed offered to dams and refusals were measured daily in order to determine the feed intake. A method of weigh-suckle-weigh followed by hand milking were used to record the milk yield. Thus, measurements were recorded thrice during the test day; in the morning (06: 00h), afternoon (12: 00h) and evening (18: 00h); this was followed by hand milking immediately after the last weighing at 18: 00 h. If a kid urinated during the period of suckling its day's record was cancelled but the measurement was repeated during the following day. The total daily milk yield was the sum of four measurements (3 from kid weight after suckling and 1 from milking hand). During the previous day of milking, kids were separated from dams from evening (18: 00 h) to following evening (18: 00 h) after finishing milk recording.

2.6 Chemical Analyses

Samples of feeds offered and refusals were collected for chemical analyses. The metabolizable energy (ME) of feed offered was derived from *in sacco* degradability using effective degradability (ED) of OM based on suggestion by Nsahlai and Apaloo (2007): ED*15.06/0.9, where 15.06 is a factor suggested by Czerkawski (1986). At the end of the experiment, samples of feed offered and orts were analyzed to determine DM, ash, crude protein (Nx6.25), neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL). Dry matter was determined by drying samples in an oven at 60^0C for 48h until weight became constant. Ash was determined by combusting 1 g of sample per crucible in a muffle furnace for four hours at 550^oC. Nitrogen content was determined using the Leco TruMac CNS/NS. NDF, ADF and ADL were determined in duplicates using ANKOM-A200/2220 (2052 O'Neil Road, Macedon NY 14502, www.ankom.com) as described by Van Soest et al. (1991). Neutral detergent fibre content was assayed without a heat stable amylase. Both NDF and ADF were expressed inclusive of residual ash. ADL or lignin (sa) was determined by solubilization of cellulose with sulphuric acid. Hemicellulose was obtained by difference of between NDF and ADF and cellulose was calculated as the difference between ADF and lignin (sa). All these analyses were done in the laboratory of Discipline of Animal Science, University KwaZulu-Natal, Pietermaritzburg.

2.7 Statistical Analysis

Does which were sick, infected with mastitis pathogens or lost their kids before the end of the experiment were removed before analysing data. Variables were feeds intake of dams, metabolisable energy (ME) intake, milk yield, milk intake, initial live weight, live weight gain, and final live weight of kids; starting weight, final weight and live weight change of dams. Data were analyzed using the General Linear Model of SAS (Statistical Analysis System) to determine the Least Square Means (LSmeans), means and the level of differences between treatments. The model of analysis was as follows:

$$Yijklmn = \mu + Ai + Bj + Pk + Tl + Lm + Eijkklmno$$

Where: Yijklmn is the independent variable (feed intake, ME intake, milk yield, milk intake, final live weight of dam and kid, live weight change of dam and kid live weight gain). µ is the overall mean; Ai is the effect of dam ages; Bj is the effect of birth type; Pk is the effect of parity; Tl is the effect of treatments; Lm is the effect of initial live weight of kids; Eijklmno is the residual error. The treatment sum of square was partition to test of the effect of treating with urea (T2 vs. T5) and the effect of crushing (T5 vs. T6). Linear and quadratic contrasts were used to compare the effect of level of feeding diet 1. For the second lactation, the effects of previous treatments on the same parameters cited above were tested.

3 RESULTS

3.1 CHEMICAL COMPOSITION OF FEEDS AND DIETS

Table 2. Chemical composition of feeds

Feeds	MS	MS	GH	WB	CSC
Urea treatment	No	Yes	no	no	no
Dry matter	954	619	932	953	980
Organic matter	913	911	889	951	948
Nitrogen (N)	6.20	7.28	17.50	26.07	35.45
Neutral detergent fibre (NDF)	816	799	495	477	570
Acid detergent fibre (ADF)	518	523	386	125	437
ME (MJ/kg DM)	4.57	5.71	11.31	12.65	8.30
ADIN	1.4	1.6	2.2	0.8	3.2
ADIN: N	22.8	22.4	12.5	3.0	9.1
Hemicellulose	298	276	110	352	133
Cellulose	394	406	265	86	339
Acid detergent lignin	130	118	116	35	101

ME: Metabolizable energy; ADIN: Acid detergent insoluble nitrogen; ADIN: N: ratio acid detergent insoluble nitrogen in nitogen content of feed; MS: Millet stover; GH: Groundnut haulms; WB: Wheat bran; CSC: Cottonseed cake.

Table 3. Chemical composition of feeds offered and refusals (g/kg DM)

		Diet1				Diet2	Diet3
Parameters	**Feed**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**
DM	Offered	822	822	822	822	949	949
	Refusal	965	965	965	965	970	980
OM	Offered	916	916	916	916	916	916
	Refusal	933	947	940	959	945	955
NDF	Offered	613	613	613	613	619	619
	Refusal	713	715	672	726	700	823
ADF	Offered	385	385	385	385	383	383
	Refusal	510	519	480	531	479	576

DM: Dry matter; OM: Organic matter, NDF: Neutral detergent fibre; ADF: Acid detergent fibre

3.2 EFFECT OF FEEDING LEVELS ON FEED INTAKE AND PRODUCTION PERFORMANCES OF DAMS

Feed intake varied (P<0.001) among treatments (Table 4). Feed intake increased linearly (P<0.001) with increasing levels of feeding dams without any quadratic effect. None of dam variables or kid variables affected dam intake. The metabolisable energy intake of dams (dMEi) increased linearly (P<0.001) with increasing levels of feeding (Table4.) without the quadratic effect. Neither age, nor parity nor birth type of dams affected dMEi. Milk yield varied (P<0.001) among treatments (Table 5.4).

Milk yield increased either linearly (P<0.001) or in a decreasing rate (P<0.01) with increasing feeding level of dams. The age, parity and birth type did not affected (P>0.05) milk yield. Weekly milk yield of different treatments were relatively stable from week 3 to week 9; thence they tended to decrease from week 9 to week 13 except for treatment 4 (Figure 5.1). For the whole period of study milk yield of treatment 4 (T4) was the highest compared to other treatments.

Dam final live weight (dfwt) and dam weight change (dwtc) were not affected by treatments (Table 4). All dependent variables of dam did not affect (p>0.05) dfwt and dwtc. The live weight change of lactating does tended to increase (P<0.05) linearly and positively with increasing levels of feeding until weaning.

3.3 EFFECT OF UREA TREATMENT AND CRUSHING OF MILLET STOVER ON FEED INTAKE AND PRODUCTION PERFORMANCE OF DAMS

The contrast between treatments 2 versus 5 and between treatments 6 versus 5 showed that both urea treatment and crushing of millet stover did not affect (P>0.05) feed intake, dMEi or milk yield of lactating does before weaning (Table 4).

Table 4. Effect of level of feeding dams on production performance of lactating does

Treatment	Initial weight	DMI	dMEi	Daily milk yield	Dam final weight	Daily weight change (g)
T1	20.51	742	6.85	237	21.3	3.9
T2	21.57	800	7.4	236	21.5	1.3
T3	22.1	901	8.33	271	22	13.2
T4	23.72	978	9.04	354	22.4	19.2
T5	21.7	799	7.05	230	21.6	3.2
T6	20	764	6.75	246	21.6	2.5
Variation sources						
RMSE		49.34	0.45	40.99	1.25	15.67
Treatment		***	***	***	NS	NS
Age		NS	NS	NS	NS	NS
Parity		NS	NS	NS	NS	NS
Typeb		NS	NS	NS	NS	NS
Linear		***	***	***	NS	*
Quadratic		NS	NS	**	NS	NS
Contrast						
T2 vs T5		NS	NS	NS	NS	NS
T6 vs T5		NS	NS	NS	NS	NS

*T: treatment; Typeb: birth type; dMEi: dam metabolisable energy intake; DMI: dry matter intake; RMSE: root mean square error; NS (P > 0.05); * (P < 0.05); ** (P<0.01); *** (P<0.001).*

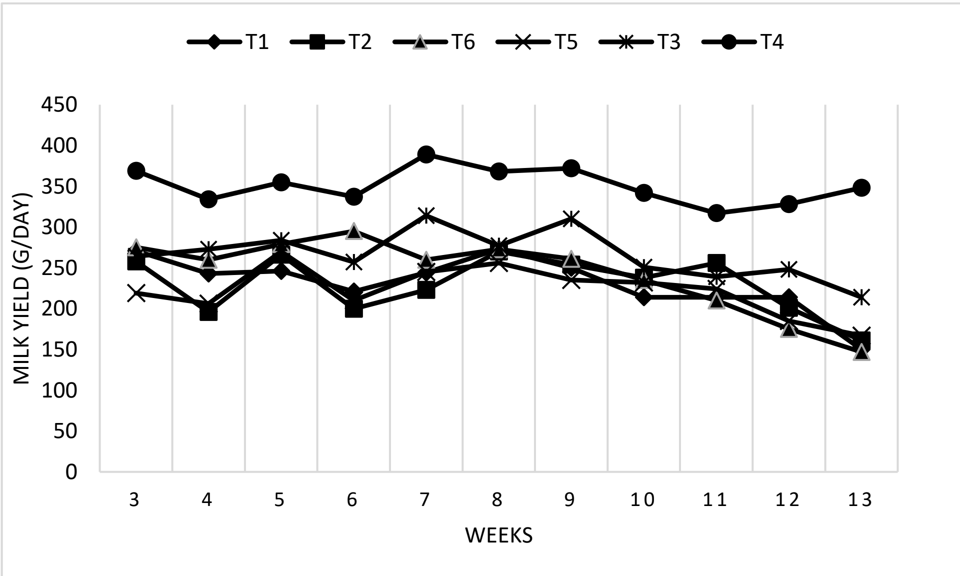

Fig. 1. Effect of level of feeding on weekly milk yield of lactating does

3.4 Effect Of Feeding Levels Of Dams On Metabolisable Energy Intake And Growth Performance Of Kids Before Weaning

The level of feeding dams increased linearly (P<0.001) metabolisable energy intake of kids before weaning (Table 5). The type of birth (0.173 (0.031), t = 5.45, P<0.001) and kid initial weight (kiwt) (0.154 (0.029), t = 5.23, P<0.001) affected strongly (P<0.001) kids' metabolisable energy intake while the age and parity of dam did not exert any effect. Kids would have an increase consumption of 0.154 MJ ME /kg per day for an extra change of 1 kg of kid initial weight.

The kid final weight (kfwt) and kid weight gain (kwtg) increased (P<0.001) linearly with increasing feeding level of dams without any quadratic effect (Table 5). The kfwt and kwtg were not affected (P>0.05) by all dam and kid variables except that with a 1 kg increased in kiwt the kfwt increased (t = 3.80; P<0.001) by 0.862 (0.227) kg.

3.5 Effect Of Urea Treatment And Crushing Of Millet Stover On Feed Intake And Production Performances Of Kids

Urea treatment of millet stover did not affect (P>0.05) the ME intake, final weight and liveweight change of kids whereas crushing negatively influence (P<0.01) final weight and liveweight change of kids (Table 5).

Table 5. Effect of level of feeding dams on preweaning growth performance of kids

Treatment	Kiwt	KMEint	Kfwt	Kwtg
T1	2.37	0.696	2.84	7.22
T2	2.46	0.766	3.16	11.49
T3	2.49	0.91	3.39	14.81
T4	2.52	1.066	4.37	27.16
T5	2.41	0.747	2.81	7.15
T6	2.35	0.737	3.69	18.31
Variation sources				
RMSE		0.262	0.48	6.27
Treatment		***	***	***
Age		NS	NS	NS
Parity		NS	NS	NS
Typeb		***	NS	NS
kiwt		***	***	NS
ksex		NS	NS	NS
Linear		***	***	***
Quadratic		NS	NS	NS
Contrast				
T2 vs T5		NS	NS	NS
T6 vs T5		NS	**	**

*T: treatment; Typeb: birth type; kiwt: kid initial weight; ksex; kid sex; Kiwt: kid initial weight; KMEint: kid metabolisable energy intake; Kfwt: kid final weight; Kwtg: kid weight gain; RMSE: root mean square error; NS: not significant (P > 0.05); * (P < 0.05); ** (P<0.01); *** (P<0.001).*

3.6 Effect Of Previous Feeding Levels On Feed Intake, Metabolisable Energy Intake And Milk Yield Of Dams

Feed intake, metabolisable energy intake and milk yield of dam were not affected (P<0.05) by previous levels of feeding (Table 6). However, previous levels of feeding, age and parity affected (at least P<0.05) final liveweight and liveweight change of dams. Birth type affected only final liveweight of dams.

Table 6. Effect of previous levels of feeding dams on production performance of lactating does

Ptreatment	Dam initial weight	Dry matter intake	dMEi	Daily milk yield	Dam final weight	Dam weight change
T1	23.52	818	7.55	219	21.28	-2.15
T2	23.5	1060	9.8	332	24.65	29.32
T3	25.26	708	6.54	142	23.53	-10.13
T4	25.13	910	8.41	369	22.84	3.13
T5	22.15	898	8.29	229	22.22	3.64
T6	21.8	890	8.22	308	23.6	14.37
Variation sources						
RMSE		95.05	0.87	81.54	0.7	8.64
Ptreatment		NS	NS	NS	***	*
Age		NS	NS	NS	***	***
Parity		NS	NS	*	*	*
Typeb		NS	NS	NS	**	NS

Ptreatment: previous treatment; T: treatment; Typeb: birth type; dMEi: dam metabolisable energy intake; RMSE: root mean square error; NS: Not significant (P > 0.05).

4 DISCUSSION

4.1 EFFECT OF LEVEL OF FEEDING

The linear increase of feed intake from T1 to T4 may be due to increasing levels of feeding which is in agreement with other reports [11], [12], [13], [14]. Some researchers reporting that DM intake of goats varied from 3 to 4% of live weight [15], [16]. When converted to DM intake/kg metabolic weight, feed intake ranged between 76.98 to 92.37 g which was relatively high compared to other works [17], [18], [19] where it has been reported 60 g/kg metabolic weight in lactating West African [18]. Again, it has been reported that DM intake could range between 13 to 50 g/kg live weight [19]. In another study, it was incorporation of supplements such as malic acid at 6 g / kg and 9 g / kg that increased food consumption in Roux bucks of Maradi [7]. Also, some researchers showed that the combination of formic acid and propionic acid in drinking water improves growth performance in rabbits [20]. DM intake in the present study was lower than that of 102 to 116 g/kg $W^{0.75}$/day and 119.6 g/kg $W^{0.75}$ /d reported by some authors [21], [22]. In fact, dMEi increased also linearly as it was derived from dry matter. The dMEi in the present study was supposed to satisfy the ME requirement (7.1 to 9.9 MJ/day) for targeted milk production of 200 to 800 ml/day. Furthermore, the dMEi ranged from 0.7012 to 0.8410 MJ/kg $BW^{0.75}$ which is so far higher than MEm required of 0.5013 and 0.462 MJ/kg $BW^{0.75}$ by some researchers [23], [24].

The linear increase of milk yield with increasing feeding levels of dam corroborated the findings of others [11], [12], [14], [25] who reported that milk production is related to the quantity of feed offered to lactating goats. So poor nutrition would lead to a drop in milk production and poor reproductive performance, slow growth, loss of body condition and increased susceptibility to disease. The variation in the amount of milk produced is relative to the species and the incorporation of an additive in the ration from which one author showed that an intake of 30 g of malic acid per Holstein dairy cows decreases feed consumption and increases milk production [26]. Diet can influence milk production hence some researchers showed that among the goats on the semi-intensive diet, those who received more energy produced quantitatively more milk (1090 g / d / animal against 954 g / d / animal) [27]. From the point of view of the chemical composition of milk, the best values were also recorded with the supplemented goats. The results in terms of mean daily gain indicate positive values in the supplemented goats (on average 25.8 and 31.2 g). The daily milk yield in the present study was lower than that observed in other studies with Red Maradi (Sokoto) goat [14], [28] and Sahelian goat [29]. The milk yield varied weekly among dietary treatments and the weekly milk yield during three months post kidding was lower than that observed on Red Maradi and West African Dwarf goats [30]. The slight variation of weekly milk yield observed until week 9 may be explained by the relative constant dry matter intake and energy intake. The decrease of milk yield from week 9 to week 13 can be attributed to physiological changes of does which naturally affected milk yield with stage of lactation [31]. The levels of female milk production can influence growth of the Creole kid as was shown in study of some author [32]. The highest milk yield of T4 may be due to high metabolisable energy intake compared to other treatments and this is in agreement with other works [33], [34], [35]. It has been postulated that milk yield increased with increasing ME intake [33]. Kids reared by dams receiving a high dietary level of 0.78 to 1 UFL / day and 85 to 105 g PDIN / day, respectively, in wet season and dry season (4), grow at start of lactation (0 to 40 d) 60% higher (83 g / d + 18 VS 53 + 17 g / d) than those whose dams receive only green forage (0.44 to 0.68 UFL/j d and 35 to 57 g PDIN / j). However, these dMEi did not satisfy the expected milk production mentioned above and this could be attributed to genetic potential of Red Maradi goat which would be considered as very low. Nowadays, Red Maradi goat is subjected to genetic dilution in Caprine Centre of Maradi due to inbreeding and low feeding allowances. The environment was too hot and dry perhaps due to global warming. Differences in milk yield compared to other studies may be attributed to feeding system, breed and livestock management systems [30], [36].

An increase in live weight change of dams is expected due to the increase in DMI and ME intake of dams with advancing lactation compared to early lactation where lactating does had low appetite. Nevertheless, mean liveweight change of all treatments stayed positive which is in agreement with some authors [21] who reported live weight gain in german fawn goat. However, other workers [11], [28], [37] observed negative liveweight change in their studies.

The linear increase of kid metabolisable energy intake (kMEint) may be explained by kids' milk intake which corresponded with daily milk yield of dam; in the present study, milk yield increased with increasing level of feeding. This kMEint ranged from 277 to 364 kJ/kg $BW^{0.75}$ which is far lower than values of 485 and 521 kJ/kg$BW^{0.75}$ recommended by some authors respectively, for suckling or preweaning kids [38], [39]. These differences might be partially attributable to breed and experimental conditions, because the ME derived from feed intake of kids was practically impossible to measure since kids stayed together with their dams. Furthermore, some researchers found that kid growth in the first three months is largely determined by milk production of their dams [29]. Some authors have shown that among the factors that influence the growth of kids during the first months, feeding under the mother promotes better growth, in fact the kids reared from a bottle have on average a lower ADG of 20% to kids raised under the mother, which leads to typical age weight 12% lower (an average difference of 1 kg at one month and 1.6 kg at 2 months) [40].

4.2 EFFECT OF UREA-TREATMENT OF MILLET STOVER

Urea treatment is known to increase feed intake because it reduces lignification and increases the rate of digestion. However, after kidding intake of lactating does is low but increases thence. That is why there appears to be an increase of feed intake with stage of lactation compared to the previous experiment where DM intake of dams before 14 days post-partum was low due to the physiological changes of does [41]. Secondly, the environment was dry and hot with low humidity, so feed dried out quite rapidly. Thus, at this phase of study, there was no difference in DM intake between T2 and T5 implying that urea treatment of millet stover did not affect dam intake which could be explained by the increase in does' intake as the lactation period progressed while liveweights of does were improving. Furthermore, at this phase of lactation does were able to eat enough feeds to meet the ME requirements to attain the goal of 400 g of milk yield. In fact, treatments T2 and T5 had the same level of feeding and the improvement of DM intake may explain the no-effect of urea treatment which is in agreement with work of some author with Red Maradi goats when comparing intake of urea treated and untreated straws during three months of study [28]. It has shown that the average quantities of raw materials ingested (824.53 g / d) of the treatment at which the ration contains millet stalks not treated with urea are lower than those of the treatment (1065.61 g / d) whose ration contains millet stalks treated with urea [42]. This shows the effect of millet stem urea treatment on food consumption in goats.

4.3 Effect Of Crushing Millet Stover

The non-significant effect between T6 and T5 showed that crushing millet stover did not affect doe's intake and similar findings were observed by some researchers who reported no intake improvement by crushing barley straw for goats and sorghum stover for cattle respectively [43], [44]. Crushing of millet had no effect due to increased DM intake in this stage of lactation in order to satisfy ME requirements of 400 g of milk production which is in agreement with some researcher [41]. Crushing reduces particle size but made it impossible to select feeds, causing feeds to become even drier in an environment characterized by low humidity, and extreme hot weather. Based on NDF (g/ kg DM) of feed offer (619) and orts (813), goats offered long millet stover were able to select what they ate. Furthermore, since T6 and T5 had the same feeding and nutrient levels, the increase of DM may be explained the similarities of DM intake and production performances of lactating does. The fact that final weight and liveweight gain of kids from T6 (3.69 kg and 18.31 g) were higher than those of T5 (2.81 kg and 7.15 g) in spite of similarity of metabolisable energy intake of milk showed that crushing of millet stover influenced negatively final weight and liveweight gain of kids. This could be due probably to superiority in dry matter intake of kids (T6) which easily ate mixed diet (groundnut haulms, wheat bran and cottonseed cake) but reject millet stover offered alone compared to kids (T5) for which diet palatability was low. Indeed, kids (T5) may not have prehension ease of diet based on crushed millet stover which could have impacted on the intake of feed and ME. These differences on kid DM intake may be explained by selective behaviour of goats which is in agreement with results reported by several authors [41], [45], [46], [47], [48]. The use of millet stalk after crushing is one of the alternatives that allows the enhancement of local food resources and the improvement of the palatability of coarse fodder such as millet straw (Soumana et al., 2016).

4.4 Effect Of Previous Levels Of Feeding

The influence of previous levels of feeding on dams' final weight and liveweight change could be due to the significant effect of feed and metabolisable energy intakes of dams when allocated to different feeding levels where does' weight varied with graded levels of feeding during the interval of two subsequent kiddings. This is in agreement with some author who found that Matebele does previously given different levels of ME gained differently in a subsequent lactation [25]. The variation of dam final weight could be due to physiological changes before kidding where the type of pregnancy would differ among treatments and this is shown by the influence of birth type on liveweight of dam in the present study. In fact, age, parity and birth type exerted effect on liveweight which may be explained by the characteristic of Red Maradi goat which is reputed as a prolific breed in West Africa [3] of which prolificacy is influenced by age/parity [49] and the recurring pregnancies increased body size of dam [50].

4.5 General

The significant effect of birth type on kid metabolisable energy intake is a reflection of milk production and the fact that twin kids shared their milk. This is the reason why kids born as singles have higher ME intake than twins. Similar findings were observed by one result in their study on Sahelian goats [29]. Kids weaning weight in the present study overlapped some results of working on Sahelian and Red Sokoto goats found weaning weights after three months of 5.6 and 3.9 kg, respectively [51]. However, results in the present study were even lower than observed (9.05 kg) by one result during 90 days on the same breed in caprine center of Maradi [52]. It has been observed 6.06 kg of kid weight only at 60 days of age on the same breed under village conditions [53]. Similarly, higher weaning weight of 5.41-7.41 kg, 10.46-12.02 kg and 14.41-23.25 kg were reported, respectively, by some authors at 3 months of age on Sahelian goat, at 4 months of age on Sahelian crossed with Anglo-Nubian goats and at 3 months of age on Damascus goats in Sudan [29], [54], [55]. The significant influence of kid initial weight on kid final weight is in agreement with some author on the same breed and Sodiq (2004) in his study on Kacang and Peranakan Etawah goats in Indonesia [52]. The average daily weight gain (ADG) in the present study were also lower than those observed by some researchers on the same breed [52], [53]. Similarity, some authors reported higher ADG of 88-92 and 66.9 g/day on Tswana goats in Botswana and Red Sokoto goat in Nigeria, respectively [51], [56]. These differences on weaning weight and live weight gain before weaning compared to other studies might be attributed to experimental conditions, kids' energy intake, perhaps to genotype and genetic dilution of red Maradi goats at Caprine Centre of Maradi. Other authors like went further to investigate effect of early weaning on growth and viability of kids and on milk production of Draa goats [10]. They showed that influence of early weaning in 45 days did not significantly influence the amount of milk in 120 days of lactation, the amount of protein, or protein level. On the other hand, amount of fat and fat content were significantly better in goats from early weaning lot. Clemence has shown that early weaning at 10 kg bodyweight did not affect body development, reproductive performance, or even milk production in young goats. On the other hand, a higher intake of concentrate during the rearing phase increased body development and the weight of the mammary gland

5 Conclusion

The level of feeding affected linearly milk yield, feed intake and ME intake of lactating Red Maradi goats with an increase of live weight change before weaning. Urea treatment and crushing of millet stover did not affect feed intake of lactating does. The effect of previous levels of feeding had effect on final liveweight of lactating does. Levels of feeding had positive effect on ME intake, final weight and average daily gain of kids. In the present study, the targeted milk yield was not attained in spite of ME supplied corresponding to the requirements, and kid's growth was very low compared to studies with the same or other breeds. It could well be that the genetic potential of Red Maradi goats is limited or even degenerated. Further investigations should be made on management system of genetic aspects to improve the phenotypic potential of this breed in Caprine Centre of Maradi.

References

[1] Kosgey, I. & Okeyo, A. (2007). Genetic improvement of small ruminants in low-input, smallholder production systems: Technical and infrastructural issues. *Small Ruminant Research* 70 (1): 76-88.

[2] INS-Niger (2011). Le Niger en chiffres. 79p.

[3] Djariri, B. (2005). Monographie de la chèvre rousse de Maradi. 27p.

[4] Malau-Aduli, A. E. O. & Anlade, Y. R. (2002). Comparative study of milk compositions of cattle, sheep and goats in Nigeria. *Animal Science Journal* 73 (6): 541-544.

[5] Wane, B., Delbaere, J. & Charpentier, C. (2005). Analyse de la sécurité alimentaire et de la vulnérabilité au Niger (CFSVA) Partie 1: Rapport. Programme Alimentaire Mondial des Nations Unies. Projet Strengthening Emergency Needs Assessment Capacity (SENAC). *Rome: FAO/PAM*: 87p.

[6] Abdou N, Gouro AS, Nsahlai IV. 2018. Effect of feeding level on production performance of lactating Red Maradi goats and post-natal performance of kids. Int. J. Bio. Chem. Sci., 11 (6): 2826-2836. DOI: https://doi.org/10.4314/ijbcs.v11i6.21.

[7] Barazi AA, Chaibou M, Mahaman MMO, Nouhou ME. 2019. Effect of supplementation of rations with feed additive on weight growth and carcass yield of Roux kids from Maradi in Niger. Int. J. Biol. Chem. Sci., 13 (6): 2487-2496https://dx.doi.org/10.4314/ijbcs.v13i6.5.

[8] Smith, O. & Akinbamijo, O. (2000). Micronutrients and reproduction in farm animals. *Animal Reproduction Science* 60: 549-560.

[9] Ademosun, A. A. (1994). Constraints and prospects for small ruminants research and development in Africa. In: Proceedings of the Second Biennial Conference on the African Small Ruminant Research Network. AICC, Arusha, Tanzania, 7–11 December 1992,: pp. 1–6.

[10] Ibnelbachyr M., Alouani S., Noutfia Y., Boujenane J. 2019. Effect of early weaning on the growth and viability of kids and on milk production of Drâa goats. *Rev. Mar. Sci. Agron. Vét.* (2019) 7 (1): 143-148 145.

[11] Greyling, J., Mmbengwa, V., Schwalbach, L. & Muller, T. (2004). Comparative milk production potential of Indigenous and Boer goats under two feeding systems in South Africa. *Small Ruminant Research* 55 (1): 97-105.

[12] Morand-Fehr, P., Fedele, V., Decandia, M. & Le Frileux, Y. (2007). Influence of farming and feeding systems on composition and quality of goat and sheep milk. *Small Ruminant Research* 68 (1): 20-34.

[13] Sultana, S., Khan, M., Hassan, M. & Khondoker, M. (2012). Effects of concentrate supplementation on growth, reproduction and milk yield of Black Bengal goats (Capra hircus). *Bangladesh Veterinarian* 29 (1): 7-16.

[14] Luka, J. & Kibon, A. (2014). Milk production of Red Sokoto goats fed with supplements in Bauchi State, Nigeria. *Discourse Journal of Agriculture and Food Sciences* 2 (8): 258-263.

[15] Kabir, F., Shahjalal, M., Miah, G., Uddin, M. & Rahman, M. (2002). Effect of concentrate supplementation to grazing on growth and reproductive performance in female goats and sheep. *Journal of Biological Sciences* 2: 333-335.

[16] Rashid, M. (2008). Goats and their nutrition. *In Manitoba Goat Association*.

[17] Gall, C. (1981). *Goat production.* Academic Press Inc. (London) Ltd.

[18] Adenuga, M., Tolkamp, B., Ademosun, A., Montsma, G. & Brouwer, B. (1991). Effect of pregnancy and lactation on liveweight, feed intake and feeding behavior in West African Dwarf (WAD) goats. *Small Ruminant Research* 4 (3): 245-255.

[19] Haenlein, G. (1991). Dietary nutrient allowances for goats and sheep. *Feedstuffs (USA).*

[20] Gohier C, Menini FX, Salaün JM, Bourdillon A, Perdriau A, 2017. Effect of the use of organic acids in oral solution on the growth performance and mortality of fattening rabbits. 17th Cunicultural Research Days, Le Mans: France; 135-138.

[21] Chowdhury, S., Rexroth, H., Kijora, C. & Peters, K. (2002). Lactation performance of german fawn goat in relation to feeding level and dietary protein protection. *Asian Australasian Journal of Animal Sciences* 15 (2): 222-237.

[22] AFRC (1998). The Nutrition of Goats. CAB International, New York, NY.

[23] Luo, J., Goetsch, A., Sahlu, T., Nsahlai, I., Johnson, Z., Moore, J., Galyean, M., Owens, F. & Ferrell, C. (2004). Prediction of metabolizable energy requirements for maintenance and gain of preweaning, growing and mature goats. *Small Ruminant Research* 53 (3): 231-252.

[24] Nsahlai, I., Goetsch, A., Luo, J., Johnson, Z., Moore, J., Sahlu, T., Ferrell, C., Galyean, M. & Owens, F. (2004). Metabolizable energy requirements of lactating goats. *Small Ruminant Research* 53 (3): 253-273.

[25] Sibanda, L., Ndlovu, L. & Bryant, M. (1997). Effects of feeding varying amounts of a grain/forage diet during late gestation and lactation on the performance of Matebele goats. *The Journal of Agricultural Science* 128 (04): 469-477.

[26] Hani MZ, Ahmed EK, Dyaaeldin AM, Osama HM, Uchenna YA, Sobhy MS, 2018. Enhancing lactational performance of Holstein dairy cows under commercial production: malic acid as an option. J Sci Food Agric., 99: 885-892.

[27] Gnanda I. B., Nianogo, A. J. Zoundi, J. S. Faye B and Zono O. 2008. Effect of energy supplementation in wet periods on the milk production of the goat of the Burkinabe Sahel *African Agronomy* 20 (1): 109 - 118 (2008).

[28] Djibrillou, O. A., Pandey, V. S., Gouro, S. A. & Verhulst, A. (1998). Effect of urea-treated or untreated straw with cotton seed on performances of lactating Maradi (Red Sokoto) goats in Niger. *Livestock Production Science* 55 (2): 117-125.

[29] Sangaré, M. & Pandey, V. (2000). Food intake, milk production and growth of kids of local, multipurpose goats grazing on dry season natural Sahelian rangeland in Mali. *Animal Science* 71 (1): 165-173.

[30] Ahamefule, F., Odilinye, O. & Nwachukwu, E. (2012). Milk Yield and Composition of Red Sokoto and Wea Dwarf Does Raised Intensively in a Hot Humid Environm. *Iranian Journal of Applied Animal Science* 2 (2): 143-149.

[31] Assan, N. (2014). Influence of stage of lactation on quantitative and qualitative milk production parameters in goats. *Scientific Journal of Animal Science* 3 (12): 291-300.

[32] Alexandre G. 1991. Pre-weaning growth of kids in Guadeloupe. Elev review. Med. vet. Pays trop., (special issue): 57-62.

[33] Hadjipanayiotou, M. & Morand-Fehr, P. (1991). Intensive feeding of dairy goats. *EAAP Publication (Netherlands).*

[34] Montaldo, H., Almanza, A. & Juárez, A. (1997). Genetic group, age and season effects on lactation curve shape in goats. *Small Ruminant Research* 24 (3): 195-202.

[35] Min, B., Hart, S., Sahlu, T. & Satter, L. (2005). The effect of diets on milk production and composition, and on lactation curves in pastured dairy goats. *Journal of Dairy Science* 88 (7): 2604-2615.

[36] Stelwagen, K. (2001). Effect of milking frequency on mammary functioning and shape of the lactation curve. *Journal of Dairy Science* 84: E204-E211.

[37] Bajhau, H. & Kennedy, J. (1990). Influence of pre-and postpartum nutrition on growth of goat kids. *Small Ruminant Research* 3 (3): 227-236.

[38] Sahlu, T., Goetsch, A., Luo, J., Nsahlai, I., Moore, J., Galyean, M., Owens, F., Ferrell, C. & Johnson, Z. (2004). Nutrient requirements of goats: developed equations, other considerations and future research to improve them. *Small Ruminant Research* 53 (3): 191-219.

[39] NRC (2007). *Nutrient Requirements of Small Ruminants.* The National Academies Press, Washington, D.C.

[40] Fanny Thuault and Antoine Tisseur, 2017. Growth of young people of Pyrenean breed Butcher goats Renewal goats. Association of the Pyrenean goat breed. Technical sheet, November, 4p.

[41] Fedele, V., Claps, S., Rubino, R., Calandrelli, M. & Pilla, A. (2002). Effect of free-choice and traditional feeding systems on goat feeding behaviour and intake. *Livestock Production Science* 74 (1): 19-31.

[42] Moumouni Ayouba Fati. 2020. Promotion of agricultural by-products and Sida cordifolia in the diet of the Red Goat of Maradi. End of cycle thesis with a view to obtaining a master's degree in animal production and biotechnology. Faculty of Agronomy Abdou Moumouni University 74p.

[43] Wahed, R. (1987).Stall-feeding barley straw to goats: The effect of refusal-rate allowance on voluntary intake and selection. University of Reading.

[44] Osafo, E., Owen, E., Methu, J., Abate, A., Tanner, J. & Aboud, A. (1997). Excess Feeding of Stovers from Sorghum and Maize for Small Ruminants and Cattle in Cereal-based Integrated Farming Systems in Africa.

[45] Animut, G., Goetsch, A., Aiken, G., Puchala, R., Detweiler, G., Krehbiel, C., Merkel, R., Sahlu, T., Dawson, L. & Johnson, Z. (2005). Performance and forage selectivity of sheep and goats co-grazing grass/forb pastures at three stocking rates. *Small Ruminant Research* 59 (2): 203-215.

[46] Jørgensen, G. H. M., Andersen, I. L. & Bøe, K. E. (2007). Feed intake and social interactions in dairy goats—the effects of feeding space and type of roughage. *Applied Animal Behaviour Science* 107 (3): 239-251.

[47] Basha, N., Scogings, P. & Nsahlai, I. (2009). Diet selection by Nguni goats in the Zululand Thornveld. *South African Journal of Animal Science* 39 (1): 33-36.

[48] Glasser, T., Landau, S., Ungar, E., Perevolotsky, A., Dvash, L., Muklada, H., Kababya, D. & Walker, J. (2012). Foraging selectivity of three goat breeds in a Mediterranean shrubland. *Small Ruminant Research* 102 (1): 7-12.

[49] Soumana I, Ayssiwede S, Issa S, et Missohou A: 2016 Effets de la complémentation avec des blocs multi-nutritionnels concentrés à base de Sida cordifolia L., une plante invasive, sur les performances zootechnico-économiques des antenais de race Balami à Déréki/Dosso (Niger). *International Journal of Innovation and Applied Studies* 15, 716.

[50] Awemu, E., Nwakolar, L. & Abubakar, B. (2002). The biological productivity of the yankasa sheep and the red sokoto goat in Nigeria, 2002. *Dept. of Animal Science, University of Nigeria, Nsukka, Nigeria*.

[51] Mioč, B., Prpić, Z., Vnučec, I., Barać, Z., Samaržija, D. & Pavić, V. (2008). Factors affecting goat milk yield and composition. *Mljekarstvo* 58 (4): 305.

[52] Makun, H., Ajanusi, J., Ehoche, O., Lakpini, C. & Otaru, S. (2008). Growth rates and milk production potential of Sahelian and Red Sokoto breeds of goats in northern Guinea Savannah. *Pakistan journal of biological sciences: PJBS* 11 (4): 601-606.

[53] Djibrillou, O. A. (1989). Facteurs influant les poids a age-types des chèvres rousses de Maradi en station au Niger - Factors affecting weight-for-age of red Maradi (Sokoto) goats at a Niger research station. *Small Ruminant Research and Development*.

[54] Marichatou, H., Mamane, L., Banoin, M. & Baril, G. (2002). Performances zootechniques des caprins au Niger: étude comparative de la chèvre rousse de Maradi et de la chèvre à robe noire dans la zone de Maradi= Rendimientos zootécnicos de los caprinos de Niger: estudio comparativo de la cabra roja de Maradi con su pariente de pelaje negro en la zone de Maradi= Zootechnical performance of goats in Niger: comparative study of the Maradi russet goat with the black-coat goat in Mardi area. *Revue d'Elevage et de Médecine vétérinaire des Pays Tropicaux* 55 (1).

[55] Shaker Momani, M., Sanogo, S., Coulibaly, D., Al-Olofi, S. & Alkhewani, T. (2012). Growth performance and milk yield in Sahelian× Anglo-Nubian goats following crossbreeding in the semi-arid zone of Mali.

[56] Mahmoud, N., El Zubeir, I. & Fadlelmoula, A. (2012). Colostrum composition and performance of Damascus goats raised under Sudan conditions. *Wudpecker J. Agr. Res* 1 (8): 341-345.

[57] Madibela, O., Boitumelo, W., Manthe, C. & Raditedu, I. (2002a). Chemical composition and in vitro dry matter digestibility of local landraces of sweet sorghum in Botswana. *Livestock Research for Rural Development* 14 (4): 1-6.