International Research Journal of Agricultural Science and Soil Science (ISSN: 2251-0044) Vol. 4(7) pp. 117-123, August, 2014
DOI: http:/dx.doi.org/10.14303/irjas.2014.049
Available online http://www.interesjournals.org/IRJAS

Full Length Research Paper

Dairy production of Burkinabe Sahelian goat in intensive and semi-intensive rationing using local resources

Gnanda B. Isidore*[1], Kabore Adama[1], Kimse Moussa[2], Zoundi S. Jean et Nianogo J. Aimé[3]

[1]Institut de l'Environnement et de Recherches Agricoles (INERA), 01 BP 476 Ouagadougou 01, Burkina Faso
[2]Laboratoire de Biologie et de Cytologie Animale, UFR Sciences de la Nature, Pôle de Recherche Production Animale, Université Nangui Abrogoua. 02 BP 801 Abidjan 02, Côte d'Ivoire
[3]Institut du Développement Rural de l'Université Polytechnique de Bobo (IDR/UPB), BP 1091 Bobo-Dioulasso 01, Burkina Faso

*Corresponding authors e-mail: gnandaisid@yahoo.fr

Abstract

Thirty-two dairy goats were randomly divided into two groups of 16 individuals. The first group was fed completely trough (intensive production system, SI), while the second group was supplemented with 50% of the needs of animals in dry matter (DM), energy and nitrogen (semi-intensive system of production, SS). The ration was composed using cottonseed (37%), local bran (33%), cowpea haulms (12.5%) and sorghum straw (17.5%). All animals received ad libitum supplement using multinutrionnel block made with local resources containing 25% of its local, 20% of iodized salt, 20% of limestone, 10% of *Acacia raddiana* pods, 10 % of cowpea pods, 10% of cement and 5% of bone powder). Goats in SS were followed for pasture to observe the types of fodder consumed and to value the frequencies of their use. Withdrawals of samples were taken on these forages to assess the overall quality of course frequented by animals. Milk production was obtained by trafficking from oxytocin injections. The results show that the leaves of wood accounted for the largest share of fodder collected by goats on rangelands (58% forage grazed). Results on forage quality are as follows: 145 g / kg DM (CP), 3.3 g / kg DM (phosphorus) 9.9 ppm (copper), 23.9 ppm (zinc) and 78 3 ppm (manganese). The production system had a significant effect (P <0.05) on milk production. Goats in SS produced 1413 g / d of milk against 1069 g / d for those subject to the SI. The highest average daily gain (ADG) (P <0.05) was obtained with kids whose mothers were taken to pasture: 41.3 g to 36.2 g against kids whose mothers were fed completely trough.

Keywords: Sahelian goats, dairy production, Block multinutrient, Driving Mode, Oxytocin, natural pasture

INTRODUCTION

In dry climate regions such as the Sahel region of Burkina Faso, improvement of goat farming depends in part on the possibility of optimal utilization of low quality forages produced locally. These products were by-products of crops that are nowdays the subject of storage by farmers for complementation of their animals in Burkina Faso (Zoundi et *al*., 2003). Despite the ability of the goat to use the poor and rich in fiber forages compared to cattle and sheep (Bosma and Bicaba 1997; Lindela and Lewis, 1995; Tezenas Montcel, 1991), an increase of this potential by adding multinutrient supplements to the diet can be a great interest in the search for improved livestock productivity. Particularly, on dairy production, it's necessary to cover animal energy and nitrogen requirement.

However, in intra-mammary osmotic regulation and milk production, certain mineral elements such as sodium, phosphorus, chlorine and potassium play an important role. They are involved in the control of the quantitative milk production synergistically with lactose

(Wolter, 1992; Martinet et Houdebine, 1993). Nevertheless, during dry season, tropical pastures are deficient these important elements.

The study was carried out to assess the impact of using Multinutrient blocks on the value of local food resources, especially crop residues in the rationing of Burkinabe Sahelian dairy goats and their milk yield.

MATERIALS AND METHODS

Experimental site

The study was carried out in north of Burkina Faso and specifically at the station of Katchari, the experimental station of the "Institut de l'Environnement et de Recherches Agricoles (INERA)" in this region, located between 13 ° 55 'and 14 ° 05 ' North latitude and 0 ° 00' 0 ° 10 ' West longitude. The annual rainfall of this area varies between 200 and 600 mm and spread over approximately 50 days. Station area is characterized by high spatial and temporal variability. Rainfall is spread from mid-June or July to mid-September and rarely reaches the month of October.

Animals and feeding protocol

Thirty-two (32) burkinabe Sahelian goats (*Capra hircus*) kid's newborns (between 1st and 4th row of kidding) and age between 3 and 6 a half years, were used for this study. Those goats coming from the herds of Katchari station of INERA. After kidding, goats were divided according to their rank kidding and postpartum weight in two groups of 16 individuals corresponding to two diets described in Table 1. Goats of group 1 were fed only to the trough (intensive production system, IS) and those of group 2 went to pasture and were supplemented at 50% of their needs in dry matter, energy and nitrogen (Semi intensive system, SS). All goats of both groups received ad libitum supplementation of multinutrient block. The needs in dry matter for production of animals were fixed at 4,75 % of their live weight and their daily requirements in energy and nitrogen matters corresponded respectively to 718 g of TDN and 146 g CP/kg of DM (Morand-Fehr *et al.,* 1987). These needs were covered with cottonseed (37%), local bran (33%), cowpea haulms (12.5%) and sorghum straw (17, 5%). The feed table of Rivière (1991) was used for determination of the nutritional values of ingredients above used.

Data collection of milk production per goat was followed for 12 weeks.

Data's collect

A. At trough

Evaluation of the milk yield*:* It was evaluated by hand milking after oxytocin injection, carried out according to the method described by Coombe et *al.* (1960). This assessment was done once a week for 12 weeks of lactation for each goat.

Sampling of milk: 100 milk samples per goat were collected respectively the 2nd, 4th, 6th and 8th week of lactation. These samples were collected using the in plastic bottles of 100 ml. Samples were stored in a refrigerator at 4 ° C until the end of the test before being analyzed. Chemical analyses of milk were performed using the procedures of AOAC (2000) for dry matter (DM), crud protein (CP), fat and ash.

Weighing of the animals: Goats were weighed monthly after calving until 3 months. Weighing were performed using a spring balance 50 kg range and precision of 200 g. Kids were weighed weekly until the 12 weeks age with a spring balance 10 kg range and precision of 5 g.

Feed refusal measurement: feed refusal was collected daily at each goat. The multinutrient blocks consumption was also estimated by monitoring and weighing.

B. Monitoring to grazing animals

This monitoring is carried out on goats were conducted in semi-intensive system (SS). It was to follow monthly these goats during their pasture to identify frequency of consumption of forage and to take samples for global quality assessment of the rangelands exploited.

Methods of chemical analyses of laboratory

To assess the quality of the rangelands, the sample forages collected in the pastures were analyzed for the following elements: nitrogen matter, organic matter, phosphorus, copper, zinc and manganese. The determination of nitrogen and phosphorus were made using the colorimetric method. The copper, zinc and manganese have been made directly to the atomic absorption spectrophotometer.

The dry matter of milk was determined by drying in an oven at 105 ° C for 24 hours and total ash (minerals) by direct incineration of milk sample in a muffle furnace. Nitrogenous substances were assayed by the Kjeldahl method. The Babcock method was used for the determination of the fat.

Data processing and statistical analyses

Feed intakes, growing performance and milk production were analysed by test t of student. SPSS version 11 software was used.

RÉSULT

Use of the fodder resources of the pastures and *and their contribution level in the food needs of goats*

The leaves, the fruits and the straws are the only ones

Table 1. Groups constitution and feeds contribution

	Diet	
Feed contribution per doe	IS	SS
Natural Pasture (8 h/day)	Not	Yes
Dry matters (g/day)	1156 ± 264	612 ± 117
Crude protein (g/day)	169 ± 40	90 ± 17
Total digestive nutrients (TDN) (g/day)	790 ± 398	547 ± 326
Calcium (g/day)	3.75 ± 0.85	1.97 ± 0.38
Phosphorus (g/day)	5.55 ± 1.30	2.93 ± 0.56
Multinutient block [1]	Unlimited	Unlimited
Goats number	16	16

NB: IS: Intensive system; SS: Semi intensive system
([1]) : The multinitrionnel block contains: 25% of its local, 20% of iodized salt, 20% of limestone, 10% of Acacia raddiana pods, 10 % of cowpea pods, 10% of cement and 5% of bone powder. Its composition remains the same: 121 g/kg DM (Crude protein); 17,0 g /kg MS (phosphorus); 66,4 g/kg MS (calcium); 3,9 g/kg MS (magnesium); 31,9 ppm (copper); 137,9 ppm (manganese) et 94,0 ppm (zinc).

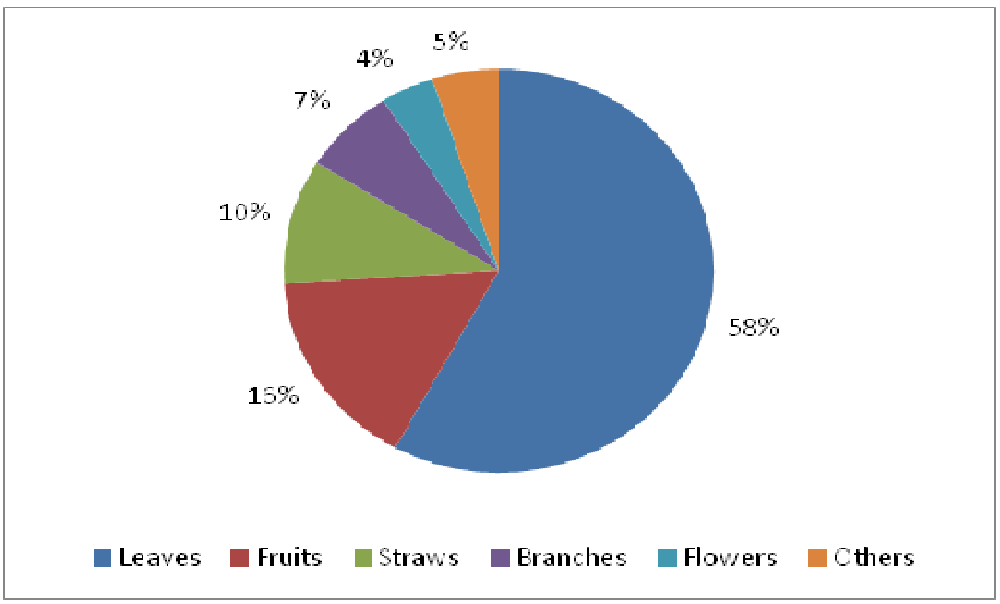

Figure 1. Relative importance of different organs or parts consumed by goats on rangelands

which remained regularly present in diet catches among the fodder exploited by the animals on the pastures.

The woody leaves represented the greatest part of fodder taken by the goats on the pastures. They constituted 58 % of the fodder grazed by does (Figure 1). Using other parts or organs such as the straws (of bush and cereals), the gums, the barks and the branches, had significant contribution only during April and May.

Fodder chemical composition average was 145 g/kg DM of CP, 3.3 g/kg DM of phosphorus; 9.9 ppm of copper; 23.9 ppm of zinc and 78.3 ppm of manganese (Table 2).

Feed intake at the trough

Whatever the system of animal diet, consumption knew a significant refusal rate (over 25%). However, by analyzing the ratio between the quantities of dry matter eaten and that available, increase evolution of this ration was observed with the progress of the lactation of animals.

The voluntary multinutrient block intake was higher with the goats fed in intensive mode (14.64 g/day/animal) than in the supplemented goats (10.1 g/day/animal).

Table 2. Average contents of nutrients from the bodies or parts taken by the animals during the grazing ground

	Leaves	Fruits	Flowers	Straw [1]	Average
Organic matter (%)	88.0±4.6	86.7±4.3	90.2±0.9	93.7±1.8	89.2±4.5
Crude protein (g/kg DM)	166±22	147±48	181±5	73±6	145±39
Phosphore (g/kg DM)	3.4±1.0	3.7±1.4	5.4±1.1	2.0±0.4	3.3±1.4
Cuivre (ppm)	12.4±4.4	9.1±4.2	12.3±4.6	6.6±2.6	9.9±4.4
Zinc (ppm)	39.5±24.5	9.0±8.4	31.5±23.2	14.1±16.3	23.9±22.2
Manganèse (ppm)	137.7±54.0	29.6±8.6	58.4±38.3	51.6±32.1	78.3±56.8

NB: ([1]) Straw of bush and cereals

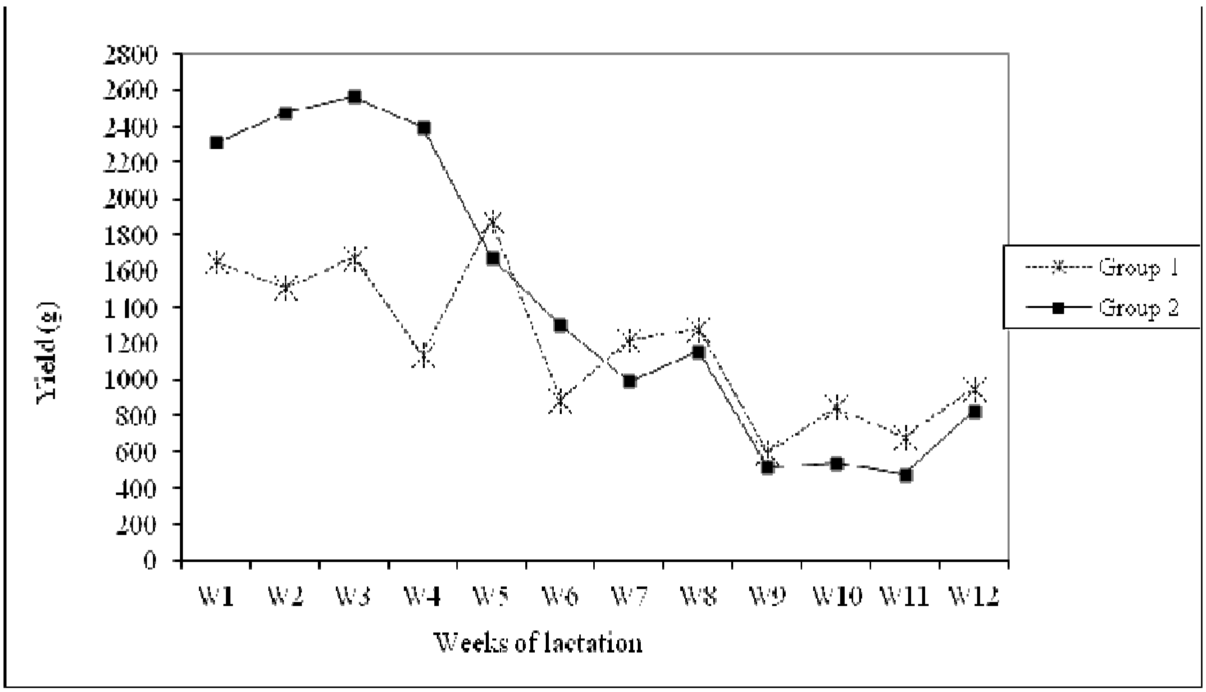

Figure 2. Evolution of milk yied within milking time

Group 1: Animals fed in intensive system of production (IS)
Group 2: Animals fed in semi-intensive system of production (SS)

Production and composition of milk

The general evolution of the lactation curves (Figure 2) indicates the peaks oscillating between the third and fourth week after does kidding. The lactation curve of goats of group 2 has a more regular stage than that presented by goats of group 1.

Milk yield obtained with goats of group 2 was significantly ($P < 0.05$) higher than that collected with goats of group 1 : 1413 g/animal/day the group 2 against 1069 g/animal/day for group 1 (Table 3).

Milk yield was 32% higher with diet SS than diet IS ($P=0.0513$). However, fat rate was not different with two diets. Average of fat rate in milk was 44.5g/day/goat. For milk chemical composition (%), no significant different was founded between two groups. Average of DM, CP, fat and minerals was 13.06%, 2.90%, 3.43% and 0.77% respectively.

Weight performances of the kids and their mothers

Kids whose mothers grazed (SS) presented most interesting growth (41.3g/d) than those whose mothers were fed in trough (36.2 g/d).

This phase of weight crisis was followed by a resumption of growth in all animals with lead weight, but not significant of goats fed with ration SS (Table 3).

Table 3. Milk production and composition and weight performances of does

Parameters	Group 1	Group 2	RMSE	P-value
Milk, solids and fat yields (g/day/doe)				
Milk yield	1069	1413	202	0.0513
Solids matter	148	191	32	0.973
Milk chemical composition (%)				
Dry matter	12.80	13.31	0.77	0.707
Fat	3.31	3.56	0.42	0.880
Crude protein	3.15	2.65	0.44	0.739
Minerals	0.75	0.78	0.04	0.981
Does weights				
Weaning weight (kg)	25.43	26.23	2.50	0.753
Final weight (kg)	25.90	27.94	2.19	0.369
Average daily gain (g)	5.30	19.40	10.39	0.210
Kids weights				
Beard weight (kg/kid)	2.17	2.14	0.25	0.910
Weight at 12 weeks (kg/kid)	5.40	5.99	5.56	0.315
Average daily gain (g)	36.20	41.30	6.31	0.269

NB: Mean in the same row with different letters are significantly different (P<0.05).
RMSE = Root mean square error

DISCUSSION

Use and quality of the food resources exploited by the goats

Many authors (Guerin et *al*., 1988; Nanglem, 2001; Tezenas du Montcel, 1991) had noted the particular ability for goat to defer most of its wood consumption when the herbaceous layer does not cover their needs.

In our study, the increase in contribution of straws, gum, bark and twigs during the months of March and April due in part to the fact that this period corresponds to that where the availability of leaves, fruits and flowers in wood, are the rarest of the year. It is mainly between November and March that wood from the area take most of their losses from leaves, fruits and flowers, with a recovery cycles at the beginning of the rainy season (Nanglem 2001). These considerations have led some authors (Tezenas du Montcel, 1991) to underline the difficulty to estimate the digestibility and the wealth composite rations of the tropical pastures due to the very strong variability of their botanical composition of grazed species and periods of year.

While referring to certain data of literature (Diagayété and Schenkel, 1986; Faye *et al*., 1990; Mandiki *et al*., 1986), the contents of copper and zinc recorded in this study are at the limits of deficiency compared to these elements, estimated between 7 and 10 ppm for the first and 45 and 50 ppm for the second. Referring to some literature data (Diagayété and Schenkel, 1986; Faye *et al*, 1990; Mandiki *et al*, 1986), the copper and zinc recorded in our study are at the limits of deficiency compared these elements, estimated from 7 to 10 ppm for the first mineral and from 45 to 50 ppm to the second mineral. Phosphorus content is slightly higher than the minimum recommended concentration of 2.3 g / kg DM with a limit of deficiency estimated at 1.8 g / kg DM (Mandiki et *al*., 1986).

In overall, crude protein content (CP) of forages, especially woody component recorded in this study, are comparable to results reported by a number of previous work (Ickowicz, 1995, Richard et *al*. . 1990)

Use of inputs of goats to the trough

The higher rate of dietary lipids ingested by animals (12.2 to 17.5% of dry matter intake) may explain the higher rate of refusal died tested. Indeed, the lipid of appropriate ruminant rations must be between 2 and 5% of the dry matter (Ouédraogo/Lompo *et al*, 2000. Remesy *et al*, 1984). When the incorporation of lipids exceeds the recommended limits, there is a depressive effect on ruminal digestibility of plant cell walls and organic matter and on voluntary feed intake, following a decline in bacterial concentration and density protozoa (Ouedraogo / Lompo *et al*, 2000; Sauvant and Bas, 2001).

However, the increase of the ratio between supply and food consumption with the progress of the lactation in goats could be explained by the improvement of the voluntary ingestion of these animals due to the improvement of their appetite with time (Blanc *et al*., 2004).

Since a large share of mineral requirements of animals of group 2 is covered by forage removed in pasture, this may explain why the consumption of mineral block of this lot is relatively low compared to that recorded with goats of group 1

Production and composition of milk

Results on peak of lactation agree with those of several works achieved in this area (Adogla-Bessa and Aganga 2001; Ouedraogo/Lompo et *al*., 2000.). The more regular evolution of the lactation curve presented by the diet B suggests the existence of a better balance between the needs of production and and food intake. There was therefore a complementary effect between diet in rangelands and supplementation, resulting in a synchronized supply and distributed in time for nutrients to animals subjected to this diet.

The superiority of the semi-intensive mode (SS) in relation to the intensive mode in terms of quantitative milk production recorded in our study confirms the fact that the conduct grazing is an additional benefit for herbivores such as goats (Blanc *et al*., 2004; Nianogo et al, 1997). This is linked to their ability to be able to exploit heterogeneous resources by selectively grazing, in order to develop a system of higher nutritional value than what is generally offered to the trough. The results reported by the Tezenas du Montcel (1991) show that goats grazed a rangeland managed arrived to provide themselves rations bringing between 18 and 37 g of digestible nitrogen and 0.29 to 0.59 energy in UFL (Forager unity) per day.

The relatively high lipid in diet B could partly explain the high level of fat content of milk produced. This wealth of grass mater (GM) seems compensate for the low protein content recorded with this milk. Indeed, Ouedraogo/Lompo et *al.* (2000) reached similar observations that more the ration was provided in lipid, more the content in proteins of milk was low.

Weight performances

Weight losses of goats during the first four weeks of lactation in this study translate what literature describes a situation of relative under nutrition (Chilliard et *al*., 1998). In early lactation, the needs are growing faster than the intake capacity of dairy. This process leads to a strong mobilization of lipids and to a lesser extent, body proteins whose purpose is to support the increase in milk production while limiting intake remains (Chilliard *et al*., 1983).

Also, there is evidence that during the period of relative under alimentation, specific adaptive mechanisms are turned on. They allow the animal to move to a new nutritional status (positive energy balance) that it reaches when the intake allows again to satisfy the needs (Chilliard et *al*., 1983).

CONCLUSION

The results of the study show that intensive system of conduct which requires goats restricting their movements and samples of forage resources of rangelands, is less effective for a better expression of their dairy performance. With supplementation, goats arrive to compensate some deficiencies of pasture so as to produce more milk. Despite the comparative advantage that procures the exploitation of the rangeland to goats, chemical analyzes results on fodders consumed by them in the pasture showed sub-carences or deficiencies in some nutriments including copper and zinc. In any event, it is interesting to note in our study that the semi-intensive mode was more advantageous for the expression of dairy goat's performance. It constitutes one way adapted to study the possibilities of decrease of livestock pressure on the rangelands, notably among the goats, generally taken in part due to degradation of vegetation cover.

ACKNOWLEDGMENTS

This study received a support from International Atomic Energy Agency (IAEA) through the project BKF 5011

REFERENCES

Adogla-Bessa T, Aganga AA (2000). Milk production of Tswana goats fed diest containing different levels of enregy. South African Journal of Science, 30 (1), p. 77-81.

AOAC (Association of Analytical Chemists), 1990. Official Methods of Analysis, 15th ed, AOAC, Washington DC, USA, 114 p.

Blanc F, Bocquier F, Debus N, Agabriel J, D'hour P, Chilliard Y (2004). La pérennité et la durabilité des élevages de ruminants dépendent des capacités adaptatives des femelles. INRA Prod. Anim. 17, p. 287-302.

Bosma RH et Bicaba MZ (1997). Effect of addition of leaves from *Combretum aculeatum* and *Leucaena leucocephala* on digestion of Sorghum stover by sheep and goats. Small Ruminant Research, 24, p. 167-173.

Chilliard Y., Bocquier F. et Doreau M (1998). Digestive and metabolic adaptations of ruminants to undernutrition and consequences on reproduction. *Reprod. Nutr. Dev*., 38 : 131-152.

Chilliard Y, Rémend B, Sauvant D et Vermorel M (1983). Particularités du métabolisme énergétique. *In* : Particularités nutritionnelles des vaches à haut potentiel de production. *Bull. Tech. C.R.Z.V. Theix, I.N.R.A*., 53 : 37-64.

Coombe JB, Wardrop ID et Tribe DE (1960). A study of milk production by the grazing ewe.With emphasis on the experimental technique employed. J. Agric. Sc., 54, p. 353-359.

Diagayété M, Schenkel H (1986). Composition minérale des ligneux consommés par les ruminants da la zone sahélienne. Revue Elev. Méd. vét. Pays trop., 39 (3-4), p.421-424.

Faye B, Kamil M, Labonne M (1990). Teneur en oligo-éléments dans les fourrages et le plasma des ruminants domestiques en République de Djibouti. Revue Elev. Méd. vét. Pays trop., 43 (3), p. 365-373.

Guerin H, Friot D, Mbaye ND, Richard D, Dieng A (1988). Régime alimentaire des ruminants domestiques (bovins, ovins, caprins) exploitant des parcours naturels sahéliens et soudano-sahéliens. II. Essai de description du régime par l'étude du comportement alimentaire. Facteurs de variation des choix alimentaires et conséquences nutritionnelles. Revue Elev. Méd. vét. Pays trop., 41 (4), p. 427-440.

Guerin H, Richard D, Heinis V (1992). Variations de la composition minérale des fourrages en zone tropicale sèche : conséquences pour la nutrition des ruminants domestiques. Poster présenté à la *41e réunion annuelle de la fédération européenne de zootechnie*, tenue à Toulouse (France) du 9 au 12 juillet 1992.

Ickowicz A (1995). Approche dynamique du bilan fourrager appliqué a des formations pastorales du Sahel Tchadien. Thèse de Docteur de l'université de Paris, spécialité : Sciences de la terre et de la santé, UFR de Sciences, Université de Paris XII, Paris, France, 492 p.

Lindela RN et Lewis H (1995). Intake, digestion and rumen parameters of goats fed mature veld ground with deep litter poultry manure and supplemented with graded levels of poorly managed groundnut hay. *Livestock Research for Rural Development*, The international journal for research into sustainable developing world agriculture, 6 (3), (Online edition).

Mandiki SNM, Kiatoko M, Olenga I (1986). Composition minérale des fourrages de la sous-région de l'Ituri (Zaïre) et proposition de complémentation pour bovins. Revue Elev. Méd. vét. Pays trop., 39 (3-4), p. 425-434.

Martinet J. et Houdebine LM (1993). Glande mammaire, mammogenèse, facteurs de croissance, lactogenèse. In : Biologie de la lactation de Martinet J. et Houdebine. Les éditions INSERM et INRA éditions, pp 3-29.

Morand-Fehr P, Sauvant D et Brun-Bellut J (1987). Recommandations alimentaires pour les caprins. Bull. Tech. C.R.Z.V. Theix, I.N.R.A., 70, p. 213-222.

Moujahed N, Kayouli C et Raach-Moujahed A (2003). La complémentation des fourrages pauvres par les blocs multinutritinnels chez les ruminants. I- Principes de base et aspects pratiques. *Livestock Research for Rural Development*, 15 (3). http://www.cipav.org.co/lrrd/lrrd14/1/alex141.htm (Online edition).

Nanglem NS (2001). Evaluation de la production de biomasse ligneuse accessible aux caprins. Mémoire d'ingénieur du développement rural, option élevage, Institut du Développement rural (IDR), université polytechnique de Bobo-Dioulasso, Bobo-Dioulasso, Burkina Faso, 97 p.

Nianogo JA, Nassa S, Soma L, Sanon HO (1997). Influence de la complémentation et du mode de conduite sur la croissance des agneaux Mossi en saison pluvieuse. Bull. Anim. HLth. Prod. Afri., 45, p. 241-249.

Ouédraogo/Lompo Z, Swadogo L, Nianogo JA (2000). Influence du taux de graines de coton dans la ration sur la production et la composition du lait chez la chèvre du Sahel burkinabé. Tropicultura, 18 (1), p. 32-36.

Richard D, Guerin H, Friot D, Mbaye N (1990). Teneurs en énergie brute et digestible de fourrages disponibles en zone tropicale. Revue Elev. Méd. vét. Pays trop., 43 (2), p. 225-231.

Rivière R (1991). Manuel d'alimentation des ruminants domestiques en milieu tropical. Paris, France, Institut d'élevage et de Médecine vétérinaire des Pays Tropicaux, Ministère de la coopération et du développement, 521 p. (Edition Collection Manuel et précis d'élevage).

Tezenas du Montcel (1991). Capacité de charge en saison sèche d'un parcours en zone nord soudanienne : cas d'une utilisation par des petits ruminants. IVème congrès International des Terres de Parcours, Montpellier, France, OROSTOM, pp.663-667.

Wolter R (1992). Alimentation de la vache laitière. Editions France Agricole, 223 p.

Zoundi SJ, Sawadogo L et Nianogo JA (2003). Pratiques et stratégies paysannes en matière de complémentation des ruminants au sein des systèmes d'exploitation mixte agriculture-élevage du plateau central et du nord du Burkina Faso. Tropicultura, 21 (3), 122 :128.

How to cite this article: Gnanda B.I., Kabore A., Kimse M., Zoundi S.J.N.J.A. (2014). Dairy production of Burkinabe Sahelian goat in intensive and semi-intensive rationing using local resources. Int. Res. J. Agric. Sci. Soil Sci. 4(7):116-123