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Yield, Intake and Chemical Profile of Milk of Commercially Available Rabbits at First Parity.

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ABSTRACT

This experiment designed to determine the milk yield, daily milk intake and chemical composition of Rabbit milk at first parity was carried out at the Rabbitry unit of Ekiti State University Teaching and Research Farm Ado- Ekiti. Eighteen Rabbits comprising 15 does and 3 bucks were used for the study. The rabbits were fed ad libitum, a rabbit ration containing 18.1% Crude protein,13.7% Crude Fibre and 2.28% fat. The animals were divided into three parts of 5 does each for collection of data on milk yield, milk intake and chemical analyses. Milk yield was determined by weigh-suckle-weigh method; Daily milk intake of kits by weighing the kits per litter before and after suckling and chemical analyses determined on milk samples collected manually at 8:00 am on 1st. 7th, 14th and 21st day of lactation by gently massaging the mammary gland of the does on injection of oxytocin. The values of milk yield recorded in this study were 460 g, 755 g and 930 g for the 7th, 14th and 21st day of lactation, respectively which were significantly ($p<0.05$) different. Milk yield and intake as the number of kits/litter increased were inversely proportional. Although, statistical significant ($p<0.05$) differences were observed among the daily milk production of does as the number of kits per litter increased, similar significant ($p<0.05$) difference in daily milk intake of 3 kittens/litter and 4 and 5 kittens per litter were observed but the 4 and 5 kittens per litter were similar ($p>0.05$). Dry matter content revealed statistical ($p>0.05$) similarities between collections on 7th and 21st day and between 14th and 21st day. However, significant ($p<0.05$) differences were obtained between 1st and the other days and between 7th and 14th day. The ash content though increased from 1.6 % on the 1st day to 2.1 % on the 21st day of lactation revealed no statistical ($p>0.05$) differences between 1st, 7th, and 14th day of collection but statistical ($p<0.05$) differences existed between 21st day and other days. The protein and fat contents revealed statistical ($p<0.05$) differences between collections on 1st day and the other days but days 7, 14 and 21 were similar ($p>0.05$). The protein content decreased from 13.5 % on the 1st to 10.8 % on the 21st day of lactation. The lactose content in the milk ranged from 1.4–1.9 g 100 g-1 and the energy content between 8.3 MJ Kg-1 and 9.3 MJ Kg-1 during the lactation period. The mineral profile of the milk except potassium, calcium and phosphorus which showed significant ($p<0.05$) differences among days of lactation were similar ($p<0.05$). In conclusion, milk yield increased with increased week of lactation and litter size. The macromineral profile of the milk increased as the lactation aged but the micromineral profile was stable. Rabbit milk is low in lactose and high in lipid, protein and energy contents.

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INTRODUCTION

In Nigeria, like other tropical countries of the world, Agricultural activities are focused solely on household consumption and for meeting emergency-petty- financial needs. However, due to pressure on available land incident by urbanization and population force, production activities in animal agriculture are gradually going intensive. Animal agriculture had largely depended on the production of beef, mutton, chevon, pork, and chicken as sources of animal protein in Nigeria to the detriment of other less common sources with potentials for short term capital investment content and simple management skill requirements like rabbits.

Rabbits are micro-livestock that is capable of producing about 41kg of meat per doe per year [1,18]. Unfortunately, rabbit farming has not received the desired attention in the tropics. Cheeke et al. [7] reported that the productivity performance of rabbits in the tropics is less or about 50% of their counterparts in the temperate countries because of the prevalent high temperature in the region which largely cause heat stress and discomfort. However, the awareness of the nutritive value of rabbit meat as an antidote for hypertensive patients is serving as an impetus to encourage rabbit farming in this region. Sequel to this all the productive aspects of the animal requires information at this stage. Generally, in livestock farming, livability cannot be absolute. Therefore, as part of efforts on hand-rearing baby rabbits, efforts should be put in place to protect the kittens should the mother doe dies during the time the youngs are been suckled. In all agricultural environments, adequate knowledge of milk yield and milk quality are essential ingredients for profitable livestock enterprise except poultry because it could aid in the preparation of suitable milk substitute in case of accidental death of the mother doe.

Milk yield has to do with the quantity of milk produced per female within a specified period of time. It varies within different farm animals and even within animals of the same breed. It is individually driven and it is influenced by a number of factors such as lactation stage [6,13]. Gestation overlapping degree [33,42], number of suckling kits [34], number of nipples [12], genotype [11,24], temperature [39] etc.

Milk quality is of practical importance in preparation of suitable artificial milk to substitute the natural one in case the mother doe unavoidably die after birth for whatever reason. Although, a lot of work had been done as touching this subject matter in many environments [2,8,15,29,40], there is paucity of information on it in Nigeria environment. Since phenotype is majorly influenced by genotype and environment, it becomes confounding and genetically unacceptable to make use of results obtained in an environment in making decision(s) in different environments. It is therefore the objective of this work to determine the milk yield and quality of commercially available rabbits in Ekiti state environment during first parity and to determine the effect of day of lactation on the milk components.

MATERIALS AND METHODS

Location of study

The study was carried out at the Rabbitry unit of the Ekiti-State University, Teaching and Research Farm, Ado-Ekiti between October and December 2012.

Experimental Animals and their Management

Before the arrival of the rabbits from Oluwatunsin Farm Ado- Ekiti., feeders and drinkers were thoroughly washed and the hutches properly disinfected. The animals used in this study were eighteen comprising of fifteen (15) does and three (3) bucks. The does were divided into three parts of 5 does each for collection of data on milk yield, milk intake and chemical analyses.. The bucks and the does were caged separately in individual hutch. The rabbits were fed ad libitum, a rabbit ration containing 18.1 % Crude protein, 13.7 % Crude Fibre and 2.28 % fat. Water was also supplied ad-libitum and lighting duration was natural. Females were presented to male for mating until pregnancy was confirmed. A nest box was placed in the cage 3-4 days before the expected day of parturition and remained there for the 21 days following parturition. The hutches were cleaned every day to ensure proper hygiene. All animals were managed similarly throughout the experimental period.

Duration of the experiment

Although, the usual lactation period of does is between 28 and 35 days depending on the reproduction rhythm and management system, however, mainly for experimental purposes, early weaning is sometimes executed and a shorter lactation period is considered [42]. For this reason, 21 days was considered as the lactation period in this study.

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Data collection

Milk yield

For this purpose, milk production was estimated by employing the weigh-suckle-weigh method. The does were weighed before the kittens were allowed to suckle and after the kittens have suckled. The differences in the weights of the does between the 2 weight determinations were recorded as milk yield.

Daily milk intake of kits

Five does were used for this. Litters were weighed immediately after birth and every day subsequently before and after suckling. Daily milk intake was determined as the difference between the two weight determinations.

Chemical analyses

The milk samples were collected manually at 8.00 am on 1st, 7th, 14th and 21st days of lactation by gently massaging the mammary gland of the does on injection of oxytocin. Milk samples collected were immediately cooled before taking to Federal University of Technology, Akure for chemical analysis. The samples were analyzed for protein, fat, dry matter and ash according to the methods of British Standard Institute (BSI, 1988), International Dairy Federation (IDF, 1987), IDF (1993) and AOAC respectively. The mineral components in terms of phosphorus (P), potassium (K), sodium (Na), magnesium (Mg), calcium (Ca), Zinc (Zn), Iron (Fe), Cupper (Cu) and manganese (Mn) were analyzed using the methods of AOAC[4, 20,21].

Statistical analyses

Data on production and milk composition were analysed by generalized least squares using the procedure of SAS (1996) according to the following mixed model:

$$Xijk = U + Ai + Wij + AWijk + eijkl$$

Where Xijk is an individual observation
U is the overall mean
Ai is the effect of doe within the group.
Wij is the effect of week of lactation
AWijk is the interaction effects of the does and week of lactation
Eijkl is the random error.

RESULTS AND DISCUSSION

Milk yield

Table 1 showed the milk yield of rabbit for 21 days experimental period. The result showed that milk yield increased significantly ($p<0.05$) with increased day of lactation. The rate of increase decreased from 295 g between the 7th and 14th day of lactation to 175 g between the 14th and 21st day of lactation. Total milk produced by the commercial rabbit does used in this study was 2.145 kg in 21 days corresponding to an average daily production of 102.14 g.

The milk yield values obtained in this study were comparable with the 2.150 kg, 2.160 kg and 2.640 kg reported by Khalil [23] for the Baladi Red, Baladi Black and Giza White in Egypt respectively. The values were also close to 2.180 kg reported by Zerrouki et al [43] for an Algerian local Rabbit breed. However, the values obtained in this study were clearly lower than the 3.567 kg observed by Mohamed and Szendrõ [32] for litters of 6 kits in a Californian line selected in Hungary; much more inferior to the milk yield of 5.5 kg produced by the strains of commercial Rabbit used by Xiccato et al., and Maertens et al., [31,41] and the 7.0 kg obtained from multiparous hybrid does, nursing 9-10 kits in their first lactation [14,31,42]. This low total milk production can be linked to the small adult weight of the animals used in this study and/or the hot climate which is capable of reducing feed intake and consequently milk production of does. It could also be that the feeding regime embarked upon by the researchers differed because it has been observed that primiparous does fed restrictively during rearing and ad libitum later had an increased milk yield at 16 days [37] or 21 days [17] compared to always ad libitum fed does. Generally, such discrepancies among reports may be due to the strain of breed used, breed x environment interaction or different experimental methods and a combination of two or more of the factors. The large coefficients of variation recorded in this study suggest absence of selection in the animals used. This is consistent with the report above that the milk yield obtained in this study was comparable with the results obtained in local breeds elsewhere but comparatively lower than the results obtained from selected lines.

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Table 1: Average milk yield (g) during 21 days suckling period.

Day	Mean	Coefficients of variance
Day 7	460 ±4.06c	40.43
Day 14	755 ±5.04b	34.91
Day 21	930 ±3.05a	34.41
Production in 21 days	2145	33.52

Means within a column with different superscripts differ (P<0.05).

Effect of litter size on milk yield and intake

The result of the effect of litter size on milk yield and intake is presented in Table 2. The litter sizes observed in this study were grouped into three: Group 1: made up of 3 kittens/litter; Group 2: made up of 4 kittens/litter and Group 3: made up of 5 kittens/litter.

The result revealed significant (p<0.05) differences in daily milk yield of does in the three groups. The milk yield increased as the number of kittens per litter increased. The daily milk intake decreased with increased number of kittens/litter. Though there was no significant (p>0.05) difference between 4 and 5 kittens per litter, significant (p<0.05) difference was recorded among 3 kittens per litter and 4 and 5 kittens per litter. The pattern of increase observed in this study agrees with the work of previous researchers who observed increased milk yield with litter size until 10 kits [32] and 11 kits [28]. This phenomenon might probably be because the kittens have stimulative effect on the mammary gland that facilitates milk yield or a natural instinct of the does to cater for the kittens

Table 2: Effect of litter size on daily milk yield of doe and daily feed intake of kittens

Litter size	Daily milk yield (g day-1)	Daily milk intake (g day-1kit-1)
3	21.95±3.01a	18.91±1.01a
4	35.95±3.23b	15.72±0.90b
5	44.29±3.80c	14.22±0.81b

Means within a column with different superscripts differ (P<0.05).

Proximate composition of rabbit milk

The proximate composition of rabbit milk is presented in Table 3. The result revealed that there were statistical (p>0.05) similarities between the dry matter contents of the milk collected on days 7 and 21 and between day 14 and day 21. However, significant (p<0.05) difference was recorded between day 1 and the other days and between days 7 and 14. It is worth noting that, the day 1 (colostrums) dry matter was highest at the four collection periods involved in this study (31.5 g 100 g-1). This can be as a result of its highest protein and fat contents' values. The milk samples collected for analysis of the colostrums' composition were collected a day after kindling meaning that the real colostrums was already consumed by the kits during the initial suckling which according to Hudson et al. [19] takes place immediately after parturition. The ash content of rabbit milk revealed no statistical (p>0.05) differences between the ash contents of the colostrums and the milk collected on days 7 and 14. However, statistical (p<0.05) differences existed between milk collected on 21st day and other days with day 21 collection showing superiority. The ash contents increased from 1.6 % in the colostrums to 2.1 % on the 21st day of lactation. This result is in agreement with the report of Maertens et al. [30] who reported an ash content of 2.1 % and 2.2 % in New Zealand white (NZW) and Califonian (CAL) rabbits reared in Egypt. Furthermore, the protein content of the milk indicated statistical (p<0.05) differences between colostrums and milk collected in all the other days. However, no statistical (p>0.05) differences existed between collections on days 7, 14 and 21. The protein content decreased from 13.5 % in the colostrums to 10.8 % on 21st day of lactation. The average value of 11.86 % obtained in this study is lower compared to the average value of 12.02 g 100 g-1 obtained for California does and higher than 11.02 g 100 g-1 obtained in New Zealand females by El Sayiad et al, [10]. This is most probably because the animals used in this study are hybrids of many crosses. The fat content demonstrated statistical (p<0.05) differences between colostrums and milk collected in all the other days which were similar (p>0.05). The average fat content of 12.76 g 100 g-1 obtained in this study is comparable with the value of 12.9 g 100 g-1 obtained by Rego et al. [36]. Lactose is one of the main constituents concerned in maintaining the constancy of the osmotic properties of milk because of its osmolarity regulation [16]. The lactose content in this study was low (1.4–1.9 g 100 g-1) especially at a later stage of the lactation. This is in agreement with the work of Maertens et al. [30] who reported a low lactose content of ≤2g 100 g-1 in New Zealand white (NZW) and Califonian (CAL) rabbits reared in Egypt. The energy content is remarkably high ranging from 8.3 MJ Kg-1 to 9.3 MJ Kg-1 during the lactation period.

These values compare well with the values of 87.9 KJ 100 g-1 in NZW and 89.9 KJ 100 g-1 in CAL as reported by Maertens et al. [30].

Ineral content of Rabbit milk

Table 5 showed the mineral profiles of the milk. Except potassium, calcium and phosphorus which showed significant ($p<0.05$) differences among the weeks of lactation others were similar ($p>0.05$). Rabbit milk is rich in calcium (4.82 – 6.43 g kg-1), phosphorus (2.77 – 3.98 g kg-1) and potassium (1.86 – 3.88 g kg-1). These values compared well with the values obtained by Darragh and Moughan[9] for sow and cow. Mineral composition of the milk changes substantially as lactation week progressed. Calcium and phosphorus concentrations increase with progressing lactation stage. This type of increment is in consonance with the reports obtained by Perret et al. [35] and Kustos et al. [25]. Magnesium content increased with lactation stage [26,28] while the microelements (zinc, copper, iron and manganese) remain unchanged in concentration as lactation progressed contrary to the reports of Kustos et al [24,26] who reported a gradual increase.

Table 3: Proximate composition of rabbit milk at different lactation stage

Parameters	Lactation (days)	Mean	Range CV (%)
Dry matter (g100 g-1)			
1 (colostrums)	31.52±2.16a	30.3-32.7	8
7	27.61±3.06c	23.4-30.2	12
14	29.03±3.16b	24.7-32.0	9
21	28.40±3.26b	24.7-32.1	8
Ash (g100 g-1)			
1 (colostrums)	1.6±0.22b	1.7-2.0	17
7	1.7±0.31b	1.7-2.0	5
14	1.7±0.27b	1.2-2.1	15
21	2.1±0.35a	1.4-2.5	12
Protein (g100 g-1)			
1 (colostrums)	13.5±1.17a	12.6-14.7	11
7	11.6±1.21b	10.1-13.6	11
14	11.1±1.31b	9.1-13.4	10
21	10.8±1.24b	9.6-13.9	10
Fat (g100 g-1)			
1 (colostrums)	15.2±2.33a	13.7-18.6	21
7	11.6±2.07b	9.1-15.1	17
14	12.1±1.23b	8.9-17.4	16
21	11.7±2.01b	9.9-14.5	13
Lactose (g100 g-1)			
1 (colostrums)	1.9±0.22	1.6-2.1	18
7	1.6±0.20	1.0-2.0	36
14	1.4±0.31	1.0-1.9	33
21	1.9±0.21	0.3-3.2	50
Energy (MJ k g-1)			
1 (colostrums)	9.3±1.05	-	-
7	8.4±0.98	8.4-8.4	0.1
14	8.5±1.22	7.5-9.6	10
21	8.3±1.31	7.1-9	27

abc Means within the same row with different superscripts are not statistically significant ($P<0.05$).

Table 4: Mineral composition (g kg-1 milk) of rabbit milk.

Mineral	Week one	Week two	Week three
Na	0.96±0.04	1.12±0.03	0.99±0.03
K	1.86±0.06c	2.68±0.04b	3.88±0.05a
Ca	4.82±0.06c	5.12±0.06b	6.43±0.05a
Mg	0.39±0.03	0.43±0.02	0.48±0.03
P	2.77±0.04c	3.22±0.03b	3.98±0.04a
Cl	0.66±0.05	0.59±0.04	0.54±0.03
Zn	0.02±0.01	0.02±0.01	0.02±0.01
Fe	0.003±0.01	0.003±0.01	0.003±0.01
Cu	0.002±0.01	0.002±0.01	0.002±0.01
Mn	0.0001±0.01	0.0001±0.01	0.0001±0.01

Means within a column with no superscript are similar (P>0.05).

CONCLUSION

The characteristics of the milk of available commercial rabbits used in this study in relations to milk yield, intake and mineral profiles are:

- An average milk production of 2145 g in 21 days, i.e. 102.24 g day-1
- An increase of milk production with increasing litter size, up to litters of 5 kits.
- Decrease in daily milk intake as number of kittens -1 increased
- Increase in macromineral profiles of the milk as lactation ages.
- Stability in micromineral components of the milk as lactation ages.

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