INTRODUCTION

Livestock plays an important role in the agricultural economy of most African Countries; its contribution to gross domestic product can reach 35% in Saharan Countries, and is estimated between 3 and 16% in central Africa.

In Cameroon, rearing of ruminants has always been extensive, on large areas of pasture. However, due to the continual shrinkage of such areas to the benefit of vegetal crops, a more intensive management of production is foreseen.

Such evolution will necessarily bring the introduction of newly developed reproductive and productive technologies, together with the implementation of more basic activities. The improvement in the efficacy of heat detection is an essential and important step forward that can be properly conducted by the farmer.

In the course of artificial insemination, the detection of oestrus allows the insemination of females at the proper time.

Differently, poor detection or misdiagnosis of oestrus would lead inevitably to lower conception rate, increased number of services per conception, economic loss and longer kidding intervals (Baril et al. 1993; Burns et al. 2002).

In a tropical environment, the knowledge of the various elements that determine heat behaviour, allows us to choose the appropriate time for breeding, avoiding thus mortality of conceptus or kids caused by possible scarcity of fodder (Delgadillo et al. 1997; Jansen and Van Den Burg, 2004).

Signs of oestrus have been reported for many breeds of goats (Rezac and Krivanek, 2001; Zarrouk et al. 2001). However, to our knowledge, there are no data available on heat manifestations in the West African Dwarf goat, with
particular regard to age. Therefore, such investigation represents the aim of the present study.

**MATERIALS AND METHODS**

**Location**
The study was carried out at the Farm of Application and Research of Dschang University (Cameroon). This farm is situated at latitude 5° 26’N, longitude 10° 26’E and 1420 m of altitude.

The annual rainfall and temperature fluctuate between 1500-2000 mm and 10-25 °C respectively. There are one dry season from November to March and one rainy season during the remaining months of the year.

**Animals, housing and feeding**
Thirty two animals (4 bucks and 28 non pregnant females) were used. They were up to 24 months of age, as determined by teeth examination and their weight ranged from 9.5 to 20 kg. Each female was identified by a numbered earring. Males and females were kept apart. All the animals grazed on natural pasture during the day and received a supplement of corn and cottonseed after grazing in the paddock.

**Assay**
To synchronise œstrus, two doses of 2 mg of alfaprostol (analogue of PGF2α, Gabbostrim and CEVA VETEM) were injected intramuscularly to each female at 11 days interval. Heat was detected eight times daily by exposing intact bucks to goats.

The observation started from the second injection of alfaprostol up to the onset and continued till the end of heat. Each female detected in heat was isolated from the herd for better detection.

**Data collection**
The anatomo-functional changes such as the characteristics of cervico-vaginal mucus, the aspect of the cervix (closed or opened), swelling and reddening of the vulva were recorded up to 24 hours Post-œstrus. All the data collected earlier than 48 hours before heat signs were not considered in the analysis. The cervix was visualised with the aid of a speculum. The elasticity of the mucus was measured with the aid of a caliper rule.

Behavioural elements recorded were: mounting, tail wagging and frequency of micturition. The number of micturition by a female in heat was recorded within one hour in the presence and then in the absence of the male.

This study was performed in accordance with EU directive 2010/63/EU for animal experiments.

**Statistical analysis**
Data were expressed as means ± SD and analysed with one way ANOVA and Duncan’s test at 5% in case of significant difference.

**RESULTS AND DISCUSSION**

**Anatomo-functional changes**
The swelling of vulva (Figure 1) was observed in more than half of females in œstrus.

All goats aged more than 20 months expressed vulvar swelling, whereas only a quarter of females aged less than 14 months showed swollen vulva. In addition, irrespective of age, the mucosa of the vulva was red in all the goats in full œstrus, and pink later, whereas the cervix was open only during heat.

The mucus was present in the vagina of all the females starting 36 hours before the onset of heat. It was transparent at œstrus and milky 24 hours later (Table 1).

It was abundant at the onset and up to 12 hours after œstrus. The elasticity of the mucus increased linearly to the peak of heat, and declined thereafter.

The age of the female did not affect any of the studied characteristics of the mucus.

**Behavioural changes**
Less than half of the females followed the male during heat (Table 2). This behaviour was reduced in goats aged less than 14 months.

Females in heat mounted males as well as other females, but the mounting of the male was the most frequent and did not vary with age of females.

The frequency of micturition of goats in heat was higher (P<0.05) in the presence of male than during its absence, and was not related to age. At heat, 94.74% of females waggled the tail, including all females of the lowest and highest age groups.

Goats that did not waggled their tail (5.26%) were part of the middle age group. The average duration of œstrus was 45.84 ± 1.68 hours. This duration varied with the age of the female and significantly increased (P<0.05) in the older females (Figure 2).

**Reddening and swelling of the vulva**
The appearance of the vulva in the West African Dwarf goat is in agreement with available data reported in literature. Indeed, one of the diagnostic elements of œstrus in most mammalian species is the swelling and reddening of the external genitalia (Ball and Peters, 2004; Senger, 2005). The increase of the vulva volume is due to the œdema, caused in turn by hyperemia during œstrus.
The influx of blood raises the pressure of local capillary and lead consequently to the formation and retention of lymph (Senger, 2005).

**Mucus discharge, opening and closing of the cervix**

The change of mucus elasticity, colour and quantity during the oestrus cycle is consistent with the data available in cattle (Fischer et al. 2008), sheep (Adam and Aizinbud, 1981; Abdel Rahim and Nazir, 1987; Obounou, 1990; Ngoula et al. 2008) and goat (Rezac and Krivaneck, 2001). The increase of mucus production during heat is important for copulation.

Physical and biochemical properties of the mucus change with the progression of the sexual cycle: it is liquid during oestrus and become more viscous under the influence of progesterone through dioestrus (Senger, 2005). This explains the change in mucus elasticity, together with the opening / closing of the cervix.

### Table 1: Characteristics of mucus before, during and after oestrus in West African Dwarf goat

<table>
<thead>
<tr>
<th>Parameters</th>
<th>-48</th>
<th>-36</th>
<th>-24</th>
<th>-12</th>
<th>(Estrus) 12</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of mucus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-14 months n= 4</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>14-20 months n= 9</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>20-24 months n= 6</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Aspect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-14 months n= 4</td>
<td>Milky</td>
<td>Milky</td>
<td>Milky</td>
<td>Transparent</td>
<td>Cloudy</td>
<td>Milky</td>
</tr>
<tr>
<td>14-20 months n= 9</td>
<td>Milky</td>
<td>Milky</td>
<td>Transparent</td>
<td>Transparent</td>
<td>Cloudy</td>
<td>Milky</td>
</tr>
<tr>
<td>20-24 months n= 6</td>
<td>Milky</td>
<td>Transparent</td>
<td>Transparent</td>
<td>Transparent</td>
<td>Cloudy</td>
<td>Milky</td>
</tr>
<tr>
<td>Abundance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-14 m months n= 4</td>
<td>Little</td>
<td>Little</td>
<td>Little</td>
<td>Abundant</td>
<td>Abundant</td>
<td>Little</td>
</tr>
<tr>
<td>14-20 months n= 9</td>
<td>Little</td>
<td>Little</td>
<td>Little</td>
<td>Abundant</td>
<td>Abundant</td>
<td>Little</td>
</tr>
<tr>
<td>20-24 months n= 6</td>
<td>Little</td>
<td>Little</td>
<td>Little</td>
<td>Abundant</td>
<td>Abundant</td>
<td>Little</td>
</tr>
<tr>
<td>Elasticity (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-14 months n= 4</td>
<td>1.00±0.00 a</td>
<td>1.75±1.5 a</td>
<td>2.50±1.73 a</td>
<td>8.00±2.94 a</td>
<td>6.00±4.76 a</td>
<td>1.50±1.29 a</td>
</tr>
<tr>
<td>14-20 months n= 9</td>
<td>1.22±0.67 a</td>
<td>2.89±0.93 a</td>
<td>3.56±1.33 a</td>
<td>7.67±1.80 a</td>
<td>7.67±2.06 a</td>
<td>2.72±1.35 a</td>
</tr>
<tr>
<td>20-24 months n= 6</td>
<td>1.17±0.9 a</td>
<td>3.00±2.10 a</td>
<td>3.00±2.10 a</td>
<td>6.00±2.28 a</td>
<td>6.33±2.16 a</td>
<td>3.67±1.86 a</td>
</tr>
</tbody>
</table>

### Table 2: Behavioural changes during heat in West African Dwarf goat

<table>
<thead>
<tr>
<th>Parameters</th>
<th>&lt; 14 months n= 4</th>
<th>14-20 months n= 9</th>
<th>20-24 months n= 6</th>
<th>Total n= 19</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of females following the male</td>
<td>25.00 a</td>
<td>55.55 b</td>
<td>50.00 b</td>
<td>47.37</td>
</tr>
<tr>
<td>Number of mounting per hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On male</td>
<td>3.00±0.82 a</td>
<td>2.44±0.88 a</td>
<td>2.67±0.82 a</td>
<td>2.63±0.83 a</td>
</tr>
<tr>
<td>on female</td>
<td>0.75±0.96 b</td>
<td>1.00±1.12 a</td>
<td>1.17±0.41 b</td>
<td>1.00±0.88 a</td>
</tr>
<tr>
<td>Number of micturition per hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the absence of male</td>
<td>1.75±0.50 a</td>
<td>1.67±0.71 a</td>
<td>2.17±0.75 a</td>
<td>1.84±0.69 a</td>
</tr>
<tr>
<td>In the presence of male</td>
<td>4.00±0.82 b</td>
<td>3.67±1.87 b</td>
<td>4.00±1.55 b</td>
<td>3.84±1.54 b</td>
</tr>
<tr>
<td>Wagging of the tail (%)</td>
<td>100.00 a</td>
<td>88.88 b</td>
<td>100.00 a</td>
<td>94.74</td>
</tr>
</tbody>
</table>

The duration of oestrus recorded in the present study is within limits (24-48 hours) reported for other goat breeds in general (Zarrouk et al. 2001).

It was longer than in certain breeds of tropical latitudes (Tamboura et al. 1998; Hafez and Hafez, 2000; Jansen and Van Der Burg, 2004), as well as Japanese and English breeds (Fabre-Nys, 2000).
This difference may be attributed certainly to the breed, but also to the structure of the herd and the age of females (Ball and Peters, 2004).

The observed differences between breeds could also be due to the method used for timing: in fact in the present study, the duration of oestrus has been considered as the time elapsing while the female is standing to be mounted. However, according to Senger (2005), the acceptance of male is considered only at the peak of oestrus behaviour. A mammalian female coming in heat is not immediately receptive, and behaviours other than acceptance of male are not evident proofs of heat.

CONCLUSION

Signs and duration of heat in the West African Dwarf goat are similar to those found in other breeds of goat. The principal manifestations in this study were swelling and reddening of the vulva, increased mucus production, opening / closing of the cervix, wagging of the tail, mounting male / female, acceptance of male, and increased frequency of micturition. The oestrus was less exhibited in younger than in older female.

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REFERENCES


