

Reproductive tract morphometry, foetal dimensions and some biochemical characteristics of tubal and foetal fluids in Caprine females during gestation

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Abstract

The changes in genital tract morphometry, foetal dimensions, the relative volumes of foetal fluids and some biochemical characteristics of foetal and tubal fluids during gestation were evaluated in Red Sokoto (Maradi) does using 28 gravid genitalia. Based on the ages of the foetuses, each genitalia was classified into one of the three phases of gestation namely: early, mid and late gestation for a comparison of all the parameters. While both the uterus and placenta were significantly enlarged ($P < 0.05$) at mid and late gestation, other morphometric characteristics of the reproductive organs were similar ($P > 0.05$) between the stages of gestation. There were significant increases ($P < 0.05$) in all foetal dimensions, namely: foetal weight, total length, crown-rump length, curved crown-rump length, vertebral column length and vertebral column and tail length at mid gestation as well as at late gestation. Besides the significant increase ($P < 0.05$) in total protein in the allantoic fluid, the biochemical characteristics in foetal fluids investigated were all unaffected by the stage of gestation ($P > 0.05$) throughout the period of gestation. This work provides base line information on foetal development in relation to the intrauterine environment in the Red Sokoto breed. Such information will be useful in breeding programmes aimed at the improvement of this breed in Nigeria.

Key words: Caprine genitalia, morphometry, biochemical, tubal, foetal, gestation

Introduction

The success of the animal industry is largely dependent on the critical step of fertilization and the related phenomena of implantation and gestation. Marked changes are known to occur in the reproductive organs of the mammalian female during gestation. As gestation advances, the uterus for example begins to undergo gradual enlargement to permit expansion of the fetus (Thatcer, 2000). The mechanisms that permit the enormous increase in size are however not yet well understood and are at present thought to be hormonal (Jainudeen and Hafez, 1980). It is

however known that the duration of each of the three phases identified in this adaptation of the uterus to accommodate the products of conception varies with the species (Hammond Jr. *et al.*, 1971; Thatcer, 2000 and Aka, 2004). Fertilization is also directly influenced by the immunologic response and composition of the secretions of the female reproductive tract (tubal fluids) which influence the survival of spermatozoa as they are transported along the tract to the site of fertilization (Aitken, 1979; Hafez, 1980). Even though these changes in relation to the development of the fetus are well

documented (Jainudeen and Hafez; 1980; Egbunike and Adegunle, 1980; Kulangara, 1972; Beier, 1974; Aitken, 1979), most of these reports are based on data from breeds of temperate origin. Such reports on breeds of tropical origin are lacking.

Whereas Ribadu *et al* (1993) reported on the morphometric characteristics of the non-pregnant one-humped camel in Nigeria, similar reports in pregnant female camels in this country are lacking. The dearth of such reports in the humid tropics is even more pronounced in the small ruminants in general and the Red Sokoto (Maradi) doe in particular; thus constituting a hindrance to the improvement of this breed for higher productivity. We therefore undertook this study to provide information on genital tract morphometry, foetal dimensions and some biochemical characteristics of some tubal and foetal fluids during gestation in a lowland humid tropical environment.

Materials and Methods

Sample Collection

The genitalia of Red Sokoto does slaughtered at the Makurdi Modern Market abattoir were examined for pregnancy (immediately after slaughter), between 0600 and 0700 hours daily for two consecutive weeks. Those that were non-gravid were discarded while the gravid genitalia were collected *intoto* and brought to our laboratory in an insulated ice-box. A total of 28 samples were obtained for this study conducted in the early dry season. The distribution was 11, 10 and 7 samples in the early, mid and late stages of gestation respectively.

Genital Tract Morphometry

Each genitalia was trimmed free of adhering fat and connective tissue after which morphometric evaluations were done by conventional methods using standard scientific equipment in our laboratory.

Foetal Dimensions

After proper dissection of the uteri, the weights of the recovered fetuses were taken. After taking

the weights, each fetus was placed in its natural position as in the womb before the evaluation of foetus dimensions according to the method of Jainudeen and Hafez (1980) in order to determine their ages. Based on the ages of the foetuses, the genitalia were then classified into their respective stages of gestation; viz: early, mid and late gestation for a comparison of the parameters.

Due to twinning, a total of 32 foetuses were recovered with a distribution of 11, 11 and 10 in the early, mid and late phases of gestation respectively. Equal numbers of 7 genitalia and 10 foetuses in each phase of gestation were then used for the respective evaluations.

Foetal and Tubal Fluids

After the dissection of each genitalia, the volumes of the amniotic and allantoic fluids were obtained by conventional laboratory methods. Tubal fluids were obtained by flushing the uterus and the cervix as reported by Egbunike and Adegunle, 1980. The foetal and tubal fluids were then stored frozen pending biochemical analyses.

Biochemical Assays

Biochemical evaluations were done according to methods outlined by the Boehringer Mannheim (Germany) Diagnostic Assays' manual (1979).

Statistical Analysis

Data were analysed using the one way analysis of variance (ANOVA) (Steel and Torrie, 1980). The method of least significance difference (LSD) was used to determine significant differences between means.

Results and Discussion

A summary of the changes in genital tract morphometry in Caprine females during gestation is presented in Table 1.

There was a significant enlargement of both the uterus and placenta ($P < 0.05$) at mid and late gestation thus indicating a normal adaptation of the uterus to accommodate the products of conception as expected. This result suggests that the myometrium must have remained quiescent to prevent premature expulsion of the foetus or foetuses in some cases, as gestation in all cases was terminated by the slaughter of the animals

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and not by abortion. All other morphometric characteristics of the genitalia were however similar between the stages of gestation ($P > 0.05$). The corpora lutea also all persisted (corpus luteum verum) in each case about the same size (maximal size) throughout pregnancy as in cattle

(Jainudeen and Hafez, 1980). This explains why there was no significant change in the weights of the ovaries during gestation. Further work is needed to establish hormonal (progesterone) levels during gestation in these animals.

Table 1: Changes in genitalia tract morphometry in Caprine females during gestation (means \pm s.e.m)

Stage of Gestation	Weight of Uterus(g)	Weight of Placenta(g)	Weight of Ovary (g)		Paired Ovaries(g)	Weight of Oviduct (g)		Paired Oviduct (g)	Weight of Cervix(g)
			RT.	LT.		RT.	LT.		
Early	151.68 \pm 21.96 ^a	70.74 \pm 20.25 ^a	1.55 \pm 0.09	1.40 \pm 0.06	2.95 \pm 0.15	0.48 \pm 0.10	0.88 \pm 0.06	0.88 \pm 0.16	3.85 \pm 1.45
	Mid	459.04 \pm 39.36 ^b	260.16 \pm 10.41 ^b	1.46 \pm 0.23	1.22 \pm 0.33	2.68 \pm 0.56	0.44 \pm 0.07	0.48 \pm 0.03	0.89 \pm 0.10
Late		477.7 \pm 51.06 ^b	289.48 \pm 38.40 ^b	1.62 \pm 0.21	1.18 \pm 0.26	2.80 \pm 0.47	0.56 \pm 0.09	0.56 \pm 0.09	1.14 \pm 0.18

^{a,b}Values in the same column bearing different superscripts are significantly different ($P < 0.05$) s.e.m: standard error of mean.

RT = Right, LT = Left

Table 2. Changes in Caprine foetal dimensions during gestation (means \pm s.e.m)

Stage of Gestation	Foetal Weight (g)	BCVRT (cm)	CR (cm)	CVR (cm)	VR (cm)	VRT (cm)
Early	21.25 \pm 3.86 ^a	11.93 \pm 0.97 ^a	7.64 \pm 0.80 ^a	9.60 \pm 0.67 ^a	7.90 \pm 0.57 ^a	9.24 \pm 0.78 ^a
Mid	545.66 \pm 27.78 ^b	36.31 \pm 0.85 ^b	22.66 \pm 0.83 ^b	27.25 \pm 0.31 ^b	23.82 \pm 0.64 ^b	28.30 \pm 0.80 ^b
Late	1475.24 \pm 97.28 ^c	52.63 \pm 1.28 ^c	32.64 \pm 1.19 ^c	39.60 \pm 1.47 ^c	35.16 \pm 1.02 ^c	43.03 \pm 1.11 ^c

^{a,b,c}Values in the same column bearing different superscripts are significantly different ($P < 0.05$) s.e.m: standard error of mean.

BCVRT= Total length

CR= Crown rump-length

CV= Curved crown-rump length

VR= Vertebral column length

VRT= Vertebral column and tail length

Foetal dimensions (Table 2) showed significant increases ($P < 0.05$) in foetal weight, total length, crown-rump length, curved crown-rump length, vertebral column length and vertebral column and tail length at mid and late gestation. These results show that there was a normal pattern of growth in these foetuses as the growth rates of

foetuses and their organs vary during different stages of intrauterine life (Jainudeen and Hafez, 1980). The steady increase in foetal size we obtained in this study might be an indication that there was an initial phase of slow growth when energy was directed towards the formation and development of body organs and tissues, after which energy was directed towards increase in size

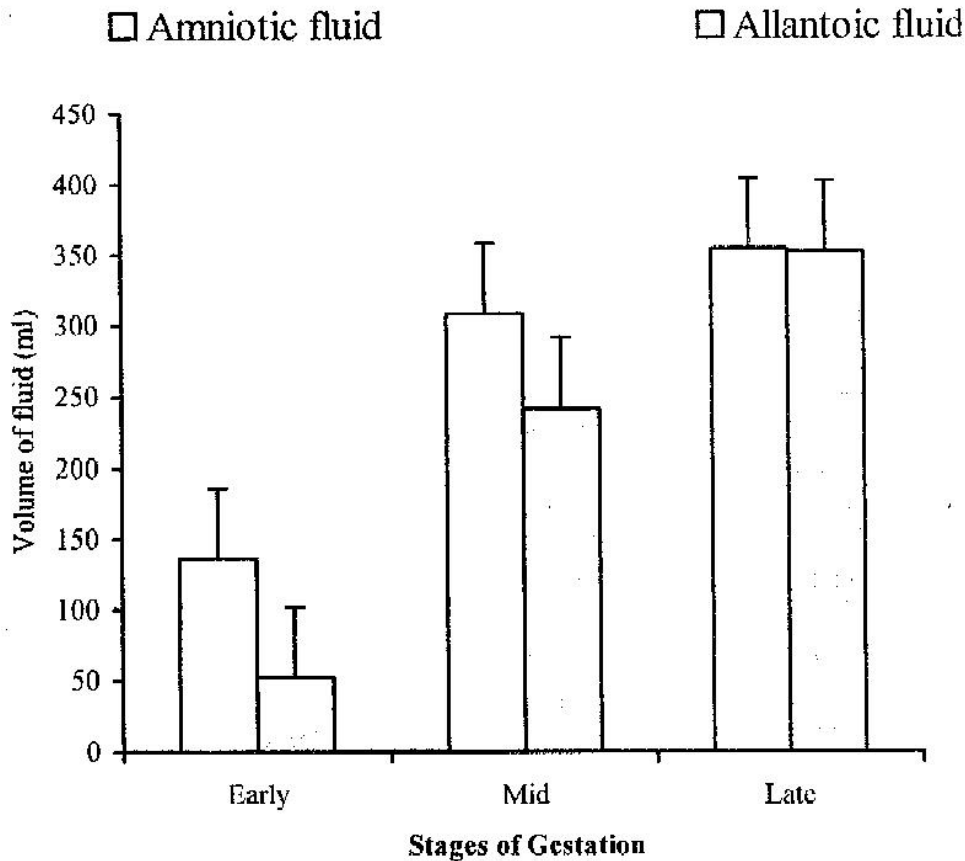


Figure 1: The relative volumes of foetal fluids during gestation in Caprine females

Fig. 1 shows the relative volumes of foetal fluids during gestation. The relative volumes of fluids in the amniotic and allantoic cavities showed much fluctuation during pregnancy in this study. There were significant increases ($P < 0.05$) throughout gestation in agreement with earlier reports which showed that foetal fluids increase in volume with advancing age of the conceptus in all species (Jainudeen and Hafez, 1980). With regard to the biochemical characteristics of foetal and tubal fluids (Tables 3 and 4 respectively), while total protein and cholesterol concentrations in the amniotic fluid were unaffected ($P > 0.05$) by the stage of gestation, there was a significant increase ($P < 0.05$) in total protein at mid gestation

and a significant drop in late gestation in the allantoic fluid. The stability of these metabolites in the amniotic fluid might probably favour not only the nutrition of the foetus but also ensure its protection from external shock and many assist in the dilation of the cervix and the lubrication of the birth canal at parturition. On the other hand the significant increase in total protein at mid gestation, in the allantois suggests that protein in the allantoic fluid may have been involved in the initial steps of nidation. Even though the significant drop in late gestation is hard to explain in the light of the absence of other reports to compare our results with, it may be related to the nutrition of the foetus.

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Table 3. Changes in some biochemical characteristics of tubal fluids of Caprine females (means \pm s.e.m) during gestation

Stage of Gestation	Uterine fluid		Oviductal fluid	
	Total protein (g/100ml)	Cholesterol (mg/100ml)	Total protein (g/100ml)	Cholesterol* (mg/100ml)
Early	3.50 \pm 0.86	106.30 \pm 78.54	1.78 \pm 0.94	-
Mid	5.21 \pm 0.78	113.51 \pm 66.20	0.40 \pm 0.13	-
Late	5.78 \pm 0.64	115.67 \pm 221.79	0.71 \pm 0.18	-

s.e.m = standard error of mean

* = Results could not be obtained beyond colour development due to technical problems.

Table 4. Changes in some biochemical characteristics of foetal fluids in Caprine species (means \pm s.e.m) during gestation

Stage of Gestation	Amniotic fluid		Allantoic fluid	
	Protein (g/100ml)	Cholesterol (mg/100ml)	Protein (g/100ml)	Cholesterol (mg/100ml)
Early	1.52 \pm 1.03	878.38 \pm 159.70	0.78 \pm 0.14 ^a	2027.02 \pm 326.20
Mid	0.43 \pm 0.24	878.38 \pm 129.38	3.23 \pm 0.75 ^b	1639.64 \pm 468.47
Late	0.86 \pm 0.15	594.59 \pm 175.16	1.39 \pm 0.18 ^c	1081.08 \pm 254.49

^{a,b,c} Values in the same column bearing different superscripts are significantly different (P< 0.05)
s.e.m – standard error of mean

The similarities between the stages of gestation, in the biochemical substances in tubal fluids obtained in this study probably indicate a suitable environment for fertilization, cleavage of fertilized eggs and gestation.

Conclusion

The results of this study show a normal pattern of physiological events during gestation in these animals. We found no evidence of maternal under – feeding or foetal growth retardation. Placental growth was also not compromised even as the biochemical characteristics of foetal and tubal fluids were normal. This study thus provides information that will be useful in programmes aimed at the improvement of these animals in their native environment.

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