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AGE CHANGES IN ORGAN WEIGHTS, GUT MORPHOLOGY AND SOME BIOCHEMICAL CHARACTERISTICS OF SERUM IN CAPRINE FETUSES DURING GESTATIONS

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ABSTRACT

32 fetuses recovered from gravid uteri were used to evaluate developmental changes in visceral organs, dimensions of the digestive tract and some biochemical characteristics of serum. The absolute weights of the liver, lungs, heart, spleen and kidney increased significantly ($P<0.05$) with advancing gestation, while the relative growth of the liver, heart and spleen was most rapid in the earlier stages and declined with advancing gestation ($P<0.05$). The relative growth of the lungs and kidney were, however, unaffected by the stage of gestation ($P>0.05$). The stomach on the other hand increased in absolute weight at late gestation ($P<0.05$) and in relative weight at both mid and late gestation ($P<0.05$). Whereas both the small intestine and caecum increased significantly in length ($P<0.05$) at both mid and late gestation, the colon and the rectum were significantly longer ($P<0.05$) only at late gestation. The rumen contributed to 48.33 ± 6.35%, 50.00 ± 3.37% and 54.00 ± 5.00% of the tissue weight of the stomach in the early, mid and late gestation respectively, while the respective tissue – weight contributions of the reticulum were 14.76 ± 2.16%, 15.20 ± 1.92% and 18.10 ± 1.23%. The percentage weight contributions of the omasum were 10.03 ± 1.40, 12.64 ± 0.94 and 14.15 ± 3.06 in the respective stages of gestation, corresponding to percentage tissue weight contributions of 26.88 ± 4.68, 22.16 ± 2.45 and 13.75 ± 1.88 in the abomasum in the respective stages of gestation. There were similarities ($P>0.05$) between the stages of gestation in serum total protein and cholesterol.

KEYWORDS: Age changes, Fetuses, Visceral. Gut, Serum, Gestation.

INTRODUCTION

Most studies of fetal growth have used birth weight as the index of fetal growth (Balinsky, 1981). This, however, does not allow for the relative contributions of the different tissues and organs in the body. The growth rates of fetuses and the component organs and tissues, however, vary during different stages of intra-uterine life (Jainudeen and Hafez, 1980). A knowledge of the relative and absolute growth in fetuses is necessary to help us understand better and appreciate the factors that affect fetal growth in relation to post-natal survival and productivity. Though the stages of development as well as the growth of organs as affected by various factors have been well documented for human embryos (Hamilton et al; 1947; Streeter, 1945; 1948; 1949 and 1951; Macri *et.al.*, 1996; Thatcher, 2000), chick embryos (Hamburger and Hamilton, 1951 and Patten, 1957) and rabbit embryos (Witschi, 1956; Edwards, 1968 and Sissman, 1970) similar reports on embryo development and organogenesis are unfortunately lacking in most other livestock species of tropical organ. Also, whereas Witlin *et.al.* (2002) reported on placental and fetal growth and development in rats, such reports are not available in animals in our environment. With regard to gut morphology, while there is sufficient information on the development of the stomach of ruminants such as cattle, sheep, goats, the domestic buffalo and the deer in temperate regions (Church, 1975); there is a complete lack of this information in animals of tropical origin. There is similarly a dearth of information on the age changes in the development of visceral organs as well as serum metabolites during gestation in our farm animals, one of the reasons being that such information will require the death of such animals. Napoli *et.al.* (1999) moreover suggested that elevated cholesterol levels in mothers induced changes in the fetal aorta that would predispose the offspring to fatty streak formation and atherosclerosis. This work was therefore undertaken to provide information on the effect of age on visceral organ weights, the dimensions of the digestive tract, the total protein and cholesterol levels in the serum of Red Sokoto (Maradi) fetuses during gestation.

MATERIALS AND METHODS

A total of 32 fetuses were recovered from gravid uteri of Red Sokoto (Maradi) dams with a distribution of 11 fetuses at early, 11 at mid and 10 fetuses at late gestation respectively. Evaluations were however made on 10 fetuses in each of the stages of gestation.

The uteri were collected between 0600 hours and 0700 hours within a period of one month and brought to our laboratory at the University of Agriculture Makurdi in an insulated ice-box.

The age of each fetus was then estimated based on its developmental horizons as reported by Jainudeen and Hafez (1980) and grouped into early, mid and late gestation.

Each fetus was carefully dissected and the visceral organs, stomach and intestines obtained. Blood samples were obtained from individual fetuses into clean-dry glass tubes (without an anti-coagulant) and the sera separated and stored frozen pending biochemical analyses. Biochemical analyses were done according to methods outlined by the Boehringer Mannheim (Germany) diagnostica (1979).

Data analysis was by the one way analysis of variance (ANOVA) (Steel and Torrie, 1980) after which the method of least significant difference (LSD) was used to determine significant differences between means.

RESULTS AND DISCUSSION

Visceral organs

The changes in visceral organ weights during gestation are presented in Table 1. The liver, lungs, heart and kidney increased significantly ($P<0.05$) in absolute weight at both mid and late gestation but not ($P>0.05$) at early gestation. This pattern of growth and development of these organs with increasing age of fetus is in agreement with the report of Jainudeen and Hafez (1980) and Aka (2004). The relative growth of the liver, heart and spleen was most rapid in the earlier stages of pregnancy and declined significantly ($P<0.05$) with advancing gestation; while that of the lungs and kidney was only apparent ($P>0.05$). The non effect ($P>0.05$) of the stage of gestation on the relative growth of the lungs and

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Table 1: Changes in visceral organ weights of caprine fetuses during gestation (Means ± s.e.m.)

Parameter	Stage of gestation		
	Early	Mid	Late
Liver (g)	1.62 ± 0.28[a]	28.44 ± 1.65[b]	48.02 ± 3.77[c]
Liver (%)	6.338 ± 0.095[a]	5.24 ± 0.29[a]	3.28 ± 0.24[b]
Lungs (g)	0.80 ± 0.003[a]	19.08 ± 2.41[b]	41.82 ± 2.91[c]
Lungs (%)	2.33 ± 0.024[a]	3.51 ± 0.42[a]	2.89 ± 0.30[a]
Heart (g)	0.30 ± 0.11[a]	4.20 ± 0.58[b]	10.18 ± 0.69[c]
Heart (%)	1.00 ± 0.10[a]	0.77 ± 0.09[b]	0.69 ± 0.04[b]
Spleen (g)	0.23 ± 0.14[a]	0.76 ± 0.09[b]	1.22 ± 0.08[c]
Spleen (%)	0.69 ± 0.23[a]	0.14 ± 0.03[b]	0.08 ± 0.01[b]
Paired kidney (g)	0.36 ± 0.09[a]	6.24 ± 0.61[b]	1.56 ± 0.60[c]
Paired kidney (%)	1.42 ± 0.09[a]	1.14 ± 0.08[a]	0.79 ± 0.04[a]

a,b,c, = values in the same row bearing different superscripts are significantly different ($P<0.05$).

s.e.m. = standard error of mean.

Table 2: Changes in the dimensions of the digestive tract of Red Sokoto fetuses during gestation (means ± s.e.m.).

Parameter	Stage of gestation		
	Early	Mid	Late
Stomach weight (g)	3.08 ± 0.67[a]	4.25 ± 0.09[a]	14.90 ± 1.69[b]
Stomach wight (%)	14.95 ± 0.08[a]	0.078 ± 0.06[b]	0.98 ± 0.06[b]
Small intestine length (cm)	288.08±14.53[a]	364.10 ± 22.62[b]	532.87±43.52[c]
Caecum length (cm)	35.01±2.56[a]	47.09 ± 1.89[b]	68.43 ± 1.72[c]
Colon and rectum length (cm)	31.93 ± 2.37[a]	41.47 ± 1.58[a]	53.90 ± 2.48[c]
Rumen (%)	48.33 ± 6.53	50.00 ± 3.37	54.00 ± 5.00
Reticulum (%)	14.76 ± 2.16	15.20 ± 1.92	18.10 ± 1.23
Omasum (%)	10.03 ± 1.04	12.64 ± 0.97	14.15 ± 3.06
Abomasum (%)	26.88 ± 4.68	22.16 ± 2.45	13.75 ± 1.88

a,b,c, = values in the same row bearing different superscripts are significantly different ($P<0.05$).

s.e.m. = standard error of mean.

Kidney implies the non relevance of age of gestation on the growth of these organs.

Digestive Tract Dimensions

The changes in the dimensions of the stomach and intestine of the fetuses during gestation as well as the percentage contributions of each stomach compartment to the stomach tissues is presented in Table 2. The stomach grew gradually in absolute weight from early to mid gestation ($P>0.05$) and was only significantly enlarged ($P<0.05$) at the late gestation attaining over 4 times its initial weight and over 3 times its weight at mid gestation (Plate 1). The relative weight of the stomach, however, decreased significantly ($P<0.05$) at both mid and late gestation. This result would be expected as there was a drastic increase in body weight at mid and late gestation in agreement with the report of Aka, (2002). The weight of the stomach expressed as a percentage of body weight as pregnancy advanced was therefore bound to produce lower values than at the early stage of gestation when body weight was relatively much smaller and more closely related to the weight of the stomach. These results imply a rapid development of the stomach as the fetus increased in size and weight with advancing gestation as reported else where in ruminants (Church, 1975; Aka 2004).

The small intestine and caecum likewise increased significantly in length ($P<0.05$) at both need and late gestation while the colon and rectum grew steadily and became only significantly longer ($P<0.05$) at late gestation. These results are in agreement with the earlier report of Stevens and Sellers (1982) who showed that the length and size of the digestive tract increased during pre-natal development.

While the rumen represented 50% of the stomach tissue at mid gestation in the present study compared to 45%

in sheep embryos at 56 days (Church, 1975); the reticulum in this study contributed 15.20% compared to 14.10% in sheep at 56 days (Church, 1975). The abomasums and the omasum on the other hand contributed to 12.64% and 22.16% respectively in the present study compared to contributions of 28.80% and 17.56% respectively in sheep embryos at 56 days (Church, 1975) which corresponds to mid gestation in the present study. The reticulum in this study contributed 15.20% compared to 14.10% in sheep at 56 days (Church, 1975). The abomasums and the omasum on the other hand contributed to 12.64% and 22.16% respectively in the present study compared to contributions of 28.80% and 17.56% respectively in sheep embryos at 56 days (Church, 1975). While these results are in most cases comparable, the differences may be due to factors like species differences in fetal development and the nutrition of the dam. These results however show a normal pattern of growth and development of the digestive tract in these fetuses. It is therefore, expected that other aspects of fetal digestive physiology like fetal swallowing, fetal gastric motility, fetal absorption and fetal excretion would proceed normally in these fetuses in the present study despite the fact that the dams were raised extensively by peasant farmers before they were brought to the abattoir for slaughter.

Some Biochemical Characteristics of Serum

With regard to the biochemical characteristics of serum (Table 3), there were similarities (P>0.05) between the stages of gestation in both serum total protein and cholesterol. This result might imply a stability of substrates available to the fetus for fetal growth throughout gestation.

Table 3: Changes in some biochemical characteristics of serum in caprine fetuses during gestation (means ± s.e.m.).

Stage of gestation	Total Protein (g/100ml)	Cholesterol (mg/100ml)
Early	11.21 ± 1.83	91.892 ± 68.465
Mid	7.03 ± 1.52	118.919 ± 48.649
Late	10.49 ± 2.23	131.531 ± 31.41

s.e.m. = standard error of mean.

CONCLUSION

This work provides base line information on fetal development in caprine fetuses in their native environment. The results are expected to be useful in research aimed at a better understanding of factors that may affect the post-natal survival as well as the improvement of the productivity of these animals.

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