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Original Research Article

Endocrine profiles and kidney function markers of apparently healthy pregnant and lactating Duroc sows

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ABSTRACT

This experiment was carried out to evaluate the effects of reproductive activities (pregnancy and lactation) on certain serum endocrine profiles and kidney function markers of Duroc sows. Thirty (30) sexually matured cycling apparently healthy Duroc sows and eight (8) Duroc boars (38 pigs), of mean weight 55.36±0.48 kg, aged between13and 15 months were used for this study. The sows (30) were randomly assigned to five groups (A to E) of six sows per group in a completely randomized design (CRD). Group A: Non pregnant (control), Group B: Early gestation (38 days), Group C: Mid gestation (78 days), Group D: Late gestation (110 days) and Group E: Post gestation (7 days postpartum). The mean serum progesterone (P_4) concentration of group D sows was significantly ($p<0.05$) increased when compared to group E. The mean serum thyroxine (T_4) concentration of group D sows (3rd trimester) was significantly ($p<0.05$) increased when compared to groups C and E. The mean blood urea nitrogen (BUN) concentration of the treated group (C) was significantly ($p<0.05$) higher when compared to group B. The mean creatinine concentration of group D was significantly ($p<0.05$) higher when compared to groups E, B and the control. The mean BUN/CRT ratio of group B sows was significantly ($p<0.05$) higher when compared to groups C, D, E and the control. There were however, no significant variations ($p>0.05$) in the mean oestradiol (E_2), cortisol (C), creatinine (CRT) concentrations and BUN/CRT ratio among all the groups. In conclusion, the serum endocrine and kidney function markers of Duroc sows in this study were significantly influenced by gestation. This study has established reference values of the endocrine profiles and kidney function markers of Duroc sows during gestation that are consistent with normal health.

Keywords: Duroc pigs, endocrine profiles, gestation, kidney function

INTRODUCTION

Pig production remains one of the veritable sources of supply of animal protein (Apata & Ojo, 2000; Udofia *et al.,* 2007). Reproduction of pigs provides man with a more uniform supply of pork meat (Chandy, 2004; Ayalew *et al.,* 2011) and by-products such as pigskin and bristle used in the manufacture of light leather and brushes especially in Asian countries (Young, 2005). The pig's output; yield of meat/tonne of live weight of breeding pigs especially number of sows per year is about six times that of cattle (Mpofu & Makuza, 2003). Pig husbandry in Nigeria thrive well under a wide range of ecological conditions (Balogun & Olumeyan, 1988), however productivity of breeding stock is highly dependent on its growth rate and reproductive efficiency (Adebambo, 1981, 1983).

Major adaptations in maternal physiology and metabolism are required for successful pregnancy outcome. Blood serum biochemical profile testing is a pre-symptomatic diagnostic tool to assess the swine herd's nutritional status and other productive and reproductive disorders (Pathan *et al.,* 2011).The profile may vary according to factors such as origin, climate, management practices, geographical distribution, season and reproductive stage of animals (Cozzi *et al.*, 2011; Pal & Acharya, 2013; Mahima *et al.,* 2013).

Physiological changes in pregnancy are primarily due to the changes in the hormonal milieu (Chandra *et al.,* 2012). Pacheco *et al.* (2016) and Souza *et al.* (2018) emphasized thatphysiological changes are related to nutrient expenditure with foetal growth, placental functioning, increased foetal covering and fluid, uterine wall and mammary glands to

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highlight the increase in the metabolic rate that occurs during gestation.

Once mating and fertilization are successfully completed, the trophoblast signals its presence to the maternal system to prevent luteolysis and maintain progesterone production, which is essential for the establishment of pregnancy (Geisert & Malayer, 2000).The implantation event is accompanied by significant changes in the tissue concentration of various cytokines, adhesion molecules, hormones, enzymes and growth factors, all of which may be crucial in initiating the foeto-maternal relationship (Rice & Chard, 1998; Saito, 2000).Progesterone acts to prevent the resumption of cyclicity, prepares the uterus for implantation and maintains myometrial quiescence (Geisert & Malayer, 2000). Progesterone is also believed to aid in the maintenance of uterine immune system during pregnancy (Rahman, 2002). Actually, myometrial quiescence during pregnancy is achieved by the combined action of progesterone, relaxin, prostacyclin and nitric oxide (Geisert & Malayer, 2000). Together with estrogen, progesterone acts to transform the endometrium into a secretory tissue capable of supporting both the pre- and post-implantation conceptus.Heshmat *et al.* (1984) reported that plasma triiodothyronine and thyroxine concentrations in the dromedary camel increased throughout pregnancy. Currently, there are no data available on the serum endocrine profiles and kidney function markers that occur during the transition period in Duroc sows kept in Nigeria. Therefore, the aim of this study was to determine the effect of pregnancy and lactation on certain serum endocrine profiles and kidney function markers of Duroc sows.

MATERIALS AND METHODS

EXPERIMENTAL ANIMALS

This experiment was carried out on Duroc pigs obtained from Chidiebere commercial breeding farm and kept in Chidiebere commercial breeding farm located at Ndoro in Ikwuano LGA, Abia State, Nigeria. Thirty (30) sexually matured cycling apparently healthy Nigerian Duroc sows and eight (8) Duroc boars (38 pigs), of mean weight 55.36±0.48 kg, aged between 13 and 15 months were used for this study. The sows and boars were acclimatized for three weeks during which they were dewormed using ivermectin at a dose of 300 µg/kg subcutaneous (SC) ones, for internal parasites and repeated 10-14 days for external parasites. The Duroc pigs were kept in well ventilated pens at room temperature (25-27^{0}C) and 12 hours light/darkness cycle maintained.

EXPERIMENTAL DESIGN

Thirty (30) Duroc sows were randomly assigned to five groups (A to E) of six sows per group in a completely randomized design (CRD). Group A: Non pregnant (control), Group B: Early gestation (38 days), Group C: Mid gestation (78 days), Group D: Late gestation (110 days) and Group E: Post gestation (7 days post-partum). The sows were synchronized using $PGF_{2\alpha}$ given twice, 11 days apart at a dose of 10 mg/kg intramuscular (IM). A total of eight boars (2 boars for each group) were introduced to naturally serve the sows in groups B, C, D (pregnant groups) and E (lactation group). Following successful mating, pregnancy was confirmed by ultrasonography (Ali & Fahmy, 2008) between days 22-23 after the introduction of sexually mature boars. The pregnant sows were identified with tag letters thus, B_{1-6}, C_{1-6}, D_{1-6}, and kept in separate pens until farrowing and are maintained in these separate pens throughout lactation. The postpartum sows were also kept in separate pens and identified thus; E_{1-6} while the control sows were identified thus A_{1-6} and kept together in a pen. The sows were fed twice daily while the piglets received breast milk only from their mothers until the end of lactation at 28 days. Sows, boars and piglets were provided with clean fresh water *ad libitum* throughout the period of the study. Four milliliters (4ml) of blood was collected from each sow in a group from the femoral vein and dispensed into plane test tubes and allowed to clot in a slanting position for 2 hours and centrifuged at 2,500 RPM for 5minutes. The resulting sera were aspirated, stored at -20^{0}C and used to determine the concentrations of oestradiol, progesterone, cortisol and thyroxine using microplate enzyme immunoassay (EIA) technique (Tietz, 1995), blood urea nitrogen (Burtis & Ashwood, 1999) and creatinine (Newman & Price, 1999). Serum BUN/CRT ratio was determined by calculation.

DATA ANALYSIS

The data collected for each of the serum endocrine profiles and kidney function markers were subjected to One Way Analysis of Variance (ANOVA) using SPSS statistical package (version 21.0). Variations in means were separated using Duncan's New multiple Range Test (Steel & Torrie, 1980). Probability values < 0.05 were considered significant.

RESULTS

The mean serum progesterone (P_4) concentration of group D sows was significantly ($p<0.05$) increased when compared to group E. The mean serum thyroxine (T_4) concentration of group D sows (3rd trimester) was significantly ($p<0.05$) increased when compared to groups C and E but showed no significant ($p>0.05$) variations when compared to group B and the control. The mean blood urea nitrogen (BUN) concentration of the treated group (C) was significantly ($p<0.05$) higher when compared to group B. The mean creatinine concentration of group D sows was significantly ($p<0.05$) higher when compared to groups E, B and the control. The mean BUN/CRT ratio of group B sows was

significantly ($p<0.05$) higher when compared to groups C, D, E and the control. There were however, no significant variations ($p>0.05$) in the mean oestradiol (E_2), cortisol (C), creatinine (CRT) concentrations and mean BUN/CRT ratio among all the groups.

Table I: **The mean hormonal profiles of Duroc sows at different stages of gestation**
E_2 = Estrogen, P_4 = Progesterone, T_4 = Thyroxine, C = Cortisol

Parameters	Pre-gestation (control)	Early gestation	Mid gestation	Late gestation	Post-gestation (lactation)
E_2 (pg/ml)	202.93±25.88	120.69±37.47	106.11±37.03	83.43±9.54	251.60±186.73
P_4(ng/ml)	22.61±15.25^{ab}	40.19±13.82^{ab}	54.79±2.64^{b}	55.62±8.16^{b}	7.47±0.35^{a}
C(µg/dl)	24.79±10.33	13.66±2.09	13.42±1.99	10.43±2.50	16.36±2.41
T_4 (µg/dl)	17.27±0.29^{b}	14.80±2.05^{b}	10.97±0.07^{a}	17.50±0.38^{b}	11.20±0.06^{a}

^{ab}Mean values in the same row with different superscripts are significantly different ($P<0.05$)

Table II: The mean kidney function markers of Duroc sows at different stages of gestation

Parameters	**Pre-gestation (control)**	**Early gestation (Ist trimester)**	**Mid gestation (2nd trimester)**	**Late gestation (3rd trimester)**	**Post-gestation (lactation)**
BUN (mg/dl)	6.32±0.06^{b}	5.56±0.29^{a}	6.63±0.31^{b}	6.29±0.05^{b}	6.30±0.10^{b}
CRT (mg/dl)	2.86±0.28	2.46±0.09	2.73±0.26	2.46±0.09	2.79±0.43
BUN/CRT ratio	2.25±0.21	2.27±0.17	2.49±0.33	2.56±0.08	2.36±0.34

^{ab}Mean values in the same row with different superscripts are significantly different ($P<0.05$)

DISCUSSION

The highest progesterone value was recorded in late stage of pregnancy and the lowest during postpartum. The increase in maternal serum progesterone concentration during late pregnancy is due to the role of corpus luteum as a source of progesterone (Sheldrick*et al.,* 1981). Maternal recognition of pregnancy turns on the mechanisms that protect functional corpora lutea to continue production of progesterone. This steroid hormone (progesterone) has an essential role in the maintenance of pregnancy (Franczak & kotwica, 2010). Our findings on the serum thyroxine (T_4) level disagrees with earlier works by Soliman (2014) who reported no significant variations in serum T_4 across gestation in Ossimi sheep. The highest levels of urea in this research have been detected with the second trimester sows. This disagrees with Baumgartner & Perthaner (1994), Hamadeh *et al.* (1996) and Lohle (1992). Our study disagrees with the highest values of blood urea in late gestation compared to non-pregnant control reported by El-Sherif & Assad (2001) in Barki ewes and Durak & Altinek (2006) in Chios ewes and Antunovic *et al.* (2002). The observed reduction in the BUN in lactating sows compared to the non-mated control disagrees with the elevated postpartum BUN values (Carcangiu *et al.,* 2007; Karapehlivan *et al.,* 2007; Salem, 2017).The elevation in the serum blood urea nitrogen (BUN) concentration of mid gestation sows compared to the non-mated group agrees with the report of Soliman (2014) in Ossimi sheep. The elevated urea/creatinine ratio is important indicator of the increased glomerular filtration rate (GFR) which increases especially in late gestation due to the increased total blood volume. The higher urea/creatinine ratio in late pregnant sows relative to non-pregnant counterparts could be due to the increase in GFR and reproductive status of the sows (Fischbach, 2000).

CONCLUSION

The serum endocrine profiles and kidney function markers of Duroc sows in this study were significantly influenced by gestation. The endocrine and kidney function markers of sows used in this study are within the physiological range required for the maintenance of homeostasis and health essential for efficient reproduction. Therefore the sows used in this study during gestation suggest having good blood compositions capable of supporting optimal reproductive performance. This study has established reference values of the endocrine profiles and kidney function markers of Duroc sows during pregnancy and lactation that are consistent with normal health in this species.

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