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Effect of physiological stages on metabolic profile Zovawk (*Sus scrofa domesticus*)

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Abstract
Present study was carried out to see the effect of different physiological stages on metabolic profile of Zovawk pigs. It was observed that the glucose level significantly decreased in lactating and pregnant sows as compared to non-pregnant group. The level of cholesterol and triglycerides increased significantly in case of pregnant as well as lactating sows. However, the LDL and HDL concentration did now show any significant difference amongst the experimental groups although slight hike of LDL was recorded during pregnancy. The total protein level was found to be significantly higher in non-pregnant sows, but significantly lowest in pregnant sows. The difference recorded in albumin concentration amongst the experimental groups was non-significant. However, globulin concentration significantly decreased during pregnancy. A significant decrease was recorded in case of BUN during pregnancy; whereas there was no significant changes in in uric acid concentration amongst the three groups. Conversely, the variation observed in the creatinine concentration among the experimental groups was only numerical. Similarly, nearly a constant level of total bilirubin, direct bilirubin and indirect bilirubin was recorded in all three experimental groups of sows irrespective of physiological stages. Data generated may be of use to assess the metabolic health of Zovawk sows.

Keywords: Zovawk, pigs, metabolic profile, pregnancy, lactation

Introduction
Pig rearing is a tradition in Mizoram, India. The indigenous pig of Mizoram is locally known as 'Zovawk'. It is reared by Mizo community for pork and manure purpose. The animals are black and white spot on forehead, white patches on the belly and white boots. These are small sized animals with an average body weight of 54 Kg in case of male and 59 Kg in case of female. Zovawk is very popular amongst the pig farmers in the state for its ability to sustain in low input system [1]. Due to unique physical character and hardiness, these small sized pigs might be a source of gene pool for future breeding strategies. Therefore, there is an utmost need for characterization of this unique germplasm of North-Eastern region of India. There is some scattered information pertaining to blood profile of Zovawk. However, no study has been carried out to investigate the metabolic profile of these pigs. The term 'metabolic profile' refers to the analysis of blood biochemical parameters that are useful to assess and prevent metabolic and nutritional disorders in dairy herds [2]. Previous studies report that the concentration of blood metabolites is influences by physiological status of the animals [3, 4].
In view of the above, present investigation is carried out to study the effect of different physiological stages on blood metabolic profile of Zovawk pigs.

Materials and methods:
Experimental animals and groupings
A total of 30 clinically healthy Zovawk sows maintained in the pig farms of the college and AICRP, College of Veterinary Sciences & Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram were selected and broadly categorized into three groups: group-I: pregnant sows, group-II; dry-non pregnant sows and group-III: lactating sows. All the experimental pigs were reared along with other animals and fed as per the routine feeding schedule followed in the Livestock Farm of the college.

Ethical approval
Application for permission to collect blood samples from the experimental animals was submitted to the chairman, Institutional Animal Ethics Committee,

College of Veterinary Sciences & A.H., CAU, Selesih (Mizoram) has been submitted vide No: F-1/HD/VPB/CVSc/CAU/16/322 dated:20/06/2016 (Establishment No:1762, dated:21/6/2016).Accordingly, ethical approval was granted Vide No: ÇVSC/CAU/IAEC/14-15/P15 dated 07-03-2017.

Collection of blood samples

Ten (10) ml of blood was collected aseptically from each animal by venipuncture of anterior venacava using pre-sterilized polypropylene disposable syringes with 18G 1.5" hypodermic needle, transferred into 10 ml capacity sterile screw-capped centrifuge tubes.The tubes were kept in a slanting manner for 1 hour at room temperature for clot formation and the serum was separated immediately after coagulation of the blood by centrifugation at 2,500 rpm for 10 minutes. The supernatant serum samples were aspirated by positive displacement 1000 µl pipettes changing the pipette tip for each sample and transferred to sterile screw capped cryo-vials. The serum samples were subsequently subjected to biochemical analysis in research laboratory of Veterinary Physiology & Biochemistry Department, College of Veterinary Sciences & A.H., CAU, Selesih, Aizawl.

Analysis of metabolic parameters

The metabolic parameters i.e. Total Protein, Albumin, Globulin, A:G ratio, Glucose, Total Cholesterol, HDL-Cholesterol, Triglyceride, Creatinine, Bilirubin (direct and conjugated), blood Urea Nitrogen and Uric acid in the serum samples was analyzed using automated clinical chemistry analyzer (Fuji Dry Chem 4000i, Fujifilm, Tokyo, Japan)

Statistical analysis of collected data

The results were statistically analyzed by following two way ANOVA method described by Snedecor and Cochran [5] using the SPSS software. $p < 0.05$ was considered to be statistically significant

Results and discussion:

Table-1 depicts the Mean ± SE values of major metabolites of the different experimental groups of Zovawk pigs. It is evident that the glucose level significantly decreased in lactating and pregnant sows as compared to non-pregnant group. Zvorc *et al.* [6] observed that glucose concentration remained unchanged during pregnancy period and then increased significantly during lactation. An increase in glucose concentration similar to our study was also found by other authors [7]. The alteration in the level of glucose occurring from gravidity to lactation are the result of changes in metabolic activities that take place at the initiation of lactation. The delivery and uptake of glucose by mammary gland are determining step for milk synthesis. It is reported that glucose uptake decreases in tissues, except for the mammary gland, and insulin resistance in the whole body increases following the lactogenesis [8].

The level of cholesterol and triglycerides increased significantly in case of pregnant as well as lactating sows. However, the LDL and HDL concentration did now show any significant difference amongst the experimental groups although slight hike of LDL was recorded during pregnancy. Nonetheless, the concentrations of lipid parameters obtained in this study are in agreement with the reference values reported by other authors in pigs [9, 10, 11]. High level of cholesterol recorded at the time of pregnancy may be attributed to changes in the concentration of sex hormones and metabolism in hepatic and adipose tissue [12, 13]. It is reported that sex hormones increases during pregnancy. The increased progesterone concentration contributes to the rise in LDL levels [12] and in return circulating LDL cholesterol is the chief substrate for placental progesterone synthesis [14]. The higher level of oestrogen during pregnancy leads to a hike in total cholesterol, LDL cholesterol and triglycerides. It is reported that LDL found in serum at pregnancy is atherogenic, small and dense [15]. Similarly, hepatic lipase concentration also increases during pregnancy that causes triglyceride synthesis in the liver and is attributed to the raised level of LDL [15]. The overall effects of changes in lipid metabolism during pregnancy are accumulation of maternal fat stores in the first half and enhanced fat mobilization in the second half of pregnancy [13].

Similarly, the total protein level was found to be significantly higher in non-pregnant sows, but significantly lowest in pregnant sows. The difference recorded in albumin concentration amongst the experimental groups was non-significant. However globulin concentration significantly decreased during pregnancy. Our findings are in constituent with the report of Dutta and Dutta [16]. The higher protein concentration recorded in the adult sows of Zovawk except pregnant groups may be due to hike in globulin fraction [17]. The decrease in albumin and hike in globulin concentrations is proportional to age except during pregnancy and these may be attributed to a reduction in protein synthesis by hepatic cells [18]. Paaby [19] reported a reduced level of plasma and serum proteins during pregnancy. Most of the previous studies reported a gradual decease in protein concentration throughout pregnancy at the order of 7-8% of the non-pregnant value [20]. Conversely, others have observed reduction in protein concentration only in the first part of pregnancy and concluded that mean concentration of total protein to fall from 7.3mg/dl to 5.5 mg/dl upto 6-7 months, after which the level is stabilized [21]. It is claimed that there was an increase in the level protein after the initial decrease upto six months [22]; whereas Liddelow [23] recorded an abrupt hike in protein concentration prior to delivery. Mack [23] and Coryell *et al.* [24] reported that the differences in protein concentration are due to individual variations in the at any given stage of pregnancy and to fluctuations occurring from time to time during pregnancy even in the same animal. However, the reduction in protein concentration observed im pregnancy is most probably the result of the dilution of the plasma because protein concentration is inversely proportional to plasma water concentration [25].

A significant decrease was recorded in case of BUN during pregnancy; whereas there was no significant changes in in uric acid concentration amongst the three groups. Conversely, the variation observed in the creatinine concentration among the experimental group was only numerical. Similar trend of variation was also reported in sheep earlier studies [26, 27]. The higher level of urea/creatinine ratio is a major indicator of e increased GFR that results especially in late gestation due to the increased total volume of blood. The cause for the hike in urea/creatinine ratio during pregnancy as compared to non-pregnant animals may be due to increase in GFR and reproductive status of the experimental animals [28, 29]. Age might have increased the free radicals and in order to neutralize that uric acid might have been increased [30]. Although Bun concentration varied significantly between pregnant and non-pregnant pigs, uric acid and creatinine

exhibited not significant variation only. This finding corroborates earlier studies [9, 31]. The decrease in BUN concentration during pregnancy may be attributed to c decrease in urea synthesis [32]. Using ^{15}N as a tracer, It was found that the rate of urea synthesis reduces by 30% in women during the initial stage of pregnancy as compared to that of control subjects, and declines by 45% in women by the last stage of pregnancy.

Present study indicates nearly a constant level of total bilirubin, direct bilirubin and indirect bilirubin in different experimental groups of sows irrespective of physiological stages, which is in accordance with the report of Palacios *et al*. [4], who stated that bilirubin were not affected by the physiological status or the genetic cross and remained in the range that is considered normal. The slight increase of total bilirubin in pregnant pigs could be a consequence of additional bilirubin derived from degradation of fetal haemoglobin [34]. Conversely, Friendship *et al*. [9] observed that bilirubin concentrations are lower in early pregnancy.

Table 1: Mean ±SE of blood metabolites in different experimental groups of Zovawk pigs

Parameters	Pregnant sows	Dry-non pregnant sows	Lactating sows
Glucose (mg/dl)	91.5±7.34^{d}	109.27±7.22^{a}	95±7.32^{c}
Total Cholesterol (mg/dl)	101±2.21^{c}	92.68±1.23^{a}	93±2.11^{b}
Triglycerides (mg/dl)	44±2.98^{b}	38.47±3.17^{a}	43.24±3.33^{b}
HDL-Cholesterol (mg/dl)	35±5.12^{a}	34.88±5.18^{a}	36.0±5.12^{a}
LDL (mg/dl)	49.20±6.3^{a}	47.31±6.2^{a}	48.34±5.8^{a}
Total protein (g/dl)	5.27 ± 0.33^{c}	7.98±0.16^{b}	7.03±0.22^{a}
Albumin (g/dl)	3.01±0.15^{a}	3.46±0.14^{a}	3.00±0.21^{a}
Globulin (mg/dl)	2.26±0.16^{b}	4.12±0.33^{a}	4.03±0.29^{a}
A:G ratio	1.33±0.12^{a}	0.77±0.10^{a}	0.74±0.14^{a}
BUN (mg/dl)	22.31±0.17^{c}	25.85±1.11^{a}	24±0.19^{a}
Uric acid (mg/dl)	1.66± 0.15^{b}	1.27±0.14^{b}	1.35± 0.15^{b}
Creatinine (mg/dl)	1.54±0.21^{a}	1.44±0.19^{a}	1.58±0.20^{a}
Total Bilirubin (mg/dl)	0.08±0.02^{a}	0.05±0.02^{a}	0.04±0.02^{a}
Direct Bilirubin (mg/dl)	0.05±0.12^{a}	0.03±0.0.9^{a}	0.03±0.13^{a}
Indirect Bilirubin (mg/dl)	0.03±0.11^{a}	0.02±0.11^{a}	0.01±0.11^{a}

Means bearing different superscript (a, b & c) in a row differ significantly (p<0.05)

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