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Mineral and electrolyte profile of Zovawk pig in different seasons

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Abstract
A study was carried out to investigate the effect of season on mineral and electrolyte profile of indigenous pig, Zovawk of Mizoram. Blood samples were collected from three different age groups *viz.* pre-weaning, grower and adult in three different seasons *viz.* summer, rainy and winter. Minerals and electrolytes *viz.* calcium, phosphorus, magnesium, sodium, potassium, chloride and iron were estimated in plasma separated from blood samples after centrifugation. Plasma concentration of phosphorus, sodium, chloride and iron showed significant variations in different seasons. Phosphorus and chloride were found higher in rainy season. Sodium was higher in winter followed by summer and rainy seasons. Iron was found lower in summer. Season had no significant effects on calcium, magnesium and potassium. The study revealed high ranges of plasma iron in indigenous pig, Zovawk of Mizoram indicating its closeness to its wild origin.

Keywords: electrolyte, mineral, Mizoram, season, Zovawk pig

Introduction
Mizoram is situated between 92015´´ - 93029´´E longitude and 21058´´-24035´´N latitude with average elevation 1132m above the mean sea level. The climate of Mizoram is tropical monsoon type where there is very short period of dry season in December and January. The state enjoys a pleasant climate throughout the year except in the summer and rainy season during which a very high relative humidity prevails (Statistical Abstract, 2003) [1].
Zovawk is one of the 7 indigenous pig breeds of India registered at ICAR- National Bureau of Animal Genetic Resources (NBAGR) India. Zovawk pig breed is originated from Mizoram state in India (NBAGR, India) [2] and it is one of the four indigenous pig breeds from North East India (Talukdar *et al.,* 2019) [3]. Zovawk had been reported to have normally higher content of Hb and RBC (Mayengbam *et al.,* 2014) [4] like other indigenous pigs (Friendship *et al.,* 1984; De *et al.,* 2013) [5, 6] and some wild pigs (De *et al.,* 2013; Harapin *et al.,* 2003; Brockus *et al.,* 2005;) [6, 7, 8]. The content of plasma Na in Zovawk was found to be higher (Mayengbam *et al.,* 2012) [9] as compared to that of other indigenous, exotic and crossbred pigs (Kumaresan *et al.,* 2009) [10]. Previous study reported variation in electrolyte profile of Zovawk in summer and winter (Mayengbam *et al.,* 2015) [11].
There is however no data available to explain changes in mineral and electrolyte profile of pigs domesticated in Mizoram during rainy season. The present study aimed to investigate the plasma mineral and electrolyte profile of Zovawk pig in summer, winter and rainy season.

Materials and Methods
Rearing of animals and record of body weight
A total of 108 Zovawk pigs reared in the All-India Co-ordinated Research Project (AICRP) on pig College of Veterinary Sciences and Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram, India were used for blood sampling. Based on the age, pigs were divided into three age groups *viz.* pre-weaning group (4 to 5 weeks old), grower group (24 to 26 weeks old) and adults (14 to 16 months old). Each group comprised of 12 pigs of either sexes. The piglets were kept with the mother till the weaning of the piglets on 56th day thereafter they were being given grower diets. The adult female pigs were in the first parity and the adult males had given 1st service. Body weight of each pig was recorded on the day of blood sampling.

Record of meteorological data

Meteorological data were recorded from the Automatic Weather Station (WatchDog, Spectrum Technologies, Inc.) located inside the campus of College of Veterinary Sciences and Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram, India. The data on meteorological parameters were recorded every six hours. The data were recorded during the whole period of study. The average minimum ambient temperature (Tmin.), average maximum ambient temperature (Tmax.), average minimum relative humidity (RHmin.), average maximum relative humidity (RHmax.) and temperature humidity index (THI) were calculated. THI was calculated by using the following formula developed by Johnson *et al.* (1962) [12]:

$$THI = 0.8T + \frac{RHT - 14.4}{100} + 46.4$$

Blood sampling and analysis

Blood samples were collected by puncturing anterior vena cava. Lithium heparin coated vacutainers were used for blood collection. Blood samples were collected in three different periods *i.e.* summer season (March to June), rainy season (July to October) and winter season (November to February). Plasma was immediately separated by centrifugation of blood samples at 3000 rpm for 20 minutes. Minerals and electrolytes *viz.* calcium, phosphorus, magnesium, sodium, potassium, chloride and iron were estimated in the fresh plasma by using commercially available diagnostic kits by following OCPC method (Bagainski, 1973; Gitelman, 1967) [13, 14] for calcium, Molybdate U.V. method (Fiske and Subbarow, 1925; Gomori, 1952) [15, 16] for phosphorus, Calmagite method (Gindeler and Heth, 1971) [17] for magnesium, Colorimetric method (Maruna, 1958; Trinder, 1951) [18, 19] for sodium, Colorimetric method (Sunderman *et al.*, 1951; Terri and Sesi, 1958) [20, 21] for potassium, Thiocyanate method (Schales and Schales, 1941; Schoenfeld and Lewenllen, 1964) [22, 23] for chloride and Ferrozine method Siedel *et al.* (1984) [24] for iron by using a UV-Vis Spectrophotometer (Chemito-Spectroscan 2600).

Statistical Analysis

The data were analyzed by using SPSS 16 version. One way analysis of variance was carried to find out the difference between different seasons (Snedecor and Cochran, 1989) [25].

Ethical Approval for Animal Experimentation

Ethical approval was obtained from Institutional Animal Ethical Committee for blood sampling.

Results and Discussion

The average body weight of pigs used in the present investigation in pre-weaning, grower and adult groups in summer, winter and rainy seasons were presented in Table 1.

Table 1: Average body weight Zovawk pigs in different groups in different seasons

Season	Pre-weaning group	Grower group	Adult group
Summer	2.72±0.19	4.94±0.31	56.58±2.29
Rainy	2.73±0.25	5.11±0.61	49.33±3.23
Winter	1.66±0.11	5.04±0.38	64.50±1.66

Ambient temperature, relative humidity and THI

The average Tmin, Tmax, RHmin, RHmax and THI were presented in Table 2. The lowest Tmin, Tmax and THI were recorded in winter while the highest Tmin, Tmax and THI were recorded in rainy season. The average THI recorded in summer and rainy seasons were >72. THI above 72 had been indicated to cause heat stress in animals (Johnson *et al.*, 1963) [26]. Zovawk pig is a well-adapted semi wild indigenous pig and previous studies indicated significant effect of summer stress on certain blood biochemical parameters of Zovawk as compared to winter (Mayengbam *et al.*, 2015) [11]. The present study indicated presence of higher THI in rainy season as compared to summer season.

Table 2: Ambient temperature, relative humidity and temperature humidity index in different seasons

Season	Average Ambient Temperature (°C)		Average Relative Humidity (%)		Average THI
	$T_{min.}$	$T_{max.}$	R.H.$_{min.}$	R.H.$_{max.}$	
Summer	19.66	28.67	50.75	93.75	72.79
Rainy	20.63	28.87	71.50	97.75	74.96
Winter	14.82	25.51	49.50	84.50	66.40

Mineral and electrolyte profile

Among the minerals and electrolytes estimated in the present study the plasma concentration of phosphorus, sodium, chloride and iron of Zovawk pigs showed significant variations in different seasons (Table 3). There was no significant variation in plasma calcium concentration of Zovawk pigs in different seasons. Previous reports indicated seasonal variation in plasma calcium depending on the age of pigs (Mayengbam *et al.*, 2015) [11]. The variations were because of a close relationship between parathyroid hormone synthesis with 1,25-dihydroxyvitamin D in Ca homeostasis. The inhibitors of PTH synthesis and secretion were increase in serum Ca and 1,25-dihydroxyvitamin D. Inhibition of PTH synthesis by 1,25-dihydroxyvitamin D completes an important endocrine feedback between the parathyroid chief cells and renal epithelial cells, because PTH stimulates renal production of 1,25-dihydroxyvitamin D (Rosol and Capen, 1999) [27].

Plasma concentration of phosphorus and chloride were found to be significantly higher in rainy season ($P< 0.05$) while there was no significant difference between summer and winter. The difference could be due to availability of more lust and green vegetables in rainy season. The increase in plasma phosphorus could indirectly lead to increase in plasma chloride level in rainy season as high plasma phosphorus could stimulate parathyroid gland (Rosol and Capen, 1999) [27] and overstimulation of parathyroid gland could result to clinical hyperchloremia (Siddiqui and Wilson, 1972) [28].

Plasma sodium of Zovawk pig was found to be higher in winter followed by summer and rainy seasons while the plasma potassium was not influenced by season. In the previous study in different age groups, plasma sodium was found to be higher in summer due to heat stress than in winter (Mayengbam *et al.*, 2015) [11]. Presence of higher sodium in winter could be due to feeding of mineral blocks to these pigs in winter due to less availability of green fodder in dry season

in Mizoram.

In the present study, plasma magnesium was not influenced by season. The Mg homeostasis is a result of balance between intestinal absorption and renal excretion with additional regulation by the adrenals, thyroids and parathyroid glands (Rosol and Capen, 1999) [27]. Mg ion had an effect on parathyroid secretory rate similar to that of Ca, but its effect was not equipotent to that of Ca (Mayer and Hurst, 1978) [29]. The finding of stable plasma Mg during in different seasons in the presence of stable Ca in the present study agreed the effects of Ca in control of PTH secretion, together with its preponderance over Mg in extracellular fluid suggesting a secondary role for Mg in parathyroid control (Rosol and Capen, 1999) [27].

Zovawk pigs were found to have higher ranges of plasma iron as compared to other pig breeds (Kaneko, 1999) [31]. This could be a characteristic feature of its closeness to its wild as wild pigs were found to have higher muscle iron than the domestic ones (Babicz and Kasprzyk, 2019) [32]. Zovawk pigs were also indicated to have higher content of TEC and Hb (Mayengbam *et al.,* 2015) [11]. As perceived by the local people of Mizoram pork meat of Zovawk pig has a characteristic red colour unlike other pork meat and the pork of Zovawk had medicinal properties in anemic individuals. The findings of higher iron content with higher TEC with Hb in the blood substantiated the medicinal value of the Zovawk pork amongst the Mizo people.

The level of plasma concentration of calcium, phosphorus, magnesium, sodium, potassium and chloride estimated in Zovawk in summer, rainy and winter were in the ranges as reported earlier (Mayengbam *et al.,* 2015) [11].

Table 3: Mineral and electrolyte profile of Zovawk pigs (Mean ± S.E.) in different seasons

Parameter	Summer	Rainy	Winter
Calcium (mg/dl)	9.23 ± 0.19	9.51 ± 0.60	9.03 ± 0.39
Phosphorus (mg/dl)	4.76^{a} ± 0.14	6.75^{b} ± 0.51	4.31^{a} ± 0.12
Magnesium (mEq/l)u 1	2.87 ± 0.10	6.28 ± 4.03	2.48 ± 0.13
Sodium (mmol/l)	169.46^{b} ± 2.72	147.23^{a} ± 6.35	193.92^{c} ± 2.74
Potassium (mmol/l)	5.44 ± 0.21	12.13 ± 4.92	3.63 ± 0.11
Chloride (mmol/l)	95.48^{a} ± 0.72	115.06^{b} ± 3.72	99.43^{a} ± 2.54
Iron (µg/dl)	145.95^{a} ± 3.80	175.02^{b} ± 8.85	175.25^{b} ± 8.54

Conclusion

The study indicated seasonal variation in mineral and electrolyte profile of Zovawk pig of Mizoram. Phosphorus and chloride were found higher in rainy season. Sodium was higher in winter followed by summer and rainy seasons. Iron was found lower in summer. Season had no significant effects on calcium, magnesium and potassium. The study revealed high ranges of plasma iron in indigenous pig, Zovawk of Mizoram indicating its closeness to its wild origin.

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