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The Correlation Between Mineral Concentration of Seminal Plasma and Spermatozoa Motility in Rooster

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Abstract: The aim of this study was to evaluate the correlation between cooper, zinc, calcium, sodium and potassium concentration of seminal plasma and spermatozoa progressive motility percent in rooster. Seventeen Indigenous broiler breeder Roosters were used. According to spermatozoa motility, roosters were classified to 3 treatment groups with low, medium and high progressive motility percent. Seminal plasma from all groups was obtained with centrifuge of semen samples. Cooper, Zinc, Sodium, potassium and calcium concentrations in seminal plasma samples were determined on the atomic absorption spectrophotometer. There was positive correlation between cooper and zinc concentrations of seminal plasma and progressive motility percent of spermatozoa. There was no significant correlation between sodium concentrations of seminal plasma and progressive motility percent of spermatozoa. There was negative correlation between low/medium progressive motility rate groups and high motility group. While this correlation for calcium concentration was positive.

Key words: Rooster, sperm motility, seminal plasma minerals, spermatozoa, broilers breeder, Iran

INTRODUCTION

Artificial insemination is one of the most effective and widely used techniques for the genetic improvement of animals. For good results in the artificial insemination of chickens, the quality of semen should be ensured (Tabatabaei *et al*., 2009).

The importance of semen evaluation in poultry breeding for selecting breeding males or forroutinely monitoring their reproductive performance arewell recognized (Cheng *et al*., 2002). The quality of semen is affected by numerous factors. When fowl semen is collected artificially, the ejaculate typically blends with a lymph like fluid on the surface of the everted cloaca.

This transparent fluid is derived from the paracloacal vascular bodies and enters the cloaca via the lymphatic folds (Fujihara, 1992; Al-Aghbari *et al*., 1992). Consequently, seminal plasma procured from roosters generally denotes a mixture of deferent duct fluid and transparent fluid.

Nevertheless because the rooster lack accessory sex glands and because deferent duct fluid and transparent fluid are chemically distinct, it is valid to infer extra-gonadal duct function from seminal plasma composition (Al-Aghbari *et al*., 1992). Deficiencies of the minerals have been linked to impaired reproductive performance in male and female farm animals (Smith and Akinbamijo, 2000). Research has shown that trace elements can alter reproductive functions *in vivo*) Barber *et al*., 2005). For many years, reports have shown that Se deficiencies can cause impaired male fertility in cattle, boars, rats and mice. In particular, Se-deficient cattle exhibit reproductive disorders including weak or silent periods, delayed conception, poor fertilization, cystic ovaries, reduced sperm motility, mastitis and reduced uterine motility (Smith and Akinbamijo, 2000; Barber *et al*., 2005). Impairment of reproductive function in the presence of Zn deficiency has been widely reported (Chesters, 1978; Hidiroglou, 1979; Apagar, 1985). A role for Zn in reproduction may be as a vital component of enzymes involved in steroidogenesis.

It has been shown that Zn may act indirectly through the pituitary to influence gonadotropic hormones (Hurley and Doane, 1989). When there is a Zn deficiency, research has shown that the amount of Zn found in the testis, epididymis and dorsolateral prostate are reduced (Millar *et al*., 1958).

Although, semen and its components are high in Zn, the link between semen quality and Zn is not completely apparent. The aim of this study was to evaluate the correlation between mineral concentration (cooper, zinc, calcium, sodium and potassium) of seminal plasma and spermatozoa motility rate in rooster.

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MATERIALS AND METHODS

For this study, 17 Indigenous broiler breeder Roosters with nearly the same weights (2 kg) were used. All roosters were maintained in enclosed houses and were fed with standard breeder diet (2700 kcal kg^{-1}, 13% protein, 1% calcium, 0.45% phosphorous). All males received 16 h light day^{-1} throughout the experiment. The roosters were trained to give semen 7 days before the collection began. Semen was collected by the abdominal massage method (Lake, 1957). Glass test tubes were used for semen collection. After exciting of roosters with abdominal massage, the male organ became swell and protrude outwards and downwards and white semen seen in the central furrow of the organ. The semen was milked down by firm finger pressure either side of the vent in to the collecting tube. If the semen which should be white was discolored due to contamination by fecal material or blood, it was useless and was eliminated.

The glass funnel was used for semen collection in some roosters that projected their semen. In beginning the study, semen collection was performed from all roosters for determine the progressive motility rates of spermatozoa. According to spermatozoa motility percent with 4 repeating in 3 days interval, roosters were classified to 3 treatment groups with low (5 roosters), moderate (7 roosters) and high (5 roosters) progressive motility percent. Modified Ringer's solution (sodium chloride: 68 g, potassium chloride: 17.33 g, calcium chloride: 6.42 g, magnesium sulphate: 2.5 g, sodium bicarbonate: 24.5 g, distilled water: 10,000 mL) was used as a diluent of semen for spermatozoa motility evaluations (Martin, 2004).

The temperature of dilution was about 15°C and this temperature was kept during the examination. For evaluation of motility, one drop of the diluted semen was placed on the slide and covered with glass cover. The sperm motility was estimated by microscopic observation (400× magnification). Motility was expressed as the percentage of motile spermatozoa with moderate to rapid progressive movement. At least 10 microscopic fields were examined for each sample. In second part of study, semen samples collected from each treatment group was pooled in glass tube without dilution.

Ejaculates were pipetted in to 1.5 mL micro centrifuge tubes and centrifuged in order to procure seminal plasma. Seminal plasma samples were frozen at -20°C for further analysis. Cooper, Zinc, Sodium, potassium and calcium concentrations in seminal plasma samples were determined on the atomic absorption spectrophotometer. Data were analyzed by using Statistical Program (SPSS, version 16). The correlation between spermatozoa motility with mineral concentration of seminal plasma were analyzed by one-way analysis of variance and subsequent Duncan's multiple comparison test (post-hoc). The results were given as Mean±SEM (Petrie and Watson, 2006).

RESULTS AND DISCUSSION

The correlation between mineral concentration (cooper, zinc, calcium, sodium and potassium) of seminal plasma with progressive spermatozoa motility rate in rooster is shown in Table 1. There was significant positive correlation between cooper and zinc concentrations of seminal plasma and progressive motility percent of spermatozoa ($p<0.05$). Therefore, with increasing the cooper and zinc concentrations of seminal plasma, the progressive motility percent of spermatozoa was also increased.

There was no significant correlation between sodium concentrations of seminal plasma and progressive motility percent of spermatozoa ($p>0.05$). The difference of potassium and calcium concentrations between low and medium progressive motility percent groups was not significant ($p>0.05$). For potassium concentration, there was significantly negative correlation between low/medium progressive motility rate groups and high motility group ($p<0.05$). While this correlation for calcium concentration was positive ($p<0.05$).

Because there were no available similar reports, the discussion of this study was difficult. In this study, cooper, zinc, sodium and potassium concentrations in seminal plasma of rooster ranged from 3.18±0.67-12.25±2.83, 1.84±0.17-5.86±0.83, 4.12±1.76-4.82±0.95 and 1.34±0.29-3.81±0.63, respectively, according to spermatozoa progressive motility percent. In other study, the concentrations of these elements in seminal plasma of rooster were 6.79±6.42, 5.25±1.96, 3.96±1.02 and 2.88±0.65, respectively (Massanyi *et al*., 2006). In this study, there was positive correlation between cooper and zinc concentrations of seminal plasma and progressive motility percent of spermatozoa. In study of Blesbois and Mauger

Table 1: The mineral concentrations of seminal plasma in groups with different progressive spermatozoa motility percent

	Sperm motility		
Parameters	Low	Medium	High
Sperm progressive motility (%)	52.26±3.12^{a}	70.43±3.85^{b}	84.52±4.49^{c}
Cooper concentration (μg mL^{-1})	3.18±0.67^{a}	7.24±1.24^{b}	12.25±2.83^{c}
Zinc concentration (μg mL^{-1})	1.84±0.17^{a}	3.47±0.26^{b}	5.86±0.83^{c}
Calcium concentration (μg mL^{-1})	5.21±1.04^{a}	5.47±0.92^{a}	10.11±2.36^{b}
Sodium concentration (μg mL^{-1})	4.29±1.33^{a}	4.12±1.76^{a}	4.82±0.95^{a}
Potassium concentration (μg mL^{-1})	3.64±0.54^{b}	3.81±0.63^{b}	1.34±0.29^{a}

Means within a row with different superscripts differ significantly ($p<0.05$)

(1989), there was no correlation between Zinc content of seminal plasma and spermatozoa motility. A selenoprotein contributes to the stability of spermatozoa therefore when there is a Se deficiency, the quality of the sperm is decreased (Barber *et al*., 2005). Surai (2000) reported that Se-dependent glutathione peroxidase is an essential component of the antioxidant system in avian semen.

CONCLUSION

In this study, the spermatozoa progressive motility percent of rooster semen can be affected with mineral concentration of seminal plasma Cooper, zinc.

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