Plasma Minerals Profile in delayed pubertal Surti buffalo heifers treated with GnRH alone and with Phosphorus

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Abstract

An experiment was conducted on eighteen delayed pubertal Surti buffalo heifers to evaluation of plasma minerals profile in buffalo heifers during augmenting reproductive efficiency through hormonal and non-hormonal regimens. The buffalo heifers in Group-I & Group-II were treated with Buserelin acetate (5 ml, IM). While buffalo heifers in Group-II also received additional injection of Toldimphos Sodium (10 ml, IM) at 3 day interval for 4 times and buffalo heifers in Group-III served as control. The conception rate was highest in Group-II (50%) followed by Group-I (33.33%). The mean plasma calcium, phosphorus, magnesium, zinc, iron and manganese differed non-significantly between and within the treated and control groups at pre treatment and on the day of estrus. While copper and cobalt values are differed significantly between the groups but not within the groups. Non-significant differences in various plasma minerals except copper and cobalt between and within treated and control groups at different time intervals might be due to better management practices at the organized farm of buffalo heifers especially maintained on optimum nutritional supplementation and healthcare strategies. Due to non-significant differences in various plasma minerals, it could not be possible to correlate with the conception and suggested that it might be due to gonadal and reproductive hormonal insufficiency.

Key words: Buffalo heifers; GnRH; Phosphorus; Macro and Micro-minerals

Introduction

The delay in puberty consequently delays conception and results in low reproductive efficiency and lengthening of the non-productive life. A major cause of delayed puberty may be poor feeding and management under field conditions (Warriach *et al.,* 2015). Nutritional factors needed for successful reproduction are the same as those needed for maintenance, growth and lactation, that includes protein, energy, mineral and vitamins, and deficiency or excess, any of these components, which are serious enough to affect reproduction will also affect other physiological functions. Lack of minerals and trace elements such as copper, cobalt, manganese, zinc, *etc.* upset the proper functioning of the genital organs. Trace elements may function as cofactors, as activators of enzymes or stabilizers of secondary molecular structure. Ruminants frequently are subjected to severe dietary deficiencies of trace elements such as copper, cobalt, selenium, iodine, manganese and zinc. Concomitant infertility is believed to be associated with enzymatic dysfunctions resulting from these deficiencies (Parmar *et al.,* 2015). Often correcting an imbalance in mineral levels can solve a nagging problem by improving reproductive performance and health (Kumar *et al.,* 2011). Hence, the aim of the present investigation was carried out to evaluation of the plasma macro and micro minerals profile in delayed pubertal Surti buffalo heifers during augmenting reproductive efficiency through hormonal and non-hormonal regimens.

Materials and Methods

The study was conducted on 18 delayed pubertal Surti buffalo heifers (4 to 7 years old having average body weight of 250 kg) maintained at Livestock Research Station, Navsari Agricultural University, Navsari. They were then randomly divided into 3 equal groups each of 6 buffalo heifers. The buffalo heifers in Group-I & Group-II were treated with 5 ml i/m Buserelin acetate, a GnRH agonist (Gynarich, Intas Pharmaceuticals Limited, India). While buffalo heifers in Group-II also received additional injection of 10 ml i/m Toldimphos Sodium, a phosphorus preparation (T-phos, Zydus Animal Health Limited, India) at 3 day interval for 4 times and buffalo heifers in Group-III served as control. The buffalo heifers exhibiting estrus were bred either naturally or by using artificial insemination. The buffalo heifers which did not return to estrus following breeding were confirmed for pregnancy per-rectum 60 days later. The blood samples were collected in EDTA vial from each animal on 0 day (before treatment) and on the day of estrus exhibition. Blood plasma was separated immediately by centrifugation for 15 minutes at 2000 rpm. Plasma samples were stored at -20°C till analyzed for biochemical parameters. Estimation of calcium, phosphorus and magnesium were done using assay kits and procedure of Randox Laboratories Limited, United Kingdom. The levels of trace minerals, *viz.* copper, cobalt, zinc, iron and manganese were determined according to the method of Krishna and Ranjhan (1980). The data collected were suitably tabulated and analyzed following standard statistical methods of ANOVA and Duncan's new multiple range tests as shown by Steel and Torrie (1981).

Result and Discussion

The conception rate in Group-I, II and III were 33.33 per cent (2/6), 50.0 per cent (3/6) and 0.0 percent (0/6), respectively. The present findings were in agreement with Verma *et al.* (2010). Whereas Ghuman *et al.* (2009) reported lower conception rate in heifers than the present study and stated that the ovarian response to exogenous GnRH in heifers is poorer than that of cows. In the present study, lower conception rate might be due to failure of the hypothalamus to produce sufficient quantities of GnRH to cause gonadotropin release is known to be the major factor limiting delayed pubertal heifers. In Group-III, none of the buffalo heifers were conceived during the period of study might be suggested that insufficient secretions of GnRH from the hypothalamus resulted into inadequate release of FSH and LH hormones from the pituitary gland leads to lower synthesis of reproductive steroid hormones and cessation of reproductive cycle.

Macro-Minerals Profile

The mean plasma calcium levels presented in table did not differ significantly between and within the groups at any time intervals. The findings are in agreement with Ahmed *et al.* (2010) and Parmar *et al.* (2012), observed non-significantly higher mean plasma calcium concentration at induced estrus than pre-treatment for GnRH. Whereas, lower calcium level than present findings reported by Naidu *et al.* (2009) and Kumbhar *et al.* (2014). In contrast, higher mean plasma calcium level reported by Srivastava *et al.* (1981) and Paul *et al.* (2000). Calcium sensitizes the tubular genitalia for the action of hormones and lack of minerals especially calcium and phosphorus upset the proper functioning of the genital organs (Acharya, 1960).

The mean plasma levels of magnesium did not shown significant difference between and within the groups at various intervals. The present non-significant differences observed in plasma magnesium profile corroborated with the reports of Sharma *et al.* (1999), Paul *et al.* (2000) and Prajapati (2011). The present findings on magnesium levels are in close agreement with Takkar *et al.* (1982) in buffalo heifers while in contrary low level of magnesium reported by Khasatiya *et al*. (2005).

The mean plasma phosphorus concentrations were apparently higher in Group-II as compared to Group-I and Group-III on the day of estrus might be due to administration of phosphorus injection in Group-II resulted into apparently higher values after treatment. But statistically mean values of phosphorus levels did not showing significant differences between and within the treatment and control groups. The present findings corroborated with the reports of Kumbhar *et al.* (2014) in Marathwadi buffalo heifers. A lower phosphorus levels were reported by Naidu *et al.* (2009) and Ahmed *et al.* (2010). In contrary higher phosphorus level reported by Khasatiya *et al.* (2005), Paul *et al.* (2000) and Prajapati (2011). Non-significant increased plasma inorganic phosphorus levels at induced estrus than their pre-treatment levels in Group-II might be due to supplementation of chelated mineral mixture and injection of tonophosphan to the buffalo heifers. Hurley *et al.* (1980) suggested that the fertility of the animals tended to be reduced if the inorganic phosphorus level falls, while increased blood phosphorus level was related to the improvement of ovarian activity.

Micro-Minerals Profile

The perusal of data as in table 1 does not reveal significant differences in plasma zinc profile between and within the different groups at any time intervals. The mean plasma zinc levels remained similar to the observations reported by Paul *et al.* (2000) and Ahmed *et al.* (2010). Higher zinc levels than the present study was reported by Dutta *et al.* (2001), Hedaoo *et al.* (2008) and Sharma *et al.* (2010). Significantly lower levels of zinc was reported by Jain and Madan (1984), while non-significant differences were observed by Dabas *et al.* (1987) and Sharma *et al.* (1999). A reduction in zinc level might interfere with prostaglandin receptor mediated phase and consequently the luteolytic process (Parmar *et al.,* 2015).

Table 1: Macro-minerals (Calcium, Phosphorus and Magnesium, mg/dl) and Micro-minerals (Zinc, Copper, Cobalt, Iron and Manganese, ppm) profile in Surti buffalo heifers before treatment and at the time of estrus in different groups (Mean ± SEM)

Minerals / Time intervals	Group-I	Group-II	Group-III	Overall
Calcium				
Pre-treatment	10.94 ± 0.88	10.84 ± 0.70	10.59 ± 0.30	10.79 ± 0.36
At estrus	11.05 ± 0.92	11.28 ± 0.55	10.74 ± 0.41	11.07 ± 0.40
Phosphorus				
Pre-treatment	5.52 ± 0.43	5.00 ± 0.50	5.04 ± 0.23	5.18 ± 0.22
At estrus	5.33 ± 0.51	5.70 ± 0.42	4.94 ± 0.20	5.38 ± 0.25
Magnesium				
Pre-treatment	3.44 ± 0.32	3.44 ± 0.18	3.82 ± 0.82	3.57 ± 0.12
At estrus	3.64 ± 0.25	3.66 ± 0.14	3.72 ± 0.37	3.67 ± 0.12
Zinc				
Pre-treatment	1.21 ± 0.04	1.24 ± 0.07	0.93 ± 0.04	1.13 ± 0.04
At estrus	1.24 ± 0.03	1.29 ± 0.02	1.08 ± 0.03	1.20 ± 0.03
Copper				
Pre-treatment	1.13 ± 0.05^{a}	1.00 ± 0.05^{b}	1.16 ± 0.08^{a}	1.09 ± 0.04
At estrus	1.00 ± 0.01^{b}	1.16 ± 0.05^{a}	1.09 ± 0.06^{b}	1.08 ± 0.03
Cobalt				
Pre-treatment	1.47 ± 0.07^{ab}	1.54 ± 0.03^{a}	1.52 ± 0.04^{b}	1.51 ± 0.03
At estrus	1.43 ± 0.01^{ab}	1.54 ± 0.05^{b}	1.56 ± 0.05^{a}	1.50 ± 0.03
Iron				
Pre-treatment	0.93 ± 0.04	0.84 ± 0.06	0.73 ± 0.11	0.83 ± 0.05
At estrus	1.15 ± 0.03	1.12 ± 0.19	1.10 ± 0.39	1.12 ±0.10
Manganese				
Pre-treatment	0.47 ± 0.02	0.49 ± 0.02	0.50 ± 0.01	0.49 ± 0.01
At estrus	0.47 ± 0.01	0.53 ± 0.04	0.47 ± 0.02	0.49 ± 0.02

Group-I = GnRH alone, Group-II = GnRH + Phosphorus, Group-III = Control.
Means bearing different superscripts within a row (a,b) differ significantly ($p < 0.05$).

The mean plasma levels of copper presented in table 1 show significant difference between the groups but not within the groups. The present significant differences observed in plasma copper profile corroborated with the reports of Dabas *et al.* (1987), Sharma *et al.* (1999) in anoestrus buffalo-heifers. In contrary non-significant differences were reported by Jain and Madan (1984). The present findings on copper levels are in agreement with Hedaoo *et al.* (2008) and Naidu *et al.* (2009) in Murrah buffalo heifers. Higher copper levels were reported by Dutta *et al*. (2001) and Sharma *et al.* (2010), while lower copper level reported by Paul *et al.* (2000) and Sharma *et al.* (2005). Copper levels appear to be influenced by hormones of reproduction; the higher serum copper level indicated higher estrogenic and lower FSH and LH activity (Parmar, 2015).

The mean plasma cobalt values presented in table 1 differed significantly between the groups but not within the groups. A lower level of cobalt levels were reported by Sharma *et al*. (2005) and Hedaoo *et al.* (2008), while higher level of cobalt was reported by Sharma *et al.* (2010) in the GnRH treated buffaloes. Cobalt has been found to be required in the synthesis of vitamin B_{12} and its deficiency has been associated with non-functional ovaries (Parmar *et al.,* 2015).

The plasma levels of manganese presented in table did not differ significantly between and within the groups at any intervals. The present non-significant differences observed in plasma manganese profile corroborated with the reports of Jain and Madan (1984). The mean plasma manganese levels remained similar to the observations recorded by Dutta *et al*. (2001) in anoestrus heifers. Lower level of manganese was reported by Chandolia *et al.* (1987) while in contrary higher level of manganese reported by Sharma *et al.* (2010).

The perusal of data as tabulated does not reveal significant differences in plasma iron profile between and within the different groups at any time intervals. The present non-significant differences observed in plasma iron profile corroborated with Jain and Madan (1984) and Sharma *et al.* (1999). The present findings on iron values are in agreement with Kumbhar *et al.* (2014) and Hedaoo *et al.* (2008). Many earlier workers have reported that mean iron level was higher as compared to present findings (Dutta *et al*., 2001; Paul *et al.*, 2000; Sharma *et al*., 2005 and Sharma *et al.*, 2010). A low level of iron could possibly result in improper oxygenation of uterus resulting in impaired nutrition in the uterus for the conceptus causing death of the embryo (Parmar, 2015).

Conclusion

The present study could not find significant differences in various plasma minerals except copper and cobalt between and within treated and control groups at different intervals which might be due to better managemental practices at the organized farm of Surti buffaloes especially maintained on optimum nutritional supplementation and healthcare strategies. Due to non-significant differences in various plasma minerals, it could not be possible to correlate with the conception and suggested that it might be due to gonadal and reproductive hormonal insufficiency.

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