

SERUM TRACE MINERALS AND HORMONES LEVEL IN PLASTIC CONSUMED COWS

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SUMMARY

The objective of this research was to assess serum zinc, selenium, progesterone, triiodothyronine, thyroxin level in plastic grazing cows. Cows consuming plastic were selected and randomly divided into three groups, Group-II (Cyclic), Group-III (non-cyclic), Group-IV (Pregnant) and Control (Group-I). Rumenotomy was performed aseptically in treatment group. Significantly higher level of serum zinc was observed in cows from control group before and after treatment than in plastic consuming cows from other groups. Significantly higher serum selenium levels were recorded in cows from control group than other groups. Serum progesterone concentration did not differ significantly between all groups before and after treatment. In the cows from control group, Triiodothyronine level differs significantly while thyroxin hormone concentration cows did not show any significant difference than in remaining groups.

Keywords: Hormones, Inadvertent cows, Trace minerals

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In urban areas, cattle are on the streets throughout the year due to lack of space and high cost of feed. Cattle do not sort their feed fastidiously. This leads to the ingestion of both penetrating and non-penetrating foreign bodies. Plastics were the most common non - penetrating foreign body. Thus the ingested plastic materials result in conditions like chronic recurrent bloat and impaction. Apart from occupying space, these non- penetrating foreign bodies remain in the rumen and interfere with the absorption of key minerals of reproduction. Physiological consequences of these plastic born endocrine disturbing chemical (EDC) ingestion in farm animals were largely unknown. Many EDC are lipophilic and so associate with fat depots in exposed animals (Nimrod and Benson, 1996). EDC binds to the estrogen, androgen or other receptors, where it can act on endogenous steroids. Alkylphenols, Polychlorinated biphenyls (PCB) and organochlorine pesticides operate by this mechanism. The degree of affinity for the receptors is variable but is always much lower than the affinity of natural steroids by a factor of 100 to 10,000 (Dodge, 1998).

Female reproductive function can be compromised by exposure to toxic chemicals at a variety of sites, including the hypothalamus, pituitary, ovary or reproductive tract (Bretveld *et al.*, 2006). Disruption of any of these sites can ultimately manifest as a disruption of ovarian function, resulting in infertility. This study was undertaken to estimate the concentration of trace minerals like zinc and selenium which has role in reproductive hormone metabolism and reproductive hormones like progesterone, triiodothyronine (T3) and thyroxin (T4) in plastic

consumed cows before and after rumenotomy.

Cows consuming plastic were identified in and around Nagpur city by performing per-rectal examination for ascertaining the presence of plastic and subsequently their reproductive status. A total of 18 cows were selected and randomly divided into three groups, Group-II (Cyclic) (n=6) on the basis of presence of any palpable structure on the ovarian surface and Group-III (n=6) on the basis of absence of any palpable structure on the ovarian surface by per rectal examination. The pregnant cows were considered as Group-IV. Cows in confinement, having no history of plastic consumption were grouped as Control (Group-I) (n=6). To remove the impacted plastic-non penetrating foreign body material from the rumen, rumenotomy was performed aseptically as per the standard procedure and the plastic materials were removed.

Trace minerals – Selenium and Zinc levels in serum were estimated by using atomic absorption spectrophotometer (AAS). Progesterone, Triiodothyronine (T3) and Thyroxine (T4) hormone concentrations in the serum were estimated by Radio Immuno Assay (RIA) technique using standard diagnostic kits (Immunotech, France).

After removal of the impacted plastic material, fresh ruminal cud was transferred to the rumen supported with suitable fluid therapy, antibiotic coverage. The mineral mixture was fed 1 month before and after rumenotomy. In all the groups for estimating serum zinc, selenium, progesterone, triiodothyronine (T3) and thyroxin (T4) blood samples were collected.

In Group-I cows, (Control) had significantly higher (P<0.01%) level of serum zinc level (8.64±0.41 and

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8.92±0.40 ppm) in cows consumed plastic. The corresponding value in Group II, II and IV were (4.80±0.37 and 4.03±0.36 ppm), (2.99±0.46 and 2.53±0.40 ppm) and (5.34±0.63 and 4.97±0.68 ppm), respectively (Table 1). In cows consumed plastic, serum zinc level shows significant decrease than the control group of cows. Low zinc level noted was in agreement with in cattle with foreign body rumen impaction which ascribed to the effects of stress, infection, water deprivation and feed restriction. Our findings were in complete accordance with (Akinrinmade and Akinrinde, 2012) whereas zinc level as noted in the present study in Group IV cows was comparatively lower than the level reported by (Cortinhas *et al.*, 2012) in normal pregnant cows which may be attributed to the factors in this experiment.

Table 1. Mean (±SE) serum zinc level (ppm) in plastic consumed cows

Sr. No.	Treatment Group	Before	After
1.	Group-I (Control)	8.64±0.41 ^a	8.92±0.40 ^a
2.	Group-II (Cyclic)	4.80±0.37 ^b	4.03±0.36 ^b
3.	Group-III (Non Cyclic)	2.99±0.46 ^c	2.53±0.40 ^c
4.	Group-IV (Conceived)	5.34±0.63 ^b	4.97±0.68 ^b

Significantly higher (P<0.01%) serum selenium levels were recorded in cows from Group-I (67.84±6.01 and 67.93±4.89 ppm) than the cows of Group-II (39.53±4.38 and 38.16±3.91 ppm), Group-III (8.99±1.47 and 7.34±1.19 ppm) and Group-IV (33.78±3.85 and 26.82±3.02 ppm) plastic consuming cows before and after treatment, respectively (Table 2). However, the observations on concentration of selenium by Akhtar *et al.* (2009) in cyclic buffaloes were comparatively lower.

Table 2. Mean (±SE) serum selenium level (ppm) in plastic consumed cows

Sr. No.	Treatment Group	Before	After
1	Group-I (Control)	67.84±6.01 ^a	67.93±4.89 ^a
2	Group-II (Cyclic)	39.53±4.38 ^b	38.16±3.91 ^b
3	Group-III (Non cyclic)	8.99±1.47 ^c	7.34±1.19 ^d
4	Group-IV (Conceived)	33.78±3.85 ^b	26.82±3.02 ^c

Serum progesterone concentration (ng/ml) differs non significantly between Group-I, Group-III and Group-IV before and after treatment respectively (Table 3) and was comparable with the earlier findings of Kohan-Ghadra *et al.* (2011) at day 80 before parturition in cattle and Ginther *et al.* (2013) in cattle heifers. Cows from Group-II, III and IV had rumen impacted with plastic material, thus resulting in to reduced feed and fodder intake. Fall in zinc level was associated with fall in steroid hormone concentrations which indicated that there was some correlation between plasma zinc levels and progesterone-

estrogen levels which is necessary for proper reproductive performance (Akhtar *et al.*, 2009.).

Table 3. Mean (±SE) serum progesterone concentration (ng/ml) in plastic consumed cows

Sr.No.	Treatment group	Before	After
1	Group-I (Control)	2.21±0.70	2.10±0.69
2	Group-II (Cyclic)	2.40±0.65	1.59±0.56
3	Group-III (Non Cyclic)	1.21±0.21	1.98±0.60
4	Group-IV (Conceived)	7.42±6.12	1.49±0.31

Serum triiodothyronine (T3) (nmol/L) concentration (0.93±0.09 and 1.72±0.54 nmol/L) in Group-I differed significantly (P<0.05%) and among the remaining treatment group. The corresponding values in plastic consumed cows in Group-II, III and IV were (1.20±0.01 and 0.76±0.14 nmol/L), (0.67±0.14 and 0.63±0.22 nmol/L) and (0.74±0.15 and 0.66±0.17 nmol/L) before and after treatment, respectively (Table 4). Also post operatively, it was observed that the serum triiodothyronine hormone concentration decreased and this observation was comparable with the earlier findings of Gueorguiev (1999) in dairy cows during lactation.

Table 4. Mean (±SE) serum triiodothyronine (T3) (nmol/L) hormone concentration in plastic consumed cows

Sr.No.	Treatment Group	Before	After
1	Group-I (Control)	0.93±0.09 ^{ab}	1.72±0.54
2	Group-II (Cyclic)	1.20±0.01 ^a	0.76±0.14
3	Group-III (Non cyclic)	0.67±0.14 ^b	0.63±0.22
4	Group-IV (Conceived)	0.74±0.15 ^b	0.66±0.17

In the present study, it was observed that the mean thyroxine hormone concentration (nmol/L) in Group-I (13.33±6.42 and 19.33±7.02 nmol/L) which did not differ significantly than it in Group-II, III and IV cows consumed plastic before and after treatment (Table 5). Plastic originated PCBs can reduce circulating levels of T4 in animals (Zoeller *et al.*, 2000) which was in agreement with the findings of present study. Many chemicals were known to decrease the serum half-life of T4 by inducing liver enzymes that glucuronidase T4 (Tseng *et al.*, 2008). Serum thyroxine hormone concentration was comparable to the level as recorded by Gueorguiev (1999) in dairy cows.

Rumenotomy was performed to remove the impacted plastic materials and fresh ruminal cud was transferred to the rumen along with fluid therapy,

Table 5. Mean (±SE) serum thyroxine (T4) (nmol/l) hormone concentration in plastic consumed cows

Sr. No.	Treatment Group	Before	After
1	Group-I (Control)	13.33±6.42	19.33±7.02
2	Group-II (Cyclic)	24.33±4.99	15.33±5.38
3	Group-III (Non Cyclic)	7.33±4.75	15.33±6.86
4	Group-IV (Conceived)	19.33±14.76	14.00±6.32

antibiotic coverage and mineral mixture supplementation to these cows. Two months after the removal of plastic materials from rumen and treatment marked improvement was observed in the general health and reproductive status of these animals. The impacted ruminal mass of non penetrating foreign body in the form of consumed plastic material would have interfered with the normal ruminal motility, leaving no space for the feed stuff to undergo fermentation and further absorption of nutrients thus affecting the absorption of key trace minerals which has role in the reproductive hormone metabolism (Reddy *et al.*, 2004; Vanitha *et al.*, 2010) in cows. Boodur *et al.* (2010) was of the opinion that the removal of plastics from the rumen was not enough but restoration of the normal rumen ecology was important for speedy recovery of animals after rumenotomy.

CONCLUSION

Presence of impacted plastic, a non penetrating foreign body in the rumen of cyclic, non-cyclic and conceived cows exerts adverse effect on the absorption of zinc and selenium and thereby interferes with reproductive hormone metabolism in cyclic, non-cyclic and pregnant cows thereby may be responsible for reproductive performance of cows.

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