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EFFECT OF SUPRA-NUTRITIONAL SUPPLEMENTATION OF IODINE AND SELENIUM ON THYROID FUNCTION IN WEANED CROSS BRED CALVES

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ABSTRACT

The study was conducted to assess the thyroid function and growth in 24 crossbred female calves of three to four months of age on dietary supplementation with selenium and iodine. The animals were randomly allocated to four groups (G_0, G_1, $G_2$and G_3) with six animals in each group and were subjected to four dietary treatments as G_0 (calf starter), G_1 (calf starter + 0.3 ppm Se), G_2 (calf starter + 1pm KI) and G_3 (calf starter + 0.3ppm Se + 1ppm KI) or a period of 90 days. Blood and serum samples were collected on 0, 30, 60 and 90 days of the experiment. Triiodothyronine (T_3) level remained elevated in G_1 (0.3 ppm Se) after one month of selenium supplementation and continued till the end of the experiment. Throughout the study, thyroxine (T_4) concentration was significantly higher in G_2 (1 ppm KI) animals. The results of the study revealed that dietary supplementation of Se (0.3ppm) could improve the thyroid function of crossbred calves after weaning. Supplementation of KI (1ppm) alone or in combination with organic Se (0.3 ppm) did not significantly improve the thyroid function in weaned cross bred female calves.

Key words: Supra - nutritional supplementation post weaned calves, thyroid function

INTRODUCTION

Economically viable and sustainable dairy farming always necessitates adequate management practices to optimize physiological functions. The maximum exploitation of the genetic potential of the

Part of MVSc thesis of the first author

animal requires sufficient physiological back up supported by nutrition and management. This is especially important both in the prenatal and neonatal stages of the growing animal, since the foundation for the future production are laid in these stages. After birth, weaning becomes a potential source of stress for the calf. At this stage of life, if the calf is not well supported nutritionally or well protected from stress, this could have potential adverse implication for the immune status and consequent growth of the animal. So, any steps taken to improve calf welfare at weaning will also improve the lifetime performance of the animal and boost enterprise profitability.

Thyroid hormones are the most important metabolic hormones for the maintenance of homeostasis. Virtually every tissue in the body is affected either directly or indirectly by thyroid hormone in many ways. It is an important regulator of the rate of oxygen consumption and energy expenditure during resting conditions of tissues. Thyroid hormone increases the general metabolic rate and also modulates the rates of many specific reactions involved in fuel metabolism. It acts permissively in concert with other hormones in stimulating the growth process and plays a vital role in the development of nervous system. So the normal central nervous system activity and behavioural regulation are also considered as thyroid functions. Apart from these, thyroid hormones are also important in the development of reproductive system and reproductive functions. So, assessment of thyroid function in animals is considered as the best indicator of their physiological well-being.

The basic ingredients of thyroid hormones synthesis are tyrosine and iodine. The amino acid tyrosine is synthesized in sufficient amounts by the body, so it is not an essential dietary requirement. The iodine (I) needed for thyroid function must be obtained from dietary intake. Along with iodine, trace mineral selenium (Se) also play a crucial role in thyroid function. Being an integral part of the enzyme deiodinase, Se has a vital role in activating the hormone thyroxine (T_4) to its metabolically active form triiodothyronine (T_3). According to Arthur *et al.* (1988), deficiency of Se produced imbalances in the metabolism of thyroid hormones in cattle. Arthur *et al.* (1993) also reported that, in Se deficient rats there was decreased conversion of T_4 to T_3 in the tissues containing type I and type II deiodinases. Zagrodzki *et al.* (1998) observed that, in iodine deficient cows and calves thyroidal type I deiodinase and cytosolic glutathione peroxidase (GSH-Px) activities were increased as a compensatory mechanism for T_3 production. This study was undertaken to assess the impact of

selenium supplementation on thyroid function in crossbred female dairy calves of Kerala in the post weaning period.

MATERIALS AND METHODS

Twenty four weaned crossbred female calves of three to four months of age were selected from University Livestock Farm and Fodder Research Development Scheme, College of Veterinary and Animal Sciences, Mannuthy and Cattle Breeding Farm, Thumburmuzhi as the experimental animals. The calves were divided into four groups of six each and were allocated randomly to one of the four dietary treatments, **G_0** (calf starter), **G_1** (calf starter + 0.3 ppm of organic Se), **G_2** (calf starter + 1 ppm of potassium iodide) and **G_3** (calf starter + 0.3 ppm organic Se + 1 ppm potassium iodide). The calves were dewormed a week before the start of the feeding trial. Calves were fed as per ICAR standard (Ranjhan, 1998) and maintained on their respective feeding regime for a period of three months.

Blood samples were collected into vacutainers from all the animals by jugular vein puncture at 0, 30, 60 and 90 days of the experiment and serum was separated. Thyroid hormones (T_3 and T_4) were determined by radioimmunoassay using BRIA MAG 4 kit supplied by Board of Radiation and Isotope Technology, Mumbai, India, under gamma counter (Perkin Elmer model Wizard).

RESULTS AND DISCUSSION

On 30th day of experiment there was increase ($P \leq 0.01$) in serum T_3 concentrations (ng/mL) of G_1 when compared to G_0, G_2 and G_3 with the mean values of 1.20 ± 0.03, 0.71 ± 0.05, 0.72 ± 0.04 and 0.69 ±0.04 respectively (Fig.1).

On 60th and 90th day of experiment same trend was observed as that of 30th

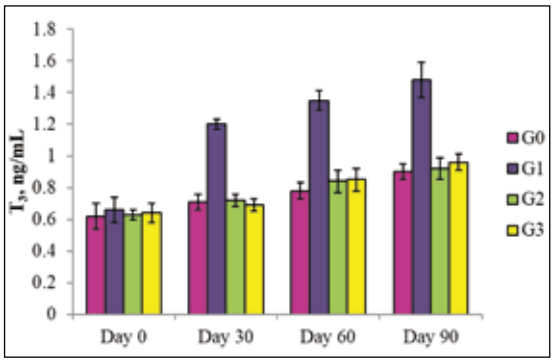

Fig. 1. Serum triiodothyronine (T_3) concentrations of experimental animals of different groups on different days, ng/mL

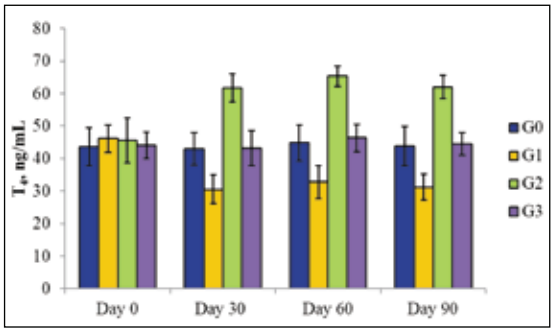

Fig. 2. Serum thyroxine (T_4) concentrations of experimental animals of different groups on different days, ng/mL

day with a significant (P≤0.01) increase in serum T_3 concentrations of G_1 calves when compared to G_0, G_2 and G_3 as depicted in Fig. 1.

On 30th day of the study, mean T_4 concentrations (ng/mL) was higher (P≤0.01) in G_2 compared to G_0, G_1 and G_3 with the mean values of 61.83 ± 4.3, 42.96 ± 5.0, 30.59± 4.5 and 43.28 ± 5.4 respectively (Fig. 2).

On 60th and 90th day of the study, similar pattern was observed as that of 30th day with significant (P≤0.01) increase in T_4 concentrations (ng/mL) of G_2 when compared to G_0, G_1 and G_3 (Fig. 2).

Supplementation of Se significantly increased the T_3 concentrations of calves throughout the experiment. Wichtel *et al.* (1996a) also found that intraruminal supplementation of Se pellets in calves increased the basal plasma concentration of T_3 and reduced the basal plasma concentration of T_4. Vara *et al.* (2009) opined that supplementation of Se yeast (0 and 0.3 mg/day/head) to finishing lambs increased the plasma T_4 and T_3 concentrations. Rose *et al*. (2012) reported that supplementation of 1000 mg Se as rumen bolus in dry dairy cows increased the free T_3 and T_4 in dams (P ≤ 0.01). However, it had no effect on thyroid hormone levels in the calves. Contrary to the present results, Kumar *et al.* (2009) reported that Se feeding @ 0.15 mg /kg of dry matter either from inorganic or organic source had no effect on the level of thyroid hormones in lambs. Increase of T_3 in the present study might be due to efficient conversion of T_4 to T_3 by type I deiodinase (selenoenzyme).

In the current study, supplementation of I to calves caused increase in T_4 levels but T_3 levels were not significantly altered. This is in accordance with the findings of Qin *et al.* (2011), who reported that supplementation of I increased T_4 levels in Liaoning Cashmere goats. Nudda *et al.* (2013) reported that supplementation with two varying doses of I in goats increased serum T_3 and T_4 concentrations in animals supplemented with the higher dose. Contrary to all these studies, Pavlata *et al.* (2005) reported no significant differences in T_3 and T_4 concentrations of kids supplemented with I. Increased T_4 concentration in the present study might be due to increased serum I concentration and I uptake by thyrocytes following I supplementation.

Combined supplementation of I and Se did not produce any effect on T_3 and T_4 levels of experimental animals. This is in line with the findings of Wichtel *et al.* (1996b), who detected supplementation of

Se and I in combination had no effect on T_3 and T_4 concentrations of Angora goats. Guyot *et al.* (2011) reported increased T_3 and T_4 concentrations in calves born to the dams supplemented with higher doses of I and Se and also that the hormone levels were unaffected in the supplemented dams. The absence of impact on thyroid hormones by supplementing I and Se in combination might be due to functional antagonism of these minerals on thyroid hormones and further studies are required to detect the antagonistic effect of these minerals.

SUMMARY

The supra-nutritional supplementation of Se and I in cross bred female calves during the post weaning period was found to affect the thyroid function significantly. When Se alone was fed to the animal there was significant increase in the level of T_3 hormone without affecting T_4 levels indicating an increased efficiency of hormone function. Whereas, in the case of I supplementation no significant increase in T_3 could be detected, though T_4 levels were found to be increased. Combined supplementation of these trace minerals did not produce any significant response in hormonal function. So, it can be inferred that supplementation of selenium is a better option for improving the thyroid function in calves during the periods of physiological stress.

Ethics statement: This study does not involve animal experimentation and was conducted on farm animals, following standard operating protocols of animal handling and sample examination, upon informed consent of owners.

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