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GROWTH PERFORMANCE AND HORMONAL PROFILE OF NEWBORN CALVES AFTER PRE-PARTUM SELENIUM INJECTION OF THEIR DAMS

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Abstract

Ten Friezian cows at late stage of gestation were intramuscularly injected with 100 mg of selenium as sodium selenite at a rate of two doses with one week in-between. Seven pregnant animals were left without treatment as controls. Weight of their calves at birth and every week for 15 week were recorded, and blood samples on 1,10, 20, 30 & 40 days post-natal were taken for hormonal analysis. Selenium supplementation improved the live body weight of calves with a mean 10.7 Kg extra gain and a mean 13..74% faster growth rate at the end of experimental period. The overall mean of weight gain and relative growth rate of calves per week were significantly increased (4.24 vs. 3.64 kg and 8.42 vs. 7.84%, respectively). Serum growth hormone (total, free and binding forms), prolactin (total and binding forms) and thyrotrophic hormone of one day old calves were significantly increased after dam supplementation. Furthermore, selenium exerted its favourable effect on growth hormone and thyrotrophic hormone up to 40 days post-natal.

INTRODUCTION

Calves in Egypt are encountered with several problems that may interfere with their physiological parameters and equilibrium. Morbidity and mortality rates are higher in new-born animals than in any other age group, and prevention of losses among them assumes special importance. Most of such losses are caused by faults in management of dams at late stage of gestation, and cannot be considered as due to diseases. These congenital defects may be caused by deficiencies of specific nutrients in the diet of dams, particularly trace elements. Selenium administration during late pregnancy of dams has been recommended in order to reduce the risk of nutritional muscular dystrophy and the resultant high mortality rate in young calves in selenium-deficient areas (Awad *et al.*, 1985). Selenium-responsive unthriftiness is characterized by inability of calves to maintain optimum growth rate, which is probably widespread and economi-

cally significant in apparently normal animals (Blood *et al.*, 1983).

The objective of the present study is to evaluate the effect selenium injection of cows during the last month of pregnancy on the growth rate of new-born calves and on their metabolic hormones.

MATERIALS AND METHODS

The experiment was carried out on 17 Friezian cows in Breeding station at Sakha, Kafr El-Sheikh province, Animal Production Research Institute. The animals were 5-8 years old in late stage of pregnancy and calved during the period from August to November. They were tied in open shed and fed on ration consisted of concentrates and rice straw. The concentrates contained 65% cotton seed cake, 20% wheat bran, 12% rice polish bran, 2% lime and 1% common salt. Green corn (Darawa), when available, was offered to these animals during this period. Ten animals were i.m. injected with 100 mg selenium as sodium selenite, at a rate of two doses with one week in between. Seven animals were left without treatment as control cases.

Weight of calves at birth and every week for 15 weeks were registered for calculation of the weight gain and relative growth rate per week. Blood samples were collected at 11 O'Clock A.M., from new-born calves on 1, 10, 20, 30 & 40 days postnatal.

Blood serum samples were assayed for growth hormone (STH), prolactin (PRL) and thyrotrophic hormone (TSH), by using immunoassay method (agglutination inhibition test) according to Wide (1962) and Schuurs (1969), as described by El-Ghandour (1985). The test depends upon the ability of hormone to neutralize its specific rabbit antisera and thus, inhibits the tendency of hormone sensitized sheep red blood cells to be agglutinated by the antisera. STH and PRL were received from the National Institute of Arthritis, Diabetes, Digestive and Kidney Diseases (NIADDK, USA), and TSH was offered by Aboul-Ela (1983), who prepared it from the pituitaries. Their antisera were prepared according to the procedure mentioned by Tadeusez (1974). The serum protein binding potency to STH or PRL was estimated by using the direct agglutination test (El-Ghandour, 1985) which depends upon evaluation of the serum hormone levels before and after the addition of its specific coated sheep red cells. The obtained titres were compared with the standard log-dose response curve of each hormone against their corresponding titres.

The data were statistically analysed according to Snedecor and Cochran (1973).

RESULTS

The weekly live body weight, weight gain and relative growth rate of calves were presented in Table 1 and figure 1. The birth weight of calves was not significantly affected after pre-partum selenium injection of their dams, while, the effects on live body weight, weight gain and relative growth rate were significantly obvious after 5 weeks post-natal at different intervals. The overall mean of weight gain and relative growth rate per week during the experimental period (1-15 weeks post-natal) were significantly increased (4.24 vs. 3.64 kg & 8.42 vs. 7.84%, respectively).

Serum hormonal profile of calves during 40 days post-natal were recorded in Table 2. A significant increase of serum STH (free, total and binding forms) were noticed in calves during the different post-natal periods after selenium supplementation of their dams. Seum PRL levels (total and binding forms)were fluctuated significantly during the post-natal period, while, the free form was stable within a limited range (0.15-0.59 IU/ml) in both supplemented and control cases. Thyrotrophic hormone level was increased significantly within a range between 3.71-6.43 CU/ml due to supplementation, as compared with the unsupplemented cases (2.42-3.12 CU/ml), with significant variations on 1, 10 & 30 days post-natal.

DISCUSSION

Selenium supplementation of dams during the last month of pregnancy showed a significant improvement in growth performance of calves (Table 1 & figure 1), while, the birth-weight didn't reflect this effect. Perry *et al.* (1978) recorded the same approach after selenium supplementation of dams at a rate 1, 2 or 5 mg per cow daily starting 90 days pre-partum (35,32 &37 kg birth-weights respectively, compared with 38 kg in unsupplemented cases). On the contrary, Awad *et al.* (1985) demonstrated a trend in favour of heavier birth weight of calves delivered from supplemented buffaloes. On the other hand, Gitter *et al.* (1978) reported a significant decrease of birth weight of calves of selenium deficient dams.

In the present study, the effect on live body weight, weight gain and relative growth rate were more obvious after 5 weeks post-natal. During this period, the animals turned out to pasture, which was considered as a critical time for animal selenium status (Prospova *et al.*, 1982, Gleed *et al.*, 1983,Cagnasso *et al.*, 1984 and Pehrson and Johnsson, 1985 b). The prolonged effect of selenium supplementation (15 weeks) was confirmed by Pehrson and Johnsson (1985 a), who mentioned that, oral adminis-

Table 1. Average live body weight, weight gain and relative growth rate of calves delivered from supplemented and unsupplemented dams with sodium selenite, during different post-natal periods (0-15 weeks).

Growth performance	Post-natal period (week)																The over-all mean per week
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Live body Weight (kg) Supplemented	27.60 ± 0.686	29.5 ± 0.749	31.90 ± 0.809	34.50 ± 0.969	37.40 ± 1.185	40.60 ± 1.392	44.80 ± 1.474	48.80* ± 1.504	53.00* ± 1.506	58.13* ± 1.941	63.38* ± 1.908	69.13** ± 1.931	75.00** ± 1.964	80.38** ± 2.095	83.60* ± 2.517	90.30* ± 2.445	-
Control	26.71 ± 1.190	28.00 ± 1.000	30.14 ± 0.962	32.43 ± 0.896	35.00 ± 0.926	38.57 ± 0.997	41.86 ± 0.986	45.57 ± 0.812	49.57 ± 1.192	52.71 ± 1.554	57.57 ± 1.645	61.71 ± 1.728	65.14 ± 2.415	68.71 ± 3.137	73.29 ± 36.17	78.71 ± 4.341	-
Body weight gain (kg) Supplemented	-	1.90 ± 0.180	2.40 ± 0.163	2.60 ± 0.221	3.00 ± 0.298	3.20 ± 0.291	4.20** ± 0.200	4.00 ± 0.211	4.20 ± 0.200	4.80* ± 0.200	5.25 ± 0.293	5.75** ± 0.342	5.88* ± 0.276	5.38 ± 0.246	5.75 ± 0.293	6.70 ± 0.448	4.24*** ± 0.138
Control	-	1.29 ± 0.312	2.14 ± 0.280	2.33 ± 0.192	2.67 ± 0.304	3.57 ± 0.312	3.33 ± 0.192	3.83 ± 0.436	4.17 ± 0.642	3.17 ± 0.642	5.00 ± 0.236	4.17 ± 0.495	4.00 ± 0.913	4.17 ± 0.830	4.83 ± 0.495	5.83 ± 0.830	3.64 ± 0.182
Relative growth rate (%) Supplemented	-	6.90 ± 0.606	8.15 ± 0.548	8.10 ± 0.563	8.65 ± 0.729	8.50 ± 0.620	9.92 ± 0.650	8.99 ± 0.316	8.68 ± 0.489	9.08* ± 0.362	9.12 ± 0.653	9.13* ± 0.677	8.51* ± 0.502	7.17 ± 0.315	7.13 ± 0.245	8.11 ± 0.640	8.42* ± 0.155
Control	-	4.83 ± 1.455	7.79 ± 1.156	7.69 ± 0.796	7.97 ± 0.949	10.24 ± 0.871	8.57 ± 0.575	8.99 ± 1.146	8.74 ± 1.284	6.29 ± 1.131	9.24 ± 0.494	7.23 ± 0.770	5.45 ± 1.579	5.31 ± 1.432	6.55 ± 0.511	7.23 ± 0.933	7.84 ± 0.301

Mean±SE (Number of calves from supplemented and un-supplemented dams were 10 & 7 respectively)

* Significant at P<0.05 ** P<0.01 ***P< 0.001.

The extra gain live body weight of calf after S-injection of dam = (90.30-27.60) - (78.71-26.71) = 10.7kg

Table 2. Blood serum hormonal profile of calves during post-natal period (1-40 days) after pre-partum selenium injection of dams, in comparing with unsupplemented group.

Post-natal period								Thyrotrophic hormone (CU/ml)
		Total form	Free form	Binding form	Total form	Free form	Binding form	
One day	Supplemented	17.03 ± 1.043***	11.90 ± 2.338*	5.85 ± 1.376**	3.65 ± 0.632***	0.59 ± 0.286	2.78 ± 0.854**	4.46 ± 0.520**
	Control	6.65 ± 1.050	5.70 ± 0.991	0.87 ± 0.580	0.19 ± 0.009	0.17 ± 0.009	0.02 ± 0.009	2.45 ± 0.400
10 days	Supplemented	13.93 ± 1.901*	6.75 ± 0.840	7.08 ± 2.322	7.17 ± 0.846	0.16 ± 0.017	7.04 ± 1.009	6.46 ± 1.594*
	Control	8.85 ± 1.458	5.14 ± 1.107	3.71 ± 1.052	7.00 ± 0.844	0.16 ± 0.014	6.34 ± 0.855	2.42 ± 0.337
20 days	Supplemented	15.43 ± 1.134 **	12.33 ± 1.490*	3.11 ± 0.936	3.44 ± 1.592 *	0.18 ± 0.017	3.27 ± 1.581*	3.71 ± 0.286
	Control	10.36 ± 0.828	7.60 ± 1.011	2.76 ± 1.135	7.97 ± 0.387	0.15 ± 0.015	7.78 ± 0.391	2.68 ± 0.600
30 days	Supplemented	16.57 ± 1.361 **	11.29 ± 1.463	5.28 ± 1.339	7.17 ± 0.992 ***	0.18 ± 0.011	6.99 ± 0.986***	3.71 ± 0.286*
	Control	11.19 ± 0.883	8.33 ± 0.534	2.86 ± 0.875	1.61 ± 0.298	0.18 ± 0.009	1.43 ± 0.298	2.50 ± 0.434
40 days	Supplemented	15.43 ± 1.134*	10.16 ± 0.698	5.28 ± 1.339**	0.17 ± 0.009***	0.17 ± 0.009	0.00 ± 0.00***	4.58 ± 1.030
	Control	11.29 ± 1.463	10.50 ± 1.655	0.792 ± 0.534	7.40 ± 1.239	0.17 ± 0.009	7.23 ± 1.248	3.12 ± 0.498

Mean±SE (Number of calves : 10 from supplemented dams & 7 from un-supplemented dams)
CU = Chicken unit
* Significant at P<0.05 ** P<0.01 ***P< 0.001

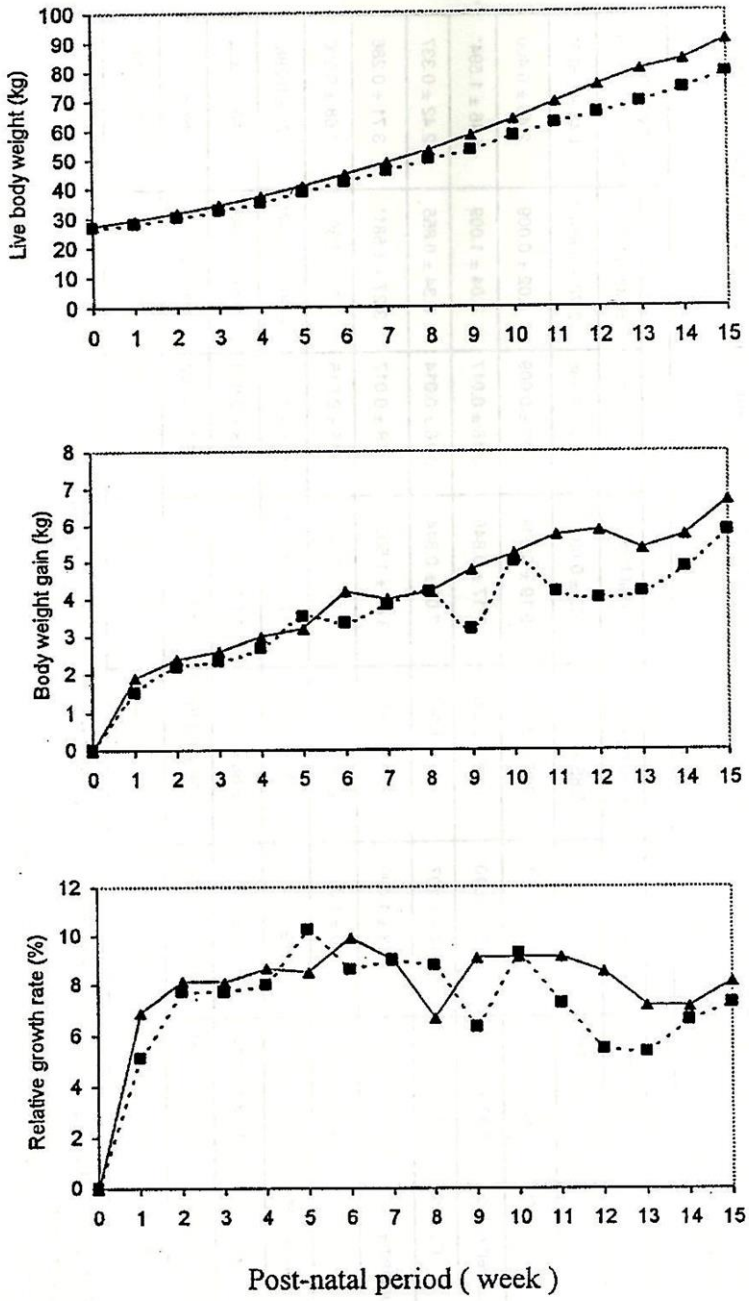

Figure 1. Live body weight, weight gain and relative growth rate of calves delivered from Se-supplemented dams (. ▲____) and in control cases (__■____) during post-natal period period (0-15 weeks).

tration of 30 mg selenium given twice during late pregnancy resulted in an equal and satisfactory selenium status in both cows and their calves at birth and during the next 2-3 months. Within available literature, Davis (1974) observed a 15% faster growth rate during the nine months after weaning among beef calves which received one to three doses of 20 mg sodium selenite. Perry *et al.* (1976) obtained a significant increase ($P< 0.05$) in body weight gain from adding 0.1 mg selenium / kg to a finishing beef cattle. Also, Gleed *et al.* (1983) concluded that supplementing the steers with selenium improved their growth rate even in the absence of clinical disease. They reported on increase in growth rate, yielding an additional 10 to 20 kg live weight gain per annum. It is noteworthy to mention that our experiment yielded a mean 10.7 kg extra gain in body weight and a mean 13.74% faster growth rate in calves delivered from supplemented dams at the end of the experiment (15 weeks). In addition, the overall mean of weight gain and relative growth rate of calves per week were significantly increased, when compared with control cases (2.24 vs. 3.64 kg & 8.42 vs. 7.84%, respectively).

In order to clarify the effect of selenium supplementation on growth rate of calves during the suckling period, endocrinological factor that control growth was studied. There is no doubt that certain trends existed in hormone values after selenium supplementation of dams, most notably the significant increase in their values in calves one day after birth (Table 2). This indicated that the foetus can sequester the element from the dams, and an additional amount can be consumed by the neonate via colostrum (Koller *et al.*, 1984). The foetal pituitary is functional during pre-natal period (McDonald, 1980 and Wahba *et al.*, 1988), and it is suggested that it can be affected by selenium passing across the placenta. In this respect, Youssef *et al.* (1988) concluded that selenium has a favourable effect on the anterior pituitary hormone secretion in Egyptian bufflaoes after parturition.

In supplemented cases, growth hormone (total form) fluctuated in non-linearity pattern within range between 13.93 and 17.03 IU/ml, during the period of experiment (1-40 days post-natal), while, in unsupplemented cases the level steadily increased from 6.65 up to 11.29 IU/ml. Hart *et al.* (1981) detected that there was a tendency for growth hormone to be higher during the pre-weaning period (1-27 days) then, after weaning. The manner of the free hormone was like the total form, while, the protein binding form was in parallel with the increased secretion of the hormone which was adjusted according to its demand. Tietz (1997) mentioned that growth hormone interacts with its specific receptor sites in the liver. It stimulated secretion of peptides called somatomedins, which circulate in blood complexed with a plasma binding protein.

Their effects include enhanced incorporation of sulfate into cartilage and stimulation of synthesis of DNA and RNA for collagen formation. Somatomedins also appear to be responsible for trophic effects of growth hormone on connective tissue,bone and muscle. It is considered that, the increased growth hormone level with its regulating binding mechanism can improve growth rate and body weight gain in supplemented cases by its promoting protein deposition, hyperglycaemia, lipolysis and skeletal growth (Welsh, 1985). However, McDonald (1980) stated that growth is not indispensable for the normal somatic development of the foetus and newborn.

The free form of the prolactin hormone in the serum was not affected in supplemented cases (Table 2). It was not a steady pattern during the period of the experiment, while, the total binding forms were significanly increased one day post-natal in calves from supplemented dams. Their variable levels are of great significance. They modulate the free hormone level in the blood and regulate hormone utilization according to its demand in the body. Hart *et al.* (1981) observed a large range in the prolactin values obtained in individual calves during their fish 110 days of life. Also, Tietz (1987) mentioned that prolactin secretion is pulsatile and diurnal and it is considered as tissue builder that having more specific target organs.

Thyrotopic hormone has a significant role in growth rate of calves by its influence on the thyroid gland, which is functionally active at birth (McDonald, 1980 and Hart *et al.* 1981). Fabry (1983) considered thyroid hormones and STH as potential predictors of growth rate. Selenium supplementation improved significantly ($P < 0.001$) TSH secretion (Table 2) during the period of experiment (the average 4.66 vs. 2.72 U/ml in unsupplemented cases). These results confirmed the effect of selenium on the anterior pituitary gland in the early post-natal period. Shamberger (1983) cited that glandular tissues, especially, the pituitary gland and liver have greatest selenium concentrations. He added that selenium has several specific metabolic functions, the most important of which is the protection of the biological membranes from lipid peroxidation.

From the afore-mentioned results, it is concluded that the increased body weight gain and growth rate of calves during the post-natal period after selenium supplementation of dams, may be attributed to their effect on the anabolic hormones secretion and their protein-binding mechanism.

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معدل أداء النمو ومستوى الهرمونات للعجول المولودة بعد حقن أمهاتها بعنصر السيلينيم قبل الولادة

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اجريت هذه الدراسة على عشر أبقار فريزيان فى المرحلة الأخيرة من الحمل بحقنها فى العضل بمائة ملليجرام سيلينيم (صوديوم سيلينيت) مقسمة على جرعتين بفاصل اسبوع بينهما ، فى حين كان هناك سبع أبقار تحت نفس الظروف تركت بدون حقن كمجموعة ضابطة . تم تسجيل أوزان العجول المولودة عند الولادة وأسبوعيا حتى الأسبوع الخامس عشر بعد الولادة ، وتم أخذ عينات دم فى الأيام ١ ، ١٠ ، ٢٠ ، ٣٠ ، ٤٠ بعد الولادة لقياس الهرمونات .

أثبتت النتائج ان هناك تحسنا واضحا فى أوزان العجول بزيادة قدرها ١٠,٧ كجم عن مثيلاتها فى المجموعة الضابطة فى نهاية التجربة (١٥ أسبوعا) وأيضا زيادة فى معدل النمو بمتوسط قدره ١٣,٧٤ ٪ فارتفع معنويا المتوسط العام فى الأسبوع للزيادة المكتسبة فى الوزن (٤,٢٤ بالمقارنة مع ٣,٦٤ كجم فى المجموعة الضابطة) ولمعدل النمو أيضا (٨,٤٢ بالمقارنة مع ٧,٨٤ ٪ فى المجموعة الضابطة).

هناك أيضا زيادة معنوية فى الهرمونات المتعلقة بالنمو فى دم العجول المولودة ، هرمون النمو (الكلى والحر والمرتبط بالبروتين) وهرمون البرولاكتين (الكلى والمرتبط بالبروتين) والهرمون الحاث للغدة الدرقية ، وذلك فى اليوم الأول بعد الولادة . وقد أستمر هذا التاثير الإيجابى على هرمون النمو الحاث للغدة الدرقية حتى اليوم الأربعين بعد الولادة .