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TOMO II

CHANGES IN SERUM INSULIN CONCENTRATIONS DURING THE FIRST 6 MONTHS OF LIFE: A PROSPECTIVE STUDY IN ITALIAN FRIESIAN CALVES(*).

G. Biagi(1), L. Bartalena(2), A. Valentini(3), M. Bagliacca(4), G.C. Signorini(5), L. Antonangeli(2), F. Bogazzi(2), G. Della Croce(1), A. Romagnoli(1)

(1) Istituto Clinica Medica Veterinaria, Università di Pisa, V.le delle Piagge, 2 - 56100 PISA, Italy.
(2) Istituto Endocrinologia, Università di Pisa, V.le del Tirreno 64 - 56018 TIRRENIA (PI), Italy.
(3) Istituto Zootecnia, Università di Viterbo, Via De Lellis - 01100 VITERBO, Italy.
(4) Dipartimento Scienze Anatomiche, Fisiologiche, Produzioni Animali, Università di Pisa, V.le delle Piagge, 2 - 56100 PISA, Italy.
(5) Istituto Farmacologia, Università di Parma, Via del Taglio - 43100 PARMA, Italy.
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INTRODUCTION

Somatic growth and development of animals are related with thyroid hormones, pituitary growth hormone, and insulin secretion. Insulin is present in the circulation at all ages and is directly involved in the regulation of metabolism by coordinating the storage and metabolization of carbohydrates, amino acids and fats (1, 5). This hormone increases the movement of glucose into many peripheral tissues (3, 4, 17) including adipose tissue (11) and muscle (10): protein synthesis in skeletal muscle is reduced in absence of insulin (12). Numerous studies report that the serum insulin concentration is to be related to glucose availability (2, 8, 16) and is related to the diet (15).

The purpose of this paper is to describe the changes in serum insulin concentrations in Italian Friesian calves during the first six months of life.

MATERIALS AND METHODS

Animals. Forty five Italian Friesian calves (19 males and 26 females) were included in this study. The animals were born at the end of normal pregnancies (272±3 days).

Table 1 - Chemical composition of the feed used during the trial (a.f.b.)

	commercial milk replacer	weaning mixture	concentrated food
Moisture.....%	4.5	12.0	13.0
Crude protein...."	23.5	16.3	15.7
Ether extract...."	13.0	3.0	5.7
Crude fiber....."	0.5	14.5	9.4
Ash....."	7.0	7.5	9.6

The animals had no clinical problems, were housed in individual boxes until 30th-40th day of life and then reared in single stalls, yoke tying. The calves were fed maternal colostrum twice a day for the first 4 days; on

the 5th day, when the average animal weight was about 36 Kg, they received 8 l of a commercial milk replacer (4 l in the morning and 4 l in the afternoon). At the 30th day (average live weight 70 Kg) the milk replacer was substituted by 400-500 g of a weaning mixture (the animals can eat the weaning mixture till from the second week). After 2-3 months the weaning mixture was gradually substituted by 1-1.5 Kg of concentrated food and 1-2 Kg of lucerne hay (alfalfa). These quantities were gradually increased up to the 6th months (average live weight 170 Kg).(See table 1 for the chemical composition of the employed feed).

Blood samples were collected from all calves by puncture of the right jugular vein in the following way: the first and the second sample were collected at 24 and 48 h after the birth, respectively; the following 10 samples at weekly intervals and the last 4 samples every month up to 6th month. Blood was drawn in the morning (from 8:00 to 9:00 h) with the exception of the first 2 samples which were obviously related to the delivery occurrence. In fact, if the calving took place during the day, the blood sample was collected 2-3 h after delivery and before sucking the maternal colostrum; if the calf birth took place at night, the blood sample was collected 12-14 h after delivery.

The births were distributed over a period of 6 months (January-June 1985) as follows: January (3 males and 4 females); February (3 males and 5 females); March (5 males and 3 females); April (2 males and 7 females); May (3 males and 3 females); June (3 males and 4 females).

Assays. Sera were frozen until analyzed. The assay was carried out in duplicate. All samples belonging to the same animal were run in the same assay to avoid interassay variations. The interassay coefficient of variations was < 5%. Serum insulin concentrations were measured by specific RIA (Insulin Test IV732, Cambridge Medical Technology, innoVet Division, MA - USA).

The data were analyzed by the following statistical model:

$$INS_{ijkl} = \mu + sex_i + month_j + day_k + (subj_{ij} * day_k)_{ijkl}$$

where: INS = insulin blood level;
sex = sex of calf;
month = month of birth;
day = age of the calf in days: the variable "day" was considered as a continuous ($b * day_k$) and a categorical variable;
subj = subject I.D.

The interaction between subject and day was considered as the error term.

RESULTS AND DISCUSSION

The estimated serum insulin levels are shown in Table 2 and the average observed values are shown in Figure 1. Sex-related differences were observed, females showing higher concentrations than male. No significative difference was observed in relationship to the month of the birth.

Serum insulin concentrations were higher on the first day than on second day (24.02±10.93 µU/ml and 18.18±7.87 µU/ml, respectively; $p<0.01$).

Table 2 - LS-means stimated at 1 day old

Factor		LS-mean	Std.Err.
Male		19.9[a]	0.49
Female		21.4[b]	0.40
Month	January	18.6	0.77
	February	20.3	0.73
	March	20.0	0.73
	April	23.2	0.69
	May	22.4	0.82
	June	20.2	0.78
day	"b"	-0.022	0.077

Serum insulin concentrations differed between the first and the second period of life (2^{nd}-70^{th} vs. 70^{th}-168^{th}).

Basal serum insulin values of 15 to 50 µU/ml have been reported in adult cattle (7, 9, 13, 14, 18). A limited number of reports are available on serum insulin concentrations in the early postnatal life, although Erb et al. also found that serum insulin concentrations declined from the first to second day after birth (6). It must be noted that the values we found were higher than those reported by Erb et al. (6): these differences may likely be due to the different breeds considered in these reports. The values we found at 6^{th} months of life were in agreement with those observed by Irvin & Trenkle (9).

Furthermore, it is interesting to note the fall in serum insulin level at 84 days. At this age in fact the calves change their feed, the weaning mixture being replaced by hay (alfalfa) and meal. The effect of hay on the absorption and consequently on plasma kinetics of nutrients may explain the phenomena observed on insulin serum levels. Later the insulin concentrations increases again and this may be due to the maturation of the digestive trait.

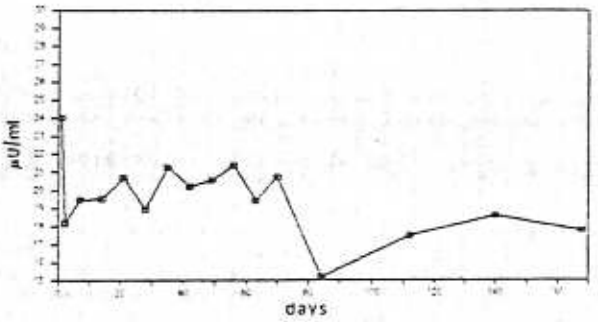

Figure 1 - Serum insulin concentrations

To our knowledge, no longitudinal studies had been so far carried out concerning the changes in serum insulin levels throughout the first 6 months of life in Italian Friesian calves. Our data clearly show that, after the initial decrease occurring during the first two days of life, the serum insulin concentrations remain fairly constant thereafter. These results suggest a complete maturation of islet cell function in the early postnatal life.

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SUMMARY

The aim of the present study was to evaluate the variations of serum insulin concentrations in Italian Frisian calves (IFC) during the first 6 months of life. For this purpose insulin levels were measured by specific RIA in 45 IFC (19 males and 26 females) born from January to June. Blood samples were drawn once a day for the first 2 days, then at weekly intervals for 10 weeks, and then at monthly intervals up to 6 months. The data were analyzed by a split-plot least square method for repeated hormonal measures over time. The serum insulin concentrations in IFC showed significant differences ($p < 0.01$) during the first 6 months of life. The serum value (estimated mean ± standard dev.) 24 h after birth was 24.0±10.92 µU/ml. A significant reduction of insulin level was observed after 48 h: 18.2±7.87 µU/ml. An increase of insulin concentration was observed at first week (19.5±11.18 µU/ml), and the values remained practically unchanged up to 10 weeks. The insulin levels decreased up to 3 months (15.2±5.36 µU/ml), then they increased again remaining around 17-18 µU/ml up to 6 months of life.

SUMÁRIO

O objectivo do presente estudo foi avaliar as variações de concentrações de insulina no soro nos Vitelos Italianos da Frísia (VIF) durante os primeiros 6 meses de vida. Para este fim, os níveis de insulina foram medidos por Radioimuneanálise específicos em 45 VIF (19 machos e 26 fêmeas) nascidos desde janeiro até junho. Foram obtidas amostrar de sangue uma vez por dia durante os 2 primeiros dias, depois com intervalos de uma semana durante 10 semanas e depois com intervalos de um mês até aos 6 meses. Os dados foram analisados por um diagrama duplo com o método dos mínimos quadrantes por medidas hormonais repetidas naquele período. A concentração de insulina no soro nos VIF mostraram diferenças significativas ($p < 0.01$) durante os primeiros 6 meses de vida. O valor de soro (valor édio estimado ± variante do padrão) 24 h depois do nascimiento era 24.0±10.92 µU/ml. Uma redução significativa do nível foi observado dipois de 48 h: 18.2±7.87 µU/ml. Um aumento de concentração de

insulina foi observado na primeira semana (19.5±11.18 µU/ml) e os valores ficaram praticamente inalteráveis até 10 semanas. Os níveis de insulina diminuiram até aos 3 meses (15.2±5.36 µU/ml), depois aumentaram outra vez ficando cerca 17-18 µU/ml até 6 meses de vida.

ZUSAMMENFASSUNG

Das Ziel dieser Untersuchung war es, die Schwankungen der Serumkonzentrationen von Insulin bei schwarz gefleckten Kälber (SGK) während der ersten 6 Lebensmonate auszuwerten. Zu diesem Zweck wurden mit einem speziellen Radioimmunotest die Insulinkonzentrationen von 45 SGK (19 männliche und 26 weibliche Tiere) untersucht, die in der Zeit von Januar bis Juni geboren waren. In den ersten beiden Tagen wurden täglich eine Blutprobe entnommen, danach 10 Wochen lang einmal wöchentlich und im folgenden bis zum 6. Monat einmal pro Monat. Die Daten wurden mit der Doppelkurvenmethode der kleinsten Quadrate für wiederholte Messungen des Hormonspiegels über die gesamte Zeitspanne hin analysiert. Die Serumkonzentrationen von Insulin bei den SGK zeigten während der ersten 6 Lebensmonate große Schwankungen ($p < 0.01$). Vierundzwanzig Stunden nach der Geburt waren die Serumwerte 24.0±10.92 µU/ml (geschätzter Mittelwert ± Standartabweichung). Nach 48 Stunden wurde ein bedeutendes Absinken der Insulinkonzentrationen beobachtet: 18.2±7.87 µU/ml. In der ersten Woche stiegen dann die Insulinkonzentrationen an (19.5±11.18 µU/ml), und diese Werte blieben 10 Wochen lang praktisch unverändert. Bis zum 3. Monat sanken die Insulinwerte wieder (15.2±5.36 µU/ml), um dann wieder anzusteigen, und blieben dann bis zum 6. Lebensmonat bei Werten von etwa 17-18 µU/ml.

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