Proceedings of the

4-7 july **2000** – Valencia Spain

These proceedings were printed as a special issue of WORLD RABBIT SCIENCE, the journal of the World Rabbit Science Association, Volume 8, supplement 1

ISSN reference of this on line version is 2308-1910
(ISSN for all the on-line versions of the proceedings of the successive World Rabbit Congresses)

CHIERICATO G. M., RIZZI C., RAVAROTTO L., ZAKARIA H.

CIRCULATING LEVELS OF METABOLITES, ENZYMES AND MINERALS OF GRIMAUD FEMALE RABBITS FROM WEANING TO 120 DAYS OF AGE

Volume A, pages 111-116

CIRCULATING LEVELS OF METABOLITES, ENZYMES AND MINERALS OF GRIMAUD FEMALE RABBITS FROM WEANING to 120 days of age

Chiericato G. M.*, Rizzi C.*, Ravarotto L., Zakaria H.***

*Dipartimento di Scienze Zootecniche - Università degli Studi di Padova
Agripolis 35020 Legnaro (Padova) – ITALY
** Istituto Zooprofilattico Sperimentale delle Venezie
Agripolis 35020 Legnaro (Padova)- ITALY

ABSTRACT

The aim of the trial was to study the metabolic, enzymatic and mineral profile of growing female rabbits from weaning to pre-pubertal age. Grimaud rabbits (30 animals) were submitted to a blood sampling at 36, 56, 77, 98 and 119 days of age, after a fasting of two hours in the morning. Ageing decreased ($P<0.01$) plasma cholesterol, whereas glucose and triglycerides did not change. Total proteins, albumin and globulin increased ($P<0.01$), as well as ($P<0.01$) urea and creatinine. The enzyme concentrations of AST, ALT LDH did not change from 36 to 119 days of age, whereas g-GT decreased ($P<0.01$). As regards the effect of ageing on the mineral profile, Ca increased ($P<0.01$) and P decreased ($P<0.01$); Mg, Na, K and Cl remained unchanged during the experimental period.

INTRODUCTION

As regards the research works on intensively reared rabbits, it is worth considering the study of some physiological aspects, in particular the evolution of the metabolic and hormonal plasma profile during the animals' growth, which determine important somatic and biochemical changes. The literature indications mainly concern circulating levels of some hormones of adult female rabbit (Kriesten and Murawski, 1988; Gadsby, 1989), whereas there are few findings on the biochemical profile during growth phase from weaning to sexual maturity concerning the endocrine status (Younglai, 1986 ; Younglai et al., 1989, Rizzi et al., 1999) and the metabolic profile (Chiericato and Rizzi, 1999).
The aim of this work is to study the metabolic, enzymatic and mineral plasma profile from weaning to prepubertal age of female rabbits belonging to a common commercial genotype.

MATERIALS AND METHODS

The trial was conducted on 30 female rabbits belonging to the Grimaud genotype; the animals weaned at 33 days of age were allocated in a single cage without hindering the caecotrophy.
During the experimental period the environmental conditions were monitored: temperature was about 24°C and the relative humidity reached a mean value of 82%. Photoperiod was 16L:8D with a light intensity of 29 lux.
The rabbits were fed a commercial pellet feed (crude protein=18,78% d.m.; crude fiber=19.15% d.m.; digestible energy=10,95 MJ/kg), which was able to satisfy the requirements of the animals (INRA, 1989).
The rabbits were weighed every week, and feed intake and their health status were checked on a daily basis.
Each animal was submitted to five blood samplings, carried out in the morning at the same time, after a fasting period of two hours. The rabbits were sampled every 21 days at following ages: 36 (I sampling), 56 (II sampling), 77 (III sampling), 98 (IV sampling) and 119 (V sampling) days of age.

The blood collected in vacutainers containing lithium heparin (150 USP) was immediately centrifuged (3500 rpm for 15 minutes at 4°C). The plasma obtained was stored at -20°C until the chemical analysis that was performed using an automatic analyser HITACHI 911 (Roche BM). The main plasma variables involved with the metabolic, enzymatic and mineral profile were quantified by the following procedures: haematocrit (Wintrobe), glucose (esochinase, Roche BM), cholesterol (CHOD-PAP, Roche BM), triglycerids (GPO-PAP, Roche BM), total protein (biuret, Roche BM), albumin (bromocresol, Roche BM), urea (urease,UV, Roche BM), creatinine (PAP, Roche BM), ALT (alanine aminotransaminase) and AST (aspartate aminotransaminase) (IFCC 37°C), g-GT (g-glutamyl transferase) (Szasz 37°C, Roche BM), LDH (lactate dehydrogenase) (DGKC 37°C, Roche BM), calcium (DPD, Roche BM), phosphor (molibdate, UV, Roche BM), magnesium (xilidil-blue, Roche BM), potassium, sodium and chloride (ISE).
After controlling variance homogeneity all the data was subjected to an analysis of variance (SAS, 1990) considering the effect of animal and the effect of age. The linear and quadratic components were also calculated.

RESULTS AND DISCUSSION

Productive performance

Table 1 shows the productive performance of the rabbits during the experimental period.
The females reached the most intensive growth rate from the weaning to three months of age (significant linear component, $P<0.01$). The changes of body gain at increasing age, being higher in the first part of productive cycle and lower after, are related to the somatic variations: in the last period, indeed, the females reached the prepubertal phase with a more marked adipogenesis.

Table1. Productive performance of Grimaud female rabbits

		I	II	III	IV	V	Error mean square
Metabolic weight	kg	1.05	1.47	1.89	2.25	2.54	1.5820
Weight gain	g/d	39.97	34.53	38.59	35.05	28.90	17.4168
Feed intake	g/d	77	111	147	153	188	403
Feed efficiency	g/g	1.91	3.22	3.81	4.36	6.67	0.6330

Ageing increased feed intake from 37 days of age (significant linear component, $P<0.01$), when the animals had a metabolic weight of 1.05 kg, to 119 days of age, when they weighed 2.54 kg $^{0.75}$. A negative effect of age on feed efficiency was also observed since it progressively increased (significant linear component, $P<0.01$).
It is worth remembering that similar results concerning the productive performance have also been observed on female rabbits belonging to another commercial genotype (Parigi-Bini et al., 1992; Chiericato and Rizzi, 1999).

Metabolic profile

The circulating levels of the main metabolites are reported in table 2. Haematocrit did not present significant changes during the experimental period. Glucose and triglycerides were constant from 36 to 119 days of age, without noteworthy variations. Cholesterol, from sampling I to V, linearly decreased (significant linear component, $P<0.01$). These results agree with those found on Provisal rabbits during a similar time interval (Chiericato and Rizzi, 1999). As concerns cholesterol,

negative changes were also observed on other monogastric species (Franchini et al., 1990). The decrease would be due to a higher utilization of cholesterol for the synthesis of sexual steroids.

Table 2. Plasma levels of some metabolites of Grimaud female rabbits

		I	II	III	IV	V	Error mean square
Heamatocrit	%	38.27	39.60	39.94	39.79	39.57	8.6515
Glucose	mmol/l	7.05	7.38	7.14	6.72	7.00	0.2842
Cholesterol	mmol/l	2.65	2.55	2.04	2.15	2.11	0.2585
Triglycerides	mmol/l	1.13	0.87	0.85	0.92	0.89	0.1302
Total proteins	g/l	45.73	58.60	59.22	62.45	61.57	15.2681
Albumin	g/l	40.87	42.00	44.50	47.31	49.30	7.0454
Globulines	g/l	4.87	11.60	14.72	15.14	12.26	8.2824
Urea	mmol/l	4.27	5.25	6.03	7.05	6.53	0.7491
Creatinine	mmol/l	61.27	81.47	94.39	105.69	113.91	81.5050

Ageing influenced all the variables of protein metabolism: total proteins (significant linear component, $P<0.01$), albumin (significant linear component, $P<0.01$) and globulin (significant quadratic component, $P<0.01$), urea and creatinine presented a significant increase (significant linear component, $P<0.01$) of their plasma levels.
The available literature indications on the effect of age on the variables studied and connected to protein metabolism of rabbit report similar trends (Chiericato and Rizzi, 1999). The increased plasma levels of total proteins found also on growing poultry (Franchini et al., 1990) would be attributable to higher globulin fraction. The higher concentrations of creatinine in older animals may be explained by the development and growth of body muscles during the experimental period (Ubaldi et al., 1982).

Enzymatic profile
Table 3 presents the enzymatic activity tested during the experimental time interval. The sampling age did not significantly affect the plasma levels of transaminses AST and ALT. The activity of g-GT presented a decrease until IV sampling and an increase after (significant linear component, $P<0.01$). The levels of LDH decreased by ageing only slightly.

Table 3. Plasma levels of some enzymes of Grimaud female rabbits

		I	II	III	IV	V	Error mean square
AST	U/l	19.27	15.13	16.39	21.10	18.96	50.3431
ALT	U/l	25.80	19.47	26.06	32.10	38.22	47.4282
g-GT	U/l	7.47	4.53	3.39	3.83	5.91	2.1654
LDH	U/l	277	159	185	201	190	4314

These results agree with those observed in a previous trial conducted on Provisal female rabbits (Chiericato and Rizzi, 1999) and with those reported by Tiez and Finley (1983).

Mineral profile

The data concerning the plasma mineral levels is reported in Table 4. Throughout the experimental period, calcium concentrations presented limited increasing variations with a significant linear trend (significant linear component, $P<0.01$).

Table 4. Plasma levels of some minerals of Grimaud female rabbits

		I	II	III	IV	V	Error mean square
Ca	mmol/l	3.35	3.40	3.57	3.71	3.71	0.0276
P	mmol/l	2.92	2.53	2.40	2.35	2.15	0.0498
Mg	mmol/l	1.07	1.06	0.99	0.94	0.96	0.0216
Na	mmol/l	146	140	145	145	146	8.4515
K	mmol/l	4.26	4.81	5.02	5.07	4.75	0.4412
Cl	mmol/l	100	101	101	94	102	8.6315

The rabbits showed lower phosphorus levels from sampling I to V (significant linear component, $P<0.01$). Also in a previous research carried out on other genotype of hybrid rabbits of same age, calcium and phosphorus levels presented an opposite trend (Chiericato and Rizzi, 1999) and confirm the results found in man (Tietz and Finley, 1983).

Plasma concentrations of magnesium, sodium, potassium and chlorine were not affected by increasing age. Similar results were observed on Provisal female rabbits at the same age (Chiericato and Rizzi, 1999).

In conclusion, the results obtained allow us to make some considerations on the effect of age on the biochemical profile of growing female rabbits, from weaning to prepubertal age.

The parameters affected by age were cholesterol, as far as the energetic metabolism was concerned and total proteins, albumin, globulin, urea and creatinine for the protein metabolism. As regards the mineral profile, calcium and phosphorus significantly varied with the progression of the productive cycle. The trends found in the parameters studied in this trial substantially agree with those observed during an analogous time interval in previous research realised on another commercial genotype (Chiericato and Rizzi, 1999). Thus, it is possible to conclude that the age of the rabbits should be taken into account in the comparative study of the plasma profile.

ACKNOWLEDGMENTS

This research, carried out with funding from “Cofinanziamento MURST 1997”, is to be equally attributed to the authors.

REFERENCES

CHIERICATO G. M., RIZZI C. 1999: Etude de l'èvolution du profil métabolique, enzymatique et minéral de la lapine du sevrage a 120 jours d'age. *8èmes Journ. Rech. Cunicole Fr., 9-10 juin, Paris,* 155-158.

FRANCHINI A., MELUZZI A., MONTEMAGGI E., MANFREDA G. 1990: Andamento di taluni parametri ematochimici di tacchini in accrescimento. *Zoot., Nutr. Anim.* **16**: 145-151.

GADSBY J.E. 1989: Control of corpus luteum function in the pregnant rabbit. *J. Reprod. Fert. Suppl.* **37**: 45-54.

INRA 1989: L'alimentation des animaux monogastriques: porc, lapin, volailles. *INRA Editions, Paris.*

KRIESTEN K., MURAWSKI U. 1988: Concentrations of serum cortisol, progesterone, estradiol-17b, cholesterol cholesterol ester in the doe during the reproductive stadium, in the fetal serum, in the amniotic fluid and in the milk of rabbits, as well as correlations between these parameters. *Comp. Biochem. Physiol., vol 90A* **3**: 413-420.

PARIGI-BINI R., XICCATO G., CINETTO M., DALLE ZOTTE A., CONVERSO R. 1992: Effetto dell'età, del peso di macellazione e del sesso sulla qualità della carcassa e della carne cunicola 1. Rilievi di macellazione e qualità della carcassa. *Zoot. Nutr. Anim*. **18**: 157-172.

RIZZI C. CANALI C., BOITI C., CHIERICATO G. M. 1999: Studio del profilo ormonale di giovani coniglie dallo svezzamento alla pubertà. *Atti LIII Convegno Nazionale SISVet, Montecatini Terme (PT), 16-18 settembre,* 475-476.

SAS 1990: User's guide: Statistics (release 6.04) *SAS Inst. Inc., Cary, NC.*

TIETZ N. W., FINLEY P.R. 1988: Clinical guide to laboratory tests. *W. B. Saunders Company Ed.*

Ubaldi A., Corbella E., Montanari P. 1982: Diagnostica clinico-chimica veterinaria. *Casa Editrice Ambrosiana, Milano.*

YOUNGLAI E. V., THOMPSON N., FOSTER W. 1989: Effects of in vivo administration of GnRH on the release of gonadotrophins in the female rabbit. *J. Reprod. Fert*. **85**: 325-329.

YOUNGLAI E.V. 1986: Age related changes in the concentrations of serum gonadotrophins and cholesterol in the female rabbit. *J. Endocr*. **109**: 287-290.