VERY LOW PROTEIN, AMINOACID-SUPPLIED DIET FOR HEAVY BROILER RABBITS: EFFECTS ON GROWTH, FEED EFFICIENCY, CARCASS AND MEAT PERFORMANCES

Cherubini R.[1], Barge P.[2], Baricco G.[3], De Poi E.[1], Masoero G.[2]*

[1]Cuniexpert team, Mangimi 4 Torri s.r.l., Via Mondovì 40, 12045 Fossano (CN), Italy
[2]CRA-PCM Consiglio per la Ricerca e la Sperimentazione in Agricoltura, Via Pianezza 115, 10151 Torino, Italy
[3]Veterinarian practitioner, Via Rosolino Pilo 60, 10145 Torino, Italy
*Corresponding author: giorgio.masoero@entecra.it

ABSTRACT

Two very low protein diets (VLP), named A1 and A2, were supplied by the four available synthetic Amino Acid (AA) (L-Lysine, DL-Methionine, L-Thryptophan and L-Threonine) and compared to two Commercial Control (C1-C2) standard diets with no antibiotic. Synthetic aminocids were added to A1 and A2 diets at levels such to equalize their content to C1 and C2 feeds: other nutritional parameters (starch, crude fiber, and digestible energy) were the same for all the diets. Ninety three rabbits belonging to "*Macchiata Italiana*" and "*Bianca italiana*" strains, in purebred and crossed, were weaned at 31 d and slaughtered at 94 d for an heavy broiler production; thus *ad libitum* feeding in individual cages was modulated in two phases with a minor crude protein level administration in the first post weaning growth: 14.5 vs. 17.5% DM (-17%) and 19.7 vs. 15.9% (-19%) respectively for the two phases. At the feeding change, on the 66th d, a crossover of treatments (A1->C2 and C1->A2) occurred in a half of the rabbits. Mortality raised to 20% overall, but it was concentrated in the C diets (38% vs. 14%, P=0.01). The feed intake was not modified by the diets or their combinations, but the growth rate of the second period was dramatically enhanced in the rabbits which were previously fed with VLP diet A1 (36.8, 39.1 g/d vs. 30.6, 30.1). The feed conversion ratio, which did not change in the first phase, was strongly improved in relative 24% in the second phase, parallel to the extension compensatory growth extent. The efficiency of the protein fed to rabbits (PER) get strongly advantage for the VLP diets in measure higher than 13%. Genetic factor enhanced significant differences in growth and feed efficiency traits mainly in the first phase. In conclusion, nitrogen restriction in a long post-weaning phase could be beneficial to heavy broiler rabbits production because their prolonged compensatory growth, positive effects on overall health status of the animals, and to maximize N utilization with minimum N output without modification in carcass and meat quality.

Key words: Rabbits, Growth, Amino acid, Carcass composition, Meat quality.

INTRODUCTION

Since the wide studies on protein requirements, fondly documented by the pioneer scientist Lebas (Lebas, 1983, 2004) two major aspects were emerging to rabbit raiser. The first aspect was the widespread enteritis syndrome, which lead the technicians to reconsider the true protein and amino-acid requirements allowing for the maximum growth to some sub-optimal levels, but absolutely considering a stable band of safety against enteritis, especially dedicated to the growing in post-weaning phase. The second aspect will be more and more an ecological necessity to directly reduce the N pollution (Maertens, 1999) and - to a large extent – to improve the whole eco-energetic balance of the foods. A corollary to this, in our opinion, will be the ontogenesis of the elements of the feed compounds, where some of the noble protein currently administered to rabbit can conflict with human direct consumption. By these new "commandments" a lot of research was spent into a rabbit "intelligent" feeding catalysed by the COSTS Action 848 (Xiccato *et al*., 2002). Furthermore, the 2006 EU ban against an improper abuse of Antibiotic as Growth Promoters (AGP) in animal feeding, and particularly the rabbit feeding, will have significantly increased the interest into good practices for well balanced diets. The goal of this research was to verify in a vertical action a pair of diet proposed as balanced for sub-optimal growth with limited N-urinary and global N emission.

MATERIALS AND METHODS

Animals and experimental design

Ninety-three rabbits at 31 days of age, dealing from Italian ANCI selection scheme of *Macchiata italiana* and *Bianca Italiana* streams purebred or crossbred were used. The rabbits single housed in two-floor cages, were fed *ad libitum* using two *formulae*: a Control diet with normal protein level (C) and very low protein level with supplemented AA (A). In the 31-66 days age-interval, the phase 1 of growing, the rabbits were thus randomly allotted to the diets C1 and A1 (Table 1).

Table 1: Ingredients and chemical composition and nutritive value of diets

		C1 phase 1-growing	A1 phase 1-growing	C2 phase 2-fattening	A2 phase 2-fattening
Ingredients (%):					
Wheat milling		27.00	33.52	20.20	27.00
Alfalfa meal		21.30	25.00	15.45	10.42
Sunflower meal		15.00	1.00	17.30	14.00
Dried beet pulp		16.50	14.00	16.10	18.10
Wheat straw		7.00	13.00	4.00	9.00
Barley		3.00	4.00	8.00	0.00
Wheat bran		3.50	3.35	3.00	4.00
Sugar cane molasses		3.00	3.00	2.00	3.00
Soybean meal 44% CP		1.00	0.00	6.00	0.80
Peas		1.00	0.00	4.00	0.00
Soybean oil		0.00	1.00	1.00	2.70
Corn		0.00	0.00	0.00	7.50
Min-Premix[1]		1.67	1.67	2.80	2.80
DL-Methionine		0.03	0.16	0.00	0.14
L-Lysine		0.00	0.15	0.15	0.34
L-Threonine		0.00	0.12	0.00	0.15
L-Thryptophan		0.00	0.04	0.00	0.05
Chemical composition (%DM):					
Dry matter		88.46	88.39	88.55	88.55
Crude protein		17.55	14.50	19.71	15.91
Ether extract		3.38	4.38	3.31	5.81
Crude Fibre		20.86	20.56	18.15	18.10
NDF		43.69	45.18	36.92	39.07
ADF		24.23	24.24	20.59	20.97
ADL		5.22	4.46	4.90	4.22
Starch		9.79	9.81	13.57	13.71
Digestible energy	(MJ/kg DM)	10.71	10.74	11.71	11.74
DCP/DE	(g/MJ)	11.47	9.45	11.78	9.49
Lys – K	(g/kg DM)	6.94	6.93	8.92	8.81
Met . M	(g/kg DM)	3.24	3.84	3.50	4.12
Thr – T	(g/kg DM)	6.16	6.18	6.90	6.88
Trp – W	(g/kg DM)	2.32	2.28	2.49	2.44

[1] Premix provided per kg diet: vitamin A, 20,000 IU; vitamin D_3, 2,000 IU; vitamin E acetate, 40 mg; vitamin B_1, 3 mg; vitamin B_2, 6 mg; vitamin B_6, 4 mg; vitamin B_{12}, 0,02 mg; vitamin PP, 51,5 mg; vitamin K_3, 2,6 mg; biotin, 0,5 mg; Fe, 200 mg; Cu, 24 mg; Mn, 40 mg; Co, 4 mg; I, 1,5 mg; Zn, 100 mg; Se, 0.1 mg

At the change of phase fixed at 66th day, when fattening was started with diets C2 and A2, an half of the rabbits on diets C1 were split to A2 and *vice-versa* A1 on C2. Thus four groups CC, CA, AC an AA were determined. The rabbits were fed *ad libitum* and biweekly weighed till to 94th day, endpoint for a heavy broiler product on demand of NW-Italian consumers.

Statistical Analysis

Data were analyzed using GLM procedure (SAS, 1987) with a fixed effects model considering the feeding factor, with four groups, the sex factor and the genetic background with two level (purebred vs. crossbred). The mortality rates were analyzed by the Chi-square Fisher's exact.

RESULTS AND DISCUSSION

In absence of antibiotic prevention the mortality level raised to 43% in the CC group (Table 2) a result significantly higher than the 14% registered in all the other groups (P=0.01). The AA group revealed the minimum level of mortality (8%) when compared to all the other (25%; P=0.086).

Table 2: Partial mortality rate in the groups and single and pooled comparisons with Chi^2 2-Tail P values

Groups		C1C2	C1A1	A1C2	A1A2	(CA+AC+AA)	(CC+CA+AC)
Groups	Mortality rate	43%	15%	19%	8%	14%	25%
C1C2	43%	*1*	*0.0854*	*0.108*	*0.012*	*0.010*	-
C1A2	15%		*1*	*1*	*0.642*	-	-
A1C2	19%			*1*	*0.421*	-	-
A1A2	8%				*1*	-	*0.086*
	# Live	12	17	22	23	62	51
	# Dead	9	3	5	2	10	17

Chi-square Fisher's exact test, by MATFORSK, http://www.matforsk.no/ola/fisher.htm

In the two phases the mortality remained equally distributed. It is clear a negative link with the relative excess in protein of the C diets which could have been prevented both by reducing (AA) or by sequencing the protein level (CA, AC). In a companion trial, with these same diets added by 0.45% of a chestnut (*Castanea sativa*) natural extract (ENC), while considering only the not crossed groups, Zoccarato *et al*. (2008) significantly reduced the relative risk of mortality to a 11% level, a value however which did not meet economic homeostasis.

The appetite of the rabbits for the diets C and A appeared to be only slightly but not significantly affected on the first phase (-4% for A1 diet, Table 3) and regardless to their sequence. This was not the case for the weight increment, which in the growing phase 1 was strongly opposed to the variation in the mortality risk above considered: effectively the relative high risk diet C1 furnished a moderate significant increment of some 7% in body mass increment (34.3^a vs. 31.9^b g/d). However, when the fattening was started and the diets C2 and A2, more energetic of some 10% were fed, the animal which before had received the C1 high protein diet, decelerate their growth in a measure as large as 20% (30.3^b vs. 37.9^a g/d) when compared to the A2 low protein amino-acid supplied diet. It must be outlined that this growth delay did not balanced the high mortality rate linked to the C1 and C2 diets, which will be continued. The switch of diets A and C between the phases did not interact with their true intrinsic dietetic values and the relative compensatory growth in the phase 2 after the braking occurred on diet A1 was fully displayed.

The feed conversion ratio, which appeared to be unchanged on the first phase, was strongly decreased of some relative 24% in the second phase, parallel to the extension of the compensatory growth. The overall advantage of the VLP-AA in the two phases was a 5.4% reduction (3.46 vs. 3.66 for AA and CC groups respectively).

The efficiency of the protein fed to rabbits (PER) get strongly advantage for the VLP diets in measure higher than 13% (1.81 for AA vs. 1.60 for CC groups). Genetic factor enhanced significant differences in growth and feed efficiency traits mainly in the first phase. The carcass traits were only slightly affected by sex factor (Table 4).

Table 3: Growth performance of rabbits (n=74): least squares means of the effects in the model

	R^2 model	RMSE	Mean	Group *Pr > F*	C1C2	C1A2	A1C2	A1A2	Genetic *Pr > F*	Pure breds	Cross breds
Live Body Weight at 31 d (g)	0.11	119.9	599.8	*0.648*	551.8	611.1	575.4	583.9	*0.015*	540.5	620.6
Live Body Weight at 66 d (g)	0.22	247.0	1772.5	*0.098*	1725.9	1850.1	1724.2	1646.1	*0.002*	1628	1845
Live Body Weight at 94 d (g)	0.17	304.1	2755.3	*0.269*	2598.2	2741.0	2790.3	2655.9	*0.004*	2573	2819
Daily Weight Gain ph.1 (g/d)	0.21	5.5	33.78	*0.076*	33.4ab	35.3a	33.2ab	30.7b	*0.005*	31.08	35.31
Daily Weight Gain ph.2 (g/d)	0.24	7.0	35.21	*0.000*	30.1b	30.6b	39.1a	36.8a	*0.5527*	33.57	34.70
Daily Weight Gain (g/d)	0.17	4.5	34.41	*0.086*	31.9b	33.2ab	35.8a	33.5ab	*0.022*	32.17	35.02
Daily Feed Intake ph.1 (g/d)	0.09	14.5	100.2	*0.445*	99.9	103.2	98.3	95.6	*0.0684*	95.6	102.8
Daily Feed Intake ph.2 (g/d)	0.14	21.0	144.3	*0.284*	135.0	139.1	148.5	140.0	*0.016*	133.7	147.6
Daily Feed Intake (g/d)	0.13	14.5	119.9	*0.622*	115.9	119.5	120.5	115.4	*0.012*	112.8	122.9
Feed Conversio Ratio ph.1	0.21	0.31	3.00	*0.076*	3.02b	2.93ab	2.98ab	3.18b	*0.016*	3.13	2.92
Feed Conversio Ratio ph.2	0.12	1.88	4.37	*0.050*	5.02ab	5.34b	4.02ab	3.87a	*0.4579*	4.75	4.37
Feed Conversio Ratio	0.13	0.32	3.51	*0.033*	3.66b	3.64b	3.39a	3.46ab	*0.6554*	3.56	3.52
Protein Efficiency Ratio ph.1(s)	0.37	0.21	2.13	*<.0001*	1.90b	1.97b	2.25a	2.22a	*0.107*	2.04	2.13
Protein Efficiency Ratio ph.2	0.41	0.24	1.42	*<.0001*	1.12c	1.37b	1.41b	1.66a	*0.271*	1.43	1.35
Protein Efficiency Ratio (DWG/g protein)	0.53	0.14	1.73	*<.0001*	1.43b	1.67b	1.72b	1.90a	*0.963*	1.69	1.69

ph.1=phase 1; $^a>^b>^c$ P<0.05; (s) significant effect of sex: females 2.14; males 2.03

Table 4: Carcass and meat performance of rabbits (n=64): least squares means of the effects

	R^2 model	RMSE	Group *Pr>F*	C1C2	C1A2	A1C2	A1A2	Females	Males	Sex *Pr>F*	Genetic *Pr>F*
Slaughter weight, g	0.11	295	*0.89*	2788	2732	2748	2668	2758	2703	*0.42*	*0.03*
Dressing %	0.09	0.021	*0.73*	0.590	0.588	0.585	0.583	0.581	0.591	*0.04*	*0.48*
Chilling losses, %	0.12	0.004	*0.30*	-0.016	-0.016	-0.017	-0.017	-0.016	-0.017	*0.03*	*0.97*
Skin %	0.09	0.012	*0.80*	0.145	0.153	0.150	0.151	0.148	0.152	*0.37*	*0.13*
Gastro Intestinal Tract %	0.12	0.019	*0.53*	0.133	0.132	0.129	0.135	0.138	0.127	*0.02*	*0.53*
pH intestine	0.10	0.166	*1.00*	6.76	6.73	6.74	6.73	6.72	6.76	*0.38*	*0.04*
Liver %	0.43	0.004	*0.68*	0.031	0.035	0.033	0.034	0.031	0.035	*0.03*	*0.12*
Perirenal fat %	0.35	0.006	*0.22*	0.018	0.017	0.013	0.011	0.015	0.013	*0.24*	*0.21*
Hindleg % /CC	0.24	0.014	*0.92*	0.279	0.290	0.283	0.283	0.285	0.282	*0.63*	*0.23*
Cooking losses hindleg %	0.43	0.020	*0.13*	-0.11ab	-0.07a	-0.09ab	-0.10b	-0.09	-0.10	*0.71*	*0.10*
Hindleg raw meat/bone ratio	0.11	0.816	*0.83*	8.04	8.08	7.87	8.42	8.37	7.83	*0.30*	*0.76*
Hindleg cooked m/b ratio	0.09	0.778	*0.90*	7.07	7.45	7.05	7.45	7.52	6.99	*0.29*	*0.49*
cooking losses LT, %	0.42	0.061	*0.08*	-0.30b	-0.20ab	-0.21a	-0.28ab	-0.25	-0.25	*0.97*	*0.21*
WBS cooked LT, %	0.12	0.754	*0.69*	2.95	2.48	2.37	2.63	2.70	2.52	*0.71*	*0.83*
pH Biceps f.	0.06	0.188	*0.98*	5.82	5.80	5.81	5.82	5.81	5.82	*0.79*	*0.40*
pH Long. D.	0.20	0.112	*0.62*	5.60	5.58	5.65	5.64	5.65	5.59	*0.19*	*0.48*
pH Hindleg	0.10	0.16	*0.24*	5.86	5.95	5.85	5.89	5.91	5.87	*0.21*	*0.57*

$^a>^b>^c$ P<0.05

CONCLUSIONS

It was concluded that nitrogen restriction in a long post-weaning phase could be beneficial to heavy broiler rabbits production because their prolonged compensatory growth and to maximize N utilization with minimum N output, without modification in carcass and meat quality. A similar, strong nitrogen restriction (up to -20%) in the fattening phase (for environmental issues, and/or for improving the health status of the animals) can be placed, without significant performance reductions in comparison with standard protein diets.

ACKNOWLEDGEMENTS

The Research was supplied by MiPAF (Rome) in the Project “RENAI”: Tecnologie alimentari per la riduzione dell’impatto ambientale da azoto negli allevamenti intensivi italiani. The authors are in debts with feed factory Mangimi 4 Torri (Q.A.S.) Fossano (CN) for feed preparation.

REFERENCES

Lebas F. 1983. Bases physiologiques du besoin protéique des lapins. Analyse critique des recommandations. *Cuni-Science, 1, 16-27.*

Lebas F. 2004. Reflections on rabbit nutrition with a special emphasis on feed ingredients utilization. *In: Proc. 8th World Rabbit Congress, 2004 September, Puebla, Mexico, 686-735.*

Maertens L. 1999. Towards reduced feeding costs, dietary safety and minimal mineral excretion in rabbits: a review and opinion article. *World Rabbit Sci.,7, 65-74.*

Xiccato G., Trocino A., Sartori A., Queaque P.I. 2002. Reducing dietary protein in phase feeling programs for growing rabbits. *In: Proc. COST Action 848, WG-1 and WG-4 Joint meeting 2002, Ispra, Italy, 26*.

Zoccarato I., Gasco L., Schiavone A., Guo K., Barge P., Rotolo L., Savarino G., Masoero G. 2008. Effect of natural extract of chestnut wood inclusion (ENC®) in normal and low protein amminoacid supplemented diet on heavy broiler rabbits. *In: Proc. 9th World Rabbit Congress, 2008 June, Verona, Italy, 873-878.*