

Influence of increased level of methionine in diets on disappearance rate of amino acids (AA) from yolk sac protein and ileal digestibility of AA in chickens and ducks

D. JAMROZ^{1*}, T. WERTELECKI¹, A. LEMME², J. ORDA¹ and A. WILICZKIEWICZ¹

¹Agricultural University, Dept. Animal Nutrition and Feed Quality, 51-630 Wrocław, Poland,

²Degussa Feed Additives AG, Hanau, Germany

*Corresponding author: djamroz@zoo.ar.wroc.pl

Two experiments were carried out on Hubbard HI-Ye broiler chickens and A11 Pekin ducks. On day 1, exactly 5 h after hatch, 30 chickens and 30 ducks were selected and then killed in order to determine the chemical composition of yolk sac residues. Other birds in both experiments were assigned into 5 treatments (every with 6 or 4 replications) and fed mixtures containing gradually increased levels of methionine (crystalline DL-Met - 99 %) - 0.30 (control), 0.33; 0.37; 0.42 and 0.48 %. The purpose of these studies was to determine the effect of increased dietary methionine on yolk sac (YS) absorption rate as estimated on day 1st, 3rd, 5th, 7th and 1st, 3rd, 4th and 6th of chickens and ducks life, respectively. There the rate of amino acids (AA) disappearance from YS protein, changes of AA profile of protein in the YS remainders as well as apparent ileal digestibility of AA in the early phase of birds' growth (on day 14th for chickens and day 21st for ducks) had also been evaluated. All estimations were executed always on the 12 birds per treatment, day of sampling and species. Increased dietary Met has not exert any distinct effect on the rate of AA disappearance from protein of YS residues in chickens, however positively influenced the absorption of Met at the period between 3rd and 5th day of life. In AA profile of YS protein the tendency of lower share of sulphur AA to lysine i.e. their slightly greater disappearance was stated in chickens fed diets enriched with Met. Increased Met addition improved the ileal digestibility of Lys, Met and total sulphur amino acids. The resorption of YS contents in ducks was to a small extent depending on the Met level in diet. The dynamic of disappearance rate was similar for some AA and no effects of dietary Met level were observed. Tendency of better AA digestibility (Met $P < 0.05$; Cys) in birds fed Met-rich diets (0.42 and 0.48 %) was observed.

Keywords: broilers; ducks; methionine; yolk sac; digestibility

Introduction

Ability of absorption of nutrients from yolk sac residues in the post-hatch period is characteristic for fast development of chickens and ducklings during first days of life (Chamblee *et al.*, 1992; Muramaki *et al.*, 1992; Nir *et al.*, 1993; Dibner *et al.*, 1998; Jamroz and Wertelecki, 1998; Jamroz *et al.*, 2001, 2004; Wertelecki and Jamroz, 2003). The main nutrients which are available from the yolk sac to birds in this period are proteins and lipids, in applied feed mixtures mainly starch, and plant protein, characterized by the specific amino acid composition and their availability (Baker and Han, 1994; Kadim *et al.*, 2002; Sklan and Noy, 2003; Wertelecki and Jamroz, 2004).

Methionine is the first limiting amino acid for poultry and the necessity of supplementation of poultry diets with it has been confirmed in scientific investigations (Han and Baker, 1993; Sklan and Noy, 2003) and in practice as well. However, only sparse information on the chickens' and ducks

requirement and conversion of methionine in first post-hatch days are available. The same concerns the knowledge about the ideal AA profile in the diets for these birds during first two weeks of life.

The purpose of the presented study was to determine the influence of increased methionine levels in diet on the dynamic of protein and amino acids resorption from yolk sac, amino acid profile in residual protein in yolk sac and AA digestibility in chickens and ducks at 14 or 21 days of life.

Materials and methods

Two experiments were carried out on Hubbard HI-Ye broiler chickens and A11 Pekin ducks. On day 1, exactly 5 h after hatch, 30 chickens and 30 ducks were selected and then killed in order to determine the chemical composition of yolk sac residues. Other birds in both experiments were assigned into 5 treatments (every with 6 or 4 replications) and fed mixtures containing gradually increased levels of methionine. Those were achieved by addition of crystalline DL-methionine (99 %) at doses of 0.30 (control), 0.33; 0.37; 0.42 and 0.48 % (Table 1).

Table 1 Design of experiments.

Treatments	DL-methionine supplement (in %)	Total dietary level of Met+Cys (in %)
I	-	0.67
II	0.03	0.70
III	0.07	0.74
IV	0.12	0.79
V	0.18	0.85

* by lysine content 0.95 % for chickens and 1.16 % for ducks in first 7 days post-hatch

** the mixture was composed from the maize, barley, wheat, soya bean meal, peas, soya oil and mineral-vitamin premixes and contained 12.2 MJ ME/kg for chickens and 11.7-12.3 MJ EM/kg for ducks.

The purpose of these studies was to determine the effect of increased dietary methionine on yolk sac absorption rate as estimated on day 1st, 3rd, 5th, 7th and 1st, 3rd, 4th and 6th of chickens and ducks life, respectively.

The rate of amino acids (AA) disappearance from yolk sac protein, changes of AA profile of protein in the yolk sac remainders as well as apparent ileal digestibility of AA in the early phase of birds' growth (on day 14th for chickens and day 21st for ducks) had also been evaluated. All estimations were executed always on the 12 birds per treatment, day of sampling and species. Chemical analyses of the biological material were realized according to the standard analytical methods AOAC then evaluated statistically using one- and two factorial ANOVA.

Results and discussion

Increased dietary Met has not exert distinct effects on the rate of AA disappearance from protein of yolk sac residues in **chickens**, however positively influenced the absorption of Met at the period between 3rd and 5th day of life. In AA profile of yolk sac protein the tendency of lower share of sulphur AA to lysine i.e. their slightly greater disappearance was stated in chickens fed diets enriched with Met. It was also stated that increased Met addition only slightly improved the ileal digestibility of Lys, Met and total sulphur amino acids.

The process of resorption of yolk sac contents in **ducks** was to a small extent depending on the Met level in diet. The dynamic of disappearance rate was similar for some AA and no clear effects of dietary Met level were stated. Tendency of better AA digestibility (Met P<0.05; Cys) in birds fed Met-rich diets (0.42 and 0.48 %) was observed.

Table 2 Amino acids profile of yolk sac protein (as calculated to Lys = 100 %).

AA	Methionine level in diets (%)														
	0.30			0.33			0.37			0.42			0.48		
	Chickens														
	1	3	5	1	3	5	1	3	5	1	3	5	1	3	5
Met	42	42	36	42	35	30	44	39	32	43	36	30	49	40	32
Cys	32	31	32	32	30	29	33	32	26	31	30	31	36	33	33
Thr	74	70	69	72	72	69	73	72	69	71	75	72	73	73	72
Ile	71	69	68	73	63	65	69	67	70	71	66	66	68	65	68
Leu	134	132	127	138	127	126	137	126	127	134	133	130	136	131	131
Tyr	57	56	55	56	56	53	57	54	56	55	57	59	55	55	57
Phe	83	78	73	78	74	68	83	76	75	82	75	69	81	75	72
Try	26	9231	30	29	30	30	29	30	28	28	28	43	31	34	31
	Ducks														
	1	3	4	1	3	4	1	3	4	1	3	4	1	3	4
Met	50	32	27	49	30	22	41	29	28	46	31	26	53	32	30
Cys	31	26	26	30	27	21	26	27	24	28	25	23	29	26	24
Thr	76	64	64	77	62	57	75	66	60	79	65	65	85	67	63
Ile	61	59	57	62	54	52	61	58	56	61	58	55	61	57	54
Leu	124	118	115	125	114	108	125	119	114	127	118	116	125	115	113
Tyr	67	70	60	70	66	61	68	67	59	70	68	63	71	65	62
Phe	77	68	65	79	65	62	77	69	64	81	66	66	83	67	64
Try	11	9	10	11	11	8	10	15	16	12	11	17	12	13	14

Table 3 Ileal apparent digestibility of amino acids (%) (means; \pm SD).

	Methionine level in diets (%)														
	0.30			0.33			0.37			0.42			0.48		
	Chickens (on day 14 of life)														
Met	92		1.9	91		1.9	91		2.2	93		2.5	94		1.2
Cys	83		3.3	80		3.1	79		2.9	83		1.3	82		2.2
Thr	78		4.4	77		2.6	75		3.0	78		1.5	77		1.8
Ileu	84		4.0	82		3.0	80		2.5	79		6.7	83		2.3
Leu	82		4.4	82		3.0	80		2.7	82		3.3	82		2.2
Tyr	78		4.6	78		2.9	72		3.6	75		2.2	75		3.4
Phe	86		3.3	85		2.9	84		2.2	82		6.0	84		2.9
Try	90		1.6	87		2.4	87		1.8	87		3.9	88		3.3
Lys	85		3.7	84		2.8	83		2.1	84		2.1	86		1.3
	Ducks (on day 21 of life)														
Met	91	ab	3.1	91	a	2.6	91	a	2.2	93	ab	1.0	94	b	1.6
Cys	75		5.3	76		5.2	77		2.8	76		2.1	78		3.2
Thr	68		4.7	71		5.2	70		2.9	68		4.1	69		5.2
Ileu	77		3.8	76		3.4	77		2.6	76		3.1	77		2.2
Leu	81		2.7	82		3.0	83		2.0	82		2.0	83		2.3
Tyr	71		4.8	70		4.5	72		3.4	70		3.8	71		4.2
Phe	85		2.2	85		2.4	85		1.9	85		1.8	84		2.3
Try	73		4.1	73		4.4	73		3.9	72		3.4	73		4.0
Lys	83		2.4	83		3.8	83		2.5	84		2.1	84		2.8

The significant decrease of yolk sac weight noted in the presented study at the period from day 0 to 5, confirms that the yolk sac residues serves as an important nutrients source, what is consistent with the data obtained by other authors (Chamblee *et al.*,1992; Jamroz and Wertelecki,1998; Jamroz *et al.*, 2004). The protein content in YS residues decreased clearly, within it the methionine content was considerably reduced, while other amino acids, in them lysine, content remains relatively constant. This effect suggests that methionine plays a special role during the first days of life. The amino acid profile in residues of yolk sac protein did not reveal any clear responses to the dietary Met levels.

Gradually increased Met level in diets slightly improved the ileal digestibility of methionine and sulphur amino acids. Presented in some publications values of apparent digestibility of AA shown on great variability of these values depending on the method of estimation, age of birds, diets and other parameters (Han and Baker,1993; Jamroz *et al.*,2001; Kadim *et al.*,2002).

Methionine as the donor of the methyl groups is very important for energy metabolism and its utilization. However, unexpectedly, in such very young birds the decrease of energy digestibility (77, 71, 67 and 64 %, respectively) was observed and it is difficult for explanation. Anticipated, improved digestibility and absorption of sulphur amino acids caused by increased Met level in the diet (Lemme et al.,2005; Sklan and Noy,2003) was not observed in presented studies.

References

- BAKER, D.H. and HAN, J.** (1994) Ideal amino acid profile for chicks during the first three weeks post-hatching. *Poultry Science*, **73**:1441-1447.
- CHAMBLEE, T.N., BRAKE, J.D., SCHULTZ, C.D. and THAXTON, J.P.** (1992) Yolk sac absorption and initiation of growth in broilers. *Poultry Science*, **71**:1811-1816.
- DIBNER, J.J., KNIGHT, C.D. and IVEY, F.J.** (1998) The feeding of neonatal poultry. *World Poultry-Elsevier*, **5**,14:36-40.
- HAN, J. and BAKER, D.H.** (1993) Effect of excess methionine or lysine for broiler fed a corn-soybean meal diet. *Poultry Science*,**72**:1070-1074.
- JAMROZ, D. and WERTELECKI, T.** (1998) Influence of fat addition to feed mixtures on the rate of yolk sac resorption in chickens, blood and pancreas enzyme activity. *Journal of Animal and Feed Science*, **7**: 271-276.
- JAMROZ, D., JAKOBSEN, K., ORDA, J., SKORUPIŃSKA, J. and WILICZKIEWICZ, A.,** (2001) Development of the gastrointestinal tract and digestibility of dietary fibre and amino acids in young chickens, ducks and geese fed diets with high amount of barley. *Comparative Biochemistry and Physiology, Part A*,**130**:643-652.
- JAMROZ, D., WERTELECKI, T., WILICZKIEWICZ, A., ORDA, J. and , SKORUPIŃSKA, J.** (2004) Dynamic of yolk sac resorption and post-hatching development of the gastrointestinal tract in chickens, ducks and geese. *Journal of Animal Physiology and Animal Nutrition*, **88**:239-250.
- KADIM, I.T., MOUGHAN, P.J. and RAVINDRAN, V.** (2002) Ileal amino acid digestibility assay for the growing meat chicken – comparison of ileal and excreta amino acid digestibility in the chicken. *British Poultry Science*, **44**: 588-597.
- LEMME, A., KOZŁOWSKI, K., JANKOWSKI, J., PETRI, A. and ZDUŃCZYK, Z.** (2005) Responses of 36- to 63-day-old BUT Big-6 turkey toms to graded dietary methionine + cystine levels. *Journal of Animal and Feed Science*, Suppl.1,**14**:467-470.
- MURAMAKI, H., AKIBA, J. and HORIGUCHI, M.** (1992) Growth and utilization of nutrients in newly-hatched chick with or without removal of residual yolk. *Growth, Development and Aging*, **56**:75-84.
- NIR, I., NITSAN, Z. and MAHAGNA, M.** (1993) Comparative growth and development of the digestive organs and of some enzymes in broiler and egg type chicks after hatching. *British Poultry Science*, **34**:523-532.
- SKLAN, D. and NOY, J.** (2003) Crude protein and essential amino acid requirements in chicks during the first week post-hatch. *British Poultry Science*, **44**:266-274.
- WERTELECKI, T. and JAMROZ, D.** (2003) The effect of different protein level in feed on yolk sac resorption and changes of some allometric parameters of gastrointestinal tract in chicks. *Annales of Animal Science*, Suppl., **2**:243-247.
- WERTELECKI, T. and JAMROZ, D.** (2004) Amino acid profile of yolk sac in chickens fed mixtures with lowered protein content. *Medycyna Weterynaryjna*, **60**:976-981 (in Polish).