The Effect of Iodine in Various Forms on the Content of Selected Essential Amino Acids and Their Accumulation into the Broilers Chest Muscles

Mária Angelovičová[1], L'ubica Mrázová[1], Martin Kliment[1], Jana Tkačová[1], Martin Král[1], Ebrahim Alfaig[1]

Slovak University of Agriculture in Nitra, Faculty of Biotechnology and Food Sciences
949 76-Nitra, Tr. A. Hlinku, 2, Slovakia

Abstract
The aim of this study was comparison of a biological effectiveness of iodized oil premix and potassium iodide premix applied in feed mixtures on the protein value and selected essential amino acids content of broiler chickens meat. According to the obtained results of experiment of broiler chickens and chemical analyses of feed and breast muscles it was found that by using iodized oil the content of the selected essential amino acids was decreased with statistically significant ($P<0.01$, $P<0.001$) compared with using of potassium iodide premix, while as the protein content was not affected by the different forms of iodine. The biological value of protein was calculated and expressed as protein efficiency ratio (PER) and it was 3.048 to 3.626 during different fattening period.

Keywords: **Keywords**: amino acid, breast muscle, broiler chicken, feed, iodine

1. Introduction

Iodine affects the metabolism of all nutrients. It has the synergistic and antagonistic relationships with other macro and microelements. Its occurrence is related to geographical conditions. For the research of compensation other antibiotics feed supplements, it is important to address this now trace the central focus, not only in relation to the performance of animals, but also following the food quality and safety and health. Broiler strains with higher weight gain potential, such as Ross and Cobb, suffer a stronger influence of dietary Crude protein content than other genetic strains [12]. Protein and amino acid requirements vary considerably according to the physiological state of the bird, that is, the rate of growth. Other factors contributing to variations in amino acid requirements of the chickens include age, body size, sex and breed. Amino acid requirements decrease with age and at the same time, the ideal balance of amino acids changes gradually to reflect those of maintenance [14]. For instance, the percentage of amino acid required in the diet is the highest for young growing animals and declines gradually to maturity, when only enough amino acid to maintain body tissue is required [11]. The balance of amino acids needed for maintenance is not proportional to the balance of amino acids in a bird's tissues, but rather reflects the relative rate of obligatory loss of each individual amino acid [5]. For this reason, the balance needed for maintenance is considerably different from that needed for growth [10]. Dietary amino acid levels slightly below maintenance can sustain life, but muscle mass and functions are impaired [8]. Matching the amino acid profile of the diet with animal requirements is crucial for maximizing animal performance. Because the contributions of maintenance and growth to total amino acid

*Corresponding author: Mária Angelovičová, Tel. +421376415805,
Email:maria.angelovicova@gmail.com

requirement change with body size and the ideal different, the composition of the ideal amino acid pattern will change continuously during the growth period [9]. The most representative body compartment of the body amino acid pool is the skeletal muscle [4]. As the breast muscle accounts for 60% of the edible protein of the broiler carcass [7], it is an important component when studying animal response to dietary essential amino acid and total protein levels.

The aim of this paper was the investigation of the effectiveness of iodine oil premix and potassium iodide premix for performance of broiler chickens and biological value of protein in the breast muscle of fattening type chickens.

2. Materials and methods

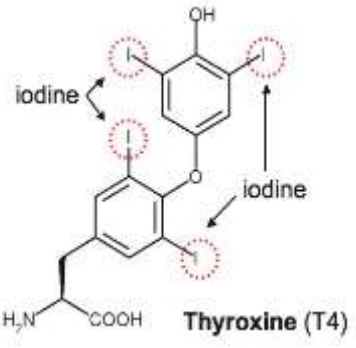
Broiler chickens Coob 500 were kept in deep litter hall for poultry farming. The capacity of the hall was 24 000 birds and equipped with boxes containing the feeding and drinking equipments. The experimental groups was divided according to the feed mixture active compounds, so the first group was the group of potassium iodide premix (PI) and the second was iodized oil premix (IO).

During the experiment the following variable had been studied: body weight of broiler chickens–scale Soenhle 7740, feed intake–for the whole group, as the difference of feed weighed at the beginning and end of the experiment, crude protein content–instrument Kjeltec Auto, Methionine, Lysine and Threonine in breast muscles of broiler chickens–amino acid analyzer AAA 400 M, protein quality was calculated on the basis of *protein efficiency ratio* (PER).

amino acid profiles for maintenance and growth

$$PER = \frac{\text{Weight gain (g/bird)}}{\text{Feed intake (g/bird)} * \text{Protein content feed}}$$

The chickens were fed with powder feed mixtures from 1 to 14 days by means of disc rack for feed and hat drinker for beards drinking. From 15 days to the end of feeding was used bucket feeders and watering place. Chickens were fed with feed mixtures nearly the same composition in the experimental PI and IO groups (Table 2 and 3). The difference was that the experimental IO group starter feed mixture did not contain antibiotic avilamycin compared to PI experimental group starter feed mixture. In all experimental IO feed mixtures (starter, growth and final) has been used mineral supplement without potassium iodide compared to the PI feed mixtures. Iodine in the experimental IO feed mixtures was used in the form of iodized oil, vehicle-vegetable oil (PX IO) (Table 1). Effects of iodine linked to thyroid function.



Iodine incorporated into thyroid hormone, Thyroxine (T4) (URL 1: International Council for the Control of Iodine Deficiency Disorders).

Table 1. Experiment scheme

Experiment period (day)	1.-18.	19.-31.	32.-36.
Number of days	18	13	5
PX IP (n = 100 pcs)	starter (antibiotics, PI)	growth (PI)	final (PI)
PX IO (n = 100 pcs)	starter (0.5% IO)	growth (0.5% IO)	final (0.5% IO)

PI=premix containing potassium iodide; IO=premix of iodinated oil; n=number of birds

Table 2. Composition of the feed mixtures (%)

Variable	Feed mixture		
	Starter	Growth	Final
Corn	25.00	30.00	30.00
Wheat	38.00	35.50	37.00
Plant oil	1.50	2.00	2.50
Soybean meal	27.00	26.00	26.50
Wheat feed meal	0.155	0.306	0.306
Mycosorb	0.025	-	-
Betaine 96%	0.015	0.01	0.01
Fish meal	5.00	2.50	-
Prebiotics	0.10	-	-
Sodium chloride	0.25	0.35	0.35
Monocalcium phosphate	1.10	1.40	1.40
Calcium carbonate	1.10	1.40	1.40
Coccidiostat	0.05	-	-
L-lysine premix	0.26	0.179	0.179
L-threonine premix	0.10	0.07	0.07
DL-methionine premix	0.25	0.20	0.20
Vitamin premix	0.045	0.04	0.04
Mineral premix	0.045	0.04	0.04
Feed enzymes	0.005	0.005	0.005

Table 3. Nutrient and energy content in 1 kg feed mixture

Index	Measurement unit	Feed mixture		
		Starter	Grower	Finisher
ME_N	[MJ]	12.884	13.047	13.182
Crude protein	[g]	226.70	207.48	195.54
Lysine	[g]	13.80	11.80	10.80
Methionine	[g]	6.124	5.667	4.786
Threonine	[g]	8.915	8.151	7.317
Linoleic acid	[g]	22.343	26.768	30.636
Calcium	[g]	9.32	9.33	8.49
Nonphytate phosphorus	[g]	4.52	4.19	3.74
Iodine	[mg]	0.89	0.87	0.76

ME_N – metabolizable energy

3. Results and discussion

Crude protein content in the broiler breast muscle

The results of the analysis and mathematical and statistical assessment of the crude protein in broiler chickens breast muscle (Figure 1, Table 4) showed almost the same values (no statistically significant difference between groups P>0.05). Iodized premixes of different sort did not affect crude protein content in breast muscle of broiler chicken.

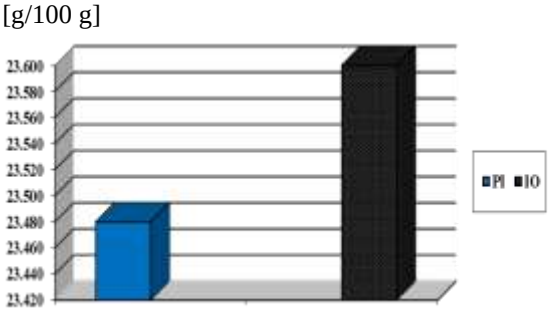


Figure 1. Crude protein content in the broiler breast muscle

Table 4. Mathematical-statistical assessment of crude protein content in the broiler breast muscle

	Group				
	PI	n = 10	IO,	n = 10	
	SD	v_c	SD	v_c	t-test
Crude protein [g/100 g]	0.36	1.52	0.48	2.04	0.46^{-}

SD–standard deviation; v_c–coefficient of variation; $^{-}$P >0.05–no statistically significant difference between groups; n=number of birds; PI=potassium iodide premix; IO=iodized oil premix

Lysine content in the broiler breast muscle

Lysine content was decreased in breast muscles of broiler chickens fed with feed mixtures, which contained an iodized oil premix. This difference of lysine content was confirmed by statistical analysis and it was statistically significant (P≤0.001) (Figure 2, Table 5) in compare with its content in breast muscles of chickens after feeding of feed mixtures with potassium iodide premix and promoting of antibiotics avilamycin. Amino acid requirements are influenced by several environmental [2], genetic [3], and nutritional [13] factors. In this context, it was shown that modern broiler strains, with high potential for the accretion of valuable parts, such as the breast muscle, have high dietary lysine requirements [3].

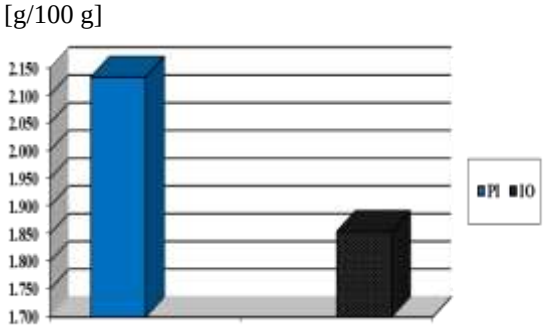


Figure 2. Lysine content in the broiler breast muscle

Table 5. Mathematical-statistical assessment of lysine contenting the broiler breast muscle

	Group				
	PI	n = 10	IO	n = 10	
	SD	v_c	SD	v_c	t-test
Lysine [g/100 g]	0.075	3.50	0.073	3.95	5.58^{+++}

SD–standard deviation, v –coefficient of variation, $^{+++}$P≤0.001 –statistically significant difference between groups, n=number of birds, PI=potassium iodide premix, IO=iodized oil premix

Methionine content in the broiler breast muscle

Mathematical and statistical assessment of results of methionine in broiler chickens breast muscle showed that the essential amino acid methionine was lower after feeding the feed mixtures with iodized chickens fed with potassium iodine premix. The different was statistically significant (P≤0.01) (Figure 3, Table 6) between groups. It found a decreased biological efficiency iodized oil at incorporation of methionine compared with the effects of potassium iodide and promoting of antibiotics avilamycin.

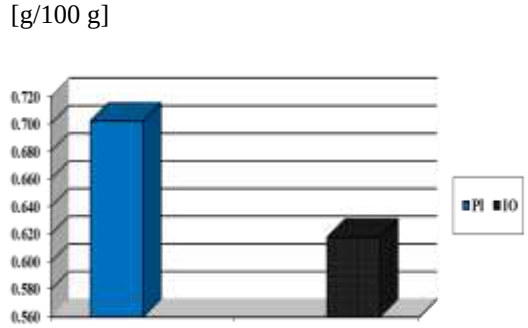


Figure 3. Methionine content in the broiler breast muscle

Table 6. Mathematical-statistical assessment of methionine content in the broiler breast muscle

	Group				
	PI	n = 10	IO	n = 10	
	SD	v_c	SD	v_c	t-test
Threonine [g/100 g]	0.046	4.19	0.038	4.03	5.10^{+++}

SD–standard deviation; v_c–coefficient of variation; $^{++}P \leq 0.01$–statistically significant difference between groups; n=number of birds; PI=potassium iodide premix; IO= iodized oil premix

Threonine content in the broiler breast muscle

The accumulation of threonine in broiler chickens breast muscle was statistically significantly lower (P≤0.001) (Figure 4, Table 7) after feeding of feed mixtures with iodine oil premix than after feeding of feed mixtures with potassium iodide premix with promoting antibiotics avilamycin.

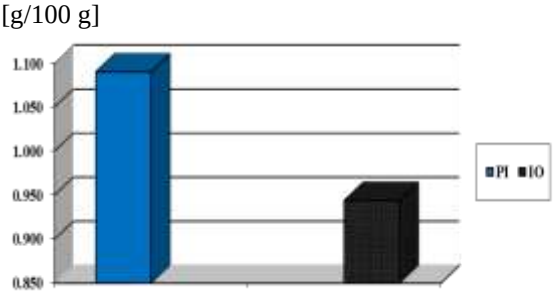


Figure 4. Threonine content in the broiler breast muscle

Table 7. Mathematical-statistical assessment of threonine content in the broiler breast muscle

	Group				
	PI	n = 10	IO	n = 10	
	SD	v_c	SD	v_c	t-test
Threonine [g/100 g]	0.046	4.19	0.038	4.03	5.10^{+++}

SD–standard deviation; v_c–coefficient of variation; $^{+++}P \leq 0.001$–statistically significant difference between groups; n=number of birds, PI=potassium iodide premix, IO=iodized oil premix

Table 8. Total body weight gain of broiler chickens, total intake of feed, total intake of crude protein, lysine, methionine and threonine per bird and protein efficiency ratio (PER)

	Group					
	PI			OI		
	Phase					
	Starter	Growth	Final	Starter	Growth	Final
The total weight gain of broiler chickens [g per bird]	573.00	1078.02	452.38	597.60	1115.94	414,42
Ґhe total intake of feed during starter, growth and final periods per bird [g per bird]	787.05	1793.37	835.79	762.02	1738.77	861.60
Ґhe total intake of crude protein during starter, growth and final periods [g per bird]	178.42	372.09	163.43	172.75	360.76	168.48
PER (protein efficiency ratio)	3.21	2.90	2.77	3.45	3.09	2.46
Ґhe total intake of lysine during starter, growth and final periods [g per bird]	10.86	21.16	9.03	10.52	20.52	9.31
Ґhe total intake of methionine during starter, growth and final periods [g per bird]	4.82	10.16	4.00	4.67	9.85	4.12
Ґhe total intake of threonine during starter, growth and final periods [g per bird]	7.02	14.62	6.11	6.79	14.17	6.30

PI=potassium iodide premix; IO=iodized oil premix

Assessment of food consumption and intake of total crude proteins, lysine, methionine and threonine, was found relatively balanced for premixes iodized oil and iodine potassium. The results were almost the same at broiler chickens body weight gain and almost the same at values of PER during the fattening period (Table 8). Quality and quantity of dietary CP influence muscle

protein mass [6], and by inference, protein metabolism and muscle growth. Abdel-Maksoud *et al.* [1] studied the protein efficiency ratio of broiler chickens during starter period (1-18 days of age), and they found that the values of protein efficiency ratio were 3.048 to 3.626, and this result was comparable to our result for the same period which were 3.21 and 3.09 after feeding of premixes potassium iodine and iodized oil respectively.

4. Conclusions

On the basis of experimental results obtained from fattening type of chickens Cobb 500 and of the chemical analysis of feed and breast muscle and the statistical analysis of the obtained results, we can conclude that the use of iodized oil premix oil in feed mixtures reduced the incorporation of the essential amino acids, lysine, methionine and threonine in the breast muscles in comparison with the effects of the mixture of potassium iodide premix and promoting of antibiotics avilamycin. While the biological value of protein which calculated as PER for the different phases, it was found that the broiler chicken breast muscles after feeding of iodized oil premix reduced the biological value of protein in the starter and the final phase, and during growth was increased compared to the action of potassium iodide. The protein content was almost the same for the effects of the iodized oil and potassium iodine.

Acknowledgements

This work was supported by Scientific Grant Agency under the contract No. VEGA 1/0007/11.

References

1. Abdel-Maksoud, A., Yan, F., Cerrate, S., Coto, C., Wang, Z., Waldroup, P. W., Effect of dietary crude protein, lysine, level and amino acid balance on performance of broilers 0 to 18 days of age, International Journal Poultry Science, 2010, 9, 21-27
2. Borges, A.F., Oliveira, R.F., Donzele, J.L., Exigência de lisina para frangos de corte machos no período de 22 a 42 dias de idade, mantidos em ambiente quente, Revista Brasileira de Zootecnia, 2002, 31, 1993-2001
3. Fatufe, A., Timmler, R., Rodehutscord, M., Response to lysine intake in composition of body weight gain and efficiency of lysine utilization of growing male chickens from two genotypes, Poultry Science, 2004, 83, 1314-1324
4. Fernández-Fígares, I., Prieto, C., Nieto, R. et al., Free amino acid concentrations in plasma, muscle and liver as indirect measures of protein adequacy in growing chickens, Animal Science, 1997, 64, 529-539
5. Gous, R.M., Morris, T.R., Evaluation of a diet dilution technique for measuring the response of broiler chickens to increasing concentrations of lysine, British Poultry Science, 1985, 26, 147-161
6. Grizard, J., Dardevet, D., Papet, I., Mosoni, L., Patureau-Mirand, P., Attaix, D., Tauveron, I., Bonin, D., Arnal, M., Nutrient regulation of skeletal muscle protein metabolism in animals. The involvement of hormones and substrates, Nutrition Research Reviews, 1995, 8, 67-91
7. Labadan, M., Hsu, K.N., Austuc, R.E., Lysine and arginine requirements of broilers chickens at two-to three-week intervals to eight weeks of age, Poultry Science, 2001, 80, 599-606
8. Leeson, S., Caston, L., Summers, J.D., Broiler response to diet energy, Poultry Science, 1996, 75, 529-535
9. Mack, S., Bercovici, D., de Groote, G., Leclercq, B., Lippens, M., et al., Ideal amino acid profile and dietary lysine specification for broiler chickens of 20-40 days of age, British Poultry Science, 1999, 40, 257-265
10. Nemavhola, Z., The effect of different diets on production performance and meat quality of the indigenous chickens. Masters of Agricultural Management (Animal Production) Dissertation, University of Limpopo, South Africa, 2001
11. Pond, W. G., Church, D. C., Pond, K. R., Basic Animal Nutrition and Feeding, 4th Edn., John Wiley and Sons, New York, USA, 1995, pp. 615
12. Sterling, K. G., Petsi, G. M., and Bakalli R. I., Performance of different broiler genotypes fed diets with varying levels of dietary crude protein and lysine, Poultry Science, 2006, 85, 1045-1054
13. Urdaneta-rincon, M., Lange, K., Peña-Ortega, L. et al., Lysine requirements of young broiler chickens are affected by level of dietary crude protein, Canadian Journal of Animal Science, 2005, 85, 195-204
14. Zubair, A. K., Leeson, S., Compensatory growth in the broiler chicken: A review, World's Poultry Science Journal, 1996, 52, 192-201
15. URL 1: International Council for the Control of Iodine Deficiency Disorders [cit. 2012-03-12]. Available: Emedicine.medscape.com / 122714 - overview, *27* January 2012