СІЛЬСЬКОГОСПОДАРСЬКІ НАУКИ

UDK 636.59.085.55:637.5.05
DOI: 10.15587/2313-8416.2014.27940

NUTRITIONAL AND BIOLOGICAL VALUE OF QUAIL MEAT WITH FEED-STAFF USAGE WITH DIFFERENT PROTEIN LEVELS

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This article is devoted to quail meat quality analyses under the influence of feed-staff feeding with different protein levels. Relationship between the levels of quails protein supply and slaughter indexes and chemical composition of the pectoral muscles is established.
Keywords: slaughter, meat, quail, feed-staff, protein, amino acids, exchange energy, power, feeding norms, fat.

Стаття присвячена аналізу м'ясних якостей перепелів під впливом згодовування комбікормів із різною протеїновою цінністю. Установлено характер зв'язку між рівнями протеїнового живлення перепелів та показниками забою і хімічного складу грудних м'язів.
Ключові слова: забій, м'ясо, перепели, комбікорм, протеїн, амінокислоти, обмінна енергія, живлення, норми годівлі, жир.

1. Introduction

Increasing of the role of information, knowledge and information technology in society significantly influences the preferences and motivations of food of animal origin criteria choice regarding to their quality and dietary value.

Poultry for its nutritional properties differs from other kinds of meat, and is recommended for diet and nutrition in different age groups, children, medical and gerodietetics nutrition. It is projected that in 2022 poultry meat in total meat balance of the world will occupy the first place, the second – pork, third – beef (1 Fisinin B.2006).

At the same time by American expert analysis meat shortage in the world at that time will be about 400 million tons (2 Prishutkina S.2006). The current state is characterized by the fact that many countries import poultry, that indicates the demand for it, and accordingly determines the intensive development of poultry industry. Moreover, species assortment and diversity is one of the key requirements of today's consumers.

In many countries today there is increasing interest in growing quails both in terms of their laboratory facilities and in connection with use as raw material for the creation of new functional foods (3 Antipova L. 2001). This type of birds, due to the fact that in poultry industry it is used relatively for not a long time (about 50–100 years), has retained much of its nutritional meat properties of wild ancestors. However, as you know, under the influence of domestication and breeding and technology factors meat quality may vary.

Analysis of recent publications shows that few studies of the impact of various factors on the meat quality of quails were held. In particular, in studies (4 González V. et.al. 2006**,** 5.Sarica. S. et.al. 2005. 6. Parizadian B.et.al. 2011. 7.Maiorano G. et.al. 2011. 8. Varigina E.2009. 9.Ibatullin I.I. et.al. 2006, 10.Sichov M. et.al. 2010, 11.el-Denqawy R. et.al. 2001) attention was focused on the study of quail meat quality due to thermal stress during transportation to slaughter house, the influence of L-carnitine supplementation on fat content in meat, breed characteristics of the accumulation of cholesterol and different levels of amino acid and lipid nutrition, nutritional properties of meat of wild quail.

Thus, the current state of elaboration of standardized quail feeding gives the reason to believe that the problem of protein quail feeding is studied a little, and therefore has some scientific and practical value.

2. Materials and methods of the study

Experimental studies conducted in conditions of problem research laboratory feed additives of National University of Life and Environmental Sciences of Ukraine. For the experiment Japanese quail with the age 32 days were used. The experiment was carried out with the method of groups. For the experiment 224 quail heads were selected, of which four groups were formed due to the analogue principle, 56 heads in each. Selection of the analogues was carried out of live weight and age. Duration of the experiment was 120 days. The main period of the experiment was divided into four sub-periods lasting 28 days (four weeks).

Experimental herd was kept at five-tier battery cage, in each cell size 60x40x20 cm 20 heads were kept (15 females and 5 males). The area per head was 120 cm^2, the front feeding – 2 cm, watering – 1 cm. Microclimate parameters where poultry was kept, met all zoohygienic standards.

Experimental feeding of quails in the accounting period was carried with a complete combination fodder according to the scheme of the experiment (Table 1).

Table 1

Figures of scientific and economic experiment

Group	Period of experiment			
	comparative (14 days)		main (120 days)	
	Contain in 100 g of combination fodder			
	raw protein, %	exchange energy, MJ	raw protein, %	exchange energy, MJ
1 – control	20	1,17	20	1,17
2 – research	20	1,17	23	1,34
3 – research	20	1,17	24	1,34
4 – research	20	1,17	25	1,34

In the diet of research groups hens the level of raw protein and exchange energy was regulated by fish flour and oil.

To investigate the anatomical and morphological analysis of carcasses, morphological and biological parameters of blood and liver at the end of the experiment controlling slaughter of quails was conducted. Slaughter of poultry was carried out by cutting off the head between the first cervical vertebra and the base of the head. For slaughter to 3 heads of each group were chosen.

Anatomical and morphological analysis of poultry carcasses was performed by the method T. M. Polyvanovoyi, amino acid composition of pectoral muscle - the method of thin-layer chromatography.

3. Results of the research

Nutritional quality of meat is determined by its chemical composition, which in turn reflects the peculiarities of birds feeding. The results showed (table 2), that under the influence of different levels of quail feeding there are changes in the chemical composition of meat.

In particular, increased levels of raw protein to 23–25 % and exchange energy MJ/100 to 1,34 g (second – fourth groups) influenced the increase of content of dry matter, organic matter, protein, fat and reduce of nitrogen-free extractives (MAR), water and ash.

Table 2

Chemical composition of big pectoral muscle, %

Rate	Groups			
	1	2	3	4
Water	75,70±0,38	74,70±0,25*	74,50±0,46*	74,40±0,53*
Dry matter	24,30±0,38	25,30±0,25	25,50±0,46*	25,60±0,53*
Ash	0,93±0,03	0,87±0,01	0,80±0,02	1,10±0,03*
Organic matter	23,39±0,36	24,46±0,26	24,69±0,43*	24,54±0,49
Protein	19,91±0,30	22,03±0,26*	22,28±0,13*	22,72±0,14*
Fat	0,88±0,01	1,00±0,05*	1,06±0,01*	1,01±0,03*
MAR	2,60±0,16	1,43±0,12**	1,34±0,14**	0,80±0,09***

**P<0,05; ** P<0,01; *** P<0,001 in comparison with 1st group*

The increase of raw protein in the quails diet from 20 % (first group) to 23 –25 % (second - fourth) helped to reduce water content in meat from 75,7 to 74,4 % (P <0.05) and increase content of dry matter from 24,3 to 25,6 %. The highest dry matter content was in quails meat of 4th experimental group, which was 5,3 % higher compared with the rate of quails meat of control group.

Ash content in the quails meat of control group was 0,93 %, in poultry meat of research groups – 0,80–1,10 %. In the meat of quails of 4th experimental group the highest content of ash was revealed, which is probably higher than the rate of the control group by 0,17 %. Ash content in the quails meat of 2nd and 3rd experimental group compared with the rate in the control birds and 4th experimental groups was lower by 0,06 and 0,3 %. Regarding to the control indicated difference is statistically improbable. Compared with the rate in poultry of 4th group ash content in quails meat of 2nd and 3rd research groups shows significant difference (P <0,01).

In addition, the quails meat of research groups increasing the content of organic matter also had place.

The main mass of the organic matter is protein and fat. Protein content in quails meat of control group was 19,91 %, while in the meat of research groups - ranged from 22,03 to 22,72 %.

Increase in protein content and exchange energy in quail feed of research groups caused greater accumulation of protein in meat at 2,12–2,81 % compared to its content in the birds of the first group (P<0,05). It should be noted that the more quail consumes protein from food the more it accumulated in the pectoral muscles. Thus, the increase of raw protein in the quail diets of research groups from 23 % to 24 % and 25 caused the increase of its content in meat from 22,03 to 22,28 % and 22,72 %. In general, most of protein in the muscle layers was in the 4th research group, and was 22,72 %, which is 2,0–3,1 % higher compared with the rate in birds of 2nd and 3rd research groups.

The influence of different levels of feeding quails on the fat content in the meat was determined. In particular, increased levels of raw protein and exchange

energy in diets of quails increased the fat content in meat from 0,88 % (first group) to 1,00–1,06 % (second – fourth group). Highest fat content in hens meat was in the 3rd and 4th experimental groups and was 1,01–1,06 % or 14,7–20,5 % (in relative units) higher compared with analogs of the first group (P <0,05).

Thus, an increase in the energy value of quail diets likely increase of the fat content of pectoral muscles is observed.

Along with increasing of mass fraction of fat in quails meat of research groups reduction of nitrogen-free extractives is marked. Mass fraction of MAR in quails meat of control group was 2,6 %, while in hens meat of research groups – 0,80–1,43 %. In this case, the difference compared with the rate in quails of control group is statistically significant (P < 0,01).

It should be pointed out that with the increase of raw protein and exchange energy in hens diets of research groups MAR content in meat decreased from 1,43 (second group) to 1,34 and 0,8 % (third and fourth group). By this measure among poultry of research groups likely differences are not observed.

These data indicates that the increase of protein levels and exchange energy in the diets of quails decreases water content and nitrogen-free extractives and increases the content of dry matter, organic matter, especially protein and fat in the meat. Magnitude of the changes that occur in the chemical composition of poultry of the research groups at the same time is not the same, which is caused by different levels of raw protein in the diet.

The biological value of poultry is determined by full value of protein, content and the ratio of these essential amino acids. Protein in white quail meat is contains enough of all the essential amino acids for humans (Table 3).

The results of the research suggest that increase of quail feeding levels increases the accumulation of essential amino acids in pectoral muscle. Thus, the number of methionine in quails meat of research groups ranged from 572 to 638 mg. However, it should be noted that the increase of the level of raw protein in the quail diets of research groups from 20 (first group) to 23–25 % (second – fourth group) caused the increasing of methionine content in meat by 2,4–2,7 times (P <0,001). The highest content of methionine was in quails meat of 3rd experimental group and was 638 mg, 1,4–11,5 % higher compared with the rate in quails of 2nd and 4th experimental groups. And the difference between the 3rd and 4th experimental groups was statistically significant (P <0,05).

Table 3

Amino acid composition of big pectoral muscle, mg/100 g

Rate	Groups			
	1	2	3	4
Methionine	238±14,0	629±15,3***	638±16,3***	572±14,2***
Tryptophan	268±18,5	454±23,5**	445±10,3**	563±15,7***
Leucine	655±13,2	1187±107,4*	1775±148,4**	1535±15,9***
Isoleucine	953±48,9	1154±29,4*	998±73,5	937±45,2
Lysine	1718±52,2	2163±65,8**	1990±27,9**	19,54±5,0*
Arginine	1426±57,5	1702±42,4*	1216±7,4	1219±23,5*
Threonine	367±24,5	1140±27,6***	979±53,7**	864±52,4**
Phenylalanine	865±28,3	1121±46,4**	832±36,7	737±12,2*
Valine	992±39,8	1259±17,6**	1025±64,7	862±21,0
Histidine	663±12,4	852±14,5***	738±21,8*	628±17,9
Glycine	974±36,9	10,94±20,9	991±34,9	905±60,3
Total	**9119**	**12755**	**11627**	**10776**

**P<0,05; ** P<0,01; *** P<0,001 in comparison with 1st group*

Analyzing the data content of methionine in quails meat depending on the level of raw protein, it should be noted that the increase of its level to 23 and 24 %, caused the increase of methionine content from 629 to 638, and up to 25 % – on the contrary, decrease by 9,9–11,5 % compared with the second and third experimental groups.

The same pattern was stated with tryptophan content in pectoral muscle. In muscle layers of research groups tryptophan content was 1,7–2,1 times higher (P<0,001) than in the analogs of control group. The highest content of tryptophan was in quails meat of 4th experimental group and was 563 mg, 24 and 26,5 % higher compared with this rate of 2 and 3rd experimental groups (P <0,05).

Analysis of got material shows that the quails meat of 3rd experimental group with increasing content of methionine tryptophan content decreased slightly compared with the rate in hens of 2nd and 4th experimental groups. Thus, the content of tryptophan in quails meat of 3rd group was the lowest and was 445 mg.

The introduction of feed of animal origin (fish flour) to the combination fodder increased leucine content in it, which helped to increase its plausible in muscle tissue. Leucine content in quails meat of control group was 655 mg, in research groups were in the range 1187–1535 mg.

In particular, it should be noted that increasing of raw protein levels in combination fodders of quails of 3rd experimental group caused a significant increase of leucine content in pectoral muscle. In this regard, it is worth mentioning that during the analysis of tryptophan content in meat quite opposite phenomenon was found – reduction of tryptophan in pectoral muscle with increasing levels of raw protein up to 24 %. In this case,

among all groups, the maximum number of tryptophan (1775 mg) was in the quails meat of 3rd experimental group that consumed feed containing 24 % of raw protein.

Increased content of raw protein in the quails fodder to 25 % (fourth group) caused a reduction of leucine by 13,5 % compared with the rate in the third experimental group, although its level is significantly higher than the rate in the control.

Among the essential amino acids lysine has the greatest value. Analysis of experimental data showed that the use of feed with different levels of raw protein caused a change in the amount of lysine in meat. In particular, in birds of the research groups significant ($P<0,05$, $P<0,01$) increase in lysine content in pectoral muscle was observed compared with control 13,7–25,9 % (236–445 mg).

Statistical analysis of the material has enabled to identify the influence of different levels of raw protein in the fodder on the content of lysine in meat in the research groups. Thus, increasing the level of raw protein in the diet of quails to

from 23 % (the second group) to 24 and 25 % (third and fourth groups) helped to reduce the accumulation of lysine in meat by 8,7–10,7 %, although the difference is statistically improbable.

On the basis of studies it was found that increased levels of raw protein up to 23 % cause the biggest accumulation of essential amino acids in muscle tissue, while increasing it to 24 and 25 % helps to reduce certain amino acids in meat. Thus, the total amount of essential amino acids in muscle tissue of quails of 2nd experimental group was 12755 mg, and the levels of hens of 3rd and 4th experimental groups were 11627 mg and 10776 mg.

4. Conclusions

So as a result of experimental studies it was found that increased levels of quail feeding cause not only increasing egg efficiency, but also significantly improve the biological value of meat, that increases the content of essential amino acids in it.

References

1. Fysynyn, V. Sovremennaya tendencyya razvytyya rossyjskogo ymy`rovogo ptycevodstva [Text] / V. Y. Fysynyn // Efektyvne ptaxivnycztvo. – 2006. – Vol. 11. – P. 8–12.

2. Pryshutkyna, S. Populyarnost produkcy y rastet [Text] / S. Pryshutkyna // Ptycevodstvo. – 2006. – Vol. 10. – P. 11–16.

3. Antypova, L. Funkcyonalne produkt y z myasa perepelov y krolykov [Electronic resource] / L. V. Antypova, S. V. Polyanskyx, A. V. Sokolov // Myasne texnologyy. – Available at: http://www.meatbranch.com/publ/view/331.html.

4. González, V. A. Effect of heat stress during transport and rest before slaughter on the metabolic profile, blood gases and meat quality of quail [Text] / V. A. Gonzalez, G. E. Rojas, A. E. Aguilera, S. C. Flores-Peinado, C. Lemus-Flores, A. Olmos-Hernandez, D. Mota-Rojas // International Journal of Poultry Science. – 2007. – Vol. 6, Issue 6. – P. 397–402. doi: 10.3923/ijps.2007.397.402

5. Sarica, S. The effect of dietary L-carnitine supplementation on growth performance, carcass traits, and composition of edible meat in Japanese quail (Coturnix coturnix japonica) [Text] / S. Sarica, M. Corduk, K. Kilinc // Journal of Applied Poultry Research. – 2005. – Vol. 14, Issue 4. – P. 709–715. doi: 10.1093/japr/14.4.709

6. Parizadian, B. Study the effects of different levels of energy and L-carnitine on meat quality and serum lipids of Japanese quail [Text] / B. Parizadian, M. Shams Shargh, S. Zerehdarah // Asian Journal of Animal and Veterinary Advances. – 2011. – Vol. 6, Issue 9. – P. 944–952. doi: 10.3923/ajava.2011.944.952

7. Maiorano, G. Cholesterol content and intramuscular collagen properties of pectoralis superficialis muscle of quail from different genetic groups [Text] / G. Maiorano, S. Knaga, A. Witkowski, D. Cianciullo, M. Bednarczyk // Poultry Science. – 2011. – Vol. 90, Issue 7. – P. 1620–1626. doi: 10.3382/ps.2010-01190

8. Varygyna, E. Energo-amynokyslotnoe pytanye perepelov myasnogo napravlenyya produktyvnosty` [Text] : dyss. ... kand. byol. nauk : 06.02.02 / E. S. Varygyna. – Moscow, 2009. – 216 p.

9. Ibatullin, I. I. Naukovo-praktychni rekomendaciyi z godivli perepeliv / I. I. Ibatullin, V. V. Otchenashko, N. M. Slobodyanyuk. – Kiev: NAU, 2006. – 44 p.

10. Sychov, M. Biologichna efektyvnist m'yasa ta pechinky m'yasnyx perepeliv za riznyx dzherel zhyru v kombikormi [Text] / M. Sychov, N. Slobodyanyuk // Prodovolcha industriya APK. – 2010. – Vol. 5-6. – P. 30–33.

11. El-Denqawy, R. Investigation on the nutritive value and microbiological quality of wild quail carcasses [Text] / R. A. El-Denqawy, A. M. Nassar // Die Nahrung. – 2001. – Vol. 45, Issue 1. – P. 50–54. doi: 10.1002/1521-3803(20010101)45:1<50::aid-food50>3.0.co;2-j

Рекомендовано до публікації д-р с/г наук Сичов М. Ю.
Дата надходження рукопису 24.09.2014

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