Effect of Lower Protein Level in Feed on Production Performance of Zagorje Turkey

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SUMMARY

Interest for production and marketing of Zagorje turkey in Croatia is rising. Traditional way of breeding Zagorje turkey is manifested through the variety of production and nutritional practices. Typical Croatian customer demands a carcass of Zagorje turkey that has a low weight, ranging between 2.5 – 3.5 kg and is pre-processed in the slaughterhouse. As the data on nutrition, breeding and production of light autochthonous turkey breeds, particularly, among them, Zagorje turkey, are insufficient; there is a need for research on the nutritional and technological aspects of free-range production of Zagorje turkey. In that direction we carried out the research of the effect of different protein level in the diet of turkey chicks up to 8 weeks of age to the final production performance and meat quality of Zagorje turkey slaughtered at the age of six months. Two control (68 ♂ and 68 ♀) and two experimental groups (68 ♂ and 68 ♀) of Zagorje turkeys were housed indoors for the first 8 weeks. After that period each group had access to a fenced pasture of 0.5 ha. Both experimental groups were fed a diet with 25 % less protein than the control groups during the first period of 8 weeks, while after this period all of the groups were fed equally until the end of month 6. At the end of production period, birds of both sexes of the experimental groups had a lower body weight that the control ones, but still within the suitable category for Croatian consumers, while males from the control groups were too heavy (6854 g). Feed conversion ratio (FCR) over the whole experimental period both in the control and experimental groups ranged between 3.47-4.06 kg (concentrates only), without a pattern considering treatment or sex. In the same time, share of different parts of body in the carcass differed between treatments and sexes.

KEY WORDS

protein level, production performance, free range, Zagorje turkey

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INTRODUCTION

First written evidence of the existence of turkey in Croatia appears in the year 1561 (citation from Kodinetz, 1940). During the past four and a half centuries of breeding on the limited geographical area, with a very small influence from aside, a population of birds with distinct characteristics was formed and is considered to be a breed of its own – Zagorje turkey.

Zagorje turkey became known in Europe in the thirties of the 20th century when it was exported to many European countries and annual exports amounted 50000-70000 birds. This activity ceased at the beginning of the World War Two, when the Zagorje turkey fell into oblivion, in the economic, rearing and scientific sense.

In a past few years in Croatia there are existing projects of preserving, recovering and spreading the population of Zagorje turkeys. At the same time there is a growing interest on consuming alternative kind of meat as well as turkey meat from our «homeland» Zagorje turkey, raised in other way than intensive-indoor production.

Zagorje turkey is over the centuries traditionally produced in the outdoor system. Zootechnically speaking, that means that the birds are kept free for most of their lives, moving freely through meadows, orchards, groves or other habitats rich in vegetation and fauna. Adult Zagorje turkeys are provided with a solid shelter (poultry house) only during the night or unfavorable weather conditions. Rearing of young birds, until formation of caruncles, is also carried out indoors.

To make a production of Zagorje turkey a serious business, it is essential to increase the number of big scale producers (several hundreds of birds) and to define the technology of breeding and nutrition, which is suitable for our – Croatian conditions of free range production.

First records of phenotype characteristics of Zagorje turkey were published by Kodinetz (1940). He found that, at 28 weeks, male birds achieved a body weight of 6.01 kg, while females had 3.95 kg, with the traditional way of production (nutrition without knowledge of requirements and housing differing greatly, usage of grassed pens).

Mužic et al. (1999) measured body weight of 753 Zagorje turkeys aged 9-11 months produced traditionally in the area of Krapinsko-zagorska and Varaždinska Counties. The average body weight of male and female birds was 6.8 kg and 3.9 kg, respectively.

Janječić (2002) investigated the phenotypic traits of four strains of Zagorje turkey produced in combined indoor and outdoor system. For the first 8 weeks birds were fed concentrates according to Croatian Feed Quality Regulation and up to 7 months according to requirements, with access to a grassed pen. The average body weights of males and females of different strains were as follows: black strain 7.2 and 4.3 kg, bronze strain 6.4 and 4.4 kg, grey strain 6.5 and 3.8 kg and pale strain 6.8 and 4.2 kg, respectively. During the first 8 weeks FCR was 2.44. Slaughtering and processing of carcasses gave the following average parameters for all of the strains: dressing percentage ♂= 63.5%, ♀=64.8%; wings ♂=12.3%, ♀=12.9%; drum sticks ♂=14.3%, ♀=13.9%; thighs ♂=14.6%, ♀=15.2; chest ♂=34.2%, ♀=31.5%; fillet ♂=23.0%, ♀=22.8% and back ♂=24.5%, ♀=26.4%.

Auckland et al. (1969) examined the effect of undernutrition of turkeys during the period up to 6 weeks of age on the finishing body weights at 20 weeks. The authors established that the effect of undernutrition has on the body weight during the first 6 weeks, completely disappears at the age of 20 weeks. On the other hand, Nixey (citation from Nixey and Grey, 1989), reports a great negative effect of protein undernutrition in turkey chicks up to 28 days on finishing of heavy lines of turkeys at the age of 24 weeks. Such a contradictory result could be explained today by a big difference in the research animals. Modern heavy breeds and hybrids of turkeys grow faster and are later mature, so they keep growing even after the week 24, unlike turkeys from the 70's of the last century.

Revignton and Moran (1990) investigated the effect of lowered dietary nutrient levels on the productive performance on the heavy hybrids of turkeys. Underfed birds had lower body weighs and worse FCR at 16 weeks, with less adipose tissue than the birds fed according to the NCR Requirements. Those differences were lowered by the week 28 and completely disappeared by the week 57.

Ferket and Sell (1990) examined a 30 % reduction in protein and 10 % in energy to the NRC Requirements in the diet of Nicholas turkeys between day 10 and week 6. They found that this restricted nutrition resulted in lowered daily gain and poorer FCR.

Kidd et al. (1997) investigated the reduction in protein level, with the supplement of L-threonine, in the diet of Large White Nicholas turkeys on the growth and meat quality. Reduction in the protein level of 26 and 34 % to the one given by the NRC Regulation resulted in slower growth up to week 18, but with the supplement of 0,1 % of L-threonine, the differences were canceled.

Technology of breeding and production of modern turkey hybrids needs substantial financial input considering housing and nutrition. This investment is returned quickly through fast growth and high dressing percentage, especially high percentage of

chest. However, nothing of mentioned above is true in case of Zagorje turkey, because the particular quality of meat of this breed is achieved through interaction between the genetic traits and specific – extensive way of housing and nutrition.

Zagorje turkey is marketed only as a whole carcass, where weight and appearance of a processed carcass are the most important marketing aspects, while the absolute share of chest and other parts of carcass is of little significance. According to author's own observation, Croatian customers prefer turkeys with the weight of a processed carcass between 2.5 and 3.5 kg, what automatically excludes modern hybrids, which achieve this body weight at age when the quality of meat is still no adequate.

Considering the mentioned comparison between Zagorje turkey and modern hybrid turkeys, lack of data on nutrition, breeding and production performance of light autochthonous turkey breeds, there is a clear need for research of nutrition and free range technology of Zagorje turkey.

In that direction, a research was carried out to investigate the effect of different crude protein level in the diet of turkey chicks from 0-8 weeks on the production performance and quality of Zagorje turkey at 6 months.

MATERIAL AND METHODS

For the research purposes we used turkey chicks produced by registered producers from Krapinsko-Zagorska and Varaždinska County and which are controlled by CLSC. 272 day old turkey chicks were divided into four groups: two control ones (68 ♂ and 68 ♀) and two experimental (68 ♂ and 68 ♀). A 6-month trial period was divided into two phases. For the first 8 weeks turkey chicks were kept under the regulated microclimate conditions on the Faculty of Agriculture in Zagreb and than were transferred to Glina, where they had access to a fenced natural pasture of 0.5 ha per group, connecting to a poultry house with 0.5 m^2 of littered floor per bird. Each pasture had a shed of 6 m^2. Water and feed were given to the birds outside, under a shed and inside the poultry house.

Nutritional treatment consisted of two basic periods. During the first 8 weeks control groups were fed concentrates mixed according to Croatian Feed Quality Regulation, while protein level in the diet of the experimental groups was lowered. From week 8 to 24 all the groups (both control and experimental) were fed the same feed containing 20 % of crude protein. Besides, birds had access to a green fodder on the natural pasture. Feeding plan for the research is given in Table 1. Composition of concentrates used in the trial is given in Table 2. Feedstuffs used to mix concentrates for this trial are listed in Table 3.

Table 1. Feeding plan for the experimental period

Group	Week		
	0 - 4	4 - 8	9 - 24
Control	28 % c.p.	24 % c.p.	20 % c.p.
Trial	24 % c.p.	20 % c.p.	20 % c.p.

Table 2. Calculative composition of concentrates used in the trial

Nutrient		28 % c.p.	24 % c.p.	20 % c.p.
Metabolizable energy	MJ/kg	11,23	11,13	11,21
Ash	%	7,90	7,75	7,75
Crude protein	%	28,10	24,22	20,46
Crude fat	%	5,27	5,06	4,65
Crude fiber	%	3,49	4,10	4,35
Lysine	%	1,74	1,43	1,33
Methionine	%	0,65	0,56	0,52
Methionine+Cystine	%	0,94	0,82	0,76
Tryptophane	%	0,34	0,29	0,24
Threonine	%	1,02	0,87	0,72
Arginine	%	1,94	1,66	1,36
Ca	%	1,36	1,35	1,37
P total	%	0,96	0,92	0,92
P available	%	0,51	0,50	0,52
Na	%	0,24	0,21	0,22
Ca/P	%	1,43	1,47	1,49
Mg	%	0,15	0,15	0,14

Table 3. Experimental mixed feed formulas, (%)

Feedstuff	Mixed feed		
	28 % c.p.	24 % c.p.	20 % c.p.
Corn	40,50	46,00	53,55
Soybean meal	36,00	31,00	25,00
Alfalfa, dehydrated	-	3,00	5,00
Full fat soybean, toasted	12,00	12,00	10,00
Fish meal	7,00	3,30	1,00
Limestone	2,00	2,00	2,00
MCaP	1,40	1,60	2,00
NaCl	0,40	0,40	0,45
Methionine	0,20	0,20	0,25
Premix*	0,50	0,50	0,50
Total	100,00	100,00	100,00

* PROVIT PUR - Premix produced by POLJOPRERADA D. D., Zagreb

Weighing of birds and feed consumed was done on day 1, week 4 and 8 and after that, once a month until the end of the trial. At the end of week 26, twenty (10 ♂+10 ♀) of birds from each group were randomly selected and sacrificed for slaughtering and process, according to the method of Hahn and Spinder (2002). Following record was taken: dressing percentage, percentage of wings, drumsticks, thighs, chest with and without bones, back and abdominal fat of the whole carcass. All the data were processed by

Table 4. Body weight of control and trial groups of turkey chicks during the first 8 weeks of rearing period, (g)

	Day 1				Week 4				Week 8			
	control		trial		control		trial		control		trial	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
N	68	68	68	68	62	62	61	60	62	60	61	59
x	51.2	50.1	50.1	50.1	514.5*	379.0*	444.5*	271.9*	1477.7*	1135.1*	1038.8*	590.8*
s	4.8	4.5	4.4	4.7	73.7	37.5	42.4	51.6	217.9	111.9	118.2	124.3
sx	0.5	0.5	0.5	0.5	6.7	6.7	6.8	6.8	26.5	14.5	17.7	17.7

*P<0.01 values indicated by an asterisk in the same row for the same sex are significantly different

using statistical package SAS (1996, GLM procedure - Adjustment for multiple Comparisons: Tukey-Kramer.

RESULTS AND DISCUSION

Because of two phases of the trial and its finish by slaughtering the turkeys, the results are divided into three chapters.

Body weight, mortality rate and FCR for the first 8 weeks of rearing on the Faculty of Agriculture in Zagreb are given in Tables 4, 5 and 6.

During the first 8 weeks of rearing the indoor period, control groups achieved expected body weight, while the trial ones (lower protein level in the diet) grew slower than expected. Besides that, turkey chicks fed poorer diet had somewhat higher mortality rate than the control ones, as shown in Table 5.

Considering the increase of the total mortality rate (6-8 % above expected) over the whole period, it should be pointed out that a day old chicks had light staphylococcal infection of the umbilicus, which needed a therapy and resulted in increased mortality rate.

FCR was monitored in relation to two types of concentrates used during the 8-week period, and the results are shown in Table 6. FCR achieved is in accordance to results reported by Janječić (2002), but with higher variation within and among the groups, what could be assigned to previously mentioned disease.

Table 5. Mortality rate of Zagorje turkey chicks during the first 8 weeks of rearing

Parameter	Control		Trial	
	♂	♀	♂	♀
Absolute	6	8	7	9
Relative, (%)	8.82	11.76	10.29	13.24

Table 6. Average FCR in control and trial groups of turkey chicks, (kg/kg)

	Prestarter	Starter
Control ♂	1.86	2.65
Control ♀	1.71	2.50
Trial ♂	2.11	3.07
Trial ♀	1.83	2.94

After 8 weeks of rearing indoors, chicks were transferred to Glina, to a poultry house with a separate grassed pen for each group.

During the next 18 weeks turkeys of all groups were fed the same concentrate (20 % c.p.) and had access to a grassed pen with abundant pasture and rich with insects.

Body weights of Zagorje turkeys of control and trial groups during the 4-month period of free-range production are given in Table 7.

Production in continued Glina during the summer and autumn period was successful, with a very low mortality rate. Finishing body weights obtained in the trial groups were better than the expected, while birds in the control continued their growth slower and did not catch up with the trial groups, as it was expected after their body weight at 8 weeks. The average body weight of birds in control groups of 6854.9 kg, with dressing percentage of 67.2 %, makes the weight of processed carcass of 4605 g, what is too big weight for the average Croatian consumer. Furthermore, this indicates that there is a basis for slowing down the growth rate by lower level of nutrition during the first period of rearing of male Zagorje turkeys, as the trial birds were within the category suitable for Croatian customers. In the same period all the birds were fed the same concentrate and grazed on equal pastures. Under this conditions control birds (average for both sexes) achieved slightly better FCR, as shown in Table 8.

As it could be seen from the data given in Table 8, there is a variability of obtained FCR between the periods and groups. For now, this cannot be explained with certainty, but we believe that one of the reasons could be in genetic diversity of Zagorje turkey.

Considering the absolute values of FCR for the whole period of 6 months, it is between 3.47 and 4.06 kg/kg and is rather high. But, these are the first data for Zagorje turkey and as such, they make a base for further economical analyses of free-range production.

Table 7. Average body weight of Zagorje turkeys at the end of month, (g)

Statistical parameter	Month 3				Month 4			
	control ♂	control ♀	trial ♂	trial ♀	control ♂	control ♀	trial ♂	trial ♀
N	62	59	60	59	61	59	60	59
Average	2814.0*	1988.1*	2015.4*	1279.9*	4368.0*	2976.3*	2959.1*	2266.1*
Standard Deviation	257.2	161.1	238.7	185.1	466.1	397.7	253.8	254.8
Standard Error	27.3	27.9	27.7	27,9	45.5	46.3	45.9	46.3
Period	Month 5				Month 6			
N	61	59	59	59	61	59	58	58
Average	5559.0*	3905.1*	3847.3*	3065.3*	6854.9*	4647.5*	4697.4*	3776.7*
Standard Deviation	426.8	547.3	255.4	241.9	591.2	630.1	389.9	280.4
Standard Error	49.8	50.7	50.6	50.6	63.5	64.6	65.1	65.1

*$P < 0.01$ values indicated by an asterisk in the same row for the same sex are significantly different

Table 8. Average FCR for concentrates during the second phase and over the whole trial, (kg/kg)

Group	Period					
	Month 3	Month 4	Month 5	Month 6	Month 3-6	Month 0–6
Control ♂	2.93	3.71	4.67	8.32	4.91	3.58
Control ♀	3.34	3.92	4.73	7.21	4.80	3.45
Trial ♂	4.08	3.46	7.68	7.69	5.73	4.06
Trial ♀	2.86	6.21	4.21	5.46	4.68	3.47

Table 9. Average dressing percentage of free range produced Zagorje turkey, (%)

Statistical parameter	Control ♂	Control ♀	Trial ♂	Trial ♂
N	10	10	10	10
Average	67.26^{NS}	66.73^{NS}	67.24^{NS}	67.02^{NS}
Standard deviation	2.01	2.44	1.53	4.22
Standard error	0.86	0.86	0.86	0.86

NS values indicated by NS in the same row for the same sex are not significantly different

Table 10. Share of different body parts in processed carcass, (%)

Group	Statistical parameter	Wings	Drumsticks	Thighs	Chest with bones	Chest without bones	Back	Abdominal fat
	N	10	10	10	10	10	10	10
Control	Average	13.26^{ab}	13.03	15.88^{a}	33.26^{b}	23.44	22.50	1.78^{a}
Males	Standard deviation	0.99	0.85	0.88	2.41	1.87	1.39	0.56
	Standard error	0,30	0.21	0.22	0.50	0.41	0.37	0.24
Trial	Average	14.64^{b}	12.90	16.29	31.09^{b}	23.52	23.06	2.92^{a}
Males	Standard deviation	1.36	0.71	0.47	1.11	0.91	1.22	0.53
	Standard error	0,30	0.21	0.22	0.50	0.41	0.37	0.24
Control	Average	13.97	13.23	16.88^{a}	31.82	23.87	22.41	2.41
Females	Standard deviation	0.64	0.42	0.64	1.15	1.16	1.02	0.93
	Standard error	0,30	0.21	0.22	0.50	0.41	0.37	0.24
Trial	Average	14.78^{a}	12.78	16.40	31.82	23.70	22.35	2.32
Females	Standard deviation	0.66	0.52	0.75	1.29	1.03	1.06	0.96
	Standard error	0,30	0.21	0.22	0.50	0.41	0.37	0.24

$^{a}P < 0.01$, $^{b}P < 0.05$ values indicated by the same letter in the same column are significantly different

After the slaughtering and processing, dressing percentage and percentage of different body parts in the carcass were obtained, as shown in Tables 9 and 10.

Dressing percentage of Zagorje turkey carcasses, obtained after processing according to Hahn and Spindler (2002), did not show important differences between control and trial birds and are better for 2-3 % than values reported by Janječić (2002). It is important to point out that the trail groups, fed poorer, are not behind the control ones when speaking of dressing percentage, or, in other words, slower growing (lighter) turkeys are not, in that sense, less valuable product for consumers.

Share of drumsticks and back in the whole carcass between control and trial groups of Zagorje turkey, males and females, are not different and in relation to hybrid Nicholas turkey (Orbanić, 1994), Zagorje turkey has higher percentages of these categories, what makes it less attractive for cutting. The difference is even more evident in share of chest meat. Zagorje turkey has in average only 23-24 % of meat in chest, while Nicholas hybrid (Orbanić, 1994) has up to 29 %.

Male birds of control group have significantly lower share of drumsticks and thighs in the carcass, when compared to other groups. In the same time, they have higher share of chest with bones, what is a logical result of calculation and indicate a higher percentage of bone tissue in the chest.

Also, less abdominal fat in male control turkeys could be assigned to better gain of muscle tissue in animals with better nutritional support when young.

CONCLUSION:

- during 8 weeks of indoor rearing of turkey chicks, control groups achieved expected body weight, while the trial ones (less protein in the diet) grew somewhat slower, with higher mortality rate and worse FCR than control groups,
- control groups continued to grow faster and reached higher finishing body weights then trial groups, when production was continued for 4 months by using grassed pens and nutrition with concentrates according to requirements,
- as preferred weight of processed carcass of Zagorje turkey by Croatian consumers is between 3,0-3,5 kg, male turkeys from control group were too heavy, indicating that lowering the growth intensity by undernutrition during the first 8 weeks is justified,
- considering the FCR achieved throughout the whole trial (range between 3.47 and 4.06 kg/kg), heterogeneity in sense of treatment and sex should be emphasized, but it is also necessary to say that these are the first records in Croatia of feed consumption of Zagorje turkey during the first 6 months of production,
- nutritional treatment had different effect on share of body parts in processed carcass, but as Zagorje turkey is sold only as a whole carcass, this, for now, is no disadvantage.

REFERENCES

Auckland J.N., Moriss T.R., Jennings R.C.(1969). Compensatory growth under-nutrition in market turkeys. British poultry Science 10 293-302.

Ferket P.R., Sell J.L. (1990). Effect of early protein and energy restriction of large turkey toms fed high-fat or low-fat realimentation diets. 1. Performance characteristic. Poultry Science 69 (11) 1974-1981.

Hahn G., Spindler M. (2002). Method of dissection of turkey carcases. World's Poultry Science Journal 58 (2) 179-197.

Janječić Z. (2002). Phenotype and genotype characteristics of Zagorje turkey. Disertation. Faculty of Agriculture, University of Zagreb, Zagreb

Kidd M.T., Kerr B.J., England J.A., Waldroup P.W. (1997). Performance and carcass composition of Large White toms as affected by dietarry crude protein and threonine supplements. Poultry Science 76 (10) 1392-1397.

Kodinetz G. (1940). Beitrag zur Kenntnis der Rasse und der Entwiclung des Zagorianer Truthuhnes (Meleagris gallopavo). Zeitschrift für Tierzüctung und Züchtungsbiologie (47) 2:140-165.

Mužic S., Janječić Z., Đikić M., Sinković K. (1999). Current situation of the Zagorje turkey in Croatia. Acta Agraria Kaposvariensis (3) 2 : 213-218.

Nixey C., Grey T.C. (1989). Recent advances in turkey science, Butterworths, London, Boston, Singapure, Sydney, Toronto, Wellington

Orbanić S. (1994): Klaonička kakvoća trupova pazinskih purana, Diplomski rad, Agronomski Fakultet Zagreb.

Revington W.H., Moran E.T. (1990). Effect of nutrient level and feed form on the performance on heavy breeder turkey toms. Animal Feed Science and Technology 29 (3-4) 321-331.

SAS Institute (1996): SAS/STAT. SAS Institute Inc., Cary, NC.

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