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Effects of different dietary protein levels on the biochemical and production parameters of ostriches (*Struthio camelus*)

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ABSTRACT

The aim of this study was to investigate the effects of different dietary protein levels on the biochemical and production parameters of ostriches. Eighteen adult, eight-year-old ostriches (*Struthio camelus*) (six male and twelve female) were studied. For the experiment the ostriches were randomly divided into two groups of 3 breeding pairs each (one male and two female) to be fed with 20% and 23% crude protein, respectively. The 20% crude protein group was fed layer feed (20% crude protein, 2900 kcal/kg ME) and alfalfa (*ad libitum*) and the 23% crude protein group with layer feed (23% crude protein, 2900 kcal/kg ME) and alfalfa (*ad libitum*) between May and September. It was determined that biochemical parameters of ostriches which were fed with diets that included 20% and 23% crude protein levels did not differ significantly, but a significant difference ($P<0.01$) was found in egg fertility ratio and hatchability of eggs between dietary protein levels. It was concluded that a high crude protein level in breeding ostriches had a negative effect on the number of eggs and hatchability of total eggs, and the results of the present study showed that the crude protein ratio was not required to exceed 20%.

Key words: ostrich, biochemical parameters, feed, crude protein

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Introduction

Nutrition is an important part of ratite management. Ratite diets are currently formulated based on poultry values due to a lack of research in this field. Nutrient requirements of growing birds and breeders change constantly and therefore require frequent diet alterations according to stage of growth or production. This is essential for optimum growth with a maximum economical utilization of feed. To succeed in this goal, ostrich diets require ideal levels and inter balances between protein, energy, vitamins and minerals. A deficiency or imbalance in any of these nutrients will impair growth and production, resulting in poor utilization of feed (CILLIERS and ANCEL, 1999). Commercial intensive farming of ostriches requires accurate evaluation of the nutritional content of ingredients available for the formulation of diets, as well as adequate knowledge of the nutritional requirements of the birds at different stages of production (BRAND et al., 2000c). Most commercial feed companies are producing starter, grower and breeder rations. Limits on the addition of other sources of roughage or nutrients, such as alfalfa hay, may be recommended by the manufacturer. Protein contents vary from 16 to 22 percent. Starter rations, very high in protein (28 percent), are not recommended because such diets may be associated with leg abnormalities in turkeys. These diets are based on limited scientific nutritional research, due to the fact that few studies have been conducted on ostriches. Therefore, the exact nutritional requirements of the ostrich are unknown and nutritionists still do not agree on the nutritional standards to be used for ostriches (BRAND et al., 1999; BRAND et al., 2002). The aim of this study was to investigate the effects of different dietary protein levels on the biochemical and production parameters of ostriches.

Materials and methods

The experimental birds used in the present study were obtained from The Ostrich Raising Unit, Faculty of Agriculture, Uludag University in the Bursa region, western part of Turkey. Eighteen adult, eight-year-old ostriches *(Struthio camelus)* (six males and twelve females) were studied. In the experimental period the ostriches used were 6 breeding pairs (one male and two females).

The ostriches were randomly divided into two groups, to be fed with 20% and 23% crude protein, respectively. The 20% crude protein group (Group I) was fed with layer feed (20% crude protein, 2900 kcal/kg ME) and alfalfa (*ad libitum*), and the 23% crude protein group (Group II) with layer feed (23% crude protein, 2900 kcal/kg ME) and alfalfa (*ad libitum*) between May and September. Afterwards, the groups were given alfalfa hay, corn silage (*ad libitum*) and 700 g/day mixed grain per ostrich for 7 months in the winter period. Drinking water was available *ad libitum* for both groups.

The composition of the experimental diets of ostriches used in the study was analyzed by using the Weende method (A.O.A.C. Official Methods of Analysis. 14th Ed. Association of Official Analytical Chemists. Washington, D.C., 1984). Phosphorus analyze from feed mineral matters was estimated using the Vanodomolibdo Phosphoric Yellow Color method, and calcium, sodium, potassium and manganese were determined using the Dry Burning method (KACAR, 1972) and is presented in Table 1.

Table 1. Composition of nutrient matters of ostrich egg feeds

Nutritient matters		Group I	Group II
Dry matter	(%)	88.58	89.38
Organic Matter	(%)	78.99	78.90
Metabolic Energy	(Kcal/kg)	2900	2883
Crude protein	(%)	19.84	23.32
Ether Extracts	(%)	5.23	6.49
Crude Fiber	(%)	8.99	10.10
Nitrogen free extra matters	(%)	44.93	38.99
Ash	(%)	9.59	10.48
Ca	(%)	1.96	1.85
P	(%)	0.98	0.73
Na	(%)	0.20	0.22
K	(%)	0.91	1.05
Mn	(%)	0.03	0.04

At the end of the feeding period, birds' heads were covered with a hood to facilitate handling (SPINU et al., 1999). Blood samples were taken from wing vein using heparinised vacutainer blood collection tubes and,

Table 2. Biochemical parameters of ostriches fed with different protein contents

Parameters	n	Group I X ± SD	Group II X ± SD
Glucose (mmol/l)	12	11.87 ± 1.61	11.65 ± 1.01
Cholesterol (mmol/l)	12	2.99 ± 0.24	2.99 ± 0.22
Total protein (g/dl)	12	40.50 ± 6.20	45.00 ± 5.40
Urea (mmol/l)	12	0.25 ± 0.09	0.33 ± 0.10
Uric acid (mg/dl)	12	5.00 ± 0.93	4.48 ± 0.59
Calcium (mmol/l)	12	3.55 ± 0.97	3.51 ± 0.73
Phosphorus (mmol/l)	12	0.88 ± 0.31	0.74 ± 0.22

transported in an ice chest to a laboratory for analysis. Blood samples were centrifuged at 3000 rpm for 5 min, and serum separated and stored at -20 °C for later analysis. Serum glucose (Biocon 4341), total cholesterol (Technicon SM4-1139M90), total protein (Biotrol A01394U), urea (Biosystems COD 11516), uric acid (Biotrol T01392FE), calcium (Bayer-Technicon 32585) and inorganic phosphorus (Biosystems COD 11508) levels were determined by using Auto Technicon DAX 72 autoanalyzer. The biochemical parameters of ostriches fed different protein levels are illustrated in Table 2. Statistically, the differences between the groups for the biochemical parameters were tested using the Mann-Whitney U-test, and production parameters were also analyzed by using Minitab Statistical Packet Program SPSS 10.0.1 by Duncan's multiple range test and Student-t test (MINITAB RELEASE 10.1, Copyright-Minitab Inc., 1989).

Table 3. Average egg production and egg production characteristics of groups

	Egg production		Egg weight	Fertility ration	Hatch of fertile	Hatchability
Groups	n	%	(g)	(%)	(%)	(%)
			N.S.	*	*	*
I	205	28.71	1600 ± 9.5	81.2 ± 2.84	85.1 ± 3.94	69.4 ± 4.28
II	193	27.03	1537 ± 7.50	61.1 ± 5.35	66.2 ± 6.50	39.9 ± 4.27

*P<0.01
N.S. = non-significant

Table 4. Effect of protein levels on some production performances of breeding ostriches

Measurement	Unit	Protein levels (%) Group I X ± Sx	Group II X ± Sx
Concentrate feed consumption	g/bird/day	1192 ± 23.20	1247 ± 27.70
Roughage feed consumption	g/bird/day	1471 ± 66.90	1488 ± 65.50
Total feed consumption	g/bird/day	2604 ± 85.00	2735 ± 79.00
Feed consumption per egg	g/bird/day	4152 ± 1041	4613 ± 1204

Results and discussion

In the present study it was determined that the serum of ostriches fed diets including 20% and 23% crude protein had no significance in the conclusion of statistical analysis. The variability observed in ostriches could have had several causes such as age, sex, time of last feeding, etc. Mean serum glucose concentrations in Group I (11.87 ± 1.61 mmol/l) were slightly higher than in Group II (11.65 ± 1.01 mmol/l), which are similar to the normal range for glucose of ostriches (COSTA et al., 1993; POLAT et al., 2001).

Cholesterol concentrations in our study were determined as 2.99 ± 0.24 mmol/l in Group I and 2.99 ± 0.22 mmol/l in Group II. LEVY et al. (1989) reported that although serum cholesterol concentrations decreased markedly in ostriches >12 months old, concentrations were comparable with those for zoo ratites, and they found 1.7 ± 0.5 mmol/l serum cholesterol concentrations in adult ostriches. Although changes in serum protein concentrations between the groups were small, concentration in Group I was lower than in Group II. The values recorded in this study are similar to those reported by COSTA et al. (1993) and OKOTEI-EBOH et al. (1992).

Urea concentrations in this study were lower in Group I than in Group II. While the findings are compatible with those of POLAT et al. (2001), they differ from those of PALOMEQUE et al. (1991) and LEVY et al. (1989). In contrast, serum uric acid concentrations in Group I were higher than in Group II, and uric acid concentrations of ostriches were lower than those normally found in adult ostriches (COSTA et al., 1993; PALOMEQUE et al., 1991), but

higher than those of LEVY et al. (1989). BRAND et al. (2002) reported that blood urea and uric acid concentrations in the high protein (17%) fed group were higher than in the low protein (13%) fed group, which probably indicated an excessive intake of protein in the high protein fed group.

Calcium concentrations in the present study were identical in both Group I and Group II, as also reported by PALOMEQUE et al. (1991), but both values were significantly higher than previously reported for ostriches (LEVY et al., 1989; POLAT et al., 2001). Serum inorganic phosphorus concentrations were determined as 0.88 ± 0.31 mmol/l in Group I and 0.74 ± 0.22 mmol/l in Group II. The values found were lower than reported by BEZUIDENHAUT and COETZER (1986), and GRAY and BROWN (1995).

Average egg production and egg production characteristics of groups and the effect of protein levels on some production performances of breeding ostriches are shown in Tables 3 and 4. Feed consumption per egg was approximately 0.5 kg lower in 20% crude protein levels than in 23% crude protein, although the difference was not statistically significant. A significant difference ($P<0.01$) was found in egg fertility ratio, hatch of fertile and hatchability of total eggs between dietary protein levels, but egg weight was non-significant between Group I and Group II. These parameters were higher in the 20% crude protein level compared to the 23% crude protein level. The different protein levels had no effect either on egg production or egg weight. Similar findings were reported by BRAND et al. (2000b). High protein levels were also found to have no effect on live weight or growth performance of ostriches (BRAND et al., 2000a; BRAND et al., 2000c). However, GANDINI et al. (1986) showed that the highest mean body weight gain from ostrich diets containing protein levels of 14%, 16%, 18% and 20% was obtained from feeding the 20% protein diet. This result was not significantly different at the 0.05 level of probability.

Conclusion

Because the high levels of crude protein in ostrich feeds had a negative influence on egg production and hatchability, it was concluded that the crude protein ratio is not required to exceed 20%.

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SAŽETAK

Istražen je učinak hranidbe temeljene na različitoj količini proteina na biokemijske i proizvodne pokazatelje nojeva. Istraživanje je provedeno na 18 odraslih nojeva (*Struthio camelus*) u dobi od osam godina i to šest mužjaka i 12 ženki. Životinje su bile podijeljene u dvije skupine s po tri uzgojna para (jedan mužjak i dvije ženke). Prva skupina je dobivala 20% sirovog proteina, 2900 kcal/kg ME i lucerku (*ad libitum*), a druga 23% sirovog proteina, 2900 kcal/kg ME i lucerku (*ad libitum*) u razdoblju od svibnja do rujna. Ustanovljeno je da se biokemijski pokazatelji nojeva obje skupine nisu značajno razlikovali. Značajne razlike ($P < 0,01$) bile su utvrđene u oplođenosti i leživosti jaja u odnosu na sadržaj proteina. Zaključeno je da davanje velikih količina sirovog proteina rasplodnim nojevima negativno utječe na ukupan broj i leživost jaja te da količina sirovog proteina ne bi smjela biti veća od 20%.

Ključne riječi: noj, biokemijski pokazatelji, hrana, sirovi protein

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