Effect of an increasing dietary energy level on the feed intake and production of breeding ostriches

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Abstract

Elucidating the factors affecting feed intake are important in order to quantify the nutrient requirements of breeding ostriches. The experiment was conducted to determine to what extent dietary energy content will affect different production parameters of breeding ostriches. Ninety pairs of breeding ostriches were divided into six groups, consisting of 15 breeding pairs per group. Six diets with increased metabolisable energy contents (8.0, 8.7, 9.4, 10.1, 10.8 and 11.5 MJ ME/kg feed) were provided *ad libitum* to birds during the breeding season. All the other nutrients were balanced according to the nutrient requirements of the birds. Production data was analyzed by one-way analysis of variance. Average feed intake/bird/day (kg) amongst the different diets were not statistically different ($P>0.05$), with an average feed intake value of 3.7±0.2kg per bird per day. The increase in live masses of both the female (respectively 5.3, 2.8, 5.1, 10.8, 11.3 and 15.7 kg) and male (respectively -2.1, 1.6, 3.2, 4.9, 0.9 and 10.0 kg), however indicated that both the male and female breeders over-consumed energy on the diets with the higher energy values. No significant differences ($P>0.05$) were observed for other production parameters measured, like total eggs produced per female per season (mean value of 45.6±5.8), number of chicks hatched (mean value of 21.3±4.5), number of infertile eggs (mean value 11.6±3.6), number of dead-in-shell eggs (mean value of 7.5±1.8) or egg mass (1405 ± 30.5 g). The present study revealed that breeding ostriches were unable to regulate their feed intake due to dietary energy level. Results from the present study were important for the determination of the maximum feed intake of breeding ostriches as well as the determination of the required concentration of the other accompanied essential dietary nutrients.

Keywords: ostriches, nutrition, energy, feed intake, egg production, chick production

Introduction

It is currently not common practice to use the feeding strategies of poultry breeders for breeding ostriches. Gaining scientific information pertaining to the nutrient requirements of breeding ostriches are much needed in order to feed breeding ostriches to optimise production levels.

Feed intake of animals is regulated in a dialogue between the animal and the diet. This dialogue in turn is influenced by many factors (Ranft & Hennig, 1991). It is a well-known fact that poultry are able to control their feed intake at different dietary energy levels. Harms (1964) stated that the hen eats to meet the energy requirement, and that a sudden change in the dietary energy level will result in a change in feed intake to compensate for energy differences. It is uncertain whether the same is true for breeding ostriches. Determining how dietary energy affects feed intake is essential in determining if a ration will meet the requirements of the birds. Brand *et al.* (2004) and Brand *et al.* (2000) proved that slaughter ostriches are able to regulate their feed intake at various dietary energy levels. The investigation as to whether dietary energy interferes with the feed intake of ostrich birds will provide valuable guidelines for the determination of the nutrient requirement and maximum feed intake of breeding ostriches.

Material and Methods

Ninety pairs of breeding ostriches were divided into six groups, consisting of 15 breeding pairs per group. Six diets varying in ME content (8.0, 8.7, 9.4, 10.1, 10.8 and 11.5 MJ ME/kg feed) were provided *ad libitum* to both males and females. Protein and lysine were held constant at 12% and 0.58% respectively. The trial was conducted in Oudtshoorn (South Africa) during the 2008-2009 breeding season. The annual breeding season in South Africa starts in June and ends in January the following year. Table 5.1 lists the the raw materials and formulated nutrient composition and Table 5.2 the analyzed nutrient composition of each diet. Breeding pairs were kept in a 1:1 ratio in single breeding camps. Rations were given in the morning three times a week, and eggs were collected daily. The age of the birds used in the trial varied between 2 and 10 years.

Table 5.1 Ingredient and nutrient composition of the experimental diets with increasing ME content provided to ostrich birds during one season

Ingredients (kg/ton feed)	**Diet 1**	**Diet 2**	**Diet 3**	**Diet 4**	**Diet 5**	**Diet 6**
Energy level (MJ ME/kg feed)	8.0	8.7	9.4	10.1	10.8	11.5
Oats hulls	619	495	371	248	124	0.00
Maize	0.00	107	214	322	429	536
Alfalfa meal	0.00	35	69	104	138	173
Canola meal	242	215	188	162	135	108
Flaxseed	0.0	10	20	30	40	50
Limestone	45	44	43	42	41	40
Dicalciumphosphate	28	27	27	26	26	25
Molasses	50	50	50	50	50	50
Salt	10	10	10	10	10	10
Vitamin&mineral premix	5.00	5.00	5.00	5.00	5.00	5.00
Synthetic lysine	0.30	0.30	0.30	0.30	0.30	0.30
Nutrients						
ME (MJ ME/kg feed)	8.00	8.70	9.40	10.1	10.8	11.5
Crude protein (%)	12.0	12.0	12.0	12.0	12.0	12.0
Lysine (%)	0.60	0.60	0.60	0.60	0.60	0.60
Methionine&Cysteine (%)	0.46	0.50	0.50	0.50	0.50	0.47
Threonine (%)	0.45	0.50	0.50	0.50	0.50	0.45
Arginine (%)	0.59	0.60	0.60	0.60	0.60	0.63
Tryptophan (%)	0.15	0.10	0.10	0.10	0.10	0.13

Fat (%)	1.80	2.40	2.90	3.50	4.00	4.60
Fatty acid C18:2 (%)	0.00	0.30	0.60	0.90	1.20	1.50
Fiber (%)	20.7	18.0	15.2	12.5	9.70	7.00
Calcium (%)	2.60	2.60	2.60	2.50	2.50	2.50
Phosphorus (%)	0.60	0.60	0.60	0.60	0.60	0.60

Table 5.2 Analyzed nutrient composition of the six experimental diets varying in ME content fed to breeding ostriches

Nutrient composition	**Diet 1**	**Diet 2**	**Diet 3**	**Diet 4**	**Diet 5**	**Diet 6**
ME (MJ ME/kg feed)	8.00	8.70	9.40	10.1	10.8	11.5
Crude protein (%)	12.7	12.8	12.9	12.8	12.8	13.2
Dry Material (%)	91.7	91.6	91.4	91.2	90.3	90.6
Ash (%)	12.4	12.0	12.0	11.9	11.5	12.2
Fat (%)	2.37	2.87	3.35	3.17	3.81	3.76
Crude fiber (%)	21.7	19.7	17.7	18.1	15.2	12.7

The average feed intake/bird/day was calculated as follows. The feed given to each camp was weighed each month and feed not eaten was weighed back at the end of the season. This represents the amount eaten for the camp for the whole season. The value was divided by the number of breeding days (210) and 2, since one female and one male were in the camp. The assumption was therefore made that the male and female in each camp would consume the same quantity of feed. Records were kept of total egg and chick production, dead-in-shell, and infertile egg production. The live mass of the birds were measured at the onset and end of the season to calculate the change in mass over the season. Statistical analysis was performed on the data, using Statgraphics (2005) for one-way ANOVA. To analyze the effect of age on the data, an ANACOVA was done using Statistica (2009). Diet was used as categorical predictor and age as the covariate.

Results and Discussion

Production results of breeding ostriches provided with diets with an increasing ME content are provided in Table 5.3. Average feed intake/bird/day (kg) amongst the different diets did not differ ($P>0.05$), with a mean feed intake value per bird of 3.7±0.2kg. Average feed intake was fairly constant and was therefore not suppressed at any dietary energy level. The result of the present study was not anticipated and is in contrast with the findings of Brand *et al*. (2004) and Brand *et al*. (2000) for slaughter ostriches. Several factors may have influenced the results obtained. Previous studies revealed that an ME intake of 22 MJ ME per bird per day is sufficient to maintain the energy requirement of female birds (Brand, 2008). The minimum average feed intake per day during the current study was 29.6 MJ ME/day. The increase in live mass of the birds (8.5±1.07kg; $P<0.05$) also indicates that the birds may have over-consumed energy on the diets with the higher energy values. This principle was also described by Brand & Gous (2006). The study also revealed that the age of the female birds had an influence on feed intake ($P<0.05$). Older female birds therefore tend to consume more feed on a daily basis and can possibly be ascribed to higher maintenance and egg production costs. It is of interest to note that the age of the males did not contribute to the observed variation among the male birds ($P>0.05$).

Table 5.3 Average feed intake and production records of ostrich birds fed diets varying in ME content

Energy level (MJ ME/kg feed)	8.0	8.7	9.4	10.1	10.8	11.5	
Crude protein (%)	12.0	12.0	12.0	12.0	12.0	12.0	
Lysine levels (%)	0.60	0.60	0.60	0.60	0.60	0.60	se[2]
Average feed intake (kg/bird/day)	3.70[a]	3.80[a]	3.70[a]	3.90[a]	3.70[a]	3.60[a]	0.2
Egg production (eggs/female/season) (n[1]=90)	47.2[a]	43.9[a]	48.3[a]	57.1[a]	33.6[a]	43.6[a]	5.8
Chick production (chicks/female/season)	20.0[a]	18.3[a]	18.5[a]	32.6[a]	16.5[a]	21.6[a]	4.5
Dead-in-shell eggs (eggs/female/season)	7.20[a]	7.70[a]	7.20[a]	11.1[a]	5.10[a]	6.90[a]	1.8
Infertile eggs (eggs/female/season)	13.7[a]	13.9[a]	16.7[a]	7.70[a]	7.80[a]	9.70[a]	3.6
Males' start mass (kg)	117.6[a]	125.1[a]	121.3[a]	119.7[a]	119.5[a]	117.9[a]	3.3
Males' end mass (kg)	122.9[a]	127.9[a]	126.4[a]	130.5[a]	130.8[a]	133.5[a]	4.0
Females' start mass (kg)	118.5[a]	114.9[a]	111.1[a]	113.1[a]	116.8[a]	118.5[a]	3.3
Females' end mass (kg)	116.4[a]	116.5[a]	114.3[a]	111.3[a]	117.7[a]	128.5[a]	4.9
Males' mass change (kg)	5.30[ab]	2.80[a]	5.10[a]	10.8[ab]	11.3[ab]	15.6[b]	2.4
Females' mass change (kg)	-2.10[a]	1.60[a]	3.20[a]	4.90[a]	0.90[a]	10.0[a]	3.4
Egg weight (g)	1488.1[a]	1384.0[a]	1367.1[a]	1395.5[a]	1374.1[a]	1425.9[a]	31.1

[a,b,:]means in rows with different superscripts differ significantly (P<0.05)
[1]n=number of females
[2]se=standard error

No significant differences (P>0.05) were observed for total eggs produced per female per season (45.6±5.8), number of chicks hatched (21.3±4.5), number of infertile eggs (11.6±3.6), and for number of dead-in-shell eggs (7.5±1.8). The age of the birds similarly had no impact on the production levels. See Figure 1.

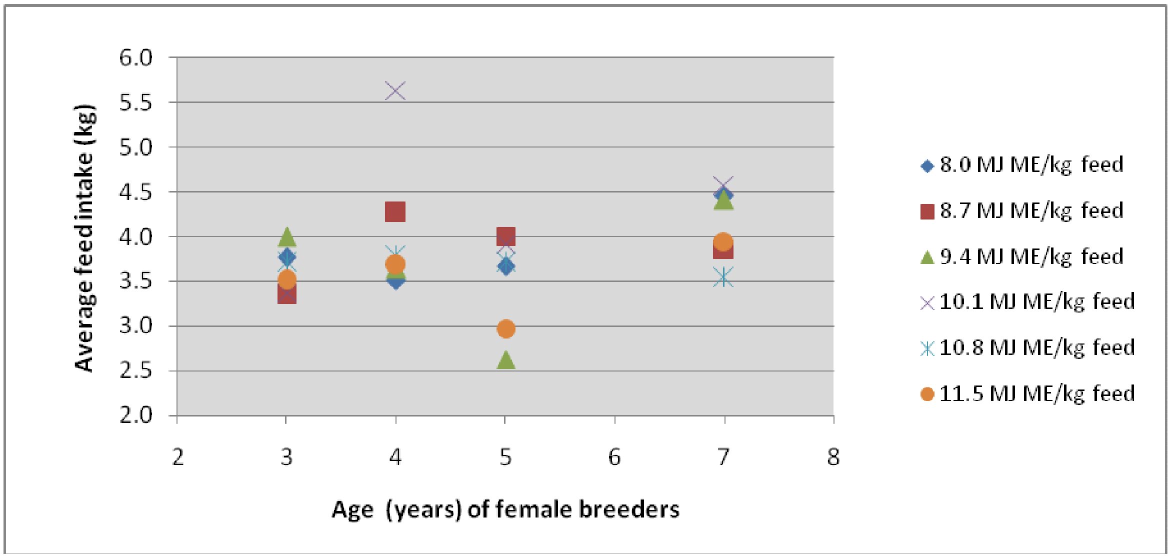

Figure 1 Effect of age on average feed intake (kg) of ostrich birds

The average change in the mass of female birds over the breeding season was 3.1±3.4kg. ANOVA analysis revealed no significant difference in the change in the mass of female birds on different treatments (P=0.21), although regression analysis revealed an increase of 2.5 kg per bird per 0.7 MJ increase in dietary energy value (y=2.46x – 20.9; SEest = 13.1; R^2 = 0.05; P<0.05) with increasing dietary ME contents (Figure 2).

Significant differences (P<0.05) in the mass change of male birds were observed which ranged between 2.8±2.4kg and 15.6±2.4kg over the breeding season (y = 3.37x – 24.4; SEest = 9.3; R^2 = 0.16; P<0.05). The statistical significant difference was amongst the 8.7 and 11.5 and 9.4 and 11.5 MJ ME/kg feed diets (Figure 3). The differences amongst the males can possibly be ascribed to higher fat accretion in the body of those males that were fed a diet higher in ME content. The energy provided probably exceeded their requirements, which resulted in mass gain. The mass gain for the 9.0, 9.5 and 11.5 MJ ME/kg feed diet was more than 10.0kg for each male on average. Lin *et al.* (1980) stated that when caloric intake is more than the body's requirement for energy, the excess food is stored as fat in broilers. Lin (1981) added that excess energy of the diet is invariably stored as fat in broilers when body maintenance and muscle growth requirements are satisfied. For growing pigs it was noticed that dietary crude protein that was not deposited as protein, was shifted to a pool of energy, which was utilized for adenosine triphosphate synthesis or lipid deposition (van Milgen *et al.*, 2001).

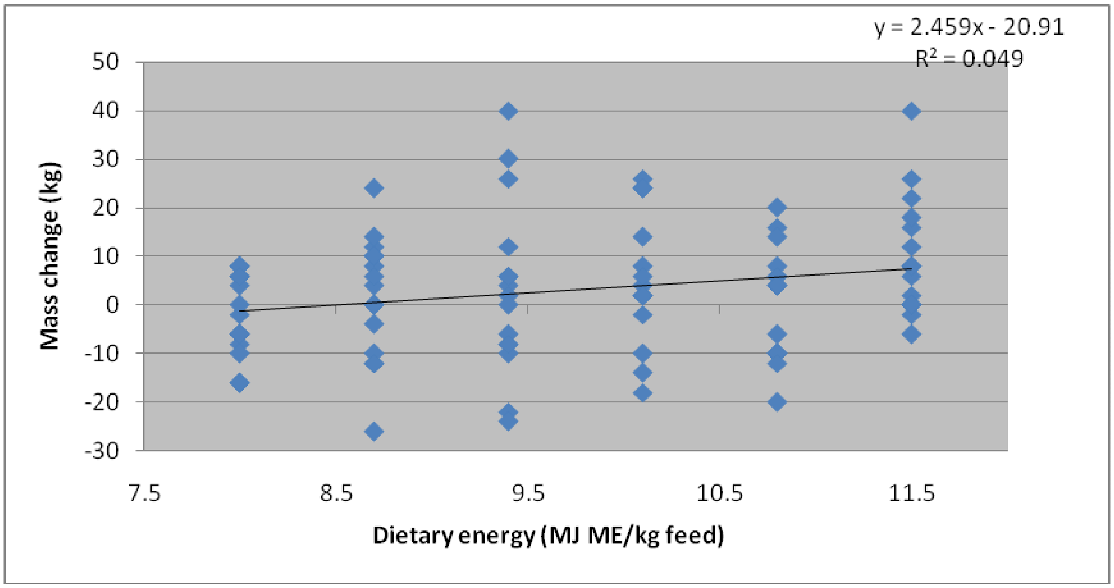

Figure 2 Change in mass of female birds receiving diets with increasing energy content

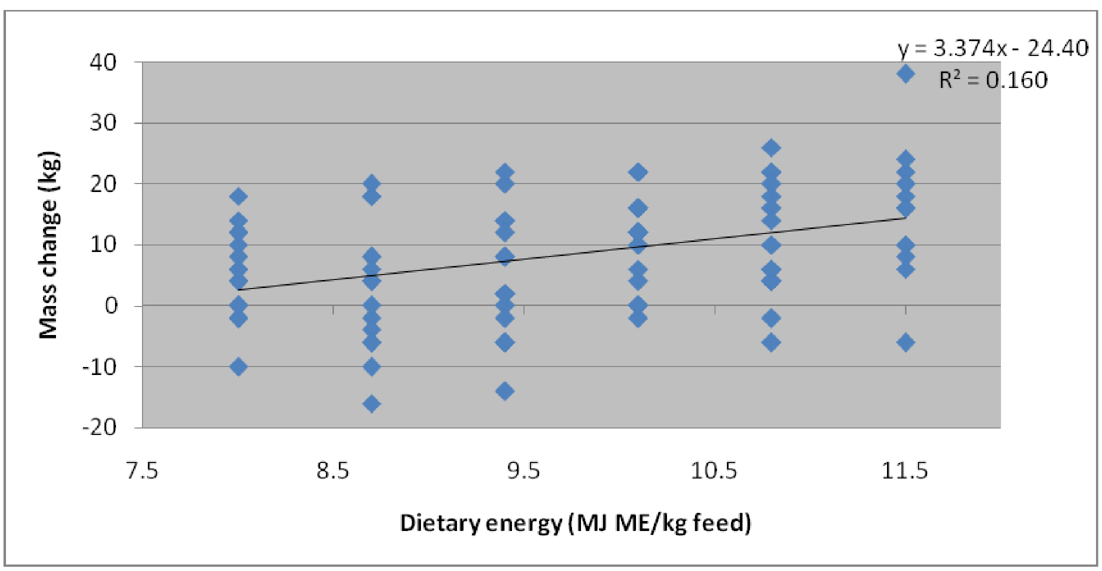

Figure 3 Change in mass of male birds receiving diets with increasing energy content

The treatments had no significant effect on the weight of the eggs; however a tendency for lower egg weight (P=0.06) was observed between the 8.0 and 9.4 MJ ME/kg feed diets. Their respective weights of the 8.0 and 9.4 MJ ME/kg feed diet were 1488.1±30.5g and 1367.1±30.5g and the average weight of all treatments was 1405.8±31g. Regression analysis of the data revealed that egg weight did not increase due to the energy value of the feed or the high energy intake by the bird. Egg weight was not influenced by dietary energy levels that ranged from 7.5 MJ ME/kg feed to 10.5 MJ ME/kg feed (Brand *et al.*, 2003).

Conclusion

No evidence exists from the present study that breeding ostriches were able to regulate their feed intake due to dietary energy level. This study also confirms that dietary energy has no significant influence on egg production, unless a lower daily ME allotment of 22 MJ ME/bird/day is given (Brand, 2008). Results from the present study are important for the determination of the nutrient requirements and maximum feed intake of breeding ostriches.

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