

DETERMINATION OF THE NUTRIENT REQUIREMENTS OF BREEDING OSTRICHES

by

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Abstract

Title: Determination of the nutrient requirements of breeding ostriches
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The nutrient requirements for breeding ostriches are currently not well-defined. Quantification of the nutrient requirements will improve the financial wellbeing of the industry. A study of the growth of the reproductive organs and liver, together with various production studies, were therefore undertaken in order to gain knowledge about the nutrition of breeding ostriches, thereby quantifying the nutrient requirements of breeding ostriches.

Various studies were conducted to determine the influence of dietary protein, amino acids and energy on production levels of breeding ostriches.

In a first study, five diets, varying in crude protein (CP) but with a constant energy content of 9.2 MJ ME/kg feed, were provided at a feed intake level of 2.5 kg/bird/day. The dietary CP levels were 7.5%, 9.1%, 10.8%, 12.3% and 14.0%. No differences ($P>0.05$) between treatments (total eggs per female per season) were found for number of unfertilized eggs (eggs per female per season; 9.1 ± 1.8), dead-in-shell chicks (8.2 ± 1.3), number of chicks hatched (19.5 ± 2.5) and change in mass of females (-16.2 ± 1.6 kg). A tendency was observed for a difference in total egg production (mean and standard error; 39.1 ± 3.6 ; $P=0.08$). The 12.3% CP diet caused the lowest ($P<0.05$) change in live mass (-3.8 ± 2.0 kg) for male birds. No interaction ($P>0.05$) occurred between the genotype of the bird and the dietary protein concentration for both egg and chick production.

In a second study, six diets varying in ME (MJ ME/kg feed), were provided at an average feed intake level of 3.4 kg/bird/day. The levels were 7.5, 8.0, 8.5, 9.0, 9.5 and 10.0 MJ ME/kg feed respectively. No differences ($P>0.05$) were observed for total eggs produced per female per season (44.9 ± 7.6), number of chicks hatched (15.7 ± 4.1),

number of infertile eggs (12.0 ± 3.9), number of dead-in-shell eggs (12.0 ± 3.1) and change in mass of females (10.6 ± 3.5 kg). Males increased linearly ($y = 2.4x + 2.45$; $R^2 = 0.09$; $P < 0.05$) in live mass as the dietary energy content increased. Two eggs per diet per month were analyzed for crude protein, crude fat and trace elements, and one egg per diet per month was analyzed for fatty acid composition. Eggs from the first and last month of the season were subjected to amino acid analysis. Analysis of variance showed no difference in crude protein and fat ($P > 0.05$) content of eggs between the experimental diets, as well as for the calcium content of eggshells. The proline content differed ($P < 0.05$) between the diets. The C18:3n-3 (linolenic acid) content of the eggs increased ($P < 0.05$) amongst the dietary treatments. Crude protein, fat and C18:3n-3 content in eggs increased ($P < 0.05$) for the number of the egg in the laying cycle.

In a third study, the feed intake of breeding ostriches, as affected by dietary energy content was investigated. Average feed intake (kg feed/bird/day) was not affected ($P > 0.05$) at any dietary energy level when levels of 8.0, 8.7, 9.4, 10.1, 10.8 and 11.5 MJ ME/kg feed were provided. The mean and standard error was 3.7 ± 0.2 kg.

The production of breeding female ostriches was not influenced by dietary ME and protein at these feed intake levels. Ostrich birds do not have the ability to regulate their feed intake at any dietary energy level as used in this study. The amount of nutrients deposited in the eggs had no influence on the reproductive efficiency of the breeding female ostrich. The experiments also revealed that female breeding ostriches were independent of dietary energy and protein as used in this study for the mean frequency of egg laying at various dietary protein and energy levels ($P > 0.05$).

In a fourth study, the growth and development of the reproductive organs of female birds at the onset of the breeding season were investigated. The amount of nutrients needs to be determined in order to support the growth of the reproductive organs during the breeding season, due to the fact that these organs are linked to egg production. It was thus necessary to investigate whether the reproductive organs grew and developed during a season. The first slaughter interval was conducted at the start of the breeding season. The ovary, oviduct and liver were collected, weighed after each slaughter and analyzed. Ovary and oviduct were analyzed for crude protein and fat. No differences ($P > 0.05$) were observed between the different slaughter intervals for the mass, crude protein and fat content of both organs. No trend ($P > 0.05$) in the weight of the oviduct could be observed over the 49-day period, this weight being highly correlated with body weight; whereas the ovary weight tended to be correlated with the time after the onset of the breeding period, although the variation in weights, both within and between weighings, was very high. The variation in the weight of the ovary probably reflects differences in the laying pattern of individuals. The number of follicles were not affected ($P > 0.05$) by the number of days after mating. Livers were assessed for crude protein and fat, but no difference ($P > 0.05$) was detected between the intervals, but the weight difference amongst the slaughter intervals was significant ($P < 0.05$), suggesting that the ostriches used liver reserves to supplement nutrients that obtained from the diet for the development of the reproductive organs. This data will be used in an optimising model (Brand & Gous, 2006) to

predict the nutrient requirements of female breeding ostriches. This study suggests that the female breeding ostrich might need additional protein during the first 7 weeks of the breeding season.

Results from Chapter 4 and previous studies were used to calculate the energy, protein and amino acid requirements for the egg production and maintenance of the breeding female ostrich. Two methods were used to determine the energy requirement for egg production. The Metabolisable Energy requirement for egg production (ME_e) and efficiency of ME utilization for energy deposition in the egg (k_e) was calculated as 12.2 MJ (for an average size egg of 1.4kg) and 0.8 respectively. The Effective Energy requirement for egg production (EE_e) and maintenance (EE_m) was calculated as 15.9 MJ/day and 17.1 MJ/day respectively. Average total daily protein requirement (TP_t) was calculated as 175g/day. The amino acid requirements for maintenance and egg production is also provided, which is lower than previous studies. This study also provides evidence that the nutrient requirements are different for every month of the breeding season.



Opsomming

Titel: Beraming van die voedingsbehoefte van broeivolstruise
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Tans heers daar onsekerheid oor die voedingsbehoefte van volstruis broeivolstruise. Kwantifisering van die voedingsbehoefte sal 'n finansiële hupstoot aan die industrie gee. 'n Groeistudie van die reproduksie-organe en lewer, tesame met 'n aantal produksie-studies, is uitgevoer om inligting oor die voedingsbehoefte van volstruis broeivoëls te versamel. Daarby is die voedingsbehoefte teoreties bereken.

'n Aantal studies was uitgevoer om die invloed van dieet proteïen en aminosure en energie op produksie-data te bepaal.

Eerstens is vyf diëte, wisselend in ru-proteïen (RP) en beperk tot 'n inname van 2.5 kg/voël/dag, aan broeivolstruise gevoer. Die RP van elke dieet was 7.5%, 9.1%, 10.8%, 12.3% en 14.0%. Die energiewaarde van die voer is konstant by 9.2 MJ ME/kg voer gehou. Geen verskille ($P > 0.05$) was tussen die behandelings waargeneem vir aantal geil eiers (totale eiers geproduseer per voël per seisoen; 9.1 ± 1.8), aantal dood-in-dop (8.2 ± 1.3), aantal kuikens (19.5 ± 2.5) en verandering in massa van wyfies (-16.2 ± 1.6 kg) nie. 'n Neiging ($P = 0.08$) is wel waargeneem vir totale aantal eiers geproduseer. Die gemiddelde en standaard fout was 39.1 ± 3.6 . Die 12.3% dieet het tot die laagste verandering ($P < 0.05$) in lewendige massa (-3.8 ± 2.0 kg) vir die mannetjies gelei. Geen interaksie ($P > 0.05$) was tussen die genotipe en dieet proteïen konsentrasie vir beide eier- en kuiken-produksie opgemerk nie.

In 'n tweede studie is ses diëte, variërend in ME (MJ ME/kg voer), by 'n gemiddelde tempo van 3.4 kg/voël/dag gevoer. Die verskillende ME-vlakke was 7.5, 8.0, 8.5, 9.0, 9.5 en 10.0 MJ ME/kg voer. Geen betekenisvolle verskille ($P > 0.05$) is vir totale eiers geproduseer per voël per seisoen (44.9 ± 7.8), aantal kuikens uitgebroei (15.7 ± 4.1), aantal geil eiers (12.0 ± 3.9), aantal dood-in-dop eiers (12.0 ± 3.1) en massa verandering van wyfies

(10.6 ± 3.5 kg) opgemerk nie. Die mannetjies het toegeneem in liggaamsmassa ($P < 0.05$) soos daar 'n toename was in die energievlak van die dieët. Twee eiers per dieët per maand is vir ru-proteïen, vet en spoorelemente, en een eier per diet per maand vir vetsure ontleed. Eiers van die eerste en laaste maand van die seisoen is ontleed vir aminosure. Analise van variansie het aangetoon dat daar geen verskille ($P > 0.05$) bestaan vir die ru-proteïen en vetinhoud van die eiers by die verskillende eksperimentele diëte, asook die kalsiuminhoud van die eierdoppe. Prolien vlakke het tussen die diëte verskil ($P < 0.05$). Die C18:3n-3 (linoleïensuur) inhoud van die eiers het verskil ($P < 0.05$) tussen die dieët behandelings. Vir die hoeveelste eier in die lê siklus het die ru-proteïen-, vet- en C18:3n-3 inhoud van die eiers verhoog ($P < 0.05$).

In 'n derde studie is ondersoek ingestel na die voerinnamte van die broeivolstruise soos moontlik beïnvloed deur die energievlak van die dieët. Gemiddelde voerinnamte (kg voer/voël/dag) is nie ($P > 0.05$) deur die verskillende dieët energie vlakke van 8.0, 8.7, 9.4, 10.1, 10.8 en 11.5 MJ ME/kg voer beïnvloed nie. Die gemiddelde en standaardfout was 3.7 ± 0.2 kg.

Die produksie van broeivolstruise nie deur verskillende dieëtvlakke van proteïen en energie by vlakke soos gevoer in hierdie studie geraak nie. Broeivolstruise in hierdie studie het nie die vermoë gehad om hul voerinnamte te beheer by enige dieët energievlak soos gebruik nie. Die aantal nutriënte wat in die eiers neergelê is, het geen bydrae tot die reproduksievermoë van die wyfie gehad nie. Die studie het verder bewys dat die gemiddelde frekwensie van eier-lê by wyfies onafhanklik was by dieët-energie en -proteïenvlakke ($P > 0.05$) soos in hierdie studie gebruik.

In 'n vierde studie is die groei en ontwikkeling van die reproduksie-organe van die wyfies bestudeer tydens die aanvang van die broeiseisoen. Die hoeveelheid of konsentrasie van voedingstowwe moes bepaal word om die groei van die reproduksie-organe te ondersteun tydens die broeiseisoen, omdat hierdie organe aan eierproduksie gekoppel is. 'n Studie is derhalwe uitgevoer om te bepaal tot watter mate die reproduksie organe groei en ontwikkel tydens die broeiseisoen. Die eerste slagting is uitgevoer op die dag van afkamp. Die ovaria, ovidukt en lewer is versamel, geweeg en ontleed. Die ovaria en ovidukt is ontleed vir ru-proteïen en vet. Geen verskille ($P > 0.05$) is tussen die verskillende slagtings vir die gewig, ru-proteïen en vetinhoud vir beide organe opgemerk nie. Geen betekenisvolle tendens in die gewig van die ovidukt is waargeneem oor die 49-dae periode nie, maar die gewig was hoogs gekorreleerd met liggaamsmassa. Ovaria-gewig het geneig om gekorreleerd te wees met die aantal dae na afkamp. Variasie binne en buite die gewigte was baie hoog. Die aantal follikels teenwoordig is nie beïnvloed ($P > 0.05$) deur die aantal dae na paring. Die lewers is ontleed vir ru-proteïen en vet, maar geen verskille ($P > 0.05$) is tussen die intervalle opgemerk nie, maar die gewigte van dag 0 en 49 na paring het verskil ($P < 0.05$). Dit kan aangevoer word dat die voëls moontlik lewer reserwes gebruik het om die voedingstowwe van die dieët te supplementeer vir die ontwikkeling van die reproduksie-organe. Data uit hierdie studie kan gebruik word in 'n optimiseringsmodel (Brand & Gous, 2006) om die voedingsbehoefte van

broeivolstruise te bepaal. Hierdie studie beveel aan dat die broeiwyfie moontlik addisionele proteïen tydens die eerste sewe weke van die broeiseisoen benodig.

Resultate van Hoofstuk 4 en vorige studies is gebruik om die energie- proteïen- en aminosuurbehoefte vir eierproduksie en onderhoud van broeivolstruise te bereken. Twee metodes is gebruik om die energiebehoefte vir eierproduksie te bereken. Metaboliseerbare Energie behoefte vir eierproduksie (ME_e) en effektiwiteit van ME benutting vir energie deponering in eier (k_o) is onderskeidelik as 12.2 MJ (vir 'n eier wat gemiddeld 1.4kg weeg) en 0.8 bereken. Effektiewe Energie behoefte vir eierproduksie (EE_e) en onderhoud (EE_m) was onderskeidelik as 15.9 MJ/dag en 17.1 MJ/dag bereken. Die gemiddelde daaglikse proteïenbehoefte (TP_i) is as 175g proteïen/dag bereken. 'n Aanduiding van die aminosuur behoefte vir onderhoud en eierproduksie word ook gegee, wat laer is as vorige studies.

