

Allometric description of ostrich (*Struthio camelus* var. *domesticus*) growth and development

by

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Pectora roburant cultus recti

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Abstract

Title: Modelling ostrich (*Struthio camelus* var. *domesticus*) growth and development

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The ostrich industry has overcome many challenges since it originated. However, it is still vulnerable to sudden changes in customer preferences and economic cycles. As feed costs are the greatest expense in ostrich production, optimising feed formulations is vital. This will be possible if the growth and development of the ostrich can be simulated by modelling software. Various studies were conducted to describe ostrich growth in the form of equations that can be used in modelling software to increase the accuracy of predictions.

In the first study, birds were given the choice of four diets with varying energy (8.5 or 13.5 MJ ME/kg feed) and protein (180 or 120 g/kg feed) levels. The birds preferred the high density diet (high energy and protein) in each growth phase. A growth curve of assumed optimal growth was constructed. The chemical fractions of the body were shown to increase non-linearly with advancing age and equations were established to predict the change of the body composition over time.

In the second trial, birds received a formulated growth diet and were fed according to their nutrient requirements. Growth data was collected on the separate body components of maturing birds. Feather and skin nodule growth was defined for birds hatched in the summer. Allometric equations were set up to determine, predict and model the ostrich skin size and skin weight, some bones, some organs and the commercially valuable muscles through the growth cycle.

The final trial was conducted to determine the effect of diet density (energy and amino acid level) on the growth of ostrich body components. A four-stage, 3 x 5 (energy x protein) factorial design was developed with varying energy and protein feeding regimes. Protein (amino acid) level had no influence on body component growth. Energy level had no effect on feather growth, skin nodule

growth, bone and organ growth and muscle growth. Increased levels of dietary energy increased the skin size and skin weight. Increasing the dietary energy level also had a significant effect on the total body fat of the birds. Allometric equations were set up for each variable to predict the effect of diet on ostrich growth.

Results in this study provide a framework for simulation modelling. Predicting ostrich growth and development is paramount to accurate diet formulations and lower feeding costs.

Uittreksel

Die volstruisindustrie het reeds vele struikelblokke oorkom, maar bly steeds kwesbaar vir skielike veranderinge in die ekonomiese klimaat asook in die voorkeure van die verbruiker. Een van die belangrikste insetkoste in volstruisproduksie is voer en daarom is dit noodsaaklik om voerformulerings te optimiseer. Die doel van hierdie tesis was om by te dra tot die ontwikkeling van modellering sagteware wat die groei en ontwikkeling van die volstruis naboots. Die spesifieke doel was om volstruisgroei te bestudeer en te bespreek deur middel van vergelykings wat gebruik kan word om die akkuraatheid van die simulasiemodelle te verhoog.

Tydens die eerste studie is die voëls die keuse van vier diëte gegee waarvan die energie- (8.5 of 13.5 MJ ME/kg voer) en proteïen- (180 of 120 g/kg voer) vlakke verskil het. Die voëls het in die hoëdigtheid voer (hoog in energie en proteïen) in elke groeifase gekies. Uit hierdie data, wat aanvaar is om optimale groei te verteenwoordig, is 'n groeikurwe gekonstrueer wat getoon het dat die chemiese komponente van die liggaam nie-linieër toegeneem het oor tyd. Vergelykings is hieruit afgelei wat die verandering in die liggaamsamestelling oor tyd kan voorspel.

In die tweede studie het die voëls 'n vier-fase geformuleerde groeidieët ontvang en is na gelang van hulle voedings behoeftes gevoer. Groeidata is ingesamel van die individuele liggaams-komponente van die groeiende volstruis. Veer- en velgroei is gedefinieer vir die voëls wat in die somer uitgebroei het. Allometriese vergelykings is opgestel om te bepaal hoe die volstruis se velgrootte, velgewig, sekere bene en organe, asook die kommersiële belangrike spiere gedurende die groei-siklus verander.

Die finale studie is uitgevoer om die effek van voedingsvlak (energie- en aminosuurvlak) op die groei van die volstruis se liggaamskomponente te bepaal. 'n Vier-fase, 3 x 5 (energie x proteïen) faktoriale ontwerp is gebruik met veranderende energie- en proteïenvlakke. Proteïen- (aminozuur) vlakke het geen invloed op die groei van die liggaamskomponente gehad nie. Energievlak het geen effek op die veer-, vel-, velknoppie-, been-, organe- en spiergroei gehad nie. Toenemende vlakke van energie het wel gelei tot 'n toename in die velgrootte en massa. Die toename in voedingsenergievlakke het ook 'n betekenisvolle effek op die totale liggaamsvet van die voëls gehad. Allometriese vergelykings is opgestel vir elk van die veranderlikes om die effek van die diëet op elke komponent van die volstruis te bepaal.

Die resultate van hierdie studies verskaf 'n raamwerk vir die simulering en modellering van die groei en ontwikkeling van die volstruis. Akkurate voorspellings van die groei en ontwikkeling van die volstruis is noodsaaklik vir akkurate dieëtfomulering en verlaagde voedingskoste.

General Introduction

Ostrich farming is well established in Southern Africa and contributes greatly to the economy of the Western Cape. However, the industry is vulnerable to sudden changes in economic conditions and consumer preferences with regards to leather products, feathers and meat.

The cost of feed is the largest expense in an intensive ostrich production system. This creates the need to optimise ostrich production by maximising growth and reducing feeding costs. Creating a model that simulates the growth and performance of ostriches reared under various conditions will increase the flexibility of ostrich farming and reduce production costs. When growth is simulated, the nutrient requirements of the birds can be modelled as it changes throughout the growth cycle.

A fundamental step toward the prediction and modelling of ostrich production as a system is to have an in depth knowledge on the theory of the particular system. Biological responses to changing circumstances need to be defined scientifically.

This research was therefore conducted to provide some insight into ostrich growth.