NOTA BREVE

GROWTH OF GREATER RHEA (*RHEA AMERICANA*) MALES AND FEMALES FED WITH DIFFERENT PROTEIN LEVELS

CRECIMIENTO EN MACHOS Y HEMBRAS DE ÑANDÚ (*RHEA AMERICANA*) ALIMENTADOS CON DIFERENTES NIVELES DE PROTEÍNAS

Cabrera, M.C.[1,2], M. del Puerto[1,2], R. Olivero[2], Y.E. Godoy[2], W. Malceñido[2], O. Bentancur[3] and A. Saadoun[1,4]*

[1]Laboratorio de Fisiología y Fisiopatología de la Nutrición. Sección Fisiología & Nutrición. Facultad de Ciencias. Calle Igua 4225. CP 11400. Montevideo. Uruguay.
[2]Laboratorio de Nutrición y Ciencia de los Alimentos. Facultad de Agronomía. Avenida Garzón 809. Montevideo. Uruguay.
[3]Departamento de Biometría, Estadística y Computación. Facultad de Agronomía. Avenida Garzón 809. Montevideo. Uruguay.
[4]Departamento Básico de Medicina. Facultad de Medicina. Unidad Asociada de la Facultad de Ciencias. Hospital de Clínicas, Piso 15. Avenida Italia s/n. Montevideo. Uruguay. *asaadoun@fcien.edu.uy

ADDITIONAL KEYWORDS

Rhea americana. Nutrition. Growth.

PALABRAS CLAVE ADICIONALES

Rhea americana. Nutrición. Crecimiento.

SUMMARY

Rheas (*Rhea americana)* were fed with diets containing low (150 g/kg), medium (175.4 g/kg) or high level of protein (218 g/kg) from 22 to 29 weeks of age. The rheas grow similarly on M and H diet and significantly more than on L diet ($p<0.05$). There are not significant differences for body weight and for body weight gain between the diets M and H. It is concluded that, at this age, a protein level in diet of 175.4 g/kg could be sufficient to support the growth.

RESUMEN

Ñandúes (*Rhea americana)* se alimentaron con dietas con bajo (150 g/kg), medio (175,4 g/kg) o alto nivel de proteína (218 g/kg) desde 22 a 29 semanas de edad. Los ñandúes crecieron en forma similar con la dieta M o H y más que con la dieta L ($p<0,05$). No hubo diferencias para peso corporal o ganancia de peso entre las dietas H y M. Se concluyó que, a esta edad, una dieta con 175,4 g/kg de proteína podría ser suficiente para mantener el crecimiento.

INTRODUCTION

The concentrated diets offered to farm reared rheas (*Rhea Americana)* were generally formulated based on information coming from poultry or most often on ostrich nutrition rules (Angel, 1996; Cilliers, *et al*., 1999; Ullrey and Allen, 1996). However, there are many anatomical and physiological differences between ostrich, poultry and rhea to justify specific studies on these birds (Angel, 1996). The present study, the first in

our knowledge, was conducted to establish a first batch of information on the optimum protein requirement for growth from 22 weeks and 29 weeks of age in rhea males and females.

MATERIALS AND METHODS

Animals and housing

From hatching to 20 weeks of age, the rheas sexed and identified individually were reared in a semi intensive system. At 20 weeks of age, the rheas were selected by live weight and transported to the experimental facilities of Faculty of Agronomy (UDELAR-Uruguay). Three groups with 10 animals each one (5 females and 5 males maintained together) were formed and placed in an open experimental house. Food and water were offered *ad libitum*. To ensure the access of each animal to food, the number of bins was equivalent to the number of birds.

Diets, management and analysis

The experiment was done from 22 to 29 weeks of age; the rheas were individually weighed at the start and weekly. The food intake was recorded daily for the whole group (no individually food intakes were registered), and for each protein level considered. Diets were based in corn, soybean and lucerne pellet (NRC, 1994), to allow three levels of protein: Low (L, 150 g/kg), Medium (M, 175.4 g/kg) and High (H, 218 g/kg) and a ME of 11.8 MJ/kg based in poultry EM values.

Statistical analysis

The data obtained (22 to 29 weeks of age) were subjected to ANOVA using the GLM procedure. An individual rhea chick was the experimental unit for analysis of all data. Mains effects were protein levels, sex and age for the analysis through the experimental period and protein level and sex for the analysis at each age. The comparative analysis between means was conducted using linear and quadratic contrasts when treatment effects were significant (Snedecor and Cochran, 1989). In addition, at each age, means were compared using Tukey-Kramer test. All the statistical analysis were made using software NCSS 2004, Statistical Systems, Kaysville.Utah.

As grouped food intake data were recorded, a specific linear model (GLM procedure from SAS system) was used as follows: $Yij = U + Ti + Dj + Eij$

Where U is general average, Ti is treatment effect, Dj day measure effect and Eij experimental error. Here the repetitions are the daily measurements (50 days).

Previously a test was performed between measurements in each treatment to discard a correlation and how it was not existing the above model that presume errors independence is valid. The data were subjected to ANOVA and a Tukey's Studentized Range were used to separate the means when effect were significant ($p<0.05$).

RESULTS AND DISCUSSION

The rheas fed during the growth phase with diet M and H grew similarly and better than the rheas receiving the diet L. In the group L, one male was

Table I. *Body weight and body weight gain (kg) in males and females rhea (*Rhea americana*) fed Low (L), Medium (M) or High (H) protein level diet from 22 to 29 weeks of age.* (Peso y ganancia de peso corporal (kg) en machos y hembras ñandú (*Rhea americana*) alimentados con Bajo (L), Medio (M) o Alto (H) nivel de proteína en la dieta de 22 a 29 semanas de edad).

Age (weeks)		22	23	24	25	26	27	28	29
					Body weight				
L (15%)	Male (n= 4)*	7.36±0.75^{a}	7.94±0.84^{a}	8.61±0.91^{a}	9.30±0.89^{a}	10.33±0.95^{a}	10.52±0.94^{a}	11.48±0.93^{ab}	11.96±0.96^{ab}
	Female (n= 5)	7.39±0.67^{a}	7.95±0.75^{a}	8.61±0.82^{a}	9.33±0.80^{a}	9.50±0.85^{a}	9.58±0.85^{a}	9.89±0.83^{a}	10.26±0.86^{a}
M (18%)	Male (n= 5)	8.22±0.67^{a}	9.78±0.75^{a}	10.62±0.82^{a}	11.69±0.80^{a}	12.46±0.85^{a}	13.26±0.85^{a}	14.12±0.83^{b}	14.89±0.86^{b}
	Female (n= 5)	8.42±0.67^{a}	10.14±0.75^{a}	10.57±0.82^{a}	11.49±0.80^{a}	12.23±0.85^{a}	12.74±0.85^{a}	13.43±0.83^{ab}	13.63±0.86^{ab}
H (21%)	Male (n= 5)	7.53±0.61^{a}	8.90±0.68^{a}	10.16±0.75^{a}	10.58±0.73^{a}	11.50±0.77^{a}	11.97±0.77^{a}	12.43±0.76^{ab}	13.23±0.79^{ab}
	Female (n= 5)	8.94±0.75^{a}	10.28±0.84^{a}	10.79±0.92^{a}	11.42±0.89^{a}	12.32±0.95^{a}	12.73±0.94^{a}	13.24±0.93^{ab}	13.36±0.96^{ab}
L	Males+Females	7.37±0.50^{a}	7.95±0.56^{a}	8.61±0.61^{a}	9.31±0.59^{a}	9.91±0.63^{a}	10.05±0.63^{a}	10.68±0.62^{a}	11.11±0.64^{a}
M	Males+Females	8.32±0.47^{a}	9.96±0.53^{b}	10.59±0.58^{b}	11.59±0.56^{b}	12.35±0.60^{b}	12.99±0.60^{b}	13.78±0.59^{b}	14.26±0.61^{b}
H	Males+Females	8.24±0.47^{a}	9.59±0.53^{ab}	10.48±0.58^{ab}	11.00±0.56^{ab}	11.91±0.60^{ab}	12.35±0.60^{ab}	12.83±0.59^{b}	13.30±0.61^{ab}
					Body weight gain				
L (15%)	Male (n=4)*		0.58±0.23^{a}	1.25±0.37^{ab}	1.94±0.33^{a}	2.97±0.39^{ab}	3.16±0.42^{ab}	4.12±0.52^{ab}	4.60±0.54^{ab}
	Female (n=5)		0.57±0.21^{a}	1.22±0.33^{a}	1.94±0.30^{a}	2.11±0.35^{a}	2.19±0.37^{a}	2.50±0.46^{a}	2.89±0.48^{a}
M (18%)	Male (n=5)		1.57±0.21^{b}	2.40±0.33^{ab}	3.47±0.30^{b}	4.24±0.35^{b}	5.03±0.37^{c}	5.90±0.45^{b}	6.67±0.48^{b}
	Female (n=5)		1.72±0.21^{b}	2.15±0.33^{ab}	3.06±0.30^{ab}	3.81±0.35^{b}	4.31±0.37^{bc}	5.01±0.46^{b}	5.20±0.48^{b}
H (21%)	Male (n=5)		1.36±0.19^{b}	2.63±0.30b	3.05±0.27^{ab}	3.96±0.32^{b}	4.43±0.34^{bc}	4.89±0.42^{b}	5.70±0.44^{b}
	Female (n= 5)		1.34±0.23^{b}	1.85±0.37^{ab}	2.48±0.33^{ab}	3.38±0.39^{ab}	3.80±0.42^{ab}	4.30±0.52^{ab}	4.42±0.54^{ab}
L	Males+Females		0.58±0.15^{a}	1.23±0.25^{a}	1.93±0.22^{a}	2.54±0.26^{a}	2.68±0.28^{a}	3.31±0.34^{a}	3.74±0.36^{a}
M	Males+Females		1.64±0.15^{b}	2.27±0.24^{b}	3.27±0.21^{b}	4.02±0.24^{b}	4.68±0.27^{b}	5.46±0.33^{b}	5.94±0.34^{b}
H	Males+Females		1.35±0.15^{b}	2.24±0.24^{b}	2.77±0.21^{b}	3.67±0.24^{b}	4.12±0.27^{b}	4.60±0.33^{b}	5.06±0.34^{b}
Significances									
Body weight (P)		Ns	p<0.05, L	p<0.05, L	p<0.05, LQ	p<0.05, L	p<0.05, LQ	p<0.05, LQ	p<0.05, LQ
Body weight gain (P)			p<0.001, Q	p<001, Q	p<0.001, Q	p<0.001, LQ	p<0.001, LQ	p<0.001, LQ	p<0.001, LQ
Body weight gain (S)			ns	ns	ns	p<0.05	p<0.05	p<0.05	p<0.01

Values are means±SEM. ns= non significant. L= there is a linear effect (p<0.05), Q= there is a quadratic effect (p<0.05). There were not diferences for Sex (S) for body weight or P (protein level) x S for both. Within the column the means with different letters, differs significantly by Tukey-Kramer test (p<0.05). *One male was retired because no shows growth during the first 3 week of experiment.

retired from the group at week 3 of the experiment because no growth was registered. This observation is probably associated with a possible dwarf syndrome, sometimes observed in wild specimens. The **table I** presents the evolution of body weight means during all the experimental period for the 3 diets. The ANOVA analysis of the initial body weight (22 weeks of age) shows no significant differences between all groups ($p>0.05$). The final body weight (week 29) of males and females rhea fed with the diet M was significantly higher than the weight of the rheas fed the L and similar to the diet H.

For the body weight gain **(table I**), the ANOVA analysis shows a significant proteins level effect at 23 ($p<0.001$), 24 ($p<0.01$), 25 ($p<0.001$), 26 ($p<0.001$), 27 ($p<0.001$), 28 ($p<0.001$) and 29 week ($p<0.001$).The daily body weight gain average through the experiment was lower ($p<0.05$) in the group L (92.8±8.3 g for males and 57.9±7.4 g for females) when compared with the groups M (133.4±1.6 g for males and 103.8±9.2 g for females) and H (114.2±12.4 g for males and 88.5±14.2 g for females).

The total food consumption (males + females), done only as an useful information, was 218.7 kg, 303,9 kg and 265,3 kg for the group of animals fed with the diet L, M and H respectively. The calculated food efficiency ratio (food consumed/body weight gain at each week of the experimental period were for L diet 7.02; 6.32; 5.95; 5.64; 6.64; 6.42 and 6.49. For M diet 3.42; 4.18; 4.27; 4.43; 4.84; 4.99 and 5.12. Finally for the H diet 3.74; 3.83; 4.44; 4.27; 4.68; 5.02 and 5.24. A significant difference was found between all the treatments for the food intake expressed as kg/group/day (4.26; 5.96 and 5.07 kg/day for diets L, M and H respectively).

The results of the present investigation indicate that a food offered to the rheas, during the phase of high food intake, containing proteins level of 175.4 g/kg are sufficient to support growing.

ACKNOWLEDGEMENTS

The authors are grateful to Zulma Alicia Saadoun for English revision. The research was partially funded by INIA-URUGUAY (LIA 053).

REFERENCES

Angel, C.R. 1996. A review of ratite nutrition. *Anim. Feed Sci. Tech*., 60**:** 241-246.

Cilliers, S.C., J. Sales, J.P. Hayes, A. Chwalibog and J.J. Du Preez. 1999. Comparaison of metablizable energy values of different foodstuffs determined in ostrichs and poultry. *Brit. Poult. Sci*., 40: 491-494.

NRC. 1994. Nutrient requirements of poultry. 9. ed. Washington, D.C.: *National Academy Press*, 1994. 71 p.

Snedecor, G.W. and W.G. Cochran. 1989. Statistical Methods, 8th Edition, p. 53-57, Iowa State University Press, Ames Iowa.

Ullrey, D.E. and M.E. Allen. 1996. Nutrition and feeding of ostriches. *Anim. Feed. Sci. Tech*., 59: 27-36.

Recibido: 18-9-06. Aceptado: 12-12-06.