

EFFECT OF FLOOR TYPE ON OSTRICH (*Struthio camelus*) CHICKS BEHAVIOUR AND HEALTH, WITH EMPHASIS ON LEG DEFORMITY

تأثير نوعية الأرضية على سلوكيات وصحة صيقل النعام
مع التركيز على تشوه الأرجل

BY

AHMED SIMBAH MFAUME
(BVM (1997)-Sokoine University of Agriculture, Tanzania)

A

Thesis Submitted in Fulfilment of the Requirements for the
Degree of MSc in Wildlife Science to the Sudan University of
Science and Technology

SUPERVISED BY

Prof. Ali Saad Mohammad (main) and
Prof. Babekar Abbas (co-supervisor)

Department of Fisheries and Wildlife Sciences
College of Veterinary Medicine and Animal Production
Sudan University of Science and Technology

2008

Acknowledgement

I am very grateful to Prof. Ali Saad, Department of Fisheries and Wildlife Science, College of Veterinary Medicine, Sudan University of Science and Technology; first and foremost for agreeing to be my main supervisor. His superb guidance and constructive criticism always made my work better.

I am greatly indebted to Prof. Babekar Abbas, co-supervisor, for his encouragement and support during the set-up of the study. His critical review of the first part of my work made me feel that I could do it.

Thanks to Prof. Hamid Agab for his encouragement and continuous support. Coordination with the College administration would have been incredibly hard without him.

I would like to thank Dr Khalid Al-Malahy and Al-Watania Agriculture Company management for giving me the opportunity to achieve what I have done.

I would like to thank Dr Sivakumar (nutritionist), Mr M. Salim and Mr M. El-Hajji of Al- Watania Feed Laboratory for their cooperation and feed analysis.

Last but not least, I thank Eng. Sayed Abdallah of Al-Watania Ostrich Farm for his understanding and support; and the Ostrich Farm employees for their cooperation. All who contributed in one way or the other in completion of this work are greatly acknowledged.

This work would have been impossible if not for the unconditional support, encouragement and sacrifice made by my family.

Abstract

Ostrich (*struthio camelus*) chicks from the same hatch-group 2 days old and weighing between 0.72 to 1.06kg were studied for 16weeks. A total of 44 chicks were randomly assigned to two groups, 22 chicks in each. They were similarly managed and fed except for the type of floor. One group was reared on concrete floored room and yard, this group is later referred to as ‘*Concrete group*’. The other group was reared on a normal sand ground yard, later referred to as ‘*Sand group*’.

The average weekly live body-weights of the chicks in the two experimental groups were the same ($p \geq 0.05$) for the first two weeks of age. From the third week to the eighth week, the *sand-group* had significantly higher average live body-weights ($p \leq 0.05$) as compared to the *concrete-group*. From the ninth to sixteenth week, there was no significant difference between the two groups in terms of average live-body weight ($p \geq 0.05$)

There were a total of 7 cases of **leg deformity** in both groups ($n = 44$) of chicks under observation; that is about 15.91%. Two cases were from the sand ground (*sand group*) (28.57%); and five cases (71.43%) in the *concrete group*. There were three cases of **right** leg-tibiotarsal rotation (42.86%), two cases of **left** leg-tibiotarsal rotation (28.57%) and two cases in which both legs (**bilateral**) were affected (28.57%).

The mean bone-calcium and phosphorus percentages of the affected leg bones were significantly lower than that of the normal leg bones ($p \leq 0.05$). For normal bones, the levels were calcium $17.92 \pm 1.84\%$ and Phosphorus $8.57 \pm 0.75\%$. Deformed leg bone values were calcium, $15.29 \pm 1.02\%$ and phosphorus $7.33 \pm 0.51\%$.

Serum analysis results for chicks affected with leg deformity were Calcium 7.02 ± 0.852 mg/dl (5.64-8.01 mg/dl), Total Phosphorus 8.10 ± 0.65 mg/dl (7.19-9.30 mg/dl), Zinc 0.16 ± 0.066 μ g/dl (0.06-0.24 μ g/dl), Manganese 2.33 ± 0.852 μ g/dl (1.35-3.42 μ g/dl), Copper 54 ± 17.49 μ g/dl (37-55 μ g/dl), and Selenium 17.86 ± 7.31 μ g/dl (11.13-25.63 μ g/dl).

There were two outbreaks of *E.coli* infection in the *concrete group* while there was none on the *sand group*. Geophagy which caused sand impaction in the proventriculus, gizzard and intestines has affected seven chicks of the *sand group*; while eye-pecking and coprophagy developed in the *concrete group*; none, on the *sand group*.

A total of fifteen chicks died among the chicks under study (34.09 %; n=44). Five (11.36 %) chicks died from the *sand group* and ten (22.73%) from the *concrete group*.

The five chicks of the *sand group* died (22.73 % ; n=22). Two chicks died due to leg deformity (9.09 %, n=22) and three due to sand impaction (13.64 %, n=22).

Ten chicks died in the *concrete group* resulting in 45.45 % mortality (n=22), five died due to leg deformity (22.73%), three due to *E.coli* infection (13.64 %) and one due to eye-pecking (4.55 %).

It is concluded that rearing on concrete floor resulted in higher mortality due to leg deformity and infections, compared to rearing on sand floor. On the other hand, rearing on sand floor poses a challenge in terms of control of geophagy. Generally, rearing of ostrich chicks requires careful consideration of the management practices to ensure not only their nutritional requirements, but also their behavioral satisfaction.

Table of contents

	Abstract	ii
	Acknowledgements	iv
	Table of contents	v
	List of Tables	vii
	List of figures	viii
	List of colour plates	Ix
	Chapter One	
1.0	INTRODUCTION	1
	Chapter Two	
2.0	LITERATURE REVIEW	3
2.1	Historical Background	3
2.2	Taxonomic Classification of Ostriches	6
2.3	An Overview of Clinical Anatomy	9
2.3.1	Digestive system	9
2.3.2	Excretory system	13
2.3.3	Respiratory system	14
2.3.4	Cardiovascular system	14
2.3.5	Skeletal system	16
2.3.6	Reproductive system	18
2.3.7	Nervous system	19
2.4	Nutrition	20
2.4.1	The natural diet of ostriches	20
2.4.2	Feed nutrients	21
2.4.3	Nutrient levels in ostrich rations	26
2.4.4	Feed intake and feed conversion ratios	27
2.5	Growth Rates	29
2.6	Rearing space and husbandry	30
2.7	Diseases	35
2.7.1	Non-infectious diseases	36
2.7.1.1	Behavioural	36
2.7.1.2	Toxicity	38
2.7.1.3	Nutritional	44
2.7.1.4	Obstipation/impaction	47
2.7.1.5	Metabolic disorders	48
2.7.1.6	Gastric stasis	48
2.7.1.7	Genetic conditions	49
2.7.1.8	Leg deformity: a major non-infectious health problem	49
2.7.2	Infectious Diseases	57

2.7.2.1	Bacterial diseases	57
2.7.2.2	Viral diseases	61
2.7.2.3	Fungal diseases	70
2.7.2.4	Mycoplasma	72
2.7.2.5	Chlamydia	72
2.7.2.6	Cryptosporidium	73
2.7.2.7	<i>Toxoplasma gondii</i>	74
2.8	Zoonosis Risk	74
	Chapter Three	76
3.0	MATERIALS AND METHODS	76
3.1	Materials	76
3.1.1	Experiment birds and management	76
3.1.2	The feed	76
3.1.3	The water	77
3.2	Methods	80
3.2.1	Zootechnical observations	80
3.2.2	Blood sampling	80
3.2.3	Limb bones isolation	80
3.2.4	Statistical analysis	81
	Chapter Four	82
4.0	RESULTS	82
4.1	Zootechnical parameters	82
4.1.1	Clinical picture	82
4.1.2	Feed intake	83
4.1.3	Live weights and weekly weight gains	83
4.1.4	Feed conversion ratios (FCR)	91
4.1.5	Disease incidents and mortality	92
4.2	Biochemical analysis	96
4.2.1	Bone	96
4.2.2	Blood/serum	96
	Chapter Five	101
5.0	DISCUSSION	101
	References	116
	Appendices	133
	Arabic Abstract	144

List of Tables

Table No.	Description	Page no.
3.1	Proximate analysis of the feed used in the study	78
3.2	Water quality (chemical analysis report)	79
4.1	Average daily and weekly feed intake (kg) of ostrich chicks under observation for leg deformity (aged 2-115days old)	84
4.2	Mean weekly live weights of ostrich chicks reared on sand and concrete floor under observation for leg deformity	85
4.3	Mean weekly weight gains (in grams)	88
4.4	Feed conversion ratios	91
4.5	Disease incidences in ostrich chicks aged 2-115 days that were under observation for leg deformity	93
4.6	Causes of morbidity and mortality in the chicks under study	94
4.7	Bone calcium and phosphorus levels (%) of chicks affected with led deformity (2-115 days old)	97
4.8	Bone calcium and phosphorus of normal chicks 2-115 days old	98
4.9	Comparison of the levels of bone calcium and phosphorus between normal and affected chicks with leg deformity (2-115 days old)	99
4.10	Analysis results of serum samples of chicks affected with leg deformity for some mineral levels (2-115 days	100

old, n=7)

List of figures

Figure No.	Description	Page No.
4.1	Average weekly weights comparison	86
4.2	The trend of weekly weight developments of ostrich chicks reared on sand & concrete floor under observation for leg deformity	87
4.3	The mean weekly weight gain in (grams) of ostrich chicks reared on sand and concrete floor under observation for leg deformity	89
4.4	The mean weekly weight gain (gm) of ostrich chicks reared on sand	90
4.5	Leg deformity cases Vs affected leg	95
4.6	Leg deformity cases Vs type of floor	95

List of colour plates

Plate No.	Description	Page No.
1.	Ostrich chicks on a concrete floor	116
2.	Ostrich chicks on a natural sandy ground	116
3.	(a – c)	
	An ostrich chick, victim of eye pecking	117
	An ostrich chick, victim of eye pecking	117
	An ostrich chick, victim of eye and toe pecking	118
4.	(a – e)	
	Enteritis due to <i>E.coli</i> infection	118
	Muroid enteritis due to <i>E.coli</i> infection	119
	Severe enteritis (thickening of the enteric mucosa) due to <i>E.coli</i> infection	119
	Enteritis (thinning of the enteric mucosa) due to <i>E.coli</i> infection	120
	Pericarditis (fibrinous membrane over the heart) of an ostrich chick due to <i>E.coli</i> infection	120
5.	Coprophagy-faeces sticking on the palate of an ostrich chick	121
6.	An ostrich chick, toe pecking victim	121
7.	An ostrich chick with a bare back, feather pecking victim	122
8.	Sand and gravel impaction in the gizzard of an ostrich chick	122
9.	Leg deformity (TTR) in ostrich chick	123
10.	Sitting position of ostrich chicks with TTR	123
11.	Bruising on the medial side of the hock joint of an ostrich chick with TTR	124
12.	An ostrich chick struggling to stand up on a concrete floor	124

