RELATIONSHIP BETWEEN AGE OF CHICKEN BREEDER FLOCKS AND EGGSHELL ULTRASTRUCTURE OF HATCHING EGGS

By

GAMAL NASSER RAYAN AHMED

B.Sc. Agric. Sc. (Poultry Production), Ain Shams University, 2006

A thesis submitted in partial fulfillment
of
the requirements for the degree of

MASTER OF SCIENCE

in
Agricultural Science
(Poultry Breeding)

Department of Poultry Production
Faculty of Agriculture
Ain Shams University

2010

Approval Sheet

RELATIONSHIP BETWEEN AGE OF CHICKEN BREEDER FLOCKS AND EGGSHELL ULTRASTRUCTURE OF HATCHING EGGS

By

GAMAL NASSER RAYAN AHMED

B.Sc. Agric. Sc. (Poultry Production), Ain Shams University, 2006

This thesis for M.Sc. degree has been approved by:

Dr. Tareef Abd-Elaziz Shamma **…….**
Prof. Emeritus of Poultry Breeding, Faculty of Agriculture, Al-Azhar University

Dr. Ali Zein El-Dein Hassan **…….**
Prof. of Poultry Breeding, Faculty of Agriculture, Ain Shams University

Dr. Ahmed Galal El-Sayed **…….**
Prof. of Poultry Breeding, Faculty of Agriculture, Ain Shams University

Dr. Ahmed Hatem Ibrahim El-Attar **…….**
Prof. of Poultry Breeding, Faculty of Agriculture, Ain Shams University

Date of Examination: 15 / 5 / 2010

RELATIONSHIP BETWEEN AGE OF CHICKEN BREEDER FLOCKS AND EGGSHELL ULTRASTRUCTURE OF HATCHING EGGS

By

GAMAL NASSER RAYAN AHMED

B.Sc. Agric. Sc. (Poultry Production), Ain Shams University, 2006

Under the supervision of:

Dr. Ahmed Hatem Ibrahim El-Attar

Prof. of Poultry Breeding, Department of Poultry Production, Faculty of Agriculture, Ain Shams University (Principal Supervisor)

Dr. Moataz Mohamed Fathi

Prof. of Poultry Breeding, Department of Poultry Production, Faculty of Agriculture, Ain Shams University

Dr. Ahmed Galal El-Sayed

Prof. of Poultry Breeding, Department of Poultry Production, Faculty of Agriculture, Ain Shams University

ABSTRACT

Gamal Nasser Rayan Ahmed: Relationship between Age of Chicken Breeder Flocks and Eggshell Ultrastructure of Hatching Eggs. Unpublished M. Sc. Dissertation, Department of Poultry Production, Faculty of Agriculture, Ain Shams University, 2010.

This experiment was designed to study the impact of breeder flocks ages on eggshell ultrastructural, and its reflection on the chicks' viability to incorporate in selection programs. The brown layer breeder hens produced significantly heavier egg weight compared to the white ones. Also, egg weight increased as breeder flock age increased. The brown eggs were significantly higher relative egg weight loss compared to the white ones. According to age effect, these results detected that the relative egg weight loss increased with advancing breeder flock ages.

Egg shape index, specific gravity, true egg volume, eggshell index, wet and dry shell weight, shell percentage and shell thickness with and without membranes were significantly affected by breeder strain. With respect to age effect, the present results showed that these traits were significantly affected by breeder flock age. Eggshell breaking strength was significantly affected by breeder flock age, whereas the eggshell breaking strength decreased with advancing of breeder ages. Concerning albumen and yolk quality, they were highly significantly affected by breeder flock ages, with the exception of yolk index.

The brown eggs recorded significantly higher percentage of calcium in eggshell compared to the white ones. Also, data indicated that percentage of calcium significantly decreased as the

breeder's age increased. With regard to incubation time effect, it could be observed that the percentage of calcium significantly declined with advancing of incubation time. The present results revealed no significant difference between strains for percentage of phosphorus in eggshell. However, percentage of phosphorus in eggshell was significantly affected by breeder ages, whereas percentage of phosphorus decreased with advancing of breeder ages. With reference to incubation time effect, the percentage of phosphorus decreased as incubation time increased. Total pores per egg was highly significantly affected by strain, whereas the brown breeder hens recorded significantly higher total pores per egg compared to the white ones. Results demonstrated that total pores per egg significantly increased with advancing of breeder ages. Absolute and relative chick weights were significantly affected by strain, whereas the brown breeder hens produced heavier chick weight compared to the white ones. Also, absolute and relative chick weights were highly significantly affected breeder flock age.

Finally, the present results indicated that the total thickness of brown eggshell was significantly higher than those of white egg-shell by about 3.8%. Similar trend wasn't observed for absolute palisade thickness, whereas there was no significant difference between strains. However, the relative palisade thickness of white eggshell was significantly higher than those of brown eggshell. With respect to age effect, it could be noticed that all parameters, except of relative palisade thickness, were significantly reduced with advanced age. Concerning incubation time, the results indicated that the absolute total, palisade and cap thickness were

significantly reduced with advanced hatching time. Similar trend was noticed for relative cap thickness. Relative palisade thickness was significantly increased with advanced incubation time.

Keywords: Eggshell quality, breeder age, incubation period, Ultra-structural of eggshell, SEM

ACKNOWLEDGMENTS

Firstly, I wish to express my prayerful thanks to **"ALLAH"** who gives me everything I have.

Deep thanks and sincere appreciation to **Prof. Dr. A.H. El-Attar** (Principal Supervisor), Professor of Poultry Breeding, Poultry Production Department, Faculty of Agriculture, Ain Shams University for his direct supervision, ideal guidance, providing the facilities of work, reviewing the manuscript and his encouragement from the first step to the last one during this work. He gave me the best example of what a university professor should be.

I wish to express my thanks and sincere gratitude to **Prof. Dr. M.M. Fathi,** Professor of Poultry Breeding, Poultry Production Department, Faculty of Agriculture, Ain Shams University for his supervision, support, help and valuable advice generously given throughout the present work of the thesis.

I deeply grateful and thanks to **Prof. Dr. A. Galal**, Professor of Poultry Breeding, Poultry Production Department, Faculty of Agriculture, Ain Shams University for his encouragement, valuable advice, reading and correcting manuscript and constant interest throughout this work.

Great acknowledgments and deep grateful are due to **Dr. Sayed S. Issa**, Associate Professor of Botany Department, Ain Shams University on the facilities presented during examination of specimens in scanning electron microscope unit, Central Laboratory, Faculty of Agriculture, Ain Shams University. Also, I would like to thank Eng. Mrs. Inas Hasan, Mini-Industries Development Center, Faculty of Engineering, Ain Shams University.

I would like to express thank Prof. Dr. Essam A. EL-Sahar, Head and Professor of Agriculture Engineering Department, Dr. M. Mahrous, Mr. O. K. Abou-emera, Mr. A. Makram.

My dear feelings and gratitude go to my parents for their ensations and kind support along the course of this study.

CONTENTS

SUBJECT	Page
LIST OF TABLES	VI
LIST OF FIGURES	IX
LIST OF PHOTOGRAPHS	X
INTRODUCTION	1
REVIEW OF LITERATURE	3
1. Effect of strain and breeder flock age on:	3
1. 1. Egg weight	3
1. 2. Eggshell quality	4
1. 2. 1. Egg shape index	5
1. 2. 2. Specific gravity	5
1. 2. 3. Egg volume	6
1. 2. 4. Eggshell area (surface)	7
1. 2. 5. Eggshell strength with Quasi Static Compression	7
1. 2. 6. Shell weight	8
1. 2. 7. Shell percentage	9
1. 2. 8. Shell thickness	9
1. 2. 9. Shell membranes thickness	10
1. 3. Internal egg quality	11
1. 3. 1. Albumen quality measurements	12
1. 3. 1. 1. Albumen weight and albumen percentage	12
1. 3. 1. 2. Haugh Unit (HU)	13
1. 3. 2. Yolk quality measurements	14
1. 3. 2. 1. Yolk weight and yolk percentage	14
1. 3. 2. 2. Yolk index	15
1. 4. Chemical analysis of shell (% Ca, P)	15
1. 5. Egg weight loss during incubation	16

SUBJECT	Page
1. 6. Fertility and hatchability	17
1. 7. Total pores per egg	19
1. 8. Scanning Electron Microscopy (SEM) technique	21
1. 8. 1. Importance of (SEM) technique	21
1. 8. 2. Ultrastructure shell formation: (vertical sectional)	22
1. 8. 3. The ultrastructural various structures assessed of the mammillary layer (horizontal sectional)	26
1. 9. Chicks measurements	28
1. 9. 1. Chick weight	28
1. 9. 2. Relative chick weight to egg weight	30
MATERIALS AND METHODS	32
1. Before and During incubation	32
1.1 Egg weight	32
1.2 Egg quality measurements	33
1.2.1 Eggshell quality	33
1.2.1.1 Egg shape index	33
1.2.1.2 Specific gravity (SG)	33
1.2.1.3 Egg volume	33
1.2.1.4 True eggshell area	33
1.2.1.5 Eggshell strength	34
1.2.1.6 Shell weight	34
1.2.1.6.1 Wet shell weight	34
1.2.1.6.2 Dry shell weight	34
1.2.1.7 Shell percentage (%)	35
1.2.1.8 Shell thickness	35
1.2.1.8.1 Shell thickness with membranes	35
1.2.1.8.2 Shell thickness without membranes	35

SUBJECT	Page
1.2.1.9 Shell membranes thickness	35
1.2.1.10 Shell index	35
1.2.2 Internal egg quality	36
1.2.2.1 Albumen quality	36
1.2.2.1.1 Weight and percentage of albumen	36
1.2.2.1.2 Haugh units (HU)	36
1.2.2.2 Yolk quality	36
1.2.2.2.1 Weight and percentage of yolk	36
1.2.2.2.2 Yolk index	36
1.3 Chemical analysis of shell (% Ca, P)	37
1.4 Fertility determination	37
1.5 Air cell volume	38
1.6 Embryo weight	38
1.7 Egg weight loss during incubation	38
1.8 Total pores per egg	38
2. After hatching	39
2.1 Hatchability determination	39
2.2 Number and weight of Chicks	39
3. Scanning electron microscopy (SEM) technique	40
4. Statistical analysis	42
RESULTS AND DISCUSSION	44
1. Egg weight	44
2. Absolute and relative egg weight loss	46
3. Eggshell quality	49
3.1 Egg shape index	49
3.2 Specific gravity (SG)	49
3.3 True egg volume	50

SUBJECT	Page
3.4 True eggshell area	51
3.5 Shell weight	52
3.5.1 Wet shell weight	52
3.5.2 Dry shell weight	53
3.6 Shell percentage (%)	53
3.7 Shell thickness with and without membranes	54
3.8 Shell membranes thickness	55
3.9 Eggshell index	55
3.10 Eggshell breaking strength	56
4. Internal egg quality	70
4.1 Albumen quality	70
4.1.1 Weight and percentage of albumen	70
4.1.2 Haugh units (HU)	70
4.2 Yolk quality	73
4.2.1 Weight and percentage of yolk	73
4.2.2 Yolk index	73
5. Air cell volume	75
6. Chemical analysis of shell	77
6.1 Calcium in eggshell (%)	77
6.2 Phosphorus in eggshell (%)	78
7. Absolute and relative embryo weight	81
8. Fertility and hatchability	83
9. Total pores per egg	86
10. Absolute and relative chick weight	89
11. Scanning electron microscopy (SEM) technique	91
11.1 Eggshell ultrastructure (vertical sectional)	91
11.2 Eggshell ultrastructure (horizontal sectional)	93

SUMMARY AND CONCLUSION 110

REFERENCES 119

ARABIC SUMMARY

LIST OF TABLES

Table	TABLE TITLE	Page
1	Number of chicks produced for each sex within different ages of layer breeder strains.	40
2	Egg weight (g) and Egg weight loss (absolute and %) as affected by strain, breeder flock age and their interaction (Means ±SE).	48
3	Egg shape index (%) as affected by strain, breeder flock age, incubation time and their interactions, (Means ±SE).	58
4	Specific gravity as affected by strain, breeder flock age and their interaction at zero days of incubation (Means ±SE).	59
5	True egg volume (cm^3) as affected by strain, breeder flock age, incubation time and their interactions (Mean ±SE).	60
6	True eggshell area (cm^2) as affected by strain, breeder flock age and their interaction before incubation (at zero days of incubation) (Means ±SE).	61
7	Wet shell weight (g) as affected by strain, breeder flock age, incubation time and their interactions (Means ±SE).	62
8	Dry shell weight (g) as affected by strain, breeder flock age, incubation time and their interactions (Means ±SE).	63
9	Shell percentage as affected by strain, breeder flock age, incubation time and their interactions	64

	(Means ±SE).	
10	Shell thickness with membranes (mm) as affected by strain, breeder flock age, incubation time and their interactions (Means ±SE).	65
11	Shell thickness without membranes (mm) as affected by strain, breeder flock age, incubation time and their interactions (Means ±SE).	66
12	Shell membranes thickness (mm) as affected by strain, breeder flock age, incubation time and their interactions (Means ±SE).	67
13	Eggshell index (g /100 cm^2) as affected by strain, breeder flock age and their interaction before incubation (at zero days of incubation) (Means ±SE).	68
14	Eggshell breaking strength (Kg /cm^2) as affected by strain, breeder flock age, incubation time and their interactions (Means ±SE).	69
15	Albumen quality as affected by strain, breeder flock age and their interaction before incubation (at zero days of incubation) (Means ±SE).	72
16	Yolk quality as affected by strain, breeder flock age and their interaction before incubation (at zero days of incubation) (Means ±SE).	74
17	Air cell volume (cm) as affected by strain, breeder flock age and their interaction after 10 days of incubation (Mean ±SE).	76
18	Percentage of calcium (Ca) in eggshell as affected by strain, breeder flock age, incubation	79