CONTENTS **Page No.**

Chapter 1 : INTRODUCTION 1

Chapter 2 : REVIEW OF LITERATURE 3

2.1. Organic Selenium 3
2.1.1. Live body weight 3
2.1.2. Body weight change 4
2.1.3. Egg weight 4
2.1.4. Egg mass 4
2.1.5. Egg production 4
2.1.6. Feed consumption 4
2.1.7. Feed conversion ratio 5
2.1.8. Egg quality 5
2.1.9. Embryos 5
2.1.10. Egg yolk 5
2.1.11. Egg weight loss 6
2.1.12. Hatching traits 6
2.1.13. Chick quality 6
2.1.14. Blood parameters 7
2.1.15. Post hatch 7
2.2. Linseed oil 8
2.2.1. Live body weight 8
2.2.2. Body weight change 8
2.2.3. Egg weight 8
2.2.4. Egg mass 9
2.2.5. Egg production 9
2.2.6. Feed intake 10
2.2.7. Feed conversion ratio 10
2.2.8. Egg quality traits 11
2.2.9. Egg yolk lipids 12
2.2.10. Embryos 12
2.2.11. Hatching characteristics 13
2.2.12. Chick quality 13
2.2.13. Blood parameters 13
2.2.14. Post hatch 14
2.3. Linseed oil and selenium combination 14
2.4. Thermal Manipulation 15
2.4.1. Egg weight loss 15
2.4.2. Embryonic weight 16
2.4.3. Embryonic mortality 17
2.4.4. Hatchability 17
2.4.5. Chick weight at hatch 18
2.4.6. Chick quality 19
2.4.7. Plasma hormones at hatch. 19
2.4.8. Yolk sac and internal organs weight of baby Bandarah chicks 20
2.4.9. Thermotolerance 21
2.4.10. Performance parameters of growing period (8-12 weeks of age) 22

2.4.10.1. Body weight 22
2.4.10.2. Body weight change 23
2.4.10.3. Feed intake 23
2.4.10.4. Feed conversion ratio 23
2.4.10.5. Mortality rate 23
2.4.10.6. Plasma hormones at 12 wks of age after thermal challenge 24
2.4.10.7. Carcass traits 24
Chapter 3: MATERIALS AND METHODS 26
3.1. First division: dietary supplementation for chickens with linseed oil and organic selenium 26
3.1.1. Data collections 28
3.1.1.1. Body weight 28
3.1.1.2. Body weight change 28
3.1.1.3. Feed consumption 28
3.1.1.4. Feed conversion ratio 28
3.1.1.5. Egg production traits 28
3.1.1.5.1. Average egg weight 28
3.1.1.5.2. Egg number / hen / period 29
3.1.1.5.3. Egg production % 29
3.1.1.5.4. Egg mass 29
3.1.1.5.5. Egg quality traits 29
3. 1.1.5.5.1. External egg quality 29
3. 1.1.5.5.1.1. Egg shape index 29
3. 1.1.5.5.1.2. Egg shell percent 29
3. 1.1.5.5.1.3. Shell with membranes thickness 29
3. 1.1.5.5.1.4. Shell weight 29
3. 1.1.5.5.2. Internal egg quality 29
3. 1.1.5.5.2.1. Albumin weight 30
3. 1.1.5.5.2.2. Albumen percent 30
3. 1.1.5.5.2.3. Albumin height 30
3. 1.1.5.5.2.4. Yolk index 30
3. 1.1.5.5.2.5. Yolk weight 30
3. 1.1.5.5.2.6. Yolk percent 30
3.1.1.5.6. Yolk analysis 30
3.2. Second division : incubation parameters and embryonic thermal manipulation 30
3.2.1. Egg weight loss 31
3.2.2. Embryonic weight 31
3.2.3. Embryonic mortality 31
3.2.4. Fertility and hatchability 31
3.2.5. Chick body weight at hatch 32
3.2.6. Chick quality 32
3.2.7. Yolk sac and internal organs weight of hatched Bandarah chicks 32
3.3. Third division : post-hatch chick growth and thermochallenge exposure 32
3.3.1. Body weight 34
3.3.2. Body weight change 34
3.3.3. Feed consumption 34

3.3.4. Feed conversion ratio 34
3.3.5. Mortality rate 34
3.3.6. Carcass traits 34
3.4. Fourth division : post-hatch laying production 34
3.4.1. Body weight at sexual maturity 34
3.4.2. Age at sexual maturity 34
3.4.3. Egg production traits 35
3.4.3.1. Average egg weight 35
3.4.3.2.Egg number / hen/ period 35
3.4.3.3.Egg production % 35
3.4.3.4. Egg mass / hen 35
3.4.3.5. Feed consumption 35
3.4.3.6. Feed conversion ratio 35
3.4.4. Blood biochemical constituents 36
3.4.4.1. Blood sample collection 36
3.4.4.2. Blood parameters 36
3.4.4.3. Hormonal assay 36
3.5. Statistical analysis 36
Chapter 4: RESULTS AND DISCUSSIONS 37
4.1. First Division : dietary supplementation of Bandarah chickens with linseed oil and organic selenium 37
4.1.1. Body weight and body weight change 37
4.1.2. Egg production traits 38
4.1.2.1. Average egg weight and egg mass 38
4.1.2.2. Egg production 39
4.1.2.3. Feed consumption and feed conversion ratio 40
4.1.3. Egg quality traits 42
4.1.4. Yolk total lipids, cholesterol, HDL , LDL , total antioxidant capacity and malondialdhide 44
4.2. Second Division : embryonic thermal manipulation and incubation parameters 45
4.2.1. Egg weight loss 45
4.2.2. Embryonic mortality 47
4.2.3. Embryonic weight 49
4.2.4. Hatching parameters 51
4.2.5. Yolk sac and internal organs weight of hatched chicks 53
4.2.6. Chick quality 55
4.2.7. Blood parameters of hatched Bandarah chicks 57
4.3. Third Division : post-hatch chick growth and thermochallenge 61
4.3.1. Body weight and body weight change 61
4.3.2. Feed consumption 64
4.3.3. Feed conversion ratio 65
4.3.4. Mortality rate 67
4.3.5. Carcass traits 68
4.3.6. Blood parameters 71
4.4. Fourth Division: post-hatch laying production 73
4.4.1. Age and body weight at sexual maturity 74
4.4.2. Egg production traits 75
4.4.2.1. Average egg weight 75

4.4.2.2. Egg mass , egg number , egg production percentage 76
4.4.2.3. Feed consumption and feed conversion ratio 79
Chapter 5: SUMMARY AND CONCLUSIONS 82
Chapter 6: REFERENCES 87
Chapter 7: ARABIC SUMMARY 1

LIST OF ABBREVIATIONS

Abbreviations	Descriptions
%	Percent
Ca	Calcium
CFS	Common flax seeds
CP	Crude protein
d	Day
DHA	Docosahexaenoic acid
E	Embryonic
ED	Embryonic day
EPA	Eicosapentaenoic acid
EST	Eggshell temperatures
FAs	Fatty acids
FO	Fish oil
g	Gram
GSH-Px	Glutathione peroxidase
H_2Se	Selenite
HDL	High density lipoprotein
hr	Hour
Hsp70	Heat shock protein 70
IL-1	Interleukin-1
Kg	Kilogram
LDL	Low density lipoprotein
LDL-c	Low density lipoprotein- cholesterol
LNA	Linolenic acid
LO	Linseed oil
MDA	Malondialdhide
ME	Metabolic energy
n-3	Linolenic acid
n-6	Linoleic acid
Na_2SeO_3	Sodium selenite
No	Number

^{o}C	Degree Celsius
P	Phosphorus
Pax7	Gene expression
PGE2	Prostaglandin E2
pH	Acidity
PUFA	Polyunsaturated fatty acid
RBW	Relative body weight
RCM	Red crap meal
RH	Relative humidity
RIA	Radioimmunoassay
SAS	Statistical Analysis System
Se	Selenium
Sel plex®	Selenomethionine
SeMet	Selenomethionine
SO	Soybean oil
SOD	Superoxide dismutase
T	T lymphocytes cells
T_3	Triiodothyronine
T_4	Thyroxine
TBARS	mg malondialdhyde /kg meat
TM	Thermal manipulation
Vit.E	Vitamin E
VLDL	Very low density lipoprotein
wks	Weeks
YS	Yeast selenium

5. SUMMARY AND CONCLUSIONS

The present experiment was conducted at El-Sabahia Poultry Research Station (Alexandria), Animal production Research Institute, Agriculture Research Center. Bandarah developed chicken strain was employed in this experiment. The experiment was conducted from october 2011 up to september 2012 to investigate the effect of maternal dietary supplementation with linseed oil (0.83%) and organic selenium (0.2 mg/Kg diet) on productive performance of Bandarah chickens. Also, to study the effect of these dietary supplementation simultaneously with thermal manipulation 39.5°C (103.1 °F) for four hours daily from day 12 to 18 of incubation during embryogenesis on hatching traits, chick □s thermotolerance, physiological response and productive performance of offspring produced from the Bandarah parental flock.

Two hundred and eighty sex females with forty four males from Bandarah chicken strain were housed in floor pens during the laying stage (26-34 weeks of age). The birds were randomly divided into two groups and kept in 22 floor pens, of an open house system throughout the experimental period, with eleven replicates for each group. Sex ratio comprised 2 males for 13 females for each pen as replicate . The first group was used as control , while birds of the second one was supplemented with Linseed oil and organic selenium as Sel-plex .

One thousand and four hundred hatching eggs produced from Bandarah chickens were divided into four groups:

1. CNT group : eggs as control produced from Bandarah chickens fed diet free from linseed oil and organic selenium supplementation and non-treated with thermal manipulation during incubation .
2. CTH group : eggs as control produced from Bandarah chickens fed diet free from linseed oil and organic selenium supplementation and treated with thermal manipulation during incubation .
3. SNT group : eggs produced from Bandarah chickens fed diet supplemented with linseed oil and organic selenium and non- treated with thermal manipulation during incubation .
4. STH group : eggs produced from Bandarah chickens fed diet supplemented with linseed oil and organic selenium and treated with thermal manipulation during incubation.

One thousand baby chicks from the four experimental groups were exposed to heat challenge of 35 ºC for sex hours at eight to twelve wks of age.

Results of this experiment could be summarized as follows:

1- Dietary supplementation for Bandarah chickens with linseed oil and organic selenium :

1.1. Significantly ($p< 0.05$) decreased body weight and body weight change.

1.2. Significantly ($p< 0.05$) increased egg mass while egg weight was not significantly affected .

1.3. Significantly ($p< 0.05$) improved egg number and egg production percentages compared with those of control group.

1.4. Significantly ($p< 0.05$) decreased feed intake and improved ($p< 0.05$) feed conversion ratio compared to control group .

1.5. Significantly ($p< 0.05$) improved egg shell with membrane thickness (mm), albumen height (mm), Haugh unit score and yolk index compared with those of control group .

1.6. Significantly ($p< 0.05$) lowered egg yolk cholesterol (mg/g yolk) and malondialdhide (mg/g yolk) compared to those of control and increased ($p< 0.05$) yolk HDL(mg/g yolk), HDL/LDL ratio and total antioxidant capacity (mg/g yolk).

2. Embryonic thermal manipulation and incubation parameters :

2.1. Egg weight loss percentage was significantly ($p< 0.05$) affected by thermal manipulation among all incubation intervals. Control group treated with thermal manipulation exhibited the greatest significant ($p< 0.05$) egg weight loss during 12-18 days of incubation. Whereas, enriching the diet of parental flock with linseed oil and organic selenium decreased egg weight loss especially for those subjected to thermal manipulation .

2.2. Embryonic mortality was higher ($p< 0.05$) during early (1-7 day) and mide (7-12 day) stages of incubation for control group and non- subjected to thermal manipulation compared with dietary supplemented group and non-subjected to thermal manipulation. Also, the reduction of embryonic mortality percentage for birds group supplemented with linseed oil and organic selenium in the diet and non-subjected to thermal manipulation could be due to addition of linseed oil and organic selenium in the diet. Furthermore, thermal manipulation for control eggs represented highest embryonic mortality during the late stage (12-18 day) of incubation.

2.3. Absolute and relative weights of embryos were increased ($p< 0.05$) at day 18 of incubation for eggs subjected to thermal manipulation either dietary supplemented with linseed oil and organic selenium or not (CTH and STH groups) compared with CNT and SNT groups .

2.4. Dietary supplementation with linseed oil and organic selenium and thermal manipulation during embryogenesis had no significant influence on embryonic malposition, pipped eggs and macroscopic fertility percentages .

2.5. Lowest significant percentages of hatchability either for fertile or total eggs were observed for CTH group compared with those for other experimental groups (CNT , SNT and STH). This decrease of hatchability percentage could be due to embryonic thermal manipulation .

2.6. Dietary supplementation with linseed oil and organic selenium and thermal manipulation for eggs during embryogenesis (STH group) significantly improved the hatchability percentage compared with those without dietary supplementation and subjected to thermal manipulation (CTH group) .

2.7. Body weights at hatch were significantly ($p< 0.05$) heaviest for chicks produced from egg group of dietary supplementation and subjected to thermal manipulation (STH) compared with those produced from other egg groups (CNT , CTH , SNT).

2.8. Chick □s relative weight of yolk sac was significantly ($p<0.05$) increased for group of dietary supplementation and subjected to thermal manipulation (STH) compared with those of other experimental groups (CNT , CTH, SNT).

2.9. Relative weight of chick □s spleen was significantly ($p<0.05$) increased for group of dietary supplementation and non-subjected to thermal manipulation (SNT) compared with those of control group subjected to thermal manipulation (CTH) .

2.10. Relative weight of chick □s heart represented significant ($p<0.05$) decrease for control group subjected to thermal manipulation and free from dietary supplementation (CTH) compared with those of control group which not subjected to thermal manipulation (CNT) .

2.11. Highest ($p< 0.05$) scores of baby chick quality traits such as length, activity, downs and appearance were recorded for chicks group of dietary supplementation

with linseed oil and organic selenium and subjected to thermal manipulation (STH) compared with those of other experimental groups (CNT, CTH, SNT) .

2.12. Worst ($p< 0.05$) scores of baby chick quality traits were recorded for chicks of control group subjected to thermal manipulation without dietary supplementation (CTH) compared with other experimental groups (CNT, SNT, STH) .

2.13. Hatched chicks for group subjected to thermal manipulation without dietary supplementation (CTH) represented significant increase of plasma total lipids, total cholesterol, LDL and malondialdhide compared with those for group of dietary supplementation and thermal manipulation exposure, whereas HDL, HDL/LDL ratio and total antioxidant capacity were decreased .

2.14. Hatched chicks represented significant decrease of plasma total lipids, total cholesterol, LDL and malondialdhide for groups of dietary supplementation either subjected or non subjected to thermal manipulation during embryogenesis (STH, SNT). While, control chicks group of thermal manipulation exposure during embryogenesis without dietary supplementation (CTH) had significant increase of plasma HDL, HDL/LDL ratio and total antioxidant capacity.

2.15. Hatched chicks of control group subjected to thermal manipulation during embryogenesis without dietary supplementation (CTH) represented significant increase of triiodothyronine (T_3) , thyroxin (T_4) and corticosterone hormones compared with those for other experimental groups (CNT, SNT, STH) .

3. Post-hatch chick growth and thermochallenge exposure:

3.1. Chick □s body weight at 8, 9, 10, 11 and 12 weeks were significantly decreased due to thermal challenge for control chicks which did not possess thermal experience with no dietary supplementations (CNT) compared with chicks for group of dietary supplementation with thermal experience (STH) .

3.2. Body weights of STH chicks group (dietary supplementation and thermal experience during embryogenesis) were significantly ($p< 0.05$) increased compared with those for CNT, CTH, SNT groups throughout the growing period from 8 to 12 wks of age .

3.3. Body weight change of CNT chicks group (no thermal experience and free from dietary supplementation) was significantly ($p< 0.05$) decreased throughout 9-10 , 10-11 and 8-12 wks of age compared with chicks for group of dietary supplementation with thermal experience (STH) .

3.4. Largest body weight change during 9-10 wks of age period was significantly recorded for group of dietary supplementation coincided with thermal experience (STH) compared to other CNT, CTH, SNT groups .

3.5. Chicks for group of dietary supplementation without thermal experience (SNT) consumed least amount of feed during 11-12 weeks of age compared to other CNT, CTH, SNT groups.

3.6. Chick □s feed conversions ratio through growing periods (9-10 and 11-12 weeks of age) were significantly improved for group of dietary supplementation with thermal experience (STH) compared with other CNT, CTH, SNT groups .

3.7. Mortality rate was significantly diminished for chicks of dietary supplementation with thermal experience during embryogenesis (STH) compared with other experimental CNT, CTH and SNT groups during the experimental growing period (8-12 wks of age). While after thermochallenge exposure, the worst ($p< 0.05$) mortality rate was recorded for control chicks which had no thermal experience and free from dietary supplementation (CNT).

3.8. Highest ($p< 0.05$) value of relative dressing weight at 12 weeks of age was observed for chicks of dietary supplementation with thermal experience during embryogenesis (STH group) compared with control groups either did not possess thermal experience (CNT) or possess this experience (CTH).

3.9. Chick □s relative weights of liver, spleen, heart, thyroid gland, thigh length, thigh diameter, tibia diameter and wing length were significantly ($p< 0.05$) decreased for control group which had no thermal experience and free from dietary supplementation (CNT) compared with control group with thermal experience (CTH) and group of dietary supplementation with thermal experience (STH) .

3.10. Value of plasma total cholesterol was significantly higher for control chicks at 12 weeks of age who have not possess the thermal experience and free from dietary supplementations compared to those for control chicks group with thermal experience group (CTH).

3.11. Value of Plasma total antioxidant capacity was significantly ($p< 0.05$) lower for control chicks who had no thermal experience and free from dietary supplementation (CNT group) than those for chicks of dietary supplementation with thermal experience (STH) at 12 weeks of age . However, the chicks of CNT group recorded the highest ($p< 0.05$) value of plasma malondialdhide compared with those for other experimental groups (CTH, SNT, STH) .

3.12. Values of Plasma triiodothyronine (T_3), thyroxin (T_4) and corticosterone hormones concentrations for chicks at 12 weeks of age were significantly ($p< 0.05$) increased for control chicks who had no thermal experience and free from dietary supplementation (CNT) compared to those for control chicks with thermal experience (CTH).

4. post-hatch laying production :

4.1. Age at sexual maturity for hens of dietary supplementation and possessed thermal experience group (STH) was earliest ($p< 0.05$) compared with hens for other CNT, CTH, SNT groups.

4.2. Body weight at sexual maturity did not significantly differ between all experimental groups (CNT, CTH, SNT, STH) .

4.3. Egg weight during entire experiment (26-38 wks of age) remained ($p<0.05$) higher for birds group of dietary supplementation and did not possess thermal experience compared with those for birds group without dietary supplementation or thermal experience (CNT) .

4.4. Hens of dietary supplementation with thermal experience group (STH) produced ($p< 0.05$) higher egg mass compared with those for group of dietary supplementation without thermal experience (SNT) and numerically produced highest egg mass value compared with control one who either had no thermal experience (CNT) or possessed this experience (CTH) during 30-34 wks period and in the accumulated period (26-38 wks) of age .

4.5. Layers group of dietary supplementation with thermal experience (STH) produced ($p< 0.05$) greatest amount of eggs compared with those for group of dietary supplementation without thermal experience (SNT) and control hens who had no thermal experience (CNT) during 26-30 wks of age.

4.6. Birds group of dietary supplementation without thermal experience (SNT) consumed significantly largest amount of feed compared to those of other experimental groups (CNT, CTH, STH) during the accumulated laying period (26-38 wks) of age .

4.7. Feed conversion ratio were significantly ($p< 0.05$) improved for bird □s group of dietary supplementation and possess thermal experience (STH) compared with

birds group who had no thermal experience or dietary supplementation (CNT) and for those supplemented with linseed oil and organic selenium and had no thermal experience (SNT) .

Conclusion :

The most interesting aspect of the present work was the observe that treating the embryos from the period of 12-18 days of incubation with 39.5°C temperature created new hormonal and immune systems in the embryos which supplied the chicks during growing period with more ability to withstand and challenge the temperature increase without any deleterious effect . It means that this method of embryonic treatment could be considered as a good tool for coping the thermal stress on the growing chicks especially in the summer seasons and at areas which suffering from temperature increase. Moreover , the idea of enriching the diet of parents flock with linseed oil and organic selenium was suggested to face the suspected bad influence of increasing incubation temperature which affects the embryonic development and consequently the results of hatching process. Therefore, enriching the diet of parent flocks with linseed oil and organic selenium accompanied with thermal manipulation during embryogenesis could be considerd as double kicks for improving embryonic development and hatchability percentage besides increasing the chick ability for coping the thermal challenge during growing period .