STUDIES ON THE EFFECT OF FORCEMOLTING IN LAYERS PAST ONE YEAR OF PRODUCTION ON THEIR SUBSEQUENT PRODUCTION AND CERTAIN SERUM BIOCHEMICAL CHARACTERISTIC S

BY
Dr. MOHAMMED YASEEN KHAN,
B.V.Sc.,

THESIS SUBMITTED TO THE
ANDHRA PRADESH AGRICULTURAL UNIVERSITY
IN PART OF FULFILEMNT OF THE REQUIREMENTS
FOR THE AWARD OF DEGREE OF

MASTER OF VETERINARY SCIENCE
(POULTRY SCIENCE)

DEPARTMENT OF POULTRY SCIENCE
COLLEGE OF VETERINARY SCIENCE
ANDHRA PRADESH AGRICULTURAL UNIVERSITY
RAJENDRANAGAR, HYDERABAD 500 030, (A. P.)

1 9 8 3

CERTIFICATE

Sri Mohammed Yaseen Khan has satisfactorily prosecuted the course of research and that the thesis entitled "Studies on the effect of force molting in layers past one year of production on their subsequent production and certain serum biochemical characteristics" submitted by him is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by him for a degree of any University.

Date : 25 5 [illegible]

(MAJOR ADVISOR)

CERTIFICATE

This is to certify that the thesis entitled "Studies on the effect of force molting in layers past one year of production on their subsequent production and certain serum biochemical characteristics" submitted in partial fulfilment of the requirement for the degree of Master of Veterinary Science of Andhra Pradesh Agricultural University, Hyderabad is a record of the bonafide research work carried out by Sri Mohammed Yaseen Khan, under my guidance and supervision. The subject of the thesis has been approved by the student's advisory committee.

No part of the thesis has been submitted for any other degree or diploma or has been published. Published part has been fully acknowledged. All the assistance and help received during the course of the investigation has been duly acknowledged by him.

CHAIRMAN OF THE ADVISORY COMMITTEE

Thesis approved by the Student Advisory Committee

CHAIRMAN : (DR. G.L.N. REDDY) .. .. ..

MEMBER : (DR. S.J. REDDY) .. ..

MEMBER : (DR. G.NAGESWARA RAO) .. .. ..

MEMBER : (DR. P.V. RAO) .. ..

TABLE OF CONTENTS

LIST OF TABLES

ACKNOWLEDGEMENTS

It is with immense pleasure that I express my deep sense of gratitude to Dr. G.L.N. Reddy, Assistant Research Officer, All India Co-ordinated Research Project on Poultry for Eggs, Andhra Pradesh Agricultural University, Hyderabad who as a Chairman of my Advisory Committee offered valuable suggestions, able guidance and encouragement in the conduct of the present investigation and presentation of thesis.

I owe my thanks to Dr. P.V.Rao, Professor and Head, Department of Poultry Science, College of Veterinary Science, Andhra Pradesh Agricultural University, Hyderabad, who as a member of my advisory committee provided for me all the required facilities for conducting this work.

I am thankful to Dr. S.Jyothesswara Reddy, Ph.D. (U.S.A.) Assistant Professor, Department of Poultry Science, College of Veterinary Science, Tirupati, Andhra Pradesh Agricultural University who as member of my advisory committee, rendered his kind help throughout, guiding me in different aspects with valuable advice, constructive criticism and encouragement.

I am also grateful to Dr. G.Nageshwara Rao, Ph.D. Professor and Head, Department of Statistics and Mathematics, College of Agriculture, Andhra Pradesh Agricultural University,Hyderabad, for his valuable suggestions and encouragement given during this investigation and preparation of thesis.

Words fail me to express my feeling of gratitude to Dr. S.K. Meera Mohiuddin, Associate Professor and Head, Department of Pathology, whole hearted consent to place laboratory facilities for conducting biochemical studies.

I am also thank ful to my Colleagues Dr. M.A. Majeed,M.V.Sc. and Md. Osman, M.Sc.(Ag), staff of Department of Poultry Science for their ready help and cooperation in carryingout my research work.

I am deeply obliged to my beloved parents who encouraged me for further studies and gave me the physical and moral support during the period of my post-graduate study.

I am greatly indebted to my wife Shamshad Begum and other family members specially Naseerunnisa Begum Saheba and Sri M. Ghouse Mohiuddin, B.A.B.E. for their love, affection and immense support extended to me.

(MOHAMMED YASEEN KHAN)

DEDICATED TO MY BELOVED

PARENTS

AUTHOR : MOHAMMED YASEEN KHAN

TITLE : "Studies on the effect of force molting in layers past one year of production on their subsequent production and certain serum biochemical characteristics"

DEGREE TO WHICH IT IS SUBMITTED : M.V.Sc. (Poultry Science)

GUIDE : Dr. G.L.N. REDDY
Assistant Research Officer
All India Co-ordinated Research Project on Poultry for Eggs
Andhra Pradesh Agricultural Univers
Rajendranagar, Hyderabad 500 030.

UNIVERSITY : Andhra Pradesh Agricultural University

YEAR : 1983

ABSTRACT

The present investigation was undertaken to study the effect of different methods of force molting on the post-molt performance of the birds. Two strains of White Leghorn layers past one year of production (90 birds of each strain) were selected on the basis of uniform body weight and record of previous egg production. These birds were randomly distributed into 9 groups of 10 birds for each strain. Triplicate groups were subjected to two force molting methods (i) salt restriction method and (ii) conventional method of force molting. The third group was

maintained as control. Production characteristics such as percent hen day production, egg quality, feed consumption and feed efficiency, body weight gain/loss and percent mortality, were studied during the initiation of the programme and peak production following force molting. The experiment lasted for 18 weeks following the molt to evaluate the post molt performance. Heart blood samples from the birds were collected at the initiation of the programme, when the birds reached zero production and at the peak production following molt to study the biochemical characters.

It was observed that force molting resulted in significant (P/_0.05) increase in percent hen day production, improved feed efficiency and superior egg quality. However feed consumption was slightly in-creased due to the higher body weights and egg production. The study further revealed that the serum calcium, inorganic phosphate, serum protein and blood sugar were significantly (P/_0.05) decreased during molt (at zero production). At peak production (post molt) the level of these constituents were on par with that of control. However the alkaline phosphatase activity during molt was significantly (P/_0.05) increased over control and came to normal at peak production.

Between the two methods of force molting employed in this study, salt deprivation method was found to be superior over the conventional method of force molting because hens subjected to salt deprivation produced significantly ($P \leq 0.05$) more number of eggs, had superior egg quality and less mortality when compared with hens, force molted by conventional method. It was also observed that strain S_1 (BV 300) was superior to strain S_2 (AICRP on poultry) because of its higher egg production, better feed efficiency, superior egg quality and lower mortality, which may be probably due to genetic potential of the strains.

Thus it can be concluded that force molting results in improved performance of birds during the second laying cycle since it gives rest period for the hens to rejuvinate their body physiological processes. Salt deprivation method was found to be superior to the conventional method of force molting because it has a rapid effect, easy implementation, greater safety and produced no adverse effects during the second laying cycle.

CHAPTER I

INTRODUCTION

Molting refers to shedding and removal of feathers. During growing period young chicks will molt and replace their brownish fluff with the feathers and further the birds molt at just before laying followed by tight feather coat. Physiologically the laying hen molts after a full year of laying period. This molting is supposed to be a rest period for the birds because there is no egg production and is intended to rejuvenate the body processes for the next laying cycle. Molting process usually follows an orderly shedding of feathers with respect to different parts of body such as head, neck, body (breast, back, fluff, abdomen), wing and tail. Natural molting requires about four months for the hen to shed her feathers and grow a new set. However, it is possible to speed up the process through a programme of force molting, that rapidly molts, favours growth of a new set of feathers, then stimulate them to production.

The primary reason for implementation of force molting is that it will help to overcome the scarcity of replacement chicks either in commercial or breeder farm and also it costs less to force molt hens than to purchase day-old chicks and grow them to point of lay pullets. Forced molting will be beneficial for the post-ponement of subsequent revival of egg production when there is a slump in egg prices or glut of eggs in the market or lack of demand for commercial chicks in a hatchery. Besides, force molting results in increased postmolt performance, im-proved feed effeciency and superior egg quality.

Forced molting is brought about by the manipulation of environmental variables to stop egg production and recycle hen for another season of egg laying. The environmental variables most of them adopted in force molting regime involves the restriction of daily photoperiod, feed and water intake. Other procedures employed for inducing force molt or rest in layers includes, use of antiovulatory drugs, dietary alteration such as excess zinc, or magnesium in diet, insufficient salt or calcium etc.

Thus the present investigation has been taken up to study whether conventional force molting method (feed and water restriction) or salt deprivation method is efficient in inducing force molt or rest under Indian conditions. Besides, the postmolt performance of the bird such as egg production, egg quality, feed consumption and feed effeciency were also studied.

CHAPTER II

REVIEW OF LITERATURE

A critical review of the available literature on the effect of force molting on the post molt performance of the birds is presented below.

The egg production in the second cycle may be 80-88% of the first cycle as reported by Mack O North (1972). The quality of egg shell and internal contents of egg improved in molted flocks. The egg size in molted flocks is larger than that in the corresponding stages of first cycle.

Various experiments have been conducted to induce forced rest or pause by substituting or reducing certain constituents in feed without adversely affecting the normal condition of the bird.

Blair and Gilbert (1973) studied the effect of low calcium (0.04 percent) diet in laying flock for inducing forced rest and concluded that forced pause is brought about in the birds fed on low calcium diet because of the reduction of the ovarian size by about 80 percent. They observed that the disadvantage of low calcium was, it lead to skeletal defects and predisposed the bird to develop cage layer fatigue.

Feeding of low salt diet for inducing force rest or pause was studied by Whitehead and Shannon (1974) to be very effective and easy to implement. Improvement in the egg and shell quality were also observed.

One of the advantages after a period of force molting, is subsequent improvement in egg quality. Hurwitz et al. (1975) described an improvement in shell weight per unit of surface area following a forced molting programme, while Summers and Leeson (1976) showed an improvement in both shell deformation and albumen quality measurements immediately following a pause in lay induced by water deprivation. Whilst there was an indication that shell deformation values were improved immediately following the molt.

An experiment was conducted by Nesbeth et al. (1976) to indicate the influence of low salt diet in pause. Hens receiving low salt diet showed a progressive decline of egg production to approximately 0 percent in 17 days and when they were returned to normal diet on 23rd day recovery began immediately. The feeding of low salt resulted in a significant decrease in body weight and a reduction in specific gravity of eggs after the 8th day, but did not significantly affect egg weight or mortality.

Similar findings were reported by Begin and Johnson (1976) in bringing about pause in layers. Hens receiving low salt diet ceased the egg production on 16th day. Upon resuming the bird on salt adequate diet they started laying immediately. There was a significant ($P < 0.05$) improvement in egg weight, albumen height and shell quality. No adverse effects were noticed during the experimental period.

Roland and Bushong (1978) found that on returning to production after force molt a flock lays eggs with smoother texture, strong shells and a higher percentage of thick white than eggs laid before molting.

Swanson *et al.* (1978) observed that force molting brought about by feed and water restriction resulted in an significant ($P < 0.05$) increase in egg weight and quality.

Brake *et al.* (1979) observed that force molted hens fed with pullet grower ration has improved egg production and feed conversion but egg size and shell quality were not improved significantly.

Haematological studies on forced molted hens indicated increased PCV, WBC count, heterophills and eosinophills while protein and blood sugar were reduced.

Plasma thyroxin levels were unaltered, while adrenal cholesterol, was slightly higher (Brake and Thaxton, 1979a). Serum calcium, inorganic phosphate, SGPT and serum albumen were all depressed in birds during molt (Gildersleeve *et al.*, 1980). Similarly, Francis and Roberson (1980) found a significant reduction in serum inorganic phosphate, potassium and albumen. However lactate dehydrogenase activity and SGOT were significantly increased.

CHAPTER III

MATERIALS AND METHODS

In the present investigation an effort was made to study the effect of different methods of force molting on the postmolt performance of the birds. The methods adopted for inducing force molt were conventional method of forcemolting (feed and water restriction) and s t deprivation method. Two strains of White Leghorn layers, (S_1; BV 300) and S_2 (AICRP, on Poultry) past one year of production were used in this study. Nienty birds of each strain were selected on the basis of uniform body weight and record of previous egg production. These birds were randomly distributed into 9 groups of 10 birds for each strain. Triplicate groups were subjected to two methods of force molting i.e., salt deprivation (M_1), conventional method (M_2) and the third group (M_0) was maintained as control.

Production characteristics such as percent hen day production, egg quality, feed consumption, feed efficiency, body weight gain/loss and percent mortality were studied during the initiation of the programme and at peak production following force molting. Heart blood samples from the birds were collected at the initiation of the programme, when the birds reached zero production and at the peak production following molt to study the serum calcium, serum protein, serum inorganic phosphate, serum alkaline phosphatase activity and blood sugar.

3.1 Methods adopted for inducing force molt

3.1.1 Salt deprivation method (Nesbeth et al. 1976).

A layer ration was formulated without animal protein and using a mineral mixture without salt. Birds were offered the salt restricted diet (0.02 percent) upto 28 days, then they were fed normal diet containing 0.48 percent salt till 12 weeks to evaluate the post molt performance.

3.1.2 Conventional force molting method (Mack O North, 1972)

Feed and water were totally withdrawn for the first two days. On 3rd day 45 gm of feed/bird and ad lib. water was given. On 4th day no feed and water. On 5th day, same as 3rd day, 6th day no feed and water. 7th day same as 3rd day. 8th day no feed and water. 9th day same as 3rd day. From 10th day to 60th day the birds were given 75 percent of full feed intake. From 61st day onwards they were offered ad lib. feed and water upto 12 weeks to evaluate the post molt performance.

Table 1. Percent composition of layer ration used in experiment

Ingredients	Ration for salt deprivated method	Ration for conventional forcemolting method
Maize, yellow	49	44
Rice broken	5	7
Rice polish	8	12
Groundnut cake	25	21
Fish meal	-	8
Til cake	5	-
Mineral mixture	3	3
Shell grit	5	5
Rovimix	+	+
Rovibe	+	+
<u>Calculated composition</u>		
C.P. %	18.10	18.13
ME, Kcal/kg	2753	2646
Lysine, %	0.64	0.60
Methionine, %	0.28	0.34

3.2 <u>Egg production</u>

The percent hen day production was calculated at the initiation of the programme i.e. at the end of the first laying cycle and was compared with that of post molt performance of the birds (12 weeks production).

3.3 <u>Egg quality</u>

Egg quality *viz.*, egg weight, shell thickness and Haugh Unit Score were determined at the initiation of molting programme and at peak production following molt. Nine eggs from each treatment were collected to record the above parameters.

After taking the weight of the eggs they were broken on an egg breaking stand and the Haugh Unit score were determined directly with the help of Haugh Unit meter. After emptying the egg contents completely the egg shells were kept over night at room temperature. The shell thickness with shell membranes was measured with the help of screw-guage at three places of the shell i.e., at the narrow end, broad end and in the middle. The average of these three values is taken as a shell thickness.

3.4 Feed consumption and feed efficiency

Feed consumption was recorded on weekly basis. Feed efficiency was calculated as feed required (kg) to produce dozen eggs.

3.5 Body weight

Individual body weights were recorded at the initiation of the force molting programme, when the birds reached zero production and at the peak production following molt to calculate the body weight loss or gain during different perio-ds.

3.6 Mortality

Mortality was recorded for the calculation of hen day egg production, feed consumption and also to know the effect of different methods of molting on the two strains. Post-mortem examination was conducted on all birds that died and the causes of death were recorded.

3.7 Bio-chemical parameters

To study the effect of force molting on the various biochemical parameters about 10 ml blood samples were collected by cardiac puncture from 6 birds randomly from each treatment and in each of the strains. Serum was seperated by keeping the test tube in slant position at room temperature for 4 hours. The seperated serum was utilised for the estimation of serum calcium, protein, inorganic phosphate and alkaline phosphatase activity. A part of the blood collected was transferred in to a vial containing anticoagulent for the purpose of blood glucose estimation.

Serum calcium was estimated as per the procedure of Clark-Collip modification (1925) of Kramer - Tisdall method (1921). Serum total protein was estimated according to the procedure of Cornall et al. (1949). Serum phosphorus was estimated as per the method of Fiske and Subbarow (1925). Serum alkaline phosphatase activity was estimated according to the method of Bodansky (1932) and blood sugar was estimated according to the procedure of Nelson and Somogyi (1957).

3.8 Statistical analysis

The experimental results were subjected to statistical analysis according to the procedures given in Snedecor and Cochran (1967). The data were subjected to randomised block design 2 x 3 mixed factorial analysis of variance to determine the significance of post molt performance between the strains, molting methods and their interaction.

CHAPTER IV

RESULTS

4.1 PRODUCTION CHARACTERS

4.1.1 Percent hen day production

Data on the percent hen day production at the post molt laying period were statistically analysed and presented in Table 1, which revealed significant ($P < 0.05$) differences due to strains and molting methods. Interaction effects of strain and molting were found to be non significant.

S_1 strain (BV 300) was significantly superior to S_2 (AICRP, on Poultry) which laid 4.11 percent more eggs than S_2. Both the strains of birds showed response to force molting methods and were superior to the control birds (M_0). Salt free fed birds (M_1) and conventionally molted birds (M_2) gave 27.54 and 19.22 percent more eggs respectively over the control. It was also found that the birds which were fed on salt free diet layed 6.98 percent more eggs than the birds which were subjected to conventional force molting method.

4.1.2 Egg quality

Egg weight, shell thickness and Haugh Unit Score data were subjected to statistical analysis to asses the effect of various treatments on egg quality.

Table 2. Effect of force molting methods on percent hen day production with two different strains

Molting method	Strain		Mean for molting method	Interaction
	S_1	S_2		
Control	51.46	49.46	50.46	
Salt free	65.23	63.50	64.36	
Conventional	61.83	58.50	60.16	
Mean of strains	59.50	57.15		
SEM $\pm$	0.21		0.25	0.36
C.D. ($P < 0.05$)	0.65		0.80	NS

4.1.2.1 Egg weight

It was observed that the egg weights of birds subjected to force molting methods were more as compared to the control. Higher egg weights of 6.42 and 4.89 gm were recorded with the salt free and conventionally molted birds respectively as compared to the controls (Table 2). Strain S_1 recorded significantly higher egg weight than strain S_2.

4.1.2.2 Shell thickness

The data on the mean shell thickness were statistically analysed, which showed significant ($P \angle 0.05$) differences due to molting methods and strains (Table 3). It was noted that the mean shell thickness of force molted birds was more as compared to control. The birds on salt free diet la d thinner shelled eggs (0.32) than conventionally molted birds (0.33) while there was no significant difference between the two strains.

4.1.2.3 Haugh Unit Score

Statistical analysis of the Haugh Unit Score revealed significant ($P \angle 0.05$) differences due to molting and strain while the interaction effect of molting and strain was not significant (Table 4). Haugh Unit score was superior in force molted birds than control, while in

Table 3. Effect of force molting methods on egg weight with two different strains

Molting method	Strain		Mean for molting method	Interaction
	S_1	S_2		
Control	61.54	60.57	61.05	
Salt free	68.14	66.80	67.47	
Conventional	67.09	64.79	65.94	
Mean of strains	65.59	64.05		
SEM ±	0.28		0.34	0.48
C.D. (P∠0.05)	0.87		1.07	NS

Table 4. Effect of force molting methods on shell thickness with two different strains

Molting method	Strain		Mean for molting method	Interaction
	S_1	S_2		
Control	0.30	0.29	0.29	
Salt free	0.33	0.32	0.32	
Conventional	0.34	0.33	0.33	
Mean of strains	0.32	0.31		
SEM ±	0.0021		0.0026	0.0037
C.D. (P<0.05)	NS		0.008	NS

Table 5. Effect of force molting methods on Haugh Unit score with two different strains

Molting method	Strain		Mean for molting method	Interaction
	S_1	S_2		
Control	66.80	65.00	65.90	
Salt free	71.60	69.20	70.40	
Conventional	73.20	71.60	72.40	
Mean of strains	68.60	70.53		
SEM ±	0.39		0.48	0.67
C.D. ($P < 0.05$)	1.22		1.50	NS

between two, conventional molted birds showed higher Haugh Unit score (72.40) than salt free birds (70.40). Significant ($P \angle 0.05$) variation was observed with strains, in which S_2 showed higher (70.53) value than S_1 strain (68.60).

4.1.3 Feed consumption

The data on the feed consumption as affected by molting methods and strains were statistically analysed and presented in (Table 6), which revealed significant ($P \angle 0.05$) differences due to strain and molting methods.

The feed consumption during the postmolt period was found to be significantly ($P \angle 0.05$) higher in case of birds subjected to molting as compared to control. The salt free and conventionally molted birds consumed a higher amount of feed (11.29 and 10.22 gm respectively) per bird per day than the control. Salt free birds recorded higher feed consumption than the conventionally molted birds. Significantly ($P \angle 0.05$) higher feed consumption was recorded with S_1 strain (109.88) than strain S_2 (106.06).

4.1.4 Feed efficiency

Statistically analysed data presented in the Table 7 exhibited significant differences due to molting methods

Table 6. Effect of force molting methods on feed consumption (kg)/bird/day with two different strains

Molting method	Strain		Mean for molting method	Interaction
	S_1	S_2		
Control	102.5	99.06	100.78	
Salt free	114.0	110.13	112.07	
Conventional	113.0	109.00	111.00	
Mean of strains	109.83	106.06		
SEM ±	0.34		0.42	0.59
C.D. ($P \leq 0.05$)	1.07		1.31	NS

Table 7. Effect of force molting methods on feed efficiency (kg/dozen of eggs) with two different strains

Molting method	Strain		Mean for molting method	Interaction
	S_1	S_2		
Control	2.36	2.39	2.38	
Salt free	1.99	2.08	2.03	
Conventional	2.19	2.23	2.21	
Mean of strains	2.18	2.23		
SEM $\pm$	0.026		0.034	0.045
C.D. ($P < 0.05$)	NS		0.11	NS

rather than other factors and interaction. Feed effeciency was improved with the birds as compared to the control. Improved feed effeciency was obtained with salt restriction method followed by conventional mode of molting. Both the strains did not show any significant difference, however S_1 was superior to S_2 strain.

4.1.5 Body weights

The data on the body weights were recorded in the initial, zero production and at peak production and were statistically analysed and presented in Table 8. It was observed that strains and molting methods significantly ($P \angle 0.05$) influenced the body weights at the stage of zero production. At this stage there was a drastic loss of body weights (0.36 and 0.33 kg) with conventional and salt free diet respectively as compared to the control. Higher body weight loss was observed with S_1 strain as compared to S_2 strain.

At peak production there were no significant differences due to strains or molting methods. However the force molted birds were on par with their initial body weights in which higher body weights were recorded with salt free fed birds rather than conventionally molted birds. Similarly S_1 was on par with S_2 strain.

Table 8. Effect of force molting methods on body weights with two different strains

Molting method	Strain S_1	Strain S_2	Mean for molting method	Interaction
Initial	1.64	1.57		
At zero production				
Control	1.65	1.58	1.61	
Salt free	1.29	1.27	1.28	
Conventional	1.26	1.24	1.25	
Mean of strains	1.40	1.36		
SEM $\pm$	0.012		0.014	0.02
C.D. ($P < 0.05$)	0.026		0.045	NS
At Peak Production				
Control	1.62	1.55	1.58	
Salt free	1.67	1.60	1.63	
Conventional	1.66	1.59	1.62	
Mean of strains	1.65	1.58		
SEM $\pm$	0.015		0.02	0.03
C.D. ($P < 0.05$)	NS		NS	NS

Table 9. Effect of force molting methods on percent mortality with two different strains

Molting method	Strain		Mean for molting method	Interaction
	S_1	S_2		
<u>Initial</u>	-	-		
<u>At Zero Production</u>				
Control	-	-	-	
Salt free	-	-	-	
Conventional	-	3.3	1.65	
Mean of strains	-	3.3		
SEM				
<u>At Peak Production</u>				
Control	16.6	33.30	24.95	
Salt free	13.3	33.30	23.30	
Conventional	16.6	10.00	13.30	
Mean of strains	15.50	25.53		

4.1.6 Mortality

Percent mortality was recorded in the initial stage during molt and postmolt period. The data are presented in Table 9.

No mortality was recorded in both the strains at premolt stage. During molt a mean percent mortality of 1.65 was observed with conventionally molted birds, while in the case of salt restricted birds and in the control, no mortality was recorded. During post molt period highest mortality was noted in control birds followed by conventionally molted birds and it was comparatively less in salt free fed birds. S_2 strain exhibited higher percent mortality than S_1 strain.

4.2 BIOCHEMICAL CHARACTERS

The results of various biochemical characters in blood estimated at different stages and as affected by molting methods and strains are presented.

4.2.1 Serum Calcium

The data on serum calcium (mg percent) as influenced by strains and molting methods were statistically analysed and presented in Table 10. Serum calcium content at zero production was less than the initial level and it was influenced significantly ($P < 0.05$) by strains and molting methods. Higher serum calcium content at zero production

Table 10. Effect of force molting methods on serum calcium with two different strains

Molting method	Strain S_1	Strain S_2	Mean for molting method	Interaction
<u>Initial</u>	23.00	22.50		
<u>At Zero Production</u>				
Control	20.02	19.70	19.86	
Salt free	16.80	16.80	16.88	
Conventional	16.80	16.70	16.75	
Mean of strains	17.96	17.78		
SEM ±	0.043		0.053	0,074
C.D.(P∠0.05)	0.136		0.166	NS
<u>At Peak Production</u>				
Control	19.88	18.73	19.30	
Salt free	23.90	23.00	23.45	
Conventional	23.03	22.13	22.58	
Mean of strains	22.27	21.28		
SEM ±	0.24		0.29	0.41
C.D. (P∠0.05)	0.75		0.91	NS

was observed with control followed by salt free fed birds and it was least with the conventionally molted birds. There was a significant affect of strains on the serum calcium levels, the values being 17.96 and 17.73 mg percent for strains S_1 and S_2 respectively.

At peak production there was significant ($P \angle 0.05$) difference due to molting methods rather than strain and their interaction. Higher serum calcium was noted with salt free fed birds (23.45 mg percent) followed by conventional molted birds (22.58 mg percent) and these molted birds were significantly superior in their serum calcium content to control. Serum calcium content of strain S_1 was on par with strain S_2.

4.2.2 Serum protein

The data on serum protein (gm percent) as influenced by strains and molting methods were statistically analysed at zero production and peak production (Table 11).

Serum protein content at zero production was less than the initial and it was significantly ($P \angle 0.05$) influenced by strain rather than molting and their interaction. Higher serum protein content at zero production

Table 11. Effect of force molting methods on serum protein with two different strains

Molting method	Strain		Mean for molting method	Interaction
	S_1	S_2		
Initial	5.90	5.70		
At Zero Production				
Control	5.60	5.50	5.55	
Salt free	5.10	5.00	5.05	
Conventional	5.00	4.90	4.95	
Mean of strains	5.23	5.13		
SEM ±	0.03		0.04	0.05
C.D. (P ∠ 0.05)	0.09		NS	NS
At Peak Production				
Control	4.90	4.70	4.80	
Salt free	6.00	5.90	5.95	
Conventional	5.70	5.73	5.81	
Mean of strains	5.60	5.44		
SEM ±	0.036		0.042	0.06
C.D. (P ∠ 0.05)	0.109		0.128	NS

was recorded with control followed by salt free fed birds and it was least in conventionally molted birds. Significantly ($P < 0.05$) higher serum protein was observed with S_1 strain as compared to S_2 strain.

At peak production significant ($P < 0.05$) difference due to strain and molting were observed. A higher protein content was observed with salt free method (5.95 gm percent) followed by conventionally molted birds (5.81 gm percent). The serum protein content of the control birds was further decreased to 4.80 gm percent. S_2 strain had significantly lower serum protein level than S_1 strain.

4.2.3 Serum inorganic phosphate

The data on serum inorganic phosphate (mg percent) were recorded in the initial stage, zero production and at peak production and statistically analysed. The data are presented in Table 12.

Serum phosphorus content at zero production was less than the initial level. Strains and molting significantly ($P < 0.05$) influenced the serum phosphorus content at the stage of zero production. Salt free method of molting was comparable with the conventional

Table 12. Effect of force molting methods on inorganic phosphate with two different strains

Molting method	Strain		Mean for molting method	Interaction
	S_1	S_2		
<u>Initial</u>	3.80	3.67		
<u>At Zero Production</u>				
Control	3.62	3.41	3.51	
Salt free	3.40	3.02	3.21	
Conventional	3.23	3.05	3.14	
Mean of strains	3.41	3.16		
SEM ±	0.062		0.075	0.107
C.D. ($P < 0.05$)	0.194		0.236	NS
<u>At Peak Production</u>				
Control	3.39	3.01	3.20	
Salt free	4.10	4.10	4.10	
Conventional	4.16	4.13	4.14	
Mean of strains	3.88	3.74		
SEM ±	0.03		0.037	0.052
C.D. ($P < 0.05$)	0.096		0.116	0.164

method and both were significantly ($P \angle 0.05$) inferior to control. The serum phosphorus content of strain S_1 was significantly ($P \angle 0.05$) more than that of strain S_2.

At peak production there were significant ($P \angle 0.05$) differences due to strain, molting and their interaction and the treatments T_3 (M_2 S_1) recorded maximum phosphorus content of 4.16 mg percent among all treatments. Serum phosphorus content of conventional method of molting was comparable with the salt restricted birds and both the molted birds were significantly ($P \angle 0.05$) superior in their serum phosphorus content to control. Strain S_1 recorded significantly ($P \angle 0.05$) higher phosphorus content than strain S_2.

4.2.4 Serum alkaline phosphatase activity

The serum alkaline phosphatase activity (Bodansky Units) as affected by method of molting and strains were statistically analysed at zero and peak production and the data are presented in Table 13.

At zero production, molting significantly ($P \angle 0.05$) affected the serum alkaline phosphatase activity rather than strains and their interaction. Conventionaly molted birds recorded higher activity followed by salt

Table 13. Effect of force molting methods on alkaline phosphatase activity (Bodansky units) with two different strains

Molting method	Strain		Mean for molting method	Interaction
	S_1	S_2		
Initial	8.84	8.46		
At Zero Production				
Control	8.51	8.43	8.47	
Salt free	10.49	10.43	10.46	
Conventional	10.52	10.46	10.49	
Mean of strains	9.84	9.77		
SEM $\pm$	0.034		0.041	0.06
C.D. ($P \angle 0.05$)	NS		0.13	NS
At Peak Production				
Control	8.48	8.40	8.44	
Salt free	8.83	8.73	8.78	
Conventional	8.80	8.70	8.75	
Mean of strains	8.70	8.61		
SEM $\pm$	0.011		0.014	0.02
C.D. ($P \angle 0.05$)	0.033		0.043	0.06

free fed birds, and its activity was low in control birds. There was no significant effect of strain on the activity of alkaline phosphatase; however higher activity was recorded in strain S_1 than in strain S_2.

At peak production, both the factors and their interaction affected the activity of alkaline phosphatase significantly. Salt free fed birds recorded higher activity than conventionally molted birds and both the molted birds were significantly superior to control. Strain S_1 recorded significantly higher activity than strain S_2.

4.2.5 Blood sugar

The data on blood sugar (mg percent) as influenced by strains and molting methods were statistically analysed at zero and peak production and presented in Table 14.

Blood sugar content at zero production was less than the initial, while conventional and salt free fed birds except control showed higher blood sugar content at peak production than initial.

At zero production the blood sugar was significantly ($P < 0.05$) influenced by strains and molting methods and the control recorded higher blood sugar than the force molted birds. Strain S_1 recorded significantly higher values than strain S_2.

At peak production higher blood sugar values were obtained in forced molted birds than control, between the two methods of molting. Salt restriction was superior to conventionally molted birds. Significantly ($P \angle 0.05$) higher blood sugar was estimated in strain S_1 as compared to strain S_2.

Table 14. Effect of force molting methods on Blood sugar with two different strains

Molting method	Strain S$_1$	Strain S$_2$	Mean for molting method	Interaction
<u>Initial</u>	226.5	225.00		
<u>At Zero Production</u>				
Control	224.83	220.50	222.66	
Salt free	210.00	206.59	208.28	
Conventional	208.00	203.00	205.50	
Mean of strains	214.27	210.03		
SEM $\pm$	0.96		1.18	1.66
C.D. (P$\angle$0.05)	3.03		3.71	NS
<u>At Peak Production</u>				
Control	210.57	205.40	207.98	
Salt free	242.50	233.55	238.02	
Conventional	243.57	228.20	235.88	
Mean of strains	232.21	222.38		
SEM $\pm$	0.71		0.87	1.22
C.D.(P$\angle$0.05)	2.23		2.73	3.85

CHAPTER V

DISCUSSION AND CONCLUSIONS

5.1 PRODUCTION CHARACTERISTICS

These included percent hen day production, egg quality, feed consumption, feed efficiency, body weight gain/loss and depletion.

5.1.1 Percent hen day production

The results obtained from this study revealed that force molting resulted in increased (64.36 and 60.16) percent hen-day production in the case of salt free and conventional method respectively when compared to non molted hens (50.46). These findings are in agreement with those of Lee et al. (1980) and Roland and Brake (1982), who reported a significant increase in egg production in birds subjected to force molt. This increased performance in egg production was due to sufficient rest provided for the bird to rejuvinate its reproductive tract.

It was observed that the birds fed on salt free diet layed 6.98 percent more eggs than that of birds which were subjected to conventional force molting method, indicating salt deprivation method to be more efficient over the conventional method of force molting. This was also observed by Campus and Baiao (1979). The probable reason for the increased performance of birds subjected to salt free diet was that, it induces forced rest rapidly and has less adverse effect on the physiological performance of the bird.

The strain variation seen in the experiment may be due to increased feed consumption with better conversion ratio in case of S_1 strain and probably because of genetic variation between the strain.

5.1.2 <u>Egg quality</u>

It has been observed from the study that the quality of egg produced by force molted flock was significantly ($P < 0.05$) improved over the non molted flock.

5.1.2.1 Egg weight

There was a significant ($P < 0.05$) improvement in the egg weight of birds subjected to both the force molting programme. Improvement in the egg weights due to force molting was also reported by Swanson *et al.* (1978) and Hambree *et al.* (1980). Thus the main advantage of force molting programme derived from the study is the production of large size eggs in the second cycle when compared with first laying cycle. This is mainly due to advancement in the age of the birds, increased body weight and feed consumption.

5.1.2.2 Shell thickness

A significant ($P < 0.05$) improvement in shell thickness of force molted flock was observed as against the non molted hens. The reason for this improvement may be that force molted flock has consumed more feed, and thus more calcium was deposited in the shell increasing its thickness. Similar findings were also reported by Hurwitz *et al.* (1975) and Roland and Brake (1982). It was also observed that the birds fed on salt free diet laid eggs with thinner shells than the conventionally molted because the production of the birds fed on salt restriction diet was significantly more than the conventionally molted flock which might have in turn resulted in thinner shelled eggs. However there was no significant difference in the shell thickness between the two strains.

5.1.2.3 Haugh Unit Score

The Haugh Unit score was significantly ($P < 0.05$) higher in birds subjected to molt. This is because of the rest period which the molted birds had for the rejuvination of reproductive tract. Similarly higher score was reported by Roberson and Francis (1979) and Nordstrom (1980). Between the methods higher Haugh Unit score was recorded with conventionally molted birds (72.40) than salt free fed birds (70.40). Significant variations are also seen with the strains. The Haugh Unit score of S_2 birds was more than the S_1. This was probably due to the smaller egg size in these birds which is usually positively correlated with egg quality characteristics.

5.1.3 Feed consumption

Significantly (P∠0.05) higher fed consumption was noticed in birds subjected to two force molting methods as against non-molted birds. This is obviously due to higher egg production and weight gain as compared to non molted birds. Similar findings were also reported by Summers and Leeson (1978), Campus and Baiao (1979) Lee et al. (1980) and Roland and Brake (1982).

5.1.4 Feed efficiency

The feed efficiency at peak production after molt as recorded during the experiment was superior in case of birds subjected to molt as compared to non-molted birds. These findings are in agreement with those of Campus and Baiao (1979) and Lee et al. (1980). Higher feed efficiency was obtained in the case of salt free fed method than conventional method of molting, which may be due to higher egg production in the case of salt free fed birds. There was no significant difference in the feed efficiency of the two strains; however strain S_1 was on par with the strain S_2.

5.1.5 Body weight

There was a significant ($P < 0.05$) decrease in the body weight during molt, because the birds consumed less feed during molt. The loss in the body weight during molt as reported by Brake and Thaxton (1979) was mainly due to loss of weight of the liver, ovary, oviduct and the adipose tissue. Similar results were reported by Casey (1974) Summers and Leeson (1976) Carter and Ward (1981). However these losses were regained when both the flocks reached peak production after resumption of normal feed.

The gain in the body weight was found to be significant between the two methods and strains. Forced molted birds were on par with the control.

5.1.6 Mortality

At zero production a mean percent mortality of 1.65 was observed with conventional molted birds while in the case of salt restricted birds and control no mortality was recorded. At peak production highest mortality was noted in control birds followed by conventionally molted

5.2 BIOCHEMICAL CHARACTERISTICS

The results of different biochemical characters in blood as estimated from the study of different stages of force molting revealed that serum calcium, inorganic phosphate, serum protein and blood sugar were significantly ($P < 0.05$) decreased during molt (at zero production). At peak production (post molt) the above parameters were on par with that of control. The study further revealed that the alkaline phosphatase activity during molt was significantly ($P < 0.05$) increased over control and came to normal at peak production.

The results obtained in this study are in agreement with those of previous reports (Brake and Thaxton, 1979a,b) concerning the physiological and biochemical changes of birds subjected to force molt. Gildersleeve et al. (1980) reported an increase in the alkaline phosphatase activity during molt.

Force molting created stress in the birds and acts on physiological processes which mediate via pituitary adrenal axis. Adrenal ascorbic acid depletion increases production of adrenal corticoids. This elevated level of adrenal corticoids causes a decrease in the serum calcium, inorganic phosphate, serum protein and blood sugar which in turn leads to cessation of egg laying. The other probable reason for the decrease in total calcium and plasma protein experienced by the force molted hens was due to the loss of estrogen dependent phospholipoprotein complex from the plasma (Butler, 1971). One of the proteins of this complex is phosvitin which binds a large proportion of plasma total calcium. The loss of this yolk protein precursor is thought to lead to decrease plasma total calcium. Specially the loss of phosivitin has been demonstrated to cause plasma total calcium to decrease to 5-6 mg/100 ml, representing largely ionic and chelated forms of calcium (Sturkie, 1976b).

With the regression in the ovarian size during molt, oestrogen level gets considerably decreased which is believed to cause a decrease in the plasma inorganic phosphate (Simkiss, 1967).

The decreased blood sugar level may elevate the activity of alkaline phosphatase which inturn acts on fructose 1-6 diphosphate for the production of glucose (gluconeogenesis). This may be the probable reason for the increased alkaline phosphatase activity during molt.

Between the two methods of force molting employed in this study salt deprivation method seems to be superior over the conventional method of force molting because hens subjected to salt deprivation produced significantly ($P \angle 0.05$) more number of eggs of superior egg quality and less mortality when compared with that of hens force-molted by conventional method. Besides, salt deprivation method has a rapid effect, very easy to implement, safe and does not produce any adverse effects.

Between the two strains of birds taken up in this study it was observed that strain S_1 (BV 300) was superior over the strain S_2 (AICRP, on Poultry) because of its increased egg production, improved feed efficiency, superior egg quality and less mortality, which may probably be due to genetic potential of the strain.

5.3 CONCLUSIONS

Based upon the investigation carried out in this study it is concluded that;

1. Forced molting programme is beneficial because of its increased post molt performance, improved feed efficiency, higher egg weights and improved egg quality.

2. Salt deprivation method was found to be superior to conventional method of force molting because hens subjected to salt deprivation produced significantly more number of eggs of superior egg quality, improved feed efficiency and less mortality.

3. Besides, salt deprivation method has a rapid effect, very easy to implement, safe and does not produce any adverse effect.

CHAPTER VI

SUMMARY

The present investigation was undertaken to study the effect of different methods of force molting on the post molt performance of the birds. Two strains of White Leghorn layers past one year of production (90 birds of each strain) were selected on the basis of uniform body weight and record of previous egg production. These birds were randomly distributed into 9 groups of 10 birds for each strain. Triplicate groups were subjected to two force molting methods: (i) salt restriction method (ii) conventional method of force molting and the third group was maintained as control. Production characteristics such as percent hen day production, egg quality, feed consumption and feed efficiency, body weight gain/loss and percent mortality were studied during the initiation of the programme and at peak production following force molting. Heart blood samples from the birds were collected at the initiation of the programme, when the birds reached zero production and at the peak production following molt to study the biochemical characters.

It was observed that force molting resulted in significant $(P < 0.05)$ increased in percent hen day production, improved feed efficiency and superior egg quality.

However feed consumption was slightly increased due to higher body weights and egg production. The study further revealed that the serum calcium, inorganic phosphate, serum protein and blood sugar were significantly ($P \angle 0.05$) decreased during molt (at zero production). At peak production (post molt) the levels of these constituents were on par with those of control. However the alkaline phosphatase activity during molt was significantly ($P \angle 0.05$) increased over control and came to normal at peak production.

Between the two methods of force molting employed in this study, salt deprivation method was found to be superior over the conventional method of force molting because hens subjected to salt deprivation produced significantly ($P \angle 0.05$) more number of eggs of superior egg quality and less mortality when compared with that of hens, force molted by conventional method. It was also observed that strain S_1 (BV 300) was superior to the strain S_2 (AICRP, on Poultry) because of its higher egg production, improved feed efficiency, superior egg quality and less mortality, which may probably be due to genetic potential of the strain.

Thus it can be concluded that force molting results in improved performance of birds during the second laying cycle since it gives rest period for the hens to rejuvinate their body processes. Salt deprevation method was found to be superior over the conventional method of force molting because it has a rapid effect, very easy to implement, safe and does not produce any adverse effect besides promoting a higher level of performance of the birds in the second laying cycle.

LITERATURE CITED

Begin, J.J. and T.H. Johnson, 1976. Effect of dietary salt on the performance of laying hens. Poult. Sci. 55: 2395-2404.

Blair, R. and Gilbert, H.B. 1973. A comparision of the effects of too low calcium diets on egg production in the domestic fowl. Brit. Poult. Sci. 14: 131-135.

Bodansky, J. 1932. Determination of serum alkaline phosphatase activity. J. Biol. Chem. 101: 93-99.

Brake. J., Thaxton. P, 1979a. Physiological changes in caged layers during a force molt. 1. Body temperature and selected blood constituents. Poult. Sci. 58: 699-706.

Brake. J., and P. Thaxton, 1979b. Physiological changes in caged layers during a force molt. 2. Gross changes in organs. Poult. Sci. 58: 707-716.

Brake, J., P. Thaxton, Garlich, J. and Sherwood, D.H. 1979. Comparision of fortified ground corn and pullet grower feeding resumes during a force molt on subsequent layer performance. 58: 785-790.

Butler, E.J., 1971. Plasma proteins. In Physiology and Bio-chemistry of the Domestic Fowl. Vol. 3. D.J. Bell and B.M. Freeman, ed; Academic Press, New York.

Campus, E.J., and M.C. Baiao. 1979. The effect of methods of force molting on performance of commercial layers. Poult. Sci. 58: 1040-1041 (Abstr).

Carter, T.A. and Ward, J.B., 1981. Limited and full feeding of layers during the non laying period of molting cycle. Poult. Sci. 60: 1635-1636 (Abstr).

Casey, J.M., 1974. Effect of restricted feeding on performance of molted S.C.W.L. females. Poult. Sci. 53: 1907-1911.

Clark, E.P. and J.B. Collip, 1925. A study of the Tisdall method for determination of blood serum calcium with suggested modification. J. Biol. Chem. 63: 461-464.

Cornall, A.G., C.J. Bradwill and M.M. David, 1949. Determination of serum protein by means of biuret reaction. J. Biol. Chem. 17: 751-755.

Fiske, C.H. and Y. Subbarow, 1925. The colorimetric determination of phosphorus. J. Biol. Chem. 66: 375-400.

Francis, D.W. and R.H. Roberson, 1980. Chemical constituent of blood from chickens subjected to molt. Poult. Sci. 59: 1610-1615.

Gildersleeve, R.P., W.A. Johnson, D.S. Satterlee and T.R. Scott, 1980. Serum biochemical rhythms in laying hens and in hens before a forced molt. Poult. Sci. 59: 1568-1569.

Hambree, O.J., Adams, A.W., and Craig, J.V., 1980. Effect of force molting by conventional and experimental light restriction methods on performance and agonistic behaviorer of hens. Poult. Sci. 59: 215-223.

Hurvitz, S., S.Bornstein and Y. Lev, 1975. Some responses of laying hens to induced arrest of egg production. Poult. Sci. 54: 415-422.

Lee, K., Holiday, O.R. and C.E. Petty, 1980. Effect of force molt and rest on egg production, feed efficiency and mortality of s.C.W.L.H. Poult. Sci. 59: 1566(Abstr.)

Mack O North, 1972. Commercial Chicken Production Manual. The AVB Publishing Company. Inc. Box 831, West port, Connectiont.

Nelson and Somogyi, 1957. Methods in Enzymology. Ed. Colowick S.P. and Kaplan No. 365: 1957.

Nesbeth, W.G., C.R. Douglas, and R.H. Harims, 1976. Response of laying hens to a low salt diet. Poult. Sci. 55: 2128-2132.

Nordstrom, Jono. 1980. Albumen quality of egg laid during molt induction. Poult. Sci. 59: 1711-1714.

Roberson, R.H. and D.W. Francis, 1979. The effect of two molting methods on the performance of hyline and Thaver hens. Poult. Sci. 58: 1098 (Abstr).

Roland, D.A., and Brake, J. 1982. Influence of premolt production on post molt performance with explanation for improvement in egg production due to force molting. Poult. Sci. 61: 2473-2481.

Roland, D.A., and R.D. Bushong, 1978. The influence of force molting on the incidence of uncollectable eggs. Poult. Sci. 57: 22-26.

Simkiss, K., 1967. Calcium metabolism in the laying bird. In _Calcium in Reproductive Physiology_. K. Simkiss, ed. _Reinhold Publishing Corp., New York._

Snedecor, G.W. and W.G. Cochran, 1967. _Statistical Methods._ 6th edn., Oxford and IBH Publishing _Co., Calcutta._

Sturkie, P.D., 1976b. Reproduction in the female and egg production. In _Avian Physiology_. 3rd ed. P.D. Sturkie, ed. Springer - _Verlag, New York._

Summers, J.D., and S. Leeson, 1976. Effect of water deprivation on egg produstion and egg quality. Poult. Sci. 55: 441-444.

Swanson, M.H., Bell, D.D. and Kuney, D.R. 1973. Effect of water restriction and feed withdrawal time on force molt performance. Poult. Sci. 57: 1166 (Abstr.).

Whitehead, C.C. and D.W.F. Shannon, 1974. Effects of low sodium diets on subsequent performance of a laying hen. Br. Poult. Sci. 159: 429-434.

V I T A

I, Mohammed Yaseen Khan was born to Smt. Waheedunisa Begum and Sri Mohammed Nizam Khan in Kumarpalli, Hanamkonda Taluk, Warangal District, Andhra Pradesh. I passed B.V.Sc., in first division from College of Veterinary Science, Rajendranagar, Hyderabad in 1981. During 1981, I joined for my M.V.Sc. (Poultry Science) in the Department of Poultry Science, College of Veterinary Science, Andhra Pradesh Agricultural University, Hyderabad. I worked for my M.V.Sc. degree under the able guidance of Dr. G.L.N. Reddy.

(MOHAMMED YASEEN KHAN)