# EGG WEIGHT PROFILE IN THREE STRAINS OF WHITE LEGHORNS

By

K. B. PRABHAKARAN

## THESIS

Submitted in partial fulfilment of the requirement for the degree

## Master of Veterinary Science

Faculty of Veterinary and Animal Sciences

KERALA AGRICULTURAL UNIVERSITY

Department of Poultry Science

COLLEGE OF VETERINARY AND ANIMAL SCIENCES

MANNUTHY - THRISSUR

1996

# DECLARATION

I hereby declare that the thesis entitled **"EGG WEIGHT PROFILE IN THREE STRAINS OF WHITE LEGHORNS"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Mannuthy,
29.7.1996

**K.B. PRABHAKARAN**

# CERTIFICATE

Certified that this thesis, entitled **"EGG WEIGHT PROFILE IN THREE STRAINS OF WHITE LEGHORNS"** is a record of research work done independently by **Sri. K.B. Prabhakaran**, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

**Dr. A. Jalaludeen**
(Chairman, Advisory Committee)
Associate Professor
Centre for Advanced Studies in
Poultry Science
College of Veterinary and
Animal Sciences
Mannuthy

Mannuthy,

# CERTIFICATE

We, the undersigned members of the Advisory Committee of **Sri. K.B. Prabhakaran**, a candidate for the degree of Master of Veterinary Science in Veterinary Pathology, agree that the thesis entitled **"EGG WEIGHT PROFILE IN THREE STRAINS OF WHITE LEGHORNS"** may be submitted by Sri. Prabhakaran, in partial fulfilment of the requirement for the degree.

**Dr. A. Jalaludeen**
(Chairman, Advisory Committee)
Associate Professor
Centre for Advanced Studies in Poultry Science
College of Veterinary and Animal Sciences
Mannuthy

**Dr. A.K.K. Unni**
Director
Centre for Advanced Studies
in Poultry Science
College of Veterinary and
Animal Sciences, Mannuthy
(Member)

**Dr. G. Raghunathan Nair**
Professor
University Poultry Farm
College of Veterinary and
Animal Sciences, Mannuthy
(Member)

**Dr. B. Nandakumaran**
Associate Professor
Centre for Advanced Studies in
Animal Genetics and Breeding
College of Veterinary and
Animal Sciences, Mannuthy
(Member)

**External Examiner**

# ACKNOWLEDGEMENT

I do hereby owe my sincere and intense gratitude with immense pleasure, for the unstinted co-operation rendered to me by

Dr. A. Jalaludeen, Associate Professor, Centre for Advanced Studies in Poultry Science, for his constant back up, needful suggestion and competent guidance throughout this work as Chairman of the Advisory Committee.

Dr. A. Ramakrishnan, Director (Retd.), Centre for Advanced Studies in Poultry Science, for the hale hearted co-operation and timely help for the completion of study, even in the period of his retirement.

Dr. A.K.K. Unni, Director, Centre for Advanced Studies in Poultry Science and member of Advisory Committee, for his eloquent discourse and contributory advice for the preparation of the thesis.

Dr. G. Reghunathan Nair, Professor, University Poultry Farm and member of the Advisory Committee, who took the initiative and throughout kept up a very keen interest in the period of the study.

Dr. B. Nandakumaran, Associate Professor, Centre for Advanced Studies in Animal Genetics and Breeding and member of the Advisory Committee, for his help and guidance.

Dr. A. Rajan, Dean, College of Veterinary and Animal Sciences, Mannuthy for providing the necessary facilities to carry out this work.

Dr. Leo Joesph, Associate Professor, AICRP on Poultry for Eggs, for his propitious help at a dead lift and highly obliged to him for the study.

Dr. P.A. Peethambaran, Associate Professor, Centre for Advanced Studies in Poultry Science for his relentless suggestion and strenuous efforts for the completion of the thesis.

Smt. Laly John, Assistant Professor for the gracious help offered for the analysis of data.

Dr. Vijayan, Assistant Professor, Dr. P. Anitha, Assistant Professor, Dr. Lalithakunjamma, Associate Professor for their consistant and whole hearted help at various stages of this work.

All the staff members, Department of Poultry Science for their dedication and co-operation rendered for the work.

Dr. B. Padmakumar, Dr. Kamna Barkataki and Dr. Sudheeshkumar, A.S., M.V.Sc. scholars, Department of Poultry Science for their ingenuous support and critical comments during the course of study.

All those of AICRP on poultry for eggs and University Poultry Farm, Mannuthy who helped directly or indirectly for the completion of the work.

**K.B. PRABHAKARAN**

# CONTENTS

## LIST OF TABLES

## LIST OF ILLUSTRATIONS

## LIST OF APPENDICES

# *Introduction*

# INTRODUCTION

During the past three decades, Indian Poultry Industry witnessed spectacular development. This was made possible by the relentless efforts and concerted research in all spheres of poultry production particularly breeding, nutrition and management involving modern methods of technological advancements.

Today, India ranks fifth position in the world in egg production with annual estimated yield of 24800 million eggs during the year 1993 as against the annual production of 2881 million eggs in the year 1961 (Anon, 1994). Inspite of these achievements, the per capita annual availability of eggs in the year 1993 was only 28 which is very meagre in comparison to that of developed countries.

Poultry breeders in the country are constantly engaged in the genetic refinement of the available germplasms. The profitability of layer stocks depend primarily on the egg production efficiency under different agro-climatic conditions. The economic evaluation of strains also depends on the performance of traits such as egg weight and shell quality that are significantly related to marketing of eggs.

The eggs being perishable are to be marketed at the earliest when the quality is high as the consumers are conscious about the quality of fresh eggs. Fixing the price of eggs ignoring its weight will negatively affect the interest of consumers and may also cause delay in the disposal of eggs in the lower weight classes. Wide variation in egg size is likely to affect consumer preference, thereby detering the demand.

Small and medium sized eggs fetch relatively low prices for producers. Therefore, grading of eggs will facilitate for preparing pricing agreements between buyers and sellers and this will help in proper packing and safe transportation of eggs to distant places. Large eggs fetch better prices and offer easy and sustainable market outlets. In a rapidly changing society, pricing of eggs on number basis is non-remunerative and unsatisfactory. Hence, egg number and weight have to be given equal priority in fixing prices on commercial lines. These two traits are to be improved simultaneously by modern methods of breeding. As the correlation between these traits is negative, considerable decline in egg weight occurs unless constant and reasonable weightage is ensured in selection. A thorough investigation on the egg weight profile from onset of laying will be of substantial use in determining appropriate selection methods in different strains.

Since egg weight is a highly heritable quantitative trait controlled by several autosomal genes, selection for sire and dam lines may become necessary as the genetic transmission is equal from both parents. Body weight, age at sexual maturity, season, clutch size and management practices may bring about significant variations in egg weight. In promising strains early egg weight that elicits maximum response to selection has to be identified. The relative merits of measuring egg weight period-wise is not in general agreement among researchers. The correlation between chronological age of birds with egg weight as well as with production traits is not well documented. Publications on the profile of egg weight in different strains are also limited.

Therefore, an investigation was taken up in three strains of white leghorn viz., IWN, IWP and control population (CP) maintained at the Mannuthy Centre of AICRP on Poultry Improvement with the following objectives:

1. To assess the gain in egg weight with the chronological age of birds and

2. To study the magnitude of variation in egg weight and its correlation with egg production and body weight.

# *Review of Literature*

# REVIEW OF LITERATURE

## Body weight

The body weight (BW) of layer stock is important because of its direct relation with egg weight and sexual maturity which in turn determine the net profit of the enterprise. At the time of housing BW is not usually given much emphasis as a selection criterion. In breeding operations, body weight is measured at 20 weeks of age (at sexual maturity) and at 40 weeks of age (at physical maturity).

Waters (1937) demonstrated that the percentage of mature body weight attained at age at first egg is lower in early maturity than in late maturing strains.

Jull (1952) described the importance of the good body size at the time when laying commences.

Saeki *et al.* (1966) and Sarma *et al.* (1977) had reported the body weight of White Leghorn at various ages.

Raj *et al.* (1980) studied the influence of body weight at housing on the subsequent laying house performance of White Leghorn. Pullets were divided into four body weight groups, viz., light, medium, heavy and intermingled groups. They noticed significant differences in egg weight, age at first egg and egg production between different body weight groups.

Radhakrishnan and Ramakrishnan (1982), Joseph (1982) and Singh (1983) also reported body weight of White Leghorns at various ages. Their findings indicated that body weight influenced sexual maturity, egg weight and production.

Although various nutritional and environmental factors influence egg size, there is evidence to suggest that adult body weight is the most important factor that decides egg weight (Summers and Leeson, 1983). While evaluating the influence of pullet body weight on the production performance in two strains of White Leghorn viz., IWN and IWP, Sudheeshkumar (1995) reported the mean 20 week body weight as 1304.7 and 1335.2 g, respectively.

The body weight of different strains/lines of White Leghorns at different ages reported by different workers are presented in Table 1.

## Age at sexual maturity

The age in days when laying commences is important with respect to its bearing on annual lay. The birds which start laying at an early age will lay more eggs. However, it is important that the pullet should have attained reasonably good body size by the time the laying commences.

Table 1. Body weight of White Leghorn chicken as reported by various authors

| Author/s | Year | Country | Strain/Line | Age | Body weight (g) |
|---|---|---|---|---|---|
| Roberts *et al.* | 1952 | USA | Line-1 | 44 w | 1974 ± 33 |
| | | | 9 | " | 1739 ± 36 |
| | | | 3 | " | 1635 ± 24 |
| | | | 10 | " | 1845 ± 30 |
| Saeki *et al.* | 1966 | | | 199 d | 1541.8 |
| Plessis and Erasmus | 1973 | | | Bm | 2040 |
| Poulose and Sathe | 1974 | India | Strain A | 144 d | 1135 |
| | | | | 250 d | 1654 |
| | | | B | 144 d | 1062 |
| | | | | 250 d | 1573 |
| | | | C | 144 d | 1243 |
| | | | | 250 d | 1894 |
| Vanchev *et al.* | 1975 | | Line 6E | | 1800 |
| Prakashbabu *et al.* | 1975 | India | Strain T | 32 w | 1593 |
| | | | M | " | 1550 |
| | | | V | " | 1648.8 |

Contd.

Table 1 (Contd.)

| Author/s | Year | Country | Strain/Line | Age | Body weight (g) |
|---|---|---|---|---|---|
| Hanumaiah *et al.* | 1976 | India | | 175 d | 1543±26.46 |
| Johari *et al.* | 1977 | India | | 20 w.Av | 971.6±7.51 |
| | | | | 20 w | 1200 |
| | | | | " | 700 |
| Sarma *et al.* | 1977 | India | | 20 w | 1360 |
| | | | | " | 1440 |
| | | | | " | 1470 |
| | | | | " | 1200 |
| | | | | " | 1340 |
| | | | | " | 1220 |
| Krishnan *et al.* | 1977 | India | | 20 w | 1033 ± 104 |
| | | | | " | 1099 ± 129 |
| | | | | " | 1060 ± 92 |
| Christmas *et al.* | 1979 | USA | | 150 d | 1514 |
| | | | | " | 1550 |
| | | | | " | 1273 |
| | | | | " | 1509 |
| | | | | " | 1587 |
| | | | | " | 1505 |
| | | | | " | 1468 |

Contd.

Table 1 (Contd.)

| Author/s | Year | Country | Strain/Line | Age | Body weight (g) |
|---|---|---|---|---|---|
| Raj *et al.* | 1980 | India | I gp | 20 w | 852±3.81 |
| | | | | 40 w | 1310.68±20.05 |
| | | | II gp | 20 w | 950.83±3.66 |
| | | | | 40 w | 1435.32±20.46 |
| | | | III gp | 20 w | 1046.88±5.39 |
| | | | | 40 w | 1500.9±27.70 |
| | | | IV gp | 20 w | 947.92±11.99 |
| | | | | 40 w | 1421.3±26.21 |
| Jain and Roberts | 1980 | Canada | | | 1601.0±0.34 |
| Mann | 1980 | | | 20 w | 1270.0 |

Contd.

Table 1 (Contd.)

| Author/s | Year | Country | Strain/Line | Age | Body weight (g) |
|---|---|---|---|---|---|
| Jain *et al.* | 1980 | India | | 28 w | 1320.50± 113.10 |
| Saeki and Inone | 1980 | Japan | | FE | 1762.7± 223.7 |
| Das *et al.* | 1982 | India | | 20 w | 1233± 0.009 |
| | | | | 40 w | 1605± 0.014 |
| Radhakrishnan and Ramakrishnan | 1982 | India | Strain F | 20 w<br>40 w | 886.0<br>1382.0 |
| Joseph | 1982 | India | Strain IWN | 20 w | 1181.5± 2.8 |
| | | | | 40 w | 1457± 4.0 |
| Singh and Chaudhary | 1982 | India | sel | FE | 1488.01± 253.38 |
| | | | non-sel | FE | 1467.65± 175.34 |

Contd.

Table 1 (Contd.)

| Author/s | Year | Country | Strain/Line | Age | Body weight (g) |
|---|---|---|---|---|---|
| Singh | 1983 | India | Strain IWN | 20 w | 1219.56± 12.75 |
| | | | | 40 w | 1585.51± 21.01 |
| | | | F | 20 w | 1113.13± 9.04 |
| | | | | 40 w | 1531.71± 17.30 |
| | | | IWP | 20 w | 1152.03± 14.88 |
| | | | | 40 w | 1628.57± 23.99 |
| Dunnigton and Siegel | 1984 | USA | | FE<br>168 d | 1357±13<br>1344±16 |
| | | | | FE<br>168 d | 1414±20<br>1311±18 |

Contd.

Table 1 (Contd.)

| Author/s | Year | Country | Strain/Line | Age | Body weight (g) | |
|---|---|---|---|---|---|---|
| Connie *et al.* | 1985 | - | Heavy | 20 w | 1377 | |
| | | | Medium | " | 1256 | |
| | | | Light | " | 1131 | |
| Leeson and Summers | 1987 | Canada | - | 19 w | 1308 | |
| | | | | " | 1411 | |
| | | | | " | 1564 | |
| Anon | 1989 | India | Strain IWD | 20 w<br>40 w | 1265 | 1532 |
| | | | IWF | " | 1192 | 1509 |
| | | | IWK | " | 1151 | 1460 |
| | | | IWG | " | 1219 | 1588 |
| | | | IWH | " | 1144 | 1398 |
| | | | IWI | " | 1175 | 1512 |
| | | | IWJ | " | 1236 | 1546 |
| | | | CON | " | 1095 | 1544 |
| | | | IWM | " | 995 | 1424 |

Contd.

Table 1 (Contd.)

| Author/s | Year | Country | Strain/Line | Age | Body weight (g) | |
|---|---|---|---|---|---|---|
| | | | IWN | 20 w<br>40 w | 975 | 1461 |
| | | | CON | " | 864 | 1472 |
| | | | IWN | " | 1332 | 1623 |
| | | | IWP | " | 1405 | 1752 |
| | | | CON | " | 1190 | 1548 |
| Anon | 1992 | India | Strain IWN | 20 w<br>40 w | 1117.7 | 1481.5 |
| | | | IWP | " | 1266.4 | 1576.8 |
| | | | control | " | 1143 | 1615 |

w - week
d - days
Bm - Bodyweight at maturity
FE - First egg
sel - selected

non-sel - non-selected
gp - group
con - control
Av - average

Upp and Thompson (1927) showed the influence of date of hatch on sexual maturity.

Kumar and Kapri (1968) studied internal egg quality and its relationship with other economic traits in White Leghorn birds and reported that age at sexual maturity has no effect on egg weight.

Aggarwal (1970) observed the age at first egg as 188 days in White Leghorns. The results further indicated that selection for early sexual maturity will result in birds which lay a large number of small sized good quality eggs.

Johari *et al.* (1977) studied genetic and phenotypic correlations for some traits of economic importance in a strain of White Leghorn. Body weight at 20 weeks of age averaged 971.6 g and observed that age at sexual maturity was 170.2 days. They also reported that age at sexual maturity decreased with increasing 20 week body weight.

Sarma *et al.* (1977) compared performance of six strains of White Leghorns housed on deep litter and in cages from 20 week of age. They observed significant difference in age at sexual maturity between the strain but type of housing did not have a significant effect.

Singh and Chaudhary (1982) studied the genetic influence in production characters in White Leghorn and indicated that selected flock for high egg production matured earlier than the control flock.

The age at sexual maturity reported by various investigators is presented in Table 2.

**Egg production**

The number of eggs produced in a certain time interval is generally used as a measure of production capacity of a hen under specific environmental condition. It is apparent that egg number alone can account for upto 90 per cent of variation in economic return.

Mohapatra (1972) during selection study for egg mass reported egg number for 40 weeks and 100 days of production as 57.32 and 58.81 respectively.

Choi (1973) studied the performance of three strains of White Leghorn and reported an average hen day egg production of 56.62 per cent in 500 days of age.

Prakashbabu *et al.* (1975) observed the effect of non-genetic sources of variation on certain performance traits in White Leghorn and reported mean hen housed egg production from 140 to 260 days of age in three strains viz., T, M, V as 54.54, 51.52 and 35.26 respectively.

Table 2. Age at sexual maturity (ASM) of White Leghnorn chicken as reported by various authors

| Author/s | Year | Country | Strain/Line | ASM (days) |
| --- | --- | --- | --- | --- |
| Aggarwal | 1970 | India | | 188 |
| Seyed and Rizvi | 1972 | India | | 195.6 |
| Choi | 1973 | S.Korea | | 185-201 |
| Poulose and Sathe | 1974 | India | Strain A<br>B<br>C | 155<br>167<br>139 |
| Prakashbabu *et al.* | 1975 | India | Strain T<br>M<br>V | 180<br>186<br>194 |
| Hanumaiah *et al.* | 1976 | India | | $175 \pm 1.74$ |
| Johari *et al.* | 1977 | India | Meyer strain | 170.2 |
| Krishnan *et al.* | 1977 | India | | $169 \pm 9$<br>$169 \pm 10$<br>$175 \pm 14$ |

Contd.

Table 2 (Contd.)

| Author/s | Year | Country | Strain/Line | ASM (days) |
|---|---|---|---|---|
| Sarma *et al.* | 1977 | India | | 176 |
| | | | | 189 |
| | | | | 170 |
| | | | | 169 |
| | | | | 174 |
| Gurung and Taylor | 1978 | | | 199.34±0.56 |
| Christmas *et al.* | 1979 | USA | | 168 |
| | | | | 171 |
| | | | | 172 |
| | | | | 161 |
| | | | | 151 |
| Saeki and Inone | 1980 | Japan | | 158.9±20.7 |
| Raj *et al.* | 1980 | India | | 191.26±2.38 |
| | | | | 175.87±2.65 |
| | | | | 168.06±2.97 |
| | | | | 183.78±2.98 |
| Maan | 1980 | | | 170 |
| Al-Rawi | 1980 | S.Arabia | | 173 |

Contd.

Table 2 (Contd.)

| Author/s | Year | Country | Strain/Line | ASM (days) |
|---|---|---|---|---|
| Jain and Roberts | 1980 | Canada | | 160.4±0.49 |
| Jain *et al.* | 1980 | India | | 198.36±15.81 |
| Saeki and Inone | 1980 | | | 158.9±20.7 |
| Das *et al.* | 1982 | India | | 150.83±0.672 |
| Singh *et al.* | 1982 | India | sel | 203.39±32.71 |
| | | | non-sel | 215.23±17.09 |
| Radhakrishnan and Ramakrishnan | 1982 | India | Strain F | 182.6 |
| Joseph | 1982 | India | Strain IWN | 166.0±0.3 |
| | | | IWP | 162.1±1.1 |
| Singh | 1983 | India | Strain F | 176.95±2.16 |
| | | | IWN | 186.23±4.78 |
| | | | IWP | 182.49±1.73 |

Contd.

Table 2 (Contd.)

| Author/s | Year | Country | Strain/Line | ASM (days) |
|---|---|---|---|---|
| Dunnigton and Siegel | 1984 | USA | Line | $182 \pm 2$ |
| | | | Line | $168 \pm 1$ |
| Sah *et al.* | 1985 | India | Strain OT | $165.64 \pm 0.37$ |
| Anon | 1989 | India | Strain IWD | 155 |
| | | | IWF | 160 |
| | | | IWK | 161 |
| | | | CON | 154 |
| | | | Strain IWG | 145 |
| | | | IWH | 143 |
| | | | IWI | 153 |
| | | | IWJ | 142 |
| | | | CON | 178 |
| | | | Strain IWM | 156 |
| | | | IWN | 162 |
| | | | CON | 185 |
| | | | Strain IWN | 149 |
| | | | IWP | 148 |
| Anon | 1992 | India | Strain IWN | 168.5 |
| | | | IWP | 160.9 |
| | | | control | 170.5 |

sel - selected    non-sel - non selected    con - control

Johari *et al.* (1977) investigated genetic and phenotypic correlation for some traits of economic importance in a strain of White Leghorn and observed an average egg production of 78.9 per cent in 280 days of age.

Singh (1983) studied genetic effect influencing egger traits from diallel mating system in three pure strains of White Leghorn and observed a maximum egg number of 84.23 eggs in F strain, followed by IWP strain with 73.52 eggs and IWN strain with 72.07 eggs.

Liljedahl *et al.* (1984) opined that increase in genetic variations are attributable to the expression of an enhanced number of genes determing egg production at later stages.

The various measurements of egg production usually employed are egg number upto specific age, egg number upto an instant number of days of production or ratio of production to a fixed age. Hen housed production, a combination of egg production and viability, is the total number of eggs laid divided by the number of birds at the start of the recording period.

The egg production of different strains/lines of White Leghorn reported by different workers are depicted in Table 3.

Table 3. Egg production of White Leghnorn chicken as reported by various authors

| Author/s | Year | Country | Age/Strain/ line | Criterion of measurement | Value |
|---|---|---|---|---|---|
| Aggarwal | 1970 | India | | 4 m | 36 |
| Mohapatra | 1972 | India | | 40 w.EN | 57.32 |
| | | | | 100 d.EN | 58.81 |
| Choi | 1973 | S.Korea | | 500 d.HDP% | 56-62 |
| | | | | 500 d.HHP% | 182-204 |
| Poulose and Sathe | 1974 | India | Strain A | HHP% | 63 |
| | | | B | HHP-HDP% | 57 59 |
| | | | C | HHP-HDP% | 72 74 |
| Vanchev *et al.* | 1975 | | Line 6E | EN | 234 |
| Prakashbabu *et al.* | 1975 | India | Strain T | 140-260 d.HHP | 54.54 |
| | | | M | " | 51.52 |
| | | | V | " | 35.26 |
| Hanumaiah *et al.* | 1976 | India | | EN | 68±1.34 |
| Johari *et al.* | 1977 | India | | 280 d.Av p | 78.9 |

Contd.

Table 3 (Contd.)

| Author/s | Year | Country | Age/Strain/ line | Criterion of measurement | Value |
|---|---|---|---|---|---|
| Sarma *et al.* | 1977 | India | 6 Strains | 280 d.HHP-HDP | 61.3 65.5 |
| | | | | " | 58.1 61.1 |
| | | | | " | 50.7 52.4 |
| | | | | " | 59.6 61.5 |
| | | | | " | 61.6 64.3 |
| | | | | " | 65.3 68.0 |
| Krishnan *et al.* | 1978 | India | | 280 dp | 79±146 |
| | | | | " | 76±15 |
| | | | | " | 82±13 |
| Szado and Baczkowska | 1978 | Poland | | Av 2yp | 62 |
| | | | | 480 dp | 164 |
| Renganathan *et al.* | 1979 | India | Strain 77 | 260 dp | 48.03±2.03 |
| | | | | " | 57.81±1.02 |
| | | | Strain 99 | 260 d | 52.51±2.28 |
| | | | | " | 64.23±0.87 |
| Christmas *et al.* | 1979 | USA | 6 trials | HDP% | 67.2 |
| | | | | " | 67.4 |
| | | | | " | 69.0 |
| | | | | " | 68.4 |
| | | | | " | 69.4 |
| | | | | " | 66.9 |
| | | | | " | 71.5 |

Contd.

Table 3 (Contd.)

| Author/s | Year | Country | Age/Strain/ line | Criterion of measurement | Value |
|---|---|---|---|---|---|
| Raj *et al.* | 1980 | India | Meyer strain | 40 wp | 59.54±2.41 |
| | | | | " | 72.65±2.24 |
| | | | | " | 74.93±2.53 |
| | | | | " | 69.16±2.72 |
| Mann | 1980 | | | 280 dp | 65 |
| Jain and Roberts | 1980 | India | | 275 d Av.EN | 84.9 |
| Al-Rawi | 1980 | S.Arabia | | 90 d HDP | 37 |
| | | | | 40 HDP | 43 |
| | | | | An HDP | 166 |
| Jain *et al.* | 1980 | India | | 350 dp | 93.29±19.18<br>61.78% |
| Kumar *et al.* | 1981 | India | Strain IWI | 131 dp | 92.1±1.05 |
| | | | IWH | 131 dp | 87.4±1.10 |
| Das *et al.* | 1982 | India | | 21-40 w.EN | 90.25±0.935 |
| Singh and Chaudhary | 1982 | India | sel | 90 dp | 61.62±11.36 |
| | | | non-sel | " | 59.25±6.72 |

Contd.

Table 3 (Contd.)

| Author/s | Year | Country | Age/Strain/ line | Criterion of measurement | Value |
|---|---|---|---|---|---|
| Radhakrishnan and Ramakrishnan | 1982 | India | Strain F | 140-180d HHN | 28.30 |
| Singh | 1983 | India | Strain F | 280 d | 84.23±2.11 |
| | | | IWP | 280 d | 73.52±2.02 |
| | | | IWN | 280 d | 72.07±2.53 |
| Sah *et al.* | 1985 | India | | 260 d | 41.83±1.01 |
| Anon | 1989 | India | Strain IWD | 280 d.EN | 95.5 96.2 |
| | | | IWF | " | 94.0 95.0 |
| | | | IWK | " | 90.0 91.3 |
| | | | Strain IWG | " | 101.9 109.5 |
| | | | IWH | " | 97.8 102.0 |
| | | | IWI | " | 87.3 95.2 |
| | | | IWJ | " | 103.9 110.0 |
| | | | CON | " | 61.9 66.6 |

Contd.

Table 3 (Contd.)

| Author/s | Year | Country | Age/Strain/ line | Criterion of measurement | Value | |
|---|---|---|---|---|---|---|
| | | | Strain IWM | 280 d.EN | 74.8 | 79.6 |
| | | | IWN | " | 73.1 | 79.9 |
| | | | CON | " | 68.0 | 69.4 |
| | | | Strain IWN | " | 101.2 | 103.5 |
| | | | IWP | " | 95.9 | 99.1 |
| | | | CON | " | 90.0 | |
| Anon | 1992 | India | Strain IWN | 40 w.HHN | 82.6 | |
| | | | IWP | " | 87.2 | |
| | | | control | " | 75.2 | |

d - days
w - week
Av - average
EN - egg number
HDP - Hen day production
m - month
con - control
Av.p - average production

HHP - hen housed production
HHN - hen housed number
dp - days production
yp - year production
wp - week production
w.EN - week egg number
d.EN - days egg number

## Egg weight

Egg weight is an important economic trait in egg type chicken. Egg size and egg weight are synonymous terms so far as newly laid eggs are concerned. The larger the size, the heavier the egg. Weight of an egg is the most easily measured criterion of size. Therefore inheritance studies usually deal in terms of egg weight.

Funk and Kempster (1934) and Hall (1939) have shown that differences in mean annual egg weight among strains of the same breed or variety are sometimes greater than differences in mean annual egg weight among different breeds and varieties.

Roberts *et al.* (1952) reported that egg weight in White Leghorn was influenced by several genes without dominance and that males and females are of equal importance in determining egg weight.

Saeki *et al.* (1966) studied laying performance in the pullet year of two strains of White Leghorn and reported an average annual egg weight of 51.3 g for both the strains.

Galvano (1970) investigated relationship of egg weight and quality with body weight and age of hens and concluded that egg weight increased significantly as age and body weight increased.

Krishnan *et al.* (1978) studied various sampling procedures in measurement of egg weight and indicated that two day weighing are as good as weighing the eggs on all 28 days. They recommended that egg collected on the 14th and 28th days or 13th and 14th days of a 28 day period be used for recording the egg weight for all practical purposes.

Christmas *et al.* (1979) opined that season of maturity of the laying hen influences egg size at all phases of the production year. Neither bird size at maturity nor rate of production appeared to be contributing factors to the seasonal difference in egg size.

Mann (1980) evaluated economic traits in White Leghorn from 20 to 40 weeks of age and reported an average egg weight of 53 g.

Evaluation of egg mass as a selection criterion in chicken was made by Jain and Roberts (1980) using random bred White Leghorn females and observed that egg weight at 275, 325, 375 and 540 days of age were 57.5, 59.5, 61.6 and 63.5 g respectively.

Changes in egg weight with age of hens from different lines and line crosses were studied by Lukyanova and Burdashkina (1981) and observed highly significant difference in egg weight.

Kumar *et al.* (1981) reported significant difference in egg weight between strain of IWI and IWH and the average values observed were 59.2 and 50.7 g respectively.

There was no significant difference in egg weight between IWN and IWP strain of White Leghorn at 38 weeks of age (Joseph, 1982). The average egg weight value was 51.7 g for the two strains.

Das *et al.* (1982) studied the inheritance of some economic traits in White Leghorn chicken and observed an average egg weight of 49.54 g from 21 to 40 weeks of age.

In an attempt to identify a suitable bird for backyard system of rearing, Radhakrishnan and Ramakrishnan (1982) studied pullets belonging to nine genetic groups obtained by mating White Leghorn, Rhode Island Red, Australorp and their reciprocal crosses. The mean egg weight data revealed that pure bred White Leghorns recorded significantly higher egg weight (53.2 g) at 280 days of age than other pure bred and their reciprocal crosses.

Singh (1983) conducted a 3x3 diallel crossing experiment using IWN, IWP and F strain of White Leghorn to identify genetic effects influencing egger traits. Among the pure strain, IWN gave a mean egg weight of 55.0 g followed by F strain (53.54 g) and IWP (53.15 g) at 38 weeks of age.

Sah *et al*. (1985) compared some economic characters in desi, White Leghorn and their reciprocal crosses under farm and village conditions of rearing. They reported that the weight of first egg in White Leghorn was 46.05 g as against 22.66 g in desi chicken.

The egg weight values of three strains of White Leghorn viz. IWN, IWP and CP at 32 weeks and 40 weeks of age were 50.9, 52.6; 49.6 and 53.15, 54.2 and 50.3 g respectively (Anon, 1992).

The average egg weight of White Leghorn chicken as reported by various authors are presented in Table 4.

## Correlation

Correlation reflects the relationship among various traits in a population.

Blyth (1952) opined that egg weight is negatively associated with maximum rate of production and that relation break down in the poorer producers because of irregularities in their performances, constitute divergence from the potential maximum.

Roberts *et al*. (1952) studied the inheritance of egg weight in four inbred lines of single comb White Leghorn and observed correlation between mean body weight (44 week of age)

Table 4. Egg weight (EW) of White Leghnorn chicken as reported by various authors

| Author/s | Year | Country | Strain/line | Age | Egg weight (g) |
|---|---|---|---|---|---|
| Roberts *et al.* | 1952 | USA | Line 1 | 11-13m | 60.3±0.5 |
| | | | 9 | " | 46.4±0.5 |
| | | | 3 | " | 45.4±0.3 |
| | | | 10 | " | 59.8±0.6 |
| Saeki *et al.* | 1966 | Japan | 2 strains | An | 51.3 |
| Aggarwal | 1970 | India | | 20-24 m | 48.0 |
| Mohapatra | 1972 | India | | 40 w | 42.99 |
| | | | | 100 d | 43.13 |
| Choi | 1973 | S.Korea | | | 54.1-55.3 |
| Poulose and Sathe | 1974 | India | Strain A | 25/52 w | 42.0 55.0 |
| | | | B | " | 38.1 54.7 |
| | | | C | " | 40.5 55.3 |
| Vanchev *et al.* | 1975 | - | Line 6E | Av | 56.4 |
| Prakashbabu *et al.* | 1975 | India | Strain T | 32 w | 47.02 |
| | | | M | " | 45.53 |
| | | | V | " | 52.13 |

Contd.

Table 4 (Contd.)

| Author/s | Year | Country | Strain/line | Age | Egg weight (g) |
|---|---|---|---|---|---|
| Hanumaiah *et al.* | 1976 | India | | | 55±0.55 |
| Gurung and Taylor | 1978 | | | Av | 51.22±3.19 |
| Rahmatullah *et al.* | 1978 | India | | | 52.11 |
| Szado and Baczkowska | 1978 | Poland | | | 58.0 |
| Jain *et al.* | 1978 | India | | 400 d | 58.74 |
| Iype | 1979 | India | F | 230-240 d | 51.0<br>50.0 |
| Reganathan *et al.* | 1979 | India | Line 77<br>Line 99 | 32 w<br>" | 52.05-54.21<br>51.25-52.85 |
| Al-Rawi | 1980 | S.Arabia | | | 52.3 |
| Raj *et al.* | 1980 | India | | upto 40 w | 47.71±0.53<br>48.02±0.46<br>47.84±0.51<br>47.88±0.45 |

Contd.

Table 4 (Contd.)

| Author/s | Year | Country | Strain/line | Age | Egg weight (g) |
|---|---|---|---|---|---|
| Maan | 1980 | | | 280 d.Av | 53.0 |
| Jain and Roberts | 1980 | India | | 275 d<br>325 d<br>375 d<br>540 d | 57.5±0.39<br>59.5±0.43<br>61.6±0.41<br>63.5±0.34 |
| Saeki and Inone | 1980 | Japan | | 1st egg | 35.6±6.7 |
| Lukyanova and Burdashkina | 1981 | Russia | Line K63<br>Line Poltava clay | | 55.1-58.3 |
| Kumar *et al.* | 1981 | India | Strain IWI<br>IWH | 131 d.Av<br>" | 59.2±1.2<br>50.7 |
| Das *et al.* | 1982 | India | - | 21-40 w | 49.54±0.199 |
| Radhakrishnan and Ramakrishnan | 1982 | India | Strain F | 280 d | 53.2 |
| Joseph | 1982 | India | Strain IWN<br>IWP | 38 w<br>" | 51.7±0.1<br>51.7±0.1 |

Contd.

Table 4 (Contd.)

| Author/s | Year | Country | Strain/line | Age | Egg weight (g) |
|---|---|---|---|---|---|
| Singh | 1983 | India | Strain IWN | 38 w | 55.00±0.61 |
| | | | IWP | " | 53.15±0.53 |
| | | | F | " | 53.54±0.79 |
| Sah *et al.* | 1985 | India | Strain OT | 1st egg | 46.05±0.46 |
| Anon | 1989 | India | Strain IWD | 40 w | 52.9 |
| | | | IWF | " | 53.2 |
| | | | IWK | " | 55.3 |
| | | | CON | " | 48.7 |
| | | | Strain IWG | " | 52.3 |
| | | | IWI | " | 53.5 |
| | | | IWJ | " | 52.9 |
| | | | CON | " | 56.0 |
| | | | Strain IWM | " | 50.0 |
| | | | IWN | " | 51.0 |
| | | | CON | " | 52.1 |
| | | | Strain IWN | " | 51.0 |
| | | | IWP | " | 51.6 |
| | | | CON | " | 50.2 |
| Anon | 1992 | India | Strain IWN | 32/40 w | 50.9 53.1 |
| | | | IWP | " | 52.6 54.2 |
| | | | control | " | 49.6 51.4 |

An - annual m - month w - week
d - days Av - average con - control

and mean egg weight (11-13 months of age) as 0.40, 0.60, 0.09 and 0.53 respectively in four lines.

Van Albada (1956) observed that pullets which commenced laying before the age of seven months had weak correlation between age at first egg and subsequent production. The largest correlations were between age at last egg and length of the production period (0.789) and between age at first egg and average length of the laying cycle upto 7 months (-0.793). Annual production showed a correlation of -0.033 with mean egg weight.

Gruev *et al.* (1965) conducted studies on correlation between egg weight and some other characters of Stazagorsk Red Hens. They found that the annual egg production was negatively correlated with egg weight (-0.0399 and -0.0784) in the two years and age at first egg was positively correlated with egg weight (0.4051 and 0.2409).

Krutikova (1975) studied the variation in the correlations between egg production, body weight, clutch length, egg weight in poultry and reported correlation between production and egg weight, clutch length and live weight as -0.12, 0.69, -0.43 respectively in first month of egg production.

The effect of clutch size, age at maturity and body weight on egg number was investigated by Krishnan *et al.*

(1977) using three flocks of Mayer strain of White Leghorn. Correlation between relative age at maturity with 20 week body weight and 40 week egg production for the three flocks was -0.339, -0.436, -0.546, -0.598 and -0.076, -0.379 respectively. The values of correlation for body weight at 20 week with 40 week production in three flocks were 0.302, 0.574 and 0.059 respectively.

Yeo (1979) studied the relationship between body weight at sexual maturity and other economic characters in White Leghorn layers. Body weight at sexual maturity (18 week of age) was negatively correlated with age at first egg (-0.128) and possitively correlated with body weight during the subsequent laying period (0.583).

Kumar *et al.* (1981) reported highly significant correlations between egg production during the first month of lay and that in the third and fourth months (0.25-0.37) in IWI and IWH strains of White Leghorns.

Leojoseph (1991) after studying seven consecutive generations in IWN and IWP strains observed that egg number and egg weight exhibited negative genetic and phenotypic relationship in both the strains. Egg weight and mature body weight showed positive relationship genetically and phenotypically in the two strains.

Bell and Adams (1992) studied the first cycle production characteristics in White Leghorn chicken. The correlation between age at peak production (week) with per cent egg production at 50 week of age was 0.0001 and that between age at peak production (week) and peak production percentage was 0.0063 in the first cycle of production. The value between 50 week production with peak production per cent was 0.0001.

Correlations between production traits in White Leghorn chicken as reported by various authors are presented in Table 5.

Table 5. Correlation between production traits in White Legorn as reported by various authors

| Author/s | Year | Country | Breed/Strain/ Line | Traits | Value |
|---|---|---|---|---|---|
| Roberts *et al.* | 1952 | USA | 4 lines | 11-13m Av.ew and 44 w Av.bw | $0.62 \pm 0.05$ |
| Van Albada | 1956 | | | ALE- P.yr length | 0.789 |
| | | | | AFE- Av.lc upto 7 m | -0.793 |
| | | | | An.P- Av.ew | -0.033 |
| Gruev *et al.* | 1965 | | S.Z.Red Hen | An.P- EW (2 years) | -0.0399<br>-0.0784 |
| | | | Red Hen | AFE- EW (2 years) | 0.4051<br>0.2409 |

Contd.

Table 5 (Contd.)

| Author/s | Year | Country | Breed/Strain/ Line | Traits | Value |
|---|---|---|---|---|---|
| Krishnan *et al.* | 1977 | India | Meyer strain | | |
| | | | I flock | ASM-BW20<br>ASM-40w.ep | -0.339<br>-0.436 |
| | | | II flock | " | -0.546<br>-0.598 |
| | | | III flock | " | -0.076<br>-0.379 |
| | | | Meyer strain | | |
| | | | I flock | 20 w.BW-<br>40 w.ep | 0.302 |
| | | | II flock | " | 0.574 |
| | | | III flock | " | 0.059 |
| Yeo | 1979 | S. Korea | | BW 18-<br>AFE | -0.128 |
| | | | | BW 18-<br>Laying period BW | 0.583 |

Contd.

Table 5 (Contd.)

| Author/s | Year | Country | Breed/Strain/ Line | Traits | Value |
|---|---|---|---|---|---|
| Kumar *et al.* | 1981 | India | Strain IWI IWH | EN 1st m- EN 3rd and 4th m | 0.25-0.37 |
| Bell and Adams | 1992 | California | | Ag.PP- 50 w.EP | 0.143 |
| | | | | Ag.PP- P.EP% | -0.101 |
| | | | | P.EP%- 50 w.EP | 0.452 |

An.p - annual production
ASM - age at sexual maturity
BW 20 - 20 week body weight
BW 40 - 40 week body weight
BW 18 - 18 week body weight
Ag.PP - age at peak production
w.EP - week egg production
p.EP - peak egg production
w - weeks

m - months
EN - egg number
Av.BW - average body weight
ALE - age at last egg
P-yr - production year
AFE - age at first egg
Av.lc - average laying cycle
yr - year

# *Materials and Methods*

# MATERIALS AND METHODS

An experiment was carried out at the Mannuthy Centre of All India Co-ordinated Research Project (AICRP) on Poultry Improvement during the period from July 1993 through March 1994 in order to study the egg weight profile upto 52 weeks of age in three strains of White Leghorn.

The experimental stock consisted of birds belonging to three strains of White Leghorn viz., IWN, IWP and control population (CP) maintained at the Mannuthy Centre. The former two strains have undergone selection for the past thirteen generations and the latter a non-selected strain, the control population was brought from the Project Directorate of AICRP on Poultry Improvement, Hyderabad during the year 1989.

One hundred pullets from each strain selected at random at 18 weeks of age were used for the study. The birds were housed in single-bird cages of identical dimensions of 25x37x37 cm. All the birds were hatched in March 1993. The IWN strain was hatched five days earlier than that of IWP and CP birds. No artificial lighting was provided in the experimental house during the rearing and laying periods. The birds were given a standard layer mash. Feed and water were provided ad libitum. Routine managemental practices were followed throughout the experimental period and were identical for all strains.

The data pertaining to egg weight and other production characteristics were studied in all the birds till 52 weeks of age. The following observations in three strains of White Leghorn were recorded during the course of the study.

1. Body weight
2. Age at first egg
3. Age at 10 and 50 per cent production
4. Hen-housed egg production
5. Egg weight
6. Weekly gain in egg weight
7. Correlation between egg weight and body weight
8. Correlation between egg weight and egg production

The individual body weight of birds at 20 and 40 weeks of age were recorded to the nearest 10 g and the mean values in each strain were worked out. The sexual maturity in all the strains were assessed based on the age at first egg and ages at 10 and 50 per cent production in days. The hen-housed production in terms of egg number and percentage were arrived for eight, 28-day periods from 21 to 52 weeks of age.

The eggs from all birds were weighed individually on every day to the nearest 0.1 g. From these data, the mean egg weight in each week for each of the strains were calculated. The gain in egg weight per week in each strain was arrived at to estimate the influence of the chronological age of birds. The magnitude of variations in egg weight among the strains are expressed with mean values and standard error. The correlations between egg weight and body weight, egg weight and egg production were estimated to evaluate the inter-relationship between these traits within the strains.

The data collected were subjected to statistical analysis as per Snedecor and Cochran (1967).

# *Results*

# RESULTS

A study was conducted to assess the egg weight profile with the chronological age of the bird in three strains of White Leghorn. The results obtained are presented in this chapter.

## Body weight

The mean body weight at 20 and 40 weeks of age in three strains of White Leghorn viz., IWN, IWP and CP are given in Table 6. The mean body weight at 20 weeks of age was 1.339, 1.421 and 1.229 kg in IWN, IWP and CP respectively. The corresponding values at 40 weeks of age for the above strains were 1.539, 1.546 and 1.445 kg respectively. The results indicated that IWP strain pullets were heavier than the other two strains at 20 and 40 weeks of age, whereas pullets of control population showed lowest body weight. The IWN strain birds registered a body weight in between that of control population and IWP strain.

The analysis of variance of 20 week and 40 week body weight are presented in Table 7. The results indicated a statistically significant difference between the three strains at both the periods. The body weight of control population was lower ($P<0.05$) when compared to the other two strains at

Table 6. Mean body weight (kg) at 20 and 40 weeks of age in three strains of White Leghorn

| Age (in weeks) | Strain code | | | |
|---|---|---|---|---|
| | IWN | IWP | CP | Mean |
| 20 | 1.339±0.01[b] | 1.421±0.01[c] | 1.229±0.01[a] | 1.331±0.01 |
| 40 | 1.539±0.02[b] | 1.546±0.02[b] | 1.445±0.02[a] | 1.510±0.01 |

Means bearing different superscripts within an age group differ significantly (P<0.05)

Table 7. Mean squares from ANOVA for body weight at 20 and 40 weeks of age in three strains of White Leghorn

| Source | 20 week | | 40 week | |
|---|---|---|---|---|
| | df | MSS | df | MSS |
| Between strain | 2 | 0.907* | 2 | 0.299* |
| Error | 294 | 0.016 | 278 | 0.026 |
| Total | 296 | | 280 | |

* Significant (P<0.05)

20 and 40 weeks of age. The body weight at 20 weeks in IWN and IWP strains was significantly different, the latter being heavier. However, the body weights of IWN and IWP strains were statistically similar at 40 weeks of age, while the control population registered a significantly lower body weight.

## Age at sexual maturity

Sexual maturity measured in terms of age at first egg, age at 10 and 50 per cent production are presented in Table 8.

Mean age at first egg was 149.53, 136.41 and 153.85 days in IWN, IWP and control population, respectively. The results showed that sexual maturity was early in IWP strain, late in control population and intermediary in IWN strain. The analysis of variance of age at first egg presented in Table 9 showed a significant difference in this trait. It was significantly lower for the IWP strain when compared with other two strains. The average age at first egg in control population was significantly higher. The age at first egg for the IWN strain was intermediary and was statistically different from both IWP and control population.

Age at 10 per cent production (Table 8) was 140, 133 and 140 days in IWN, IWP and control population, respectively. Pullets in the IWP strain attained 10 per cent production at 133 days of age which was earlier than other strains.

Table 8. Age at sexual maturity (days) in three strains of White Leghorn

| Strain code | Average age at first egg | Age at 10% production | Age at 50% production |
|---|---|---|---|
| IWN | 149.53±0.89 [a] | 140 | 153 |
| IWP | 136.41±0.89 [b] | 133 | 143 |
| CP | 153.85±0.90 [c] | 140 | 162 |
| Mean | 146.50±0.67 | 137.6 | 152.6 |

Means bearing different superscripts differ significantly (P<0.05)

Table 9. Mean squares from ANOVA for age at first egg in three strains of White Leghorn

| | df | MSS |
|---|---|---|
| Between strain | 2 | 8145.471* |
| Error | 293 | 78.434 |
| Total | 295 | |

* Significant (P<0.05)

Age at 50 per cent production was 153, 143 and 162 days in IWN, IWP and control population, respectively. The results indicated that IWP pullets attained 50 per cent production earlier than other two strains whereas the control population reached 50 per cent production very late. Age at 50 per cent production in IWN strain was in between IWP and control population (Table 8).

## Egg production

Mean Hen Housed Number (HHN) and Hen Housed Per cent (HHP) egg production from 19 to 52 weeks of age in three strains of White Leghorn are shown in Table 10. Hen housed egg number and per cent egg production were calculated for each 28-day period starting from 21 weeks of age. Since egg laying commenced earlier, egg production during 19 and 20 weeks was also accounted and shown separately but this data was not included for statistical analysis to find out the difference in egg production.

The HHN till 20 weeks of age was 0.26, 2.54 and 0.24 in IWN, IWP and control population, respectively. The corresponding HHP was 1.86, 18.14 and 1.71 per cent in the above strains. The results indicated that egg production in the initial two weeks was higher in IWP strain than the other strains. The same trend was repeated during the first 28-day period from 21 to 24 weeks of age. Hen housed production for

Table 10. Mean hen housed egg number and per cent egg production from 19 to 52 weeks of age in three strains of White Leghorn

| Age in weeks | Egg production | | | | | | Overall mean | |
|---|---|---|---|---|---|---|---|---|
| | IWN | | IWP | | CP | | | |
| | Hen-housed number | Hen-housed production (%) | Hen-housed number | Hen-housed production (%) | Hen-housed number | Hen-housed production (%) | Hen-housed number | Hen-housed production (%) |
| 19-20 | 0.26 | 1.86 | 2.54 | 18.14 | 0.24 | 1.71 | 1.01 | 7.24 |
| 21-24 | 13.71 | 48.96 | 17.51 | 62.54 | 10.41 | 37.18 | 13.88 | 49.56 |
| 25-28 | 20.03 | 71.54 | 17.03 | 60.82 | 20.79 | 74.25 | 19.28 | 68.87 |
| 29-32 | 21.22 | 75.78 | 18.28 | 65.29 | 21.19 | 75.68 | 20.23 | 72.25 |
| 33-36 | 21.95 | 78.39 | 20.57 | 73.46 | 22.34 | 79.79 | 21.62 | 77.21 |
| 37-40 | 20.78 | 74.20 | 18.21 | 65.04 | 19.49 | 69.61 | 19.49 | 69.62 |
| 41-44 | 19.62 | 70.07 | 16.82 | 60.07 | 19.51 | 69.68 | 18.65 | 66.6 |
| 45-48 | 19.04 | 68.00 | 16.54 | 59.07 | 19.47 | 69.54 | 18.35 | 65.54 |
| 49-52 | 19.23 | 68.67 | 16.49 | 58.89 | 19.89 | 71.04 | 18.54 | 66.20 |
| Overall mean | | 65.48 | | 60.50 | | 64.42 | | 60.34 |

this period was 48.96, 62.54 and 37.18 per cent, respectively for IWN, IWP and control population. Egg production from 25 to 28 weeks of age was 71.54, 60.82 and 74.25 per cent in IWN, IWP and CP, respectively, which showed a drop in egg production in IWP strain. During 29 to 32 weeks of age, hen housed egg production in IWN and control population was almost similar and was numerically higher than that of IWP strain. The highest hen housed egg production was recorded for all the strains during the period from 33 to 36 weeks of age. Hen housed egg production during 33 to 36 weeks of age for the strains IWN, IWP and control population was 78.39, 73.46 and 79.79 per cent, respectively. Thereafter the egg production declined gradually in all the strains. Hen housed egg production recorded for the last period (49 to 52 weeks of age) was 68.67, 58.89 and 71.04 per cent for the strains IWN, IWP and CP, respectively. The overall mean hen housed egg production from 19 to 52 weeks of age was 65.48, 60.50 and 64.42 per cent for the strains IWN, IWP and CP, respectively. When the egg production data for 19 and 20 weeks of age was excluded the overall egg production means rose to 68.45, 63.15 and 68.35 per cent for the above strains respectively which were statistically homogenous.

## Egg weight

### Weekly egg weight

The mean egg weight (g) from 19 to 52 weeks of age in three strains of White Leghorn viz., IWN, IWP and CP is presented in Table 11.

### IWN strain

In IWN strain, mean egg weight (EW) at 19 and 20 weeks of age was 31.60 g and 35.03 g, respectively. The egg weight increased gradually from 38.72 g to 44.0 g during the period from 21 to 24 weeks of age. Subsequently, the rate of increase in egg weight was slow. The egg weight was from 45.45 to 46.24 g during 25 to 28 weeks of age and 48.27 to 50.40 g during 29 to 32 weeks of age. In IWN strain an egg weight of above 50 g was obtained at 32 weeks of age. The mean egg weight ranged from 51.08 to 52.41 g during the period from 33 to 42 weeks of age and thereafter it was in the 53 gram range except at 46 and 52 weeks. The highest mean egg weight in IWN strain was at 48 weeks of age (53.91 g).

Overall mean egg weight from 19 to 52 weeks of age in IWN strain was 49.02 g which was numerically higher than that of IWP and control population. The mean egg weight recorded at 30 weeks of age was close to overall mean in this strain.

Table 11. Weekly mean egg weight (g) from 19 to 52 weeks of age in three strains of White Leghorn

| Age in weeks | Strain code IWN $\bar{X}$ | IWN SE | IWP $\bar{X}$ | IWP SE | CP $\bar{X}$ | CP SE | Overall mean |
|---|---|---|---|---|---|---|---|
| 19 | 31.60 | 1.060 | 36.16 | 0.834 | 30.10 | 0.000 | 32.62 |
| 20 | 35.03 | 0.986 | 37.02 | 0.766 | 32.97 | 0.558 | 35.01 |
| 21 | 38.72 | 0.525 | 38.99 | 0.764 | 35.69 | 0.424 | 37.80 |
| 22 | 41.53 | 0.534 | 41.17 | 0.315 | 37.47 | 0.476 | 40.06 |
| 23 | 42.45 | 0.358 | 42.11 | 0.421 | 37.44 | 0.911 | 40.67 |
| 24 | 44.00 | 0.306 | 43.41 | 0.337 | 40.30 | 0.306 | 42.57 |
| 25 | 45.45 | 0.308 | 43.35 | 0.600 | 41.78 | 0.276 | 43.53 |
| 26 | 46.02 | 0.256 | 43.45 | 0.497 | 42.40 | 0.303 | 43.96 |
| 27 | 45.63 | 0.301 | 44.47 | 0.332 | 42.40 | 0.301 | 44.17 |
| 28 | 46.24 | 0.340 | 46.10 | 0.307 | 43.33 | 0.304 | 45.22 |
| 29 | 48.27 | 0.307 | 46.99 | 0.346 | 44.63 | 0.318 | 46.63 |
| 30 | 49.75 | 0.344 | 48.00 | 0.388 | 45.25 | 0.331 | 47.67 |
| 31 | 49.27 | 0.320 | 49.17 | 0.295 | 45.92 | 0.325 | 48.12 |
| 32 | 50.40 | 0.309 | 49.40 | 0.655 | 46.56 | 0.406 | 48.79 |
| 33 | 51.08 | 0.345 | 49.71 | 0.317 | 46.79 | 0.295 | 49.19 |
| 34 | 51.63 | 0.323 | 49.79 | 0.304 | 46.87 | 0.317 | 49.43 |
| 35 | 51.27 | 0.395 | 50.67 | 0.465 | 47.86 | 0.339 | 49.93 |
| 36 | 51.62 | 0.320 | 50.60 | 0.345 | 47.62 | 0.338 | 49.95 |
| 37 | 51.22 | 0.403 | 50.88 | 0.313 | 47.76 | 0.316 | 49.95 |
| 38 | 51.69 | 0.309 | 50.97 | 0.438 | 48.38 | 0.328 | 50.50 |
| 39 | 52.86 | 0.337 | 51.25 | 0.428 | 48.26 | 0.343 | 50.79 |
| 40 | 52.38 | 0.357 | 51.44 | 0.410 | 47.78 | 0.494 | 50.53 |
| 41 | 52.95 | 0.329 | 51.61 | 0.380 | 47.94 | 0.373 | 50.83 |
| 42 | 52.41 | 0.403 | 51.81 | 0.522 | 49.03 | 0.342 | 51.08 |
| 43 | 53.80 | 0.336 | 52.64 | 0.352 | 49.10 | 0.356 | 51.85 |
| 44 | 53.80 | 0.333 | 51.63 | 0.431 | 48.90 | 0.349 | 51.44 |
| 45 | 53.48 | 0.305 | 51.42 | 0.549 | 48.68 | 0.368 | 51.19 |
| 46 | 52.66 | 0.352 | 51.47 | 0.517 | 49.23 | 0.394 | 51.12 |
| 47 | 53.40 | 0.377 | 52.56 | 0.413 | 49.38 | 0.412 | 51.78 |
| 48 | 53.91 | 0.307 | 51.51 | 0.411 | 48.83 | 0.364 | 51.42 |
| 49 | 53.27 | 0.342 | 52.30 | 0.386 | 48.74 | 0.353 | 51.44 |
| 50 | 53.60 | 0.329 | 51.40 | 0.372 | 48.37 | 0.367 | 51.12 |
| 51 | 53.05 | 0.327 | 52.00 | 0.396 | 48.58 | 0.398 | 51.21 |
| 52 | 52.10 | 0.390 | 51.49 | 0.446 | 48.90 | 0.362 | 50.83 |
| Overall Mean | 49.02 | | 48.14 | | 45.10 | | 47.43 |

Table 12. Mean squares from ANOVA for egg weight in three strains of White Leghorn

| Source | Strain code | | | | | |
|---|---|---|---|---|---|---|
| | IWN | | IWP | | CP | |
| | df | MSS | df | MSS | df | MSS |
| Between weeks | 31 | 1247.635** | 31 | 1291.787** | 31 | 980.435** |
| Error | 2863 | 10.926 | 2771 | 132.323 | 2876 | 13.043 |
| Total | 2894 | | 2802 | | 2907 | |

* Significant (P<0.01)

Statistical analysis of the data excluding 19 and 20 weeks of age revealed that the differences in egg weight between weeks within the strain was statistically significant (Table 12).

Statistical significance between mean weekly egg weights in IWN strain of White Leghorn from 21 to 52 weeks of age is shown in Appendix-I.

Mean weekly egg weight from 21 to 24 weeks of age varied significantly with the subsequent weekly mean egg weights as age advances. However, 22 week mean egg weight is non-significant with 23 week value.

From 25 to 28 weeks, the mean values were non-significant among each other but showed a significant difference with 29 to 52 weeks mean egg weight. The 29 week mean value was significant to subsequent values till 52 weeks of age. In general, the mean egg weight from 30 to 32 weeks of age were comparable among themselves. The 30 week mean egg weight was not significant to 31 and 32 weeks of age and it was significant from 33 weeks of age. Thirty one week mean egg weight value was significant to all subsequent weeks except with 32 weeks of age. The mean egg weight at 32 weeks was statistically different to the values during all the other weeks except the value for 33 and 35 weeks. Thirty three to 38 weeks mean egg weight values were comparable. Likewise, the values from 39 to 42 weeks were also statistically comparable. Forty three to 52 weeks mean egg weight values were not statistically different except at 46 with 48 weeks of age.

Weekly egg weight curve of IWN strain from 19 to 52 weeks of age is represented in Fig.1.

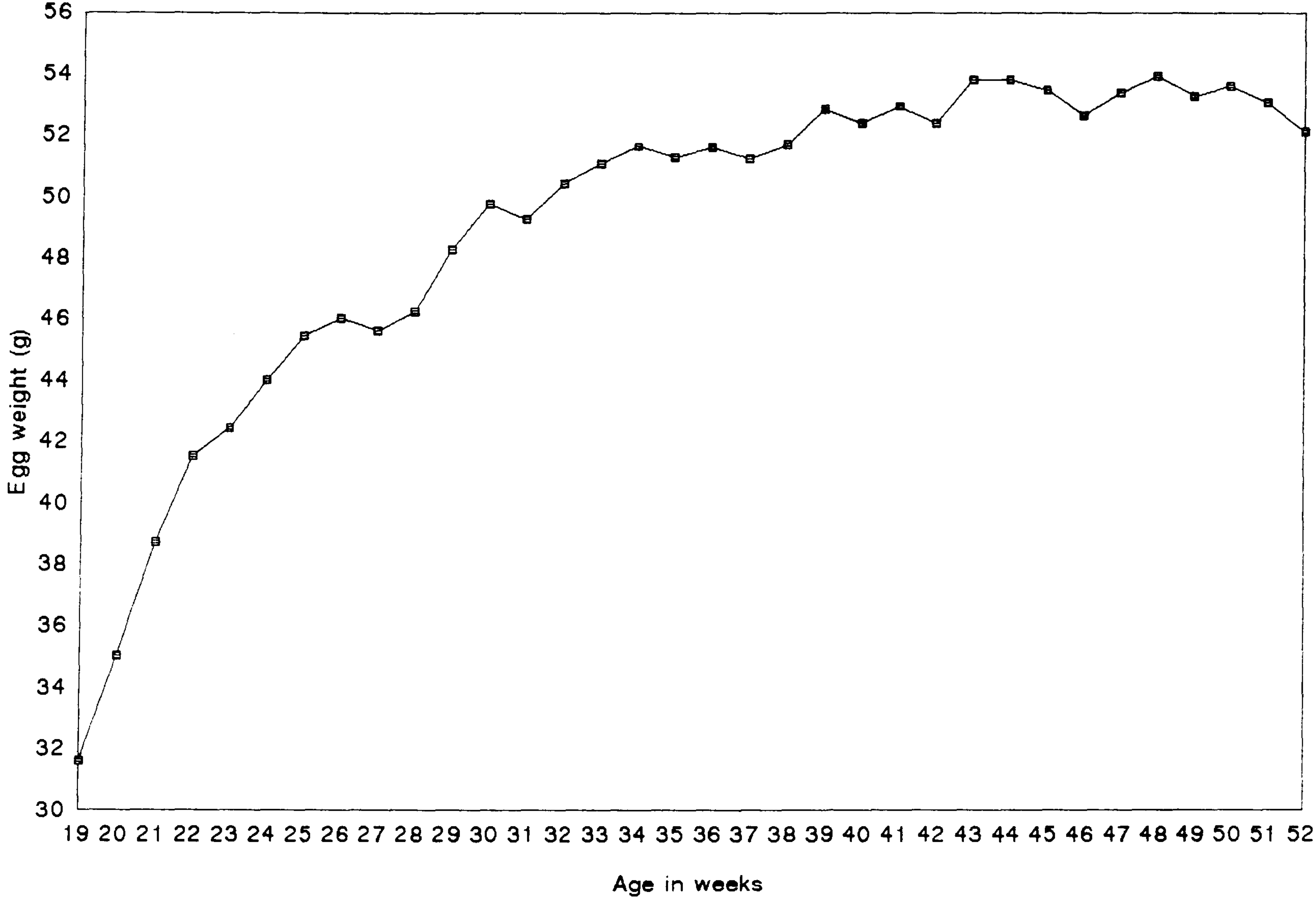
**IWP strain**

The overall mean egg weight in IWP strain was 48.14 g (Table 11). This was 0.88 g lower than that of IWN strain. The highest mean egg weight in IWP strain was 52.64 g recorded at 43 weeks of age, which was also lower than IWN strain. However, at the commencement of laying the mean egg weight was higher in IWP strain than other strains tested and it was 36.16 g at 19 week and 37.02 g at 20 weeks of age.

The egg weight averaged from 38.99 to 43.41 g during the period from 21 to 24 weeks of age and from 43.35 to 46.10 g during 25 to 28 weeks of age.

Further increase in mean egg weight was recorded as 46.99 to 49.79 g from 29 to 34 weeks of age. Subsequently, mean weekly egg weights registered only a gradual increase till the maximum egg weight which was obtained at 43 weeks and later the rise in egg weight was not regular. The mean egg weight at 52 weeks of age in IWP strain was 51.49 g.

Fig.1 Mean weekly egg weight curve of IWN strain from 19 to 52 weeks of age



In IWP strain an egg weight level of above 50 g was crossed only at 35 weeks of age which was three weeks later than that of IWN strain. The mean egg weight recorded at 30 weeks of age was very close to overall mean egg weight in this strain.

Statistical significance between mean weekly egg weight in IWP strain from 21 to 52 weeks of age is shown in Appendix-II.

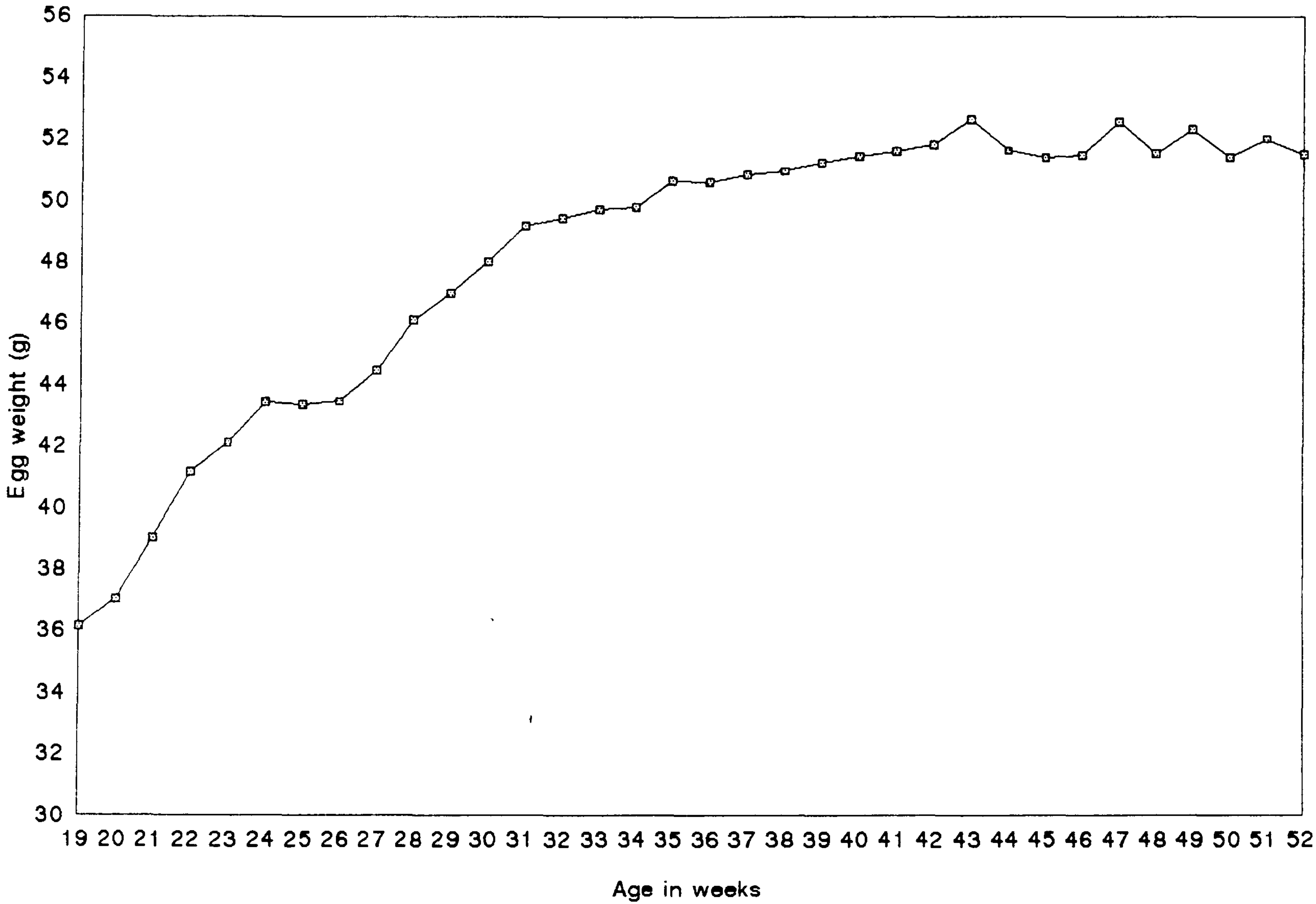
At 21 weeks of age, mean egg weight was found to be significant with mean values from 24 to 52 weeks of age. However, 22 and 23 weeks mean egg weights did not vary significantly upto 27 weeks of age. In general, 21 to 27 weeks mean egg weights were found to be significant with mean values from 30 to 52 weeks of age. The values at 28, 29 and 30 weeks were found to be significant subsequently from 33, 36 and 40 weeks of age respectively. From 31 to 52 weeks of age mean egg weight values were statistically similar except that between 31 and 43 weeks of age.

Weekly egg weight curve in IWP strain from 19-52 weeks of age is depicted in Fig.2.

**Control population**

The egg weight trend in control population was entirely different at all ages in comparison with IWN and IWP strains.

Fig.2 Mean weekly egg weight curve of
IWP strain from 19 to 52 weeks of age



The mean egg weights ranged from 30.10 to 49.38 g with an overall mean value of 45.10 g during the entire period (Table 11).

At the commencement of laying egg weight was 30.10 g at 19 weeks of age and 32.97 g at 20 weeks of age. The mean egg weight averaged from 35.69 to 40.30 g during the period from 21 to 24 weeks of age and the range was from 41.78 to 43.33 g during 25 to 28 weeks of age.

Increase in mean egg weight values from 29 weeks was gradual. The mean egg weight at 30 week of age was 45.25 g which was close to the overall mean for the strain. The mean egg weight in control population never crossed 50 g mark during the period from 19 to 52 weeks of age. The highest mean egg weight of 49.38 g in control population was registered at 47 weeks of age.

Statistical significance between mean weekly egg weight from 21 to 52 weeks of age in control population is shown in Appendix-III.

Twenty one week mean egg weight was found to be significantly different from 22 to 52 weeks mean values. Twenty two week mean value was found to be significant to subsequent weekly values except at 23 week. Weekly mean egg weight values at 23, 24 and 25 weeks of age were significant to subsequent weekly values from 24, 25 and 28 weeks of age, respectively. Twenty six to 28 week egg weigths showed significant difference from 29 weeks onwards.

Mean egg weights at 29 and 30 weeks of age were found to be significant subsequently from 30 and 31 weeks of age, respectively. Mean values from 31 to 34 weeks of age did not differ significantly among themselves. Thirty two weeks egg weight was found to be significant from 36 weeks onwards. From 42 week the mean egg weight values were non-significant to subsequent mean values upto 52 weeks of age.

Weekly egg weight curve in control population from 19 to 52 weeks of age is depicted in Fig.3.

## Period-wise egg weight

The period-wise mean egg weight in the three strains are presented in Table 13. The periods were formed by pooling mean egg weight for four weeks (28 days) starting from 21 weeks of age. Thus, altogether there were eight periods. Though egg weight means for 19 and 20 weeks of age were also calculated this data was not considered for statistical analysis.

The mean egg weight in IWN strain in the first period of laying (21 to 24 weeks of age) was 41.70 g followed by 45.84 g and 49.42 g in the second and third periods, respectively. The fourth period mean (51.40 g) was higher than the overall period-wise mean egg weight for the IWN strain. The egg

Fig.3 Mean weekly egg weight curve of control population
from 19 to 52 weeks of age

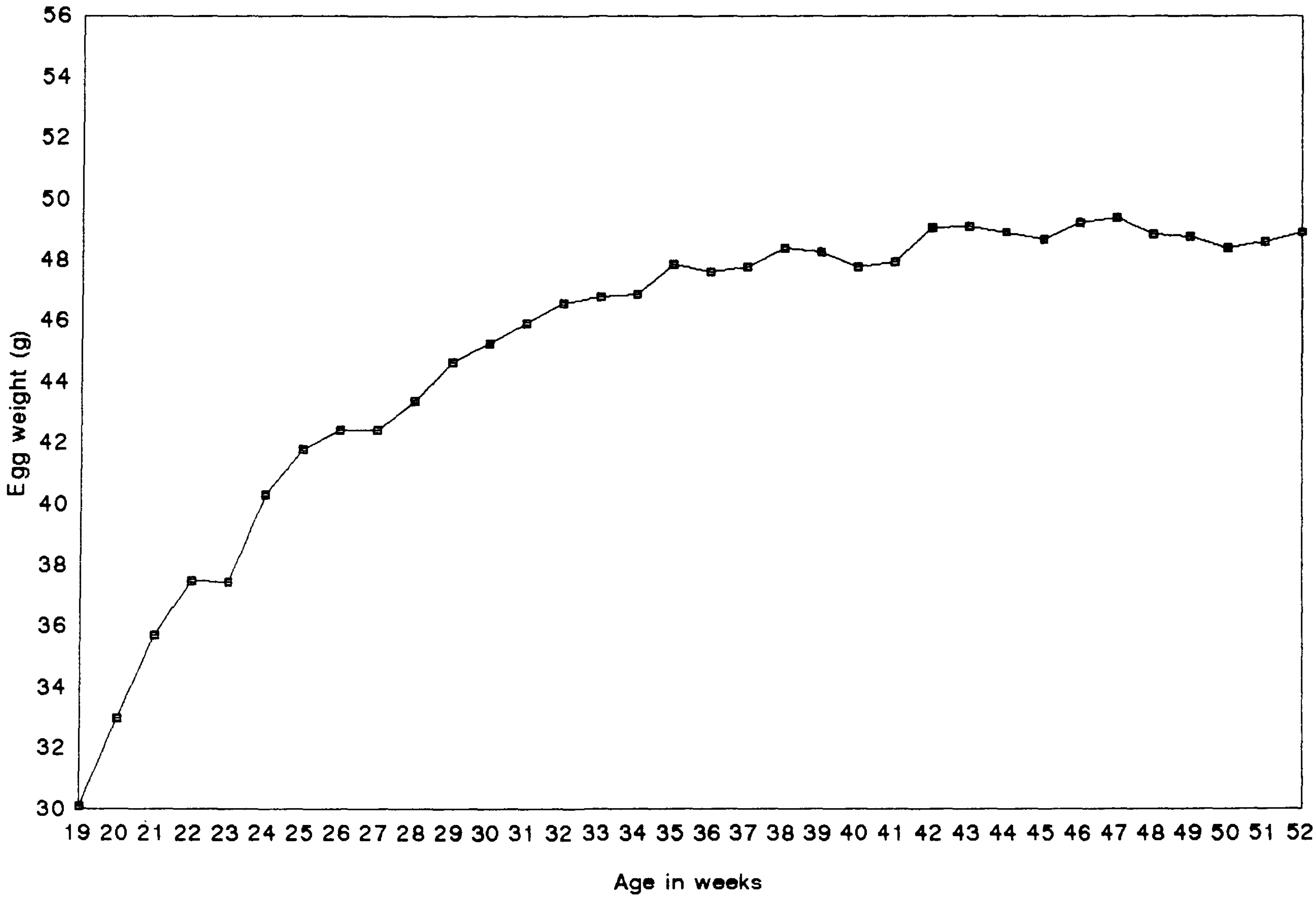


Table 13. Period-wise mean egg weight (g) from 21 to 52 weeks of age in three strains of White Leghorn

| Period | Age in weeks | Strain code | | | | | | Overall mean |
|---|---|---|---|---|---|---|---|---|
| | | IWN | | IWP | | CP | | |
| | | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | |
| I | 21-24 | 41.70 | 1.109 | 41.42 | 0.931 | 37.73 | 0.954 | $40.28^{a}$ |
| II | 25-28 | 45.84 | 0.180 | 44.39 | 0.638 | 42.48 | 0.320 | $44.24^{b}$ |
| III | 29-32 | 49.42 | 0.449 | 48.39 | 0.558 | 45.59 | 0.417 | $47.80^{c}$ |
| IV | 33-36 | 51.40 | 0.136 | 50.19 | 0.256 | 47.29 | 0.268 | $49.63^{d}$ |
| V | 37-40 | 52.04 | 0.363 | 51.14 | 0.129 | 48.05 | 0.161 | $50.41^{e}$ |
| VI | 41-44 | 53.24 | 0.342 | 51.92 | 0.243 | 48.74 | 0.271 | $51.30^{f}$ |
| VII | 45-48 | 53.36 | 0.260 | 51.74 | 0.274 | 49.03 | 0.165 | $51.38^{f}$ |
| VIII | 49-52 | 53.01 | 0.322 | 51.80 | 0.213 | 48.65 | 0.113 | $51.15^{f}$ |
| Overall mean | 21-52 | $50.00^{A}$ | 0.395 | $48.87^{B}$ | 0.405 | $45.94^{C}$ | 0.333 | 48.27 |

Means bearing different superscripts differ significantly ($P<0.05$)

Table 14. Mean squares from ANOVA for period-wise egg weight in three strains of White Leghorn

| Source | df | MSS |
|---|---|---|
| Between strain | 2 | 140.096* |
| Between period | 7 | 195.643* |
| Between strain between period | 14 | 0.389 |
| Error | 69 | 0.570 |
| Total | 92 | |

* Significant (P<0.05)

weight increase to 52.04 g in the fifth period was slow. In the last three periods covering 41 to 52 weeks of age the mean egg weight was more or less similar and the values were 53.24, 53.36 and 53.01 g for the concerned periods, respectively. Overall period-wise mean egg weight in IWN strain was 50 g.

The mean egg weight in IWP strain at the first period was 41.42 g which was slightly lower than that of IWN strain. In the second period, 25 to 28 weeks of age, the mean egg weight in IWP strain was 44.39 g and there after a sharp increase in egg weight was observed during the third period. Third period mean egg weight (48.39 g) was found to be close to overall period-wise mean value (48.87 g) in IWP strain. Fourth period mean egg weight value (50.19 g) was higher than the overall mean. From fifth period mean egg weight was more or less same and the values were 51.14, 51.92, 51.74 and 51.8 g for fifth, sixth, seventh and eighth periods, respectively.

In control population, the mean egg weight for the first period was very low (37.73 g) as compared to IWN and IWP strains. A sharp increase in mean egg weight was observed in the second period. Third period mean egg weight (45.59 g) was close to overall mean (45.94 g) and fourth period mean (47.29) was higher than the overall mean. Period-wise mean egg weight values of 48.05, 48.74, 49.03 and 48.65 g were registered for the periods fifth, sixth, seventh and eighth, respectively.

Overall period-wise mean egg weight in control strain was lower than IWN and IWP strains.

Statistical analysis of period-wise mean egg weight (Table 14) showed a significant difference between the strains tested. Egg weight was significantly higher ($P<0.05$) in IWN strain and lower in control population. However, with regard to IWP strain the egg weight was medium and was significantly different from both IWN and CP. It was also revealed a statistically significant difference in overall period-wise mean egg weight. Significant increase ($P<0.05$) in period-wise egg weight was observed from I to V periods and thereafter it was statistically similar.

The period-wise mean egg weight comparison between strains is depicted in Fig.4.

## Weight of first egg

### IWN strain

The frequency distribution of weight of first egg in one gram increments as influenced by age at first egg (AFE) in respect of IWN strain is presented in Table 15. The weights of first egg ranged from 29.8 to 57.1 g indicating very wide variation with an overall mean of 39.13 g. Among the 95 pullets 40 birds laid their first eggs with the weight ranged from 29.8 to 37.9 g. Another 48 pullets laid eggs weighing

Fig.4 Period-wise mean egg weight comparison among three strains of White Leghorn

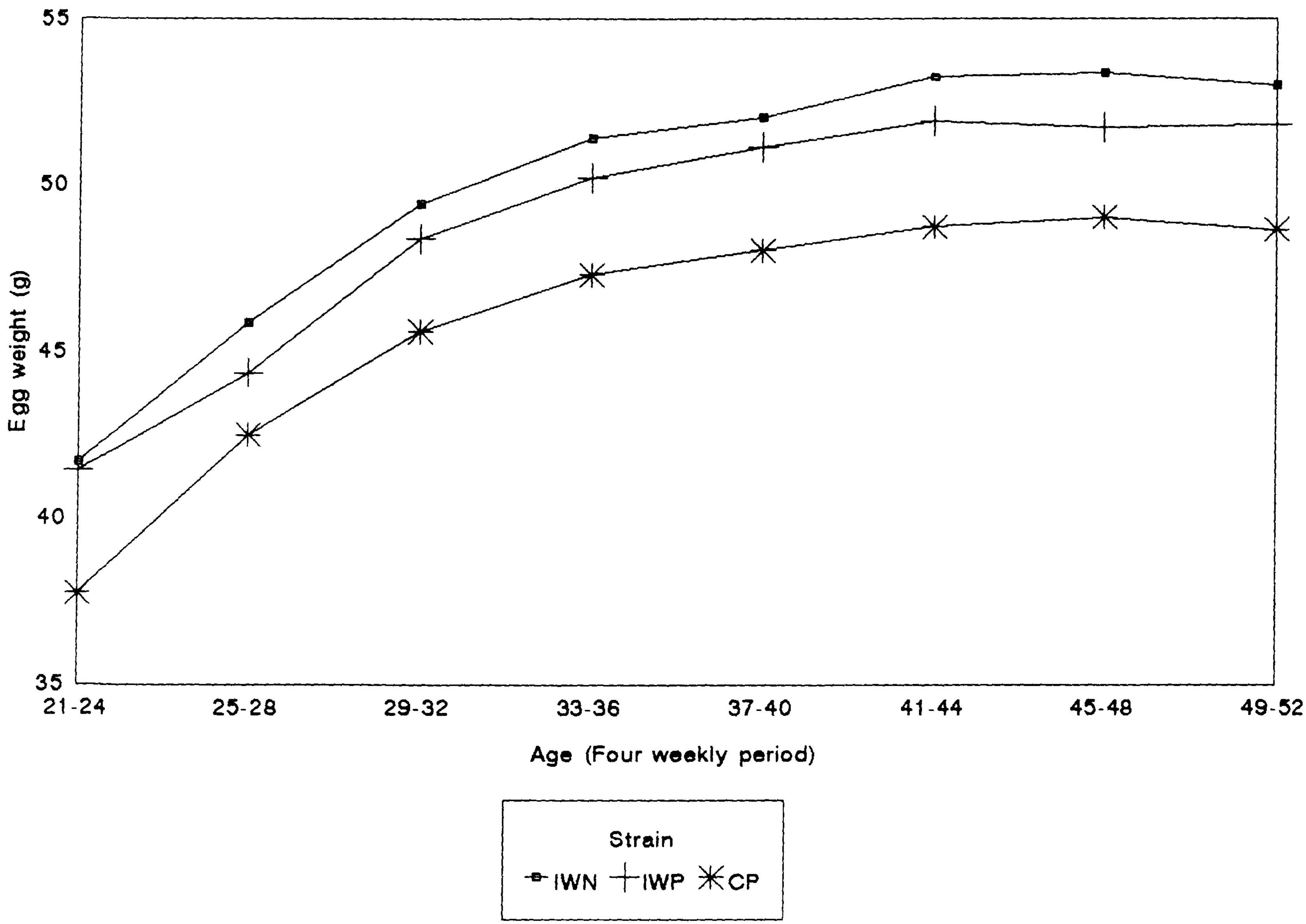


Table 15. Frequency distribution of first egg weight (g) as influenced by age of pullets (days) in IWN strain

| First egg weight range (g) | AFE in days/weeks | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 127-133<br>19 | 134-140<br>20 | 141-147<br>21 | 148-154<br>22 | 155-161<br>23 | 162-168<br>24 | |
| ≤29.9 | | | 1 | | | | 1 |
| 30-30.9 | | 1 | 1 | | | | 2 |
| 31-31.9 | | | 1 | | | | 1 |
| 32-32.9 | | 1 | 1 | 1 | | | 3 |
| 33-33.9 | 1 | 2 | 1 | 2 | 1 | | 7 |
| 34-34.9 | | | 2 | 1 | | | 3 |
| 35-35.9 | | | 3 | 2 | 1 | | 6 |
| 36-36.9 | | | 2 | 2 | 1 | | 5 |
| 37-37.9 | | 2 | 6 | 1 | 2 | 1 | 12 |
| 38-38.9 | | | 2 | 3 | 1 | | 6 |
| 39-39.9 | | 1 | 1 | 5 | 4 | 1 | 12 |
| 40-40.9 | | 2 | 3 | 4 | 4 | 2 | 15 |
| 41-41.9 | | | 1 | 2 | 1 | 1 | 5 |
| 42-42.9 | | | 1 | 1 | 1 | | 3 |
| 43-43.9 | | | 1 | 2 | | 2 | 5 |
| 44-44.9 | | | | 1 | 1 | | 2 |
| ≥45.0 | | 1 | 1 | 3 | 2 | | 7 |
| Total | 1 | 10 | 28 | 30 | 19 | 7 | 95 |

38.0 to 44.9 g range. Only seven pullets laid medium/large eggs in the range of 45.0 to 57.1 g. These results indicated that 92.63 per cent first eggs were smaller in size. It was also revealed that the age at first egg was distributed between 19 and 24 weeks of age.

**IWP strain**

The frequency distribution of weight of first egg in IWP strain is given in Table 16. The individual weights of eggs laid by 43 pullets ranged from 30.0 to 37.9 g and those laid by 38 pullets ranged from 38 to 44.9 g. Only 11 pullets laid their first eggs weighed 45.0 to 53.6 g. Thus, altogether 88.04 per cent of first eggs were smaller in size. It was also revealed that the ages at first egg were mainly at 19, 20 and 21 weeks of age. The weight of first egg ranged from 30.0 to 63.2 g with an overall mean of 38.69 g.

**Control population**

The frequency distribution of weight of first egg as influenced by age at first egg in control population is given in Table 17. The individual weights of eggs laid by 59 pullets ranged from 30.0 to 37.9 g and those of 32 pullets ranged from 38.0 to 44.9 g. Only 6 pullets laid eggs weighed above 45 g. It was also revealed that the ages at first egg were mainly from 20 to 24 weeks of age. However, 12.37 per cent pullets laid their first egg after 24 weeks of age. The

Table 16. Frequency distribution of first egg weight (g) as influenced by age of pullets (days) in IWP strain

| First egg weight range (g) | AFE in days/weeks | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 127-133<br>19 | 134-140<br>20 | 141-147<br>21 | 148-154<br>22 | 155-161<br>23 | 162-168<br>24 | |
| 30-30.9 | 4 | 2 | | | | | 6 |
| 31-31.9 | | 1 | | | | | 1 |
| 32-32.9 | | 2 | | | | | 2 |
| 33-33.9 | 2 | 4 | | | | | 6 |
| 34-34.9 | | 3 | | | | | 3 |
| 35-35.9 | | 5 | 2 | | | | 7 |
| 36-36.9 | 1 | 7 | 5 | | | | 13 |
| 37-37.9 | | 3 | 1 | | 1 | | 5 |
| 38-38.9 | 7 | 8 | 3 | | | | 18 |
| 39-39.9 | 1 | 4 | 3 | | | | 8 |
| 40-40.9 | 3 | 4 | | | | | 7 |
| 41-41.9 | | 1 | | | | | 1 |
| 42-42.9 | | 1 | | | | | 1 |
| 43-43.9 | | | | | | | |
| 44-44.9 | | 3 | | | | | 3 |
| ≥45 | 1 | 8 | 2 | | | | 11 |
| Total | 19 | 56 | 16 | | 1 | | 92 |

Table 17. Frequency distribution of first egg weight (g) as influenced by age of pullets (days) in control population

| First egg weight range (g) | AFE in days/weeks | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | 134-140<br>20 | 141-147<br>21 | 148-154<br>22 | 155-161<br>23 | 162-168<br>24 | ≥168 | |
| ≤29.9 | | 2 | | | | | 2 |
| 30-30.9 | 2 | | 1 | | | | 3 |
| 31-31.9 | 4 | 2 | 1 | 1 | | | 8 |
| 32-32.9 | 2 | 2 | 2 | 1 | 2 | | 9 |
| 33-33.9 | 2 | 6 | | 2 | | | 10 |
| 34-34.9 | | 1 | 1 | 1 | | | 3 |
| 35-35.9 | 1 | 3 | 3 | 1 | | | 8 |
| 36-36.9 | 1 | 1 | 2 | 1 | 2 | | 7 |
| 37-37.9 | | | 2 | 4 | | 3 | 9 |
| 38-38.9 | | 1 | 2 | 2 | 1 | | 6 |
| 39-39.9 | | | 2 | 2 | 1 | 1 | 6 |
| 40-40.9 | | | 3 | 2 | 2 | 2 | 9 |
| 41-41.9 | | 1 | | | | | 1 |
| 42-42.9 | | | 1 | 1 | | 2 | 4 |
| 43-43.9 | | 1 | | 1 | 1 | 2 | 5 |
| 44-44.9 | | | | | 1 | | 1 |
| ≥45 | | | 2 | | 2 | 2 | 6 |
| Total | 12 | 20 | 22 | 19 | 12 | 12 | 97 |

weight of first egg ranged from 29.7 to 51.0 g with an overall mean of 36.40 g.

## Egg weight gain

The mean weekly gain in egg weight in three strains viz., IWN, IWP and CP from 20 to 52 weeks of age is shown in Table 18.

### IWN strain

In IWN strain the weekly gains were at a higher rate upto 22 weeks of age. At 20 , 21 and 22 weeks, the gains were 3.43, 3.69 and 2.81 g, respectively. The egg weight gains at 23, 24 and 25 weeks were also moderately high and the mean values were 0.92, 1.55 and 1.45 g, respectively. Such higher gains were also exhibited during 29, 30, 32 and 39 weeks of age. The gain was also high (1.39 g) at 43 weeks of age. In the other weeks the gains ranged either from 0.33 to 0.74 g or loss in egg weight from -0.95 to -0.32 g per week. After adjusting all the negative gains, the net gain from 20 to 52 weeks of age was 20.5 g over a total laying period of 34 weeks.

### IWP strain

In IWP strain, although the gain in egg weight was low at 20 weeks (0.86 g) it was fairly high at 21 and 22 weeks of age

Table 18. Weekly mean gain in egg weight (g) from 20 to 52 weeks of age in three strains of White Leghorn

| Age in weeks | Strain code IWN | IWP | CP |
|---|---|---|---|
| 19 EW | 31.60 | 36.16 | 30.10 |
| 20 | 3.43 | 0.86 | 2.87 |
| 21 | 3.69 | 1.97 | 2.72 |
| 22 | 2.81 | 2.18 | 1.78 |
| 23 | 0.92 | 0.94 | -0.03 |
| 24 | 1.55 | 1.30 | 2.86 |
| 25 | 1.45 | -0.06 | 1.48 |
| 26 | 0.57 | 0.10 | 0.62 |
| 27 | -0.39 | 1.02 | 0.00 |
| 28 | 0.61 | 1.63 | 0.93 |
| 29 | 2.03 | 0.89 | 1.30 |
| 30 | 1.48 | 1.01 | 0.62 |
| 31 | -0.48 | 1.17 | 0.67 |
| 32 | 1.13 | 0.23 | 0.64 |
| 33 | 0.68 | 0.31 | 0.23 |
| 34 | 0.55 | 0.08 | 0.08 |
| 35 | -0.36 | 0.88 | 0.99 |
| 36 | 0.35 | -0.07 | -0.24 |
| 37 | -0.40 | 0.28 | 0.14 |
| 38 | 0.47 | 0.09 | 0.62 |
| 39 | 1.17 | 0.28 | -0.12 |
| 40 | -0.48 | 0.19 | -0.48 |
| 41 | 0.57 | 0.17 | 0.16 |
| 42 | -0.54 | 0.20 | 1.09 |
| 43 | 1.39 | 0.83 | 0.07 |
| 44 | 0.00 | -1.01 | -0.20 |
| 45 | -0.32 | -0.21 | -0.22 |
| 46 | -0.82 | 0.05 | 0.55 |
| 47 | 0.74 | 1.09 | 0.15 |
| 48 | 0.51 | -1.05 | -0.55 |
| 49 | -0.64 | 0.79 | -0.09 |
| 50 | 0.33 | -0.90 | -0.37 |
| 51 | -0.55 | 0.60 | 0.21 |
| 52 | -0.95 | -0.51 | 0.32 |
| Overall gain | 20.50 | 15.33 | 18.80 |

(1.97 and 2.18 g). The increase in egg weight was moderately high at 27 and 28 weeks of age (1.02 and 1.63 g). The gain at 30 and 31 weeks of age was also higher (1.01 and 1.17 g). At 47 weeks mean gain was 1.09 g. In all other weeks, the weekly gains ranged between 0.60 to 0.79 g and the losses whenever registered ranged between -1.05 to -0.51 g. After adjusting the negative gains the overall net gain was 15.33 g per egg in IWP strain which was 5.17 g lesser than that in IWN strain.

**Control population**

The mean gain in egg weight was high upto 22 weeks of age in the order of 2.87, 2.72 and 1.78 g per week. The gain at 23 weeks of age was negative. The gain in egg weight at 24 and 25 weeks of age were 2.86 and 1.48 g, respectively and later on the weekly gains were positive upto 35 weeks of age. At 42 weeks of age a higher gain in egg weight of 1.09 g was observed. After adjusting the negative gain the overall mean net gain in egg weight in control population was 18.8 g which was 1.70 g lesser than IWN strain but 3.47 g more than IWP strain.

## Per cent variation in weekly mean egg weight

Per cent variation in relation with weekly mean egg weight as influenced by age in the three strains are set out in Table 19. The higher per cent variation in weekly egg

Table 19. Per cent variation in weekly mean egg weight as influenced by age in three strains of White Leghorn

| Age in weeks | | Strain code IWN | IWP | CP |
|---|---|---|---|---|
| | 19 EW | 31.60 | 36.16 | 30.10 |
| 20 | | 10.85 | 2.38 | 9.53 |
| 21 | | 10.53 | 5.32 | 8.25 |
| 22 | | 7.26 | 5.59 | 4.99 |
| 23 | | 2.22 | 2.28 | -0.08 |
| 24 | | 3.65 | 3.09 | 7.64 |
| 25 | | 3.39 | -0.14 | 3.67 |
| 26 | | 1.25 | 0.23 | 1.48 |
| 27 | | -0.85 | 2.35 | 0.00 |
| 28 | | 1.34 | 3.67 | 2.19 |
| 29 | | 4.31 | 1.93 | 3.00 |
| 30 | | 3.07 | 2.15 | 1.39 |
| 31 | | -0.96 | 2.44 | 1.48 |
| 32 | | 2.29 | 0.47 | 1.39 |
| 33 | | 1.35 | 0.63 | 0.49 |
| 34 | | 1.08 | 0.16 | 0.17 |
| 35 | | -0.70 | 1.77 | 2.11 |
| 36 | | 0.68 | -0.14 | -0.50 |
| 37 | | -0.77 | 0.55 | 0.29 |
| 38 | | 0.92 | 0.18 | 1.30 |
| 39 | | 2.26 | 0.55 | -0.25 |
| 40 | | -0.91 | 0.37 | -1.00 |
| 41 | | 1.09 | 0.33 | 0.33 |
| 42 | | -1.02 | 0.39 | 2.27 |
| 43 | | 2.65 | 1.60 | 0.14 |
| 44 | | 0.00 | -1.92 | -0.41 |
| 45 | | -0.59 | -0.41 | -0.44 |
| 46 | | -1.53 | 0.10 | 1.13 |
| 47 | | 1.41 | 2.12 | 0.30 |
| 48 | | 0.96 | -2.00 | -1.11 |
| 49 | | -1.19 | 1.53 | -0.18 |
| 50 | | 0.62 | -0.17 | -0.76 |
| 51 | | -1.03 | 1.17 | 0.43 |
| 52 | | -1.79 | -0.98 | 0.66 |
| | 52 EW | 52.10 | 51.49 | 48.90 |

weight was noticed at 20 weeks of age in case of IWN (10.85 per cent) and control population (9.53 per cent). With respect to IWP strain it was at 22 weeks of age (5.59 per cent). In IWN strain the first decline in egg weight was noticed at 27 weeks of age (0.85 per cent) whereas it was at 25 weeks of age in IWP (0.14 per cent) and 23 weeks of age in CP (0.08 per cent). At 44 weeks of age no variation in egg weight could be observed in IWN strain while in IWP and control population, there was decline in the per cent egg weight. It was observed a maximum reduction of 1.79 per cent at 52 weeks in IWN strain. However in IWP and control population, the maximum per cent reduction in egg weight was observed at 48 weeks of age, with values 2.0 and 1.11 respectively.

**Magnitude of variation in mean egg weight in comparison with CP**

Magnitude of variation in weekly mean egg weight in comparison with the control population is shown in Table 20. As compared with CP, the pullets in the IWN and IWP strains laid heavier eggs from 19 to 52 weeks of age. The egg weight of IWN and IWP pullets were heavier at 19 and 20 weeks of age in comparison with CP. It was 6.06 and 4.05 g more in IWP strain than CP at 19 and 20 weeks of age, respectively. The corresponding values in IWN strain during the same period were 1.50 and 2.06 g, respectively. From 21 to 24 weeks of age

Table 20. The magnitude of variation in weekly mean egg weight (g) in IWN and IWP strains in comparison with the control population (CP)

| Age in weeks | Strain code IWN | IWP | CP |
|---|---|---|---|
| 19 | 1.50 | 6.06 | 30.10 |
| 20 | 2.06 | 4.05 | 32.97 |
| 21 | 3.03 | 3.30 | 35.69 |
| 22 | 4.06 | 3.70 | 37.47 |
| 23 | 5.01 | 4.67 | 37.44 |
| 24 | 3.70 | 3.11 | 40.30 |
| 25 | 3.67 | 1.57 | 41.78 |
| 26 | 3.62 | 1.05 | 42.40 |
| 27 | 3.23 | 2.07 | 42.40 |
| 28 | 2.91 | 2.77 | 43.33 |
| 29 | 3.64 | 2.36 | 44.63 |
| 30 | 4.50 | 2.75 | 45.25 |
| 31 | 3.35 | 3.25 | 45.92 |
| 32 | 3.84 | 2.84 | 46.56 |
| 33 | 4.29 | 2.92 | 46.79 |
| 34 | 4.76 | 2.92 | 46.87 |
| 35 | 3.41 | 2.81 | 47.86 |
| 36 | 4.00 | 2.98 | 47.62 |
| 37 | 3.46 | 3.12 | 47.76 |
| 38 | 3.31 | 2.59 | 48.38 |
| 39 | 4.60 | 2.99 | 48.26 |
| 40 | 4.60 | 3.66 | 47.78 |
| 41 | 5.01 | 3.67 | 47.94 |
| 42 | 3.38 | 2.78 | 49.03 |
| 43 | 4.70 | 3.54 | 49.10 |
| 44 | 4.90 | 2.73 | 48.90 |
| 45 | 4.80 | 2.74 | 48.68 |
| 46 | 3.43 | 2.24 | 49.23 |
| 47 | 4.02 | 3.18 | 49.38 |
| 48 | 5.08 | 2.68 | 48.83 |
| 49 | 4.53 | 3.56 | 48.74 |
| 50 | 5.23 | 3.03 | 48.37 |
| 51 | 4.47 | 3.42 | 48.58 |
| 52 | 3.20 | 2.59 | 48.90 |

the magnitude of variation in mean egg weight in IWN and IWP strains were comparable. From 25 to 52 weeks of age, the IWN pullets laid heavier eggs than IWP pullets in comparison with control population.

## Classification of egg weight

A total number of 45317 eggs obtained from the three strains during the period of study were distributed in six different classes based on weight as very small (<=37.9 g), small (38-44.9 g), medium (45-49.9 g), standard medium (50-52.9 g), large (53-59.9 g) and extra large (>=60 g).

The per cent distribution of eggs under different weight classes in the three strains is given in Table 21.

The maximum number of eggs (32.08 per cent) in IWN strain falls under large class and lowest number of eggs (1.15 per cent) in very small class. In IWP strain, maximum number (35.66 per cent) comes under medium class and lowest number of eggs (2.41 per cent) under extra large class. While in control population, maximum number of eggs (39.71 per cent) belonged to medium class and lowest number of eggs under extra large (0.28 per cent) class, when eggs under the medium and standard medium were pooled, this class formed the major category in all strains.

Table 21. Per cent distribution of eggs under different weight classes in three strains of White Leghorn

| Egg weight classes | Egg weight range (g) | Strain code | | | Overall mean |
|---|---|---|---|---|---|
| | | IWN | IWP | CP | |
| Very small | $\leq$ 37.9 | 1.15 (179) | 2.68 (386) | 4.15 (636) | 2.65 (1201) |
| Small | 38-44.9 | 12.66 (1973) | 19.53 (2812) | 31.91 (4893) | 21.35 (9678) |
| Medium | 45-49.9 | 26.78 (4174) | 35.66 (5135) | 39.71 (6089) | 33.98 (15398) |
| Standard medium | 50-52.9 | 25.25 (3935) | 20.18 (2906) | 15.14 (2321) | 20.22 (9162) |
| Large | 53-59.9 | 32.08 (4999) | 19.54 (2814) | 8.81 (1351) | 20.22 (9164) |
| Extra large | $\geq$ 60 | 2.08 (324) | 2.41 (347) | 0.28 (43) | 1.58 (714) |
| Total | | 100 (15584) | 100 (14400) | 100 (15333) | 100 (45317) |

Note: Figures in parenthesis indicate number of eggs weighed

In the pooled population medium class (33.98 per cent) forms the highest per cent distribution of egg weight and lowest per cent distribution was observed to be extra large (1.58 per cent).

The per cent distribution of eggs under different weight classes in the three strains viz., IWN, IWP and CP is depicted in Fig.5.

The overall egg weight profile viz., mean egg weight, mean gain in egg weight and per cent gain in egg weight from 19 to 52 weeks of age in IWN, IWP and control population are presented in Tables 22, 23 and 24, respectively.

## Correlation matrix

### Egg weight and body weight

Correlation between egg weight and body weight in three strains of White Leghorn is shown in Table 25.

The first egg weight was negatively correlated with 20 week body weight with values of -0.004, -0.109 and -0.151 in IWN, IWP and control population, respectively but these correlation values were non-significant. Significant positive correlation was obtained between 40 week egg weight with 20 and 40 week body weights in IWN strain. No significant correlation could be observed in IWP strain between 40 week

Fig.5 Per cent distribution of egg weight classes in three strains of White Leghorn

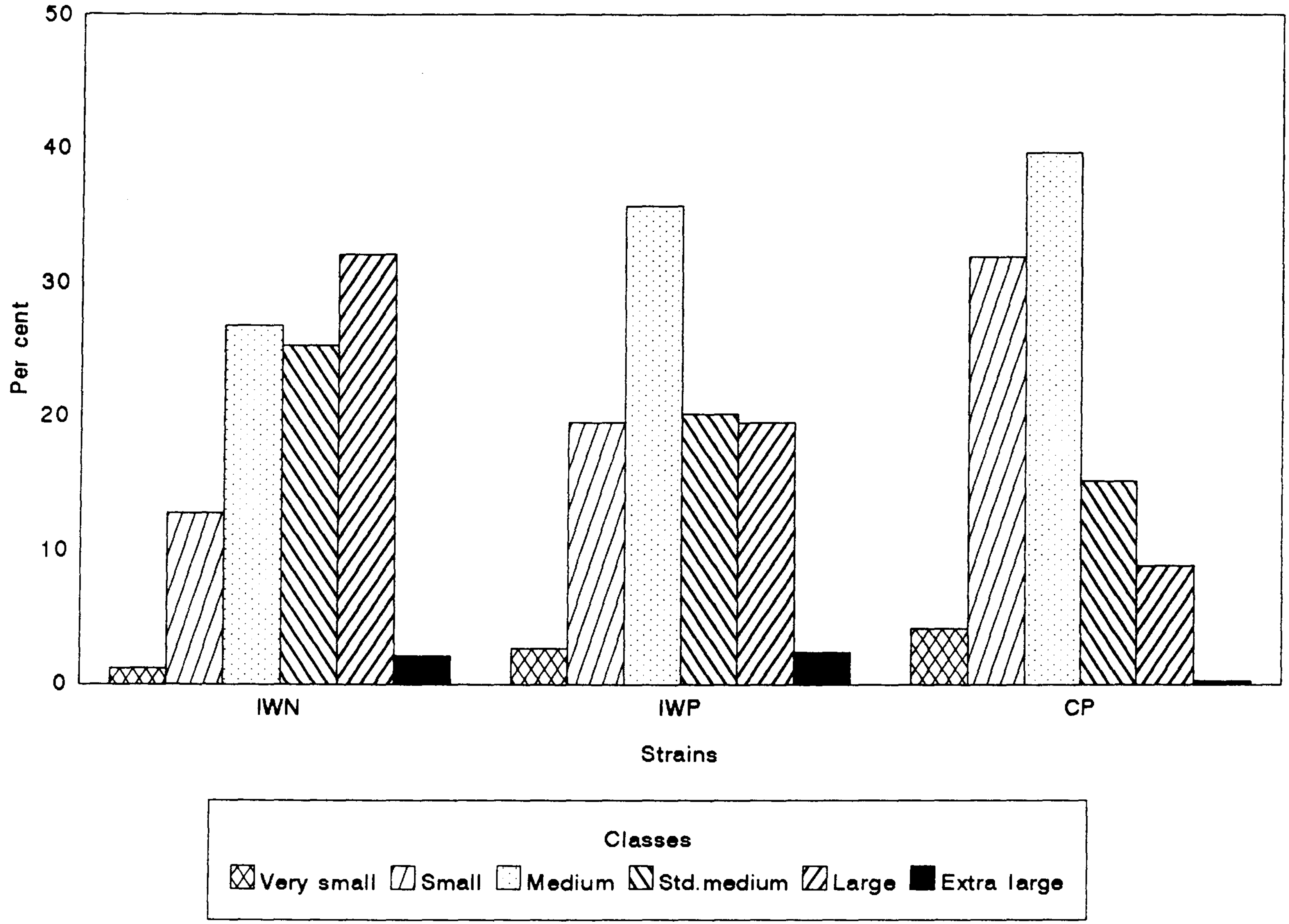


Table 22. Summary of egg weight profile from 19 to 52 weeks of age in IWN strain of White Leghorn

| Age in weeks | No. of hens involved | No. of eggs weighed | Mean EW | | Mean gain in EW | Per cent gain in EW |
|---|---|---|---|---|---|---|
| | | | $\bar{X}$ | SE | | |
| 19 | 2 | 2 | 31.60 | 1.060 | | |
| 20 | 10 | 24 | 35.03 | 0.986 | 3.43 | 10.85 |
| 21 | 38 | 124 | 38.72 | 0.525 | 3.69 | 10.53 |
| 22 | 68 | 296 | 41.53 | 0.534 | 2.81 | 7.26 |
| 23 | 85 | 444 | 42.45 | 0.358 | 0.92 | 2.22 |
| 24 | 90 | 507 | 44.00 | 0.306 | 1.55 | 3.65 |
| 25 | 94 | 532 | 45.45 | 0.308 | 1.45 | 3.39 |
| 26 | 94 | 516 | 46.02 | 0.256 | 0.57 | 1.25 |
| 27 | 93 | 473 | 45.63 | 0.301 | -0.39 | -0.85 |
| 28 | 93 | 482 | 46.24 | 0.340 | 0.61 | 1.34 |
| 29 | 94 | 562 | 48.27 | 0.307 | 2.03 | 4.31 |
| 30 | 94 | 542 | 49.75 | 0.344 | 1.48 | 3.07 |
| 31 | 92 | 508 | 49.27 | 0.320 | -0.48 | -0.96 |
| 32 | 93 | 510 | 50.40 | 0.309 | 1.13 | 2.29 |
| 33 | 94 | 552 | 51.08 | 0.345 | 0.68 | 1.35 |
| 34 | 93 | 559 | 51.63 | 0.323 | 0.55 | 1.08 |
| 35 | 93 | 533 | 51.27 | 0.395 | -0.36 | -0.70 |
| 36 | 94 | 551 | 51.62 | 0.320 | 0.35 | 0.68 |
| 37 | 94 | 501 | 51.22 | 0.403 | -0.40 | -0.77 |
| 38 | 94 | 509 | 51.69 | 0.309 | 0.47 | 0.92 |
| 39 | 94 | 543 | 52.86 | 0.337 | 1.17 | 2.26 |
| 40 | 94 | 525 | 52.38 | 0.357 | -0.48 | -0.91 |
| 41 | 92 | 477 | 52.95 | 0.329 | 0.57 | 1.09 |
| 42 | 92 | 503 | 52.41 | 0.403 | -0.54 | -1.02 |
| 43 | 91 | 480 | 53.80 | 0.336 | 1.39 | 2.65 |
| 44 | 94 | 502 | 53.80 | 0.333 | 0.00 | 0.00 |
| 45 | 92 | 477 | 53.48 | 0.305 | -0.32 | -0.59 |
| 46 | 94 | 470 | 52.66 | 0.352 | -0.82 | -1.53 |
| 47 | 94 | 458 | 53.40 | 0.377 | 0.74 | 1.41 |
| 48 | 94 | 499 | 53.91 | 0.307 | 0.51 | 0.96 |
| 49 | 94 | 482 | 53.27 | 0.342 | -0.64 | -1.19 |
| 50 | 93 | 481 | 53.60 | 0.329 | 0.33 | 0.62 |
| 51 | 94 | 478 | 53.05 | 0.327 | -0.55 | -1.03 |
| 52 | 93 | 482 | 52.10 | 0.390 | -0.95 | -1.79 |

Table 23. Summary of egg weight profile from 19 to 52 weeks of age in IWP strain of White Leghorn

| Age in weeks | No. of hens involved | No. of eggs weighed | Mean EW | | Mean gain in EW | Per cent gain in EW |
|---|---|---|---|---|---|---|
| | | | $\bar{X}$ | Se | | |
| 19 | 19 | 43 | 36.16 | 0.834 | | |
| 20 | 77 | 211 | 37.02 | 0.766 | 0.86 | 2.38 |
| 21 | 85 | 369 | 38.99 | 0.764 | 1.97 | 5.32 |
| 22 | 89 | 457 | 41.17 | 0.315 | 2.18 | 5.59 |
| 23 | 88 | 468 | 42.11 | 0.421 | 0.94 | 2.28 |
| 24 | 89 | 458 | 43.41 | 0.337 | 1.30 | 3.09 |
| 25 | 90 | 462 | 43.35 | 0.600 | -0.06 | -0.14 |
| 26 | 89 | 357 | 43.45 | 0.497 | 0.10 | 0.23 |
| 27 | 85 | 428 | 44.47 | 0.332 | 1.02 | 2.35 |
| 28 | 88 | 456 | 46.10 | 0.307 | 1.63 | 3.67 |
| 29 | 89 | 457 | 46.99 | 0.346 | 0.89 | 1.93 |
| 30 | 86 | 448 | 48.00 | 0.388 | 1.01 | 2.15 |
| 31 | 86 | 431 | 49.17 | 0.295 | 1.17 | 2.44 |
| 32 | 88 | 492 | 49.40 | 0.655 | 0.23 | 0.47 |
| 33 | 92 | 522 | 49.71 | 0.317 | 0.31 | 0.63 |
| 34 | 92 | 534 | 49.79 | 0.304 | 0.08 | 0.16 |
| 35 | 90 | 513 | 50.67 | 0.465 | 0.88 | 1.77 |
| 36 | 89 | 488 | 50.60 | 0.345 | -0.07 | -0.14 |
| 37 | 90 | 455 | 50.88 | 0.313 | 0.28 | 0.55 |
| 38 | 89 | 483 | 50.97 | 0.438 | 0.09 | 0.18 |
| 39 | 89 | 466 | 51.25 | 0.428 | 0.28 | 0.55 |
| 40 | 89 | 417 | 51.44 | 0.410 | 0.19 | 0.37 |
| 41 | 89 | 441 | 51.61 | 0.380 | 0.17 | 0.33 |
| 42 | 86 | 413 | 51.81 | 0.522 | 0.20 | 0.39 |
| 43 | 85 | 415 | 52.64 | 0.352 | 0.83 | 1.60 |
| 44 | 84 | 413 | 51.63 | 0.431 | -1.01 | -1.92 |
| 45 | 84 | 394 | 51.42 | 0.549 | -0.21 | -0.41 |
| 46 | 88 | 431 | 51.47 | 0.517 | 0.05 | 0.10 |
| 47 | 87 | 407 | 52.56 | 0.413 | 1.09 | 2.12 |
| 48 | 84 | 422 | 51.51 | 0.411 | -1.05 | -2.00 |
| 49 | 87 | 404 | 52.30 | 0.386 | 0.79 | 1.53 |
| 50 | 86 | 433 | 51.40 | 0.372 | -0.09 | -0.17 |
| 51 | 85 | 406 | 52.00 | 0.396 | 0.60 | 1.17 |
| 52 | 86 | 406 | 51.49 | 0.446 | -0.51 | -0.98 |

Table 24. Summary of egg weight profile from 19 to 52 weeks of age in control population of White Leghorn

| Age in weeks | No. of hens involved | No. of eggs weighed | Mean EW $\bar{X}$ | Mean EW SE | Mean gain in EW | Per cent gain in EW |
|---|---|---|---|---|---|---|
| 19 | 1 | 1 | 30.10 | 0.000 | | |
| 20 | 11 | 23 | 32.97 | 0.558 | 2.87 | 9.53 |
| 21 | 25 | 82 | 35.69 | 0.424 | 2.72 | 8.25 |
| 22 | 51 | 182 | 37.47 | 0.476 | 1.78 | 4.99 |
| 23 | 72 | 323 | 37.44 | 0.911 | -0.03 | -0.08 |
| 24 | 83 | 454 | 40.30 | 0.306 | 2.86 | 7.64 |
| 25 | 92 | 531 | 41.78 | 0.276 | 1.48 | 3.67 |
| 26 | 93 | 484 | 42.40 | 0.303 | 0.62 | 1.48 |
| 27 | 94 | 520 | 42.40 | 0.301 | 0.00 | 0.00 |
| 28 | 94 | 544 | 43.33 | 0.304 | 0.93 | 2.19 |
| 29 | 96 | 547 | 44.63 | 0.318 | 1.30 | 3.00 |
| 30 | 95 | 519 | 45.25 | 0.331 | 0.62 | 1.39 |
| 31 | 92 | 511 | 45.92 | 0.325 | 0.67 | 1.48 |
| 32 | 96 | 542 | 46.56 | 0.406 | 0.64 | 1.39 |
| 33 | 96 | 579 | 46.79 | 0.295 | 0.23 | 0.49 |
| 34 | 97 | 547 | 46.87 | 0.317 | 0.08 | 0.17 |
| 35 | 97 | 554 | 47.86 | 0.339 | 0.99 | 2.11 |
| 36 | 97 | 554 | 47.62 | 0.338 | -0.24 | -0.50 |
| 37 | 96 | 508 | 47.76 | 0.316 | 0.14 | 0.29 |
| 38 | 97 | 524 | 48.38 | 0.328 | 0.62 | 1.30 |
| 39 | 95 | 481 | 48.26 | 0.343 | -0.12 | -0.25 |
| 40 | 95 | 436 | 47.78 | 0.494 | -0.48 | -1.00 |
| 41 | 94 | 480 | 47.94 | 0.373 | 0.16 | 0.33 |
| 42 | 93 | 461 | 49.03 | 0.342 | 1.09 | 2.27 |
| 43 | 96 | 506 | 49.10 | 0.356 | 0.07 | 0.14 |
| 44 | 97 | 504 | 48.90 | 0.349 | -0.20 | -0.41 |
| 45 | 97 | 454 | 48.68 | 0.368 | -0.22 | -0.44 |
| 46 | 97 | 485 | 49.23 | 0.394 | 0.55 | 1.13 |
| 47 | 96 | 496 | 49.38 | 0.412 | 0.15 | 0.30 |
| 48 | 97 | 512 | 48.83 | 0.364 | -0.55 | -1.11 |
| 49 | 97 | 502 | 48.74 | 0.353 | -0.09 | -0.18 |
| 50 | 97 | 502 | 48.37 | 0.367 | -0.37 | -0.76 |
| 51 | 97 | 492 | 48.58 | 0.398 | 0.21 | 0.43 |
| 52 | 97 | 493 | 48.90 | 0.362 | 0.32 | 0.66 |

Table 25. Correlation matrix between egg weight and body weights in three strains of White Leghorn

| Egg weight (age in weeks) | Strain code | | | | | |
|---|---|---|---|---|---|---|
| | I WN | | I WP | | CP | |
| | BW 20 | BW 40 | BW 20 | BW 40 | BW20 | BW40 |
| FEW | -0.004 | 0.082 | -0.109 | -0.118 | -0.151 | 0.186 |
| 24 | 0.066 | -0.002 | 0.023 | 0.020 | 0.378** | 0.185 |
| 28 | 0.067 | 0.206* | -0.049 | 0.013 | 0.263* | 0.220* |
| 32 | 0.058 | 0.183 | 0.018 | 0.044 | -0.048 | 0.000 |
| 36 | 0.103 | 0.187 | -0.011 | 0.050 | 0.089 | 0.235* |
| 40 | 0.272** | 0.240* | 0.007 | 0.114 | 0.265* | 0.253* |
| 44 | 0.167 | 0.114 | -0.162 | 0.012 | 0.072 | 0.266* |
| 48 | 0.160 | 0.238* | 0.035 | 0.183 | 0.216* | 0.260* |
| 52 | 0.145 | 0.275** | -0.025 | -0.007 | 0.136 | 0.182 |

** Significant (P<0.01)
* Significant (P<0.05)

egg weight and body weight at 20 and 40 weeks of age. Significant correlations were also noticed between body weight at 40 week and egg weights at 48 and 52 weeks in IWN strain. In control population, significant positive correlation was observed in egg weights at 24, 28, 40 and 48 weeks with body weight at 20 weeks whereas the body weight at 40 weeks was significantly correlated with egg weights at 28, 36, 40, 44 and 48 weeks of age.

**Between egg weights**

Correlation between egg weights in IWN, IWP and control population are presented in Tables 26, 27 and 28, respectively.

**IWN strain**

No significant correlation could be observed between FEW and egg weights from 24 to 52 weeks of age. Significant correlation was obtained between egg weight at 24 and 36 weeks. The 28 and 32 weeks egg weights were significantly correlated with egg weights from 36 to 52 weeks except at 40 week. High positive correlations were observed in egg weight at 36 weeks of age with egg weights at 40, 44, 48 and 52 weeks of age (Table 26).

Table 26. Correlation matrix between weekly egg weightsin IWN strain of White Leghorn

| Egg weight (age in weeks) | Egg w eight (age in weeks) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FEW | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 |
| 24 | -0.01 | 1.00 | | | | | | | |
| 28 | 0.10 | 0.14 | 1.00 | | | | | | |
| 32 | 0.09 | 0.01 | 0.16 | 1.00 | | | | | |
| 36 | 0.07 | 0.24* | 0.29** | 0.26* | 1.00 | | | | |
| 40 | 0.08 | 0.01 | 0.14 | 0.15 | 0.42** | 1.00 | | | |
| 44 | -0.04 | 0.02 | 0.25* | 0.25* | 0.56** | 0.54** | 1.00 | | |
| 48 | 0.05 | 0.11 | 0.38** | 0.38** | 0.76** | 0.45** | 0.60** | 1.00 | |
| 52 | -0.11 | 0.08 | 0.37** | 0.23* | 0.65** | 0.39** | 0.53** | 0.77* | 1.00 |

Table 27. Correlation matrix between weekly egg weights in IWP strain of White Leghorn

| Egg weight (age in weeks) | Egg weight (age in weeks) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FEW | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 |
| 24 | 0.33** | 1.00 | | | | | | | |
| 28 | 0.40** | 0.51** | 1.00 | | | | | | |
| 32 | 0.21* | 0.42** | 0.36** | 1.00 | | | | | |
| 36 | 0.46** | 0.71** | 0.64** | 0.60** | 1.00 | | | | |
| 40 | 0.31** | 0.42** | 0.43** | 0.37** | 0.63** | 1.00 | | | |
| 44 | 0.12 | -0.003 | 0.01 | 0.02 | -0.002 | 0.016 | 1.00 | | |
| 48 | 0.004 | 0.01 | -0.02 | -0.04 | -0.02 | 0.023 | 0.47** | 1.00 | |
| 52 | -0.003 | 0.03 | 0.04 | 0.01 | 0.03 | 0.05 | 0.29** | 0.31* | 1.00 |

** Significant ($P<0.01$)
* Significant ($P<0.05$)

Significant correlation were obtained between egg weights from 40 to 48 weeks with succeeding weekly egg weights upto 52 weeks of age.

**IWP strain**

Significant positive correlations were observed in IWP strain between FEW with egg weights at 24, 28, 36 and 40 weeks of age (Table 27). Significant positive correlation was observed among egg weights from 28 to 40 weeks of age and also between egg weight at 44 weeks with the values at 48 and 52 weeks of age. No significant correlation was observed in egg weights from 24 to 40 weeks with egg weights from 44 to 52 weeks of age.

**Control population**

Significant negative correlation was observed in egg weight at 24 weeks with first egg weight. Positive correlation were obtained between first egg weight and egg weights from 36 to 52 weeks except 40 week. Significant positive correlation could be observed in egg weight at 28 week with egg weights from 36 to 52 weeks of age (Table 28). Similarly, significant positive correlation was seen among egg weights from 36 to 52 weeks with egg weights from 40 to 52 weeks of age. The egg weights at 40, 44 and 48 weeks of age were significantly correlated with the succeeding egg weights upto 52 weeks of age.

Table 28. Correlation matrix between weekly egg weights in control population (CP) of White Leghorn

| Egg weight (age in weeks) | Egg weight (age in weeks) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FEW | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 |
| 24 | -0.25* | 1.00 | | | | | | | |
| 28 | 0.11 | 0.16 | 1.00 | | | | | | |
| 32 | 0.04 | -0.09 | 0.10 | 1.00 | | | | | |
| 36 | 0.41** | 0.01 | 0.44** | 0.13 | 1.00 | | | | |
| 40 | 0.06 | 0.27** | 0.26** | 0.04 | 0.44** | 1.00 | | | |
| 44 | 0.35** | -0.03 | 0.42** | 0.27** | 0.87** | 0.35** | 1.00 | | |
| 48 | 0.32** | 0.08 | 0.47** | 0.16 | 0.86** | 0.44** | 0.83** | 1.00 | |
| 52 | 0.34** | 0.03 | 0.50** | 0.24* | 0.79** | 0.38** | 0.78** | 0.85** | 1.00 |

** Significant (P<0.01)
* Significant (P<0.05)

**Egg weight and egg number**

Correlation between egg weight and egg number in IWN, IWP and control population are given in Tables 29, 30 and 31 respectively.

In IWN strain, significant positive correlation was observed at 24 week egg weight with 24 to 52 weeks egg number. Significant negative correlation was found between 36 weeks egg weight with 32 to 52 weeks egg number. In general, 36 to 52 weeks egg weights were negatively correlated with 24 to 52 weeks egg number.

In IWP strain, significant positive correlation was observed between 44 weeks egg weight with 44, 48 and 52 weeks egg number. A significant negative correlation was observed at 24 weeks egg weight with egg number from 32 to 52 weeks of age. Similarly, significant negative correlation was seen at 36 weeks egg weight with egg number from 24 to 52 weeks of age.

In control population, significant positive correlation values were obtained between 24 weeks egg weight with egg number from 24 to 52 weeks of age. Whereas, significant negative correlation was observed between first egg weight with egg number from 24 to 52 weeks of age. in general, significant negative correlation was observed from 36 and 44

Table 29. Correlation matrix between egg number and weekly egg weight in IWN strain of White Leghorn

| Egg number (age in weeks) | Egg weight (age in weeks) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FEW | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 |
| 24 | -0.26 | 0.42** | 0.08 | -0.07 | -0.11 | -0.001 | 0.07 | 0.13 | -0.15 |
| 28 | -0.20 | 0.43** | 0.22* | -0.09 | -0.20 | -0.06 | 0.02 | -0.17 | -0.20 |
| 32 | -0.10 | 0.42** | 0.24* | 0.07 | -0.22* | -0.07 | -0.01 | -0.17 | -0.19 |
| 36 | -0.06 | 0.45** | 0.23* | 0.15 | -0.21* | -0.09 | -0.04 | -0.17 | -0.18 |
| 40 | -0.01 | 0.38** | 0.25* | 0.18 | -0.22* | -0.08 | -0.06 | -0.15 | -0.17 |
| 44 | -0.01 | 0.31** | 0.19 | 0.18 | -0.25* | -0.08 | -0.08 | -0.18 | -0.21 |
| 48 | 0.03 | 0.29** | 0.18 | 0.18 | -0.26* | -0.10 | -0.10 | -0.19 | -0.20 |
| 52 | 0.05 | 0.26* | 0.17 | 0.18 | -0.25* | -0.09 | -0.11 | -0.18 | -0.18 |

Table 30. Correlation matrix between egg number and weekly egg weights in IWP strain of White Leghorn

| Egg number (age in weeks | Egg weight (age in weeks) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FEW | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 |
| 24 | 0.022 | -0.04 | -0.21 | -0.18 | -0.23* | -0.18 | 0.05 | 0.03 | -0.07 |
| 28 | -0.02 | -0.10 | -0.06 | -0.22* | -0.32** | -0.28* | 0.08 | 0.02 | -0.02 |
| 32 | 0.01 | -0.22* | -0.09 | -0.06 | -0.32** | -0.27* | 0.11 | -0.04 | -0.03 |
| 36 | 0.01 | -0.25* | -0.13 | -0.05 | -0.33** | -0.23 | 0.16 | -0.07 | -0.02 |
| 40 | 0.04 | -0.27** | -0.16 | -0.09 | -0.37** | -0.18 | 0.18 | -0.05 | 0.02 |
| 44 | 0.08 | -0.27** | -0.18 | -0.14 | -0.37** | -0.16 | 0.33** | 0.06 | 0.08 |
| 48 | 0.08 | -0.29** | -0.21 | -0.16 | -0.39** | -0.17 | 0.44** | 0.21 | 0.14 |
| 52 | 0.08 | -0.27* | -0.20 | -0.13 | -0.36** | -0.14 | 0.50** | 0.30 | 0.22* |

** Significant (P<0.01)
* Significant (P<0.05)

Table 31. Correlation matrix between egg number and weekly egg weights in control population (CP) of White Leghorn

| Egg number (age in weeks) | Egg weight (age in weeks) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FEW | 24 | 28 | 32 | 36 | 40 | 44 | 48 | 52 |
| 24 | -0.60** | 0.56** | -0.001 | -0.04 | -0.29** | 0.13 | -0.26* | -0.14 | -0.16 |
| 28 | -0.60** | 0.68** | 0.11 | -0.07 | -0.33** | 0.05 | -0.29** | -0.17 | -0.15 |
| 32 | -0.51** | 0.62** | 0.10 | 0.06 | -0.33** | 0.13 | -0.26* | -0.16 | -0.13 |
| 36 | -0.49** | 0.61** | 0.06 | 0.08 | -0.37** | 0.11 | -0.28** | -0.20 | -0.17 |
| 40 | -0.48** | 0.58** | 0.04 | 0.06 | -0.37** | 0.16 | -0.29** | -0.23* | -0.21* |
| 44 | -0.44** | 0.54** | 0.01 | 0.05 | -0.38** | 0.20 | -0.32** | -0.25* | -0.24* |
| 48 | -0.42** | 0.51** | -0.03 | 0.04 | -0.38** | 0.16 | -0.32** | -0.27** | -0.29** |
| 52 | -0.41** | 0.49** | -0.08 | 0.003 | -0.40** | 0.14 | -0.34** | -0.30** | -0.34** |

Table 32. Correlation between egg number in three strains of White Leghorn

| Age in weeks | Strain code | | |
|---|---|---|---|
| | 1 WN | 1 WP | CP |
| 24-28 | 0.91** | 0.76** | 0.90** |
| 28-32 | 0.92** | 0.84** | 0.93** |
| 32-36 | 0.97** | 0.97** | 0.98** |
| 36-40 | 0.98** | 0.97** | 0.98** |
| 40-44 | 0.97** | 0.96** | 0.98** |
| 44-48 | 0.99** | 0.97** | 0.98** |
| 48-52 | 0.99** | 0.97** | 0.99** |

** Significant ($P<0.01$)
* Significant ($P<0.05$)

to 52 weeks egg weight with egg number from 40 to 52 weeks of age.

**Between egg number**

Significantly high positive correlation was observed among egg number from 24 to 52 weeks of age in all the three strains (Table 32) and is in line with those reported by.

# *Discussion*

# DISCUSSION

The results pertaining to the study of egg weight profile in three strain of White Leghorn is discussed in this chapter.

## Body weight

A perusal of the data on mean body weight presented in Table 6 revealed that the pure strain IWP had the maximum body weight at 20 weeks of age (1.421 kg) and the control population had the minimum body weight (1.229 kg). IWN strain attained an intermediary body weight of 1.339 kg at 20 weeks of age.

Among the three strains, IWP registered the maximum body weight of 1.546 kg at 40 weeks of age and control population registered a minimum of 1.445 kg and IWN attained a weight of 1.539 kg at 40 weeks. This difference between the genetic groups IWN and IWP was non-significant while the body weight of control population was significantly lower than IWN and IWP strains. Hanumaiah *et al*. (1976) and Singh (1983) also had reported significant differences in body weights between genetic groups in a cross experiment. The body weights observed at the above ages were in agreement with Sudheeshkumar (1995) who worked with the same strains. Since the control population is being maintained as a genetic control, it is expected to have the same body weight generation after generation as no efforts are being made to change its genome (Anon, 1989, 1992). However, selection and mating systems of identical nature are being followed in both IWN and IWP strains which can be the reason for change in body weight at 20 weeks in these strains. In the previous generations as well (Anon, 1992) IWN strain had a lower body weight at 20 weeks than IWP. However, the adult body weights were almost comparable in these two strains in previous generations. A physiological compensatory mechanism might be in operation controlling this phenomenon. In the present study also the body weight at 40 weeks in these two strains were comparable statistically.

## Age at sexual maturity

The quick sigmoid rise to peak egg production arises mainly due to differences in age at first egg (sexual maturity) of individual hens in the population. When the egg production records are synchronised for sexual maturity, the 'hook' at the start of the production record disappears. In large studies, with population well structured for variance component estimation, changes in the heritability of egg production traits with increasing age are customarily small. The heritability of hen housed egg production usually decreases, while that of survivor egg production or rate of lay usually increases with age in the first laying cycle.

The data pertaining to age at sexual maturity (Table 8) revealed that the average age at first egg in IWP strain was 136.41 ± 0.89 days which was the lowest among the genetic groups studied. The difference in age at first egg among the strains was found to be statistically significant. The strains IWN and IWP were selected for increased egg production and the control population is a genetic control. Selection for increased egg production is the reason for the lower average age at first egg in both IWP and IWN strains. Singh and Chaudhary (1982) also reported that flocks selected for high egg production matured earlier than the control flock. The age at sexual maturity in this study is lower than those reported in the literature (Table 2) probably due to the selection carried out in both IWN and IWP strains for the past 13 generations and to a certain extent due to the management. A higher body weight at 20 weeks of age for IWP strain had its reflection in age at sexual maturity. Strain IWP registered 136.41 ± 0.89 days as the age at sexual maturity which was the lowest and was found to be statistically significant (Table 8). However, the age at sexual maturity is critically assessed in the light of body weight at 20 weeks of age and early egg weights.

**Egg production**

The egg production of chicken is a result of many genes acting on a large number of biochemical processes, which in turn control a range of anatomical and physiological traits. With appropriate environmental conditions, the genes controlling all the processes associated with egg production can act to allow the chicken to express fully its genetic potential. How exactly egg production is measured determines what part of genome is being considered. If egg production is measured from age at first egg, the trait probably excludes many genes asserting on sexual maturity. If only egg production (part record) is considered, then genes responsible for persistency that do not act on early production, are not included.

Mean hen housed egg number and hen housed per cent egg production (Table 10) revealed that the strains were statistically comparable in respect of this trait from 19 to 52 weeks of age. Egg production pattern was similar from 25 to 52 weeks of age in case of IWN and control population. But in case of IWP strain, a high initial production followed by peak and then a decline in production was noticed during 21 to 52 weeks of age.

The overall mean hen housed egg production from 19 to 52 weeks of age were 65.48, 60.50 and 64.42 per cent in IWN, IWP and CP respectively (Table 10). It is evident from the table that during the initial period of 19 to 20 weeks, IWP attained 18.14 per cent production as against 1.86 per cent and 1.71 per cent in IWN and CP respectively. Moreover, IWP strain reached 62.54 per cent as against 48.96 and 37.18 per cent in IWN and CP respectively during 21 to 24 weeks period. This evidently indicates that reliance on part-period egg production from 20 to 40 weeks of age in IWN and IWP strains for selection has lead to greater exploitation of that part of genome controlling initial egg production in IWP strain. This quick sigmoid rise to peak egg production in IWP strain is attributable to the lower age at sexual maturity (136.41 $\pm$ 0.89 days) in that population.

A close perusal of Table 10 indicated that IWN registered +0.39, -1.54 and -2.37 per cent variation in hen housed egg production during 41 to 44, 45 to 48 and 49 to 52 weeks period, respectively, compared to the genetic control. The corresponding figures for the IWP strain were -9.61, -10.47 and -12.15 per cent respectively. This clearly suggests that changes in the variation of egg production traits with changes in the age of birds are much larger in IWP strain. This trend has to be corroborated with the initial 18.14 per cent production registered in IWP strain. This increased genetic variation, since the data has been collected from a breeding station, can be attributed to an increased number of genes determining egg production at later ages in this strain. As such it may be a caution against using part records for selection for improvement of this trait in IWP strain. To explain such situation, Liljedahl *et al.* (1984) hypothesised that the increase in genetic variations are attributable to the expression of an enhanced number of genes determining egg production at later stages.

## Egg weight

The mean weekly egg weight presented in Table 11 and its statistical analysis in Table 12 revealed significant differences in egg weight between weeks within the strains, IWN, IWP and the CP.

### IWN strain

The initial egg weight i.e., mean egg weight at 19 and 20 weeks of age was 31.60 g and 35.03 g respectively. The increase in egg weight was 5.28 g during the period from 21 to 24 weeks of age whereas corresponding figure during 25 to 28 weeks was 0.79 g and that during 29 to 32 weeks of age was 2.13 g. It is apparent from Table 11 that IWN strain could attain an egg weight of 50 g at 32 weeks of age. The mean egg weight ranged from 51.08 g to 52.41 g during 33 to 42 weeks of age and thereafter it was in the range of 53 g except during 46 and 52 weeks. The highest mean egg weight was 53.91g at 48 weeks of age.

Differences in egg weight between weeks was found to be statistically significant. This observation falls in line with those reported by Galvanov (1970) and Lukyanova and Burdashkina (1981). Overall mean egg weight of 49.02 g recorded by the strain was the highest in this study which was comparable to that recorded at 30 weeks of age. Further it is evident from Table 11 that the mean values for the period from 25 to 28 weeks were comparable and they were significantly different from the values for 29 to 52 weeks of age. Moreover, the mean egg weights from 30 to 32 weeks of age were similar among themselves. These observations tend to suggest that the practice of relying on 32 weeks mean egg weight as a selection criteria can be advanced to 29 or 30 weeks in this strain.

**IWP strain**

The mean egg weights at 19 and 20 weeks of age were 36.16 and 37.02 g respectively. These values were 4.56 and 1.99 g higher than the corresponding figures for IWN strain. This trend can be attributed to the higher 20 week body weight recorded by this strain. The increment in egg weight was 4.42 g during the period from 21 to 24 weeks as against 5.28 g in IWN strain during the same period. However, the increment was 2.75 g during 25 to 28 weeks of age as against 0.79 g in IWN strain. The 32 week egg weight was 49.4 g which was 2.41 g higher than the 29 week egg weight. The corresponding increment during the period in IWN was only 2.13 g. However, inspite of the encouraging increments recorded by this strain during different periods barring 21 to 24 weeks, it failed to register 50 g mean egg weight at 32 weeks of age. The further increase in egg weight was very gradual and the highest weight was registered during 43 weeks of age (52.64 g) as against 53.9 g reported by IWN strain at 48 weeks of age.

The mean egg weight recorded at 30 weeks of age was very close to the overall mean egg weight of 48.14 g in the strain as well. Moreover, it is apparent from Table 11 and Appendix II that the mean weights were comparable statistically from 31 to 52 weeks of age except that between 31 and 43 weeks. These birds commenced laying medium sized eggs with a mean value of 46.10 g at the age of 28 weeks. This weight was comparable to egg weights upto 32 weeks of age during which period the weight was 49.40 g. Considering the above observations, it is reasonable to surmise that reliance of egg weight at 28 weeks of age is likely to benefit selection programmes in IWP strain. Though this strain registered higher adult body weight it failed to register a better mean adult egg weight. Added to this, this strain registered the maximum egg weight of 52.64 g at 43 weeks of age. This phenomena evades a scientific explanation since generally the egg weight tends to be better with better body weight.

**Control population**

This population has been maintained as a genetic control and as such the results obtained are comparable to previous generations (Anon, 1992) and it is maintained only for making comparison with the strains in which selection studies are being carried out.

The mean egg weight in the control population did not cross 50 g mark during the period from 19 to 52 weeks of age. the highest mean egg weight was 49.38 g recorded at 47 weeks of age. The corresponding figures in IWN was 53.91 g (an increment of 4.53 g) and in IWP it was 52.64 g (an increment of 3.26 g).

The mean egg weight values observed in different strains in this study agree with the general pattern seen in commercial strains. Das *et al.* (1982) studied the inheritance of some economic traits and reported an average egg weight value of 49.54 g from 21 to 40 weeks of age in White Leghorn chicken. The differences in mean egg weights between weeks within each of the strains viz., IWN, IWP and control population were statistically significant (Table 12, Appendices I, II and III). Since egg weight changes with the chronological age much attention should be bestowed on the relationship between egg weight and age. The results of the present study falls in line with that reported by Lukyanova and Burdashkina (1981) who observed highly significant difference in egg weight with ages in hens from different lines and line crosses.

The interstrain variations in mean egg weights between IWN and IWP was examined to decifer the differences. It was observed that the phases of laying small eggs (21 to 27 weeks) as well as medium eggs (28 to 52 weeks) were longer in IWP strain than IWN strain. Moreover, mean egg weight in IWP strain did not touch the 'large egg' mark. Therefore, it was evident that the IWP strain laid small and medium sized eggs thereby a concomitant reduction in the overall mean egg weight in that strain.

The attainment of higher mean egg weights and transformation from small to medium eggs occurred at different ages in IWN and IWP strains. It can be attributed that the weight of an egg is influenced by a number of genetic and non genetic factors. Since both these pure lines were on identical conditions of management, the differences can be attributed mostly to genetic factors.

**Period-wise egg weight**

The period-wise mean egg weight from 21 to 52 weeks of age presented in Table 13 indicated that there were significant differences between the strains and different periods. Overall mean egg weight was significantly higher with IWN strain and lower with control population. Strain IWP registered a medium value which was significantly different from both IWN and CP. Differences in mean egg weight among strains of the same breed or variety have been reported by Funk and Kempster (1934) and Hall (1939). Significant increase in period-wise egg weight (data pooled from the three strains) was observed until 44 weeks of age and subsequently no such difference could be seen. This is in close agreement with Lukyanova and Burdashkina (1981) who reported increased egg weight with advancement of age.

**Weight of first egg**

The weight of first egg as influenced by age at first egg for the strains IWN, IWP and CP showed wide range within each strain (Tables 15 to 17).

In IWN strain 42.10 per cent birds laid their first egg within the weight range of 29.8 to 37.9 g and 50.53 per cent pullets laid eggs in the range of 38.0 to 44.9 g and only 7.36 per cent pullets laid medium/large eggs in the range of 45.0 to 57.1 g. The study also reveals that 92.63 per cent of first eggs laid by IWN strain were smaller in size and that the pullets of the strain had their age at first egg between 19 and 24 weeks. The range of 29.8 to 57.1 g as the weight of first egg is suggestive of wide variation for this trait in IWN strain. Egg weight being a trait having medium to high range of heritability coupled with the wide range of variations observed in the IWN strain would suggest that only little attention is required to improve the weight of first egg. Such an approach, in itself is very likely to refine the egg weight profile in IWN strain. For this purpose, it is desirable that the optimum body weight suggested for this strain, 1304.7 g (Sudheesh Kumar, 1995) is also taken cognisance of in the future selection programme to refine the weight of first egg since both these traits are correlated.

In the case of IWP strain 46.74 per cent of pullets laid their first egg within the range of 30.0 and 37.9 g, 41.30 per cent of pullets laid eggs within the weight range of 38.0 to 44.9 g and only 11.95 per cent pullets laid their first eggs ranging from 45.0 to 63.2 g. It was also apparent from the results that 88.04 per cent of the first eggs were small in size in IWP strain and 92.63 per cent were small in IWN strain. Increment in egg weight registered by the IWN strain was better in comparison with IWP strain. This was also evident from the maximum egg weight attained by IWN strain at 48 weeks of age in comparison with 43 weeks of age to IWP strain.

In control population the results obtained for this trait has been presented (Table 17) but drawing conclusions will not be valid in as much as the strain has been maintained only as a genetic control. However, it can be pointed out that the control population is one having a low egg weight profile.

**Egg weight gain**

The magnitudes of egg weight gain were higher in IWN strain from 19 to 22 weeks and from 24 to 26 weeks of age as compared to IWP strain (Table 18). In comparison to control population, the gain in egg weight was definitely higher from 19 to 23, 29 to 30 and 33 to 34 weeks of age. The magnitude of gains were 3.43, 3.69 and 2.81 g respectively at 20, 21 and 22 weeks of age which can be considered as reasonably good gain. Similarly, the gain registered by IWN strain at 23, 24 and 25 weeks, 0.92, 1.55 and 1.45 g, respectively could be considered as moderate to high gain. Similar gains were also exhibited by the strain during 29, 30, 32 and 39 weeks of age. The gain in egg weight was also reasonably high at 43 weeks of age (1.39 g). Thereafter these gains ranged either from 0.33 to 0.74 g or loss in egg weight ranged from -0.95 to -0.32 g per week. The net gain from 20 to 52 weeks of age was 20.5 g over a total laying period of 34 weeks, after adjusting all the negative gain. When the initial egg weight (weight of first egg) was considered along with gain in egg weight by IWN strain, it can reasonably be concluded that the desirable approach to refine the egg weight of this strain should centre around improving the weight of first egg. While attempting this task during selection, the optimum 20 week body weight of 1304.7 g suggested for this strain (Sudheesh Kumar, 1995) must also be kept in mind.

In the case of IWP strain (Table 18) it was apparent that the initial egg weight of 36.16 g was quite satisfactory and that explains the low gain of 0.86 g corresponding to 3.43 g in IWN as the gain in weight during 19 to 20 weeks of age. However, this strain has a potential of attaining better gains in weight during the periods from 21 to 24 weeks of age. The gains registered by this strain at 27 and 28 weeks of age (1.02 and 1.63 g) could be considered as moderate to high. At 47 weeks of age the gain was a remarkable 1.09 g. Subsequently, the weekly gains ranged between 0.60 to 0.79 g and a loss of -1.05 to -0.51 g per week. The overall net gain registered by this strain was 15.33 g as against 20.5 g recorded by IWN strain. The difference of 5.17 g less than that of IWN strain has to be reckoned with. It is very desirable that this strain is brought at least on par with IWN strain with respect to the weekly gains in weight and the net gain in weight. In the technical programme of the breeding project (Anon, 1992) pertaining to these strains, generally emphasis was given to egg weight in the case of selection of sires. Since the egg weight profile of IWP strain is not comparable with IWN, based on this study, it is suggested that emphasis should be paid to egg weight even in the selection of dams since both sires and dams contribute towards inheritance of this trait.

In the control population, the initial egg weight was 30.10 g, the lowest registered among the strains. The overall mean net gain in egg weight was 18.8 g which was 3.47 g more than IWP strain. Though this strain is a low egg weight profile strain it has the potential for good gain in weekly egg weight.

**Per cent variation**

The per cent variation of egg weight between weeks was higher in all the strains upto 24 weeks of age (Table 19). Literature pertaining to egg weight profile from first egg to 52 weeks of age in general and with special reference to per cent variation in mean weekly egg weight are scanty. Since per cent variation in mean weekly egg weight is only a reflection of egg weight gain no further discussion is warranted.

**Magnitude of variation**

The magnitude of variation in weekly mean egg weight in IWN and IWP strains in comparison with the control population given in Table 20 showed that both IWN and IWP pullets laid heavier eggs from first egg till 52 weeks of age. During the initial period of 19 and 20 weeks of age, the eggs laid by IWP pullets were heavier to a tune of 4.56 and 1.99 g, respectively, than the IWN strain. The variation in mean egg weight in IWN and IWP pullets during 21 to 24 weeks of age were comparable. Subsequently, IWN pullets laid heavier eggs than IWP pullets. Since the control population is maintained only as a genetic control without selection it is expected to have wider variations in egg weight.

## Classification of egg weight

Egg number and egg weight are the two principal traits in layer stocks which determine profitability. While the former is directly related to economic returns, the latter is related to the marketability of eggs. Small and medium sized eggs fetch a relatively lesser price. This factor should be borne in mind while, considering the per cent distribution of eggs under different weight classes for the strains IWN, IWP and CP.

The marketable eggs (includes medium, standard medium and large eggs) obtained from the strains IWN, IWP and CP were 84.11, 75.38 and 63.66 per cent, respectively (Table 21). A genuine comparison among the three genetic stocks indicated that IWN strain had a preponderance of marketable eggs. Though 75.38 per cent of marketable eggs was registered by IWP strain, it requires further refinement with regard to egg weight. Since control population is merely a genetic control, no discussion is warranted. However, the CP is one having a low genetic potential for egg weight.

## Correlation matrix

It could be seen from Table 25 that in IWN strain there was high positive correlation between 20 week body weight and egg weight at 40 weeks. The egg weight at 40 and 52 weeks of age were significantly correlated with body weight at 40 weeks in this strain. But in respect of IWP strain the correlation between egg weight at any age and body weight at 20 and 40 weeks were feeble and non-significant; whereas, in control population the correlation between egg weight at different ages and body weight at 20 and 40 weeks were significant and positive. These observations are generally in line with that reported by Leo (1991). The trends obtained in IWP strain could at best be taken as indications and further correlation studies making use of larger number of birds is suggested.

The correlation matrix of egg weights (Tables 26, 27 and 28) indicated that the egg weight at 52 weeks of age is highly and positively correlated with egg weight at 28 weeks and thereafter in IWN strain. Since significant positive correlations were observed among egg weights from 28 to 40 weeks of age in IWP strain, reliance on egg weight at 28 weeks of age in this strain will be effective in improving the mature egg weight. But in control population even the weight of first egg is seen highly correlated with egg weight at 52 weeks. Other correlations obtained followed the general trend.

The trend of relationship between egg number and egg weight at different ages in the three strains studied (Tables 29, 30 and 31) indicated that in IWN strain there was significantly strong correlation between egg weight at 24 weeks and egg number recorded in all ages. This is an indication on the efforts made by the breeders on incorporating the two generally negatively correlated traits to a desirable situation. But with IWP strain the results were erratic. The breeders should strive to achieve the situation attained with respect to correlation between egg weight and egg number in IWN in the case of IWP as well.

The trend of results on correlation analysis while conforms earlier observations, there does exist perceptible difference among the three strains. In general IWN and control population showed uniformity; whereas the observations made on IWP strain were erratic. Considering the fact that both IWN and IWP have been under selection process for the last 13 generations the difference observed between these two strains in this study might be due to the collection of data from small population size used in the present investigation.

Breeders usually measure the weight of eggs from all individual birds in the breeding programme when they are between 30 and 40 weeks of age. Selection in layer stock is primarily for egg number. This tends to bring down egg weight since these traits are negatively correlated. Hence, the results of the present study should be considered as a pointer to the future selection of strains IWN and IWP.

There is paucity of published work with respect to weekly increments in egg weight and complete egg weight profile in various stocks and as such comparison of the observations of this study becomes difficult. Considering the egg weight level of 50 g as a base, IWN reached this level at 32 weeks of age and IWP at 35 weeks of age and CP did not attain this base even at 52 weeks of age. In general, the indications obtained in this study are very suggestive of the ideal period for the measurement of egg weight for selection purposes and for inclusion in the breeding programme.

The selection pressure to be applied for the refinement of egg weight in both IWN and IWP strains should be kept high in all future selection programmes until the desired egg weight profile is achieved.

# *Summary*

# SUMMARY

An investigation was taken up in three strains of White Leghorn viz., IWN, IWP and control population maintained at the All India Co-ordinated Research Project on Poultry Improvement at the Mannuthy Centre with the objective of assessing the gain in egg weight with the chronological age of the birds and to study the magnitude of variation in egg weight and its correlation with egg production and body weight.

One hundred pullets from each strain selected at random at 18 weeks of age were used for the study. They were housed in single bird cages of identical dimensions. Routine managemental practices were followed throughout the experimental period.

The data pertaining to the egg weight and other production characteristics were studied upto 52 weeks of age.

The individual body weight of birds at 20 and 40 weeks of age were recorded and the mean values of each strain were worked out. The sexual maturity was assessed based on the age at first egg and ages at 10 and 50 per cent production in days. Daily egg production was recorded and from this data hen housed production in terms of egg number and percentages were arrived at for eight, 28 day periods from 21 to 52 weeks of age.

The eggs from all birds were weighed individually every day and from this data the mean egg weight in each week for the strains was calculated. The gain in egg weight per week was worked out to assess the influence of chronological age of birds.

The following observations were made from this investigation:

1. The body weight at 20 weeks of age was significantly higher for IWP strain than IWN and control population. Control population had the lowest 20 week body weight while that of IWN was intermediary.

2. The body weight at 40 weeks of age in IWN and IWP was statistically similar and was higher than control population.

3. The age at sexual maturity was consistently earlier in IWP strain when measured in terms of age at first egg, age at 10 and 50 per cent production. While control population always attained sexual maturity at much later age than IWP strain. The IWN strain was intermediary in nature.

4. The mean per cent hen housed egg production in the strains, IWN, IWP and CP were 65.48, 60.50 and 64.42 respectively and was statistically comparable.

5. The lowest egg weight was recorded in all the three genetic groups at 19 weeks of age.

6. The highest egg weight was recorded at 48 (53.91 g), 43 (52.64g) and 47 (49.38g) weeks of age respectively for IWN, IWP and control population.

7. The overall mean weekly egg weights from 19 to 52 weeks of age for the strains IWN, IWP and CP were 49.02, 48.14 and 45.10 g respectively. The differences in egg weight between weeks with each strain was statistically significant.

8. Period-wise mean egg weight from 21 to 52 weeks was statistically higher in IWN strain and lower in CP. It was medium with IWP strain and was statistically different from both IWN and CP.

9. Assuming egg weight level of 50 g as base, IWN reached this level at 32 weeks, IWP at 35 weeks and CP did not attain this base even at 52 weeks of age.

10. The age at first egg was distributed between 19 and 24 weeks of age in IWN strain. In IWP strain the ages at first egg were mainly at 19, 20 and 21 weeks of age. However, in control population 12.37 per cent pullets laid their first-egg only after 24 weeks of age.

11. The net gain in egg weight from 20 to 52 weeks of age was 20.5, 15.33 and 18.8 g in IWN, IWP and control population, respectively.

12. The per cent variations of egg weight between weeks was higher in all the strains upto 24 weeks of age. The magnitude of variation being higher in IWN followed by control population and IWP.

13. Birds under IWN strain laid higher percentage of marketable eggs compared to IWP strain and CP. Per cent marketable eggs laid by CP was lower and it was medium for IWP strain.

14. Correlation between egg weight and body weights indicated that 20 and 40 week body weights were significantly correlated with 40 week egg weight in IWN and CP strain while in IWP strain, the correlations were feeble and nonsignificant.

15. Correlation values from 28 to 52 weeks mean weekly egg weights were significant among themselves in IWN strain and CP. Similarly, weekly mean egg weights were significantly different from 24 to 36 weeks in IWP strain.

16. Correlation values between egg weight and egg number were positively significant in IWN and CP strain at 24 week egg weight with 24 to 52 week egg number, while in IWP strain the value were negatively significant.

17. The ideal period for the measurement of egg weight for selection purposes in IWN strain was found to be 29 to 30 weeks of age and in IWP strain it was at 28 weeks of age.

# *References*

## REFERENCES


Aggarwal, C.K. (1970). Phenotypic correlations of some economic traits in White Leghorn pullets. *Indian Vet. J.* **47**(1): 34-38.

Al-Rawi, B.A. (1980). Evaluation of performance in layers. *Poult. Sci.* **59**(3): 654-656.

Anon. (1989). Annual Report, Project Directorate on Poultry (ICAR), Rajendra Nagar, Hyderabad. pp. 2.18-2.21.

Anon. (1992). Annual Progress Report, All India Co-ordinated Research Project on Poultry for eggs, Mannuthy.

Anon. (1994). Indian Poultry Industry Yearbook. Ed. Gupta, S.P. A-25, Priyadarsini Vihar, Delhi. pp. 6-10, 75-77, 83-89.

Bell, D.D. and Adams, C.J. (1992). First and second cycle egg production characteristics in commercial table egg flocks. *Poult. Sci.* **71**(3): 448-459.

Blyth, J.S.S. (1952). The correlation between egg number and egg weight in the fowl: An investigation of its inconsistancy **31**(2): 254-268.

Choi, C.H. (1973). Performance of the domestic fowl. *Anim. Breed. Abstr.* **41**(12): 5527.

Christmas, R.B., Douglas, C.R., Kalch, L.W. and Harms, R.H. (1979). The effect of season of maturity of the laying hen on subsequent egg size at periodic intervals in the laying cycle. *Poult. Sci.* **58**(4): 848-851.

Connie, L.B., Beane, W.L., Ruszler, P.L. and Cherry, J.A. (1985). Body weight influence on egg production. *Poult. Sci.* **64**(12): 2259-2262.

Das, D., Goswami, R.N., Aziz, A., Sarma, H.K., Ksih, E.R. and Dhar, W. (1982). Inheritance of some economic traits in White Leghorn chicken. *Indian J. Poult. Sci.* **17**(4): 262-264.

Dunnigton, E.A. and Siegel, P.B. (1984). Age and body weight at sexual maturity in female White Leghorn Chickens. *Poult. Sci.* **63**(4): 828-830.

Funk, E.M. and Kempster, H.L. (1934). Egg weight in the domestic fowl. *Missouri. Agr. Exp. Sta. Bull.* 332. Cited in Poultry Breeding (1952). Ed. by Morley A. Jull. pp. 327.

Galvano, G. (1970). Observations on the relationship of egg weight and quality with body weight and age of hens. *Anim. Breed. Abstr.* **38**(2): 723.

Gruev, V., Conkov, C.M. and Nozeer, S.V. (1965). Correlations between egg weight and some other characters of *Stara zagorsk* Red hens. *Anim. Breed. Abstr.* **33**(1): 723.

Gurung, B.S. and Taylor, C.M. (1978). Genetic analysis of egg weight of White Leghorn. *Poult. Advisor* **11**(9): 45-48.

Hall, G.O. (1939). Breed variations among egg characters. *Poult. Sci.* **18**: 282-287. Cited in Poultry Breeding, Ed. by Morley, A. Jull (1952). pp. 322-335.

Hanumaiah, B.M., Gowdh, C.V. and Kondaiah, N. (1976). Heterosis pattern on the production traits of White Leghorn and Rhode Island Red crosses. *Indian J. Poult. Sci.* **11**(4): 203-205.

Hays, F.A. (1939). The significance of body weight in breeding for egg production. Massachusetts Agr. Exp. Stat. Bull. 364, Cited in Poultry Breeding (1952) Ed. by Morley A. Jull. pp. 332.

Hurst, C.C. (1925). Experiments in Genetics. Cambridge University Press, London, Cited in Poultry Breeding and Genetics (1993) Ed. by R.D. Crawford. pp. 705.

Iype, S. (1979). Inheritance of egg weight in Forsgate strain of White Leghorns. *Kerala J. Vet. Sci.* **10**(1): 71-74.

Jain, G.L. and Roberts, C.W. (1980). Evaluation of egg mass on a selection criterion in chickens. *Indian Vet. J.* **57**(3): 229-234.

Jain, L.S., Sharma, V.V., Rajora, N.K. and Bhatnagar, M.S. (1978). Egg size, egg mass and efficiency of feed conversion in pure and cross bred chickens involving desi and exotic germplasm. *Indian J. Anim. Sci.* **48**(4): 280-283.

Jain, R.S., Banergee, A.K. and Chaudhary, R.P. (1980). Genetic studies on production traits in White Leghorn. *Indian Vet. J.* **57**(8): 671-675.

Johari, D.C., Dutt, M. and Husain, K.Q. (1977). Genetic and phenotypic correlation for some traits of economic importance in a strain of White Leghorn. *Indian J. Poult. Sci.* **12**(12): 17-20.

Johari, D.C., Kataria, M.C., Sharma, D., Singh, D.P. and Gopal, R. (1992). Evaluation of random bred control population of White Leghorn. I. Economic traits. *Indian J. Poult. Sci.* **27**(1): 6-9.

Joseph, C.V. (1982). Inheritance of body weight, egg weight and age at first egg in White Leghorn birds. M.V.Sc. thesis, Kerala Agricultural University, Vellanikkara.

Jull, M.A. (1952). Poultry Breeding. Published by John Wiley and Sons Inc., New York. III edn. pp.298.

Krishnan, A.R., Sethuraman, B., Sheriff, E.R., Srinath, M., Vedanayakam, K., Kadirvelu, R. and Kothandaraman, P. (1977). Effect of clutch size, age and maturity and body weight on egg number in White Leghorns. *Indian Poult. Gaz.* **61**(4): 138-145.

Krishnan, A.R., Kadirvel, R. and Kothandaraman, P. (1978). Measurement of egg weight-comparative merits of various sampling procedures. *Indian Poult. Gaz.* **62**(3): 114-118.

Kumar, J. and Kapri, B.D. (1968). Genetic studies on internal egg quality and its relationship with other economic traits in White Leghorn birds - IV. *Indian Vet. J.* **45**(11): 943-947.

Kumar, N., Singh, C.S.P. and Mishra, H.R. (1981). Studies on some egg production characters in two strains of White Leghorn birds. *Indian J. Poult. Sci.* **16**(4): 418-420.

Krutikova, I.V. (1975). Variation in the correlations between egg production and other characters in poultry. *Anim Breed. Abst.* **43**(6): 2613.

Leeson, S. and Summers, J.O. (1987). Effect of immature body weight on laying performance. *Poult. Sci.* **66**(12): 1924-1928.

Leo, J. (1991). Genetic divergence in two strains of White Leghorns for traits of economic importance. Ph.D. thesis, Department of Poultry Science, Univ. Agri. Sci., Bangalore.

Liljedahl, L.E., Gavora, J.S., Fairfull, R.W. and Gowe, R.S. (1984). Age changes in genetic and environmental variation in laying hens. *Theor. Appl. Genet.* 67: 391-401, Cited in Poultry Breeding and Genetics (1993) Ed. by R.D. Crawford. pp. 707.

Lukyanova, V.D. and Burdashkina, V.M. (1981). Changes in egg weight with age in hens from different lines and line crosses. *Anim. Breed. Abstr.* **49**(11): 6623.

Mann, R.S. (1980). Genetic evaluation of economic traits in poultry. Thesis Abstracts. HAU **6**(4): 266-267.

Mahto, B., Singh, C.S.P., Mishra, H.R. and Sharma, B.D. (1980). Studies on weight and measurements of eggs in White Leghorn birds during advanced stage of lay. *Indian J. Poult. Sci.* **15**(4): 268-270.

Mohapatra, S.C. (1972). Selection for egg mass. *Indian Poult. Gaz.* **56**(3): 137-140.

Plessis, P.H.C. and Erasmus, J. (1973). The relationship between egg production, egg weight and body weight in laying hens. *Anim Breed. Abstr.* **41**(5): 2368.

Poulose, M.V. and Sathe, B.S. (1974). Comparative studies on some economic traits of three exotic strains of White Leghorn breed. *Indian J. Poult. Sci.* **9**(1): 44.

Prakashbabu, M., Biswas, D.K., Mohapatra, S.C. and Premnarain (1975). Effect of non-genetic sources of variation of some performance traits in White Leghorn. *Indian J. Anim. Sci.* **45**(10): 762-766.

Radhakrishnan, P.M. and Ramakrishnan, A. (1982). Evaluation of pure bred White Leghorn, Rhode Island Red, Australorp and their reciprocal crosses under backyard condition. *Kerala J. Vet. Sci.* **13**(2): 193-198.

Rahmatullah, M.S., Singh, R.P., Shukla, S.N. and Misra, M.S. (1978). Breed and strain differences in internal egg quality of egg. *Indian J. Poult. Sci.* **13**(4): 203-208.

Rahn, A.P. (1976). Seasonal commercial egg production curve difference. *Poult. Sci.* **55**(4): 1302-1307.

Raj, K., Kothadaraman, P., Kadirvel, R. and Reddy, P.R. (1980). The effect of body weight at housing on the laying performance of White Leghorn. *Cherion* **9**(2): 97-101.

Renganathan, P., Mohapatra, S.C., Ayyagari, V.B., Venkataramaiah, A. and Chaudhari, D. (1979). A comparative study in index selection for egg production and egg weight verses selection for egg mass in chickens. *Indian Vet. J.* **56**(9): 757-763.

Roberts, E., Card, L.E. and Shaklee, W.E. (1952). Inheritance of egg weight. *Poult. Sci.* **31**(5): 870-875.

Saeki, Y. and Inone, Y. (1980). Body growth, egg production, age at first egg and egg size in Red jungle fowls, and on attempt at their genetic analyses by the reciprocal crossing with White Leghorns. *Anim Breed. Abstr.* **48**(3): 1497.

Saeki, Y., Sekidera, S., Okame, Y. and Akita, T. (1966). Laying performance and genetic parameters in some breeds of chicken. I. Heritabilies of some economic traits and genetic correlations of laying performance. *Anim Breed. Abstr.* **34**(4): 3371.

Sah, K.M., Singh, R.L., Singh, S.K., Prasad, C.M. and Sharma, B.D. (1985). A comparative study on some economic characters in desi, White Leghorn and their reciprocal crosses. *Indian J. Anim. Sci.* **55**(1): 79-82.

Sarma, P.L.N., Kumar, T.A. and Reddy, C.V. (1977). Production characteristics of certain White Leghorn strains available in India. *Indian J. Poult. Sci.* **12**(3): 28-33.

Seyed, H.S.H. and Rizvi, A.H. (1972). Effect of date of hatch on age at first egg in White Leghorn pullets. *Indian Vet. J.* **49**(7): 678-681.

Singh, K.R. (1983). Genetic effects influencing egger traits from diallel mating system. *M.V.Sc. thesis*, Kerala Agricultural University, Vellanikkara.

Singh, R.V. and Chaudhary, R.P. (1982). Genetic studies on production characters in White Leghorn - Poultry flock (1). *Indian J. Poult. Sci.* **17**(1): 1-6.

Snedecor, G.W. and Cochran, W.G. (1967). Statistical Methods. Oxford and IBH Publishing Co., Calcutta. 6th edn.

Sudheeshkumar, A.S. (1995). The influence of pullet body weight on production traits in White Leghorns. M.V.Sc. thesis, Kerala Agricultural University, Vellanikkara.

Summers, J.D. and Leeson, S. (1983). Factors influencing early egg size. *Poult. Sci.* **62**(7): 1155-1159.

Szado, J. and Baczkowska, H. (1978). Cross breeding for the dual-purpose type of fowl. *Anim. Breed. Abstr.* **46**(9): 4632.

Upp, C.W. and Thompson, R.B. (1927). Influence of time of hatch on hatchability of the eggs, rate of growth of chicks, and characteristics of the adult female. *Oklahama Agr. Exp. Sta. Bull.* 167. Cited in Poultry Breeding (1952) by Morley A. Jull. pp. 296.

Van Albada, M. (1956). On the significance of some characteristics of egg production in breeding utility breeds of poultry. *Anim. Breed. Abstr.* **24**(1): 361.

Vanchev, T., Donchev, R., Ignatov, S. and Burzova, I. (1975). Heritabilities of genetic and phenotypic correlations of some principal characters in five 6E White Leghorns. *Anim. Breed. Abstr.* **43**(9): 4292.

Waters, N.F. (1937). Body weight, egg weight, sexual maturity and growth rate in the domestic fowl. *Poult Sci*. 16: 305-313. Cited in Poultry Breeding (1952). Ed. by Morley A. Jull. pp. 327-335.

Yeo, J.S. and Ohh, B.K. (1979). Relationship between body weight at sexual maturity and other economic characters in layers. *Anim. Breed. Abstr.* **47**(9): 5104.

# Appendices

## Appendix-I

Statistical significance between mean weekly egg weights in IWN strain of White Leghorn from 21 to 52 weeks of age

| | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 22 | | | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 23 | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 24 | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 25 | | | | | | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 26 | | | | | | | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 27 | | | | | | | | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 28 | | | | | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 29 | | | | | | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 30 | | | | | | | | | | | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 31 | | | | | | | | | | | | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 32 | | | | | | | | | | | | | - | * | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 33 | | | | | | | | | | | | | | - | - | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 34 | | | | | | | | | | | | | | | - | - | - | - | * | - | * | - | * | * | * | * | * | * | * | * | * | - |
| 35 | | | | | | | | | | | | | | | | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | - |
| 36 | | | | | | | | | | | | | | | | | - | - | * | - | * | - | * | * | * | * | * | * | * | * | * | - |
| 37 | | | | | | | | | | | | | | | | | | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 38 | | | | | | | | | | | | | | | | | | | * | - | * | - | * | * | * | * | * | * | * | * | * | - |
| 39 | | | | | | | | | | | | | | | | | | | | - | - | - | * | * | - | - | - | * | - | - | - | - |
| 40 | | | | | | | | | | | | | | | | | | | | | - | - | * | * | * | - | * | * | - | * | - | - |
| 41 | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | * | - | - | - | - |
| 42 | | | | | | | | | | | | | | | | | | | | | | | * | * | * | - | * | * | - | * | - | - |
| 43 | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - |
| 44 | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - |
| 45 | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - |
| 46 | | | | | | | | | | | | | | | | | | | | | | | | | | | - | * | - | - | - | - |
| 47 | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - |
| 48 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - |
| 49 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - |
| 50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - |
| 51 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - |
| 52 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

* Significant (P<0.01)        - Non significant

Appendix-II

Statistical significance between mean weekly egg weights in IWP strain of White Leghorn from 21 to 52 weeks of age

| | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 22 | | | - | - | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 23 | | | | - | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 24 | | | | | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 25 | | | | | | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 26 | | | | | | | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 27 | | | | | | | | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 28 | | | | | | | | | - | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 29 | | | | | | | | | | - | - | - | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 30 | | | | | | | | | | | - | - | - | - | - | - | - | - | - | * | * | * | * | * | - | * | * | * | * | - | * | * |
| 31 | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - | * | - | - | - | - | - | - | - | - | - |
| 32 | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 34 | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 35 | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 36 | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 37 | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 38 | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 39 | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 40 | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - | - |
| 41 | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - | - |
| 42 | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - |
| 43 | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - |
| 44 | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - |
| 45 | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - |
| 46 | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - |
| 47 | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - |
| 48 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - |
| 49 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - |
| 50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - |
| 51 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - |
| 52 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

* Significant (P<0.01)  - Non significant

Appendix-III

Statistical significance between mean weekly egg weights in control population of White Leghorn from 21 to 52 weeks of age

| | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 22 | | | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 23 | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 24 | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 25 | | | | | | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 26 | | | | | | | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 27 | | | | | | | | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 28 | | | | | | | | | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 29 | | | | | | | | | | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 30 | | | | | | | | | | | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 31 | | | | | | | | | | | | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 32 | | | | | | | | | | | | | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 33 | | | | | | | | | | | | | | - | - | - | - | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * |
| 34 | | | | | | | | | | | | | | | * | - | - | * | * | - | * | * | * | * | * | * | * | * | * | * | * | * |
| 35 | | | | | | | | | | | | | | | | - | - | - | - | * | - | * | * | * | - | * | * | - | - | - | - | * |
| 36 | | | | | | | | | | | | | | | | | - | - | - | - | - | * | * | * | * | * | * | * | * | * | - | * |
| 37 | | | | | | | | | | | | | | | | | | - | - | - | - | * | * | * | - | * | * | * | * | - | - | * |
| 38 | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | * | - | - | - | - | - |
| 39 | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | * | * | - | - | - | - | - |
| 40 | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | * | - | - | - |
| 41 | | | | | | | | | | | | | | | | | | | | | | * | * | - | - | * | * | - | - | - | - | - |
| 42 | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - | - |
| 43 | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - | - |
| 44 | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - | - |
| 45 | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - | - |
| 46 | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - | - |
| 47 | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - | - |
| 48 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - | - |
| 49 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - | - |
| 50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - | - |
| 51 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | - |
| 52 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

* Significant (P<0.01)   - Non significant

# EGG WEIGHT PROFILE IN THREE STRAINS OF WHITE LEGHORNS

By

K. B. PRABHAKARAN

## ABSTRACT OF A THESIS

Submitted in partial fulfilment of the requirement for the degree

**Master of Veterinary Science**

Faculty of Veterinary and Animal Sciences

KERALA AGRICULTURAL UNIVERSITY

Department of Poultry Science

COLLEGE OF VETERINARY AND ANIMAL SCIENCES

MANNUTHY - THRISSUR

1996

# ABSTRACT

An experiment was conducted to study the egg weight profile in three strains of White Leghorn viz., IWN, IWP and control population (CP) maintained at the All India Co-ordinated Research Project on Poultry Improvement, Mannuthy Centre. One hundred pullets from each strain chosen at random at 18 weeks of age were used for the study. The body weight at 20 and 40 weeks of age, average age at first egg, per cent hen housed production, weekly egg weight, 28-day period-wise egg weight, weight of first egg, magnitude of variation in egg weight, per cent variation in egg weight, distribution of eggs under different weight classes and correlation of egg weight with body weight and production were studied from 19 to 52 weeks of age.

The mean body weight at 20 weeks of age was 1.339, 1.421 and 1.229 kg in IWN, IWP and CP respectively. The corresponding values at 40 weeks of age for the above strains were 1.539, 1.546 and 1.445 kg respectively. The results indicated a statistically significant difference between three strains at both the periods. Mean age at first egg was 149.53, 136.41 and 153.85 days in IWN, IWP and CP respectively. The overall mean hen housed egg production from 19 to 52 weeks of age was 65.48, 60.50 and 64.42 per cent for the above strains respectively which were statistically comparable.

The overall mean egg weight from 19 to 52 weeks of age was 49.02, 48.14 and 45.10 g respectively for the strain IWN, IWP and CP. The difference in egg weight between weeks within each strain was statistically significant. Statistical analysis of period-wise mean egg weight showed a significant difference between the strains. It was significantly higher in IWN strain, lower in control population and medium in IWP strain.

The weights of first egg ranged from 29.8 to 57.1 g in IWN strain, 29.8 to 63.2 g in IWP strain and 29.7 to 51.0 g in CP. The net gain in egg weight from 20 to 52 weeks was 20.5, 15.33 and 18.8 g for the strain IWN, IWP and CP respectively. Per cent variation in weekly mean egg weight was higher in the initial period in all the strains. As compared with CP pullets, the IWN and IWP strains laid heavier eggs from 19 to 52 weeks of age.

Per cent marketable eggs were higher in IWN strain, lower in control population and medium with IWP strain. Correlation between egg weight and body weight indicated that 20 and 40 week body weights had significant correlation with 40 week egg weight in IWN and CP strains. Weekly egg weights were significantly correlated from 28 to 52 weeks in IWN and CP while from 24 to 36 weeks in IWP strain. Twenty four week egg weight with 24 to 52 week egg number had significant correlation in IWN and CP strain but in IWP, the values were negative.

Considering the overall egg weight profile in the above strains, the ideal period for the measurement of egg weight for selection purpose in IWN strain was found to be 29 to 30 weeks of age and 28 weeks of age in IWP strain.