

**EVALUATION OF EGG SHELL QUALITY AND SELECTED
NUTRITIONAL PARAMETERS ASSOCIATED WITH THE AGE OF
FOWLS IN POULTRY FARM**

By

V. JAYACHITRA

Reg. No. 96 PLS 03

**A THESIS SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND
HIGHER EDUCATION FOR WOMEN - DEEMED UNIVERSITY, COIMBATORE - 641 043
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE IN LIFE SCIENCES**

MAY - 1998

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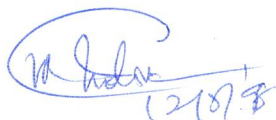
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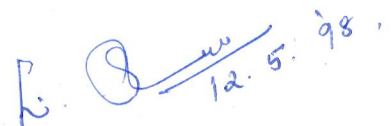
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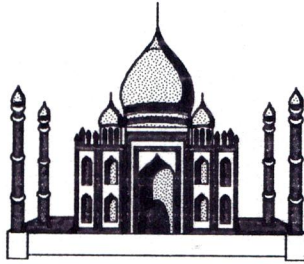
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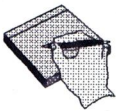
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*Dedicated to my
Beloved parents...*



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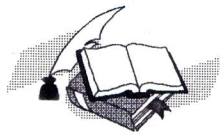
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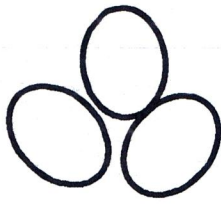
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Introduction



I. INTRODUCTION

Poultry industry is a fast growing sector which contributes handsomely to the national income. In the last few decades, the industry has touched new heights and has become one of the essential ancillary industries in our predominantly agricultural economy. Still the opportunities for growth are vast and the industry is bound to make inroads in hitherto unknown areas of the country (Thurairaj, 1989).

In years to come, eggs and poultry meat may remain as the only source of animal protein that can satisfy the ever increasing demand for foods of animal origin, created by more and more of post-independent children embarking into their youth and adult hood (Satapathy, 1989).

Layer production will record a steady growth in the coming years. Extra care on natural hair and increasing use of shampoos with egg yolk base by people, apart from awareness of nutritive value of table eggs and existing wide gap between availability and requirement will definitely point to the bright prospects for eggers (Choudary, 1989).

Poultry farming has gained much importance as a subsidiary occupation of the farmers. It is believed that poultry farming could play an effective role in improving the socio-economic status of the small farmers. The Government has launched a massive programme of poultry farming spread over different states of India not only to cater to the

increasing demand for poultry products but also to provide a subsidiary source of income to the farmers (Patil et al., 1995).

Egg production ranks second in efficiency, in converting feed into food. The hen's egg is one of nature's greatest dietary inventions. It provides human with a source of all of the essential nutrients particularly vitamin B₁₂, a mixture of aminoacids that is the "Gold standard" for nutritionists (Farrell, 1997).

In growth of egg production, India has achieved a break through. The developing countries have progressed more rapidly than the developed countries during the last decades. (Bandyopadhyay, 1996). Within south Asia, India has recorded the highest annual growth rate of about 22.1% in chicken population and 8.8% in egg production during 1985 - 1990 (Reddy, 1994).

The poultry development in India, in terms of value of production has registered faster annual growth rate (10.68%) in comparison to livestock sector (6.22%), crop husbandry (4.22%) and Gross domestic product (7.14%) during 1980 - 1991 (Ravindra et al., 1996).

Tamil Nadu is one of the leading states in egg production because of the availability of technical and infrastructural facilities and also of ideal agroclimatic conditions. In Namakkal, there are about 18 million hybrid layer population, producing nearly 8 to 9 million eggs per day (Saminathan et al., 1996).

Marketing of eggs and chicken meat is one of the sensitive yet important areas of poultry industry, which allows the producer or farmer either to continue or get away from the activity (Rao, 1996).

It is mandatory that, in the marketing channel, a high quality has to be maintained in order that the product fetches a higher price and sustained demand. Supply of poor quality produce would soon precipitate in reduced consumer preferences and decreased demand. In case of eggs, besides marketing, it is equally essential to know whether the egg is fit for incubation or not (Sreenivasaiah, 1986).

Egg shell quality is a primary concern of the layer industry due to the economic losses associated with the incidence of inferior shell quality (Hamilton et al., 1979; Hamilton, 1982; Ronald, 1988).

Egg shell represents a packaging material to humans, for the hen it serves to protect and fortify the developing embryo during incubation (Leeson and clunies, 1988).

Egg shell breakage is still one of the main problems facing the poultry industry today. It has been reported that upto 10% of table eggs fail to reach the frying pan or mixing bowl. Much of this loss occurs in the chicken barn or during transportation and grading (Leeson and clunies, 1988).

The thicker the shell, the more resistant it is to breakage when eggs are subjected to rough handling. Egg with cracked shells are neither fit for incubation nor for marketing. Cracked shells allow easy entry to microbes followed by quick rotting of eggs. Very thin shelled or cracked eggs lose their weight faster and hence quickly deteriorate and are unfit for incubation. Any defect in the shell makes the egg unsuitable for incubation (Sreenivasaiah, 1986).

It is well known that the birds usually do not lay so well in their second laying year and in later years as in their first laying year. A decline of as much as 15 percent or more is considered normal, the decline being relatively greater each succeeding year in the case of general purpose breeds (Clark, 1940).

The mean weight of eggs laid during the second and third laying years is usually higher than the mean weight of eggs laid during the first laying year, the third-year mean weight being slightly lower than the second-year mean weight. As compared with birds in their second and later laying years, pullets in their first laying year are handicapped in the matter of annual egg weight, by the number of relatively small eggs they lay during the first 2 or 3 months (Hays, 1944).

Pullets in early lay produce small eggs with better shell quality than older hens. The age of birds is one of the factors affecting shell quality. The incidence of thin, porous or soft shelled eggs is higher with older hens (Ronald, 1984 and Ravichawla, 1996).

Every egg producer has his extra large eggs, after 45 or 50 weeks when his egg shell quality starts to go down (McErlane, 1997).

Most of our problems with shell strength are with eggs laid by older hens. The shell farming process "wears out" as the hens ages; in addition, older hens lay larger eggs which necessarily have thinner shells. Birds secrete only a finite amount of shell material, so that as the egg gets larger, the shell must get thinner (Leeson and clunies, 1988).

Calcium for the shell is derived either from the diet or from the body reserves but increasing the level of calcium and phosphorous in the diet can not improve shell quality (Keshavarz and Nakajima , 1993).

Absorption of calcium from the intestine cannot proceed rapidly enough regardless of the calcium concentration of the diet. During active shell secretion, calcium is withdrawn from the bone to be replaced during subsequent periods when the uterus is inactive (Leeson and Clunies, 1988).

The organic matrix is an important determinant of shell quality. Shell membranes undergo changes in amino acid composition as the bird ages, with subsequent effects on shell quality (Britton and Hale, 1977 and Blake et al., 1985).

A normal egg contains all the essentials necessary for the maintenance of life and is the most perfect single food unit known to man. The egg supplies 5 dietary essentials - proteins, fats, carbohydrates, minerals and vitamins. The nutritive excellence of the egg enhances the value of any food in which it is incorporated. Eggs' excellent contribution to nutritive needs make them especially important for children during growth period. The white of the egg is full of concentrated proteins and yolk contains two-thirds fat of high energy value and one-thirds proteins (Singh, 1990).

The protein in eggs is of exceptional quality. In fact, nutritionists use it as the standard for measuring all other forms of protein. The quality of protein depends on its biological value. The more the protein is absorbed, digested and used, the higher its biological value. The biological value of egg protein is 95% (Maxcell, 1984).

Egg is a good source of vitamins and minerals, provides 11% fat and meats 3- 4% of total caloric need of an adult (Sreevani and krishna kumar, 1994).

Internal egg quality attributes are mostly used in the grading of eggs. Grading is a classification of eggs according to characteristics that have an economic value.

Hence the objectives of the study are

(i) To analyse egg shell quality parameters like shell thickness, shell weight, shell calcium, cracked eggs and misshapen eggs, during the first year of the laying cycle, to assess the effect of age on shell quality.

(ii) To study the influence of age on nutritional parameters of the egg, particularly proteins, carbohydrates and fats.



Review of Literature



II. REVIEW OF LITERATURE

The literature related to the present study is presented under the following heads.

- i) Egg shell quality
- ii) Influence of age on egg shell quality
- iii) Nutritional parameters of the egg and the influence of age on nutritional parameters.

i) EGG SHELL QUALITY

The quality of the egg shell is of primary importance in marketing, for weak shelled eggs are more liable to break at all stages than eggs with good shells. Further the keeping quality of the internal contents of the egg depends to some extent on the quality of the shell. The climate and soil also seem to exercise some influence on egg shell quality. As a general rule, birds from a dry locality produce better shells than those from a wet locality (Nath, 1962).

Ahmed et al., (1984) reported that, many factors are involved in the shell quality viz, the thickness, porosity, roughness and colour. Among these, the shell thickness is the most important trait from the point of handling and transportation. Both thickness and porosity of the shell affects the hatching quality. Shell thickness varies with season. Thinner shell is seen mostly in summer. A strain must be selected which gives less chance for breakage of egg due to its good shell quality.

Current research programme involving radioactive calcium, indicating the active role of bone and its relative contribution of calcium to the egg shell, was studied by Leeson and clunies (1988).

The management practice of forced or induced moulting has been shown to improve egg shell quality and egg production in ageing flocks (Karunajeewa et al.,1989 and wakeling 1977).

Singh (1990) observed that the entire egg contains more than 2.0gms of calcium and 99% of its calcium is found in the shell.

Singh (1990) studied that the shell thickness is an indication of shell strength. Egg shells vary greatly in thickness. The thickness of a shell is correlated with the size of the egg and the bird. The egg shells are of most uniform thickness in winter but become thinner in summer season. The increasing temperature (environmental) above 21⁰ C results in a reduction in shell thickness. The nutritional factors like calcium, phosphorous, vitamin D, vitamin A and Zinc are important in the process of shell formation and influence shell thickness.

Electron microscopic observations were made by scientists at the Glasgow University to note the changes in egg shell structure of stressed hens. It was found that when the mamillary layer of the shell was formed under stress conditions it led to abnormalities in shell structure. In laying cages, if the number of birds was more than the

room available, a higher level of incidence of abnormal features in the shell structure was observed (Gaffar, 1994).

Choudary et al., (1994) observed that insecticide poisoning with Gamaxine (Benzene hexachloride) through damaged maize grains produce a number of shell less eggs, thin shelled eggs and chalky eggs.

Kulkarni and Thakur (1994) reported that the effect of egg weight was significant on shell weight, thickness, albumen width, yolk height, width and albumen and yolk weights. The haugh units showed increasing trend with the decreasing weight of egg. The albumen and yolk index did not show a definite trend with the change in the egg weight.

Lewis et al., (1994) observed that egg shell quality is negatively correlated with photoperiod, with shell weight decreasing by about 0.06g/h after adjustments have been made for age and genotype.

Brown (1995) observed that intermittent lighting programmes can be a useful tool in controlling excess feed consumption, egg size and nervous behaviour in caged layers. A properly used intermittent lighting programme can be very effective in improving body weight, uniformity of egg size, reducing electricity usage, feed intake, maintaining egg size and slightly improving egg shell strength.

Hess and Lein (1995) observed that in the table-egg layers, alterations in dietary nutrient levels have been shown to significantly increase egg shell thickness and control the normal increase in egg size that occurs as hens age, thus reducing the number of cracked eggs.

Housing systems did not influence egg quality traits (albumen height, haugh units, yolk colour, shell thickness and density) markedly, although significant differences occurred. Genotype of layers influenced egg quality traits more as did housing systems (Suto et al., 1996).

Roberts (1996) reported that providing cooled drinking water for laying birds during periods of heat stress, not only benefits their general health, but also improves shell quality. The quality of the egg shells was assessed using traditional measures of shell quality, as well as examining the incidence of ultrastructural features of the mamillary layer, normally thought to be associated with poor shell strength and quality.

Sankaralingam et al., (1996) studied the effect of shape index on hatchability. They concluded that, there is a trend for the eggs with shape index more than 70 to have better hatchability than the eggs having lesser shape index values.

Nys (1996) observed that high temperature, exceeding the optimum ambient temperature of 24⁰C for extended periods, reduce feed consumption as well as egg

production and quality in layers. Lower egg shell quality results from decreased calcium consumption, but is mainly the consequence of respiratory alkalosis induced by hyperthermia. An increased level of dietary calcium has little effect on shell quality, but the use of coarse calcium particles such as limestone or marble chips partly restores the decline in quality and could increase feed consumption under high temperature conditions.

Ravichawla (1996) found that 30 - 40% of all egg shell damage, irrespective of the mineral content of drinking water consist of eggs with very thin cracks. The significance of this lies in the fact that it is very difficult to defect these eggs by normal egg candling procedures.

Hunton(1997) studied the problem of saline drinking water in Australia, where many water sources contain upto 2g NaCl/ L. Both ultrastructural and conventional measures of shell quality were adversely affected by saline drinking water. Further research showed that some of these effects could be largely reversed by the addition of zinc compounds to the drinking water.

ii) INFLUENCE OF AGE ON EGG SHELL QUALITY

Ronald (1980) studied that the egg weight increased as the birds aged, however shell weight remained fairly constant throughout the experiment.

Banerjee (1980) observed that, birds which mature early, such as those reared during increasing daylength, will lay smaller eggs than birds reared on a constant daylength or a decreasing day length. He also reported that birds at 20 to 26 weeks of age will lay smaller eggs than at 40 to 50 weeks. Maximum egg size can be expected when the birds reach about one year old. Egg size tends to get smaller just before birds stop laying.

Ramani (1984) observed that age of birds is one of the factors affecting the shell quality. The incidence of thin, porous or soft shelled egg was higher with older birds.

Belyavin (1986) observed that, one problem facing producers is the apparent decline in shell strength with age in commercial laying flocks, which results in increasing down-grading of eggs. Some say, it is "Just old age" and nothing can be done about it. This seems unlikely as chickens are not old after one period of lay. A further cause is said to be that modern hens have "burnt themselves out" by the end of the laying period. Other explanations are that it is a decline in the efficiency of calcium utilization and also that a fixed weight of egg shell is being stretched around an ever increasing size of egg.

Ronald (1986) reported that, the occurrence of eggs with poor shell quality in old laying hens or for hens with egg shell problems. They recommended calcium, in the form of either limestone or oyster shell, both in large size depending on the severity and type of problem.

Leeson and clunies (1988) observed that most of the problems with shell strength are with eggs laid by older hens. The shell forming process 'wearsout' as the hen ages, in addition, older hens lay larger eggs which necessarily have thinner shells. Birds secrete only a finite amount of shell material , so that as the egg gets larger, the shell must get thinner.

Talukdar and Nandre (1990) observed that, since the eggs got larger as the birds aged, thus constant amount of calcium deposition had to be spread thinner around the egg forcing the egg shell to become thinner. This may be the primary reason, for the decline in shell quality as the hen ages. As the hen ages, shell quality declines because

- 1) Her ability to absorb calcium decreases
- 2) Her ability to mobilize skeletal calcium decreases and
- 3) Her genetic potential for production has increased at a faster rate than her ability to maintain adequate shell deposition.

Hess and Lein (1995) reported that the egg shell quality is vital in broiler breeder production because it maintains optimum hatchability, minimizes contamination of eggs during incubation and ensures higher quality chicks. Shell quality generally declines as breeders age and temperature increases and poor shell quality causes excessive moisture loss during incubation.

Faria et al., (1996) studied about the egg shell quality, mainly in the hens more than 50 weeks old and in hot climates. They concluded that both diurnal feed restriction and oyster shell supplementation did not result in better egg shell quality in terms of shell breakage, shell thickness and specific gravity.

Oliveria et al., (1996) studied about the dietary calcium level, particle size and feeding programmes of limestone on egg quality in laying hens in the second cycle. They reported that the egg output and the quality were reduced with the age of the birds. The particle size of limestone improved egg shell quality in the end phase. In the initial phase they reduced the egg losses.

iii) NUTRITIONAL PARAMETERS OF THE EGG AND THE INFLUENCE OF AGE ON NUTRITIONAL PARAMETERS

Jull (1958) reported that the egg is composed largely of proteins and lipids, two of the most important dietary essentials. The egg is a poor source of carbohydrates. They also observed that the yolk vary in colour from pale straw colour to deep reddish yellow or orange. The size of the yolk influences the size of the finished egg. There is less wastage in marketing eggs of good quality than in marketing those of poor quality. Quality is at its best in fresh-laid eggs. When eggs are held in too high temperature during the early holding period, water from the albumen not only evaporates through the shell but also passes through the vitelline membrane to the yolk. The enlargement of yolk tends to

stretch and weaken the viteline membrane. As the egg deteriorate in quality the thick white tends to break down into thin white and the yolk becomes more mobile.

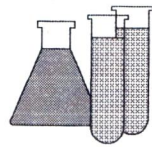
The internal contents of the egg consists of yolk surrounded by albumen or white. The percentages of the three ordinarily visible parts of the egg are shell 11, yolk 30, and white 59. The percentages of constituents of the whole egg are, water 65.9, protein 12.83, minerals 10.70 and fat 10.6. The quality of the white deteriorates with the age of eggs. Thin white is a sign of age and when it is very thin, the yolk is not held in position in the unbroken egg, so that the egg, when candled, shows a sided and sunken yolk resulting in its down grading (Nath, 1962).

Krishnappa and Reddy (1984) observed that fat is almost concentrated in the yolk in the form of emulsion. The proportion of unsaturated fatty acids are high in the egg.

The proteins are present in every part of the egg. The chief sources of proteins in the egg are the albumen (50%) and yolk (44%) and only a small amount is present in the shell and shell membrane. The egg contains only 1% of carbohydrates of the total egg contents. The energy values of the egg varies with the size of the eggs. A standard sized egg (58g) yields 93cal of energy. The lipids are concentrated in the egg yolk. The egg yolk contains two - thirds fat of high energy value and one- thirds protein of phosphorous containing type (Singh, 1990).

Singh (1996) reported that the egg white is not a homogeneous mass. There are at least 4 layers of albumen and total egg white is 58 percent of egg weight. Immediately under the inner shell membrane, there is a layer of 'thin albumen' which constitutes about 21 percent of total egg white. This layer is followed by a firm or thick layer of albumen. It is a major layer and constitutes about 55 percent of total egg white. There is another layer below the thick albumen referred as inner thin albumen which is about 17.5 percent of total egg white. This layer is followed by chalaziferous layer of thick albumen which surrounds the yolk. The inner thick white together with chalazae forms only 3 percent of total egg white.

Sharma and Bhatti (1996) observed the effect of forced moulting in layers on the interior quality of eggs. They found that the interior quality of eggs can be improved by forced moulting, providing 15 to 17 percent protein in ration.



Materials and Methods

III. MATERIALS AND METHODS

The present investigation deals with the evaluation of egg shell quality and selected nutritional parameters related to the age of fowls in poultry. The work was carried out on eggs obtained from white leghorn, the babcock layer Br-300, maintained at ACN poultry farm in Appanaikkanpalayam near Thudialur 10kms away from the Coimbatore city (Fig.1). The eggs were collected from 23,36,53, 66 and 75 weeks old layers from the month of May 1997 to April 1998. For better results eggs were collected from the same batch of flocks.

EGG SHELL QUALITY

The egg shell quality was assessed by observing the following parameters.

SHELL THICKNESS

Shell thickness was recorded to an accuracy of 0.01mm by a precision screw gauge after peeling off the shell membranes (Fig. 2).

SHELL WEIGHT

The eggs were broken without spoiling the shell. The shell membranes were removed. The shells were dried at room temperature and weighed in an electronic balance.

SHELL CALCIUM

The calcium present in the egg shell was estimated by versenate (EDTA) titration method.

REAGENTS

Standard calcium solution - 0.01N

0.005 g of pure calcium carbonate (dried at 105⁰C for two hours) was dissolved in minimum quantity of 0.2N Hydrochloric acid. The solution was boiled to expel carbon dioxide, cooled and diluted to one litre.

Standard EDTA solution - 0.01N

2g of Ethylene Diamine tetra Acetic Acid (EDTA) - Di sodium salt was dissolved in water and diluted to one litre.

Patton Reeder's reagent (Calcium indicator)

0.5 g of patton and Reeder's reagent was titrated with 50g of anhydrous sodium sulphate.

Potassium cyanide - 3.5% solution

3.5 g of potassium cyanide was dissolved 100ml of water.

Potassium hydroxide - 50% solution

50g of potassium hydroxide was dissolved in water and diluted to 100ml.

Hydroxyl amine hydrochloride - 5% solution

5g of Hydroxylamine hydrochloride was dissolved in water and diluted to 100ml.

PROCEDURE

The egg shell was ground well to the size of 10 microns and 0.3g was taken in a conical flask. 5ml of perchloric acid: Nitric acid mixture (1:3) was added and was digested for one hour after placing a funnel on top of the conical flask, till the coming out of white fumes. The digested solution was diluted to 100ml with distilled water in a volumetric flask.

5ml of the digested solution was taken in a porcelain dish. To the solution 3ml of Hydroxylamine hydrochloride, 4ml of potassium hydroxide and 3ml of potassium cyanide were added and the volume was made up to 30ml with distilled water. A few drops of Patton Reeder's reagent was added as an indicator, and was titrated against 0.01N EDTA di-sodium salt solution. The end point was the colour change from whitish red to blue.

CALCULATION

$$\text{Ca in me \%} = \frac{\text{Titre value} \times \text{Normality of EDTA} \times 100}{\text{wt}}$$

$$= \frac{\text{Titre value} \times 0.01 \times 100}{\text{wt}}$$

$$\text{Ca in percent} = \frac{\text{Titre value} \times \text{Normality of EDTA} \times 100 \times 20}{\text{wt} \times 1000}$$

SHELL CRACKS

40 eggs collected at random from each of the selected age groups (23,36, 53, 66 and 75 weeks) were examined for shell cracks. All eggs were manually inspected to detect thin cracks which became visible when slight pressure was applied to the egg shell. When the pressure was removed the egg shell reverted to a normal appearance. The cracks other than very thin cracks were observed visually (Fig 3) . From the observations the percentage of cracked eggs in each age group was calculated.

SHAPE INDEX

Before breaking open the eggs the longest length and broadest breadth of the eggs were measured by using a slide calipers (Fig .4 and Fig.5). Then the shape index was calculated using the given formula.

$$\text{shape index} = \frac{\text{breadth}}{\text{length}} \times 100$$

NUTRITIONAL PARAMETERS

The nutritional parameters of the eggs analysed were proteins, fats and carbohydrates.

ESTIMATION OF TOTAL PROTEINS

Protein in the sample was estimated by Nitrogen method.

REAGENTS

Con. Sulphuric acid

Potassium sulphate

Mercuric oxide

Sodium hydroxide - sodium thiosulphate solution.

600g of sodium hydroxide and 50g of sodium thiosulphate ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$) were dissolved in distilled water and made up to one litre.

Indicator solution

0.2 g of methyl red was dissolved in 100ml of ethanol. 0.2g of methylene blue was dissolved 100ml of ethanol. For mixed indicator, two parts of methyl red solution were added to one part of methylene blue solution.

Boric acid (4% solution)

Standard hydrochloric acid or sulphuric acid, 0.09N.

PROCEDURE

5 ml of the sample was taken. 0.02g of mercuric oxide, 0.5g of potassium sulphate and 2.5ml of concentrated sulphuric acid were added to the sample and the mixture was digested at 300°C for 2 ½ hours to get a clear solution. The digested solution was cooled for 10minutes and 100ml of distilled water was added.

The digested solution was distilled with 50% sodium hydroxide- sodium thiosulphate solution in microkjeldhal distillation unit. The distillate was collected in 5ml of 4% boric acid having two drops of methyl red and methylene blue indicator. The distillate was collected and the colour of the solution was changed to green. 25ml of the distillate was collected.

The distillate was titrated against 0.09N hydrochloric acid and the end point was the change of colour from green to pink or red.

CALCULATION

$$1 \text{ ml of } 1\text{N HCl} \quad \equiv \quad 14\text{mg N}_2$$

$$\equiv \quad 0.014\text{g N}_2$$

$$\% \text{ N}_2 \quad = \quad \frac{\text{Titre value} \times 0.014 \times 0.09\text{N} \times 100}{5\text{ml}} \quad \times \quad 6.25$$

[6.25 is the conversion factor for protein from samples other than fruits and pulses]

ESTIMATION OF TOTAL FAT

Total fat present in the sample was estimated by chloroform methanol mixture method.

REAGENTS

Chloroform : methanol mixture (3 :1)

PROCEDURE

5ml of the sample was taken and ground well with 5ml of chloroform : methanol mixture. The homogenate was centrifuged and was taken in a small weighed beaker and this beaker was placed inside a large beaker and filled with water along the sides and kept overnight without any disturbance. In between the methanol with dissolved protein layer and chloroform with dissolved fat , a white precipitate was formed. The methanol layer was removed without disturbing the chloroform layer. Then the chloroform was evaporated in an oven at about 60⁰C. The beaker was weighed.

CALCULATIONS

Amount of total fat present in the sample = final weight - initial weight.

ESTIMATION OF TOTAL CARBOHYDRATES

The carbohydrates in the sample was estimated by phenol sulphuric acid method.

REAGENTS

Phenol 5% redistilled (reagent grade)

Phenol(50g) was dissolved in distilled water and diluted to one litre.

Sulphuric acid 96% (reagent grade)

Hydrochloric acid, 2.5N

Sodium carbonate

Stock standard glucose

100mg of glucose was dissolved in 100ml of distilled water.

Working standard solution

10ml of stock was diluted to 100ml with distilled water.

PROCEDURE

5ml of the sample was taken in a test tube. It was hydrolysed by keeping it in a boiling water bath, for 3 hours, with 5ml of 2.5N hydrochloric acid and was cooled to room temperature. Then the sample was neutralised with solid sodium carbonate until the effervescence was ceased. The solution was made upto 100ml with distilled water and centrifuged for half an hour. 0.2ml of the supernatant was taken in a test tube and the volume was made upto 1ml with distilled water.

0.2ml, 0.4ml, 0.6ml, 0.8ml and 1.0ml of the glucose working standard solution was taken in a series of test tubes. The solution in each tube was made upto 1ml with distilled water. A blank was also set up with 1ml of distilled water.

Then 1ml of phenol solution was added in each tube including blank. To all the test tubes, 5ml of 96% sulphuric acid was added and shaken well. After 10 minutes contents in the test tubes were shaken thoroughly and the tubes were placed in the boiling water bath at 25° - 30° C for about 20 minutes. Then the tubes were cooled and the

colour developed was read in colorimeter at 490nm. The total carbohydrate present in the sample was calculated by using the standard graph.

CALCULATION

Absorbance corresponding to 0.2ml of the sample

$$= X \text{ mg of glucose}$$

100ml of the sample solution contains

$$= \frac{X}{0.2} \times 100 \text{ (mg of glucose)}$$

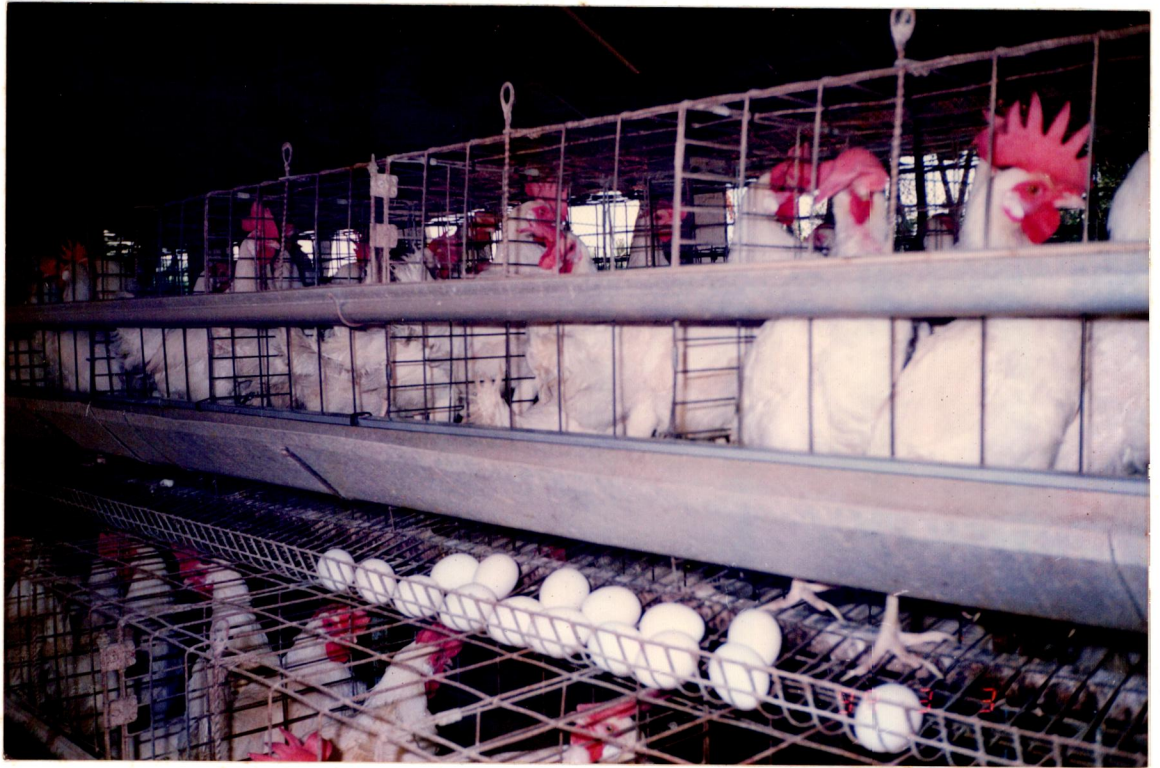


FIG - 1. POULTRY FARM IN APPANAIKKANPALAYAM

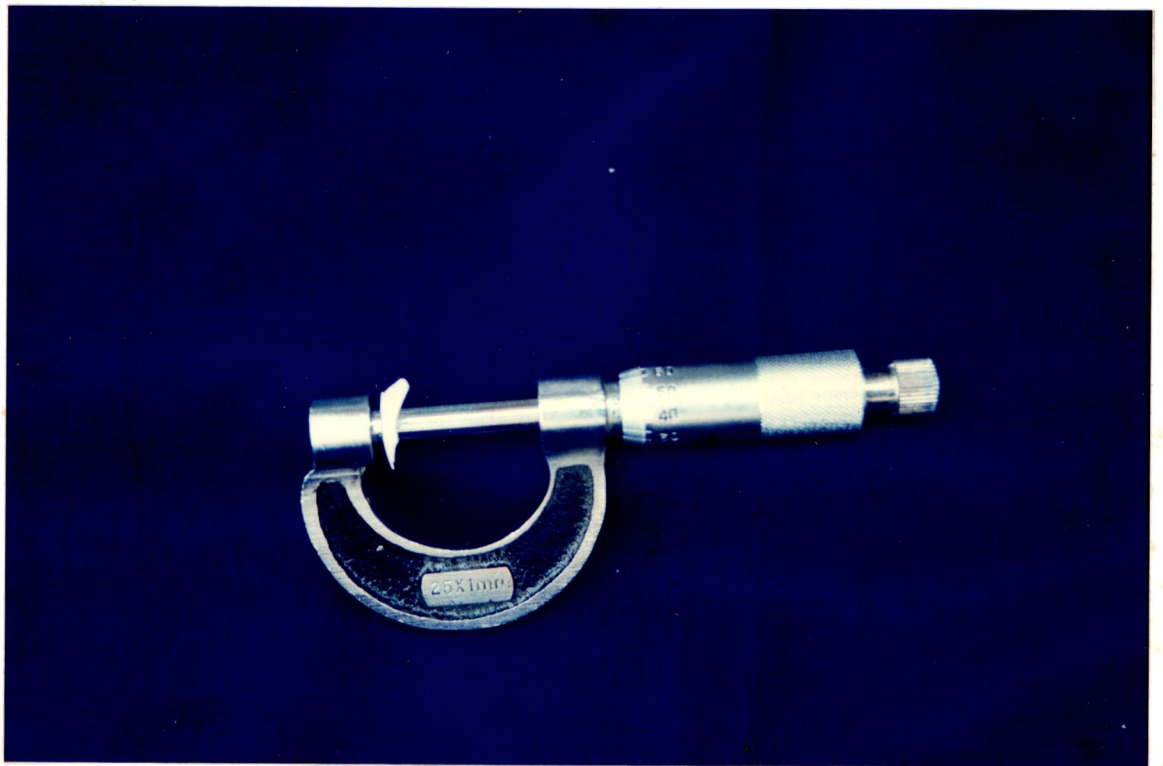


FIG - 2. MEASUREMENT OF SHELL THICKNESS USING SCREW-GAUGE

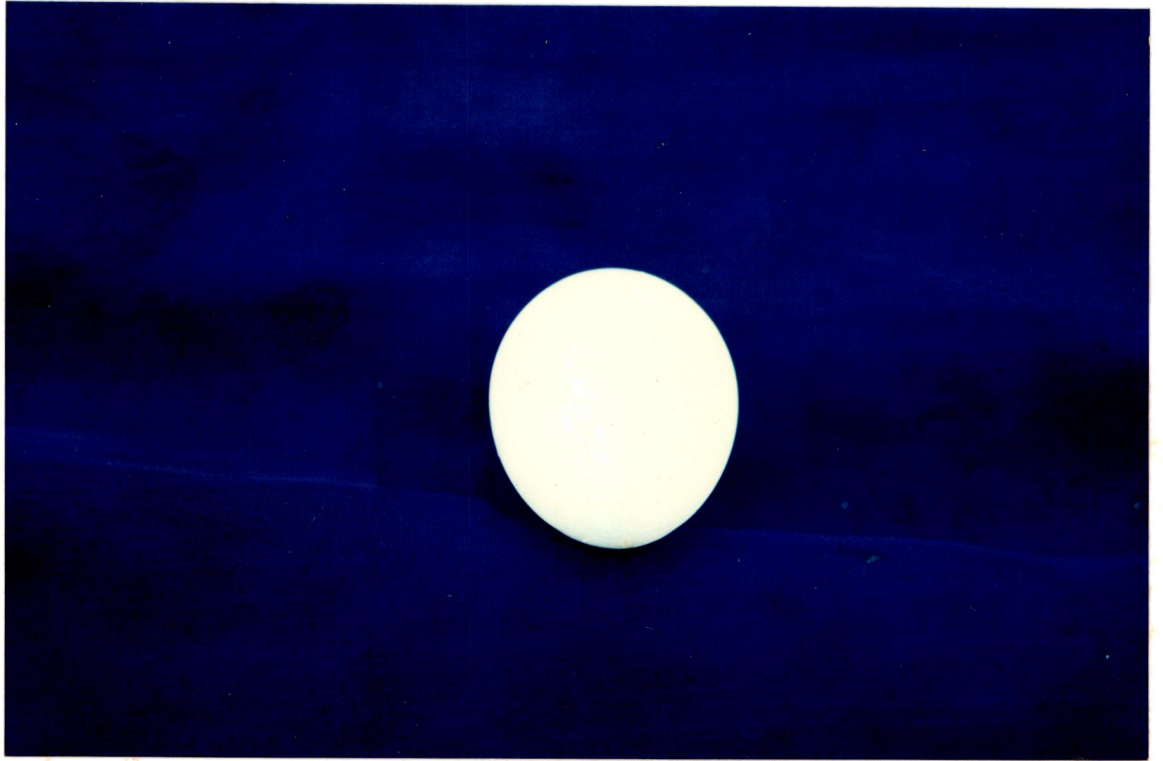


FIG - 3. PRESENCE OF CRACK IN AN EGG SHELL

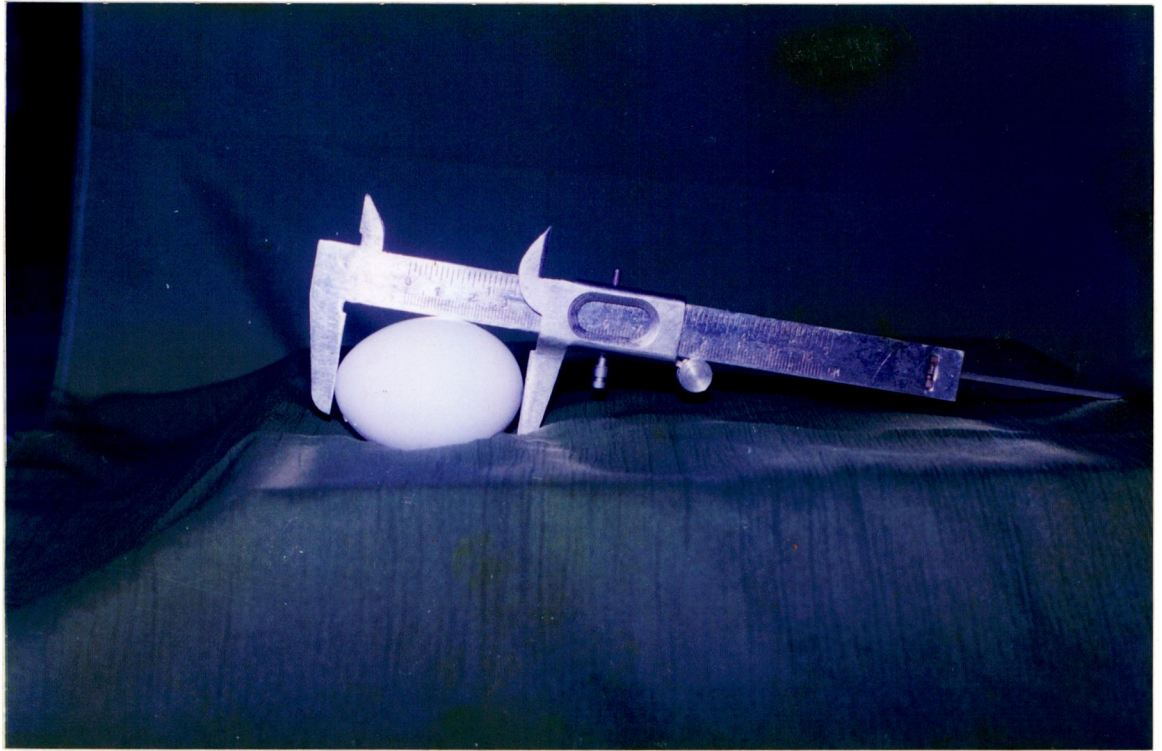


FIG - 4. MEASUREMENT OF EGG LENGTH USING VERNIER CALIPERS

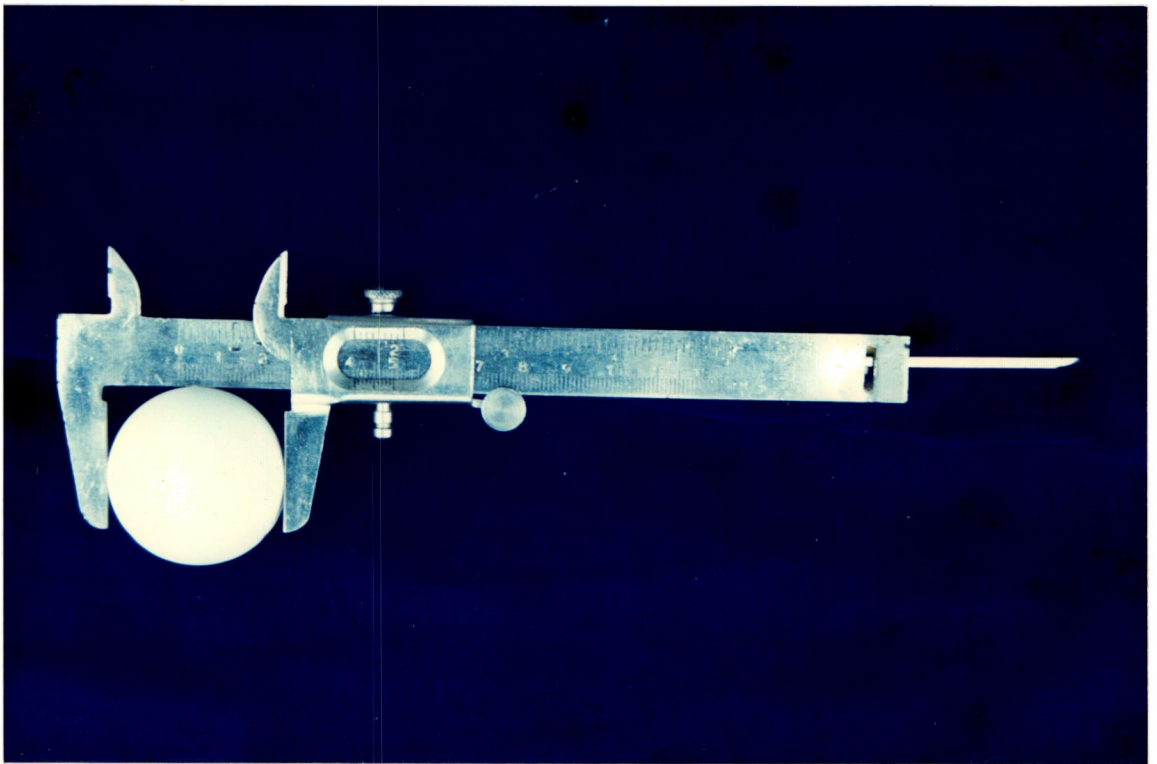


FIG - 5. MEASUREMENT OF EGG BREADTH USING VERNIER CALIPERS



Results



IV. RESULTS

In the present study, the egg shell quality and selected nutritional parameters related to age were analysed during the first year of the laying cycle. The shell quality parameters observed were shell thickness, shell weight, shell calcium, shell cracks (%) and shape index. The observations were presented in Table I. The selected nutritional parameters of the egg contents include proteins, carbohydrates and fats. The results were given in Table II.

SHELL THICKNESS

The shell thickness was found to be 0.40 ± 0.0334 at 23 weeks, 0.42 ± 0.0311 at 36 weeks, 0.38 ± 0.0289 at 53 weeks, 0.36 ± 0.0252 at 66 weeks and 0.35 ± 0.0212 at 75 weeks. During the first year of the laying cycle shell thickness was found to decrease gradually as the hens aged. The decrease was observed from 53 weeks onwards (Fig.6).

SHELL WEIGHT

The shell weight was 5.81 ± 0.0158 at 23 weeks, 6.75 ± 0.0277 at 36 weeks, 6.75 ± 0.029 at 53 weeks, 6.77 ± 0.0289 at 66 weeks and 6.76 ± 0.0283 at 75 weeks. An increase in shell weight was observed from 23 to 36 weeks. The shell weight remained fairly constant from 53 to 75 weeks (Fig.7)

SHELL CALCIUM

The egg shell calcium constituted about 40% of the total egg shell weight at 23 and 36 weeks. At 53 weeks it was about 39% of the total shell weight. It constituted about 38% at 66 and 75 weeks. The egg shell calcium remained more or less constant during the study period (Fig. 8).

SHELL CRACKS (%)

The incidence of cracked eggs was found to increase with the age of hens. The observed results were, 6 , 6 ,10, 12 and 15 % at 23, 36, 53, 66 and 75 weeks respectively(Fig.9).

SHAPE INDEX

The shape index ranged from 73.10 to 73.22 with an average of 73.17 at 23 weeks from 74.71 to 74.73 with an average of 74.72 at 36 weeks, from 74.72 to 74.88 with an average of 74.81 at 53 weeks, from 72.85 to 72.93 with an average of 72.89 at 66 weeks and from 74.67 to 74.77 with an average of 74.71 at 75 weeks. In the present study the shape index was found to be normal and there was no incidence of misshapen eggs.

PROTEINS

The total protein was found to be about 12.8% of the total egg contents at 23 weeks, 12.64% at 36 weeks, 12.08% at 53 weeks, 12.53 % at 66 weeks and 12.28% at 75 weeks.

FATS

The total fats constituted about 10.6% of the total egg contents at 23 weeks, 10.8% at 36 weeks, 10.2% at 53 weeks, 9.9% at 66 weeks and 10.0% at 75 weeks of age.

CARBOHYDRATES

The total carbohydrates formed about 1.4% the egg content at 23 weeks, 1.2% at 36 weeks, 1.0 % at 53 weeks, 1.25 % at 66 weeks and 1.3 % at 75 weeks of age.

The concentration of total proteins, fats and carbohydrates remained almost constant during the first year of the laying cycle (Fig.10, Fig.11 and Fig.12).

TABLE I

SHELL QUALITY PARAMETERS RELATED TO AGE OF HENS

S.No	Age in Weeks	Shell Thickness (mm)	Shell Weight (g)	Shell Calcium (%)	Shell Cracks (%)	Shape Index (%)	
		n = 6	n=6	n = 6	n = 40	range n = 6	mean ± S.D
1	23	0.40 ± 0.0334	5.81 ± 0.0158	40	6	73.10 - 73.22	73.17 ± 0.0456
2	36	0.42 ± 0.0311	6.75 ± 0.0277	40	6	74.71 - 74.73	74.72 ± 0.0242
3	53	0.38 ± 0.0289	6.75 ± 0.0294	39	10	74.72 - 74.88	74.81 ± 0.0563
4	66	0.36 ± 0.0252	6.77 ± 0.0289	38	12	72.85 - 72.93	72.89 ± 0.0279
5	75	0.35 ± 0.0212	6.76 ± 0.0283	38	15	74.67 - 74.77	74.71 ± 0.0344

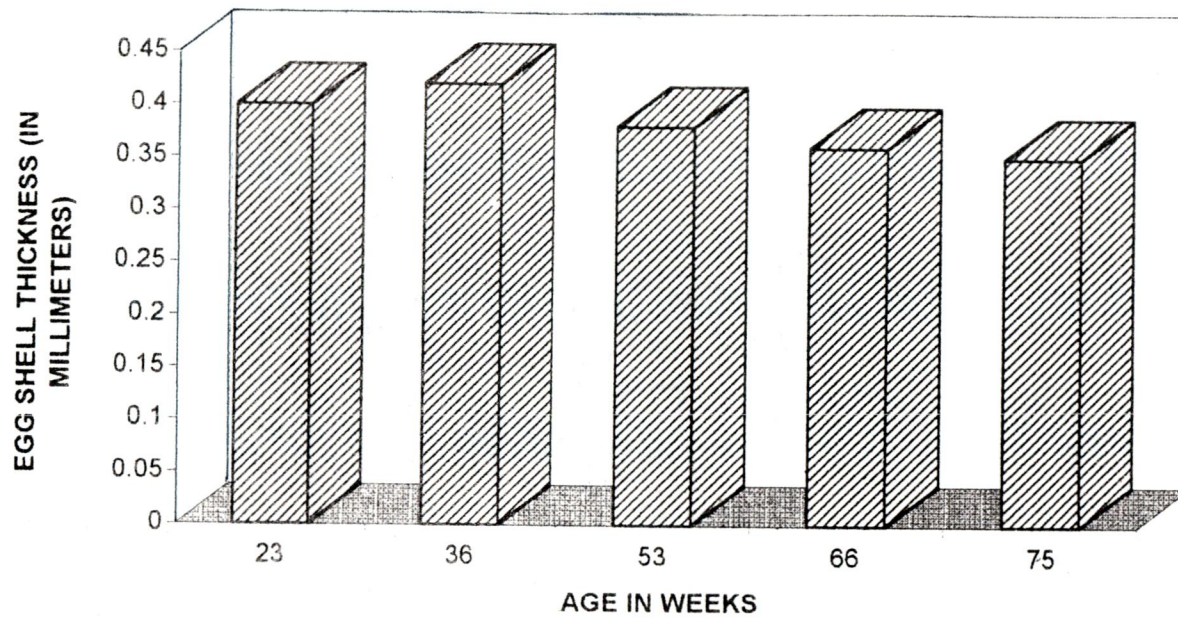
Note : Shell Calcium is expressed as percentage of the total shell weight.

TABLE II

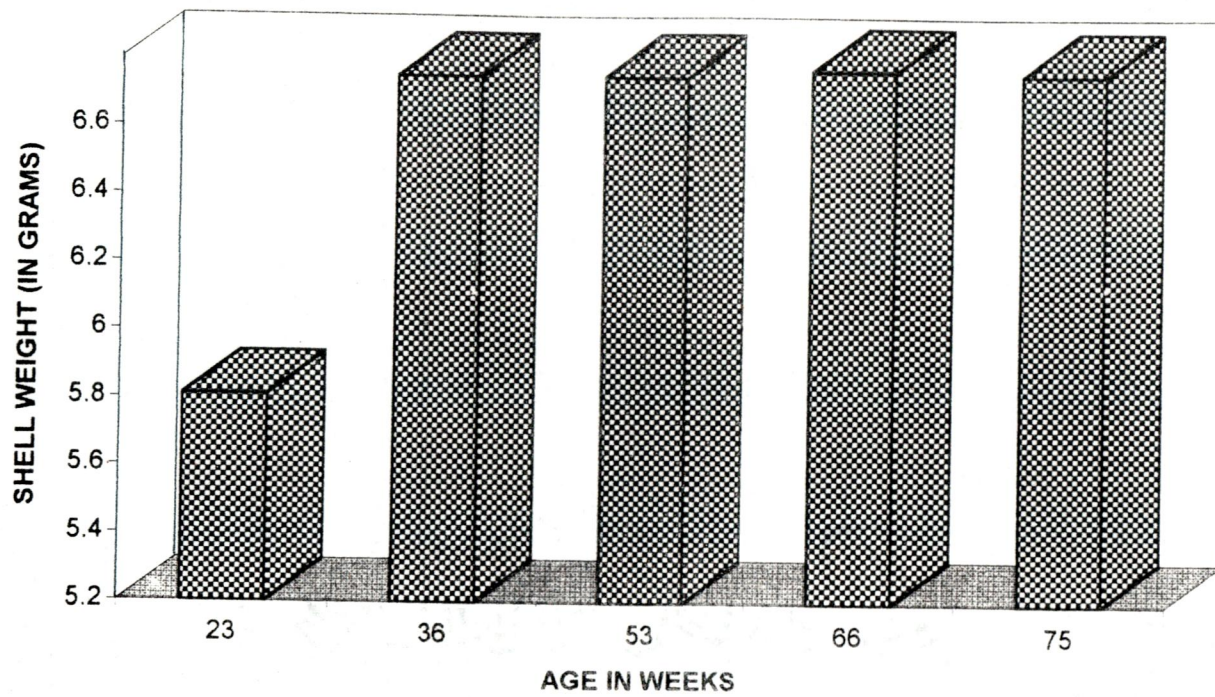
NUTRITIONAL PARAMETERS RELATED TO AGE OF HENS

S.No	Age in weeks	Egg weight (grams)	Proteins (%)	Fats (%)	Carbohydrates (%)
1	23	46.95 ± 0.0294	12.80	10.60	1.4
2	36	56.54 ± 0.0292	12.64	10.80	1.2
3	53	66.31 ± 0.0389	12.08	10.20	1.0
4	66	67.44 ± 0.0372	12.53	9.90	1.25
5	75	68.02 ± 0.0424	12.28	10.00	1.3

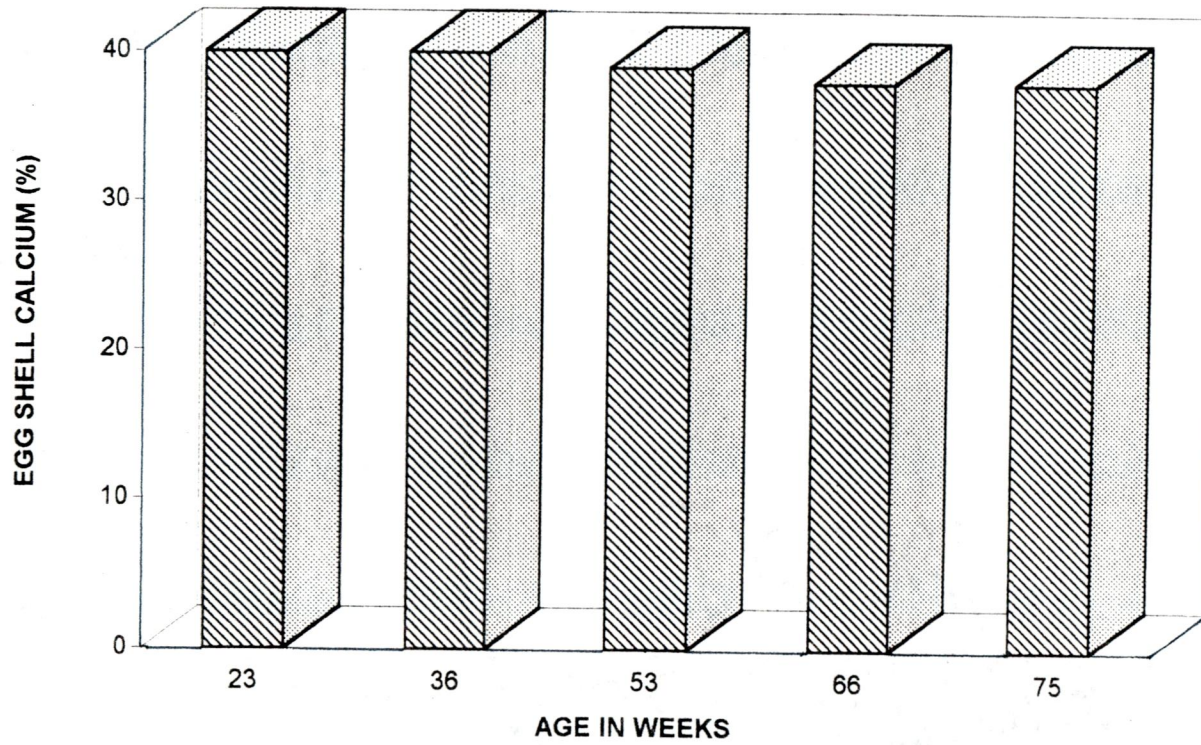
Note : Proteins, Carbohydrates and fats are expressed as percentages of the total egg contents.



**FIG 6. EGG SHELL THICKNESS RELATED TO AGE OF HENS
(IN MILLIMETERS)**



**FIG - 7 EGG SHELL WEIGHT RELATED TO AGE OF HENS
(IN GRAMS)**



**FIG - 8 EGG SHELL CALCIUM RELATED TO AGE OF HENS
(EXPRESSED AS % OF THE TOTAL SHELL WEIGHT)**

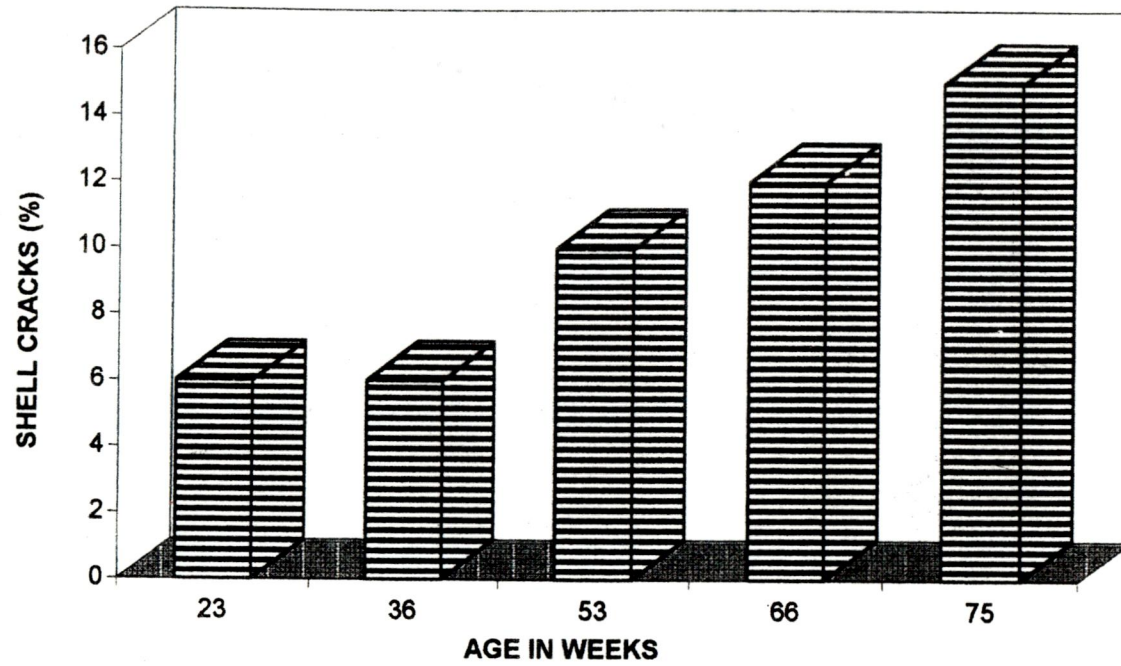
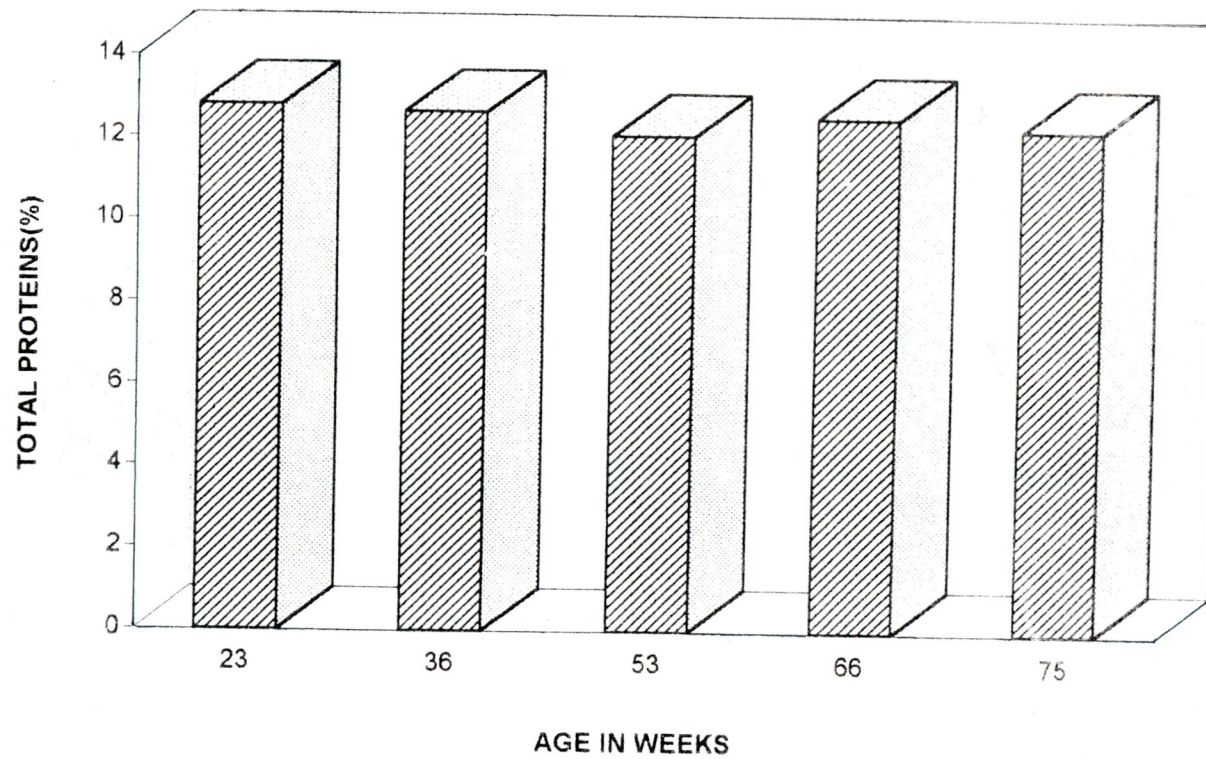


FIG - 9 SHELL CRACKS RELATED TO AGE OF HENS (EXPRESSED AS %)



**FIG - 10. TOTAL PROTEINS IN THE EGG CONTENTS RELATED TO AGE OF HENS
(EXPRESSED AS % OF THE TOTAL EGG WEIGHT)**

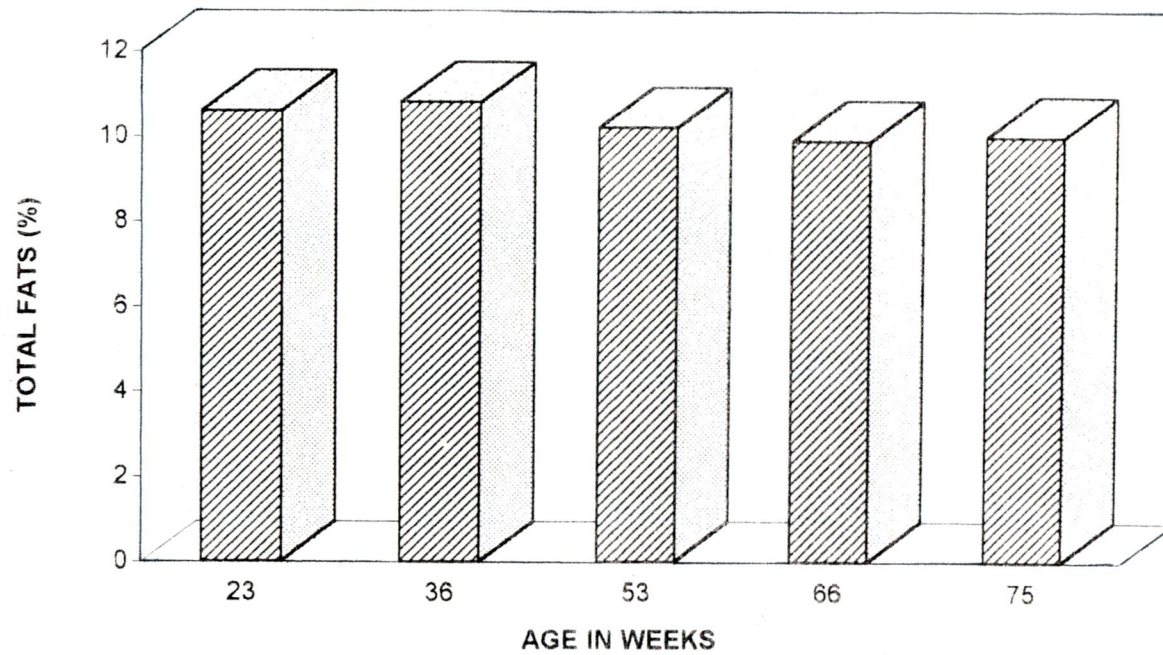
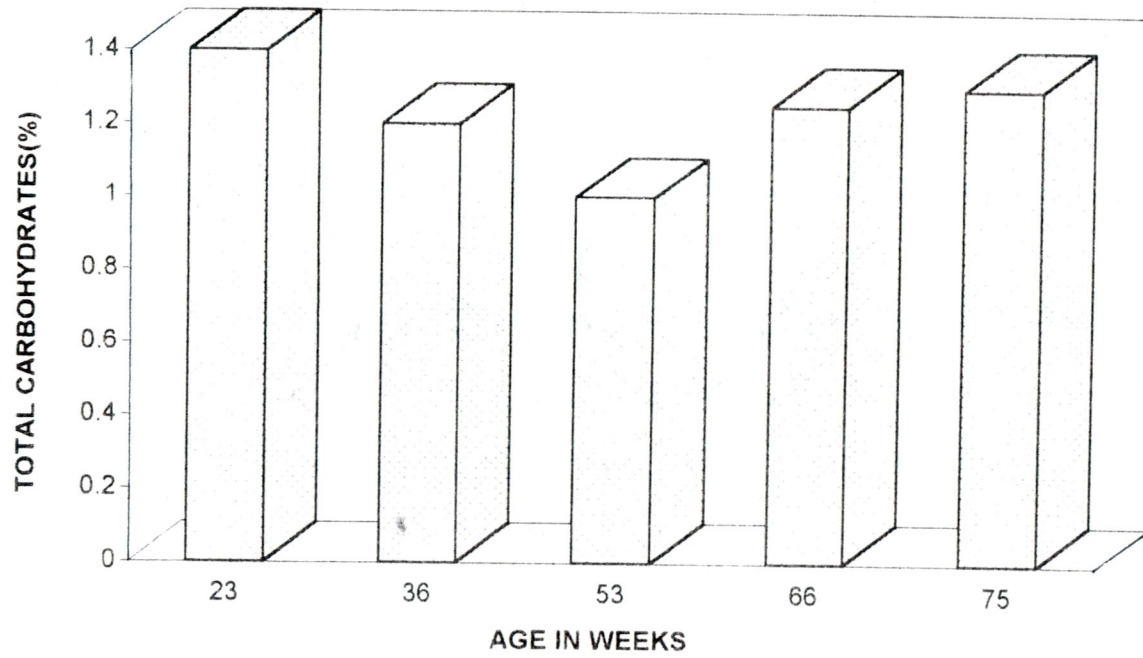


FIG - 11. TOTAL FATS IN THE EGG CONTENTS RELATED TO AGE OF HENS (EXPRESSED AS % OF THE TOTAL EGG CONTENT)



**FIG - 12. TOTAL CARBOHYDRATES IN THE EGG CONTENTS RELATED TO AGE OF HENS
(EXPRESSED AS % OF THE TOTAL EGG CONTENT)**



Discussion



V. DISCUSSION

Few products come as neatly packed as does the egg. This unique food not only comes in convenient meal size portions, but also encased in a durable hygienic and biodegradable shell. Despite this inherent strength of the shell, which is related to its geometric design, egg shell breakage is still one of the main problems facing the poultry industry today. It has been reported that upto 10% of table eggs fail to reach the frying pan or mixing bowl. Much of this loss occurs in the chicken barn or during transportation and grading. Most of our problems with shell strength are with eggs laid by older hens (Leeson and clunies, 1988).

In attempting to reduce the financial loss from egg breakage, shell quality deterioration in older hens were evaluated. For better understanding of shell quality, shell structure and some of the basic mechanisms of shell formation are mentioned here.

SHELL STRUCTURE

Shell is a hard covering of egg. It is made up of almost entirely of calcium carbonate deposited on an organic matrix consisting of protein and mucopolysaccharides. The shell is intimately bound by the shell membranes on the insides. It is attached to the shell membranes by numerous conical extensions on its inner surface, the tips of which are actually embedded in the fibres of the membranes. Permeating the shell are numerous pores (7000 -8000 pores) which are funnel shaped, 6-23 μ at their inner end and 15-65 μ

at their mouths. The outer surface of the shell is covered by an organic cuticle which is about 10μ thick and lies over the mouths of pores. The cuticle seals the pores and is useful in reducing moisture losses and preventing bacterial penetrations through the egg shell. The egg shell is translucent when the egg is laid but becomes opaque as soon as it dries (Singh, 1990).

SHELL FORMATION

The laying hen is a long day breeder, responding sexually to an increase in day length. Almost immediately after laying an egg, the bird will release the next ovum, or yolk, for the egg to be laid the next day. After release from the ovary, the yolk travels down the oviduct collecting successive layers of albumen and membranes until, it reaches the uterus where the shell will be deposited.

During the 24 hour cycle of the process, the egg will spend 15 to 16 hours in the uterus receiving its shell, which is composed mainly of calcium carbonate so that there is a heavy demand for this nutrient while the shell is forming. Unfortunately for the birds, the period of active shell secretion partially coincides with the period of darkness when the birds will not eat. The mean rate of calcium deposition is well over 100mg / hr. Since the total blood pool of the hen contains only 25mg, there must be a total turnover of blood calcium each 15 minutes. The fundamental source of this calcium is the bird's food, yet the mechanism of getting this to the shell gland is not simple.

Absorption of calcium from the intestine cannot proceed rapidly enough regardless of the calcium concentration of the diet. In order to solve this problem, the bird has developed specialized calcium stores throughout its skeleton, called medullary bone, this marrow like tissue occurs mainly in the long bones and will readily give up its concentrated store of calcium. During active shell secretion, calcium is withdrawn from the bone to be replaced during subsequent periods when the uterus is inactive (Leeson and clunies, 1988).

The breed of hen from which the eggs were obtained for the present study is worth mentioning.

WHITE LEGHORN

It is a mediterranean breed. OF the breeds of Italian origin, the leghorn is by far the most popular. Poultry breeders in America and England have developed leghorns into really good layers. The fowls are lighter in body weight than those of Asiatic breeds. The first importation of leghorn into U.S.A was in 1835 from Italy while the U.K imported it later. The breed is famous for the compactness of the various sections of body, uniform blending and pretty carriage. The leghorn includes various colour varieties, the best known of which are the white, brown and black. The white leghorn has become the favourite on account of its excellent laying qualities.

In India, the white leghorn has given good results, especially in the drier parts of the country, but is not regarded as suited for heavy or wet soils or for hills. In India,

about 40 years ago white leghorn fowls were introduced by christian missionaries and fanciers in U.P, Travancore, cochin and few other states; the indigenous non-descript fowls in the villages were graded up with the white leghorns. In towns and cities, pure-bred strains of the leghorn are raised in numbers and kept for egg production. Today, white leghorn is one of the most popular breeds throughout the plains of India. They commence laying at about 20 to 21 weeks of age.

INFLUENCE OF AGE ON SHELL QUALITY

The term quality refers to that inherent property of any product which determines the degree of excellence and those condition which the consumer wants and for which he is prepare to pay (Sreenivasaiah, 1986).

In case of eggs besides marketing it is equally essential to know whether the egg is fit for incubation or not. The factors that deteriorate egg shell quality are the age of the layers, heat stress in hot environmental temperatures, saline drinking water, the ingestion of different levels of mycotoxins and low dietary calcium (Roberts, 1996).

Age of birds is one of the factors affecting the shell quality. The incidence of thin, porous or soft shelled eggs is higher with older hens. The difference between poor egg shell and good egg shell quality interms of economic returns for a producer includes weak shells, cracked eggs and misshapen eggs. Hence the important shell quality

estimates are the following; shell thickness, shell weight, shell calcium, incidence of cracked eggs and misshapen eggs.

SHELL THICKNESS

From the results it is evident that shell thickness starts to decrease from 53 weeks onwards, indicating that the findings are similar to that of McErlane (1997). He has reported that egg shell quality starts to go down after 45 - 50 weeks when egg size starts to increase and hence advocated the addition of Eggshell 49, a combination of proteinated trace minerals, in feed of hens after 45 or 50 weeks; till then there is no deterioration in egg shell quality. According to him, as a chicken ages, the size of the egg increases. The bird can only produce so much calcium, so much egg shell and so it is spread thinner over a bigger egg and end up with poor quality.

The shell thickness is an indication of shell strength. Egg shells vary greatly in thickness. The thickness of the shell is correlated with the size of the egg and the age of the bird (Singh, 1990).

Many factors are involved in the shell quality. Among them, shell thickness is one of the most important trait from the point of handling and transportation. Thickness and porosity of the shell also affect the hatching quality of the egg (Ahmed et al., 1984).

SHELL WEIGHT AND SHELL CALCIUM

There is an increase in egg size as the hen ages but there is no corresponding increase either in shell weight or shell calcium.

Several researches have recorded similar results. Ronald (1980) observed that the egg size increased as the birds aged, however shell weight remained fairly constant throughout the experiment. McErlane (1997) reported that the older hen can produce only the same amount of calcium even though there is increase in egg size after 45 or 50 weeks.

Auburn University research showed that the weight of the egg shell remain fairly constant throughout the laying cycle. But egg size continues to increase. And so, the hen has to spread the same amount of shell around a larger egg. This causes the shell to be thinner and to break easier.

An increase in egg size and egg weight with no related increase in shell weight and shell calcium, but a corresponding decrease in shell thickness, resulting in poor shell quality in eggs laid by aged layers was reported by several workers. An apparent decline in shell strength with age in commercial laying flocks resulting in increasing downgrading of eggs was reported by Belyavin (1986), Balnave and yoselewitz(1988).

Most of the problems with shell strength are with eggs laid by older hens. The shell farming process wears out as the hen ages. In addition older hens lay larger eggs which necessarily have thinner shells because, birds can secrete only a finite amount of shell material so that, as the egg gets larger the shell must get thinner.

The decline in shell quality in the case of breeders was reported by Hess and Lein(1995). The poor shell quality causes excessive moisture loss during incubation.

Calcium metabolism is a contributing factor to shell formation. Calcium represents approximately 38- 40% of the egg shell by weight (2.2 - 2.4g). According to Romonoff (1929) an avian egg shell contains 2.21g of calcium. Plimmer et al., (1924) reported that the average weight of calcium in shell, between 44 and 48 weeks of age was approximately about 2.09g. Singh (1990) observed that the entire egg contains more than 2.0g of calcium and 99% of its calcium is found in the shell. In the present investigation also similar values were obtained.

According to Talukdar and Nandre (1990) as the hen ages, shell quality declines because her ability to absorb calcium decreases, her ability to mobilize skeletal calcium decreases, where as her genetic potential for production has increased at a faster rate than her ability to maintain adequate shell deposition.

Current research programme by Leeson and Clunies (1988) involving radioactive calcium also indicated the active role of bone and its relative contribution of calcium to the egg shell.

INCIDENCE OF CRACKED EGGS

The incidence of shell cracks increases with the age of hens.

Sreenivasaiiah (1986) recorded cracks (%) for eggs marketed in and around Hyderabad. The percentage of cracked eggs recorded were 10, 12, 15, and 20 for different groups of eggs of egg weight 45.3, 53.7, 58.8 and 57.1 respectively. The incidence of cracked eggs increases when the egg weight increases. The increase in egg weight occurs after 40 -50 weeks when the egg size also increases (fig.13). Therefore as the hen ages, egg size increases, shell quality declines and cracks (%) increases.

Panda and panda (1973) reported that 6.4 to 13.7% of eggs are lost from the stage of production to consumption due to cracks and various other factors. An occurrence of 12.5% cracks was reported by Richard and Nesheim (1990). Sreevani and krishnakumar (1994) reported 15.2% incidence of cracked eggs and McErlane (1997) reported 12 to 13% incidence of cracked eggs.

The cracked shells allow easy entry to microbes followed by quick rotting of eggs. Very thin shelled or cracked eggs lose their weight faster and hence quickly deteriorate and are unfit for incubation, and for marketing.

INCIDENCE OF MISSHAPEN EGGS

The shape of an egg is represented by its shape index. In the present study the shape index in the range of 70 -75% indicates that the eggs are of normal shape. The hens lay normal eggs during the first year of laying.

Shape of the egg plays a vital role in the marketing channel. Very long eggs as well as very round eggs do not fit properly into the egg filler flats and hence they are liable to break during their packing and transportation. Besides, such eggs do not fit properly into the setter (incubation) tray, thereby rendering them unfit for incubation. The misshapen eggs are due to several factors. Such eggs are best discarded in the marketing channel as well as unfit for incubation. The normal shaped eggs will have shape index ranging from 70- 75% (Sreenivasaiah, 1986).

Most eggs are oval with one end larger and more blunt than the other. Eggs differ considerably in shape. A number of factors affect shell shape. Influence of hereditary and physiological factors are generally responsible for the diversities in the shell shapes. The factors coordinating the inner circular muscles responsible for moving eggs forward in oviduct and outer longitudinal muscles, which extend the oviduct are responsible for shaping eggs in oviduct. Commencement of laying, cycle of laying and pause in laying noticeably affect shell shape (Singh, 1990).

NUTRITIONAL PARAMETERS OF THE EGG AND THE INFLUENCE OF AGE ON NUTRITIONAL PARAMETERS

The internal quality of the egg plays an important role in the grading of the eggs. In an attempt to assess its internal quality the major nutritional parameters like proteins, carbohydrates and fats were evaluated related to age.

The amount of proteins, carbohydrates and fats in the inner content of the egg is almost constant during the first year of laying cycle. There is no correlation between the increase in egg weight and the amount of proteins, carbohydrates and fats present in the albumen and yolk. The increase in egg weight (fig.14) with age is not followed by a corresponding increase in the concentration of proteins, carbohydrates and fats.

From the study it is observed that the amount of proteins ranges from 12.08 to 12.78%, fats from 9.9 to 10.8% and carbohydrates from 1.0 to 1.5%. Similar results were reported by Nath (1962) and Jull (1958). According to Nath (1962) the percentages of constituents of the whole egg are water - 65.9, proteins - 12.83, and fat -10.6. Jull (1958) reported that the two important dietary essentials of the egg are proteins and lipids and egg is a poor source of carbohydrates.

The proteins are present in every part of the egg and the chief sources of proteins are the albumen and yolk. The egg contains only 1% of carbohydrates of the

total egg contents. The lipids are concentrated in the egg yolk which contains two-third fats and one-third proteins (Singh, 1990).

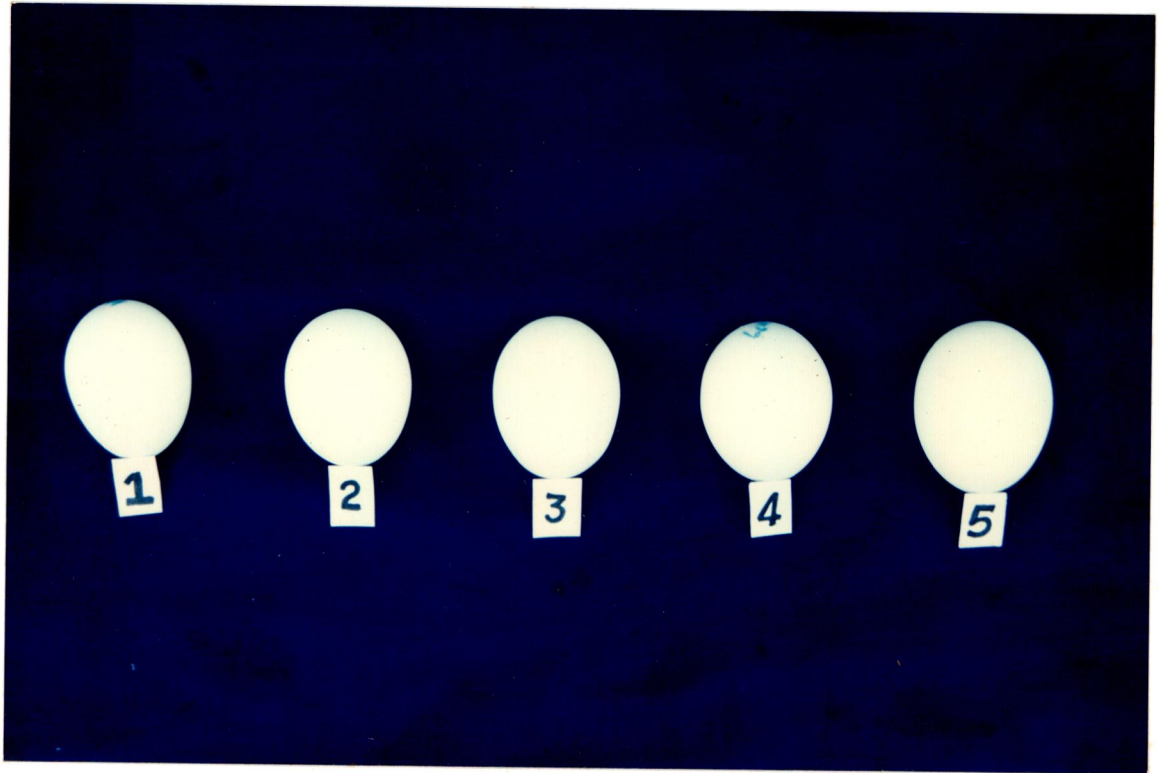


FIG - 13. VARIATION IN EGG SIZE RELATED TO AGE OF HENS

1 - 23 WEEKS

2 - 36 WEEKS

3 - 53 WEEKS

4 - 66 WEEKS

5 - 75 WEEKS

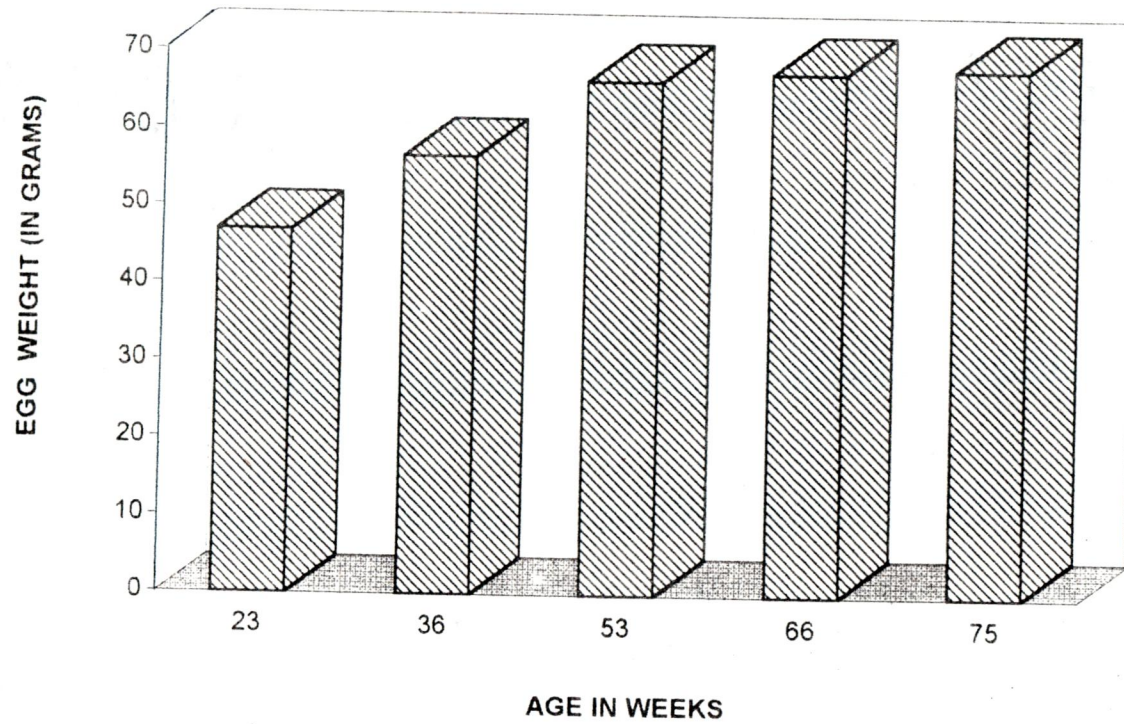


FIG - 14 EGG WEIGHT RELATED TO AGE OF HENS (IN GRAMS)



Summary and Conclusion

VI. SUMMARY AND CONCLUSION

1. The present study was undertaken to study the egg shell quality and selected nutritional parameters associated with the age of fowls in poultry farm.
2. The work was carried out on eggs obtained from white leghorn, the babcock layer Br - 300 maintained at ACN poultry farm in Appanaikkanpalayam near Thudialur, 10kms away from the Coimbatore city.
3. The white leghorn has become the favourite on account of its excellent laying qualities. Today, white leghorn is one of the most popular breeds throughout the plains of India.
4. The eggs were collected from 23,36, 53, 66 and 75 weeks old layers from the month of May 1997 to April 1998.
5. For better results eggs were collected from the same batch of flocks.
6. The egg shell quality was assessed by observing, shell thickness, shell weight, shell calcium, shell cracks and shape index.
7. The nutritional parameters of the egg assessed were, proteins, fats and carbohydrates.
8. During the first year of the laying cycle shell thickness was found to decrease gradually as the hens aged. The decrease was observed from 53 weeks onwards.
9. An increase in shell weight was observed from 23 to 36 weeks. The shell weight remained fairly constant from 53 to 75 weeks.
10. The egg shell calcium remained more or less constant during the study period.

11. The incidence of cracked eggs was found to increase with the age of hens.
12. In the present study the shape index was found to be normal and there was no incidence of misshapen eggs. The shape index in the range of 70 -75 indicates that the eggs are of normal shape.
13. An increase in egg size and egg weight with no related increase in shell weight and shell calcium resulting in poor shell quality was observed.
14. Egg shell breakage is one of the main problems facing the poultry industry today. Age of birds is one of the factors affecting shell quality.
15. The concentration of total proteins, fats and carbohydrates remained almost constant during the first year of the laying cycle.

From the study it may be concluded that the bird can produce only the same amount of shell material or calcium during the laying cycle. As the hens ages, the size of the egg increases. As the egg size increases the same amount of shell material is spread over a larger egg causing thinning of the egg shell. This results in poor egg shell quality. Similarly the bird can produce only the same amount of proteins, fats and carbohydrates during the laying cycle.



Bibliography



BIBLIOGRAPHY

- Ahmed, M., Krishnan, A.R. and Pannerselvam, S., 1984. A look at the economic traits in poultry. *Poultry Guide*. XX1 (10): 41.
- Balnave, D. and yoselewitz, I., 1988. Egg shell quality is affected by salinity in water. *Poultry misset.*, 4(6) : 16-17.
- Bandyopadhyay, U.V., 1996. Role of large and small scale poultry sectors in India and other developing countries. Proceeding of the world's poultry congress. IV : 458.
- Banerjee, C.G., 1980. Factors affecting egg size. In : A text book of animal husbandry. (4th Edi) oxford and IBH Publishers : pp 664 -665.
- Belyavin, C.G., 1986. Egg quality important but not understood. *Poultry Guide*. XXIII (10) : 51-52.
- Blake, J.P., Kling, L.J. and Halteman, W.A., 1985. The relationship of the aminoacid composition of a portion of the outer egg shell membrane to egg shell quality. *Poultry. Sci.* 64 : 176 -182.

- Britton, W.M. and Hale, K.K., 1977. Aminoacid analysis of shell membranes of eggs from young and old hens varying in shell quality. *Poultry. Sci.* 56: 865-871.
- Brown, J., 1995. Intermittent lighting can be a tool for increased profits. *Poultry Adviser.* XX VIII (III) : 30-31.
- Choudary, M.R., 1989. Poultry news. *Poultry Adviser.* XXII (1) :26.
- Choudary, C., Ramasastry, T., Mohanamba, T. and Dutt, P.A. K., 1995. Insecticide poisoning in poultry. *Poultry Adviser.* XXVIII(III) : 53-55.
- Clark, T.B., 1940. The relation of production and egg weight to age in white leghorn fowls. *Poul.Sci.* 19: 61-66.
- Faria, D.E.D., Junqueira, O.M., Sakomura, N.K. and Santana, A.E., 1996. Evaluation of feed system and oyster shell supplementation on performance and egg shell quality of laying hens. Proceedings of the world's poultry congress. New Delhi, India. II : 267 - 269.
- Farrell, D.J., 1997. The importance of eggs in a healthy diet. *Poultry International.* 36 (11) : 72.

Gaffar, T.A., 1994. Stress on egg shell structure. *Poultry Adviser*. XXVII (VII): 64.

Hamilton, R.M.G., 1982. Methods and factors that affect the measurement of egg shell quality. *Poultry. Sci.* 61: 2022 - 2039.

Hamilton, R.M.G., Holland's, K.G., voisey, P.W., and Grunder, A.A., 1979. Relationship between egg shell quality and shell breakage and factors that affects shell breakage in the field. *A review world's poul. sci. J.*, 35 : 177-190.

Hays, F.A., 1944. Variability of egg weight in Rhode island reds. *Mass.Agr. Exp. sta. Bull.* 411 : 1-16.

Hess. J. and Lein .R., 1995. Two stage feeding of broiler breeders good egg or bad egg. *Poultry Adviser*. XXVIII (III) : 70 - 71.

Hunton, P., 1997. Breed differences a hot topic in Australia. *Poultry International*. 36 (11) : 92-94.

Jull, M.A., 1958. Marketing eggs. In : *Poultry husbandry*. (3rd edi). TMH publishers : pp 188 - 253.

Jull, M.A., 1958. Effect of diet on egg quality. In: *Poultry husbandry*. (3rd Edi). TMH publishers: pp 304 - 349.

- Karunajeewa, H., Abu-serewa, S. and Harris, P.A., 1989. Effects of an iduced pause in egg production and supplementation of the diet with iron on egg shell colour, quality and performance of brown egg layers. *British. poul. sci.*, 30 : 257 -264.
- Keshavarz, K., 1995. An overview of calcium and phosphorous nutrition of growing pullets and laying hens. In : proceedings of the cornell nutrition conference for feed manufacturers, October 24-26, Rochester N.Y : 161 -170.
- Keshavarz, K., and Nakajima, S. ,1993. Re-evaluation of calcium and phosphorous requirements of laying hens for optimum performance and egg shell quality. *Poultry .sci.*, 72 : 144-153.
- Krishnappa, P. and Reddy, R.,1984. Nutritive value of egg. *Poultry Guide*. XXI (3) : 68 -70.
- Kulkarni, V.V. and Thakur, Y.P., 1994. Effect of egg weight and strain on the internal quality of chicken eggs. *Cheiron*. 23(5) : 246-247.
- Leeson, S. and Clunies, M., 1988. Packaging miracle in an egg shell. *Poultry Adviser*. XXI (VII) : 43-46.

Lewis, P.D., Perry, G.C. and Morris, T.R., 1994. Lighting and egg shell quality. *World's Poul. Sci. J.*, 50(3) : 288-291.

Maxcell., 1984. How an egg works for you. *Poultry Guide*. XXI (11) : 73-74.

McErlane, B., 1997. Eggshell 49 will increase egg shell quality. *Milne's Poultry digest* : 16 - 17.

Nalbandov, A.V. and Card, L.E., 1944. Further evidence on the cause and inheritance of blood and meat spots. *Poul.Sci.* 20 : 469.

Nath, P., 1962. Composition and quality of eggs. In : Hand book of animal husbandry, ICAR(Eds. Sen, S.K. and Nath, P.) Kanpur : p 162.

Nath, P., 1962. Evaluation of eggs. In : Hand book of animal husbandry, ICAR(Eds. Sen, S.K. and Nath, P.) Kanpur : pp 158 - 162.

Nys, Y., 1996. Egg shell quality, *World Poultry Misset.*, 12(4) : 33.

Oliveira, J.E. G., Bertechini, A.G. and Oliveira, B.R., 1996. Dietary calcium level, particle size and feeding programmes of limestone on egg quality in laying hens in the second cycle. Proceedings of the world's Poultry congress. New Delhi, India. IV : 196.

- Panda, P.C. and Panda, B., 1973. Quality of shelled eggs marketed in India. *Indian. J. Poul. Sci.* 8(1) : 19 - 26.
- Patil, E.R., Jadhav, H.D., Thakare, G.G. and Talathi, J.M., 1995. Socio-economic condition of poultry farm owners in Ratnagiri district. *Poultry Adviser*. XXVIII (III) : 25- 26.
- Plimmer, R.A.A. and Lownder., 1924. Inorganic minerals in egg shell. *Biochem.*18 (353) : 1163 - 1169.
- Ramani, A., 1984. Factors affecting shell quality. *Poultry Guide* : XXI(11) : 47 - 48.
- Rao, K.N., 1996. Marketing systems of chicken eggs and meat in India. Proceedings of the world's poultry congress. New Delhi, India. IV : 453.
- Ravichawla., 1996. Egg production in 1995 - 96 put at 26, 524 million. *Poultry times of India* : 25.
- Ravindra, D., Rao, K.R. and Sathe, B.S., 1996. Poultry development in India -constraints and suggestions. Proceedings of the world's poultry congress. New Delhi, India. IV : 467 - 468.

Sankaralingam, S., Unni, A.K.K., Sangilimadan, K. and Joseph, L., 1996. Effect of shape index on hatchability in IWP strain. Proceedings of the world's poultry congress. New Delhi, India. IV : 89.

Satapathy, N., 1989. Poultry news. *Poultry Adviser*. XXII (1) : 25.

Sharma, M.L. and Bhatti, J.S., 1996. Effect of forced moulting in layers on the internal quality of eggs. Proceedings of the world's poultry congress. New Delhi, India. IV : 122.

Singh, A., 1990. Nutritive value of egg. *Poultry Guide*. XXVII(1) : 25- 31.

Singh, A., 1990. Factors affecting characteristics of egg shell and shell membranes. *Poultry Guide* . XXVII (9) : 65 - 69.

Singh, R.A., 1996. Egg and its preservation . In : Poultry production (3rd edi) Kalyani publishers. New Delhi : pp 237 -257.

Sreenivasaiah, P.V., 1986. Quality identification of shell eggs candling. *Poultry Guide*. XXIII (6) : 38 -43.

Sreevani, M. and Krishnakumar., 1994. A qualitative study of shelled eggs marketed in and around Hyderabad. *Poultry Guide*. XXXI (6) : 71 -73.

Suto, Z., Horn, P. and Ujvarine, J., 1996. The effect of different housing systems on production and egg quality traits of brown and leghorn type layers . Proceedings of the World's Poultry Congress. New Delhi, India. II : 635 -638.

Talukdar, J.K. and Nandre, S.B., 1990. Egg breakage, a major cause for increase in egg prices. *Poultry Guide*. XXVII (4) : 37 -38.

Thurairaj, V.T., 1989. Poultry news. *Poultry Adviser*. XXII (1) : 23- 24.

Wakeling, D.E., 1977. Induced moulting a review of the literature, current practice and areas for further research. *World's Poul. Sci. J.* 33 : 12-20.