INTRODUCTION

India is predominantly an agricultural country. Indian agriculture includes crop husbandry, livestock and poultry husbandry, forestry, fishery etc. The agricultural development plans are based on certain principles like (a) maximisation of output by effective utilisation of land, water and other natural resources (b) integrated development of crop enterprise, livestock, poultry, fishery and rural industry and (c) preservation of forest wealth, conservation of soil etc. For successful implementation of any strategy, input and outputs, marketing, research, extension and credit are of paramount importance.

From the above mentioned agricultural areas, poultry production in India remained as a backyard venture till 1960's and now it has emerged as an encouraging enterprise for rural folk especially for small farmers, landless labourers and educated unemployed and also, for big entrepreneurs maintaining the birds on large scale in thousands. One of the important factors in poultry farming is the selection of breed; for eg. hens selected for egg production can lay one egg per day in their first year following the onset of puberty, and during this period, the hen will consume approximately 40 kg. of feed and deposit 22 kg. in eggs. Owing to the pristine interest in rearing birds for better table value and/or for higher egg productivity, various breeds of domestic fowl have been engaged in poultry farming in India.

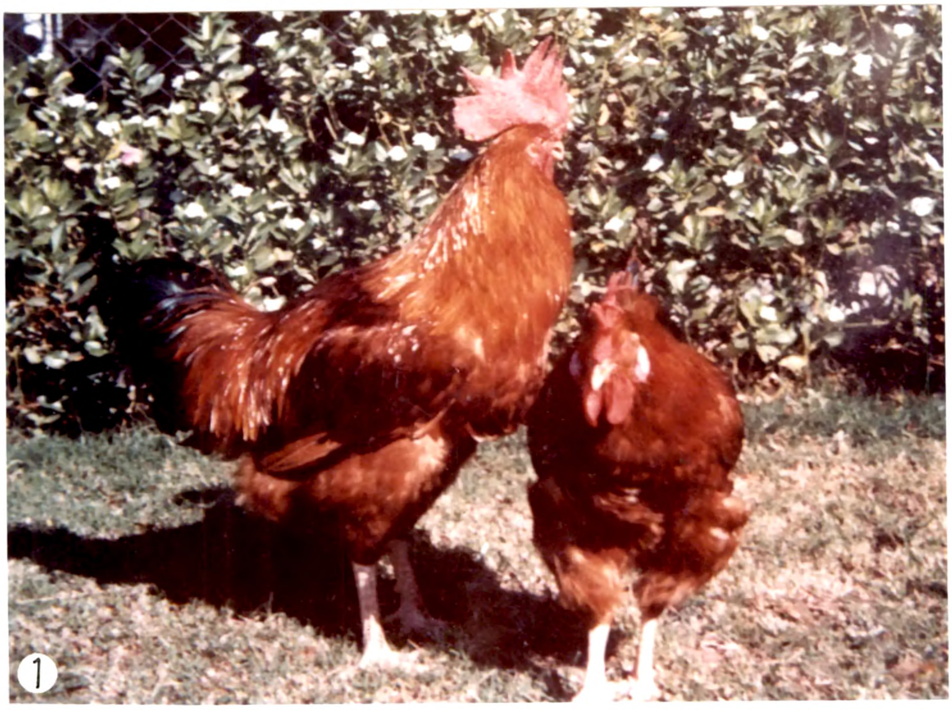
The Red Jungle fowl (*Gallus gallus*) has been recognised as the ancestor for the many present day poultry breeds of the world. The Red Jungle fowl lived in the jungles of India and in the forests of neighbouring countries like Burma, Sri Lanka, Malaysia and Java. The poultry population in India consists of Indigenous (Desi) and exotic (improved) birds. Though the indigenous birds are strong enough to withstand the diversified agroclimatic conditions of our country, these birds are poor layers of small sized eggs. Few recognised breeds among the indigenous birds are: 1. ***Aseel***, one of the best table birds found all over the country. 2. ***Busra***, which is found in Gujarat and Maharashtra is a poor layer. 3. ***Chittangong,*** the regional bird found in Chittangong is a good table bird. 4. ***Denki,*** commonly found in Andhra Pradesh is a poor layer. 5. ***Punjab brown***, seen in Punjab and Harayana is a good table bird. The exotic breeds found in India can be classified into four important classes according to their place of origin: 1. **Asiatic** (countries other than India) which includes *Brhma, Langshan* and *Cochi.* 2. **American** - *Plymouth Rock, Wayandotte, Rhode Island Red* and, *New Hampshire.* 3. **English** - *Sussex, Orphington, Australop, Cornish, Darking and Red cap.* 4. **Mediterranean** - *Leghorn, Minorca, Ancona, Spanish, Andalusian and Buttercup*. From the above mentioned exotic breeds, breeds of American origin- Rhode Island Red and Mediterranean origin - White Leghorn are the most commonly maintained flock in poultry farms of India. Rhode Island Red hens are good layers of brown shelled eggs. It is considered as a dual purpose breed for meat and egg production. It is a sturdy breed which can withstand cold and damp climates. Leghorn hens are considered as good layers, and is further hybridised with high yielding lines or strains (Figures,1& 2)

PLATE I (fig. 1 - 2)

Photographs of two of the most common breeds of domestic fowl reared in poultry farms.

Figure 1: Photograph of Rhode Island Red breed of domestic fowl. This breed is considered as dual purpose breed, and it is reared most commonly in Government Poultry.

Figure 2: Photograph of White Leghorn breed of domestic fowl. This breed is considered as a good layer breed.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Besides the selection of breed, the management techniques also play a predominant role in egg productivity (Callenbach *et al.,* 1943; Morris, 1968; Dunn *et al.,* 1990; Dunn and Sharp, 1992; Shanawany *et al.,* 1993a; Tucker and Charles, 1993 Lewis *et al.,* 1996a,b; Sandoval and Gernet, 1996). The management of egger stock involves, brooder house, watering and feeding, housing and ventilation, litter or cage management, lighting, health care by timely vaccination and debeaking programmes. The ways and means of providing warmth to the newly hatched chicks are called brooding. In nature, broody hens provide a normal body temperature of 107°F to the chicks. Artificial brooding involves, electrical brooders or even a 15 watt bulb which is fixed in each compartment to allow feeding at all hours of the day. The newly hatched chick is made up of 60 -70% water and death of the chick may occur due to rapid dehydration, hence clean and cool water must be available to chicks all the time. Day old chicks should be fed on 8% glucose water and antibiotics and, later on from day-2 onwards, they should be fed with finely ground maize and then shifted to the well-balanced chick mash thereafter. Commonly employed feed management programme in Government poultry in Baroda, Gujarat is documented in tables 1;2. Lighting in poultry involves a continuous lighting programme upto 8 weeks of age. Night lighting during this period (brooding stage) avoids overcrowding and piling up of chicks and guide the chicks to find their way to the feeders and waterers. To provide lighting, one 60 watt bulb/9.2 sq. mt. area is used. In order to maintain a healthy flock of birds, proper vaccination should be carried out (Table 3). Timely debeaking programmes are necessary to avoid the development of some bad habits like egg eating and cannibalism in the flock maintained under conventional deep litter system. The traditional method of raising broilers or eggers under deep litter system has been replaced to a large extent by the complete confinment system and especially by designing high stocking

Table.1: Composition (Kg/ton) of chick, grower,and layer mash.

CONSTITUENTS		CHICK	GROWER	LAYER
1.	Corn	481	420	385
2.	Groundnut cake	180	110	120
3.	Rice bran	150	200	200
4.	Wheat bran	76	100	-
5.	Rice polish	-	90	130
6.	Fish meal	50	30	40
7.	Proto Liv.	30	15	40
8.	Mineral mixture	25	25	26
9.	Dicalcium phosphate	4	5	15
10.	Coxidot	0.5	-	-
11.	Ventrimix (A,B,2D,3K)	0.1	0.1	0.1
12.	Salt	4	5	4
13.	Calside/Shell Grit	-	-	40
14	Lysine	-	-	-
15.	Methionine	-	-	-
16	Mangenese sulphate.	-	-	-
17	Neftine-200	-	0.25	-

Table 2. Amount of feed consumed at different period of rear in Government poultry *(ad libitum* schedule).

Government Poultry				Present Experiment			
Age (in days).	*Number of days.*	*feed/day (gms.)*	*Total feed consumed (Kg.)*	*Age (in days).*	*Number of days.*	*feed/day (gms.)*	*Total feed consumed (Kg.)*
1-- 28	28	37.5	1.05	1 -- 56	56	30	3.2
29 -- 56	28	57.5	1.61	56-- IL	---	90	5.1
57 -- 84	28	80	2.24	IL -- 530	---	110	43.2
85 -- 112	28	102.5	2.87	-	-	-	-
113 -- 140	28	120	3.36	-	-	-	-
141 -- 178	38	135	4.996	-	-	-	-
179 -- 530	352	135	47.38	-	-	-	-
Total no. of days.	530	Overall ☞	63.5	Total no. of days	approximately 530	Overall ☞	51.5

Table: 3 Vaccination programme for chicks.

Age	Disease	Vaccine name	Route	Dose
Day old	Marek's	Cell free or cell herpes	Intramuscular	2 crops
4-5 days	Ranikhet	Ranikhet disease vaccine F_1 ($RDVF_1$)	Intranasal or intraocular	2 crops
4-5 days	Fowl Pox	Pigeon pox	Feather follicles	Swab
6-8 weeks	Fowl Pox	Chicken embryo adopted	Wing web	Two pricks
9-12 weeks	Ranikhet	RDVK	Subcutaneous or intramuscular	0.5 ml

density cages. In cages the birds are kept in single, double or even in three rows; these cages can be further modified by arranging them one over the other in multistoryed fashion, so as to accomodate more number of birds in less area. In such cages, the movement of the bird is restricted, hence, the energy can be conserved and can be more efficiently transferred to the eggs. The feed and water trays are held outside the cages, therefore, wastage of feed during feeding is minimised and fresh water can be supplied continuously. Another advantage of single cageing is that the eggs laid by the birds can rollout into the collecting trays, thus the eggs can be collected easily and the hens do not get a chance to destroy the eggs, nor, the eggs are infected by microbes present in the litter in the deep litter system (Figures, 3, 4,5 & 6).

The research in poultry science has moved too far in the direction of molecular biology and away from the studies with whole animals, says Morris in his Gorden Memorial Lecture; Poultry Science: Next 20 years? (1996). During the past 20 years, the study of reproductive physiology in birds has advanced from extrapolations of our existing knowledge of reproduction in mammals to deriving the mechanisms that control reproduction in avian specie (Riddle *et al.,* 1924; Legait and Legait, 1959; Fromme-Bouman, 1962;Thapliyal and Pandha, 1967a,b; Jallageas and Assenmacher, 1973; 1974; Oshi and Konishi, 1978; Kalland *et al.,* 1978; Pankakoshi *et al.,* 1982; Patel *et al.,* 1985; Patel *et al.,* 1986; Ramachandran and Patel, 1986; Ramachandran *et al.,* 1987;Ramachandran and Patel,1988; Francavilla, *et al.,* 1991; Ayyar *et al.,* 1992; Joyce *et al.,* 1993; Palmero *et al.,* 1989, 1992, 1993; de Krester *et al.,*1995) . The main objectives of the poultry research should be to increase egg productivity by making modifications in pre-existing management practice, so as to bring down the cost of maintainence of

PLATE II (figs3 - 4)

Photpgraph showing brooder house.

Figure3 : Photograph of a well developed brooder house.

Figure4: Photograph of a conventional deep litter system brooder house in Government poultry.


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PLATE III (figs 5-6)

Photographs showing rearing system for egger stock.

Figure 5: Egger stock housed in a single cages arranged in a row.

Figure 6: Egger stock housed in a multistoryed single cages. This system has an advantage of maintaining large number of hens in minimum space.

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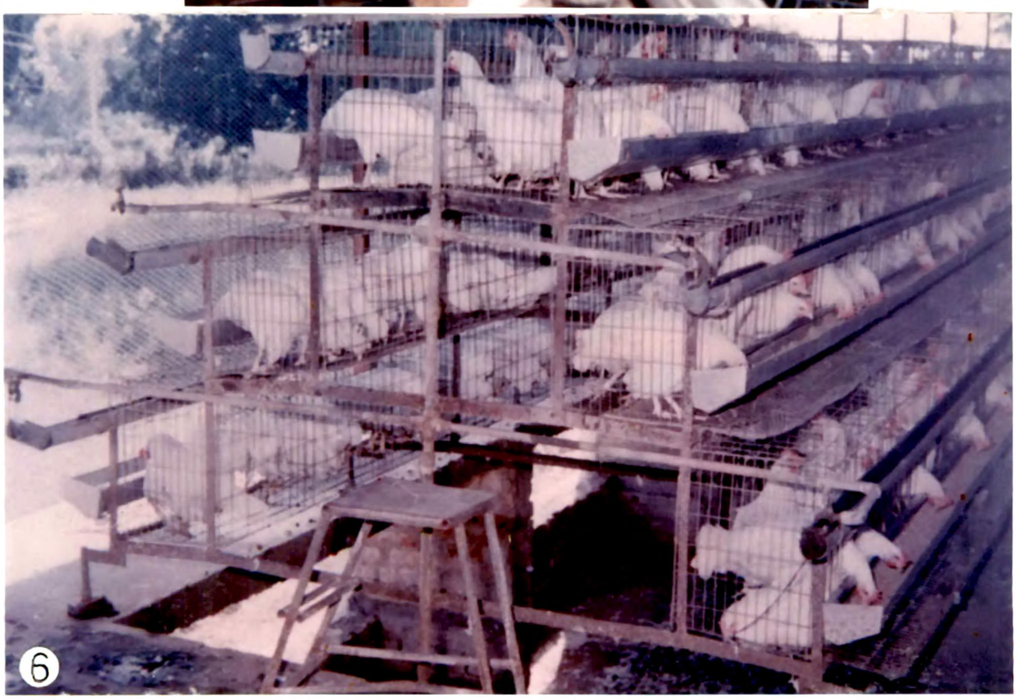

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birds, which would lead to increase in profit margin for poultry farmers. In this connection, several attempts have been made by altering some basic management techniques like feed and lighting programmes, but no single technique could fetch a fruitful result, as lack of a theory - or a good hypothesis is a limiting factor in poultry research too (Sykes 1956; Hutchinson *et al.*, 1957; Morris *et al.,* 1964; Dunn *et al.,* 1990; Sandoval and Gernat 1996).

The influence of light on reproduction was first demonstrated in 1921 by Rowan, who subjected migrating juncos to supplemental light, to mimic the long days of spring. Under these conditions, the bird mated and laid eggs during winter of Edmonton (short day-length) (Etches, 1996). Now, it is well established that light is perceived through photoreceptors that transduce energy contained in photons into biological signals (Etches, 1996). Hypothalamic photoreceptors, which have never been histologically identified in birds, convert the electromagnetic signal into a hormonal message through their action on the hypothalamic neurons that secrete gonadotrophin releasing hormone (GnRH). The pituitary gonadotropes then respond to GnRH by producing LH and FSH. Avian LH and FSH were first chromatographically separated by Stockell-Hartree and Cunningham (1969) from chicken pituitary glands. Hormone binding properties of FSH receptors in the avian gonad were studied by Ishii and Farner (1976) in the white crowned sparrow, and by Ishii and Adachi (1977) in the Japanese quail and those of LH receptors by Kikuchi and Ishii (1989,1992) in the Japanese quail. Furthermore, chicken LH and FSH bind to different sites in the avian gonads and stimulate androgen and oestrogen production from small follicles, and progesterone from largest preovulatory follicles (Kinkuchi and Ishii, 1989.). The above findings are in agreement to the previous findings that light regulates the timing of oviposition because, an "open period" in which ovulation inducing hormone(s) may be released is determined by an endogenous biological clock, the phase of which is set externally by light and dark signals (Morris, 1973; Bhatti and Morris, 1977). It is also reported that a minimum of 2.5h scotophase was sufficient to control the time of ovulation (Lanson, 1960). In the later studies 6h scotophase in a normal cycle was shown to be much effective for oviposition and other circadian rhythms in chickens (Cain and Wilson, 1974)

In recent years, the manipulation of photoperiodism to ensure year - round egg production is an established practice, and now has become one of the most powerful management tools available to the poultry producers (Sykes 1956; Hutchinson *et al.*, 1957; Morris *et al.*, 1964; Dunn *et al.*, 1990). Photoperiodic manipulations affect the onset of lay, rate of lay, timing of lay, shell quality, egg size and feed efficiency. However, such photic manipulations need a careful scrutiny with reference of selection of breed, (Lewis, 1994), rearing age of the pullets in the photic schedule and even the shifting age of pullets from photoperiodic regimes all of which evoke differential responses (in terms of total egg output and age at 50% egg production; Lewis, 1994). In this respect, periods of light and dark are usually combined in either one of the following modules, such as the most common photoschedule of conventional lighting regime containing a single photophase (i.e period of illumination) and a single scotophase (i.e period of darkness) which together totals to 24 hrs. , split or intermittent lighting regimes containing more than one photophase and scotophase in 24 hrs. and, a skeleton photoperiod of asymmetric photophase and scotophase (Etches, 1996). It is also documented that increasing photoperiodic schedule (step-up) causes advancement in sexual development in the pullets and tend to stimulate rate of lay after sexual maturity, and conversely, decreasing photoperiod (step-down) has opposite effect (Lewis *et al.,* 1992).

In general, selection of photic schedules are based on a common hypothesis that, a middling day (eg. LD 12:12) commonly evokes "long day" response when used after an exposure of pullets to short day (eg. LD 8:16), but causes "short day" response in birds which have previously been exposed to long days (eg. LD 16:8) (Etches, 1993). Lewis *et al.* (1992) showed that the age at first egg advanced in growing pullets of ISA Brown, when exposed to long photoperiod and the degree of advancement can be modified by the size and timing of light change. Besides attainment of sexual maturity, lighting regimes during rearing also effect body weight and growth rates of pullets (Eiton and Soller, 1991). Rearing pullets under long photoperiod or natural daylength as against short days (8H light/day) delays the onset of sexual maturity in meat strain pullets (Payne. 1975; Proudfoot. 1980; Renden and Oates. 1989). The observations of these workers are in agreement with the concept of a saturation day length i.e a day length beyond which additional light hours are not stimulatory, but in turn leads to juvenile photorefractoriness (Urbanski and Follet, 1982; Sharp,1988,1993). Advancement in egg lay in pullets reared under a short-day (8h) regimen from day 1 V/s natural day length was shown by Abbaker *et al,* (1994). Reduction in the rate of egg lay when photoperiod is shortened during the laying year is also documented by many workers (Sykes, 1956; Hutchinson and Taylor, 1957; Morris *et al.*, 1964). Evidences about minimum photoperiod for maximum egg production, under a constant day length from 0 - 72 weeks of age, suggest that LD 10:14 is sufficient but LD 8:16 is not, for better egg lay performance in the fowl (Morris, 1979). However, by contrasting a step-up and a step-down rearing photoperiodic programme it is possible to obtain a difference of 6 weeks or more in age at 50% lay and its consequential effect on overall egg yield. It is also a fact that, the flocks brought into lay early will give smaller eggs and for that reason, lay more eggs to a fixed finishing age than the birds maturing later (Morris, 1980, 1994). The sensitivity of the young pullets to an increasing photoperiod varies with age and, it is maximum between 9 - 12 weeks as, increasing the photoperiod soon after 18 weeks has little or no effect on 'age at 50% lay' (Morris, 1963; Lewis, 1992). Thus the maximum or a minimum photoperiod which should be set for a step-up programme is uncertain (Morris, 1994). It is also reported that the experiments in which pullets were transferred rapidly from LD 8:16 to LD 15:9 laid same number of eggs as other birds given the same increment more slowly (Morris, 1994). Ahemeral lighting programmes on the other hand are generally employed to reduce rate of lay and to increase egg size early in lay (Shanawayny, *et al.,* 1993). The underlying mechanism about the advancement of sexual maturity or a delay in the same by altering photic schedules is still not well understood. However, one of the direct or indirect modulatory influences of light must be on the time consumed by the egg during its passage through oviduct. The oviposition interval consists mainly of the interval from oviposition to the next ovulation and the time spent by the ovum in the oviduct. The time factor in egg formation under normal and ahemeral light-dark cycle has been documented (Warren and Scott, 1935; Melek *et al.*, 1973). These workers showed that the oviposition interval was increased by lengthening light-dark cycles as the time spent by the ovum in different parts of the oviduct was also increased.

Feeding habits of domestic fowl are directly related with the photic manipulation as, feed efficiency is a function of locomotor activity which is reduced to a minimum in periods of darkness. On the other hand, the efficiency of feed utilization is increased by intermittent photic schedules; under these photic schedules increase in feed utilization ranges from 2% to 5% (Morris, 1973). The combined effect of these two factors on egg lay was observed in ISA Brown and Shaver 288 hens fed *ad labitum* and given a 5h increase or, a 2h, 5h, or 10h decrease in photoperiod at 215 days of age exhibited a curvilinear rate of lay and egg output, where Shaver hens reduced their egg output and rate of lay as compared to ISA Brown when photoperiod was decrease (Lewis *et al.,* 1996). In commercial production units, there should be an optimum balance between the biological potential of modern strains of poultry and the cost of realization of this potential. Hence cost of feed and feeding systems also need a careful scrutiny (see Etches, 1996). The nutrient requirements of poultry depend upon age, breed, health status, temperature and humidity, sex and reproductive status of the bird, and hence a proper rationed diet is essential (Table 1). The conventional diet programme employed in poultry is of *ad libitum* , so that the rearing flock will consume a quantity of feed that greatly exceeds their requirement for nutrition (Leeson and Summers, 1991). Eitan and Soller (1991) have shown that onset of lay in broiler breeder pullets is dependent on attainment of threshold body weight and age and both of which can be affected by lighting regimen during rearing photostimulation, and feed management. In contrast, some workers have documented a delay of sexual maturity as a result of feed restriction (Proudfoot, 1979; McDaniel *et al.,* 1981). It is also to be noted that, when the birds are reared under feed and light restrictions, they adapt quickly and learn to satisfy their food requirements in the limited time available (Lepkovsky *et al.,* 1960). Advancement in sexual maturity and early onset of lay also depend on weight gain and/or increased fat deposition resulting from increase in feeding opportunity (Lewis *et al.,* 1996). Following the photoperiod change, there is a definite increase in food intake and rate of body weight gain as compared to the birds maintained on a constant photoperiod (Lewis and Perry, 1989, 1995). Gross efficiencies of egg production in terms of both mass and energy increased in feed restricted birds (Macleod and Shannon, 1978). Time of feeding can profoundly affect the laying responses of the fowl. It has been shown that both egg production and mean egg weight were improved by evening feeding as compared to morning (Balnave, 1973; 1977). The amount of feed restriction also affect egg production as, it is shown that egg production substantially decreased when the food is restricted by more than 10% of *ad libitum* intake (Agricultural Research Council, 1975).

The egg is considered as an ideal component of human diet, as it provides all the essential micro. and macronutrients. The formation and deposition of these micronutrients in development of egg are due to the metabolic activities of liver, ovary and oviduct, and are influenced /regulated by neuroendocrine principles. The egg consists of three main parts; yolk, albumen and shell, and the composition of both yolk and albumen in terms of either protein and lipid contents have been investigated (Riemenschneider *et al.,* 1938; Cruickshank, 1941; Broady, 1945; Romanoff and Romanoff, 1949; Shorland, 1951; Rhodes and Lea, 1956; Evans and Bandermer, 1961; Patton and Palmer, 1961; Parkinson, 1966; Christe and Moore, 1970, 1972; Edwards, 1974; Cunningham and Lee, 1978;Roca, 1984; Hall and McKay, 1993). The yolk constitutes around 31% of the total egg weight and consists of germinal disc, latebra, white yolk, concentric rings of yellow yolk material and vitelline membrane surrounding the yolk. The concentric rings of yolk material accumulate slowly around the core of white yolk from the day of hatch onwards until the follicle is recruited into the yellow yolk hierarchy, five to seven days before ovulation. The yellow yolk is made up of closely packed polygonal yolk spheres of 140µm diameter. These spheres contain yolk proteins and lipids in subdroplets, lamella bodies and finely dispersed aqueous phase. The subdroplets contain about 23% of yolk proteins in the form of two phosvitins and two lipovitelins. These proteins are synthesised in the liver as precursor molecules of vitellogenin, transported to the ovary through the vascular system, and deposited in the growing oocytes by receptor - mediated endocytosis. As vitellogenin enters the ovum, it is cleaved into phosvitin and lipovitellin. The yolk lipids are in the form of very low density lipoproteins (VLDLs), these are yolk macromolecules, which contain 12% proteins. The aqueous phase of yolk contains 10% of yolk solids, most of which are proteins. These proteins are basically immunoglobulin of sub-class IgG and in addition also contain vitamins. The egg white/albumen is secreted in the reproductive tract; it is a mixture of more than 40 different proteins. After the egg is deposited with albumen, water is added by the process of "plumping" by oviduct. The water thus added separates the albumen into middle layer of thick albumen surrounded by an outer and inner thin layers. In the fresh egg, approximately 57% of the albumen is thick white, 17% is inner thin albumen and 23% is outer thin albumen. In general, albumen forms the major water reservoir for the developing embryo and hence it is a poor source of proteins than yolk. The albumen also contains traces of lipids and minerals. Thus, the egg consists of several components that function together as a single unit to define the boundary of embryonic growth. The outer covering of egg, the shell, is composed of crystals of calcium carbonate which are arranged in a compact fashion. Most of the studies on avian egg deals with the egg composition, and, they are nutritionally biased (Riemenschneider *et al.*, 1938; Cruickshank, 1941; Broady, 1945; Romanoff and Romanoff, 1949; Shorland, 1951). Whereas, some of the workers have dealt mainly with the lipid component; cholesterol, phospholipids and triglycerides (Hall and MaKay, 1993) others had studied protein and other components (Christe and Moore, 1970, 1972; Edwards, 1974; Cunningham and Lee, 1978;Rickeleff, 1979; Roca, 1984). Influence of diet, light, temperature and genetic factors have also been studied (Eitan and Soller, 1971; Oldale *et al.,* 1977; Proudfoot, 1979; Coggins and Wells, 1980; McDaniel *et al.,*1981; Tucker and Charles, 1993; Lewis *et al.,* 1996b) , but no studies have been undertaken to evaluate the nutritional value of the eggs laid by the hens subjected to photoperiodic or hormonal manipulations.

The post-hatched growth phase in birds has been widely studied in relation to the influence of growth and thyroid hormones. Role of growth hormone is indicated by the observations of increased growth rates and bone growth in hypophysectomised chicks given chicken pituitary extracts (Libby *et al.,* 1955; Glick, 1960; Nalbandov, 1966), and the role of thyroid hormones is documented by the observed growth retardation post-surgical thyroidectomy, radiothyroidectomy or chemical thyroidectomy (Blivaiss, 1947; Whinchester and Davis, 1952; Marks, 1971; King and King, 1973; Howarth and Marks, 1973), indicating a clearcut role of these hormones in growth and development of chicks. Besides these two hormones, the probable role of adrenocorticoid hormones with reference to growth and maturation has also been assessed. Growth retardatory influence of glucocorticoids has been noted in birds treated with cortisol injections (Kowalewsky, 1962), similar effect of glucocorticoids have been noted in chicks (Govora and Kondra, 1970; Govora and Hodgson, 1970). However, the studies involving hormonal interactions during development are focused only on metabolic parameters and gravimetric alterations (Conn and Fajans, 1956; Haward and Constable, 1958; Baum and Meyer, 1960; Kitabachi *et al.*, 1968; 1973; Olefsky and Kimmerling, 1976; Davison *et al.*, 1983; Saddoun *et al.*, 1987; Brake *et al.*, 1988). The role of non-classical hormones in avian reproduction is getting much attention, and previous studies in our laboratory as well as by others have suggested, both antagonistic and parallel adrenal-gonad relationship in adult birds (Fromme-Bouman, 1962, Lorenzen and Farner, 1964; Hohn *et al.*,1965; Dusseav and Meir, 1971; Martin, 1973; Wilson and Follet, 1975; Jallageas *et al.*, 1978; Bengt, 1979; Ramachandran and Patel, 1986). Continuing on the same theme of research, pilot experiments on white leghorn chicks were carried out, wherein, chicks treated with corticosterone or dexamethasone for 30 days showed retardatory influence of the former and, stimulatory influence of the latter, on growth and maturation of the testes (Joseph and Ramachandran, 1993).

A scan of literature shows an existing lacuna in terms of studies involving photoendocrine manipulations in relation to growth and development and their influence on qualitative and quantitative aspects of egg laying in the domestic fowl. Therefore, it was thought pertinent to undertake studies involving the effect of photoendocrine manipulation in chicks during first 90 days of post-hatched development, in terms of laying performance, the structure and composition of eggs and growth kinetics and endocrine alterations thereat.

In a nutshell, the thrust of the experimental investigations of the present thesis are :

1. To study the effect of a step-up photoperiod (LD 6:18 from day 1 to 90 and LD 12:12 thereafter) on various aspects of egg laying performance and biochemical composition of these eggs (Chapters,1, 4)

2. To study the influence of mild hyper/hypocorticalism during the first 90 days of rearing, on egg laying performance and alterations in biochemical composition of eggs laid by these birds (Chaptes, 2, 5).

3. To assess the influence of short photoperiod in combination with mild hyper/hypocorticalism during the first 90 days of post-hatched development, on egg laying and biochemical composition of eggs laid by these birds. (Chapters 3, 6).

4. To study the influence of hyper./hypocoricalism alone, or in combination with short-photoperiod during rearing stages, on growth of liver and lymphoid organs and, histomorphology of thyroid, adrenal and ovary, and serum hormone profile of T_3,T_4, corticosterone and progesterone(Chapters, 7,8,9).