# ELMA CREAM LAYING HYBRID

MANUAL

ELMA

Egg Laying Master

## Performance Data of ELMA CREAM Laying Hybrid

Table 1

| | |
|---|---|
| **LIVEABILITY** | |
| 0-17 weeks of age | 97 - 98% |
| 18-100 weeks of age | 92 - 94% |
| **FEED CONSUMPTION** | |
| 0-17 weeks of age | 5.8 kg |
| 18-19 weeks of age | 1.2 kg |
| 20-100 weeks of age | 62.2 kg |
| **BODY WEIGHT** | |
| At 17 weeks of age | 1315-1425 g |
| At 100 weeks of age | 1900-2060 g |
| **MATURITY** | |
| Age at 50% production | 20-21 week |
| Age at 90% production | 22-23 week |
| **EGG PRODUCTION / HEN HOUSED** | |
| For 30 weeks of age | 65 pcs |
| For 52 weeks of age | 209 pcs |
| For 72 weeks of age | 331 pcs |
| For 100 weeks of age | 482 pcs |
| **EGG MASS / HEN HOUSED** | |
| For 100 weeks of age | 31.3 kg |
| **EGG WEIGHT** (weekly average) | |
| At 30 weeks of age | 61.2 g |
| At 52 weeks of age | 65.8 g |
| At 72 weeks of age | 67.6 g |
| At 100 weeks of age | 68.3 g |
| Average egg weight | 64.7 g |
| **EGGSHELL** | |
| Shell strength | >40 N |
| Shell colour | Cream |

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## Introduction

ELMA hybrids have been developed considering today's market expectations to adapt particularly well to the new environmental conditions caused by climate change.

The primary goal in developing ELMA hybrids was to achieve the ideal laying hybrid, a perfect combination of the production parameters in order to maximize profit.

### It involves:

- outstanding egg production ability,
- superb shell strength and egg quality,
- excellent feed conversion,
- calm temperament,
- outstanding liveability, in both breeding and commercial flocks.

ELMA CREAM layers with calm temperament and high resiliency can easily cope with different climatic and management conditions both in cage and in alternative systems while producing a large number of high-quality cream shell-colour consumption eggs.

**ELMA Layers Ltd.**

## Biosecurity

Animal husbandry starts with the basics of the biosecurity measures. Why do we take biosecurity so seriously? It is simple. Pathogens such as bacteria, viruses, fungi can reach the flocks in numerous ways. They can be introduced with feed, litter, wild birds, rodents, insects, equipment, clothes, vehicles, and so on. These pathogens can cause poor performance and diseases may spread causing great damages in the flock. That is why we believe it is better to fear and prevent these problems occurring, than cure or in the worst case eradicate the flocks.

## First Things First

1. Isolate the farm from any other live stocks in order to reduce chance of introducing diseases and improve viability with a clean house environment.
2. Traffic is considered to be the largest risk factor of the disease control. Therefore, we pay special attention to the disinfection. In terms of employees or visitors shower facilities and farm clothing are provided.
3. Incoming traffic should be minimised and always disinfected as thoroughly as possible.
4. Number of visitors should be reduced. Only those can enter who are required to.
5. Disinfectant footbaths, which are placed in front of each house are to be refilled and exchanged every day.
6. Trespassing or entering the farm is prohibited for unauthorized persons. Therefore, all the doors should be kept locked and NO TRESPASSING signs need to be written on the front door. In order to admonish people entering bio-secure area, BIOSECURITY ZONE superscription should be also signed.

## When a Farm is being Built

Build the farm far from anything that can cause contamination or infection such as other live stocks, processing plant, hatchery or high traffic motorways where live animal transport is frequent. Take care to prevent ingress of air-born hazards. Build a fence around the farm with a closed gate singed with UNAUTHORIZED ENTRY PROHIBITED. Set up a car park outside the fence because visitors are not allowed to enter by car. Basically the principle is to have as few visitors as possible, only those who are required to go in should be allowed. Apply a black and white biosecurity system. Black means dirty and white means clean.

Wild animals, especially birds and rodents poses a serious risk of infection. The best way to reduce this risk is to keep the surroundings free of vegetation. Clean and place a 1 metre stripe concrete around the poultry house to keep away rodents. Build the walls with smooth materials that are easy to keep clean and disinfected.

## When a Flock Starts

One farm has to contain the same age and breeding level chickens to avoid horizontal contamination. Growing and laying farms must be well separated. To reduce a risk of infection, it is best to have a decent distance between the hatchery, the feed mixing plant and the slaughterhouse.

## Personals

Before entering a poultry house, one have to fit a list of bio-secure formulas. Such as wearing boots, disinfecting hands and removing all personal belongings. Changing the clothes and using different boots in each poultry house is advised. On the fence a BIOSECURITY ZONE sign warns to do so. A "black and white" clothing room is provided inside the biosecurity building.

## Vehicles

The aim is to minimise the incoming traffic to the farm.

- Feed supply: To keep the traffic outside, the silos should be placed close to the fence, so the truck can fill them without getting in the biosecurity zone.
- Dead bird collection: Cadavers have to be collected at least once a day and placed into collecting boxes. The boxes are to be closed, and laid next to the fence. Deep freezers allow longer emptying frequencies.
- Egg storage: In order to reduce the risk of an infection, the egg storage ought to be far from any other buildings. Best to place it to the fence's line, so egg-transport vehicles do not need to enter the territory of the farm.

Despite of that, some vehicles must enter the farm. In that case vehicles should be fairly disinfected. If the driver has to get out of the vehicle, he/she has to wear disposable clothing and boots.

## Record of Entering

Register all the visitors who need to get into the farm. Record name, plate number of the vehicle, reason and the date of the entering. The person needs to declare what was the last time he/she visited another poultry facility such as hatchery, slaughterhouse, feed mill, etc...

In case someone needs to visit more flocks this order has to be followed: start the visit with the youngest then the older ones.

## Sanitizing

The most efficient method to minimise the negative impact of disease-causing pathogens on the performance of laying flocks is to avoid exposure to those organisms.

An insecticide programme is the most efficient if it is applied immediately in a warm house, therefore it has to be done soon after depopulation.

The flexible part of the equipment has to be disassembled, while manure and litter must be eliminated. Transfer the litter far from the farm to a fermentation plant, but do not split on the road while doing that. The residue of the feed must be removed from the silos, bins and feeders. Dry cleaning should be done as soon as possible after the old flock is removed.

The inside of the house and the built-in equipment are to be washed thoroughly with tensides and sufficient water.

High pressure cleaners are suitable for washing the walls, the floors and the items. After the detergent washing, clean water rinsing is needed. Then let the walls and the items to get dry and new litter material can be placed.

Disinfection is an essential part of hygiene; therefore, it must be done thoroughly including each wall and all the equipment such as nests, feeders, drinkers, fan blades outside and inside.

Keeping the surrounding area clean is part of the disinfection procedure.

## Feed and Water

Feed hygiene includes the neatness of the silos. They must be regularly cleaned and then replenished.

Feed must be obtained from skilled manufacturer, and should be mixed from high-quality ingredients and contain all the nutritionals which are required to the ideal body development and production of the birds. Feed should be balanced for energy, protein, macro- and microelements and vitamins. Heat treatment is useful to avoid microbial contamination.

The quality of the drinking water has to be checked at least every half a year for microbiological and chemical compounds. Chlorinate water, if necessary. Use effective detergents and disinfectants act only in empty house, in order to remove biofilm and carbonate deposit from the water pipelines.

Water lines must be flushed before and after vaccination or medication.

## Housing

This section does not aim to give detailed plans for building poultry houses, but draw attention to the various aspects of house construction which need special consideration in tropical climates.

It is convenient to divide these considerations into two classes, open and closed houses. The decision as to which type to build will be influenced by economics, availability of a reliable electricity supply, anticipated temperatures and type of building materials locally available. Generally closed houses will be chosen in cold or moderate climate countries as well as Middle East and North African countries, whilst open houses will likely be more suitable in the rest of Africa, the Indian sub-continent and Far East.

## Closed Houses

Closed houses have much better temperature control and allow lighting patterns to be adopted, both of which will help maximise stock performance. Key points in construction are:

- Good wall and roof insulation is vital to minimise heating cost on the other hand to reduce solar radiation. It is likely that manufactured materials will be used for both the basic structure and providing its insulating properties.

- Buildings with large thermal masses have less daily fluctuation in the temperature of the structures, this can be used to advantage in reducing maximum ambient temperatures when linked with generous night ventilation levels. Modern, isolated materials such as double-skin metal faced insulating panels, heavily built local stone, concrete block or brick cavity walls and a concrete roof is an ideal construction for making the best use of this principle.
- The temperature of air entering the house is usually reduced by drawing it through water sprays situated in the air inlets. However this cooling method must be ceased when the house relative humidity exceeds 70%.
- Exhaust fans are usually mounted in the side walls to effect cross ventilation and create greater air movement at bird level. A combination of cross and tunnel ventilation with climate computer is preferable. In cage units roof extraction may be more efficient, as the cages themselves would impede good cross ventilation.
- Careful light baffling of air inlets and outlets is necessary to permit lighting patterns to be applied within the house without limiting air flow.
- Standby generators are essential with large closed houses to ensure that the ventilation and cooling systems are always operational.

## Open Houses

With open houses it is difficult to control the ambient temperature beyond reflecting and absorbing solar radiation, however, they are relatively inexpensive to erect and suitable for areas which lack reliable electricity supplies.

Important areas for consideration are detailed below.

- Many local materials can be successfully used in roof construction to insulate the house against solar heating, these include, various types of palm leaf, reed thatch, maize stalk and copra.
- Corrugated roofs may be cooled by fitting sprinklers along the ridge, but this does require a satisfactory water and electricity supply.
- Extended overhangs at the eaves will ensure direct sunlight is excluded from the house, at least during the hottest part of the day.
- Minimum direct solar heat gain is achieved by orientating the long axis of the house north south.
- Vegetation and trees planted around the buildings will minimise reflected solar heating and create shade.
- Open ridges of various designs will permit bird heat to escape from the house. Where possible these should have their openings facing downwind.
- High roofs will allow a lower temperature at bird level and a more effective natural flow of hot air to the ridge.
- Bird comfort can be helped by using vertically mounted fans to create horizontal air movement at bird level. Air speeds of 2 m/sec will double sensible heat loss; at this velocity the air movement should be ruffling the plumage. In extremes of temperature and when heat stress is being suffered the flock may be sprayed with water using a nozzle hosepipe to provide instant cooling.
- All rearing, and laying houses in regions which have wide seasonal temperature variations, will benefit from having curtains along the side walls which can be used when high temperatures are not prevailing.
- Good storm water drainage is essential in all tropical countries which have to cope with sudden heavy rainfalls. It is recommended that either a ditch is dug around the house or the house floor sufficiently elevated above the surrounding land to avoid flooding.

## Stocking Density

The rate of stocking for layers is influenced more by environmental factors, like type of housing and ambient temperature, than by the breed itself. Slatted floors, for example, generally allow a tighter stocking rate than all litter, while the higher temperatures of tropical regions usually necessitate a more liberal density than that adopted in temperate areas.

As a guide the following recommendations are made for use in all litter units where the average temperature at bird level is about 20°C (68°F). These rates should be reduced by 2% for each 1°C (0.556°F) increase in ambient temperature above 20°C (68°F).

## Feeding Space

Insufficient feeding space is perhaps the biggest single cause of unevenness in a laying flock, and it will be most pronounced when a controlled feeding programme is in use. The following recommendations of this manual should therefore be regarded as the minimum requirement for satisfactory performance.

During the first week extra feeding space should be available to ensure the birds get off to a good start. We prefer chick-paper alongside the drinker lines, very close to them, but not beneath. In certain cases new egg trays, chick box lids, plastic trays can be used as additional feeders for the first 3-4 days. This supplementary feeding should be sited so that the birds cannot go far in any direction without encountering feed.

## Drinking Space

Water is essential for growth and egg production, therefore an adequate and easily accessible number of drinking points is vital. The need for sufficient water is no greater than in tropical regions where evaporative cooling plays a dominant role in maintaining the birds' normal body temperature of 41°C (106°F).

Figures given in this manual are those required at 20-30°C (68-86°F), at temperatures above this a more generous allowance should be made to prevent drinker crowding by the birds at peak demand.

The need for sufficient water intake at all ages means that the mentioned allowances are recommended from day old.

During the first week additional drinkers, in the form of founts or mini drinkers placed randomly in each direction, will ensure early drinking and minimise the incidence of non-starters.

Light intensities of 20-30 lux in the first few days are also necessary to make sure the birds find water and feed easily and quickly.

## New Day-old Chick Arrival

- Target house temperature at chicks' level: 34-35°C (93-95°F), warm up period: 24-48 hours before arrival.
- Relative humidity: 60-70%
- Light intensity: 20-30 lux, provided by conventional light bulbs or LED light in warm-white (2700-3000K) spectrum. Low frequency fluorescent lamps should be avoided.
- Light hours: 23
- Trigger all drinkers for function and set proper height. Check and adjust them frequently when birds are using them. Nipple drinkers should be at the chicks' eye level, trough and bell drinkers on the ground level.
- Chick paper should be slightly covered by mashed or crumbled chick starter I feed.
- In closed houses set minimum ventilation.
- Carbon-dioxide ($CO_2$) concentration must be below 2000 ppm.

## Beak Trimming

Although routine beak trimming is unnecessary in controlled environment housing in temperate climates, the high temperatures, and in open housing high light intensity, makes the operation an essential in tropical regions, but countries' welfare regulations must be accepted.

Beak trimming can be done in the hatchery by a precise infra-red equipment, but in the farm can be also performed between 7 and 10 days of age using a precision de-beaker. Care must be taken that the beak is not cut too severely nor unevenly as this will lead to impaired feed intake and will reduce the performance.

Properly performed the operation should last throughout the birds' life, giving it a rounded but slightly shorter beak, which does not hinder its mating or feeding behaviour but may reduce mortality, feed wastage and feather loss.

## Vaccination Programme

Disease conditions vary throughout the World, therefore vaccination programmes should be designed by your local veterinarian to accommodate these peculiarities.

## Body Weight Guide

Birds' weight should be checked every week between 4 to 16 weeks of age. It is most important to get an accurate assessment of body weight and evenness during the growing period as this information will indicate if changes are needed to the feeding programme. Standard deviation (CV%) must be kept below 10%.

Weigh 1% of the flock each time. For accurate body weighing a minimum of 50 birds per group should be encircled and weighed all of them, including any culls.

## Microclimate

Closed houses should be equipped with a ventilation system that capacity exceeds 4.7 $m^3$/ body weight kg in an hour, and which is adjustable between minimum and maximum level according to the birds' demands and climate conditions. Stepless setting is a minimal requirement, a control by climate computer is advisable.

Air carbon-dioxide ($CO_2$) concentration should not exceed 2000 ppm and maximum ammonium ($NH_3$) level of 10 ppm can still be tolerated by the birds. Dust level should be kept low in the house.

## Lightening Pattern

Regulable conventional light bulbs or LED lights in warm-white (2700-3000K) spectrum are preferred. Using fluorescent lamps that operate below 2000 Hz frequency should be avoided.

The step down to 10 hours by 7 weeks and increase at 17 weeks of age are designed to maximise early egg size, and maximising the number of eggs in the early period of lay.

All light increases should be in the evening to permit feeding in the cooler part of the day, and allow the majority of eggs to be collected during normal working hours.

It is vital that at no time during the laying period should day length decrease, therefore any tendency for dawn to occur later must be counter balanced at the end of the day with extra artificial light.

## Nutrition

Satisfactory performance will only be achieved if a flock receives the correct daily quantities of nutrients for its particular age and stage of development. In the middle rearing period some control of daily intake will probably be required to achieve the desired rate of growth.

Levels of nutrient inclusion are detailed in the Ration Specification section, however, the quality of the feed itself is also important. If the feed grounded too finely it may reduce its palatability, and physically the pecking may cause mandibular problems, which adversely affect bird vitality.

As energy may be considered as the only nutritional requirement influenced by temperature change this section will consider formulation change made necessary by changes in voluntary energy intake.

While the birds are in the comfort zone the concentration of non-energy nutrients in the diet should be increased in proportion to the decline in feed intake.

Beyond 30°C (86°F) egg output will decline irrespective of nutrient intake so layer rations should be formulated to support the best anticipated level of performance to void wasting protein. Energy levels in the ration should also be reduced to encourage intake and permit sensible crude protein inclusion levels.

The quantity of vitamins and minerals should be increased as temperature rises to maintain the same level of intake as that recommended for 20°C (68°F).

Some control of body weight gain is desirable during the rearing of the birds, accordingly it is recommended that a conventional chick starter I feed set up for temperate climate conditions is fed ad libitum to 3 weeks of age followed by a starter II to 9 weeks and grower ration until 17 to 18 weeks. Before the start of the egg production, pre-layer ration is advised for 10-14 days, followed by layer I at 5% production and from approx. the 60 weeks of age, layer II. We recommend to change the feed from layer I to layer II when production declines under 85% (HD). Production level is more important than the age of birds. In tropical regions voluntary reduced intakes may be balanced by a more concentrated feed. We recommend AD LIBITUM feeding from the 1st day up to the end of production. Figures of the daily feed intake of the birds in the weight development and feed consumption tables are just for information.

All rations should be protected with antioxidants and if necessary, mycotoxin-binder adsorbents, however, storage conditions should be of a standard which prevents extremely high temperatures and humidity.

If the livestock is not vaccinated against coccidiosis, coccidiostats should be included in the relevant rations in the rearing period, carefully following manufacturers' recommendations.

## Metabolizable Energy Intake

Voluntary energy intake decreases curvilinearly as mean daily temperature rises due to the birds' declining energy requirement for heat production.

The intake will be determined by factors such as feather cover and degree of acclimatisation as well as temperature itself. As an indication of the feathering influence the maintenance demand of a laying hen may increase considerably when comparing a perfectly feathered with a naked bird.

Up to the panting threshold of 27-30°C (81-86°F) energy intake can be stimulated by raising the dietary concentration, however, beyond this temperature it should be reduced to a level at which the voluntary intake of energy is accommodated in a sensible level of feed intake. If high dietary concentrations are combined with very low voluntary energy intakes it will be impossible to formulate for satisfactory intakes of protein and other nutrients.

The adoption of a lighting pattern which allows feeding in the cooler part of the day will stimulate feed intake and raise daily egg output. Our recommendation is: AD LIBITUM feeding, but the feeders' content should be fed up once a day, to ensure that also the smallest feed particles are picked up by the birds.

## Water Intake

Below 20°C (68°F) the daily water intake of laying birds is fairly constant at about 20 litres/100 birds. It then increases curvilinearly as a reflection of the rising evaporative heat output, especially once panting has started.

The easily accessible drinking water is important because its influence on feed intake, egg content and has vital role in heat dissipation at high temperatures.

Provided measures are taken to minimise splashing and wet litter the use of trough drinkers is to be encouraged in tropical climates, certainly great attention should be given before nipple drinkers are installed. Troughs or circular hanging drinkers allow the bird to at least submerge its wattles and help maximise sensible heat loss.

Water deprivation should be avoided at all costs as this adversely affects production and heat loss. Where possible reservoir tanks of sufficient size to hold three days water should be installed, especially where water cooling is used in closed houses.

## Heat Loss

As temperature rises there is a linear reduction in the total daily heat production. Below the panting threshold about 28°C (82°F) sensible heat loss is responsible for the majority of heat dissipation, although actual levels will be influenced by the degree of feathering.

Once the panting threshold has been passed evaporative heat loss increases dramatically, and by 37°C (99°F) it becomes the major method of losing heat. Sensible heat loss, however, rapidly becomes less important, although the highly vascular comb and wattles tend to increase in size to permit extra sensible heat loss.

Heat stress can be avoided, or at least reduced, by various methods including speeding up air movement through the flock, fogging the house atmosphere or incoming air and housing at the correct stocking density. Before an evaporative cooling method is adopted, consideration should be given to its' influence upon the relative humidity within the house. In addition, a good level of roof and wall insulation to reflect solar radiation and sufficient overhang on open sided houses to keep direct sunlight off the stock will obviously help keep the birds in the comfort zone.

High air speed will increase the convective heat loss from birds with sensible heat loss doubling at speeds of 2 m/s. Total ventilation allowance need only be the same as that used in tempered climates, namely 4.7 $m^3$/h/kg body weight or one 610 mm 900 rpm fan/1000 adults.

In open houses fans should be mounted vertically at a height of about 1 metre to create horizontal air movement at bird level, and well-secured for bird and worker protection. If house temperatures at any time approach 41°C (106°F) air movement should not be discontinued as this will raise the birds' body temperature. Provided mean ambient temperatures are not reduced below 24°C (75°F) it will be advantageous in closed houses to ventilate at night to reduce the temperature of the house structures and delay its increase the following day.

Evaporative coolers in air inlets of closed houses reduce the incoming air temperature, but raises its' relative humidity. As the maximum permissible ambient humidity is 16 g/kg and there is little benefit in increasing the ventilation above 4.3 $m^3$/h/bird the water cooler output should be 16 g/h/bird. When house relative humidity levels exceed 70% evaporative cooling should be discontinued.

Fogging the internal atmosphere from nozzles located inside the house not only reduces the air temperature but also moistens the birds' head parts and increases their effectiveness as sources of heat loss. Care must be taken to ensure that the particle size from the nozzles is fine enough not to dampen the litter. Usually nozzles work at 140 kPa pressure and use 3.4 litres/hour and produce a mist rather than fog.

When stocking densities are too tight, radiative heat transfer between birds is increased and the air temperature around the birds rises, especially in cages. As the level of sensible loss of heat is dependent on the temperature gradient between the bird and its immediate environment over stocking will impose a limitation on the birds' ability to lose heat directly.

## Nestbox Space

The production of clean eggs and minimization of floor laying is very much influenced by the provision of sufficient, well sited and well managed nest boxes.

Allow automatic laying nest system or 20-25 individual nests per 100 hens where each nest is approximately 30-35 cm high, 25 cm wide and 30-35 cm deep. Grouped in banks of 10 or 12 in two tier formation, non-automatic nests, whether back to back or wall mounted, should be well ventilated to deter broodiness and positioned to exclude direct sunlight and give the birds' maximum privacy.

Adequate training of birds to use the nests is essential in the first month of lay if floor laying is to be minimised. This will involve frequent patrolling of the poultry house and physically placing any birds laying on the floor or slats into nest boxes.

## Egg Care

Frequency of egg collecting is important all over the world, but doubly so in tropical countries. Eggs should therefore be collected a minimum of twice a day.

Frequent attention to nest box litter and training of "floor layers" is also vital in reducing the bacterial and mould contamination.

## Egg Output

Provided intakes of nutrients other than energy are maintained at a satisfactory level, egg output (the product of egg size and numbers) will initially increase as temperature rises, reaching a maximum at about 24°C (75°F).

When the mean temperature exceeds 27°C (81°F) daily egg mass will begin to decline, especially if the flock has already started panting.

Above 30°C (86°F) output will deteriorate rapidly due to the reduction in voluntary energy intake. Even if attempts are made to maintain protein intake it is unlikely that egg production will be commercially viable when the average temperature consistently exceeds 35°C (95°F).

As mean daily temperature rises egg weight reduces linearly by about 0.3 grams per 1°C (0.556°F) due to the lower intake of energy. 1 gram of egg requires 6.69 kJ (1.60 kcals) of energy.

While the average daily temperature is below 27-30°C (81-86°F) good levels of egg production can be achieved by increasing the dietary concentration of amino acids, vitamins and minerals, as energy demands decrease, to ensure a constant daily intake of these nutrients.

However, when the mean daily temperature exceeds 30°C (86°F) the depressed output which occurs irrespective of the intake of non-energy nutrients suggests that the only practical approach is to concentrate efforts on stimulating energy intake, as this is the limiting factor to egg output.

High temperature may be tolerated for part of the day provided the average is within the birds' comfort zone (not panting). Acclimatized stock may tolerate otherwise lethal high daily means over 35°C (95°F) for short periods of the year provided they are below 30°C (86°F) for the remainder, because they can lose weight for a few weeks while continuing to lay at a reduced rate.

When the panting threshold has been passed fluctuating temperatures (wide diurnal variations) may help production, especially if the average is below 29°C (84°F) during day light hours, because the bird responds to the mean temperature and not the maximum.

Table 2: **Space and Equipment Requirements**

| Age (weeks) | | 0-6 | 7-18 | 19≤ |
|---|---|---|---|---|
| Density (bird/m²) | Floor | 20-24 | 10-12 | 7-8 |
| | Aviary | 26-28 | 26-28 | 14-16 |
| | Cage | 80-50 | 40-25 | 13-18 (minimum 490 cm²) - non-EU<br>10-13 (minimum 750 cm²) - EU |
| Drinking space | Birds/nipple | 10-12 | 8 | 4-6 |
| | Birds/drinker (ø 46 cm) | 100-130 | | |
| Feeding space | Through or circular feeder (space/bird) | 4 cm + chick paper in the first 3-4 days | 7 cm | 10 cm |

Table 3: **Temperature Requirements**

| Age (days) | Temperature at Chicks' Level | |
|---|---|---|
| | °C | °F |
| 0 - 2 | 34 - 35 | 93 - 95 |
| 3 - 7 | 32 | 90 |
| 8 - 14 | 30 | 86 |
| 15 - 21 | 27 | 81 |
| 22 - 28 | 24 | 75 |
| 29 - 35 | 22 | 72 |
| 35 - 119 | 20 | 68 |

Table 4: **Lighting Programme**

| Age (weeks) | Hours of Light | Light Intensity (lux) |
|---|---|---|
| 1 | 22 | 20-30 |
| 2 | 20 | 10-20 |
| 3 | 18 | 10 |
| 4 | 16 | 3-5 |
| 5 | 14 | 3-5 |
| 6 | 12 | 3-5 |
| 7 | 10 | 3-5 |
| 8 | 10 | 3-5 |
| 9 | 10 | 3-5 |
| 10 | 10 | 3-5 |
| 11 | 10 | 3-5 |
| 12 | 10 | 3-5 |
| 13 | 10 | 3-5 |
| 14 | 10 | 3-5 |
| 15 | 10 | 3-5 |
| 16 | 10 | 3-5 |
| 17 | 11 | 3-5 |
| 18 | 12 | 4-6 |
| 19 | 13 | 5-7 |
| 20-100 | 14 | 10-12 |

Table 5: **Weight and Feed Intake (growing period)**

| At the End of the Week | Body Weight (g) | | Feed Intake | | Feed Type |
|---|---|---|---|---|---|
| | Average | Min. - Max. | Average (g/bird/day) | Cumulative (kg) | |
| 1 | 80 | 75 - 85 | 10 | 0.1 | Starter I |
| 2 | 130 | 125 - 135 | 18 | 0.2 | |
| 3 | 190 | 180 - 200 | 24 | 0.4 | |
| 4 | 270 | 260 - 280 | 30 | 0.6 | Starter II |
| 5 | 370 | 355 - 385 | 35 | 0.8 | |
| 6 | 470 | 450 - 490 | 39 | 1.1 | |
| 7 | 570 | 545 - 595 | 44 | 1.4 | |
| 8 | 670 | 645 - 695 | 48 | 1.7 | |
| 9 | 760 | 730 - 790 | 52 | 2.1 | Grower |
| 10 | 860 | 825 - 895 | 56 | 2.5 | |
| 11 | 940 | 900 - 980 | 59 | 2.9 | |
| 12 | 1030 | 990 - 1070 | 62 | 3.3 | |
| 13 | 1100 | 1055 - 1145 | 65 | 3.8 | |
| 14 | 1170 | 1125 - 1215 | 68 | 4.3 | |
| 15 | 1240 | 1190 - 1290 | 71 | 4.8 | |
| 16 | 1300 | 1250 - 1350 | 74 | 5.3 | |
| 17 | 1370 | 1315 - 1425 | 78 | 5.8 | |
| 18 | 1430 | 1375 - 1485 | 82 | 6.4 | Pre-layer |
| 19 | 1490 | 1430 - 1550 | 87 | 7.0 | |

Table 6: **Weight and Feed Intake (laying period)**

| At the End of the Week | Body Weight (g) | | Feed Intake | | Feed Type |
|---|---|---|---|---|---|
| | Average | Min. - Max. | Average (g/bird/day) | Cumulative (kg) | |
| 20 | 1560 | 1500 - 1620 | 91 | 0.6 | Layer I approx. 20-60 weeks |
| 21 | 1620 | 1555 - 1685 | 93 | 1.3 | |
| 22 | 1670 | 1605 - 1735 | 96 | 2.0 | |
| 23 | 1710 | 1640 - 1780 | 98 | 2.6 | |
| 24 | 1750 | 1680 - 1820 | 100 | 3.3 | |
| 25 | 1790 | 1720 - 1860 | 102 | 4.1 | |
| 30 | 1830 | 1755 - 1905 | 107 | 7.8 | |
| 35 | 1850 | 1775 - 1925 | 108 | 11.6 | |
| 40 | 1860 | 1785 - 1935 | 108 | 15.4 | |
| 45 | 1870 | 1795 - 1945 | 109 | 19.2 | |
| 50 | 1880 | 1805 - 1955 | 109 | 23.0 | |
| 55 | 1890 | 1815 - 1965 | 110 | 26.8 | |
| 60 | 1900 | 1825 - 1975 | 110 | 30.7 | Layer II < 85% HD production |
| 65 | 1910 | 1835 - 1985 | 111 | 34.5 | |
| 70 | 1920 | 1845 - 1995 | 111 | 38.4 | |
| 75 | 1930 | 1855 - 2005 | 112 | 42.3 | |
| 80 | 1940 | 1860 - 2020 | 112 | 46.3 | |
| 85 | 1950 | 1870 - 2030 | 113 | 50.2 | |
| 90 | 1960 | 1880 - 2040 | 113 | 54.2 | |
| 95 | 1970 | 1890 - 2050 | 114 | 58.2 | |
| 100 | 1980 | 1900 - 2060 | 114 | 62.2 | |

Table 7: **Energy and Nutrients (growing period)**

| Feed Type | | Starter I | Starter II | Grower | Pre-layer |
|---|---|---|---|---|---|
| | | 1-3 weeks | 4-8 weeks | 9-17 weeks | 18-19 weeks |
| Met. energy | MJ/kg | 12.35 | 12.00 | 11.50 | 11.70 |
| Crude protein | % | 20.00 | 18.00 | 15.50 | 17.50 |
| Lysine | % | 1.20 | 1.00 | 0.75 | 0.80 |
| Methionine | % | 0.48 | 0.42 | 0.35 | 0.40 |
| Methionine + cysteine | % | 0.84 | 0.74 | 0.61 | 0.70 |
| Threonine | % | 0.75 | 0.65 | 0.50 | 0.60 |
| Valine | % | 0.93 | 0.78 | 0.60 | 0.65 |
| Arginine | % | 1.22 | 1.02 | 0.77 | 0.82 |
| Tryptophan | % | 0.24 | 0.22 | 0.17 | 0.18 |
| Isoleucine | % | 0.84 | 0.75 | 0.60 | 0.64 |
| Dig. lysine | % | 1.00 | 0.83 | 0.60 | 0.70 |
| Dig. methionine | % | 0.40 | 0.35 | 0.30 | 0.35 |
| Dig. methionine + cysteine | % | 0.70 | 0.60 | 0.50 | 0.58 |
| Dig. threonine | % | 0.63 | 0.55 | 0.42 | 0.50 |
| Dig. valine | % | 0.76 | 0.65 | 0.50 | 0.54 |
| Dig. arginine | % | 1.02 | 0.84 | 0.63 | 0.68 |
| Dig. tryptophan | % | 0.20 | 0.18 | 0.14 | 0.15 |
| Dig. isoleucine | % | 0.69 | 0.62 | 0.49 | 0.52 |
| Calcium | % | 1.00 | 1.00 | 1.00 | 2.50 |
| Phosphorus, available | % | 0.48 | 0.44 | 0.38 | 0.44 |
| Sodium | % | 0.17 | 0.17 | 0.17 | 0.17 |
| Chloride | % | 0.18-0.25 | 0.18-0.25 | 0.18-0.25 | 0.18-0.25 |
| Linolenic acid | % | 1.50 | 1.25 | 1.00 | 1.50 |

Table 8: **Energy and Nutrients (laying period)**

| Feed Type | | Layer I | Layer II |
|---|---|---|---|
| | | 20-60 weeks | <85% HD production |
| Met. energy | MJ/kg | 11.40 | 11.30 |
| Crude protein | % | 17.50 | 16.50 |
| Lysine | % | 0.85 | 0.80 |
| Methionine | % | 0.41 | 0.40 |
| Methionine + cysteine | % | 0.72 | 0.70 |
| Threonine | % | 0.57 | 0.55 |
| Valine | % | 0.66 | 0.63 |
| Arginine | % | 0.85 | 0.81 |
| Tryptophan | % | 0.17 | 0.16 |
| Isoleucine | % | 0.66 | 0.63 |
| Dig. lysine | % | 0.67 | 0.65 |
| Dig. methionine | % | 0.36 | 0.34 |
| Dig. methionine + cysteine | % | 0.59 | 0.58 |
| Dig. threonine | % | 0.46 | 0.45 |
| Dig. valine | % | 0.54 | 0.52 |
| Dig. arginine | % | 0.70 | 0.66 |
| Dig. tryptophan | % | 0.14 | 0.13 |
| Dig. isoleucine | % | 0.54 | 0.51 |
| Calcium | % | 3.70 | 3.90 |
| Phosphorus, available | % | 0.39 | 0.37 |
| Sodium | % | 0.17 | 0.17 |
| Chloride | % | 0.14-0.28 | 0.14-0.28 |
| Linolenic acid | % | 1.90 | 1.70 |

Table 9: **Performance Targets**

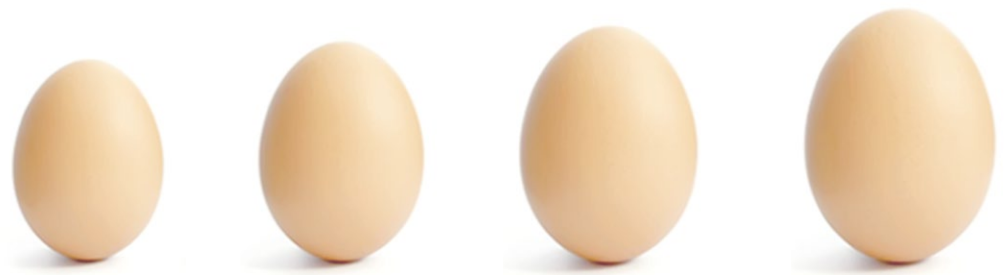
| Age (weeks) | Egg Production | | Weekly Egg Number (HH pcs) | Egg Number Cumulative (HH pcs) | Weekly Average Egg Weight (g) | Egg Weight Cumulative Average (g) | Weekly Egg Mass (HH g) | Egg Mass Cumulative (HH kg) |
|---|---|---|---|---|---|---|---|---|
| | Hen Housed (HH %) | Hen Day (HD %) | | | | | | |
| 19 | 9.4 | 9.4 | 0.7 | 0.7 | 43.5 | 43.9 | 28.6 | 0.0 |
| 20 | 25.7 | 25.8 | 1.8 | 2.5 | 46.2 | 44.8 | 83.2 | 0.1 |
| 21 | 56.0 | 56.2 | 3.9 | 6.4 | 49.4 | 46.3 | 193.7 | 0.3 |
| 22 | 81.2 | 81.5 | 5.7 | 12.1 | 51.9 | 47.7 | 295.0 | 0.6 |
| 23 | 91.1 | 91.5 | 6.4 | 18.4 | 53.8 | 49.0 | 343.1 | 0.9 |
| 24 | 93.6 | 94.1 | 6.5 | 25.0 | 56.1 | 50.1 | 367.6 | 1.3 |
| 25 | 95.1 | 95.8 | 6.7 | 31.6 | 57.4 | 51.2 | 382.6 | 1.7 |
| 26 | 95.4 | 96.2 | 6.7 | 38.3 | 59.0 | 52.2 | 393.8 | 2.1 |
| 27 | 95.7 | 96.6 | 6.7 | 45.0 | 59.8 | 53.0 | 400.4 | 2.5 |
| 28 | 95.8 | 96.8 | 6.7 | 51.7 | 60.4 | 53.7 | 404.9 | 2.9 |
| 29 | 95.7 | 96.8 | 6.7 | 58.4 | 60.8 | 54.4 | 407.2 | 3.3 |
| 30 | 95.6 | 96.8 | 6.7 | 65.1 | 61.2 | 54.9 | 409.5 | 3.7 |
| 31 | 95.5 | 96.8 | 6.7 | 71.8 | 61.6 | 55.5 | 411.7 | 4.1 |
| 32 | 95.4 | 96.8 | 6.7 | 78.5 | 61.8 | 55.9 | 412.6 | 4.5 |
| 33 | 95.3 | 96.8 | 6.7 | 85.2 | 62.0 | 56.3 | 413.6 | 4.9 |
| 34 | 95.2 | 96.8 | 6.7 | 91.8 | 62.2 | 56.7 | 414.5 | 5.4 |
| 35 | 95.1 | 96.8 | 6.7 | 98.5 | 62.4 | 57.0 | 415.4 | 5.8 |
| 36 | 95.0 | 96.8 | 6.7 | 105.2 | 62.6 | 57.3 | 416.3 | 6.2 |
| 37 | 94.8 | 96.7 | 6.6 | 111.8 | 62.8 | 57.6 | 416.8 | 6.6 |
| 38 | 94.6 | 96.6 | 6.6 | 118.4 | 63.0 | 57.9 | 417.2 | 7.0 |
| 39 | 94.4 | 96.4 | 6.6 | 125.0 | 63.2 | 58.1 | 417.7 | 7.4 |
| 40 | 94.2 | 96.3 | 6.6 | 131.6 | 63.4 | 58.4 | 418.1 | 7.9 |
| 41 | 94.1 | 96.2 | 6.6 | 138.2 | 63.6 | 58.6 | 418.6 | 8.3 |
| 42 | 93.9 | 96.1 | 6.6 | 144.8 | 63.8 | 58.8 | 419.0 | 8.7 |
| 43 | 93.6 | 95.9 | 6.5 | 151.3 | 64.0 | 59.0 | 419.0 | 9.1 |
| 44 | 93.3 | 95.7 | 6.5 | 157.9 | 64.2 | 59.2 | 419.0 | 9.5 |
| 45 | 93.0 | 95.5 | 6.5 | 164.4 | 64.4 | 59.4 | 419.0 | 10.0 |
| 46 | 92.7 | 95.3 | 6.5 | 170.9 | 64.6 | 59.6 | 418.9 | 10.4 |
| 47 | 92.4 | 95.1 | 6.5 | 177.3 | 64.8 | 59.8 | 418.9 | 10.8 |
| 48 | 92.1 | 94.9 | 6.4 | 183.8 | 65.0 | 59.9 | 418.8 | 11.2 |
| 49 | 91.8 | 94.6 | 6.4 | 190.2 | 65.2 | 60.1 | 418.8 | 11.6 |
| 50 | 91.5 | 94.4 | 6.4 | 196.6 | 65.4 | 60.3 | 418.7 | 12.1 |
| 51 | 91.2 | 94.2 | 6.4 | 203.0 | 65.6 | 60.4 | 418.6 | 12.5 |
| 52 | 90.9 | 94.0 | 6.4 | 209.3 | 65.8 | 60.6 | 418.6 | 12.9 |
| 53 | 90.5 | 93.7 | 6.3 | 215.7 | 66.0 | 60.8 | 418.0 | 13.3 |
| 54 | 90.1 | 93.4 | 6.3 | 222.0 | 66.2 | 60.9 | 417.4 | 13.7 |
| 55 | 89.7 | 93.0 | 6.3 | 228.3 | 66.4 | 61.1 | 416.9 | 14.1 |
| 56 | 89.3 | 92.7 | 6.3 | 234.5 | 66.6 | 61.2 | 416.3 | 14.6 |
| 57 | 88.9 | 92.4 | 6.2 | 240.7 | 66.8 | 61.3 | 415.7 | 15.0 |
| 58 | 88.5 | 92.1 | 6.2 | 246.9 | 67.0 | 61.5 | 415.1 | 15.4 |
| 59 | 88.1 | 91.8 | 6.2 | 253.1 | 67.2 | 61.6 | 414.5 | 15.8 |
| 60 | 87.7 | 91.4 | 6.1 | 259.2 | 67.3 | 61.8 | 413.2 | 16.2 |
| 61 | 87.3 | 91.1 | 6.1 | 265.3 | 67.3 | 61.9 | 411.4 | 16.6 |
| 62 | 86.9 | 90.8 | 6.1 | 271.4 | 67.3 | 62.0 | 409.5 | 17.0 |
| 63 | 86.5 | 90.5 | 6.1 | 277.5 | 67.4 | 62.1 | 408.2 | 17.4 |
| 64 | 86.1 | 90.1 | 6.0 | 283.5 | 67.4 | 62.2 | 406.4 | 17.9 |
| 65 | 85.7 | 89.8 | 6.0 | 289.5 | 67.4 | 62.4 | 404.5 | 18.3 |
| 66 | 85.3 | 89.5 | 6.0 | 295.5 | 67.4 | 62.5 | 402.6 | 18.7 |
| 67 | 84.9 | 89.1 | 5.9 | 301.4 | 67.5 | 62.6 | 401.4 | 19.1 |
| 68 | 84.5 | 88.8 | 5.9 | 307.4 | 67.5 | 62.7 | 399.5 | 19.5 |
| 69 | 84.2 | 88.5 | 5.9 | 313.2 | 67.5 | 62.8 | 397.6 | 19.9 |
| 70 | 83.8 | 88.2 | 5.9 | 319.1 | 67.5 | 62.8 | 395.8 | 20.3 |
| 71 | 83.4 | 87.8 | 5.8 | 324.9 | 67.6 | 62.9 | 394.5 | 20.6 |
| 72 | 83.0 | 87.5 | 5.8 | 330.7 | 67.6 | 63.0 | 392.6 | 21.0 |
| 73 | 82.6 | 87.2 | 5.8 | 336.5 | 67.6 | 63.1 | 390.7 | 21.4 |
| 74 | 82.2 | 86.8 | 5.8 | 342.3 | 67.6 | 63.2 | 388.8 | 21.8 |
| 75 | 81.8 | 86.5 | 5.7 | 348.0 | 67.7 | 63.3 | 387.5 | 22.2 |
| 76 | 81.4 | 86.1 | 5.7 | 353.7 | 67.7 | 63.3 | 385.7 | 22.6 |
| 77 | 81.0 | 85.8 | 5.7 | 359.4 | 67.7 | 63.4 | 383.8 | 23.0 |
| 78 | 80.6 | 85.5 | 5.6 | 365.0 | 67.7 | 63.5 | 381.9 | 23.4 |
| 79 | 80.2 | 85.1 | 5.6 | 370.6 | 67.8 | 63.6 | 380.6 | 23.7 |
| 80 | 79.8 | 84.8 | 5.6 | 376.2 | 67.8 | 63.6 | 378.7 | 24.1 |
| 81 | 79.4 | 84.5 | 5.6 | 381.8 | 67.8 | 63.7 | 376.8 | 24.5 |
| 82 | 79.0 | 84.1 | 5.5 | 387.3 | 67.8 | 63.8 | 375.0 | 24.9 |
| 83 | 78.6 | 83.8 | 5.5 | 392.8 | 67.9 | 63.8 | 373.6 | 25.2 |
| 84 | 78.2 | 83.4 | 5.5 | 398.3 | 67.9 | 63.9 | 371.8 | 25.6 |
| 85 | 77.8 | 83.1 | 5.4 | 403.7 | 67.9 | 63.9 | 369.9 | 26.0 |
| 86 | 77.4 | 82.7 | 5.4 | 409.1 | 67.9 | 64.0 | 368.0 | 26.4 |
| 87 | 77.0 | 82.4 | 5.4 | 414.5 | 68.0 | 64.1 | 366.7 | 26.7 |
| 88 | 76.6 | 82.0 | 5.4 | 419.9 | 68.0 | 64.1 | 364.8 | 27.1 |
| 89 | 76.2 | 81.7 | 5.3 | 425.2 | 68.0 | 64.2 | 362.9 | 27.4 |
| 90 | 75.8 | 81.3 | 5.3 | 430.5 | 68.0 | 64.2 | 361.0 | 27.8 |
| 91 | 75.4 | 81.0 | 5.3 | 435.8 | 68.1 | 64.3 | 359.6 | 28.2 |
| 92 | 75.0 | 80.7 | 5.3 | 441.1 | 68.1 | 64.3 | 357.8 | 28.5 |
| 93 | 74.6 | 80.3 | 5.2 | 446.3 | 68.1 | 64.4 | 355.9 | 28.9 |
| 94 | 74.3 | 79.9 | 5.2 | 451.5 | 68.1 | 64.4 | 354.0 | 29.2 |
| 95 | 73.9 | 79.6 | 5.2 | 456.7 | 68.2 | 64.5 | 352.6 | 29.6 |
| 96 | 73.5 | 79.2 | 5.1 | 461.8 | 68.2 | 64.5 | 350.7 | 29.9 |
| 97 | 73.1 | 78.9 | 5.1 | 466.9 | 68.2 | 64.6 | 348.8 | 30.3 |
| 98 | 72.7 | 78.5 | 5.1 | 472.0 | 68.2 | 64.6 | 346.9 | 30.6 |
| 99 | 72.3 | 78.2 | 5.1 | 477.1 | 68.3 | 64.7 | 345.6 | 31.0 |
| 100 | 71.9 | 77.8 | 5.0 | 482.1 | 68.3 | 64.7 | 343.7 | 31.3 |

Table 10: **Egg Grading**

| Age (weeks) | S | M | L | XL |
|---|---|---|---|---|
| | 43-53 g (%) | 53-63 g (%) | 63-73 g (%) | >73 g (%) |
| 19 | 98.6 | 1.4 | 0.0 | 0.0 |
| 20 | 86.5 | 12.3 | 1.2 | 0.0 |
| 21 | 71.1 | 27.1 | 1.8 | 0.0 |
| 22 | 48.2 | 48.3 | 3.5 | 0.0 |
| 23 | 32.6 | 61.7 | 5.8 | 0.0 |
| 24 | 24.8 | 67.3 | 8.0 | 0.0 |
| 25 | 18.3 | 70.6 | 11.0 | 0.1 |
| 26 | 14.7 | 71.1 | 14.0 | 0.2 |
| 27 | 11.9 | 71.5 | 16.4 | 0.3 |
| 28 | 9.7 | 70.8 | 19.1 | 0.4 |
| 29 | 8.3 | 69.9 | 21.3 | 0.5 |
| 30 | 7.1 | 68.7 | 23.5 | 0.6 |
| 31 | 5.8 | 68.0 | 25.5 | 0.7 |
| 32 | 4.9 | 67.1 | 27.3 | 0.8 |
| 33 | 4.3 | 66.2 | 28.7 | 0.9 |
| 34 | 3.6 | 65.1 | 30.3 | 1.0 |
| 35 | 3.0 | 64.4 | 31.5 | 1.1 |
| 36 | 2.2 | 63.7 | 32.9 | 1.2 |
| 37 | 1.5 | 62.8 | 34.4 | 1.3 |
| 38 | 1.0 | 62.2 | 35.5 | 1.4 |
| 39 | 0.6 | 60.9 | 37.0 | 1.5 |
| 40 | 0.6 | 60.1 | 37.7 | 1.6 |
| 41 | 0.5 | 59.2 | 38.6 | 1.7 |
| 42 | 0.3 | 58.4 | 39.5 | 1.8 |
| 43 | 0.2 | 57.8 | 40.1 | 1.9 |
| 44 | 0.2 | 57.0 | 40.8 | 2.0 |
| 45 | 0.2 | 56.1 | 41.6 | 2.1 |
| 46 | 0.1 | 55.5 | 42.2 | 2.2 |
| 47 | 0.1 | 54.9 | 42.7 | 2.3 |
| 48 | 0.1 | 54.1 | 43.4 | 2.4 |
| 49 | 0.1 | 53.3 | 44.1 | 2.5 |
| 50 | 0.1 | 52.5 | 44.8 | 2.6 |
| 51 | 0.1 | 51.5 | 45.7 | 2.7 |
| 52 | 0.1 | 50.7 | 46.4 | 2.8 |
| 53 | 0.1 | 49.9 | 47.1 | 2.9 |
| 54 | 0.1 | 49.2 | 47.7 | 3.0 |
| 55 | 0.1 | 48.5 | 48.3 | 3.1 |
| 56 | 0.1 | 47.9 | 48.8 | 3.2 |
| 57 | 0.1 | 47.5 | 49.1 | 3.3 |
| 58 | 0.1 | 47.1 | 49.4 | 3.4 |
| 59 | 0.1 | 46.4 | 50.0 | 3.5 |
| 60 | 0.1 | 45.7 | 50.6 | 3.6 |
| 61 | 0.1 | 45.3 | 50.9 | 3.7 |
| 62 | 0.1 | 44.8 | 51.3 | 3.8 |
| 63 | 0.1 | 44.2 | 51.8 | 3.9 |
| 64 | 0.1 | 43.6 | 52.3 | 4.0 |
| 65 | 0.1 | 43.0 | 52.8 | 4.1 |
| 66 | 0.1 | 42.3 | 53.4 | 4.2 |
| 67 | 0.1 | 41.6 | 54.0 | 4.3 |
| 68 | 0.1 | 40.9 | 54.6 | 4.4 |
| 69 | 0.1 | 40.2 | 55.2 | 4.5 |
| 70 | 0.1 | 39.6 | 55.7 | 4.6 |
| 71 | 0.1 | 39.0 | 56.2 | 4.7 |
| 72 | 0.1 | 38.4 | 56.7 | 4.8 |
| 73 | 0.1 | 38.1 | 56.9 | 4.9 |
| 74 | 0.1 | 37.6 | 57.3 | 5.0 |
| 75 | 0.1 | 37.2 | 57.6 | 5.1 |
| 76 | 0.1 | 36.8 | 57.9 | 5.2 |
| 77 | 0.1 | 36.4 | 58.2 | 5.3 |
| 78 | 0.1 | 36.1 | 58.4 | 5.4 |
| 79 | 0.1 | 35.8 | 58.6 | 5.5 |
| 80 | 0.1 | 35.5 | 58.8 | 5.6 |
| 81 | 0.1 | 35.2 | 59.0 | 5.7 |
| 82 | 0.1 | 35.0 | 59.1 | 5.8 |
| 83 | 0.1 | 34.8 | 59.2 | 5.9 |
| 84 | 0.1 | 34.6 | 59.3 | 6.0 |
| 85 | 0.1 | 34.4 | 59.4 | 6.1 |
| 86 | 0.1 | 34.2 | 59.5 | 6.2 |
| 87 | 0.1 | 34.0 | 59.6 | 6.3 |
| 88 | 0.1 | 33.8 | 59.7 | 6.4 |
| 89 | 0.1 | 33.6 | 59.8 | 6.5 |
| 90 | 0.1 | 33.4 | 59.9 | 6.6 |
| 91 | 0.1 | 33.2 | 60.0 | 6.7 |
| 92 | 0.1 | 33.0 | 60.1 | 6.8 |
| 93 | 0.1 | 32.8 | 60.2 | 6.9 |
| 94 | 0.1 | 32.6 | 60.3 | 7.0 |
| 95 | 0.1 | 32.4 | 60.4 | 7.1 |
| 96 | 0.1 | 32.2 | 60.5 | 7.2 |
| 97 | 0.1 | 32.0 | 60.6 | 7.3 |
| 98 | 0.1 | 31.8 | 60.7 | 7.4 |
| 99 | 0.1 | 31.6 | 60.8 | 7.5 |
| 100 | 0.1 | 31.4 | 60.9 | 7.6 |

Table 11: **Recommended Vitamins and Minerals**

| Feed Type | | Starter I - II | Grower | Pre-layer, Layer I - II |
|---|---|---|---|---|
| | | 0 - 8 weeks | 9 - 17 weeks | 18 - 100 weeks |
| Added vitamins and trace minerals per kg feed | | | | |
| Vitamin A | IU/kg | 10000 | 10000 | 10000 |
| Vitamin $D_3$ | IU/kg | 3000 | 2500 | 3000 |
| Vitamin E | mg/kg | 30 | 30 | 30 |
| Vitamin $K_3$ | mg/kg | 3 | 3 | 5 |
| Vitamin $B_1$ | mg/kg | 2 | 2 | 4 |
| Vitamin $B_2$ | mg/kg | 6 | 4 | 6 |
| Vitamin $B_6$ | mg/kg | 4 | 2 | 3 |
| Vitamin $B_{12}$ | mcg/kg | 20 | 20 | 30 |
| Panthotenic acid | mg/kg | 10 | 8 | 10 |
| Niacin | mg/kg | 40 | 30 | 30 |
| Biotin | mcg/kg | 100 | 100 | 100 |
| Folic acid | mg/kg | 2 | 1 | 1 |
| Choline | mg/kg | 400 | 300 | 400 |
| Iron | mg/kg | 40 | 40 | 40 |
| Manganese | mg/kg | 100 | 100 | 100 |
| Copper | mg/kg | 8 | 8 | 8 |
| Zinc | mg/kg | 80 | 80 | 80 |
| Iodine | mg/kg | 1 | 1 | 1 |
| Selenium | mg/kg | 0.3 | 0.3 | 0.3 |



→ **Size S**
small eggs
(less than 53 g)

→ **Size M**
medium eggs
(up to 63 g)

→ **Size L**
large eggs
(up to 73 g)

→ **Size XL**
extra large eggs
(73 g and above)

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