TETRA

SELECTED FOR QUALITY

BÁBOLNA HARCO

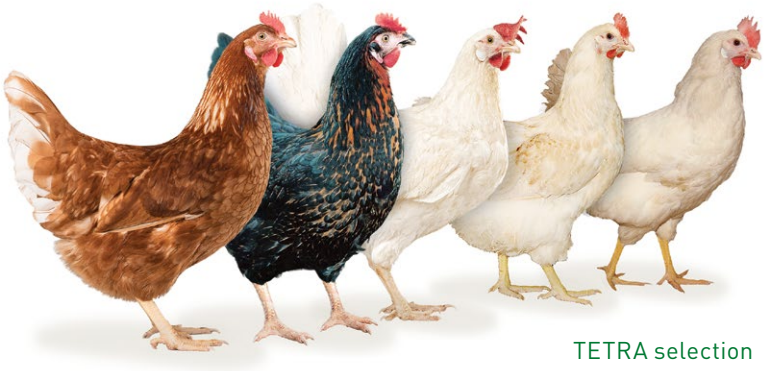
COMMERCIAL LAYER MANAGEMENT GUIDE

Introduction

BÁBOLNA HARCO (hereinafter referred to as HARCO) is a black-feathered, brown-egg layer for both cage and cage free systems. Pure lines are selected for durability, resilience and excellent egg production.

HARCO is a resistant and calm bird, with a slightly higher body weight and feed intake compared to other commercial brown-egg layers. It performs well even under less favourable conditions.

This extended manual is a guideline and information source for maximizing your profits and satisfaction with your stocks; although due to climatic or lighting conditions, special requests may require assistance from your nearest Bábolna TETRA specialist. We believe, that by following this Management Guide and keeping accurate records, the results of your flock will gradually improve year by year.



TETRA selection

TETRA – Selected for Quality

In recent decades, the consumer market has undergone some significant changes, resulting in additional requirements for the performance of production stocks. The key to this adaptation is a properly structured and efficient selection programme supported by a systematically developed consulting network, that provides a backup for the increasingly popular Bábolna TETRA parent stocks and their progenies.

Continuous investments over the last years, such as the new pedigree farm and the high-capacity layer breeder hatchery have created a larger base for selection and more efficient and safer hatching for customers. Regular market monitoring is essential for product development and to fulfill long-term needs. Hence, TETRA will continue to participate actively in product fairs and organize partner meetings in the future.

Bábolna TETRA has a well-established breeding tradition, a growing global market share and the company is determined to improve the competitiveness of its poultry breeds. Despite the diversity of the current market, TETRA focuses on the selection of the most important traits (persistency, egg quality, viability) and is committed to stabilize economic performance of their stocks for all technological environment. Current test capabilities ensure that individual and group progeny tests are carried out until 90-100 weeks of age.

The success of the company's R&D programme has been greatly due to its cooperation with partner institutions over many decades. Thanks to this, results of *in vivo* (CT) examination of the hens and their eggs, welfare indicators (state of plumage, pecking, etc.) and behavioural observations have been used in the selection index of pure lines for years. Intensive selection work continues to preserve the calm nature of breeds and aims at eliminating beak trimming.

Bábolna TETRA Ltd.

Contents

HARCO Commercial Layer Performance Specifications

Table 1

Liveability	
0-17 weeks of age	97-98%
18-90 weeks of age	93-95%
Feed consumption	
0-17 weeks of age	6.5-6.9 kg
18-90 weeks of age (average)	118-123 g/day
Body weight	
At 17 weeks of age	1.5-1.6 kg
At 90 weeks of age	2.1-2.2 kg
Maturity	
Age at 50% production	149-151 day
Age at 90% production	164-166 day
Egg production per hen housed	
Until 80 weeks of age	348-353
Until 90 weeks of age	396-402
Egg mass per hen housed	
Until 80 weeks of age	21.7 kg
Until 90 weeks of age	24.7 kg
Egg weight (weekly average)	
Average egg weight	62.0 g
Shell strength	>35 N
Shell colour	brown

General Recommendations and Biosecurity of Poultry Farms

General Rules

- Isolation of the house is vitally important for disease control.
- The movements of people are the largest threat to isolation as they may bring infection onto the farm. Ideally, shower facilities and farm clothing are provided for all employees and visitors.

Keep out cars and other vehicles from the farm area, allow minimal traffic only. Always use sanitizing liquid for proper disinfection.

- If the above protective facilities are not fully available, access to farm should be strictly limited to occassions when necessary and people entering the farm are required to wear clean coveralls, new plastic or cleansed rubber boots and a head cap.
- Disinfectant footbaths should be placed at the entrance to each house and replenished with fresh disinfectant daily.
- Doors have to be kept locked at all times to prevent unwanted visitors not wearing protective clothing.
- NO TRESPASSING signs should be prominently displayed on doors and BIOSECURITY ZONE signs fixed at the farm entrance to warn visitors of possible disease transmission.

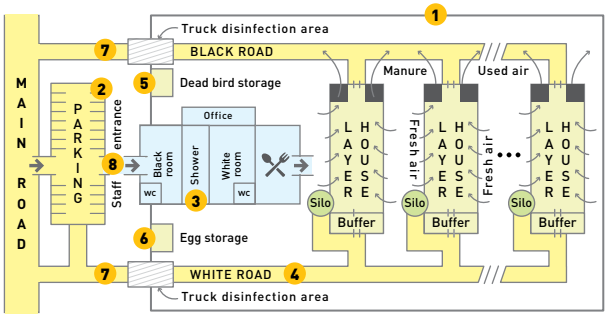
The Importance of Biosecurity

Pathogens can infect your flock in hundreds of different ways, via feed, wild birds, rodents, insects, day-old chicks, visitors, trucks, equipment and other flocks. These pathogens (bacteria, viruses, fungi, etc.) can cause poor performance as well as outbreaks of diseases. This is why TETRA takes disease prevention very seriously. It is far easier to prevent these problems from occurring, than to cure or terminate your flock.

Plan and Build

Before building a farm, one has to consider some important facts. It is best to start with a good deal of planning and great attention to detail, otherwise it will be more difficult to alter the farm after construction.

Figure 1: Farm Layout



1. Fence around the farm
2. Parking facilities
3. Black and white changing rooms
4. Way to silos
5. Dead bird storage
6. Egg storage
7. Entrance for vehicles
8. Entrance for people

Location

Build your farm as far as possible from any other farms to reduce the risk of contamination. Avoid places located close to busy motorways, where poultry transfer is very common. Prevent ingress of airborne hazards.

Single-age Flock

Avoid horizontal contamination by housing single-age flocks only. One farm should have chickens of same age and same breeding level. Make sure growing and laying farms are separated. Hatcheries located close to feed mixing plants and slaughter houses increase the transmission of infection.

Visitors

Follow the black (dirty) and white (clean) principle. Erect a fence around your farm with a closed entrance, put the sign UNAUTHORIZED ENTRY PROHIBITED on it. Everything outside the farm is "black", and inside is "white". Minimize the number of visitors, let them in only when it is required. Set up parking facilities outside the fence. Visitors are not allowed to enter by car.

Around the Poultry Houses

The surroundings of the houses are to be kept clean and tidy. This helps excluding wild birds from the premises. Clean and place a 0.5-1 m strip of stone close to the wall of the poultry houses to keep rodents out.

Construct the wall with smooth materials, which are stainless, so it can be easily washed with detergent or disinfectant.

Personal Hygiene

When entering, use boot and hand disinfectants. Have a "black and white" clothing room inside the biosecurity building, located at the fence line. Visitors have to change their clothes and remove their personal belongings. Before entering the poultry house, change your boots and use them only inside the house. Wear different boots on the farm, and inside each house. Keep your environment clean: sweep and clean the biosecurity rooms, the poultry house entrance and the surrounding roads.

Traffic Inside the Farm Premises

Ideally, no vehicles should enter the farm.

- Feed: Put silos near to the fence so the truck can fill them from outside.
- Dead birds: Collect them minimum once a day and place them in a collecting box along the line of the fence. The box has to be closed and preferably cooled. The frequency of removal also depends on the temperature conditions.
- Egg storage: Place the egg storage building far from other areas.

If you cannot avoid vehicles entering the farm (day-old chicks, litter, manure transfer, slaughter house vehicles), disinfect them thoroughly, especially the wheels with a high-pressure washer. Please consult your veterinarian about choosing the right disinfectant. If it is necessary for the driver to get out of the truck, he/she must wear disposable clothes and boots. Entry to the poultry house is prohibited for the driver.

Records of Visitors

Keep records of visitors with the following data: name, purpose of visit, date, and the name of the poultry facility, hatchery, slaughter house, feed mill visited in the last two weeks. If you have to see more than one flock go by the following rules: visit the younger flocks first, and then the older ones: the higher then the lower breeding level. Everything must be recorded in the visitors' book.

Cleansing and Disinfection

The most effective way to reduce the negative impact of disease-causing pathogens on the growth and the subsequent performance of a laying flock is to avoid exposure to these organisms. A sound sanitation program and effective isolation plans are vital to achieve this. Cleansing and disinfection are of prime importance to prevent reinfection of the new flock, coming to the farm. After depopulation, all the hiding birds and bodies must be removed. An insecticide program is most effective when applied immediately in a still-warm house environment.

The removable part of the equipment has to be dismantled, while manure and litter must be cleaned up. Transfer the litter far from the farm to a fermentation plant, but do not spill it onto the road during transportation. The residue of the feed must be removed from the silos, bins and feeders. Dry clean as soon as the old flock is removed.

Soak the inside of the house and the equipment for hours, use detergents and sufficient liquid.

High pressure cleaners are effective at cleaning, using active detergents in cold or hot water. Make sure you also clean feeders, drinkers, fans, air in- and outlets. Rinse everything with water and let the equipment and the house dry.

Always use a broad spectrum sanitizing agent for proper disinfection of the poultry houses between flocks.

Use a multi-level disinfection programme in order to reduce the number of germs in the house. Maintain walls, floors, fan blades, lights, slats, nests, feeders and drinkers, outside and inside. Make sure you care for closed areas, like sanitation and store rooms. An effective disinfection requires clean surfaces without any remaining dirty or organic material. The dosage and the application time of the disinfectant must be properly calculated. Use disinfectants with antiviral, antibacterial and antifungal effects. Sporocides can kill very resistant parasite spores as well. Change active ingredients frequently and monitor the effect by microbiological tests. Mind that some disinfectants do not work well under low temperature. They can harm human health, so follow instructions thoroughly and provide personal protection.

The cleansing and disinfection should be done not only in chicken houses, but also around the farm, i.e. in biosecurity building, feed store, litter store, egg store etc. Make sure you cleanse vehicles, tools, clothes and boots.

Water Hygiene

Water and watering systems require regular checks and maintenance. The water quality has to be checked every 6 months for microbiological and chemical compounds. Chlorinate water when necessary. When the house is empty, use effective detergents and disinfectants to remove biofilm and carbonate deposits from the pipeline.

When there are birds in the house, water lines must be flushed frequently when the weather is hot, plus before and after vaccination or medication.

Feed Hygiene

Feed quality is of prime importance. Buy feed from certified and controlled suppliers. When you mix feed yourself, use high-quality ingredients and premixes. Nutritional content, energy and protein balance, macro- and microelements, enzymes are necessary for good development and performance. Microbial contamination (bacteria, fungi) and toxins (mainly mycotoxins) should be avoided. Heat treatment reduces bacterial germs. Use toxin binding substances when needed. For Salmonella control, apply appropriate supplements. Heat treatment produces better homogeneity after handling. Layers and breeders prefer crumbled feed. Hygienic storage and transportation of feed are also important. The surrounding of silos, feed bins must be kept clean, spilled feed should be removed immediately, so as not to attract wild birds. Silos must be emptied and cleaned regularly, so two silos are recommended to each house.

Wild Bird and Rodent Control

Wild bird and rodent control is the first line of defence against transmission of dangerous diseases. In order to prevent viral, bacteriological and parasitic infections, bird-nets have to be used. Doors and walls must be intact, so as to prevent entry of wild animals. Avoid spilling of feed, remove dead birds and broken eggs. Implement a rodent control program.

Housing

Before the Arrival of the New Flock

Raise the house temperature to 34-35°C 24-48 hours prior to chick arrival to ensure that the equipment warms up as well. The desired relative humidity should be 60-70%. This humidity level have to be maintained for at least three weeks.

- Set light clocks to 23 hours per day with the light intensity of 20-30 lux. If shadows are cast onto drinkers/nipples, the use of droplights is suggested to eliminate them.
- Trigger nipples to ensure that they are working and set them at the proper height. Nipples should be at the chick's eye level and bell drinkers placed on the floor. Supplemental drinkers can be used during floor brooding and removed slowly once the chicks are established and are clearly using the main drinking system.

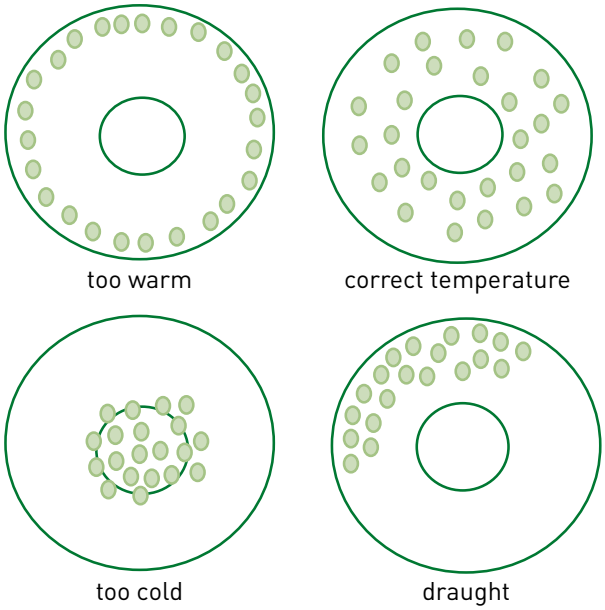
Table 2: Temperature Requirements for HARCO Pullets

Age (days)	Temperature (°C) at chicks' level
0-2	34-35
3-4	32-33
5-7	32
8-14	30
15-21	27
22-28	24
29-35	22
35-119	18-20

Checklist

- Chick behaviour is the best indicator of temperature. By following some simple rules, we can ensure the conformity of the chicks during this sensitive period.
- If the birds are calm and quiet and are spread equally in the house, it means they feel comfortable.
- Always measure the temperature at the bird's level.
- Besides temperature, it is essential to maintain proper humidity as well. Relative humidity has to be kept between 60-70% by evaporating water (floor brooding) or watering the walks (cage brooding), if necessary.

Figure 2: Indication of Chick's Well-being under the Brooder



Growth Management

TARGETS:
- Flock uniformity and body weight indicate the future laying performance of the birds.
- Ensure that targets stated in this manual are reached at the points of chick development (change in feed type).
- Keep records of mortality, feed intake, feed conversion ratio, water consumption and weekly body weight.

Floor System

Day-old chicks must be housed in cleaned, disinfected and properly prepared buildings. Room temperature should be 34-35°C, but fresh air supply is very important too, so minimum ventilation must be provided from the beginning. Use clean, mould-free straw or wood-shavings for litter. Automatic feeders have to be filled-up so that chicks can see the feed in them. Place chick-paper alongside the drinkers' lines and strew feed on it in a thin but evenly distributed layer. Keep the chick-paper dry, a 5 cm distance from the drinkers' lines is recommended. Use cleaned, scale and biofilm-free nipple drinkers for water supply. Water should be warmed up before chicks' arrival to 20-25°C. Height of the drinkers has to be checked frequently. A water droplet on the nipple helps birds find the drinkers easily. Illumination is crucial for birds to find feed and water as soon as possible. Perches are recommended from early days as they help chicks become accustomed to the proper usage of a laying house with slatted floor and scratching areas. Recommended perch length: 15 cm/bird. Stocking density: 10-12 chicks/m^2.

Aviary System

If pullets can be raised in aviary rearing facilities we suggest housing them in aviary laying houses only. Depending on the system, usually in the first 3-4 weeks of age, chicks are kept in a central area or closed cages with feed and water available. The use of chick-paper is recommended for 4 days in order to get a good start. Trigger the nipples to check water flow and to show their usage to chicks. Air temperature at chicks' level is recommended at 34-35°C in the first two-three days. After 3-4 weeks, different tiers or platforms will be opened for birds with additional feed and water supply to get them acquainted with all the available rearing levels. Use a maximum four-tier system. The first newly opened level could be the source of water, the second one is the source of feed and the third one is the roosting area. Let the birds learn to jump and fly between the different levels. An aviary laying house should be equipped with similar aviary system to the rearing house to make adaptation easier for birds. Check the birds' resting behaviour during night-time. Encourage them to rest on the platforms, not on the floor, to avoid floor eggs in the production period. In order to limit overpopulation in the aviary system, up to 28 chicks/m^2 is recommended in the rearing period, and up to 16 hens/m^2 in the laying period.

With a tailored light switch-off program we can train the pullets to move up from the scratching area to the platforms before the onset of the dark period of the day. The outer lights above the ground level should be turned off 15 minutes before the main light is switched off. Birds will move toward the lighted platforms from the litter space. Walking among the birds during this time will stimulate them to change positions from the floor toward the aviary system. The best age to make the birds get used to this and to have a long-lasting effect is the 4th -6th weeks of rearing. Next, 10 minutes later, switch off the inner lights and leave the lights on only at the top, which will stimulate the birds to move further up. Instead of a prompt black-out, use a short dimming time.

Cage System

The conventional way of rearing pullets in laying cages are still allowed in many countries, but animal welfare and state regulations can differ. We suggest placing chick-paper on the bottom of the cages and strewing feed on it. Chick-paper is used for 4 days and during this period a thin layer of feed must be frequently put on it. Make sure that chain feeders are well illuminated. Place day-old chicks on the second and third cage levels only and check them frequently whether they find water and feed. Trigger the drinking nipples for checking and for showing the chicks the source of water. After one or two weeks of rearing, chicks can be distributed to other cage levels as well.

Stocking Density

Environmental factors, such as type of housing, ventilation and temperature, have a greater effect upon stocking rate than genetics. The following recommendations (Table 3) are given as a guide for floor, aviary and cage rearing. These rates should be reduced by 2-3% for each 1°C rise in temperature.

Feeding Space

The standard data in Table 3 should be regarded as the minimum requirements for a satisfactory performance.

Drinking Space

Water is an essential nutrient by itself. It can also influence nutrient intakes by controlling feed intake. Restriction on water intake will cause a voluntary reduction in feed intake.

To ensure that all birds find water when initially housed, there should be a minimum light intensity of 20 lux at bird level. This is especially important at one day-old and where a change of drinking system occurs when moving birds into the laying house.

Table 3: Space and Equipment Requirements

Age (weeks)		0-6	7-17	from 17
Density (bird/m^2)	Floor system	20-24	max. 15	max. 9
	Aviary system	30-40	20-25	11-12
	Cage system	50-80 (min. 125 cm^2/bird)	30-40 (min. 250 cm^2/bird)	17-18 (minimum 550 cm^2/bird) - non-EU 13-14 (minimum 750 cm^2/bird) - EU
Drinking space	Birds/nipple	10-12	8	4-6
	Birds/drinker (ø 46 cm)	100-130		
Feeding space	Trough or circular feeder (space/bird)	4 cm + chick-paper in the first 4 days	7 cm	10 cm

* Place chick-paper alongside the drinkers' lines or cover the cage floor and strew feed on it in a thin layer. Check the availability of feed and water.

Lighting

The temporal resolution of birds is considerably higher compared to human vision. Therefore, low frequency (50 Hz alternating current) fluorescent tubes and energy-saving bulbs are not suitable for lighting poultry houses as birds perceive them as continuous flickering, acting as a constant source of stress, while human sight would not interpret this rate as intermittent light. Proper light sources for poultry houses provide warm white light (colour temperature: 2700-3000 K) with frequencies higher than 2000 Hz. If such light sources are not available, traditional light bulbs can be used as well. Concerning the colour of the different light sources, only red light has been proven to have a calming effect on birds and to have efficacy against pecking and cannibalism. The lighting programme has to be adjusted to natural day and night light conditions. Application of a dimmer would considerably reduce stress by gradually brightening and dimming light within 30-45 minutes. In case of a discontinuous lighting of the poultry house equipment, lighting should be switched on first in the morning and it should be the last one to be switched off in the evening.

Climate Control

During the rearing period, temperature is a key factor in determining the well-being of pullets. The poultry house must be equipped with an air conditioning device capable of providing the minimal ventilation needed, or you have to provide 4.5 m^3 fresh air/body weight kg. The birds are sensitive to draught thus it should be avoided. Ammonia concentration of the air must be kept under 10 ppm and carbon dioxide under 2000 ppm while dust particle numbers should be as low as possible.

Beak Trimming

Before a decision is made concerning beak trimming, local law and animal welfare regulations must be studied. More and more countries forbid this kind of treatment. Beak trimming needs not be carried out routinely when stock is kept in a controlled environment. If experience from previous flocks suggests that it is necessary, it will be worthwhile checking all other aspects of management first before embarking on a beak trimming programme.

The provision of more feeders and drinkers, more space per bird, appropriate nutritional components or improved ventilation may be the right action to take.

- Infrared treatment is the most recommended method for beak trimming, which can be done soon after hatching, when chicks are dried up.
- Beak trimming can also be done at about 7-8 days of age. In order to reduce stress, it should be delayed for flocks where brooding conditions have not been suitable or adequate.
- In open-sided housing, routine beak trimming is recommended, as both bright light intensities and high temperatures can produce undesirable behaviour. Make sure that all birds are properly and evenly beak trimmed.
- Each bird should mature with a rounded, but slightly shortened beak and be able to feed.

Vaccination Programmes

Always consult your local vet as rules are constantly changing according to each country's own regulations.

Table 4: Sample Vaccination Program for HARCO Commercial Stock

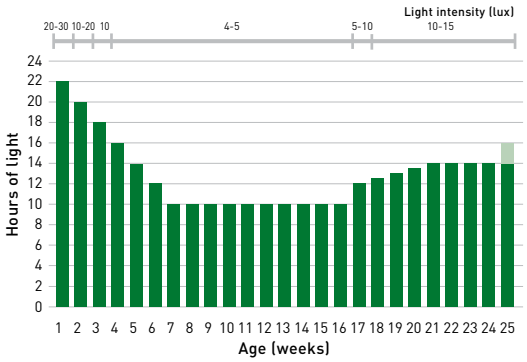
Disease	Suggested Time of Application	Occurrence
Marek's disease (MD)	First day at the hatchery	**
Newcastle disease (ND)	Suggestion: Days 1 and 12, then during week 14 and before transfer	**
Infectious bronchitis (IB)	Number of vaccination depends on disease pressure in the given area (suggestion: Day 1 and 12, Week 6, 11, 14 and before transfer)	**
Gumboro disease (IBD)	Two vaccinations (Day 18 and 28) are recommended	**
Avian encephalomyelitis (AE)	Suggestion: Week 9	*
Avian pneumovirus (APV)	Vaccination around Week 10 and before transfer	**
Coccidiosis	Vaccination is recommended on the first day (on the farm)	**
Salmonella (SE, ST)	Two live and one inactivated vaccine is recommended Suggestion: Day 1 and Week 7 and before transfer	*
Fowl pox (FP)	Vaccination is recommended before transfer	*
EDS	Vaccination before transfer	*

**: applied worldwide; *: applied locally

Lighting Programmes

- A lighting programme is only effective if no direct sunlight enters the building, otherwise the time of maturity can vary. Due to this reason, flocks moved to lay in autumn will start to produce eggs a few weeks later than stated in this manual.
- The principal function of a lighting programme is to influence the age at which a flock becomes sexually mature.
- Age, and more particularly body weight at first egg are the main factors which determine egg output. Egg numbers during the laying period decrease by 3-4 eggs for each 10-day delay in age at first egg.

Figure 3: Lighting Programme for HARCO Pullets and Layers



- Bright light is necessary for chicks to feed and drink properly. Therefore, light intensity should be monitored, especially in the first 2-3 weeks.

Table 5: Lighting Programme for HARCO Pullets and Layers

Age (weeks)	Hours of Light	Light Intensity (lux)
0-2 day	23	20-30
1	22	20-30
2	20	10-20
3	18	10
4	16	4-5
5	14	4-5
6	12	4-5
7	10	4-5
8	10	4-5
9	10	4-5
10	10	4-5
11	10	4-5
12	10	4-5
13	10	4-5
14	10	4-5
15	10	4-5
16	10	4-5
17	12	5-10
18	12.5	10-15
19	13	10-15
20	13.5	10-15
21	14	10-15
22	14	10-15
23	14	10-15
24	14	10-15
25-throughout production	14 (-16)	10-15

Controlled Environment (dark house)

- When birds are reared in a controlled environment, the onset of production is relatively easy to handle.
- After transferring the birds, the hours of lighting must be increased to 14 hours. To maintain a high production level, day length can be increased gradually to 16 hours.
- Do **not** decrease the length of lighting during the production period.
- Full benefits will not be obtained if the house is not light-proof, especially when birds are being reared during a time of naturally-increasing day length. Under such circumstances, early sexual maturity and small egg size are potential problems.

Open-house Environment

- Light stimulation is not necessary when birds are transferred to an open-sided or free range environment.
- Any adjustment to the lighting programme depends on the following:
  - natural daylight increases
  - natural daylight decreases
- For example; when the HARCO flock starts producing in late winter/spring or when the natural day length increases in the Northern Hemisphere, it is advised not to transfer them before natural sexual maturity (21-22 weeks of age).
- Personalized lighting programmes for regional climatic and lighting conditions are available from your **Bábolna TETRA representatives**.

Nutrition

The genetic potential of HARCO layers with high performance can only be exploited when their biological needs are met. Giving complete feed is necessary, with specialized nutrient content which is adapted to the animals' needs in each production phase.

The Basics

Energy and Nutrients

Due to the high productivity of intensive layers, the demand for nutrients is relatively high and varied. Scientific studies classified up to almost 40 (macro and micro) nutrients that are to be supplied in appropriate concentrations and ratios.

Energy demand is considered to be the most important factor. The recorded feed digestion (burning) provides energy for the body, a part of which (metabolizable energy or ME) can be utilized for metabolic processes such as maintenance, weight gain and production.

Proteins and Amino Acids

Protein is the highest proportion of components present in the body (feathers and eggs), therefore it is essential for growth and production. The "crude protein" content has become less valued in scientific circles, although it still has great significance in practice. Simple laboratory tests (N x 6.25) and rapid tests are available in order to monitor the protein content of the feed, which is necessary to ensure the reliability of the manufacturing plant.

In fact, protein added to feed is broken down into amino acids, from which the body compiles its own proteins, but their genetically-encoded amino acid composition and sequence are different. About 20 different amino acids are required, some of which poultry cannot synthesize, known as 'essential' amino acids, as well as those 'non-essential' amino acids only found in a very limited amount in feed. Methionine and lysine supplements are now required in almost all poultry feed, with threonine and valin usually being indicated on the values that set limits on excessive protein reduction. Birds require cystine for their plumage however, if it is not available it can be replaced by sulphur-containing methionine.

Fats, Oils, Fatty Acids

Components of fats/oils are fatty acids. Their ratio affects their melting point (solid "fats" and liquid "oils"). All energy provider compounds, like fatty acids, especially linoleic acid, are essential for the growth and development of skin and feathers, the development of the reproductive tract and are also considered to be essential in terms of eggshell formation. The linoleic acid content of maize, sunflower and soybean oil is favourably high.

Minerals

Calcium (Ca) and phosphorus (P), quantitatively are the most important components of eggshell and bone, and are also present in other tissues of the body. Grain-based feeds are poor in calcium, so ground limestone (calcium carbonate, 38% Ca) supplementation is necessary. However, plants contain a higher proportion of phosphorus but, because of phytin connections, the bioavailability of P rate is only 10-40%. Previously, a large-scale mineral phosphate supplement was needed, although today, because of the wide-range use of phytase enzyme, P-utilization has improved significantly.

Sodium (Na^+), potassium (K^+) and chloride (Cl^-) ions play an important role in blood and osmotic pressure, cell pH maintenance and enzyme activation. Sodium supplements with common salt (NaCl) usually satisfy the chlorine demand. In the case of heat stress, sodium carbonate supplementation is recommended. The potassium (K^+) content in plants is already known to be high.

Vitamins, Microelements

Vitamins are micronutrients that are essential for maintaining health, fertility and performance. Each vitamin has a separate role, so it cannot be replaced by other vitamins. Vitamins – with few exceptions – cannot be synthesized, so they must be mixed in feed. For the supply of vital functions, a few milligrams or micrograms of certain vitamins are sufficient, but these must be provided on a regular basis.

In today's intensive technology, satisfactory results can only be achieved by a purpose-built vitamin supply.

Trace elements are components of enzymes, each of which play a crucial role in certain metabolic processes. Regular poultry feeds contain a compound of 13 different vitamins and 7 trace elements; incorporation of Vitamin C is recommended in the case of increased stress. Certain poultry feed contains the same vitamins and trace elements, but their amount and utilization is not suitable for layers selected for high performance – partial absence of either microcomponent has a considerable negative impact on health and production.

Other Supplements and Additives

- Regular mixing of antioxidants protects vitamins and unsaturated fatty acids.
- In recent decades, the exogenous enzymes have caused major changes and NSP-degrading (non-starch polysaccharides) enzymes have allowed a higher grade, risk-free mixing of cereals, while the phytase enzyme has strongly improved phosphorus utilization of plant components, and also have affected digestibility of other nutrients favourably.
- Specific additives in layer feeds are carotenoids, which make the egg yolk more attractive for consumers.

Feeding during the Growing Period

By following the recommendations of our feeding program, described in the HARCO Management Guide, pullets reach their weight corresponding to their age. This is an essential condition for normal sexual maturity in addition to starting and maintaining a high level of production during the laying period.

Throughout the various phases of development, differently composed feed is recommended for chicks and pullets to fulfil the nutritional requirements of the birds. The actual weight of the flock must be determined before moving on to the next level. If pullets have not reached the desired weight by the end of a growing period, any feed changes need to be delayed.

Grain Size

For chicks, pullets and hens, coarsely grained ("structured") diets are the most appropriate, although excessively coarse feed leads to selective eating whereas too fine feed structure causes reduced feed intake and, as a result, inadequate nutrition in both cases.

In starter feeds (especially in the first phase) crumbs are the most appropriate, which is a firm guarantee for the feeding of young chicks in terms of microbiological status.

Pre-starter, Starter (0-3 weeks; 4-8 weeks)

Essentially, **starter** rations help with good skeletal and organ development plus strenghten the immune system. This is achieved by feeding **pre-starter** and **starter** *ad libitum*, in a proper ratio and adequate levels of essential amino acids for growth, immune system, feathering and skin development.

Grower (9-17 weeks)

Though **grower** diet is the lowest density ration that birds receive with higher fibre content, it is still important that all nutrients are correctly included. Fibres positively influence digestive tract development and consequently, increase appetite. It is very important for young layers to take all nutrients needed at first egg. We recommend using 5-6% crude fibre in the **grower** diet for HARCO pullets. Cereals and their by-products as well as DDGS can be used as a source of crude fibre.

Feed restriction is not recommended as it may be difficult to reach the correct body weight at first egg. As feeding portions are increased, it is essential to monitor body weight weekly during this period.

Pre-layer (18-19 weeks)

Pre-layer feed is recommended during transition from **grower** to **layer I** period with not only a significantly increased calcium added, but also a higher level of each nutrient. Before the start of egg production, **pre-layer** ration is advised for 10-14 days, followed by **layer I** at 5% production. **Pre-layer** feed should compensate lower feed intake, that often occurs at the start of production. During this period, the layers undergo significant physiological changes. The medulla of the layer's tubular bones develops which is responsible for the eggshell calcification in the production period.

An adequate amount of calcium is important to be added to feed during this period, for proper bone strength and eggshell quality during production. Increased levels of energy and amino acids are also desirable since these promote ovarian tissue development. The daily weight gain of 10-15 grams increases 3-15 days before the onset of laying eggs. In order to begin egg production, a target of 1600-1700 grams body weight should be reached and *ad libitum* feeding of properly prepared **pre-layer** feed is necessary.

Clean water should always be available and its quality needs to be checked regularly.

Body Weight Control during Rearing

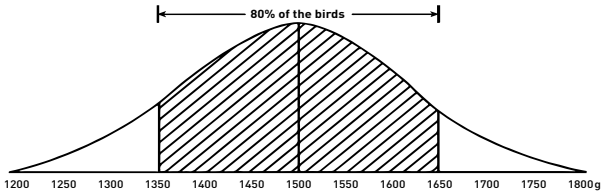
Uniformity and regular weighing are of utmost importance. During the growing period and until peak production, birds should be weighed weekly at the same time of the day. Make sure you keep records of bird weight regularly from the first weeks of growing. Changes in body weight and homogeneity of the stock provide information about normal development of HARCO birds. Flock growth is normal and birds are considered equal if their CV% is below 10%.

CV%= (standard deviation/ average body weight) x 100

HARCO pullets do not tend to become obese, so if weighing data do not differ significantly from the technological values (± 5%) and are recorded as homogeneous, you can feed birds *ad libitum* throughout the rearing period.

Nevertheless, if pullets do not reach the required weight value, run feeders more frequently and give them feed of higher nutritional value. The average body weight of HARCO pullets should be around 1430-1680 g, at the time of transfer (16-18 weeks of age).

Figure 4: Evenness of Body Weight



A uniform flock of HARCO pullets

Table 6: Weight Development and Feed Intake of HARCO Pullets

Age (weeks)	Body Weight (g)		Feed Consumption		Feed Type
	Average	Range	Average (g/day)	Cumulative (kg)	
1	77	75 - 79	12.7	0.1	Pre-starter
2	138	132 - 143	20.7	0.2	
3	209	204 - 215	27.6	0.4	
4	297	286 - 308	34.5	0.7	Starter
5	396	385 - 407	40.3	1.0	
6	517	501 - 534	46.0	1.3	
7	638	616 - 660	51.8	1.6	
8	748	726 - 770	56.4	2.0	
9	858	831 - 886	61.0	2.5	Grower
10	957	930 - 990	64.4	2.9	
11	1056	1023 - 1089	67.9	3.4	
12	1155	1122 - 1188	71.3	3.9	
13	1243	1205 - 1282	74.8	4.4	
14	1320	1282 - 1359	78.2	5.0	
15	1397	1353 - 1441	81.7	5.5	
16	1474	1430 - 1518	85.1	6.1	
17	1551	1507 - 1595	88.6	6.7	
18	1628	1579 - 1678	94.3	7.4	Pre-layer
19	1716	1667 - 1766	100.1	8.1	

* Always check average body weight of the flock before switching to the next feed type level. If body weight is lower than stated in the HARCO Management Guide, do not move on from one diet to another. Control the body weight frequently, until birds reach their target weight.

Table 7: Nutritional Recommendation for HARCO Pullets

Feed Type		Pre-starter	Starter	Grower	Pre-layer
Nutrient		0-3 weeks	4-8 weeks	9-17 weeks	18-19 weeks
Met. energy	MJ/kg	12.35	12.00	11.50	11.70
Met. energy	kcal/kg	2950	2870	2750	2800
Crude protein	%	20.00	18.00	15.50	17.50
AMINO ACIDS, TOTAL					
Lysine	%	1.20	1.00	0.75	0.80
Methionine	%	0.48	0.42	0.35	0.40
Methionine+cystine	%	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
AMINO ACIDS, DIGESTIBLE					
Lysine	%	1.00	0.83	0.60	0.70
Methionine	%	0.40	0.35	0.30	0.35
Methionine+cystine	%	0.70	0.60	0.50	0.58
Threonine	%	0.63	0.55	0.42	0.50
Valine	%	0.76	0.65	0.50	0.54
Arginine	%	1.02	0.84	0.63	0.68
Tryptophan	%	0.20	0.18	0.14	0.15
Isoleucine	%	0.69	0.62	0.49	0.52
Linoleic acid	%	1.50	1.25	1.00	1.50
Calcium	%	1.00	1.00	1.00	2.50
Phosphorus, av.	%	0.48	0.44	0.38	0.44
Sodium	%	0.17	0.17	0.17	0.17
Chlorine	%	0.18	0.18	0.18	0.18

Production Period

Floor System

There is a wide variety of houses made for egg production where birds can feel free on 100% litter, or there are houses with dropping pits that are covered with plastic or wooden slats. We suggest installing the slats 60-80 cm above the concrete floor, with an automatic laying nest system in the middle and feeder and drinker lines on both sides. In that type of laying house 1/3 scratching area and 2/3 slatted area are recommended. Put up resting perches (15 cm/bird) on the slats or at the walls. The best way to have a good start with a new flock is when birds are transferred to the laying house at the age of 16-18 weeks. The drinkers and feeders should be the same type as the birds have already been using at the rearing farm. Scratching area should be covered in 1-2 cm fresh, clean straw or wood shavings. Install ladders, so birds can jump onto slats easily. Those birds that cannot find the way up by themselves, should be helped individually during the first 4 weeks. This is a good practice for the prevention of floor eggs as well. In particular, birds can be closed by bird-nets onto the slatted area for 3-7 days to get accustomed to drinkers, feeders and nests. The suggested 7-8 birds/m^2 stocking density depends on the capacity of feeders, drinkers and fans. Houses can also be equipped with winter gardens or access to free-range area.

Aviary System

Prior to transfer to aviary laying houses hens have to be trained during rearing to become actively moving birds between the different levels of the aviary. This preliminary training develops the ability of birds to find water, feed, resting and nesting areas and to move between the different tiers of the house. The multilevel laying aviary is equipped with feeders, drinkers on different levels in the lower part of the system. The upper parts are resting areas. Automatic laying nests are integrated into the system. Placing similar equipment in aviaries to that of the rearing houses makes it easier for the birds to adopt to the change. A scratching area below the first level is necessary to prevent undesirable behaviour. It should be covered in 1-2 cm fresh, clean straw or wood shavings. Do not overpopulate the aviary: up to 16 hens/m^2 is suggested. The ideal age of transfer is up to 16-18 weeks. In the first few weeks after housing, make sure that all birds find water and feed very soon. Feed intake must be stimulated, because birds should not lose weight. Suggested room temperature is 16-18°C. Aviary houses can also be equipped with winter gardens or access to free-range area.

Cage System

There are different regulations throughout the world. There are countries where cages are banned. In many countries of the European Union at least 750 cm^2 area/hen is recquired in EU conform cages. In other cases, a minimum of 490 cm^2/hen is suggested. Birds raised in cages are the most suitable ones for such production systems. Do not change the feed structure and stimulate feed intake by frequently repeated feed distribution. Water is essential. Check if drinkers function properly, especially on the day of housing.

Management into Lay (15 weeks to peak production)

Minimize variation in body weight and sexual maturity of the birds. Prepare the flock for production by giving extra calcium, phosphorus and introduce larger feed particles. Slowly transfer from **pre-layer** feed to **layer I**, when first eggs appear (>5%).

Management during Production

HARCO birds are suitable for alternative keeping systems during the production period. In hot climates, it is advisable to provide shelter (house, trees, sheds) and extra drinking and living space for the birds. Controlled-environment houses are more suitable for all-year production programmes.

Body weight should be monitored every week until 30 weeks of age, then on a monthly basis.

Overweight hens lay fewer eggs during their production cycle, therefore daily feed consumption should be adjusted to the body weight standard.

Control of Uniformity

- Hens are usually transferred to the poultry house around 16-18 weeks of age. Body weight should be closely monitored until the onset of production.
- Flock uniformity must be the main target. The more uniform the flock is, the quicker is the increase in production. It is advised to split the daily amount of feed, giving the first round in the morning just before switching on the lights and, subsequently, distributing the rest of the feed after the peak laying hours.
- The level of feed intake in the production period is mainly affected by body weight, temperature, feathering, energy level, texture of the feed and production intensity.
- Laying hens primarily alter their daily feed intake to accommodate changes in their energy requirements. Therefore, the factors like ambient temperature etc., which influence the bird's demand for energy, will automatically affect the bird's feed consumption. If ration formulation is not modified, changes in daily intake will result in changes in nutrient intake including amino acids, vitamins, minerals, anti-coccidials, that will consequently affect bird performance.
- Hens do not completely adjust their feed consumption to extreme temperature or higher dietary energy concentration. In fact, high temperature or high energy concentration can significantly reduce energy intake and egg output.
- Hens with low body weight lay fewer eggs, whereas higher body weight at the beginning of production will be an advantage until the peak period.

Layers without Beak-trimming

There is an ever growing number of countries and operations where beak-trimming is not allowed. To prevent feed wastage and behavioural disorders, make sure you monitor and satisfy the birds' need and create a favourable environment for them. Stocking density, feeding and drinking spaces, feed, water, litter and air quality, ventilation, light intensity are the most important factors. Birds like to play with toys like straw bales, plastic strings, limestone grits. The toys must be changed from time to time, because the birds are looking for new adventures. They also like dust baths very much, so they must be provided. Well maintained, dry litter material promotes foraging and scratching.

Well balanced and properly structured feed can prevent bad behaviour, like feather pecking or cannibalism. Too finely ground or pelleted feed should be avoided. The shorter the feeding time is the more frequently pecking occurs. Feather eating can be inspected by checking the floor area. In normal cases lost feathers can be seen on the floor. If not, the flock is suspected for eating them and prompt action must be taken, because it could be a sign of unbalanced feeding.

Any other stress can lead to unfavourable behaviour, like strange noise, endo- or ectoparasites (red mite), or other health issues.

Feeding during the Production Period

First eggs appear at 19-20 weeks of age and more can be expected from week 21 (141-147 days). The daily feed intake increases from 103 to 113 grams between weeks 20 and 24. During this period, an intensive high-energy and nutritious diet is needed, with increased calcium supplementation.

Layer Diets

Layer I

At the start of egg production daily feed intake rises relatively slowly. At the same time, egg formation, the increasing egg and body weight gain further raises the nutritional intake of the layers. It is important to understand that the quality of nutrition has a crucial impact when birds reach peak production and on their performance. Feeding should be *ad libitum* and any factors reducing feed consumption should be eliminated. We recommend feeding **layer I** with high nutrient concentrations, as long as production is expected to be over 90%.

Layer II-IV

With aging, both egg production and the nutritional needs of the birds decrease. In order to optimize costs, lower concentration of crude protein and amino acid, but higher amount of calcium should be included in the ration. To prevent fattening, energy or fat/oil supplementation needs to be reduced. The proper ratio of nutrients must also be closely monitored during this period. **Layer II** should be fed as long as the production is over 80%, **layer III** would be recommended over 70% production, and at the end **layer IV** could be used.

Table 8: Weight Development and Feed Consumption of HARCO Layers

Age (weeks)	HARCO			
	Body Weight (g)		Feed Consumption	
	Average	Range	Average (g/day)	Cumulative (kg)
20	1815	1760 - 1870	103.5	0.7
21	1892	1837 - 1936	106.5	1.5
22	1958	1903 - 2019	109.1	2.2
23	2002	1942 - 2063	111.3	3.0
24	2035	1975 - 2096	113.1	3.8
25	2057	1997 - 2118	114.5	4.6
26	2068	2008 - 2129	115.5	5.4
27	2079	2019 - 2140	116.5	6.2
28	2090	2030 - 2151	117.5	7.1
29	2101	2035 - 2162	118.5	7.9
30	2112	2046 - 2178	119.5	8.7
40	2140	2096 - 2184	120.8	17.2
50	2162	2118 - 2206	121.9	25.7
60	2173	2129 - 2217	122.8	34.3
70	2184	2140 - 2228	123.6	43.0
80	2195	2151 - 2239	124.3	51.7
90	2200	2156 - 2244	124.9	60.4

* Feed amount must be adjusted to production intensity and uniformity. Check body weight weekly around peak production, increase daily feed amount for hens as production intensity rises.

Table 9: Nutritional Recommendation for HARCO Layers with Average Daily Feed Consumption (120 g/day)

Feed Type	Layer I	Layer II	Layer III	Layer IV	Layer I	Layer II	Layer III	Layer IV
Age (weeks)	20-45	46-65	66-80	81-90	19-45	46-65	66-80	81-90
Production	>90%	>80%	>70%	<70%	>90%	>80%	>70%	<70%
NUTRIENT	Daily energy requirements/bird				Standard diets (120 g/day)			
Met. energy (MJ/kg)	1.29	1.27	1.26	1.26	11.70	11.50	11.45	11.40
Met. energy (kcal/kg)	307	302	301	300	2800	2750	2740	2725
	Daily nutritional requirements (mg/bird)				Nutrients in diet (%)			
Crude protein	18700	18000	17300	16600	17.00	16.40	15.70	15.00
AMINO ACIDS, TOTAL								
Lysine	920	880	855	820	0.84	0.80	0.78	0.75
Methionine	460	440	430	400	0.42	0.40	0.39	0.36
Methionine+cystine	800	780	750	720	0.73	0.71	0.68	0.65
Threonine	640	620	600	570	0.58	0.56	0.55	0.52
Valine	740	705	680	655	0.67	0.64	0.62	0.60
Arginine	950	910	880	840	0.86	0.83	0.80	0.76
Tryptophan	190	180	175	165	0.17	0.16	0.16	0.15
Isoleucine	735	700	680	660	0.67	0.64	0.62	0.60
AMINO ACIDS, DIGESTIBLE								
Lysine	750	730	700	670	0.68	0.66	0.64	0.61
Methionine	400	380	350	330	0.36	0.35	0.32	0.30
Methionine+cystine	660	650	615	590	0.60	0.59	0.56	0.54
Threonine	520	510	490	465	0.47	0.46	0.45	0.42
Valine	600	585	560	535	0.55	0.53	0.51	0.49
Arginine	780	740	710	680	0.71	0.67	0.65	0.62
Tryptophan	155	145	140	135	0.14	0.13	0.13	0.12
Isoleucine	600	575	555	540	0.55	0.52	0.50	0.49
Linoleic acid	2000	1900	1800	1700	1.80	1.75	1.65	1.55
Calcium	4150	4300	4400	4500	3.80	3.90	4.00	4.10
Phosphorus, av.	440	420	400	380	0.40	0.38	0.36	0.35
Sodium	190	190	190	190	0.16	0.16	0.16	0.16
Chlorine	200	200	200	200	0.15-0.30	0.15-0.30	0.15-0.30	0.15-0.30

* When changing layer rations production level is more important than the actual age of the flock.

Values in Table 9 give the opportunity to make recommendations for feed consumption differing from the average (lower or higher), on the basis of the daily nutritional needs. In the case of higher feed intake (125 g/day), a moderate-intensity diet is needed, while with a lower than average (115 g/day) feed consumption, the diet should be more concentrated as shown in Table 10.

Table 10: Nutritional Recommendation for HARCO Layers with Different Daily Feed Consumptions

Feed Type		Layer I			Layer II			Layer III			Layer IV		
		Daily feed consumption											
		115 g	120 g	125 g	115 g	120 g	125 g	115 g	120 g	125 g	115 g	120 g	125 g
Crude protein	%	17.80	17.00	16.20	17.10	16.40	15.70	16.40	15.70	15.00	15.70	15.00	14.30
AMINO ACIDS, TOTAL													
Lysine	%	0.87	0.84	0.80	0.84	0.80	0.76	0.81	0.78	0.74	0.78	0.75	0.71
Methionine	%	0.44	0.42	0.40	0.42	0.40	0.38	0.41	0.39	0.37	0.38	0.36	0.35
Methionine+cystine	%	0.76	0.73	0.69	0.74	0.71	0.68	0.71	0.68	0.65	0.68	0.65	0.63
Threonine	%	0.61	0.58	0.56	0.59	0.56	0.54	0.57	0.55	0.52	0.54	0.52	0.49
Valine	%	0.70	0.67	0.64	0.67	0.64	0.61	0.65	0.62	0.59	0.62	0.60	0.57
Arginine	%	0.90	0.86	0.82	0.86	0.83	0.79	0.84	0.80	0.76	0.80	0.76	0.73
Tryptophan	%	0.18	0.17	0.16	0.17	0.16	0.16	0.17	0.16	0.15	0.16	0.15	0.14
Isoleucine	%	0.70	0.67	0.64	0.67	0.64	0.61	0.65	0.62	0.59	0.63	0.60	0.57
AMINO ACIDS, DIGESTIBLE													
Lysine	%	0.71	0.68	0.65	0.69	0.66	0.63	0.67	0.64	0.61	0.64	0.61	0.58
Methionine	%	0.38	0.36	0.35	0.36	0.35	0.33	0.33	0.32	0.30	0.31	0.30	0.29
Methionine+cystine	%	0.63	0.60	0.57	0.62	0.59	0.56	0.58	0.56	0.53	0.56	0.54	0.51
Threonine	%	0.49	0.47	0.45	0.48	0.46	0.44	0.47	0.45	0.43	0.44	0.42	0.40
Valine	%	0.57	0.55	0.52	0.56	0.53	0.51	0.53	0.51	0.49	0.51	0.49	0.46
Arginine	%	0.74	0.71	0.68	0.70	0.67	0.64	0.67	0.65	0.62	0.65	0.62	0.59
Tryptophan	%	0.15	0.14	0.13	0.14	0.13	0.13	0.13	0.13	0.12	0.13	0.12	0.12
Isoleucine	%	0.57	0.55	0.52	0.55	0.52	0.50	0.53	0.50	0.48	0.51	0.49	0.47
Linoleic acid	%	1.90	1.80	1.70	1.80	1.75	1.65	1.70	1.65	1.60	1.60	1.55	1.50
Calcium	%	3.90	3.80	3.70	4.10	3.90	3.80	4.20	4.00	3.90	4.30	4.10	4.00
Phosphorus, av.	%	0.42	0.40	0.38	0.40	0.38	0.36	0.38	0.36	0.35	0.36	0.35	0.33
Sodium	%	0.17	0.16	0.16	0.17	0.16	0.16	0.17	0.16	0.16	0.17	0.16	0.16
Chlorine	%	0.15-0.30	0.15-0.30	0.15-0.30	0.15-0.30	0.15-0.30	0.15-0.30	0.15-0.30	0.15-0.30	0.15-0.30	0.15-0.30	0.15-0.30	0.15-0.30

Vitamin and Micro-nutrient Supplementation

According to the general introduction stated earlier in this manual, vitamins, trace elements and, if necessary, other additives should always be present in the diet, in micro amounts. For **pre-starter** and **starter**, higher doses are recommended, which may be reduced in **grower**, whereas a higher dose is used in **layer I-IV** diets. The micronutrient supplementation is uniform for all age groups.

Table 11: Vitamins and Micro-nutrient Recommendation for HARCO Pullets and Layers

Added Vitamins		Pre-starter, Starter	Grower	Layer I-IV
Vitamin A	IU/kg	10000	10000	10000
Vitamin D_3	IU/kg	3000	2500	3000
Vitamin E	mg/kg	30	20	25
Vitamin K	mg/kg	3	2	2
Vitamin B_1	mg/kg	2	2	2
Vitamin B_2	mg/kg	6	4	6
Vitamin B_6	mg/kg	4	2	3
Vitamin B_{12}	mcg/kg	20	10	20
Panthotenic acid	mg/kg	12	8	8
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
Vitamin C (*in case of stress)	mg/kg			50-100*
ADDED TRACE ELEMENTS				
Iron	mg/kg	50		
Manganese	mg/kg	100		
Copper	mg/kg	8		
Zinc	mg/kg	80		
Iodine	mg/kg	1		
Selenium	mg/kg	0.3		

Limestone

In accordance with hens' calcium (Ca) requirements, limestone must be present in feed in high proportions. In addition, the quantity and shape of limestone are equally important. A lower content of Ca in the diet causes a higher feed intake, which leads to an uneven supply of nutrients. On the other hand, excess Ca supply has a controversial effect on consumption, causing the remaining nutrient supply to become insufficient.

Table 12: Supply of Fine and Coarse Limestone (recommended ratio within diet)

Feed Type	Fine (<0.5 mm)	Coarse (1.5-3.5 mm)
Layer I (20-45 weeks)	35%	65%
Layer II (46-65 weeks)	30%	70%
Layer III (66-80 weeks)	25%	75%
Layer IV (81-90 weeks)	20%	80%

Production

Table 13: Production Targets for HARCO Layers

Age (weeks)	Egg Production (%)		Egg Number		Egg Weight (g)		Egg Mass	
	Hen Housed	Hen Day	Weekly	Cumulative	Weekly Average	Cumulative Average	Weekly	Cumulative
	HH	HD	HH	HH			HH (g)	HH (kg)
19	9.7	9.7	0.7	0.7	43.7	43.7	29.6	0.0
20	38.8	38.8	2.7	3.4	46.6	45.1	126.5	0.2
21	59.2	59.3	4.1	7.5	49.5	46.6	204.9	0.4
22	77.6	77.8	5.4	13.0	51.9	47.9	281.9	0.6
23	87.3	87.6	6.1	19.1	53.8	49.1	329.0	1.0
24	90.0	90.4	6.3	25.4	55.3	50.1	348.4	1.3
25	91.5	91.9	6.4	31.8	56.5	51.0	361.5	1.7
26	92.1	92.7	6.4	38.2	57.3	51.8	369.5	2.1
27	92.4	93.1	6.5	44.7	58.0	52.5	375.3	2.4
28	92.2	92.9	6.5	51.2	58.6	53.1	377.9	2.8
29	91.9	92.7	6.4	57.6	59.1	53.6	379.8	3.2
30	91.6	92.5	6.4	64.0	59.5	54.1	381.1	3.6
31	91.3	92.2	6.4	70.4	59.8	54.6	381.8	3.9
32	91.0	92.1	6.4	76.7	60.0	55.0	382.4	4.3
33	90.7	91.9	6.3	83.1	60.3	55.3	383.0	4.7
34	90.4	91.7	6.3	89.4	60.6	55.6	383.7	5.1
35	90.1	91.5	6.3	95.7	60.8	56.0	383.6	5.5
36	89.8	91.3	6.3	102.0	61.0	56.2	383.6	5.9
37	89.5	91.1	6.3	108.3	61.2	56.5	383.6	6.2
38	89.2	90.9	6.2	114.5	61.4	56.7	383.6	6.6
39	88.9	90.7	6.2	120.8	61.6	57.0	383.5	7.0
40	88.7	90.5	6.2	127.0	61.8	57.2	383.5	7.4
41	88.3	90.2	6.2	133.1	62.0	57.4	383.0	7.8
42	87.9	89.8	6.2	139.3	62.1	57.6	381.9	8.2
43	87.5	89.5	6.1	145.4	62.2	57.8	380.8	8.5
44	87.1	89.2	6.1	151.5	62.3	58.0	379.7	8.9
45	86.7	88.9	6.1	157.6	62.4	58.1	378.6	9.3
46	86.3	88.7	6.0	163.6	62.5	58.3	377.5	9.7
47	85.9	88.4	6.0	169.7	62.6	58.4	376.4	10.1
48	85.6	88.0	6.0	175.6	62.7	58.6	375.3	10.4
49	85.2	87.7	6.0	181.6	62.8	58.7	374.1	10.8
50	84.8	87.4	5.9	187.5	62.9	58.8	373.0	11.2
51	84.4	87.1	5.9	193.4	63.0	58.9	371.9	11.6
52	84.0	86.8	5.9	199.3	63.1	59.1	370.7	11.9
53	83.6	86.4	5.9	205.2	63.1	59.2	369.6	12.3
54	83.2	86.1	5.8	211.0	63.2	59.3	368.4	12.7

Age (weeks)	Egg Production (%)		Egg Number		Egg Weight (g)		Egg Mass	
	Hen Housed	Hen Day	Weekly	Cumulative	Weekly Average	Cumulative Average	Weekly	Cumulative
	HH	HD	HH	HH			HH (g)	HH (kg)
55	82.8	85.8	5.8	216.8	63.3	59.4	367.3	13.0
56	82.5	85.6	5.8	222.6	63.4	59.5	366.1	13.4
57	82.1	85.3	5.7	228.3	63.5	59.6	365.0	13.8
58	81.7	84.9	5.7	234.0	63.6	59.7	363.8	14.1
59	81.3	84.6	5.7	239.7	63.7	59.8	362.6	14.5
60	80.8	84.2	5.7	245.4	63.8	59.9	361.0	14.8
61	80.3	83.7	5.6	251.0	63.9	60.0	359.4	15.2
62	79.8	83.3	5.6	256.6	64.0	60.1	357.8	15.6
63	79.3	82.9	5.6	262.1	64.1	60.2	356.1	15.9
64	78.9	82.5	5.5	267.7	64.2	60.3	354.5	16.3
65	78.4	82.1	5.5	273.2	64.2	60.4	352.3	16.6
66	77.9	81.7	5.5	278.6	64.3	60.4	350.6	17.0
67	77.4	81.2	5.4	284.0	64.4	60.5	349.0	17.3
68	76.9	80.8	5.4	289.4	64.4	60.6	346.8	17.7
69	76.4	80.4	5.4	294.8	64.5	60.7	345.1	18.0
70	76.0	79.9	5.3	300.1	64.6	60.7	343.5	18.4
71	75.5	79.5	5.3	305.4	64.6	60.8	341.3	18.7
72	75.0	79.1	5.2	310.6	64.7	60.9	339.6	19.0
73	74.5	78.7	5.2	315.8	64.8	61.0	337.9	19.4
74	74.0	78.3	5.2	321.0	64.8	61.0	335.7	19.7
75	73.4	77.7	5.1	326.1	64.9	61.1	333.6	20.0
76	72.8	77.2	5.1	331.2	65.0	61.2	331.4	20.4
77	72.3	76.6	5.1	336.3	65.0	61.2	328.8	20.7
78	71.7	76.1	5.0	341.3	65.1	61.3	326.6	21.0
79	71.1	75.6	5.0	346.3	65.1	61.4	323.9	21.4
80	70.4	74.9	4.9	351.2	65.2	61.4	321.3	21.7
81	69.7	74.3	4.9	356.1	65.2	61.5	318.2	22.0
82	69.1	73.6	4.8	360.9	65.3	61.5	315.6	22.3
83	68.4	72.9	4.8	365.7	65.3	61.6	312.5	22.6
84	67.7	72.4	4.7	370.5	65.4	61.7	309.9	22.9
85	66.9	71.6	4.7	375.1	65.4	61.7	306.3	23.2
86	66.2	70.8	4.6	379.8	65.4	61.8	302.8	23.5
87	65.4	70.0	4.6	384.4	65.4	61.8	299.2	23.8
88	64.6	69.4	4.5	388.9	65.5	61.9	296.1	24.1
89	63.8	68.6	4.5	393.3	65.5	61.9	292.5	24.4
90	63.1	67.8	4.4	397.8	65.5	62.0	289.0	24.7

Feeding and Egg Quality

Higher body weight reached by the end of rearing causes higher egg weight values during production. Among nutrient components, crude protein, methionine and a proportion of linoleic acid within the diet have a positive effect on egg weight.

Shell strength is a complex trait and many factors affect its quality. These include age, egg weight, the animal's behaviour, lighting programmes, feeding, disease and drugs, ambient temperature and the feeding technology used.

Calcium is the most important mineral, it plays a key role in the eggshell formation but other minerals, vitamins and nutrients take part in the process too. The balance of all different minerals, as well as the total amount of each component, are equally important for normal eggshell formation.

Egg Handling

Nests

- Clean egg production and floor egg minimization are influenced greatly by the provision of sufficient, well-located and maintained nest boxes. Floor eggs should be avoided, because of contamination, cracking and extra collection work. Nests should be well-ventilated to discourage broodiness and their litter replenished regularly to prevent breakage and minimize bacterial contamination.
- The numbers of laying nests must match the flock's size. Easy access, comfortable rubber floor or litter material, dark and draught-free environment inside nest boxes are necessary for having a quiet place for the hens. Addition of lights to nest entrance that switch on 1 hour prior to house lights help "early birds" finding the nest easier. The homogenous illumination of the scratching area, 1-2 cm litter material can effectively prevent floor eggs. Electric fence along the walls could also be a tool for reducing nesting on the floor.

How to Reduce Floor Eggs?

At the start of egg production searching for floor eggs has a primary importance. Collecting them once an hour from morning until the early afternoon, during the first 2-4 weeks, effectively reduces the number of floor eggs and has a long lasting effect for the whole laying cycle. While looking for floor eggs, hens nesting on the floor have to be placed into the laying nests. Make sure you do not disturb birds nesting in the right place, especially during the main laying period. Do not distribute feed at laying time.

Egg Collection

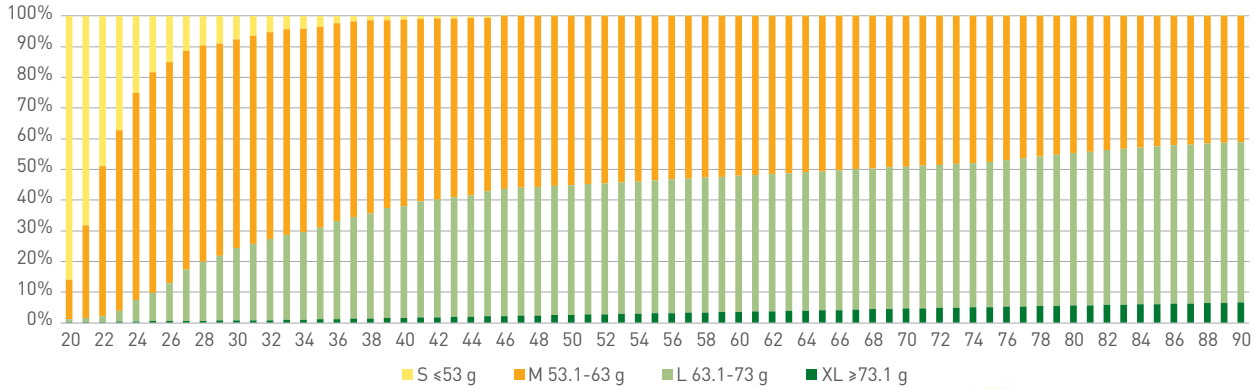
- Eggs need to be collected from nests at least 4 times a day. Most eggs will be laid during the morning hours, so collection time should be adjusted accordingly.
- Floor eggs must be collected and handled separately. Percentage of floor eggs must be registered, so management factors can be changed accordingly.

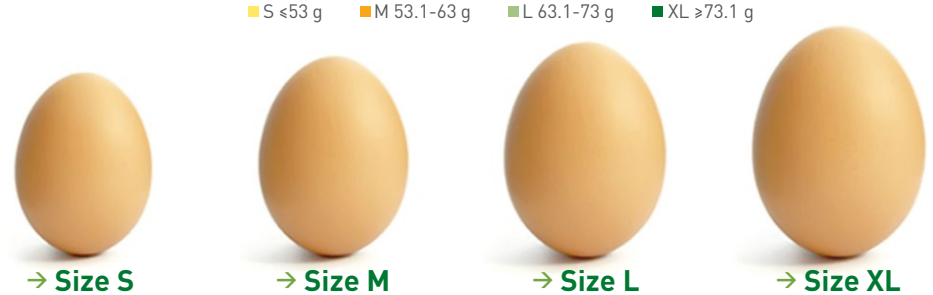
Table 14: Egg Grading for HARCO Layers

Age (weeks)	S	M	L	XL
	≤53 g	53.1-63 g	63.1-73 g	≥73.1 g
	%			
20	86.0	12.8	1.0	0.2
21	68.2	30.2	1.3	0.3
22	49.0	48.9	1.8	0.3
23	37.3	58.8	3.5	0.4
24	25.0	67.6	7.0	0.4
25	18.4	71.8	9.3	0.5
26	15.0	72.1	12.4	0.5
27	11.3	71.4	16.7	0.6
28	9.6	70.5	19.3	0.6
29	8.9	69.3	21.2	0.7
30	7.6	68.0	23.7	0.7
31	6.4	67.9	24.9	0.8
32	5.3	67.4	26.5	0.8
33	4.3	67.0	27.8	0.9
34	4.1	66.3	28.6	1.0
35	3.5	65.5	29.9	1.1
36	2.4	64.5	31.9	1.2
37	1.8	63.6	33.3	1.3
38	1.4	62.9	34.3	1.4
39	1.4	61.2	35.9	1.5
40	1.2	60.7	36.5	1.6
41	1.0	59.5	37.8	1.7
42	0.8	59.0	38.4	1.8
43	0.7	58.3	39.1	1.9
44	0.6	57.9	39.5	2.0
45	0.5	56.6	40.8	2.1
46	0.1	56.2	41.5	2.2
47	0.1	55.9	41.7	2.3
48	0.1	55.6	41.9	2.4
49	0.1	55.3	42.1	2.5
50	0.1	55.0	42.3	2.6
51	0.1	54.7	42.5	2.7
52	0.1	54.4	42.7	2.8
53	0.1	54.1	42.9	2.9
54	0.1	53.8	43.1	3.0

Age (weeks)	S	M	L	XL
	≤53 g	53.1-63 g	63.1-73 g	≥73.1 g
	%			
55	0.1	53.5	43.3	3.1
56	0.1	53.2	43.5	3.2
57	0.1	52.9	43.7	3.3
58	0.1	52.6	43.9	3.4
59	0.1	52.3	44.1	3.5
60	0.1	52.0	44.3	3.6
61	0.1	51.7	44.5	3.7
62	0.1	51.4	44.7	3.8
63	0.1	51.1	44.9	3.9
64	0.1	50.8	45.1	4.0
65	0.1	50.5	45.3	4.1
66	0.1	50.2	45.5	4.2
67	0.1	49.9	45.7	4.3
68	0.1	49.6	45.9	4.4
69	0.1	49.3	46.1	4.5
70	0.1	49.0	46.3	4.6
71	0.1	48.7	46.5	4.7
72	0.1	48.4	46.7	4.8
73	0.1	48.1	46.9	4.9
74	0.1	47.8	47.1	5.0
75	0.1	47.5	47.3	5.1
76	0.1	46.9	47.8	5.2
77	0.1	46.3	48.3	5.3
78	0.1	45.7	48.8	5.4
79	0.1	45.1	49.3	5.5
80	0.1	44.6	49.7	5.6
81	0.1	44.1	50.1	5.7
82	0.1	43.6	50.5	5.8
83	0.1	43.2	50.8	5.9
84	0.1	42.8	51.1	6.0
85	0.1	42.4	51.4	6.1
86	0.1	42.1	51.6	6.2
87	0.1	41.8	51.8	6.3
88	0.1	41.5	52.0	6.4
89	0.1	41.3	52.1	6.5
90	0.1	41.1	52.2	6.6

Figure 5: Egg Size Distribution of HARCO Layers





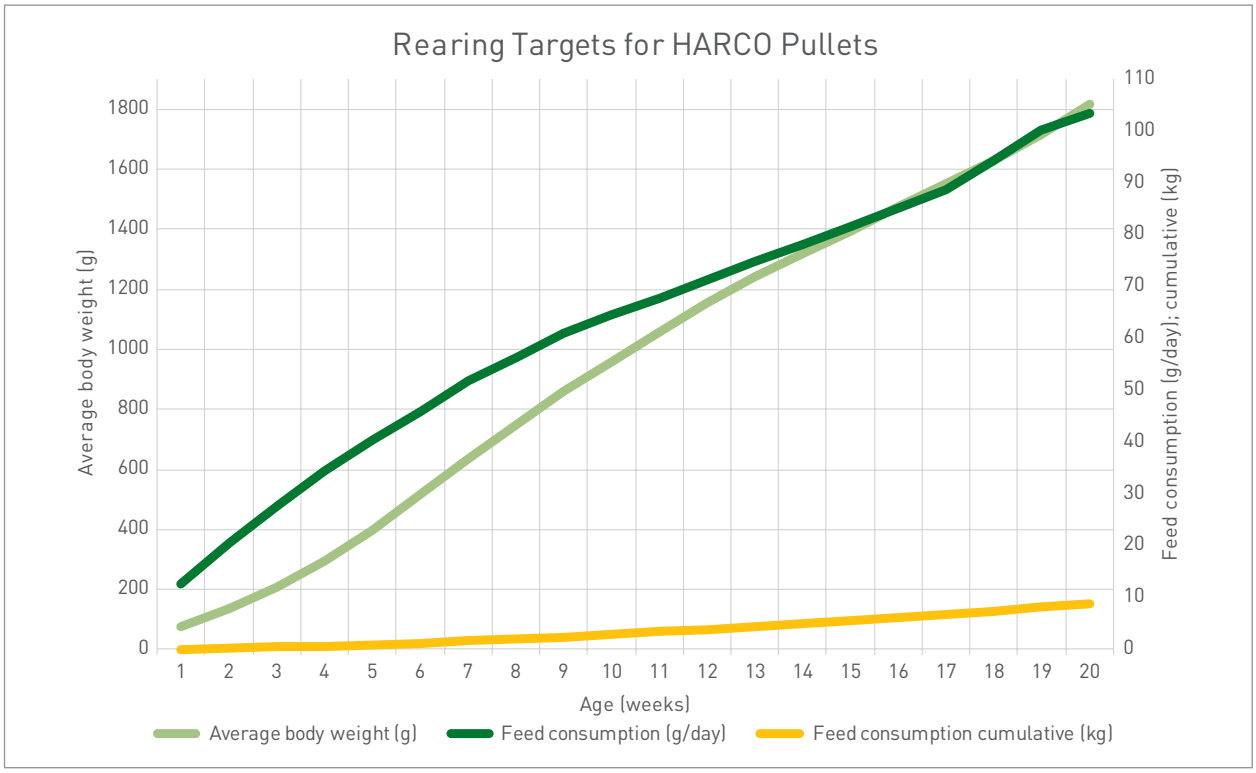
→ **Size S**
% Small eggs
(≤53.0 g)

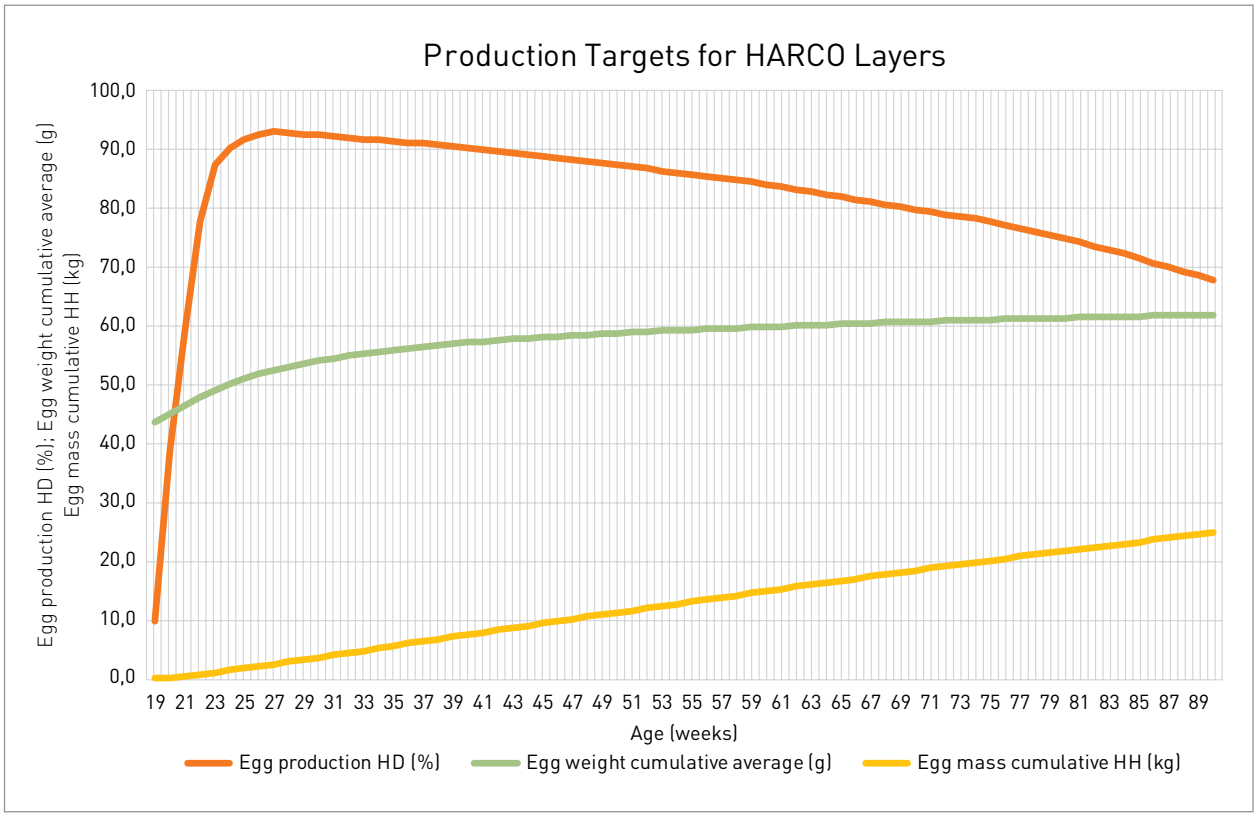
→ **Size M**
% Medium eggs
(53.1-63.0 g)

→ **Size L**
% Large eggs
(63.1-73.0 g)

→ **Size XL**
% Extra large eggs
(≥73.1 g)

Rearing and Production Targets





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