TETRA
SELECTED FOR QUALITY

BÁBOLNA TETRA-SL LL

COMMERCIAL LAYER
MANAGEMENT GUIDE

Introduction

Bábolna TETRA-SL LL (hereinafter referred to as TETRA-SL LL) is brown-feathered layer for cage or alternative systems. Pedigree lines of TETRA-SL LL are selected for their viability, efficient and long-term egg production as well as superior internal and external egg quality. Genetic selection of pure lines is an ongoing task for Bábolna TETRA geneticists to maintain and improve the quality and performance of grandparent, parent and commercial stocks.

This extended manual is a guideline and information source for maximizing your profits and satisfaction with your stocks; although special requests due to climatic or lighting conditions 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.

Bábolna TETRA Ltd.

TETRA selection

TETRA – Selected for Quality

In recent decades, the consumer market has undergone some significant changes, resulting in increased expectations towards production stocks. The key to this adaptation is a properly structured and efficient selection programme supported by a systematically developed consulting network, which lies behind the increasing popularity of Bábolna TETRA parent stock and their progenies.

Continuous investment over the last years, such as a new pedigree farm and high-capacity layer breeder hatchery, has enabled the creation of a larger base for selection and more efficient and safer hatching for their valued customers. Close contact with the market is essential for the development of their products and to fulfill long-term needs, hence TETRA will continue to actively participate in product fairs and organize partner meetings in the future.

Nowadays, Bábolna TETRA is determined to improve the competitiveness of their poultry, which has a long tradition and increasing share in the global market. Despite the diversity of the current market, TETRA focuses on the selection of the most important traits (persistency, egg quality, viability) and is determined 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 behavioral observations have been used in the selection index of pure lines for years. Intensive selection work continues to preserve a calm temperament and minimalize beak trimming.

Contents

Performance Data of TETRA-SL LL Commercial Layer

Table 1

Livability	
0-17 weeks of age	97-98%
18-90 weeks of age	93-95%
Feed consumption	
0-17 weeks of age	5.7-6.0 kg
18-90 weeks of age (average)	108-112 g/day
Body weight	
At 17 weeks of age	1.41 kg
At 90 weeks of age	1.9-2.0 kg
Maturity	
Age at 50% production	140-144 day
Age at 90% production	161-163 day
Egg production per hen housed	
Until 72 weeks of age	318-322
Until 80 weeks of age	360-365
Until 90 weeks of age	408-412
Egg mass per hen housed	
Until 72 weeks of age	20.2 kg
Until 80 weeks of age	23.0 kg
Until 90 weeks of age	26.3 kg
Egg weight (weekly average)	
In 32 weeks of age	61.9 g
In 52 weeks of age	65.0 g
In 80 weeks of age	67.2 g
In 90 weeks of age	67.5 g
Average egg weight	64.1 g
Shell strength	>35 N
Shell colour	brown

General Recommendations and Biosecurity of Poultry Farms

General rules

- Isolation of the house is vitally important to reduce the possibility of introducing a disease organism into a clean house environment.
- People traffic constitutes the largest threat to isolation and the introduction of disease-causing agents. Ideally, shower facilities and farm clothing are to be made available for all employees and necessary visitors.

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

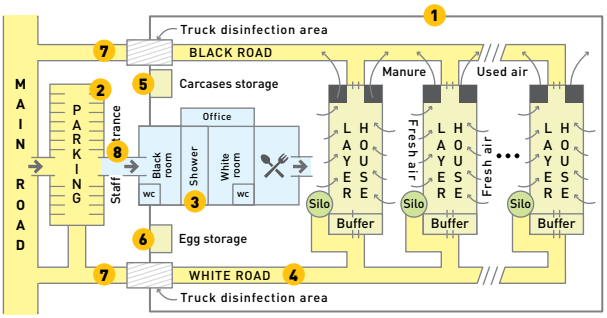
- If this is not possible, visits should be limited to only those persons that are necessary and they should be required to wear clean coveralls, new plastic or cleaned rubber boots and hair covering.
- Disinfectant footbaths should be present at the entranceway to each house and should be replenished with fresh disinfectant daily.
- Doors should be kept locked at all times to prevent unwanted, improperly attired visitors from entering. NO TRESPASSING signs should be prominently displayed on the doors and BIOSECURITY ZONE signs should be displayed at the farm entrance to warn visitors that they are entering a biosecure area.
- Remembering that people spread many diseases from farm to farm will help to encourage less people traffic to and from farms.

The importance of biosecurity

Pathogens can reach your flock in hundreds of different ways, such as 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 it very seriously indeed. It is far easier to prevent these problems from occurring, than cure or eradicate your flock.

Plan and build

Before building a farm, one has to consider some important facts. It is best to start building it with a good deal of planning and great attention to detail, otherwise it is more difficult to change it after it has been constructed.



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

Location

Put your farm as far as possible from any other farms to reduce the risk of contamination. Avoid high traffic motorways, where poultry transfer is very common. Take care to prevent ingress of air-born hazards.

Single-age flock

Avoid horizontal contamination by housing single-age flocks. One farm should contain same age and same breeding level chickens. Separate growing and laying farms are welcomed. Hatcheries closely located 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 (sign with UNAUTHORZED ENTRY PROHIBITED). Everything outside the farm is "black", and inside is "white". Minimize the number of visitors, entering only when it is required. Set up parking facilities outside of the fence. Visitors are not allowed to enter by car.

Around the poultry houses

The surroundings of the houses are to be kept free of vegetation as wild birds prefer this, clean and place a 0.5-1 m strip of stone close to the wall of the poultry houses to deter rodents.

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

Personal hygiene

Before entering, use boot and hand disinfectant. Provide 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 of the house. Wear different boots on the farm, and inside of each house. Keep your environment clean: sweep and clean biosecurity rooms, poultry house entrance and surrounding roads.

Traffic inside the farm

The best choice is, when no vehicles 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. This has to be closed and preferably cooled while, the frequency of removal depends on temperature as well.
- 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 in 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 for the driver is prohibited.

Book for visitors

Create a book for visitors. Each person has to write his name, the purpose of visit, date, and declare when he/she was visiting poultry facility, hatchery, slaughter house, feed mill in the last two weeks. If you have to visit more flocks than one, follow this rule: at first, visit the younger flocks, and only then the older ones: the higher ones first, then the lower breeding level. Everything must be recorded in the visitors' book.

Cleaning and disinfection

The most effective way to reduce the negative impact of disease-causing pathogens on the growth and subsequent performance of a laying flock is to avoid exposure to these organisms. A sound sanitation program and effective isolation plans are instrumental in achieving this goal. Cleaning and disinfection is 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 flexible part of the equipment has to be dissembled, while manure and litter must be eliminated. Transfer the litter far from the farm to a fermentation plant, but do not spill onto 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.

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

High pressure cleaners perform cleaning well, using effective detergent in cold or hot water. Do not forget feeders, drinkers, fans, air in- and outlets. Rinsing with water is the next step, after that allow the equipment and house to 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. Take care with walls, floors, fan blades, lights, slats, nests, feeders and drinkers, outside and inside. Do not forget 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 effect. Sporocides kill very resistant parasite spores as well. Change active ingredients frequently and monitor the effect by microbiological tests. Take care that some disinfectants do not work well under low temperature. Disinfectants can harm human health, so follow instructions thoroughly and use personal protection.

Cleaning and disinfection involve not only chicken houses, but all the farm area as well, included biosecurity building, feed store, litter store, egg store etc. Do not forget 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 the 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 any birds in the house, water lines must be flushed frequently in hot weather conditions, 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 by 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, use appropriate supplements. Pelleting the feed means heat treatment and better homogeneity after handling. Layer breeders prefer crumbled feed. Hygienically storing and transporting the feed is 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 preferred to each of the houses.

Wild bird and rodent control

Wild bird and rodent control is the first line of defence against transmission of dangerous diseases. It is important to prevent viral, bacteriological and parasitic infections and for this purpose, bird-nets are 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 the equipment is also warm. The desired relative humidity should be 60-70%. This humidity level should be maintained for at least three weeks.

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

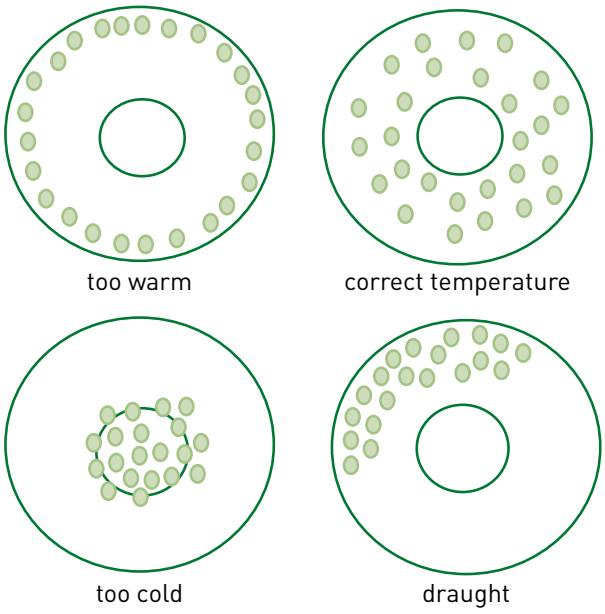
Table 2: Temperature requirements for TETRA-SL LL pullets

Age in days	Temperature (°C) on chicks's 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

- The behaviour of the chicks is the best indicator of the 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 the 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 1: Indication of chick's well-being under the brooder



Growth Management

TARGETS:

- Flock uniformity and body weight are the predictors of future laying performance of the birds
- Ensure that targets stated in this manual are reached in the main points of their 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 set in cleaned, disinfected and properly prepared house. Room temperature should be 34-35°C, but fresh air supply is a very important task, so minimum ventilation must run from the beginning. For litter clean, mould-free straw or wood-shavings are the best to use. Automatic feeders have to be filled-up to that level that the chicks can see the feed in them. Place the chick-paper alongside the drinkers' lines and strew feed on them in a thin but equally distributed layer. Maintain the chick-paper dry, a 5 cm distance from the drinkers' lines is advised. For water supply cleaned, scale and biofilm free nipple drinkers are preferred. Water should be warmed up before chicks' arrival to 20-25°C. Height of the drinkers has to be checked frequently, one water droplet on the nipple thanks to the reduced water pressure helps the birds to find them easily. Illuminations has prime importance in finding feed and water as soon as possible. Perches are preferable from the early days for helping the 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

We suggest housing pullets in aviary laying house only, if they can be raised in aviary rearing facilities. Depending on the system, usually in the first 3-4 weeks of age, chicks are kept in a central area or closed cages with available feed and water sources. Chick-paper is suggested for use for 4 days in order to get a good start. Trigger the nipples for checking the water flow and showing the chicks how to use them. Recommended air temperature at the chicks' level 34-35°C in the first two-three days. After 3-4 weeks different tiers or platforms will be opened for the birds with additional feed and water supply to let them acquaint with all the available rearing levels. Use a maximum four-tier system. One of the newly opened levels might be the source of water, the other one of feed and the third one a 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 it easier for birds to adapt. Check the birds' resting behaviour during nighttime. Encourage them to rest on the platforms instead of the floor to avoid floor eggs in the production period. In order to avoid 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 get the birds used to this and to have a long-lasting effect is the 4^{th} -6^{th} weeks of rearing. As a next step, 10 minutes later switch off the inner lights too and leave on the lights only at the top which will stimulate the birds to move further upwards. Instead of a prompt black-out, use a short dimming time.

Cage system

The conventional way of rearing pullets for laying cages are still allowed in many countries, but animal welfare and state regulations might be different. We suggest placing chick-paper on the bottom of the cages and to strew feed on it. Chick-paper is used for 4 days and during this period a thin layer of feed must be frequently refreshed on it. Take care 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 at the same time 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

Standard should be regarded as the minimum requirements for a satisfactory performance.

Drinking space

Water is essential 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 in weeks		0-6	7-18	from 19
Density (bird/m^2)	Floor system	20-24	10-12	7-8
	Aviary system	26-28	26-28	14-16
	Cage system	80-50 (125-200 cm^2/bird)	40-25 (250-400 cm^2/bird)	13-18 (minimum 490 cm^2/bird) - non-EU 10-13 (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 them 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 relaxing effect on birds and to have efficacy against picking and cannibalism. The lighting program has to be adjusted to the natural day and night light conditions. Applying 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 determining the well-being of pullets. The poultry house must be equipped with an air conditioning device capable of providing the minimal ventilation need or: 4.5 m^3/body weight kg. The birds are sensitive for draught thus it should be avoided. The ammonia concentration of the air must be kept under 10 ppm and carbon dioxide concentration must not exceed 2000 ppm while the dust concentration of the air should be as low as possible.

Beak trimming

Before decision is made concerning beak trimming, local law and animal welfare regulations must be studied. More and more countries do not allow this kind of treatment. Beak trimming need 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 first checking all other aspects of management before embarking on a programme of beak trimming. The provision of more feeders and drinkers, more space per bird, correct nutritional components or improved ventilation may be the correct 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 the 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 may promote undesirable behavior. Care must always be taken that all birds are correctly and uniformly beak trimmed.
- Each bird should mature with a rounded, but slightly shortened beak and be able to conduct normal feeding activity

Vaccination programmes

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

Table 4: Example of a vaccination program for TETRA-SL LL commercial stock

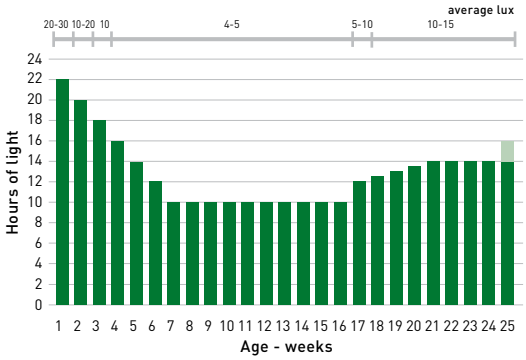
Disease	Suggested time of application	Occurrence
Marek's disease (MD)	First day at the hatchery	**
Newcastle disease (ND)	Suggestion: Days 1 and 12, then during week 14 and before transfer	**
Infectious bronchitis (IB)	The number of vaccination is depending on disease pressure in that area (suggestion: Day 1 and 12, Week 6, 11, 14 and before transfer)	**
Gumboro disease (IBD)	Two vaccinations (Day 18 and 28) 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 recommended before transfer	*
EDS	Vaccination before transfer	*

**: applied worldwide; *: applied locally

Lighting Programmes

- A lighting programme is only effective if direct sunlight is blocked from entering 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 is the main factor, which determines the package of egg output. Egg numbers during the laying period decreases by 3-4 eggs for each 10-day delay in age at first egg.

Figure 2: Lighting programme for TETRA-SL LL pullets and layers



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

Table 5: Detailed lighting programmes for TETRA-SL LL layers

Age in 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-through the 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 until 14 hours. To support high production level, day length can be increased gradually until 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. In 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 is dependent on the following:
  - Natural daylight increases
  - Natural daylight decreases
- For example; when the TETRA-SL LL flock starts production 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 TETRA-SL LL layers with high performance may only be exploited when their biological needs are met. The feeding of complete feed is necessary, with specialized nutrient content which is adapted to the animals' needs in respect of each production phase. This is a topic that the feed industry nowadays specializes in; a mix of state-of-the-art technology and up to date physiological knowledge in order to perform new tasks.

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 subsistence, weight gain and production.

Proteins and amino acids

Protein is the highest proportion of components 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 control the reliability of the manufacturing plant.

In fact, protein added in the feed is broken down into amino acids, from which the body compiles its own proteins, but their genetically-encoded amino acid composition and sequence is 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 the 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 whereas, in its absence, it is produced 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 power 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 significantly improved.

Sodium (Na^+), potassium (K^+) and chloride (Cl^-) ions play an important role in blood and osmotic pressure, maintaining the pH of cells while also activating enzymes. Sodium supplements with common salt (NaCl) usually satisfy the chlorine demand. In the case of heat stress, in the form of 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 function which is not able to be performed by other vitamins. Vitamins – with few exceptions – cannot be synthesized, so they must be

introduced by feed. For the supply of vital functions, a few milligrams or micrograms of certain vitamins is sufficient, but this 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 their high performance – partial absence of either micro-component has a noticeable 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, as well as favourably affects the digestibility of other nutrients.
- Specific additives in layer feeds are carotenoids, which make the egg yolk more attractive for consumers in some countries.

Feeding during Growing Period

By following the recommendations in our feeding program, described in TETRA Management Guide, pullets achieve their weight in accordance with 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 accommodate the nutritional requirements of the birds themselves. The actual weight of the flock must be considered 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, uneven nutrition in both cases.

In starter feeds (especially in the first phase) crumbs are the most appropriate, which in terms of the microbiological status, means increased security for the feeding of young chicks.

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

Essentially Starter rations aim to produce a good skeleton, good organ development and help to promote an active immune system. This is achieved by feeding Pre-starter and Starter *ad libitum*, with the correct balance and absolute levels of essential amino acids for growth, development of the immune system, feathering and skin condition.

Grower (9-17 weeks)

Whilst the Grower diet will be the lowest density ration that the bird receives, with higher fibre content, while it is important that all nutrients are correctly included. Fibres positively influence the development of the digestive tract and consequently, the appetite. It is very important that young layers are able to take all nutrients that they need, at the start of their production. We recommend to use 5-6% crude fibre in the grower diet for TETRA-SL LL 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 achieve the correct body weight at first egg. As feeding portions are being increased, it is essential to monitor body weight weekly during this period.

Pre-layer (18-19 weeks)

Pre-layer feed is a transition from Grower to Layer I, with not only a significantly increased calcium content, but also a higher level of each nutrient. Before the start of the 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 a layer's tubular bones are developed which provides the calcification of the eggshell in the production period.

An adequate amount of calcium is important to be added at this time, for proper bone strength and eggshell quality during production. Increased levels of energy and amino acids are also desirable since these promote the development of the ovarian tissue. 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 1500-1550 grams body weight should be achieved and *ad libitum* feeding of properly prepared Pre-layer feed is necessary.

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

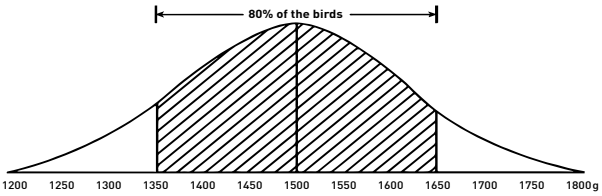
Body weight control during rearing

Uniformity and regular weighing is of utmost important. During the growing period and until peak production is reached, regular weighing must be carried out at the same hour of the same day must of the week. Regular weighing needs to start in the first few weeks, and needs to be continued weekly, throughout the growing period. Changes in body weight and homogeneity of the stock provide information about normal development of TETRA birds. The growth of a flock is normal and the birds can be considered equal if their CV% is below 10%.

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

TETRA hybrid pullets are not prone to obesity, so if the data obtained during the weighing does not differ significantly from the technological value (± 5%) and is recorded as homogeneous, *ad libitum* feeding can be used throughout the rearing period.

If the pullets, nevertheless, do not reach the required weight value, feed consumption by frequent running of the feeders might be used and feed with higher nutritional value should be implemented. The average body weight of TETRA-SL LL pullets at the time of transfer should be around 1340-1480 g, at 16-18 weeks of age.



Uniform flock of TETRA-SL LL pullets

Table 6: Weight development and feed intake of TETRA-SL LL pullets

Age in weeks	Body weight (g)		Feed consumption		Feed type
	Average	Range	g/bird/day	Cumulative (kg)	
1	70	68 – 72	11	0.08	Pre-starter
2	125	120 – 130	18	0.20	
3	190	185 – 195	24	0.37	
4	270	260 – 280	30	0.58	Starter
5	360	350 – 370	35	0.83	
6	470	455 – 485	40	1.11	
7	580	560 – 600	45	1.42	
8	680	660 – 700	49	1.76	
9	780	755 – 805	53	2.14	Grower
10	870	845 – 900	56	2.53	
11	960	930 – 990	59	2.94	
12	1050	1020 – 1080	62	3.37	
13	1130	1095 – 1165	65	3.83	
14	1200	1165 – 1235	68	4.31	
15	1270	1230 – 1310	71	4.80	
16	1340	1300 – 1380	74	5.32	
17	1410	1370 – 1450	77	5.86	
18	1480	1435 – 1525	82	6.43	Pre-layer
19	1560	1515 – 1605	87	7.04	
20	1650	1600 – 1700	90	7.67	Layer I

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

Table 7: Nutritional recommendation for TETRA-SL LL 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 a combination with dropping pit covered with slats of plastic or wood. We suggest a 60-80 cm high dropping pit, with 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. On the slats or at the walls 15 cm/birds resting perches are welcomed. The best way to have a good start with a new flock, if the 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. For jumping onto the slats ladders are recommended. Those birds that cannot find the way up themselves should be helped individually during the first 4 weeks. This is a good practice for prevention of floor eggs also. In particular cases birds might 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 is depends on the capacity of feeders, drinkers and fans. Houses might also be equipped with winter gardens or access to free-range area.

Aviary system

Hens for aviary laying system have to be trained in several levels during rearing to achieve actively moving birds through the building. After transferring them to the laying house this training enhances the access to different levels in the system in order to find water, feed, resting and nesting area. The multilevel laying aviary provides feeders, drinkers on different levels in the lower part of the system. The upper parts are resting areas. Automatic laying nests are integrated in the system. Placing similar equipment in aviaries to rearing houses makes it easy for the birds to adopt to change. 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 shaving. 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 the pullets, special care must be taken that all the 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 might be also 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 place/hen is needed in EU conform cages. For other cases a minimum of 490 cm^2 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 drinkers for a proper function especially on the day of settlement.

Management into lay (15 weeks to peak production)

Minimize variation in body weight and sexual maturity of the birds. Prepare the flock for the production period with 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

TETRA-SL LL 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 environmental 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 will the increase in production be. 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, factors which alter the bird's demand for energy, such as ambient temperature, automatically affect the bird's feed consumption. If there has been no modification of the ration formulation, changes in daily intake will result in changes in all nutrient including amino acids, vitamins, minerals, anti-coccidials, that will correspondingly affect bird's performance.
- Hens do not completely adjust their feed consumption due to extremes of temperature or higher dietary energy concentration. In fact, high temperatures or high energy concentrations can overly reduce energy intake and egg output suffers as a result.
- Hens with low body weight lay fewer eggs, whereas higher body weight at the beginning of the production will be an advantage until the peak period.

Layers without beak-trimming

The number of countries and operations increases where hens with not-trimmed beaks are accepted only. To avoid unfavourable behaviour or selection of feed particles more attention is needed to to satisfy the birds' comfort feeling. Stocking density, feeding and drinking spaces, feed, water, litter and air quality, ventilation, light intensity are the most important tasks. 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. Also they like dust baths very much so it must be provided for them. 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 grinded 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 the floor area. In normal situation lost feathers can be seen on the floor. If not, the flock is suspected for eating them and prompt actions must be taken, because it might be a sign for misbalanced feeding as well.

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

Feeding during 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 90 to 100 grams between Weeks 20 and 24. During this period, an intensive high-energy and nutritious diet needs to be fed, with increased calcium supplementation.

Layer diets

Layer I

At the start of egg production daily feed intake rises relatively slowly. At the same time the formation of the egg, the increasing egg weight and body weight gain further enhance the nutritional requirements of the layers. It is important to understand that the quality of nutrition has a crucial impact when they reach peak production and how they perform during persistency. Feeding is *ad libitum* and any factors which would reduce the feed consumption should be minimized. We recommend feeding Layer I with high nutrient concentrations, as long as production is expected to be over 90%.

Layer II-IV

With increasing age, both the production of eggs and the nutritional needs of the birds decrease. In order to optimize costs, lower concentrations of crude protein and amino acids but with higher calcium levels are possible in the ration. To prevent fattening, energy or fat/oil supplementation should be reduced. A proper ratio of nutrients should 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 TETRA-SL LL layers

Age in weeks	TETRA-SL LL				
	Body weight (g)		Feed consumption		
	Average	Range	Average g/bird/day	Range	Cumulative
20	1650	1600 - 1700	90	87 - 93	0.6
21	1720	1670 - 1760	93	90 - 96	1.3
22	1780	1730 - 1835	96	93 - 99	2.0
23	1820	1765 - 1875	98	95 - 101	2.6
24	1850	1795 - 1905	101	98 - 104	3.3
25	1870	1815 - 1925	103	100 - 106	4.1
26	1880	1825 - 1935	104	101 - 107	4.8
27	1890	1835 - 1945	105	102 - 108	5.5
28	1900	1845 - 1955	106	103 - 109	6.3
29	1910	1850 - 1965	107	104 - 110	7.0
30	1920	1860 - 1980	108	105 - 111	7.8
40	1945	1905 - 1985	111	108 - 114	15.4
50	1965	1925 - 2005	111	108 - 114	23.2
60	1975	1935 - 2015	111	108 - 114	31.0
70	1985	1945 - 2025	111	108 - 114	38.8
80	1995	1955 - 2035	110	107 - 113	46.6
90	2000	1960 - 2040	110	107 - 113	54.3

* Feed amount must be adjusted to the 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 TETRA-SL LL layers with average daily feed consumption (110 g/day)

Feed type	Layer I	Layer II	Layer III	Layer IV	Layer I	Layer II	Layer III	Layer IV
Age in weeks	20-45	46-65	66-80	81-90	20-45	46-65	66-80	81-90
Production	>90%	>80%	>70%	<70%	>90%	>80%	>70%	<70%
NUTRIENT	Daily energy requirements/bird				Standard diets (110 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	3.75	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	0.17	0.17	0.17	0.17
Chlorine	200	200	200	200	0.18	0.18	0.18	0.18

* 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 in the event of different feed consumptions than average (lower or higher), on the basis of the daily nutritional needs. In the case of higher feed intake (115 g / day), a moderate-intensity diet is needed, while with a lower than average (105 g / day) feed consumption, the diet should be more concentrated as shown in Table 10.

Table 10: Nutritional recommendation for TETRA-SL LL layers with different daily feed consumptions

Feed type	Layer I			Layer II			Layer III			Layer IV		
	Daily feed consumption											
	105 g	110 g	115 g	105 g	110 g	115 g	105 g	110 g	115 g	105 g	110 g	115 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	3.75	3.60	4.10	3.90	3.70	4.20	4.00	3.80	4.30	4.10	3.90
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	0.18	0.17	0.16	0.18	0.17	0.16	0.18	0.17	0.16	0.18	0.17	0.16
Chlorine	0.19	0.18	0.17	0.19	0.18	0.17	0.19	0.18	0.17	0.19	0.18	0.17

Vitamin and Micro-Nutrient Supplementation

According to the general introduction stated earlier in this manual, vitamins, trace elements and, if necessary, other additives are always to 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 TETRA-SL LL 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 additions

In accordance with the calcium (Ca) requirements for hens, it must be present in their feed in high proportions. In addition, the quantity and shape of limestone is 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 TETRA-SL LL layers

Age in weeks	Rate of lay %		Egg number		Egg weight		Egg mass	
			per HH cumulative		in week	cum.	g/HD	kg/HH
	per HH	per HD	average	range	g	g	in week	cumulative
19	10.0	10.0	0.7	0.5 - 0.9	45.0	45.0	4.5	0.03
20	40.0	40.0	3.5	2.6 - 4.4	48.0	47.4	19.2	0.17
21	61.0	61.1	7.8	6.4 - 9.1	51.0	49.4	31.1	0.38
22	80.0	80.2	13.4	11.7 - 15.0	53.5	51.1	42.9	0.68
23	90.0	90.3	19.7	17.8 - 21.6	55.5	52.5	50.1	1.03
24	92.8	93.2	26.2	24.1 - 28.3	57.0	53.6	53.1	1.40
25	93.8	94.3	32.7	30.5 - 35.0	58.2	54.5	54.9	1.79
26	94.3	94.9	39.3	37.0 - 41.7	59.1	55.3	56.1	2.18
27	95.3	96.0	46.0	43.6 - 48.4	59.8	56.0	57.4	2.57
28	95.0	95.8	52.7	50.2 - 55.1	60.4	56.5	57.8	2.98
29	94.7	95.6	59.3	56.8 - 61.8	60.9	57.0	58.2	3.38
30	94.4	95.4	65.9	63.3 - 68.5	61.3	57.4	58.5	3.78
31	94.1	95.1	72.5	69.8 - 75.2	61.6	57.8	58.6	4.19
32	93.8	94.9	79.0	76.3 - 81.8	61.9	58.2	58.8	4.60
33	93.5	94.7	85.6	82.8 - 88.4	62.2	58.5	58.9	5.00
34	93.2	94.5	92.1	89.3 - 94.9	62.5	58.8	59.1	5.41
35	92.9	94.3	98.6	95.7 - 101.5	62.7	59.0	59.1	5.82
36	92.6	94.1	105.1	102.2 - 108.0	62.9	59.3	59.2	6.23
37	92.3	93.9	111.6	108.6 - 114.5	63.1	59.5	59.2	6.64
38	92.0	93.7	118.0	115.0 - 121.0	63.3	59.7	59.3	7.04
39	91.7	93.5	124.4	121.4 - 127.4	63.5	59.9	59.4	7.45
40	91.4	93.3	130.8	127.7 - 133.9	63.7	60.1	59.4	7.86
41	91.0	93.0	137.2	134.1 - 140.3	63.9	60.2	59.4	8.26
42	90.6	92.6	143.5	140.4 - 146.7	64.0	60.4	59.3	8.67
43	90.2	92.3	149.8	146.6 - 153.1	64.1	60.6	59.2	9.08
44	89.8	92.0	156.1	152.8 - 159.5	64.2	60.7	59.1	9.48
45	89.4	91.7	162.4	159.0 - 165.8	64.3	60.9	59.0	9.88
46	89.0	91.4	168.6	165.1 - 172.1	64.4	61.0	58.8	10.28
47	88.6	91.1	174.8	171.3 - 178.4	64.5	61.1	58.7	10.68
48	88.2	90.7	181.0	177.4 - 184.6	64.6	61.2	58.6	11.08
49	87.8	90.4	187.1	183.4 - 190.8	64.7	61.3	58.5	11.48
50	87.4	90.1	193.3	189.5 - 197.0	64.8	61.5	58.4	11.88
51	87.0	89.8	199.3	195.5 - 203.1	64.9	61.6	58.3	12.27
52	86.6	89.5	205.4	201.5 - 209.3	65.0	61.7	58.2	12.66
53	86.2	89.1	211.4	207.5 - 215.4	65.1	61.8	58.0	13.06
54	85.8	88.8	217.4	213.5 - 221.4	65.2	61.9	57.9	13.45

Age in weeks	Rate of lay %		Egg number		Egg weight		Egg mass	
			per HH cumulative		in week	cum.	g/HD	kg/HH
	per HH	per HD	average	range	g	g	in week	cumulative
55	85.4	88.5	223.4	219.4 - 227.4	65.3	61.9	57.8	13.84
56	85.0	88.2	229.4	225.3 - 233.4	65.4	62.0	57.7	14.23
57	84.6	87.9	235.3	231.2 - 239.4	65.5	62.1	57.5	14.62
58	84.2	87.5	241.2	237.0 - 245.4	65.6	62.2	57.4	15.00
59	83.8	87.2	247.1	242.8 - 251.3	65.7	62.3	57.3	15.39
60	83.3	86.8	252.9	248.6 - 257.2	65.8	62.4	57.1	15.77
61	82.8	86.3	258.7	254.3 - 263.1	65.9	62.4	56.9	16.15
62	82.3	85.9	264.4	259.9 - 269.0	66.0	62.5	56.7	16.53
63	81.8	85.5	270.2	265.6 - 274.7	66.1	62.6	56.5	16.91
64	81.3	85.0	275.9	271.2 - 280.5	66.2	62.7	56.3	17.29
65	80.8	84.6	281.5	276.8 - 286.2	66.2	62.7	56.0	17.66
66	80.3	84.2	287.1	282.4 - 291.9	66.3	62.8	55.8	18.04
67	79.8	83.7	292.7	287.9 - 297.6	66.4	62.9	55.6	18.41
68	79.3	83.3	298.3	293.4 - 303.2	66.4	62.9	55.3	18.78
69	78.8	82.9	303.8	298.8 - 308.8	66.5	63.0	55.1	19.14
70	78.3	82.4	309.3	304.2 - 314.3	66.6	63.1	54.9	19.51
71	77.8	82.0	314.7	309.6 - 319.8	66.6	63.1	54.6	19.87
72	77.3	81.5	320.1	314.9 - 325.4	66.7	63.2	54.4	20.23
73	76.8	81.1	325.5	320.3 - 330.7	66.8	63.3	54.2	20.59
74	76.3	80.7	330.8	325.5 - 336.2	66.8	63.3	53.9	20.95
75	75.7	80.1	336.1	330.7 - 341.6	66.9	63.4	53.6	21.30
76	75.1	79.6	341.4	335.9 - 346.9	67.0	63.4	53.3	21.65
77	74.5	79.0	346.6	341.0 - 352.2	67.0	63.5	52.9	22.00
78	73.9	78.5	351.8	346.2 - 357.4	67.1	63.5	52.6	22.35
79	73.3	77.9	356.9	351.1 - 362.7	67.1	63.6	52.3	22.70
80	72.6	77.2	362.0	356.2 - 367.8	67.2	63.6	51.9	23.04
81	71.9	76.6	367.0	361.1 - 372.9	67.2	63.7	51.5	23.38
82	71.2	75.9	372.0	366.0 - 378.0	67.3	63.7	51.1	23.71
83	70.5	75.2	377.0	371.0 - 383.0	67.3	63.8	50.6	24.04
84	69.8	74.6	381.8	375.7 - 387.9	67.4	63.8	50.3	24.37
85	69.0	73.8	386.7	380.5 - 392.8	67.4	63.9	49.7	24.70
86	68.2	73.0	391.4	385.2 - 397.7	67.4	63.9	49.2	25.02
87	67.4	72.2	396.2	389.9 - 402.5	67.4	64.0	48.7	25.34
88	66.6	71.5	400.8	394.4 - 407.2	67.5	64.0	48.2	25.65
89	65.8	70.7	405.4	399.0 - 411.9	67.5	64.0	47.7	25.96
90	65.0	69.9	410.0	403.5 - 416.4	67.5	64.1	47.2	26.27

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 the proportion of linoleic acid within the diet have a positive effect on egg weight.

Shell strength is a complex trait in that many factors are known to affect the quality of the eggshell. These include age, egg weight, the animal's behavior, lighting programmes, feeding, disease and drugs, ambient temperatures and the feeding technology used.

Calcium content, being the most important mineral, plays a key role in the eggshell formation but other minerals, vitamins and nutrients are also involved. The balance of all the different minerals, as well as the total amount of each component, are equally important for normal eggshell formation.

Egg Handling

Nests

- The production of clean eggs and the minimization of eggs laid on the floor are influenced greatly by the provision of sufficient, well-sited and maintained nest boxes. Floor eggs should be avoided, because of contaminations, cracking and excess work for collection. Nests should be well-ventilated to discourage broodiness and their litter replenished regularly to prevent breakages 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 inside is needed for having a quiet place for the hens. Attraction lights at the nest entrance that switch on 1 hour prior than the lights of the house helps the "early birds" to find the nest easier. The homogenous illumination of the scratching area, 1-2 cm litter material may effectively prevent floor eggs. Electric fence along the walls could be also a tool for reducing nesting on the floor.

How to reduce floor eggs?

When egg production starts 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 long lasting effect for the whole laying cycle. While looking for floor eggs, hens which are nesting on the floor should be placed onto the laying nests. When doing so do not disturb others nesting in the right place, especially during the main laying period. By that time feed distribution should be also avoided.

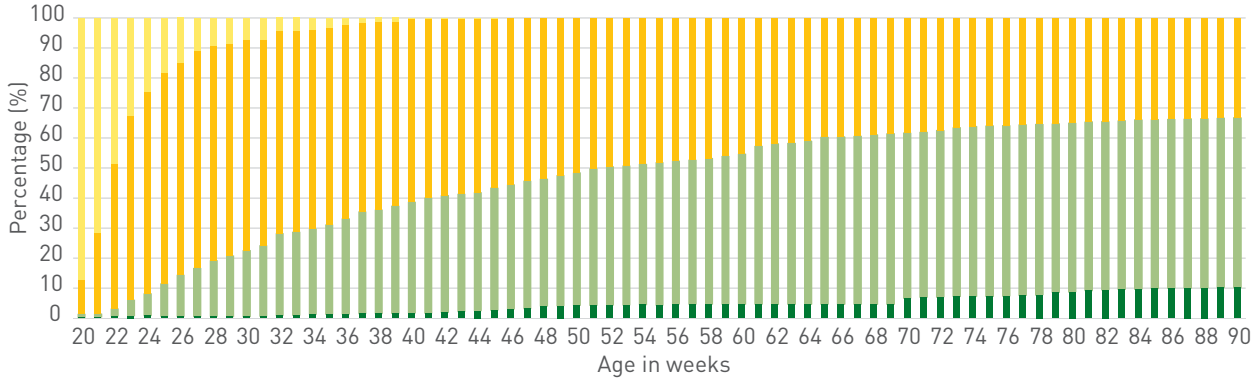
Egg collection

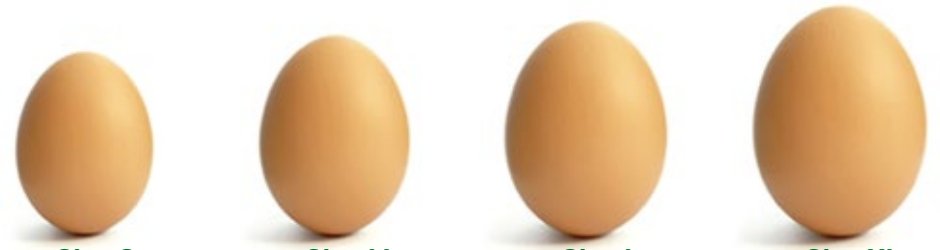
- Eggs should be collected from nests at least 4 times a day. Most eggs will be laid during the morning hours, so collection times should be adjusted accordingly.
- Floor eggs must be collected and handled separately. Percentage of floor eggs must be registered, so management factors can be changed accordingly.

Table 14: Egg grading for TETRA-SL LL layers

Age in weeks	XL % ≥73.1 g	L % 63.1-73.0 g	M % 53.1-63.0 g	S % ≤53.0 g
20	0.2	1.2	11.2	87.4
21	0.3	1.1	26.7	71.8
22	0.7	2.5	48.1	48.7
23	0.7	5.4	61.0	32.9
24	0.7	7.5	66.8	25.0
25	0.6	10.9	70.1	18.4
26	0.6	13.8	70.6	15.0
27	0.5	16.2	72.1	11.3
28	0.5	18.7	71.2	9.6
29	0.4	20.4	70.3	8.9
30	0.4	22.2	69.8	7.6
31	0.6	23.7	68.3	7.4
32	0.8	27.4	67.4	4.4
33	0.9	27.8	67.0	4.3
34	1.2	28.6	66.1	4.1
35	1.2	29.9	65.4	3.4
36	1.3	31.9	64.4	2.4
37	1.4	34.1	62.7	1.8
38	1.4	34.7	62.5	1.4
39	1.5	35.9	61.2	1.4
40	1.6	37.1	60.8	0.5
41	1.6	38.5	59.4	0.5
42	1.8	39.1	58.6	0.5
43	2.1	39.3	58.1	0.5
44	2.4	39.5	57.6	0.5
45	2.6	40.8	56.1	0.5
46	3.0	41.5	55.4	0.1
47	3.1	42.6	54.2	0.1
48	3.9	42.5	53.5	0.1
49	4.1	43.5	52.3	0.1
50	4.2	44.3	51.4	0.1
51	4.2	45.6	50.1	0.1
52	4.3	46.2	49.4	0.1
53	4.3	46.5	49.1	0.1
54	4.4	46.9	48.6	0.1
55	4.2	47.7	48.0	0.1
56	4.6	47.8	47.5	0.1
57	4.6	48.1	47.2	0.1
58	4.6	48.7	46.6	0.1
59	4.6	49.4	45.9	0.1
60	4.6	50.1	45.2	0.1
61	4.6	52.7	42.6	0.1
62	4.6	53.5	41.8	0.1
63	4.6	53.7	41.6	0.1
64	4.6	54.4	40.9	0.1
65	4.6	55.7	39.6	0.1
66	4.6	55.8	39.5	0.1
67	4.6	56.1	39.2	0.1
68	4.6	56.5	38.8	0.1
69	4.6	56.9	38.4	0.1
70	6.6	55.1	38.2	0.1
71	6.9	55.1	37.9	0.1
72	7.0	55.6	37.3	0.1
73	7.1	56.4	36.4	0.1
74	7.2	56.7	36.0	0.1
75	7.2	56.9	35.8	0.1
76	7.3	56.9	35.7	0.1
77	7.5	57.0	35.4	0.1
78	7.7	56.9	35.3	0.1
79	8.5	56.3	35.1	0.1
80	8.7	56.3	34.9	0.1
81	9.1	56.3	34.5	0.1
82	9.4	56.1	34.4	0.1
83	9.5	56.3	34.1	0.1
84	9.6	56.5	33.8	0.1
85	9.8	56.4	33.7	0.1
86	9.9	56.4	33.6	0.1
87	10.0	56.4	33.5	0.1
88	10.0	56.5	33.4	0.1
89	10.1	56.6	33.2	0.1
90	10.1	56.7	33.1	0.1

Table 15: Egg size distribution of TETRA-SL LL layers





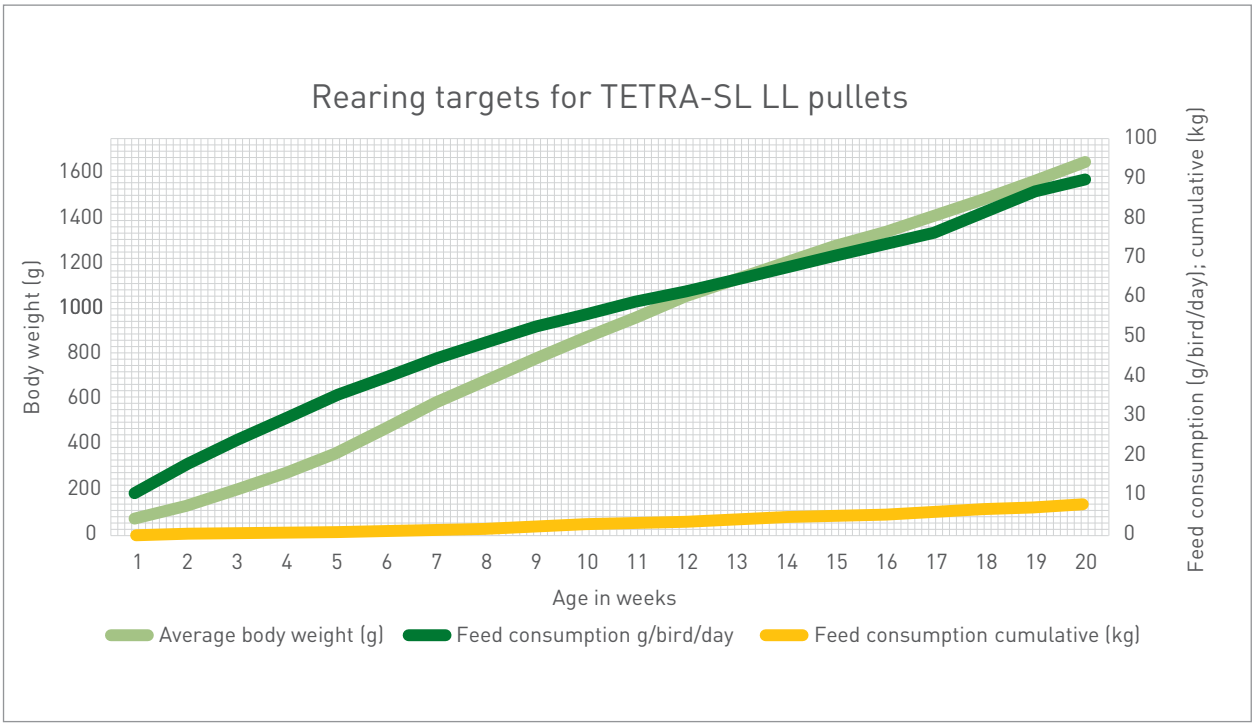
→ **Size S**
% Small eggs
(≤53.0 g)

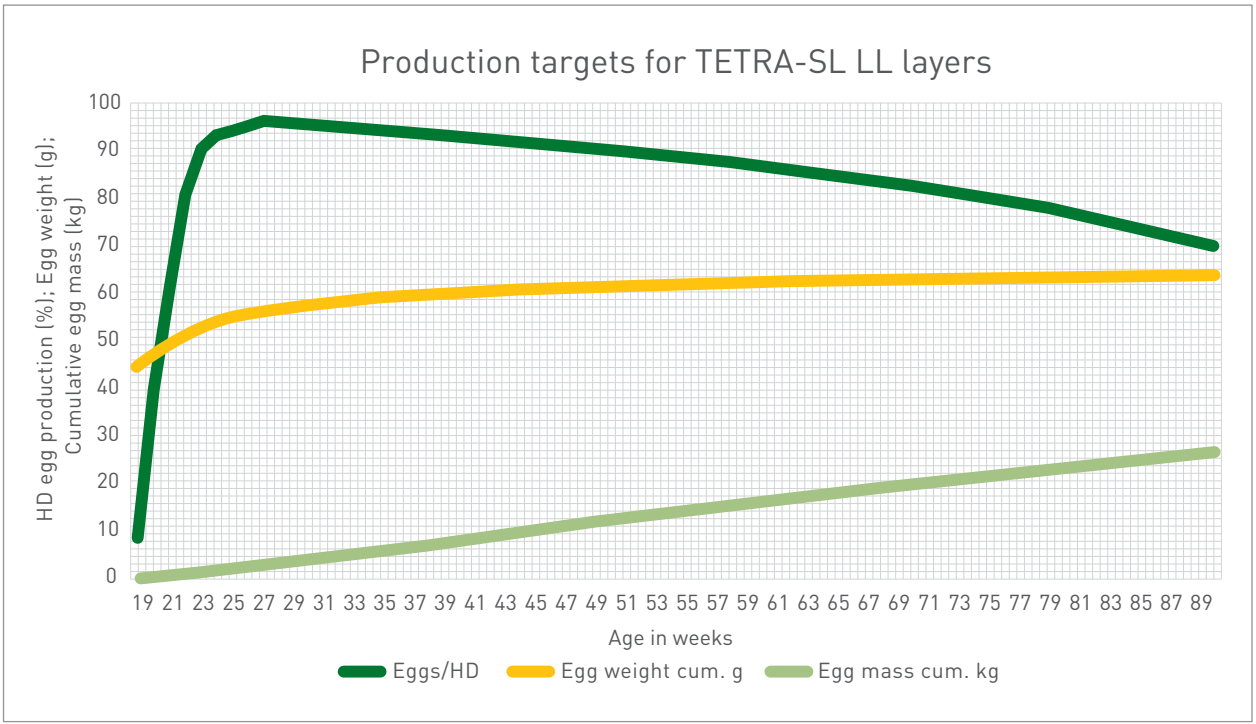
→ **Size M**
% Medium eggs
(53.1-63.0 g)

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

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

Charts


Rearing targets for TETRA-SL LL pullets
Body weight (g)
0
200
400
600
800
1000
1200
1400
1600
Feed consumption (g/bird/day); cumulative (kg)
0
10
20
30
40
50
60
70
80
90
100
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Age in weeks
Average body weight (g)
Feed consumption g/bird/day
Feed consumption cumulative (kg)


Production targets for TETRA-SL LL layers
HD egg production (%); Egg weight (g); Cumulative egg mass (kg)
0
10
20
30
40
50
60
70
80
90
100
19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89
Age in weeks
Eggs/HD
Egg weight cum. g
Egg mass cum. kg

NOTES

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TETRA-SL LL
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