VIGOSINE®: Management of Heat Stress in Broilers and Laying Hens

- What is Heat Stress?
- Prevention and Management of Heat Strokes
- Informative Poster on the Measures to be taken
- VIGOSINE®: Mode of Action and Results
Two broiler rearing buildings, with very different designs, in two countries highly exposed to heat strokes: Saudi Arabia (above) and the Philippines (below).
Prevention and management of heat stress in chickens and laying hens

Regardless of whether a heat stroke is acute or chronic, heat stress always results in a drop in technical performance: reduced laying rate or growth, and even mortality. The causes are a decrease in feed and water intake coupled with cardiac, hepatic and renal fatigue of the organism.

In order to limit the impact of hot periods in the long run, the most important measure consists in implementing preventive means at the level of the building itself.

Prior to any investment in specific equipment, a precise analysis of the feasibility and economic advantages of such investment should be carried out in relation to the local context. In the shorter term, prevention will also be implemented as regards animals and feed.

Despite these preventive measures, it is necessary, during a heat stroke, to implement additional means for lowering the temperature felt by the animals. These means become all the more important in tropical countries where high humidity makes it difficult to cool the air by water evaporation.

During a heat stroke, methodical management, involving farm management and use of dietary supplements, will be required. On this account, studying the physiological mechanisms used by poultry during heat stress provides us with valuable information.

Supplements in drinking water aim at maintaining sufficient water intake, make up for feed underintake, limit stress effects and support the liver and kidney functions.

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I. Notion of Heat Stress

I.1. Definitions:
Thermoregulation, Heat Stroke, Chronic Heat Stress

The hen’s body temperature is 40.5°C-41.5°C. This temperature is the result of thermoregulation, i.e., opposite mechanisms of thermogenesis and thermolysis:

- Thermogenesis is the production of heat by the basal metabolism and physical activity.
- Thermolysis is the elimination of excess heat. It involves several mechanisms:
  • Convection (i.e., ambient air movements), which accounts for the role of air velocity on animals;
  • Conduction (i.e., heat diffusion by contact). It occurs most particularly via the unfeathered parts of the body—comb, wattles, legs—in contact with air, water, ground or any other support;
  • Radiation (i.e., emission of calories by warm bodies); hence the importance of the temperature of surrounding equipment;
  • Evaporation through respiration: it varies depending on room temperature, relative humidity and water intake;

Under neutral temperature conditions, heat loss mainly occurs by conduction, convection and radiation. The other mechanisms play a major role in case of heat stress.

The comfortable temperature range is the temperature interval where the physiological mechanisms for temperature regulation are not, or slightly, activated:
- In laying hens, it spans from 19°C to 24°C;
- In growing chickens, it is closely related to age (Figure 1).

Any deviation from this comfortable range causes stress, invariably resulting in decreased zootechnical performance:
- Below 19°C, the bird uses dietary energy to maintain its body temperature, resulting in a more or less marked decrease in feed conversion.
- Above 24°C, active thermolysis processes are activated. At 27°C and above, feed underintake occurs; therefore, the term “heat stroke” is commonly used at temperatures exceeding 27°C, as such stress causes a significant drop in zootechnical performance, and even mortality (Figure 2).

In laying hens, the effects of heat on performance are considered perceptible:
- from 24°C regarding growing layers at the beginning of the laying period (laying virtually stops above 26°C) and egg weight (which drops by 0.4% per °C between 23°C and 27°C, then 0.8% per additional °C);
- from 28°C regarding feed conversion;
- above 30°C regarding laying rate.

Beyond the definition of stress due to instant temperature, it is advisable to discriminate between two major types of heat stress:
- Heat stroke (acute heat stress, or thermal shock), which typically occurs in the summer in temperate countries. A “heat stroke” is an excessive and rapid rise in temperature (>30°C) leading to high mortality (= direct losses).
It usually lasts a few hours only, and occurs no more than a few days per year.

- **Chronic heat stress**, which is mainly encountered in hot countries. Temperatures are regularly above 27°C and for long periods of time. Resulting mortality is low, and even null, but performance decreases are substantial in the long run (= indirect losses).

### Influence of relative humidity:

The temperature felt by the bird is all the higher since relative humidity increases (Figure 3). Excessive humidity inside the building reduces the insulating value of feathers, contributes to litter deterioration and increases microbial and parasitic hazards.

**Fig. 3 - Combined effects of room temperature and relative humidity on felt temperature based on Nilipour, 1996**

<table>
<thead>
<tr>
<th>Relative humidity (%)</th>
<th>Felt temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>10</td>
</tr>
<tr>
<td>30%</td>
<td>20</td>
</tr>
<tr>
<td>50%</td>
<td>30</td>
</tr>
<tr>
<td>70%</td>
<td>40</td>
</tr>
<tr>
<td>90%</td>
<td>50</td>
</tr>
</tbody>
</table>

On the contrary, lower relative humidity increases the risks of dust-related respiratory disease.

### I.2. Heat Adaptation Mechanisms

When the temperature felt by the birds exceeds 25°C, physiological and behavioral reactions are induced to restore the balance.

Reduced thermogenesis is achieved through lower feed intake and less moving around. As regards thermolysis, a number of mechanisms are involved; as room temperature rises, the difference with the body temperature decreases; as a result, the traditional mechanisms (conduction, radiation) reach their limit. Consequently, respiratory evaporation takes over and the respiratory rate can rise from 30 to 170 movements per minute.

These phenomena will be addressed according to their order of manifestation in relation to temperature rise.

**Limiting moving around**

This is the initial way of adaptation. The heat produced by physical activity represents approximately 15% of the total heat produced. In order to avoid producing such extra heat associated to physical activity, birds restrain from moving around as much as possible and settle in cool and ventilated areas (perching).

Heat loss by conduction is closely linked to the temperature of the surface in contact with unfeathered body parts (legs in particular), as shown in Figure 4 by the difference between groups where perches are at 20°C or 34°C, when the groups exposed to an air at 35°C.

Note that restriction from moving around is one of the causes of feed underintake in hens reared in floor pens.
Vasodilatation of peripheral vessels

In order to increase heat losses, hens, like mammals, experience vasodilatation of peripheral vessels. However, this phenomenon remains rather poorly efficacious insofar as highly vascularized and unfeathered areas only represent a small part of the body surface. Selection of the strain may be of importance in peripheral vasodilatation efficacy.

Reduction of feed intake

The heat produced by feeding functions (ingestion, digestion) is estimated to be approximately 20% of the metabolizable energy in the amount of feed ingested.

One of the means for reducing the heat produced consists in reducing the amount of feed ingested (Figure 5).

First increase, and then decrease in water intake

In hot periods, birds have an increased water intake in order to compensate for the water losses occurring by evaporation. However, when temperature rises too high, and regulating mechanisms are insufficient, water underintake takes over, and worsens stress and its consequences, leading to dehydration and even death in extreme cases.

Hyperventilation (or panting, polypnea)

Raising their respiratory rate is for birds their main means for regulating temperature. In the absence of perspiration, hyperventilation makes it possible to offset the body hyperthermia by water evaporation through the lungs. The respiratory rate readily rises from 50 to 150 movements/minute.

Decrease in immune defenses

As in any stress reaction, heat stress induces an increase in the level of corticosterone, which can rise threefold in a few hours, and a relative decrease in the number of white cells compared to other cells involved in immunity (Figure 6).

In addition, mucous membranes become dry, thereby facilitating the entry of infective agents into the respiratory tract. Such decreased immune defenses, added to the overall body fatigue and the degradation of air quality, contributes to a higher susceptibility to infectious disease during hot periods.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Thermoneutrality 24 °C</th>
<th>Heat stress 35 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.24</td>
<td>7.30</td>
</tr>
<tr>
<td>pCO2 / pO2 (mmHg)</td>
<td>58.8 / 108.4</td>
<td>50.7 / 144.5</td>
</tr>
<tr>
<td>Corticosterone (ng/ml)</td>
<td>1.23</td>
<td>2.50</td>
</tr>
<tr>
<td>Heterophile:Lymphocyte ratio (%)</td>
<td>20%</td>
<td>50%</td>
</tr>
</tbody>
</table>
I.3. Adverse Effects of Regulation Mechanisms

- **Dehydration**
  Dehydration is due to prostration of birds, which cease to drink, and hyperventilation, which increases respiratory water losses.

- **Alkalosis, cardiac fatigue (and mortality)**
  Because of hyperventilation, an acid-base imbalance (alkalosis) develops and disrupts the activity of excitable heart and nerve cells.
  This alkalosis also causes a decrease in potassium renal excretion which builds up in the blood and, at high concentrations, becomes toxic to cardiac activity.
  During a heat stroke, these phenomena account for the death of animals, which occurs after a coma or directly by cardiac arrest, often occurring in best-conformed chickens.
  As mentioned above, in the event of heat stress, the best dietary energy supply is fat. Because laying hens are in a condition close to chronic fatty liver, they are particularly unsuited for an optimal utilization of dietary fat.
  Moreover, fatty liver results in decreased circulation in the portal vein, and subsequently, in a work overload indirectly imposed on the heart.

- **Liver fatigue**
  The liver function is of primary importance during heat stress. Indeed, it is crucial that feed intake should not be worsened by poor nutrient digestion.
  As mentioned above, in the event of heat stress, the best dietary energy supply is fat. Because laying hens are in a condition close to chronic fatty liver, they are particularly unsuited for an optimal utilization of dietary fat.
  Moreover, fatty liver results in decreased circulation in the portal vein, and subsequently, in a work overload indirectly imposed on the heart.

- **Kidney fatigue**
  Heat stress first results in water overintake. Despite a positive water balance, urination increases during a heat stroke.
  In order to fight against metabolic alkalosis and prevent hyperkaliemia, potassium excretion augments in the distal part.

![Fig. 7 - Adaptation to heat stress: positives and negative effects](image-url)
II. Preventive measures against heat stress

Preventive measures should be preferred as their stake is important for two reasons:
- These measures are usually more effective than corrective measures in reducing heat stress adverse consequences,
- Structural errors will have deleterious consequences in the long run and will be difficult to correct.

As these measures sometimes generate substantial additional costs, their level of priority depends on the context of the flock involved and the risk for heat stroke.

The measures described below are listed in order of importance and also by nature: first, basic structural adjustments, and then modifications that can be implemented readily, according to requirements.

II.1. Building

* Site of settlement

In a hot country, choosing a piece of land protected as much as possible from high temperatures – if such choice is possible – is of primary importance.

The parameters to be taken into account are:
- **The orientation in relation to the dominant winds**: the building will be laid out so as to use ventilation possibilities as much as possible, favoring air velocities in static-ventilation buildings. Caution should be paid to too-close plant cover and, in some countries, risks of sandstorms and hurricanes.
- **Altitude**: it provides coolness compared to sites located close to the sea level.
- **Land topography**: avoid basin-like areas and prefer better-ventilated ones.

* Roof covering, insulation

**Insulation** must be of good quality and applied to the roof and walls. Caution should also be paid to the radiation capacities of the **paints and coatings** chosen.

* Surroundings of the building

The **surroundings** of the buildings must be laid out according to the climate, but also to biosecurity requirements.

Accordingly, grassy ground will provide more coolness than bare ground. Asphalt-like coatings must also be banned in the immediate vicinity of buildings, but direct surroundings must be neat. In case of heat due to sunshine, shading of the building should be planned during hours of sunshine, while taking care not to hinder ventilation. The ideal solution is to have a hedge of high trees at a sufficient distance of the buildings.

II.2. Equipment

* Water system and types of drinkers

The water system must have a **sufficient rate of flow** to be able to adapt to water requirements, which will be overestimated by 50% approximately: for laying hens, the water need will be about 310 ml/hen vs. the theoretical need of 220 ml/hen.

The number and rate of flow of watering places must also be carefully considered as animals greatly restrict their moving around.

Checking and good maintenance of nipples must be carried out, particularly if water is likely to obstruct them (hard water or water rich in iron).

For layers in cages, nipples are suitable, provided that there is one nipple for 5 to 6 hens, and such that hens of the same cage can have access to two nipples.

Finally, the water system will be designed so that **warming of water is limited**:
- Avoid exposition of the water tank to sunshine, avoid high roof-boarding, such as piping; be careful of external piping...
exposed to sunshine: burying water pipes more than 80 cm deep may be a solution.

- Though allowing water to return to the tank should usually be banned, this may be the only way to cool the water flowing in the high pipes of the building, obviously provided that the tank itself is maintained at an acceptable temperature.

Specific equipment designed to fight against high heat

There are three major categories of equipment showing acknowledged efficacy when wisely used in suitable weather conditions:

- **Equipment promoting air velocities**: most often fans located outside the buildings. By creating an air movement inside the building, they lower the temperature felt by the animals, the objective being to reach an air velocity of 1.5 meters/second at the level of the (feathered) animals while avoiding any unventilated areas: the temperature felt falls by 1°C for each increase by 0.20 meter/second of the air velocity (Figure 8).

![Fig. 8 - Effect of air velocity on the temperature felt by the chickens](image)

This low-cost system, however, reaches its limits above a certain temperature (32°C approximately). The difficulty to obtain homogeneous air velocities over the whole living area of the birds should also be noted. Finally, such equipment is not simple to use on layers in batteries, which make up a major check to air circulation. Horizontal fans are only efficacious on the upper tier of batteries. Vertical fans must be installed in the corridors between the batteries, and caution must be paid that their functioning does not disrupt air renewal. A test using smoke candles must be carried out in order to see air movements with precision.

For laying hens in static-ventilation buildings, Californian batteries are preferable for enhanced ventilation of each of the cage rows.

- **Equipment promoting air renewal**: air exhausters placed either at the ends, on the sides, or on the roof ridge, as required. They ensure air renewal by creating a low pressure inside the building; they may also produce air velocity over the animals if their arrangement in relation to air inlets has been designed to this end.

- **Equipment promoting air temperature decrease by water evaporation**:
  - **Spray lines**: The investment required is low, but their efficacy is limited; under optimal conditions of use, the temperature decrease obtained is about 3 to 5°C.
  - **Mist lines**: Investment is higher, but efficacy is much better; under favorable weather conditions (low outside relative humidity), temperature drops by 5 to 10°C.
  - **Pad cooling systems**: They are placed in front of air inlets and thus directly cool the incoming air. Their efficacy is remarkable in dry and humid areas; however, they require buildings to be airtight and equipped with powerful exhaust fans in order to compensate for the resistance opposed to the air passing through wet pads. In hot and dry areas (30% relative humidity), temperature may be lowered by more than 15°C.

It will be remembered that:

- **Regarding static-ventilation buildings**, selecting the right location and air inlet/outlet will be crucial. In tropical countries, associating shade with large openings and air fanning is often the only effective preventive method as evaporative cooling systems are inoperative.

- **Regarding dynamic-ventilation buildings**, the type of specific equipment will be considered in relation to technical efficacy and cost, while taking into account the real skills in using it.

![Room temperature (°C)](image)

<table>
<thead>
<tr>
<th>Action on air velocity and/or renewal</th>
<th>24</th>
<th>26</th>
<th>28</th>
<th>30</th>
<th>32</th>
<th>34</th>
<th>36</th>
<th>38+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-pressure spraying</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>High-pressure spraying or Pad Cooling (*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Relative humidity &lt; 85%</td>
</tr>
</tbody>
</table>

(*) subject to sufficient air velocity and renewal, particularly in case of high relative humidity.
II.3. Action on Animals

- **Bird density**
  Depending on whether the building is at risk or not, it is advised to reduce bird density.
  - For broilers: standard density is 17 birds maximum per m², and 30 kg maximum biomass per m² for a static-ventilation building, or 35 kg maximum for a dynamic-ventilation building.
  - For layers: in hot areas, a density higher than 400 cm² per hen is typically anti-economic: under this figure, density exacerbates heat-related stress (increase in the body temperature produced) and limits access to feeders and drinkers. The density typically adopted is approximately 500 cm² per hen, which generally represents an acceptable compromise between the expected benefit from a higher number of eggs and the sanitary and zootechnical consequences of an excessive density. Finally, it should be noted that in a number of countries, density is dictated by regulatory considerations.

- **Bird preparation**
  It is of interest to accustom young birds to high temperatures and the noise made when starting extra ventilation systems and foggers. It has been demonstrated that exposing 5-day-old chicks to a temperature close to 36°C for 24 hrs reduces mortality following a heat stroke at the end of the rearing period.

II.4. Action on Feed

The following provisions mainly apply to laying hens.

- **Feed presentation**
  Feed presentation may be changed in order to increase the amount of feed ingested during hot periods and is therefore less structural than the first measures; however, layers must be granted a period of adaptation to the new presentation (approximately 3 days).
  The "crumb" presentation is often recommended; however, it is criticized for its high economic cost, the formation of dust and its questionable efficacy, as the amount of feed ingested is self-managed according to the energy supply.

Currently, the use of “coarse” crumbs with a low percentage of fine particles (less than 20% fine particles under 0.5 mm in size, 80% between 0.5 and 3.2 mm) is considered the optimal solution on a technical and economic basis.

- **Feed formulation**
  Adapting dietary energy and protein concentrations to the real amount of feed ingested by the hens sounds an attractive concept, although difficult to manage in practice. Proteins have a thermogenic effect twice as high as that of lipids, so that a protein-rich diet results in a high heat production, i.e. the opposite of the objective sought.
  It should be remembered in particular that during hot periods, it is fundamental to have a very strict approach of the needs in essential amino acids (including lysine and methionine) and to use highly digestible raw materials so that feed underintake is not worsened by low digestibility.

II.5. Feasibility of Preventive Measures against Heat Strokes

The measures mentioned above should be assessed in relation to feasibility and farm context. It is frequent to observe failures related to inappropriate technical solutions (e.g., fogger in a humid tropical area), adjustments and/or maintenance actually not carried out (maintenance of electronic systems / calibration of sensors).

- **Technical feasibility**
  The use of complex ventilation systems involving high electricity supplies and electronic control systems will be banned in countries where the maintenance of such type of equipment cannot be provided.

- **Climatic feasibility**
  Obviously, any cooling system based on water evaporation should be avoided in tropical areas, where relative humidity is often above 80%.

- **Economic profitability**
  Finally, the initial investment and operating costs of specific equipment should be considered in relation to the expected return on investment.
From 27°C and above, in the absence of specific equipment, and above 35°C and 80% relative humidity, it is of the utmost importance to implement corrective measures, both in situations of chronic heat stress and, a fortiori, heat strokes.

III.1. Limiting Stress

Any additional stress must be prevented; therefore, it is advised not to bother the birds during a hot period. Vaccinations, handling, transfers, pickups or any other interventions should be banned. Only cautious incitement to move toward drinkers may be recommended.

III.2. Cooling the Temperature felt by the Animals

The ventilation, mist or pad cooling systems previously described are activated.

A few precautions:

- **Ventilation**: it is strongly discouraged to widely open the dynamic-ventilation building as this would reduce air velocity at the level of the birds.
- **Mist spraying**: in the western countries, mist spraying is recommended from 28°C and above for chickens, 30°C for turkeys (adult, already feathered animals); on the contrary, mist spraying should not be used if relative humidity exceeds 70% (stormy weather) as litters would otherwise be highly degraded and, subsequently, rearing conditions, too.

If the building is not sufficiently insulated, sprinkling of the roof, walls and surroundings with fresh water may be of help.

III.3. Adapting Diet and Drinking Water Supplies

- **Diet**: Physical exercise and digestion associated to the diet result in thermogenesis. In order to limit the heat thus produced, it is recommended to interrupt feeding at least 6 hours prior to the temperature peak (Figure 12) or when room temperature exceeds 28-30°C: in practice, birds should be deprived of feed from 8:00 a.m. to 8:00 p.m.

In a dark building with lighting programs, turn on the light and feed the birds from 3:00 to 7:00 a.m. (coolest period of the day).

- **Drinking water**: At least 1 drinker should be available for 100 chickens. The daily intake may increase threefold and the water: feed intake ratio may reach 8 at 37°C instead of 1.8 between 18°C and 20°C.
**Water temperature** must also be checked; ideally, it should range between 15°C and 18°C (Figure 13), which promotes consumption and contributes to eliminate excess calories.

If, despite the precautions taken during the construction of the building, water temperature cannot be maintained at or lowered to ± 18°C in hot periods, remember to empty the tank (as it may turn out to be a reservoir of tepid water) and flush water-supplying pipes in the building. Ice cubes may be added into the tank after emptying in order to cool water.

Care should be taken to maintain a good bacteriological quality of water; return of drinking water from the building to the tank must not be allowed.

**III.4. Correcting Physiological Imbalances**

- **Rehydrating**
The use of combinations of mineral salts, which are effective in theory and in the laboratory, often proves ineffective, and even dangerous on the field due to risks of excessive dosage and lethal side effects.
The same objective may be achieved, without any risks, by using dietary formulations containing mild diuretics, which stimulate water intake while supporting the kidney function.

- **Compensating for feed underintake**
Prostration and thermoregulation mechanisms lead to a substantial feed underintake. In order to remedy these decreases in performance due to such rationing, correcting measures may be considered, which should be used exclusively outside hot periods (at nighttime):
  - directly, by supplying drinkable essential amino acids (methionine, lysine), or
  - indirectly, by giving hepatic protectors that will stimulate feed consumption while enhancing digestive metabolism.

- **Fighting against stress consequences**
A vitamin supply is recommended to fight against the cellular stress resulting from hyperthermia. Vitamin C (0.3 to 1 g/liter) and vitamin E (500 mg/kg) should be retained in particular.
Aspirin, administered for 1 to 3 days at 0.3 g/liter, may also be prescribed for its anti-inflammatory effects.

- **Supporting liver and kidney functions**
Weakening of the liver, which is clear in layers and fast-growing chickens, makes it essential to enhance liver functions, particularly in chronic stress situations.
Besides, supporting the kidney function will promote elimination of stress metabolites and excess potassium.
Preferred dietary supplements are sorbitol, methionine or betaine-based formulations associated with mild diuretics.
Controlling Heat Strokes

What must be checked before hot periods?

- Ventilators and air-cooling devices proportionate to the risk
- In good working condition
- With a stock of spare parts
- Isolation
- Clean roof, bright in color
- Clear air inlets and outlets
- Compliance of electrical installation
- Reliability of control equipment and alarm
- Surroundings: short and dense grass coverage
- Feed adapted in formulation and presentation
- Sufficient number of watering places
- Adequate water flow
- Good-quality water
- Reduced density
- Division into compartments
- Birds acclimatized to heat and accustomed to ventilation
- Maintaining light intensity (broilers) or increase it early in the morning (layers)
- Objective: 17-20°C and air velocity of 0.3 m/s
- Stop the cooling process
- Adjust ventilation
- Distribute feed
- Remove dead birds

... And: training, information

What must be done during hot periods?

**MORNING**
- Fasting
- Check water flow
- Increase ventilation
- Start the cooling process
- Keep the litter dry
- Maintain light intensity (broilers) or increase it early in the morning (layers)
- Objective: 17-20°C and air velocity of 0.3 m/s

**AFTERNOON**
- Check water freshness
- Check the good functioning of equipment
- Turn down light intensity

**NIGHT**
- Stop the cooling process
- Adjust ventilation
- Distribute feed
- Remove dead birds

**EVENING**
- Caution: Risk of excess mortality!
- Do not:
  - Excessively water the inside of the building
  - Spray when relative humidity is > 60%
  - Open the doors in dynamic ventilation
  - Disturb birds during heat peak
  - Distribute poorly palatable feed
  - Redirect water from the building into the water tank
  - Disconnect the alarm
- **The right approach:**
  - Pay attention to animals
  - React to their behavior
  - Inciting them to drink

Contact your correspondent CEVA Santé Animale
Applications of VIGOSINE® in heat stress management

A heat stroke is a particular situation where the body is both in need of low energy and in a condition of stress with lipolysis. During a heat stroke, VIGOSINE® effectively fights against heat stroke consequences, in complement to ambient air cooling techniques: when given early in the morning to fasting animals, VIGOSINE® stimulates water intake and contributes to eliminate metabolic waste products, including excess free fatty acids, thereby protecting the hepatic and cardiac functions.

At the end of the day, when feed is distributed again, VIGOSINE® stimulates the birds to resume feeding and facilitates, hence promoting a return to adequate performance.

In chronic heat stress, VIGOSINE® distribution should be adapted according to the situation: distribution should be repeated on a regular basis, from once in a week for broilers to once every two weeks for layers.

I. Action and VIGOSINE® utilization program
   I.1. Stimulation of Water and Feed Intake
   I.2. Reduction in Cardiac, Hepatic and Renal Overload
   I.3. Practical Use of VIGOSINE® during Hot Periods

II. VIGOSINE® trial results
   II.1. Results of VIGOSINE® in Layers (Chronic Heat Stress)
   II.2. Results of VIGOSINE® in Broilers (Heat Stroke)
   II.3. Results of VIGOSINE® on Cardiac Mortality
I. Action and VIGOSINE® utilization program

I.1. Stimulation of Water and Feed Intake

In order to fight against dehydration due to prostration and allow kidneys to perform their ion regulating function, it is absolutely necessary to maintain water intake at a high level.

When used in periods of non-thermal shock, VIGOSINE® makes it possible to maintain feed intake at an adequate level and to stimulate water intake; therefore, dehydration adverse effects are delayed.

The protocol for use must take into account the fact feed underintake is one of the necessary adaptations to heat. Therefore, feed intake will be stimulated outside intense heat stress hours through VIGOSINE® supplies during the coolest hours of the day.

I.2. Reduction of Cardiac, Hepatic and Renal Overload

One of the deleterious consequences of heat strokes is related to the adverse physiological effects of the hormones excreted during any stress episode and leading to an excess production of free fatty acids by lipolysis.

Besides, heat strokes increase the risk for cardiac mortality, which occurs even under moderate heat conditions in the best-conformed chickens, more rarely in layers in the thick of the production period. These animals show liver and kidney hypertrophy and discoloration, as well as abdominal overfat.

Using VIGOSINE® before any heat stroke occurs raises the heat stress resistance limit of the animals as VIGOSINE® helps eliminating excess fatty acids.

When used on a regular basis, particularly in laying hens, VIGOSINE® facilitates hepatic metabolism and hence limits the risk for fatty liver.

In addition, salts and plant extracts have a detoxifying function that promotes elimination of metabolic waste products.

I.3. Practical Use of VIGOSINE® during Hot Periods

- **Prevention of heat strokes or chronic heat**
  VIGOSINE® is to be used regularly over short periods of time, particularly during difficult periods as far as feeding is concerned (starter period, transitions, finisher period). Such use makes it possible to limit hepatic overloads, which weaken the animals during heat stress.

<table>
<thead>
<tr>
<th>Objectives</th>
<th>VIGOSINE®</th>
</tr>
</thead>
<tbody>
<tr>
<td>- To support filtering organs</td>
<td>Broilers: 2 ml/liter: during feed transition (2 d), then 1 day/week until the end of the rearing period.</td>
</tr>
<tr>
<td>- To limit the risk for fatty liver</td>
<td>Layers: 2 ml/liter for 2 d every 2 to 3 weeks.</td>
</tr>
<tr>
<td>- To limit the risk for cardiac mortality</td>
<td></td>
</tr>
</tbody>
</table>

- **During a hot day**

VIGOSINE® must be given in the earliest hours of the heat stroke day so that chickens and hens have drunk enough when heat reaches its peak. Indeed, during hot hours, it is too late to take action: the most affected birds are already prostrated and no longer move to watering places.

<table>
<thead>
<tr>
<th>Objectives</th>
<th>VIGOSINE®</th>
</tr>
</thead>
<tbody>
<tr>
<td>- To hydrate birds in the morning</td>
<td>In the morning: 2-4 ml/liter for 4 to 6 hours</td>
</tr>
<tr>
<td>- To eliminate metabolic waste products</td>
<td></td>
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<tr>
<td>- To stimulate the birds to resume feeding</td>
<td>In the evening: 1-2 ml/liter for 8 to 10 hours</td>
</tr>
<tr>
<td>- To regulate digestion</td>
<td></td>
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II. VIGOSINE®
trial results

II.1. Results of VIGOSINE® in Layers (Chronic Heat Stress)

- **Protocol**
  VIGOSINE® was assessed on a flock of 42,000 46-week-old Leghorn Hy-Line layers housed in compact batteries on conveyor belts. VIGOSINE® was incorporated into drinking water at 1.5 ml/liter for 3 consecutive days. Two replicates were carried out: at 46 and 50 weeks of age. Outside temperature reached 39°C during this period, whereas it was below 32°C in the previous weeks.

- **Results**
  Feed intake and egg weight were increased in both trial periods:
  - Feed intake increased by 8% in the first replicate, and 4% in the second; water intake increased in similar proportions.
  - Egg weight was increased by 4.5% in both replicates.

  **Conclusion**
  This trial demonstrates that a moderate use of VIGOSINE® (3 days at 1.5 ml/liter) enables the layers under heat stress to better withstand such stress and better recover. As a consequence, there is more regularity in zootechnical performance on the long run.

II.2. Results of VIGOSINE® in Broilers (Heat Stroke)

- **Protocol**
  The trial was conducted in an experimental farm on 36- to 41-day-old male and female chickens. Density was 20.5 animals/m² and lighting was continuous. For each age, 2 distinct groups of 2,350 broilers were available:
  - One received VIGOSINE® at 2.5 ml/liter drinking water (from 9:00 a.m. and for 24 hours), and then 2 ml/liter within the next 12 hours;
  - The other did not receive any supplementation.

  In each room, temperature was raised on purpose in order to simulate a violent heat stroke with mortality:
  - Temperature: increase from 20°C to 32°C between 9:00 a.m. and 01:00 p.m., maintenance at 32°C until 05:00 p.m., and progressive lowering to 19°C at 09:00 p.m..
  - Low air velocities: 0.1 to 0.2 m/s
  - Relative humidity of 40% and 50%.

  The air quality (less than 20 ppm ammonia) was maintained by spreading superphosphate on the litter prior to each heat stress event.

- **Results**
  At 36 like 41 days, the groups receiving VIGOSINE® suffered significantly less mortality than control groups (Figure 3):
  -1.5% at 36 days and -2.3% at 41 days, without any noticeable influence of sex on results.
The groups receiving VIGOSINE® had a higher water and feed intake than the control group (Figure 4): the difference was +10 ml/animal and +4.5 g/animal, respectively; i.e. approximately +4% for each parameter, both at 36 and 41 days of age.

**Conclusion**

In such a context of violent heat stroke, VIGOSINE® enabled a reduction in mortality, better hydration of the birds and sooner resumption of feeding. It should be noted that the overall water intake decreased between 03:00 and 06:00 p.m. approximately, when all the birds are prostrated. This is why it is preferable to give VIGOSINE® early in the morning to limit mortality, and then at the end of the day to stimulate feed intake. Giving VIGOSINE® the day after the heat stress event seems to be useless.

II.3. Results of VIGOSINE® on Cardiac Mortality

**Protocol**

This trial assessed VIGOSINE® against a PLACEBO, each product being used in a static-ventilation building housing 26,400 broilers (initial density: 22 broilers/m²).

As soon as the daily percentage of cardiac mortality of 0.1% (verified by autopsy) of the population in either of the buildings was reached, the products were randomly assigned to the buildings and were given at the same time in each respective building for 7 days at 2 ml/liter drinking water.

Cardiac and overall mortality was then recorded each morning at a set time, as well as performance for each period (growth, feed conversion).

**Results**

Cardiac mortality reached 0.13% at 16 days in one of the buildings (B1), whereas it was 0.10% in the other (B2). Products were added to drinking water between 16 and 23 days of age. In both groups, cardiac mortality increased: +0.5% in the VIGOSINE® group (B1) versus +0.8% in the PLACEBO group (B2) (Figure 5).

While the VIGOSINE® group had a lower weight prior to supplementation (-5.5% at D16), it showed a significantly higher live body weight at the end of supplementation (+7.1% at D23), and this difference was still partly found at slaughter (+4.1% at D35) (Figure 6).

**Conclusion**

While the sudden death rate naturally increased over the 16-35-day period, VIGOSINE® made it possible to reduce these losses although the group was heavier than the control group at the end of the rearing period. These results show that VIGOSINE® reduces the risk for cardiac mortality while optimizing growth.

The effect on the MDG was observed during the period when VIGOSINE® was given; these results suggest that it is preferable to use VIGOSINE® over short periods of time (1 day at 1 ml/liter), on a frequent basis (once to twice a week), than to use it continuously.
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References
**Giving a fillip in critical times!**

**VIGOSINE®**

**CHICKEN - TURKEY - DUCK - RABBIT**

- Increases appetite and water intake.
- Optimizes feed efficiency.
- Supports hepatic and renal functions.

The supplementation ensuring the zootechnical performance of your flock during critical stages.

**VIGOSINE®** is a palatable and soluble dietary supplement, composed of natural substances compatible with all the components of the dietary ration. **COMPOSITION** Nutritional ingredients: sorbitol 250 ml, magnesium sulfate 250 ml, sodium chloride 50 ml, water and plant extracts q.s. for 1 l. **USE** Poultry, poultry Sanders for force-feeding. **WARNING** VIGOSINE® can be used at all critical stages during growth or production. It increases appetite and water intake of animals. It can also be used during the force-feeding period for optimizing feed efficiency. **INSTRUCTIONS FOR USE** Poultry: maintenance: 1 ml/liter of water for 3 to 5 days. Intensifier: 2 ml/liter of water for 5 days. Poultry Sanders: force-feeding: intensifier: 4 ml/animal/day for the first 10 days. **PACKAGING** 1 liter (jg. MA # 661207-4, 5 liters jg. MA # 661209-7.

**VIGOSINE® answers**

1. **INCREASED ENERGY REQUIREMENTS**
   - Early growth,
   - Dietary transitions,
   - Beginning of laying,
   - Difficult periods,
   - Rearing incidents, etc.

2. **FAT OVERLOADING**
   - Fat infiltrations,
   - Cardiac mortality,
   - Finisher phase for broilers,
   - Beginning and end of laying,
   - Preparation for force-feeding, etc.

3. **HEAT STROKES**
   - **Recommended protocol in the event of heat strokes:**
     - **MORNING** (Before hot hours): 2 to 4 ml VIGOSINE per liter of water for 4 to 6 hours.
     - **EVENING** (After hot hours): 1 to 2 ml VIGOSINE per liter of water for 6 to 8 hours.

4. **SHOCKS, AGRESSIONS**
   - Vaccinations, Uncrowding, Beak trimming, Confinement, Handling, Noise, Heat, etc.

**CEVA Sante Animale**