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**"Heat Stress in
Gamebirds"**



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Heat Stress in Gamebirds

PRACTICAL MITIGATION STRATEGIES OF A GROWING CHALLENGE USING AN INNOVATIVE BOTANICAL-BASED ADDITIVE

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The gamebird industry, specifically quail production, is increasingly challenged by environmental stressors, among which heat stress is one of the most critical. Rising global temperatures and prolonged heatwaves are making thermal stress a central concern for both productivity and animal well-being.



Birds, like quail and other gamebirds, are particularly sensitive due to their limited physiological capacity to cope with environmental fluctuations, which results in rapid redistribution of energy away from growth, reproduction and immune function during stress events.

The consequences could result in substantial financial losses: reduced growth, compromised immunity and even increased mortality under meat bird production systems. There may also be impaired fertility, egg production and poor egg quality for laying and breeding birds.

CAN BOTANICAL ADDITIVES REDUCE HEAT STRESS EFFECTS?

Beyond management and nutrition, innovative solutions have emerged to directly target stress at its origin: the animal's physiological response. For instance, specific monoterpenes extracted from plant extract as well as Citrus spp. or Lavandula officinalis have well document-

ed effects on the central nervous system to reduce stress perception, promoting calmer behavior and improved adaptation to environmental challenges.

These neurosensorial molecules target behavioral and neurological pathways (Val-Laillet et al., 2015), helping animals to better cope with stressors such as heat, transport and high density. Monoterpene-based active compounds have been demonstrated to reduce birds' corticosterone (blood stress marker), enhance their capacity to explore and use their rearing environment (Makinde et al., 2023) and improve pigs' social behavior (Tillotson et al., 2025).

Regarding gamebirds, experimental evidence reported on three quail strains – characterized by graded level of social motivation – lower fear response and improved social interaction, indicating reduced stress levels when exposed to cold-pressed sweet orange essential oil fractions (November/December 2020, NAGA News, pages 12-14).

Regarding heat stress challenges and the specific characteristics of gamebird production, validation of the monoterpene stress-mitigation capacity was investigated through two recent experiments.

EXPERIMENT #1 (UNIVERSITY TRIAL, MUSTAFA ET AL., 2017):

The objective of this trial was to evaluate the effect of several botanical-based feed additives in

Traits / Treatments		CTL	CEO	SEM	P value
35 day old	Body weight (BW), g	197	205	2.67	NS
	BW gain, g	189	197	1.5	NS
	Feed quantity, g/chick	590	534	3.7	NS
	FCR	3.1 ^a	2.7 ^b	0.19	P ≤ 0.05
	Mortality %	2.5	0.0	0.0	NS
	Profitability, 100 index	100 ^a	115.4 ^b	4.6	P ≤ 0.05
70 day old	Egg production, HD%	77.8 ^a	83.8 ^b	1.36	P ≤ 0.05
	Feed quantity, g/chick	2057.5 ^b	1987.8 ^a	25.3	P ≤ 0.05
	FCR	2.4 ^b	2.0 ^a	0.025	P ≤ 0.05
	Profitability, 100 index	100 ^a	154.8 ^b	6.3	P ≤ 0.05

TABLE 1. EFFECT OF A FUNCTIONAL FEED ADDITIVE ON PERFORMANCE AND ECONOMIC PROFIT OF JAPANESE QUAIL AT 35 AND 70 DAYS OF AGE, REARED UNDER ~ 93°F

Trait / Treatments	CTL	CEO	SEM	P value
Egg weight, g	10.9 ^a	11.8 ^b	0.6	P ≤ 0.05
Egg shell (ES) thickness, µm	224 ^a	274 ^b	31	P ≤ 0.05
ES strength, g/cm ²	607 ^a	699 ^b	22	P ≤ 0.05
Fertile egg, %	83.4 ^a	90.5 ^b	1.8	P ≤ 0.05
Fertile egg hatchability, %	74.2 ^a	84.4 ^b	1.1	P ≤ 0.05
Hatched chicks weight, g	8.0 ^a	8.9 ^b	0.06	P ≤ 0.05

TABLE 2. EFFECT OF A FUNCTIONAL FEED ADDITIVE ON EGGS QUALITY PARAMETERS AND HATCHING PERFORMANCE FROM 70-DAY OLD QUAIL, REARED UNDER ~ 93°F



rearing and laying quail under a long-term heat stress challenge.

A total of 288-day old unsexed Japanese quail were reared in cages for 10 weeks. Chicks were randomly distributed into six botanical-based treatments, each treatment with three replicates: 48 chicks (36 females and 12 males) per each replicate. During the 70 days of trial, the daily temperature in the quail house averaged $33 \pm 2^\circ\text{C}$ (-93°F). Key growth indicators as well as laying performance and egg parameters were monitored. A total of 1,200 fertile eggs (i.e. 200 eggs for each treatment) were collected, incubated and hatched during 17 days. Egg weight and eggshell characteristic were recorded. At the end of hatching process, live and dead chicks were counted and the percentage of fertility, hatching of fertile eggs calculated. For evaluating impacts of heat stress on breeding quail offsprings, antibody titers of Newcastle Disease (HI), Infectious Bursa Disease (IBD) and Infectious Bronchitis Viral (IBV) were measured on just-hatched chicks from heat-stress challenged breeder Japanese quail. Only the comparison between the control group (CTL) and the treatment receiving a Citrus spp. essential oil-based feed additive (CEO: 250 g/MT) will be shown and discussed (Tables 1, 2 and Figure 1).

At five weeks of age, growth performance (BW gain) and feed used did change numerically (NS) between CTL to CEO treatments. However, when considering mortality and feed efficiency, the economic profit improved significantly by +15% in favor of the quail receiving the feed additive with neuro-sensorial properties (Table 1).

At 10 weeks of age, hen housed egg production percentage and feed efficiency as well as economic profit were significantly ($p < 0.05$) improved for the supplemented group compared to Control group (Table 1).

Egg weight, eggshell speci-

cations (thickness and strength) as well as egg fertility and hatchability performance were improved from the Japanese quail group receiving the QFSM-based additive (Table 2).

Hatched chick weight (Table 2) as well as their ELISA immune titers were higher from breeding quail receiving the botanical-based feed additive compared to control breeders.

EXPERIMENT #2 (FIELD TRIAL, COTTEE ET AL., 2026):

Just-hatched chicks are more sensitive to all stress factors and encouraging sufficient water intake during the first day's post-hatch is critical for chick growth, health and overall flock performance. This study evaluated whether a short-term water administration of a monoterpene liquid blend could stimulate drinking behavior and support a strong start in commercial broiler flocks. This sensory blend was applied at 200 ml/1000 L of drinking water for the first seven days post-hatch. Three consecutive flocks (Ross 708, mixed sex) each raised in the same barn received the treatment (average $N = 23,315$ birds/flock; Sept 2024 - Feb 2025), and data were compared with three previous consecutive untreated control flocks (average $N = 25,245$ birds/flock; Mar - Aug 2024).

The Monoterpene liquid blend supplementation immediately increased water consumption. From Day (D) 1 to 7, WI was 17% higher ($P < 0.05$) compared to control birds. Treated flocks exhibited 23% higher D7 weights ($p < 0.05$) (Figure 2).

Heat stress is no longer an occasional challenge, but a systemic threat to poultry production, especially in gamebirds and quail that may be reared in open aviaries. Its impact spans performance, reproduction, immunity, innate behaviour (feed and water intakes) and welfare.

However, it is a mistake to consider heat stress as unavoidable and untreatable. As shown

FIGURE 1. EFFECT OF A FUNCTIONAL FEED ADDITIVE ON IMMUNE TITERS FROM JUST HATCHED QUAIL CHICKS FROM 70-DAY OLD BREEDING QUAIL, REARED UNDER -93°F

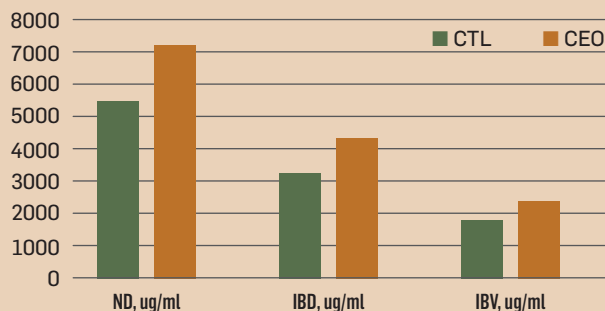
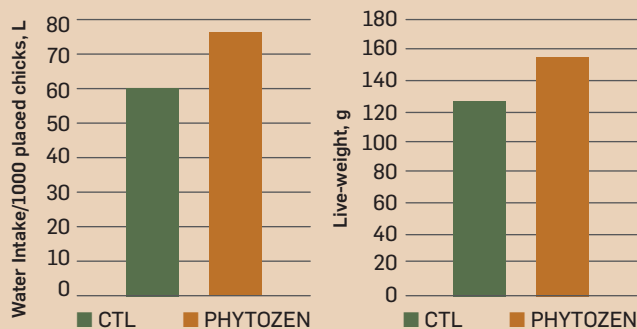


FIGURE 2. EFFECT OF A MONOTERPENES LIQUID BLEND ON WATER INTAKE (A) AND LIVE-WEIGHT (B) ON 7-D BROILER CHICKS



by experimental data, targeted interventions can significantly improve outcomes.

Current monoterpenes blend-based additives (liquid or powder) represent a novel and effective approach by:

- Reducing stress perception.
- Improving behavior and welfare.
- Enhancing productivity and economic returns.

When combined with good management practices, it offers a comprehensive strategy to mitigate the effects of heat stress in gamebirds.

As environmental conditions continue to evolve, adopting such integrated solutions will be essential to ensuring the sustainability and profitability of gamebird production systems. 🐦

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