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Effect of Date Syrup "Dibs" on Some Performance, Behavioural Indicators in Broiler Chickens Raised under Saudi Arabia Conditions

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Abstract—Several research studies and extensive reviews have been published during the previous 50 yr on the physiological consequence of thermal stress. During this time, a great deal of data has clarified how normal physiologic processes in the body are altered by stress and how these processes influence other life strategies such as reproduction, immune function, and growth. Nevertheless, much still requires determining how to distinguish between stress, regular physiologic alterations from homeostasis, distress, physiologic, and behavioural changes that may prove adverse effects to animals. We hypothesise that supplementation of Date syrup in drinking water is a novel alternative for preventing oxidative stress and stress-induced adverse effects on chickens exposed to heat stress. A total of 120 one-day-old chicks of mixed sex (Ross 308) were weighed and randomly assigned to each of the four watering treatment groups. The water treatment had added date syrup (Debis) in the following concentrations 0, 1, 4, and 8%/L of drinking water in control (0%) and treated groups (1, 4, and 8%/L), respectively. Bodyweight, feed intake, rectal temperature and live observations were measured. The number of birds in each cage performed drinking, feeding, standing, sitting, running, peering, and wing spreading. Our investigation showed that Debis improved chicken performance, and body weight significantly increased from week 4. Feed intake data did not show any significant differences. Lowered rectal temperature measurements were observed when Debis was added with 4% in drinking water starting from the fourth week. Data obtained from chicken behaviour did not show any significant differences between chickens that offered either Debis with 1 and 8%/L in their feed intake visiting during the experiment period.
We can conclude by adding date syrup (Debis) with 1% of the drinking water during the first three weeks, then increasing adding level to be 4% after the third week to get heavier bodyweight.

Keywords: date syrup, Debis, broiler, physiology, behavior, heat stress

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1. INTRODUCTION

To meet the recent rapid development of the poultry industry to provide enough food and nutrition needs globally, the urgency to improve broiler chickens' performance within hot regions, especially in Saudi Arabia, is on the rise. Heat stress can trigger various physiological disturbances (immune dysregulation, endocrine, and electrolyte imbalance) in chickens, increasing their welfare problems and reducing productivity [1]. This is mainly due to their fast rearing period and high feed efficiency, growth rate, rapid metabolism, elevated body temperature and absence of sweat glands [2]. Heat stress cannot be eliminated by modifying management processes, especially in developing countries like Saudi Arabia. They are too costly, so new feeding strategies such as adding plant extracts, yeast, and beneficial bacteria have attracted scientific and commercial interests. In Saudi Arabia, there are more than 400 date palm types, of which only about 40 types with commercial use, covered in seven regions distinguished by the suitable environment for the maturity and fruiting of the date palm. Riyadh, Qassim, the Eastern Region, and Medina are the most popular product areas in the kingdom. The date palm is a vital source of nourishment for people in Arabic countries. This fruit, which has a high energy conception (72–88%) sugar at maturity, is used as food and a medicine [3]. Date syrups are the most crucial components of a healthy diet since they provide humans with a high energy source.

Declining sugars are quickly absorbed during digestion and can trigger a feeling of satiety. It was previously believed that dates were rich in nutrients such as potassium, vitamin K, and Se, which provides over 15% of the recommended daily portion [4]. Date syrups (Debis) are mainly water-soluble vitamins that can function as coenzymes in the body. Dibis contribute to the maturation and growth of cells and protect tissues

Table 1. The ingredient and calculated composition of basal starter and grower diets

Item		Starter	Grower
Ingredient (g/kg)	Corn	505.1	524.6
	Soybean meal	385.0	350.0
	Soybean oil	35.8	59.0
	Di-calcium phosphate	14.2	10.0
	$CaCO_3$	17.3	16.7
	NaCl	3.1	2.1
	$NaHCO_3$	2.0	1.6
	Trace Mineral Premix	2.5	2.5
	Vitamin Premix	2.5	2.5
	DL-Methionine	2.5	1.0
	L-Lysine	–	–
	Sand	30.0	30.0
Calculated	Metabolizable Energy (kcal/kg)	2900.0	3100.0
Composition	Crude Protein (g/kg)	215.0	200.0
	Calcium (g/kg)	10.0	9.0
	Lysine (g/kg)	11.8	10.9

from oxidative stress [5]. The date palm has also been displayed as valuable nourishment to ensure food security during crises and famine. The date has numerous financial and medicinal benefits and has constituent various medicines and flavourings [4]. Debis has valued carbohydrates, salts, minerals, dietary fibres, vitamins, fatty acids, amino acids, and protein, showing considerable nutritive importance [4]. Debis has multiple beneficial effects, including antioxidant, anticlastogenic, antidiabetic, hypolipidemic, anticarcinogenic, antibacterial, and antifungal actions [4, 6, 7].

Debis is made by picking the fruits, grinding them, boiling them in hot water for two hours, and then cooling and filtering the mixture. The additional procedure has to merge the fruits with ethanol, and the extract is taken out for 30 min at 80°C followed by filtration. Debis is an instant energy feed as it has no ingestible material with a good smell. The current study examined the possible protecting impact of date syrup (Debis) against entire heat stress effects in broiler chickens.

We hypothesise that supplementation Date syrup in drinking water is a novel alternative for preventing oxidative stress and stress-induced adverse effects on chickens exposed to heat stress. As far as we are aware, this is the first study of the impact of date syrup on broiler chicken exposed to heat stress environments.

2. MATERIALS AND METHODS

2.1. Animals and Dietary Treatments

A total of 120 one-day-old chicks of mixed sex (Ross 308) were weighed and randomly distributed into four treatment groups, each containing five replicate pens of 6 chicks. The dietary included the basal diet for all birds (control and treatment) groups. In contrast, the water treatment had added date syrup (Debis) in the following concentrations 0, 1, 4, and 8%/L of drinking water in control (0%) and treated groups (1, 4, and 8%/L), respectively. Temperature (Ta) and relative humidity (RH) were measured continuously throughout the experiment using a data logger (HOBO Pro Series, ONSET, USA). Through the entire testing period, the average ambient temperature was 32.5 ± 2.8°C, and the relative humidity was 20.5 ± 2.2% (Mean ± SE).

Table 1 records the basal diet composed according to the National Research Council (NRC, 1994). The birds were fed starter feed from 1 to 21 day and a finisher diet from 22 to 42 day.

Chicks were reared on floor cells (2 × 2 × 1 m) with wood shavings and ad libitum feed and water sources throughout the entire experimental period. The lighting schedule consisted of 23 h light and 1 h of darkness. All birds were vaccinated according to the vaccination schedule used in conventional farming under a typical rearing system.

2.2. Behavioural Observations

Live observations of birds' behaviour were carried out three times a daily from 0900 to 1000, 1300 to 1400, and 1700 to 1800 h throughout the room using instantaneous scan sampling at 15 min intervals per h. The number of birds in each pen acted as drinking, feeding, standing, sitting, running, peering, and wing spreading was observed. Birds were observed every day for their health state, and a veterinarian diagnosed any health disorders. Observer(s) were calculated the number of birds in each pen conducting each action (drinking; feeding; standing; sitting, panting, and wing spreading) every 15 minutes during observation hours.

2.3. Broiler Performance

2.3.1. Live body weight (LBW). Chicks were weighed per replicate every week throughout the experimental period, from day 1 to 42 days of age. All birds were considered to the nearest 0.1 g.

2.3.2. Feed intake (FI). Feed was provided ad libitum. Chicks were given a specific quantity of feed every week. The residuals were weighed at the end of the same week, and differences calculated the amount of feed ingested.

Table 2. Average body weight (gram/bird) when supplementary (0, 1, 4, and 8%) liquid date syrup (Debis) added to the drinking water per week*

Age/Week	Control	1% Debis/L	4% Debis/L	8% Debis/L
First	161.6 ± 11.3^{a}	$163.1 \pm 11.3^{a, c}$	$163.2 \pm 11.3^{a, c}$	$159.9 \pm 11.3^{a, c}$
Second	371.8 ± 11.3^{a}	$369.7 \pm 11.3^{b, c}$	$370.1 \pm 11.3^{a, c}$	$363.8 \pm 11.3^{a, c}$
Third	689.0 ± 11.3^{a}	$685.9 \pm 11.3^{a, c}$	$688.6 \pm 11.3^{a, c}$	$677.0 \pm 11.3^{a, c}$
Fourth	1123.3 ± 11.3^{b}	$1119.3 \pm 11.3^{b, c}$	$1013.5 \pm 11.3^{a, d}$	$1308.7 \pm 11.3^{a, c}$
Fifth	1521.1 ± 11.3^{a}	$1418.2 \pm 11.3^{b, d}$	$1577.6 \pm 11.3^{a, c}$	$1536.8 \pm 11.3^{a, c}$
Sixth	2088.8 ± 11.3^{b}	$2121.1 \pm 11.3^{b, c}$	$2172.5 \pm 11.3^{a, c}$	$2056.1 \pm 11.3^{b, d}$

* P-Values for treatment, week and treatment × week ($P \leq 0.001$).

[a, b] Significant values between treatments (control vs. treatment addition).

[c, d] Significant values within treatments (1, 4, and 8% Debis).

2.3.3. Mortality. The mortality rate was calculated every week as both the absolute number and a percent of the total number of birds in each group.

2.4. Statistical Analysis

Data from the randomised design were subject to an analysis of variance using the MIXED model procedure of SAS (2001). An ANOVA with repeated measures was used. The Tukey-Kramer test separated the mean differences among different treatments. A ($P < 0.05$) level was used as the standard for statistical significance. The model included the birds' performance and behavioural traits as dependent variables. The independent fixed effects consisted of the impact of treatment (control or date syrup (Debis) supplementation), birds' age, and the particular interaction. The bird was included in random effect.

$$Y_{ijk} = \mu + T_i + A_j + TA_{ij} + e_{ijk},$$

where Y_{ijk} is the observation value (Performance traits, or behavioural traits), μ is the overall mean, T_i is the effect of the treatment (Control vs. Debi's supplementation), A_j is the effect of birds age (week), TA_{ij} is the effect of the interaction between treatment and age, and e_{ijk} is the residual error. Tukey–Kramer test separated the mean differences among different treatments. A significant level was considered when $P < 0.05$.

3, RESULTS AND DISCUSSION

The use of antibiotics in livestock as either growth promoters or medicament treatments faces strict objection. It has extended international crisis as some declarations disclosed their ill consequences: the development of microbial resistance to the products and their potentially harmful impacts on human health [8]. These deficiencies direct to the search for alternative substances that control these threats. Lately, there is also an increasing curiosity in using growth promoters of natural origin [9]. Probiotics, prebiotics, and medicinal plants as raw feed additives are used in poultry diets to improve birds' performance and immune response [9]. The date palm has a vital spot worldwide; in old ages, the date palm has been an essential source of nourishment for the residents of Arabic countries. Our investigation showed that using date syrup (Debis) improved chicken performance. Bodyweight increases significantly starting from week 4 with Debis in addition 4% compared to the control group and within the treatment groups (Table 2). Body weight (Mean ± SD) were records as follow 992.6 ± 4.6; 979.5 ± 4.6; 997.6 ± 4.6; 1017.1 ± 4.6 g in control and treatment group (1, 4, 8%/L) respectively, with significant treatment effect ($p < 0.0001$).

Feed intake data did not show any significant differences during the first two weeks of age. Still, they showed significant differences during weeks 3, 5 and 6, respectively, with higher feed intake when adding Debis 1% of the drinking water (Table 3), respectively, ($P < 0.0001$).

Adding date syrup (Debis) to drinking water with (4, 8%/L) did not show significant differences in feed intake corresponding to the control group during the experiment period (Table 3).

Therefore, adding Debis to drinking water (1%) during the first three weeks of age will encourage feed intake, then elevating Debi's additive to reach 4%/L will improve feed conversion ratio and getting heavier body weight at six weeks of age.

Lowered rectal temperature measurements were observed (Table 4) when Debis was added with 4%/L in drinking water starting from the fourth week ($P < 0.0001$). During the experimental period, environ-

Table 3. Average feed intake (gram/bird) when supplementary (1, 4, and 8%) liquid date syrup (Debis) added to the drinking water per week*

Age/Week	Control	1% Debis/L	4% Debis/L	8% Debis/L
First	135.6 ± 17.9^{a}	$139.5 \pm 17.9^{a, c}$	$135.6 \pm 17.9^{a, c}$	$137.6 \pm 17.9^{a, c}$
Second	264.9 ± 17.9^{a}	$262.9 \pm 17.9^{a, c}$	$268.7 \pm 17.9^{a, c}$	$263.5 \pm 17.9^{a, c}$
Third	515.5 ± 17.9^{b}	$661.4 \pm 17.9^{a, c}$	$524.0 \pm 17.9^{b, d}$	$524.4 \pm 17.9^{b, d}$
Fourth	738.6 ± 17.9^{a}	$712.4 \pm 17.9^{a, c}$	$670.4 \pm 17.9^{a, d}$	$792.6 \pm 17.9^{a, c}$
Fifth	794.2 ± 17.9^{b}	$936.2 \pm 17.9^{a, c}$	$857.7 \pm 17.9^{b, c}$	$869.2 \pm 17.9^{b, c}$
Sixth	1056.4 ± 17.9^{b}	$1250.4 \pm 17.9^{a, c}$	$1075.0 \pm 17.9^{b, d}$	$1116.4 \pm 17.9^{b, d}$

* P-Values for treatment, week and treatment × week ($P \le 0.001$).
[a, b] Significant values between treatments (control vs. treatment addition).
[c, d] Significant values within treatments (1, 4, and 8% Debis).

Table 4. Average rectal temperature (°C) when supplementary (1, 4, and 8%) liquid date syrup (Debis) were added to the drinking water per week*

Age/Week	Control	1% Debis/L	4% Debis/L	8% Debis/L
First	41.5 ± 0.1^{a}	$41.5 \pm 0.1^{a, c}$	$41.4 \pm 0.1^{a, c}$	$41.5 \pm 0.1^{a, c}$
Second	41.3 ± 0.1^{a}	$41.3 \pm 0.1^{a, c}$	$40.8 \pm 0.1^{b, d}$	$41.3 \pm 0.1^{a, c}$
Third	41.3 ± 0.1^{a}	$41.3 \pm 0.1^{a, c}$	$41.0 \pm 0.1^{a, d}$	$41.3 \pm 0.1^{a, d}$
Fourth	41.4 ± 0.1^{a}	$41.0 \pm 0.1^{b, d}$	$41.1 \pm 0.1^{a, d}$	$41.3 \pm 0.1^{a, c}$
Fifth	41.4 ± 0.1^{a}	$41.2 \pm 0.1^{a, c}$	$41.3 \pm 0.1^{a, c}$	$41.4 \pm 0.1^{a, c}$
Sixth	41.6 ± 0.1^{a}	$41.3 \pm 0.1^{b, c}$	$41.5 \pm 0.1^{a, c}$	$41.5 \pm 0.1^{a, c}$

* P-Values for treatment, week and treatment*week ($P \le 0.001$).
[a, b] Significant values between treatments (control vs. treatment addition).
[c, d] Significant values within treatments (1 vs. 4 vs. 8% Treatment addition).

mental and relative humidity were recorded 31.8 ± 4.9°C, 20.4 ± 7.7% (Mean ± SD), respectively.

Data obtained from chicken behaviour did not show any significant differences between chickens that offered either date syrup (Debis) with 1 and 8%/L in their feed intake visiting during the experiment period (Fig. 1). Visiting water trough showed that higher watering visit starting from week 3 when Debis was added to drinking water with 4%/L compared to control group and within the treatment groups.

Chicks showed lower sitting behaviour and higher standing, panting, and wingspread behaviour when Debis were added in 4%/L compared to the control group and within treatment groups, respectively (Fig. 1).

The dates syrup (Debis) compose sugars (glucose and fructose), minerals, vitamins, fibres, and antioxidants (phenols) that work synergistically to reduce heat stress. The sugars supplied a palatable sweet taste to the diet; they were caused to enhance feed, water intake and lower Adriano Cortical Traffic Hormone (ACTH) level; this indicates prompt of hypothalamus–pituitary–adrenal axis because the palatable meals lowered action in the central stress reaction [10, 11]. The increase in water intake may be aided to reduce the internal temperature by panting. The oral administration of glucose to chickens under heat stress conditions controlled the decline in feed intake and growth rate, normalised physiological immunological responses, and relieved the impact of heat stress on absolute blood viscosity and plasma osmolarity [12, 13]. Heat production is associated with digestion procedures like the passage of digestion in the gastrointestinal tract, enzyme release, absorption and utilisation of nutrients. These procedures are part of the heat increment induced by feed intake. Puvado and Thaxton [14] reported that heat stress could lower the digestibility of dry matter, protein, and carbohydrates. The net energy from starch (corn and wheat) is less due to various nutrient losses during digestion and metabolism.

Similarly, there is a loss owing to heat increment. The sugar has no indigestible matter; the total sugar is available to birds without any heat increment. The

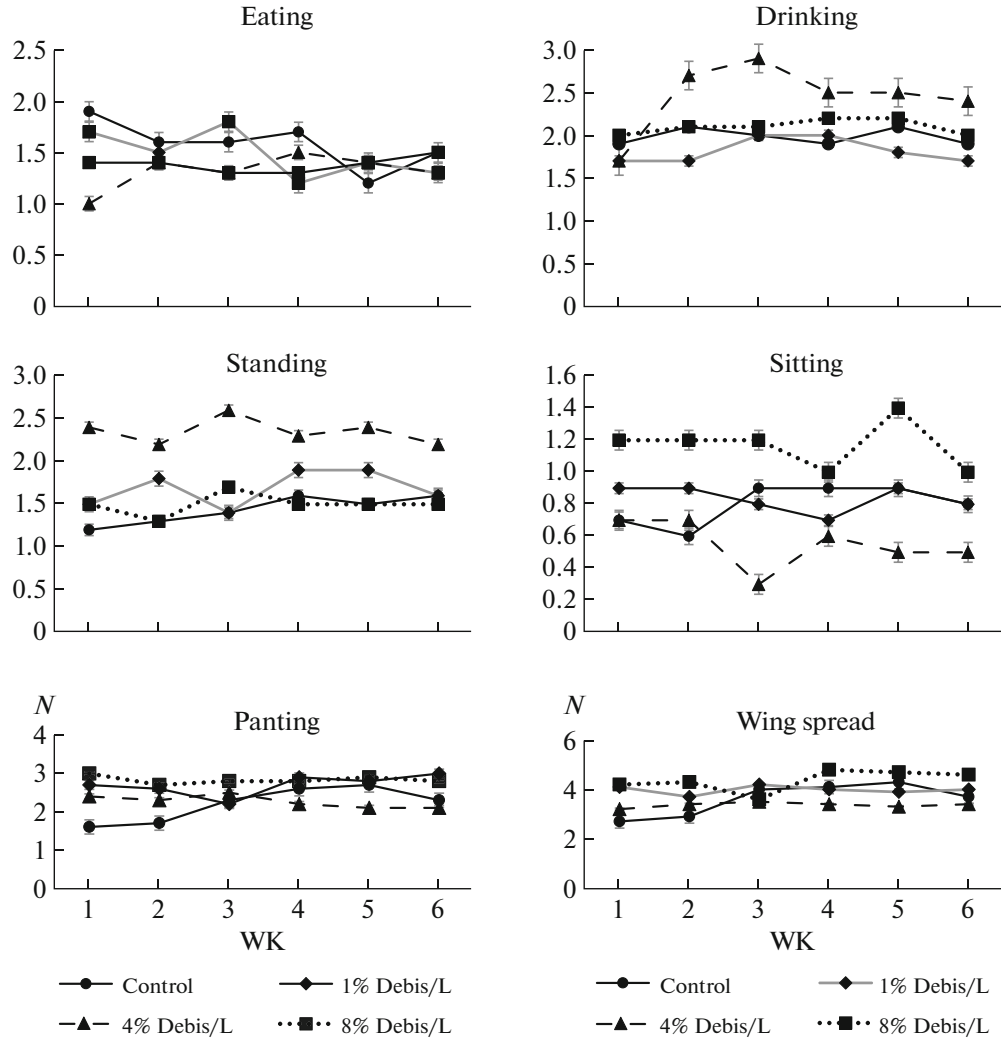

Fig. 1. Average eating, drinking, sitting, standing, panting, and wing spreading behaviour in broilers when supplementary (1, 4, and 8%) date syrup (Debis) were added to the drinking water.

date's Debis absorb fast and supply an adequate energy source; it reduces the digestion procedures needed for energy and blood, pushing to peripheral blood vessels for cooling. Furthermore, the fibres can preserve water and improve mineral uptake that inducing lowering the heat stress influence. It has been demonstrated [15–17] that giving sodium, potassium and glucose to drinking water or diet controls the decline in growth and feed intake of broiler grown under heat stress condition. Heat stress is considered a strong climatic impact on the degraded antioxidant levels in poultry production [18].

This can give us a conclusion for adding date syrup (Debis) with 1% of the drinking water during the first three weeks, then increasing adding level to be 4% after the third week to get heavier bodyweight.

This increase in body weight when using date syrup (Debis) is due to improved nutrient utilisation, particularly protein and sugars of dates, which can be digested and absorbed smoothly [19]. These results agreed that the various raw materials consist of highly digestible energy sources, as glucose and glucose derivatives, improving broiler chicks' performance [20]. The sugar content of Debis had a beneficial influence on the broilers and enhanced the digestibility of dry matter. Earlier studies demonstrated that dates were utilised successfully as an alternative carbohydrate source to maise and barley in the rations.

In the current investigation, the practical result of adding date syrup (Debis) on growth performance during the grower and finisher phases and overall. It can be explained that Debis has antioxidant and immunostimulatory effects [21] because of its carotenoid, phytosterol, phenolic acid, and flavonoid content, and simulates live weight and growth performance with its high carbohydrate content.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHOR CONTRIBUTIONS

All co-authors substantially contributed to the conception or design of the work; or the acquisition, analysis or interpretation of data for the work and drafted or critically revised the work for important intellectual content and approved the final version to be published and agreed to be accountable for all aspects of the work.

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