Productive and Physiological variations in commercial laying hen flocks in different seasons in Iraq

Noor Ali Hussein [1*], Saad Mohammed Hussein Kazem [2]
[1] Babylon Education Directorate, Ministry of Education, Hillah, Iraq
[2] College of Agriculture, Al-Qasim Green University, Department of Animal Production, Iraq

* Corresponding Author: **Noor Ali Hussein**

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Abstract
This study was conducted in one of the laying hen farms in Al-Kifl district over two periods: 1-11-2022 until 31-12-2022 and then from 1-7-2023 until 30-8-2023. In the two periods, the flock of Asia Brown laying hens (during the winter, 4400 laying Isa-Brownes hens were used and in the summer, 4160 laying hens Isa-Browne were used) were used, aged between 34-41 week. The outcomes of the study indicated that there was a remarkable increase in the characteristics of production performance (egg production rate, HD, feed consumption, percentage of broken eggs, liveability, and egg weight) during winter as opposed to summer. In addition, the majority of physiological conditions (red and white blood cell count, hematocrit, glucose, cholesterol and triglycerides) were better in winter than in summer.

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1. Introduction

The poultry industry can be considered one of the most significant since it is one of the main sources of animal protein in human beings and that eggs are one of the prominent sources of protein based on their easy digestibility and high nutritional worth (Aljebory *et al*., 2021 a) [4, 5]. Iraqi Ministry of Agriculture shows that the production of eggs in the country last year was six billion eggs annually with an average annual growth rate of 11.12. The median growth rate over the next five years (2019-2025) is 39 percent per year. This increased rate of growth can be explained by the rejuvenation of the egg production industry following 2020, government assistance in the form of import bans, the rise in the number of projects, and transition to intensive cage production (Aljebory *et al*., 2021 a&b: ALSHERIFY *et al*., 2024; COSIT., 2024) [4,5, 11]. Nevertheless, poultry industry is faced with numerous challenges such as seasons of winter and summer, particularly in Iraq. The high temperatures during summer have a significant impact on laying hens since the optimum temperature of laying hens is 18-22 degrees Celsius, and the temperature can reach up to 30 degrees Celsius in the breeding hall, which significantly influences the production of the birds through a reduction in feed intake, weakening of immunity, and alteration of the ratio of reproductive hormones because of the rise in the stress Lower temperatures also cause some physiological changes and increased feed consumption, leading to decreased production. Thus, the availability of data on the rates of the flock production and some physiological indicators can offer a chance to evaluate the state of egg-laying and create the necessary rations based on the stage of production and the state of the birds in the rearing facility (Al-Jebory *et al*., 2023) [2]. Hence, the proposed research will explore how season affects productive and physiological performance of laying hens in various seasons.

Materials

The experimental work was performed in one of the laying hen farms of the district of Al-Kifl during two periods, namely: 1-11-2022 until 31-12-2022 and 1-7-2023 until 30-8-2023.

A flock of Asia Brown laying hens aged between 34-41 weeks was utilized in the two periods (4400 laying Isa-Browne were used in winter divided into four replicas and 4160 laying Isa-Browne were used in summer divided into four replicas). The productive characteristics were examined based on (Aljebory *et al.*, 2021 a&b) [4, 5], whereas the physiological characteristics were examined based on (Salman *et al.*, 2024&2025: Arkan *et al.*, 2025) [12, 23]. The data
were statistically analyzed with the help of the SAS program (2012) [25] and the Duncan multiple choices test (1950). Both seasons involved feeding the laying hens with a diet that had 16% crude protein and 2800 metabolizable energy.

Results and discussion

Table 1: presents the impact of the study on productive performance of 34-37 week old laying hens. The HD ratio, the percent of broken eggs and the livability ratio were found to have a significant improvement ($p<0.05$) during winter. There was also increased feed consumption during the winter than during summer. There was no notable difference in egg weight between winter and summer.

Table 1: 34-37 weeks

Season	HD %	Broken egg %	Feed intake / hen (g)	Egg weight (g)	Livability (%)
Winter	82.15±1.25 a	0.65±0.01 b	99.13±1.33 a	50.23±1.00	97.46±0.18 a
Summer	76.17±2.11 b	1.59±0.19 a	95.32±0.59 b	49.78±0.64	94.10±2.55 b
Sig.	*	*	*	ns	*

Table 2: shows the effect of the study on the productive performance of laying hens aged 38-41 weeks. The HD ratio, the proportion of broken eggs and livability ratio were significantly improved ($p<0.05$) in winter. Egg weight and feed consumption were also found to be high during winter than summer.

Table 2: 38-41 weeks

Season	HD %	Broken egg %	Feed intake / hen (g)	Egg weight (g)	Livability (%)
Winter	80.35±1.10 a	0.95±0.15 b	101.10±0.87 a	54.22±0.17 a	96.24±1.22 a
Summer	73.41±1.01 b	1.81±0.13 a	97.12±0.60 b	50.44±1.18 b	93.44±2.00 b
Sig.	*	*	*	*	*

Physiological traits

Table 3 indicates that PCV increased significantly ($p<0.05$) at 34-37 weeks of age in winter, whilst, Hb, RBC and H/L levels were lower in winter than in summer. There were no considerable differences in the white blood cell count. PCV rose significantly ($p<0.05$) at 38-41(table 4) weeks of age and H/L fell significantly ($p<0.05$) in winter than in summer. There were no striking differences in Hb, RBC or WBC.

Table 3: 34-37 weeks

Season	PCV	Hb	RBC×10^6	WBC×10^3	H/L
Winter	36.15±0.12 a	12.05±0.44 b	2.65±0.14 b	32.22±1.15	0.30±0.03 b
Summer	39.65±0.58 b	13.21±0.21 a	3.10±0.36 a	31.45±2.00	0.43±0.05 a
Sig.	*	*	*	ns	*

Table 4: 38-41 weeks

Season	PCV	Hb	RBC×10^6	WBC×10^3	H/L
Winter	37.25±0.22 a	12.41±1.14	2.47±2.00	32.32±1.43	0.32±0.01 b
Summer	39.45±0.38 b	13.15±2.01	2.51±3.16	32.61±1.09	0.41±0.03 a
Sig.	*	ns	ns	ns	*

Tables 5 and 6 indicate how the study has impacted some of the biochemical parameters of the blood. Significant difference ($p<0.05$) in the levels of glucose, cholesterol and triglycerides between the summer and the winter is observed at 34-37 weeks and 38-41 weeks.

Table 5: 34-37 weeks

Season	Glucose	Cholesterol	Triglyceride
Winter	285.14±4.33 b	145.31±1.42 b	127.33±3.69 b
Summer	310.42±3.72 a	159.30±6.27 a	147.12±3.12 a
Sig.	*	*	*

Table 6: 38-41 weeks

Season	Glucose	Cholesterol	Triglyceride
Winter	241.55±5.13 b	141.92±3.41 b	139.21±4.11 b
Summer	281.12±6.12 a	153.60±4.09 a	146.63±5.35 a
Sig.	*	*	*

The productivity and worsening of physiological features during summer, in contrast to the winter, could be owed to the influence of increased temperatures. Research has revealed that when the ambient temperature exceeds 25 o C, it causes heat stress in chickens (Wasti *et al*., 2020) [27]. According to these researches, the heat stress leads to the deterioration of the physiological and productive conditions of birds. It causes the adrenal medulla to secrete more catecholamines, which in turn results in the elevation of the blood glucose levels, the reduction of liver glycogen, muscle glycogen, and respiratory rate, peripheral vasodilation, and neuronal stress (Naga and Narendra, 2018) [18]. With prolonged stress, the hypothalamic-pituitary-adrenal (HPA) axis is activated in response to stress. This causes the secretion of corticotrophin-releasing hormone (CRH) by the hypothalamus, which causes the secretion of adrenocorticotropic hormone (ACTH). The secretion of adrenal glands depends on the secretion of the pituitary gland; adrenocorticotropic hormone (ACTH) enhances the production and secretion of corticosterone (Al-Saeedi *et al*., 2023 & 2024; Noor *et al*., 2024 & 2025) [9, 10, 19]. Corticosterone triggers gluconeogenesis, which raises the level of plasma glucose (Naga & Narendra, 2018) [18]. This is what caused the high glucose during the summer. The ratio of lymphocytes to heterocysts, respiratory alkalosis, and oxidative stress are also increased as a result of heat stress. Moreover, it enhances lipid peroxidation and malondialdehyde (MDA) formation (Lara & Rostagno, 2013) [16]. This is why the H/L ratio, cholesterol and triglyceride are higher in summer. All of this adversely affect the growth performance of the birds leading to decreased productivity (Wasti *et al*., 2020) [27] as has been observed. The past studies on poultry revealed that heat stress is linked to oxidative stress in cells (Surai *et al*., 2019) [26]. Oxidative stress results in excess free radical formation which damages all the cell components such as proteins, lipids and nucleic acid. The consequences of oxidative stress vary with the severity and extent to small reversible alterations to programmed cell death and cell death in events of severe oxidative stress (Lennon *et al*., 1991) [17]. Therefore, oxidative stress among poultry is linked to biological damage, serious diseases, low growth rates, and economic losses (Estévez, 2015). In hot environments, birds' respiratory rate can increase 10 to 20 times (Saeed *et al*., 2019) [22]. Birds do not have sweat glands, all their bodies are coated with feathers, and their metabolism is fast. These features undermine thermoregulation and, consequently, they are forced to lose body heat by means of such processes as panting in a hot environment (Richards, 1970; Al-Jumaili *et al*., 2025) [8]. In panting, the amount of carbon dioxide that is excreted by the body exceeds the rate of cellular carbon dioxide production. This changes the concentration of carbonic acid (H_2CO_3) and hydrogen ions (H^+) in the blood, decreasing their concentration. On the other hand, bicarbonate ions concentration (HCO_3^-) rises hence elevating the blood pH, making it alkaline. To address the condition and remain at a normal blood pH, birds start to excrete more HCO_3 and retain H^+ in the kidneys. The higher H^+ concentration causes the shift in acid-base homeostasis, resulting in respiratory alkalosis that only heightens the amount of heat stress on the birds and decreases Productive performance (Al-Jaryan *et al*., 2023: Al-Jebory *et al*., 2023) [1, 2].

Conclusion

The present research finds that summer has a major negative effect on the performance of egg production unless rearing conditions are considered especially the provision of a proper temperature in which to rear the birds and the provision of proper feed to the birds to grow and produce eggs.

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