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EFFECT OF VARIOUS REARING SYSTEMS ON SOMEBLOOD BIOCHEMICAL ATTRIBUTES AND WEIGHTS OF EDIBLE AND INEDIBLE INTERNAL ORGANS IN BROILERS*

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ABSTRACT

This study evaluated the impact of different rearing systems on some blood biochemical parameters and the characteristics of both edible and inedible internal organs in broiler chickens. The experiment was conducted at the Poultry Fields of the Department of Animal Production, College of Agriculture/ University of Anbar, over 42 days from November 24, 2023, to January 4, 2024. A total of 180 one-day-old Ross 308 strain, with an average initial weight of 42 gm, were used in the study. The chicks were randomly assigned to three treatments, each with four replicates. An optimal environment for rearing the chicks was established, which included suitable temperature, humidity, ventilation, lighting, and health management. The treatments were categorized as follows: T1: Traditional floor-rearing system using wood shavings as bedding. T2: Battery system using metal cages with four tiers, cage dimensions (80, 120, 40) cm, and metal mesh floors with an opening size of 1.5 cm. T3: Floor rearing system using a plastic mesh floor raised 7 cm above the ground, with mesh openings of 1.5 cm. The results showed no significant differences between blood biochemical attributes or the weight of edible internal organs across all experimental treatments. Similarly, there were no notable differences in the weight of the thigh and breast among the various treatments. These findings that the different rearing systems used in the experiment did not induce any signs of stress in the birds. Furthermore, the lack of significant differences in the weight of inedible internal organs indicates that the birds' immune capacity was preserved, regardless of the rearing systems employed and maintained, irrespective of the rearing systems used.

Keywords: broiler chicken, relative weights, organs, plastic flooring, cage system.

INTRODUCTION

The recent growth of the poultry industry has resulted in a limited understanding of what constitutes proper welfare in poultry farming. As a result, breeders and

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companies have implemented various rearing systems that often compromise the welfare of the birds and reduce overall production. Additionally, these practices have a negative effect on the quality of both meat and egg production [22]. Conversely, there have been new ideas and suggestions from breeders and some companies concerning poultry rearing systems. Many of these suggestions lack scientific backing yet have gained significant acceptance among breeders. Unfortunately, these ideas are based on flawed principles that fail to ensure proper welfare for the animals, ultimately leading to a decline in poultry production, both in terms of meat and eggs [18]. Modeling the dynamics of environmental conditions in poultry rearing spaces is essential for enhancing poultry production and ensuring their health and welfare. Changes in the environment, such as variations in temperature and ventilation, are some of the most significant factors influencing poultry welfare. Therefore, these factors should serve as the foundation for establishing effective poultry-rearing systems [24]. Systems featuring plastic flooring often aid in controlling ammonia levels in poultry houses due to their ease of cleaning and enhanced ventilation. This helps reduce the harmful effects of ammonia on poultry respiratory systems, lowering stress levels and positively impacting physiological performance and growth efficiency [23]. However, a study by Diktas *et al.* [6] indicated a significant decline in vitality among chickens raised on plastic flooring compared to those raised on wood shavings in heat-stress conditions. Plastic flooring might negatively affect heat exchange in chickens, which could increase their mortality risk. Therefore, this study assessed the impact of various rearing systems on specific blood biochemical parameters and the characteristics of both edible and inedible internal organs in broiler chickens.

MATERIALS AND METHODS

The experiment was conducted at the poultry fields of the Animal Production Department, College of Agriculture, University of Anbar, over 42 days, from November 24, 2023, to January 4, 2024. One hundred eighty-one-day-old ROSS 308 chicks, with an average initial weight of 42 g, were obtained from Al-Shukr Hatchery in Abu Ghraib District, Baghdad. The chicks were randomly allocated into three treatments, each consisting of four replicates with 15 chicks per replicate, 60 chicks per treatment. Optimal environmental conditions were maintained to ensure proper chick rearing, including appropriate temperature, humidity, ventilation, and a lighting program. The treatments were structured as follows:

- T1: A conventional floor-rearing system with wood shavings as bedding.
- T2: A battery cage system with metal cages was arranged in four tiers. Each cage measured 80 cm x 120 cm x 40 cm in width, depth, and height, respectively, and had a wire mesh floor with 1.5 cm openings.
- T3: Floor rearing system with a raised plastic mesh floor, elevated 7 cm above the ground, with mesh openings of 1.5 cm.

Blood sampling and assay

Blood was drawn from the wing veins of the birds and placed in tubes containing an anticoagulant (K2EDTA). Plasma biochemical analyses were conducted to determine blood parameters. To estimate blood glucose levels, ready-made analysis kits manufactured by Linear Chemicals, Spain were used. For total protein levels, the concentration of total protein in blood plasma was measured using an enzymatic method with a ready-made kit produced by Biosystems, Spain. As for albumin levels, the concentration of albumin in blood plasma was measured using a kit produced by

AGAPPE, Switzerland. The concentration of globulin was calculated using the following equation, as reported by [7].

Globulin concentration (g/L) =Total protein concentration–Albumin concentration.

For high-density lipoproteins (HDL), they were measured using a kit produced by AGAPPE, Switzerland. The concentration of very-low-density lipoproteins (VLDL) was calculated using the equation provided by [21) as follows:

$$VLDL = T.G / 5.$$

The concentration of low-density lipoproteins (LDL) was estimated using the equation provided by [23) as follows:

$$LDL = Total\ Cholesterol – (HDL + VLDL.$$

As for liver enzymes (AST, ALT, ALP), their concentrations were determined using ready-made kits produced by Bio Merieux, France. The relative weights of the edible and inedible internal organs, as well as the weights of the thigh and breast cuts, were calculated according to the method [8].

Statistical analysis

The statistical analysis system [20] software was used for data analysis, employing the complete randomized design (CRD). Duncan's multiple range test (1) was used to test the significance of differences among treatments.

RESULTS AND DISCUSSION

Relative weights of the internal organs

Table 2 and 3 shows the effect of the experimental treatments on the relative weights of internal organs in broiler chickens, indicating no significant difference for the liver, gizzard, heart, pancreas, spleen, duodenum, gallbladder, bursa of Fabricius, breast, thigh, large intestine, jejunum, ileum, and Glandular Stomach across all treatments. These results align with the findings of AL-Dhanki *et al.* and Şimşek *et al.* [2, 19], who reported that the flooring type did not significantly affect carcass productivity or the weights of cuts and internal organs. Studies conducted by Al-Taii [10] and Rehman [17] found that the type of flooring used can impact the quality of broiler chicken carcasses and the relative weights of their hearts, abdominal fat, and gizzards. Providing comfortable flooring encourages better feeding behavior and increased activity among the birds, leading to higher feed intake. This feed intake increase accounts for the gizzard's enlargement as it processes more significant amounts of feed. Consequently, this also leads to the growth of the proventriculus, which is responsible for the digestion of food. The significance of the bursa of Fabricius indicates an improvement in white blood cell production, likely stemming from enhanced physiological processes. This enhancement bolsters immunity, as white blood cells are essential to the body's immune defense system. Additionally, the observed increase in body weight and white blood cell count is associated with the growth and development of immune organs, such as the bursa of Fabricius [3].

Table 1: Ingredient and Chemical composition calculated of experimental diets.

Ingredients	Starter 1-14 day	Grower 15-28	Finisher 29-42 day
Yellow corn	55.5	60.4	64.8
Soybean *	35	30	25
Protein concentrate **	5	5	5
Oil	2.2	2.67	3.6
Dicalcium phosphate	0.7	0.5	0.3
Limestone	1.2	1.1	1
DL-methionine	0.2	0.15	0.12
Lysine	0.1	0.08	0.08
Salt	0.1	0.1	0.1
Total	100	100	100
Chemical composition, Calculated ***			
Crude protein	23.52	21.53	19.51
ME, kcal/kg	3017	3101	3210
Methionine + Cystine	1.09	0.99	0.91
Calcium	0.97	0.88	0.78
phosphorus	0.48	0.43	0.39
Available phosphorus	0.39	0.35	0.30

***** Soybean meal 48% crude protein

** Protein concentrate contains: 40% CP, 5% Ca,3.7% Methionine, 4.12% Methionine and Cystine, 3.85% Lysine , 4.68% AP, Metabolizable Energy 2107 Kcal kg^{-1}, 2.50 mg Sodium, 1.70 mg threonine, 0.42mg Tryptophan, 4.20 mg choline and each 1 kg of this concentrate contain: 100000 IU vitamin A, 33000; IU vitamin D3, 100 mg; vitamin E, 2.55 mg; vitamin K3, 25 mg; vitamin B1, 10 mg; B2, 50 mg; vitamin B6, 24 mg vitamin B12; 51 mg niacin; 1.5 mg folic acid; 15 mg; biotin,500 µg and 13.5 mg pantothenic acid.

***Calculated based on feed consumption Tables of NRC (1994).

Table 2: Effect of different rearing systems on the relative weights of edible internal organs and parts of broiler

Organs	Treatments			SEM*	Trait Mean	Significance Level
	T1	T2	T3			
Liver %	2.46	2.55	2.67	0.1	2.56	N.S
Gizzard %	1.45	1.05	1.11	0.13	1.20	N.S
Heart %	0.388	0.412	0.506	0.02	0.43	N.S
Spleen %	0.101	0.134	0.145	0.015	0.12	N.S
Breast %	28.6	30.0	31.4	0.758	30.0	N.S
Thigh %	28.2	30.0	31.8	0.994	30.0	N.S

SEM: Standard Error Mean; NS: Non-significant.

Different letters (a, b, c) within the same row indicate significant differences among treatments (P≤0.05).

Table 3: Effect of different rearing systems on the relative weights of inedible internal organs of broiler

Organs	Treatments			SEM*	Trait Mean	Significance Level
	T1	T2	T3			
Pancreas	0.239	0.197	0.237	0.018	0.22	N. S
Duodenum	0.541	0.320	0.438	0.044	0.43	N. S
Gallbladde	0.058	0.044	0.063	0.007	0.05	N. S
Fabricius	0.033	0.044	0.059	0.009	0.04	N. S
Large	0.792	0.652	0.836	0.045	0.76	N. S
Jejunum	0.688	0.617	0.929	0.076	0.74	N. S
Ileum %	0.947	0.676	1.01	0.083	0.88	N. S
Glandular	0.346	0.376	0.482	0.037	0.40	N. S

NS: Non-significant; *SEM :Standard Error Mean.

Blood biochemical parameters

Table 4 shows the effects of various experimental treatments on the biochemical blood traits of broiler chickens. The results indicate that there were no significant differences in the biochemical blood traits measured, which included very low-density lipoproteins, low-density lipoproteins, high-density lipoproteins, triglycerides, cholesterol, alkaline phosphatase (ALP) activity, aspartate aminotransferase (AST) activity, alanine aminotransferase (ALT) activity, globulin, albumin, total protein, and glucose across all treatments. It is important to note that environmental conditions are influential factors affecting the blood parameters of poultry [12].

These biochemical attributes can assist in diagnosing the production and health status of the bird [9, 11]. The results of this experiment are consistent with the findings of Nawab et al. [15], who reported no significant differences in blood cholesterol levels among various treatments involving different rearing systems. Similarly, Liu et al. [13] found no significant differences in blood triglyceride concentrations across different rearing systems, a conclusion that was also supported by Al-Enzy *et al.* [4], Kaukonen [16]. However, the results of this experiment contradict those of Kaukonen [16], which reported a significant decrease in blood triglyceride concentrations in birds raised in free-range systems compared to those raised in conventional bedding systems. This observation aligns with the findings of reference [5], which noted that the flooring used in broiler chicken rearing directly affects the birds' body temperature, particularly under stress, as they regulate temperature through conduction via their foot pads.

Conclusions

The various rearing systems for broilers used in the experiment did not significantly impact the relative weights of the edible and inedible internal organs and tissues across all treatments. Furthermore, no significant effects were observed in any of the rearing systems concerning specific biochemical traits of the blood across all experimental treatments.

Table 4: Effect of different rearing systems on blood biochemical parameters of broiler

Period	Treatments			SEM*	Trait Mean	Significance Level
	T1	T2	T3			
VLDL	27.3	26.9	24.6	2.20	26.30	N. S
LDL	53.3	60.4	60.8	3.78	58.22	N. S
HDL	77.5	73.9	74.4	1.94	75.30	N. S
• **Triglycerides**	136	134	123	11.04	131.5	N. S
• **Cholesterol**	158	161	159	5.11	159	N. S
ALP	382	309	353	16.1	348	N. S
AST	69.4	68.8	66.0	1.55	68.1	N. S
ALT	10.4	10.6	9.63	1.06	10.24	N. S
• **Globulin**	2.16	2.1	2.13	0.08	2.16	N. S
• **Albumin**	1.57	1.47	1.60	0.06	1.54	N. S
• **Protein**	3.73	3.65	3.73	0.11	3.70	N. S
• **Glucose**	186	179	184	2.09	183	N. S

*SEM :Standard Error Mean.

Different letters (a, b, c) within the same row indicate significant differences between treatments at a significance level of ($P \leq 0.05$).

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تأثير أنظمة التربية المختلفة في معايير الدم الكيمياحيوية وأوزان الأعضاء الداخلية الصالحة وغير الصالحة للأكل في فروج اللحم*

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الملخص

أجريت هذه الدراسة بهدف بيان تأثير أنظمة تربية مختلفة في بعض صفات الدم والأعضاء والاحشاء الداخلية المأكولة وغير المأكولة لفروج اللحم. أجريت التجربة في حقول الدواجن التابعة لقسم الإنتاج الحيواني في كلية الزراعة /جامعة الانبار لمدة 42 يوماً من (2023/11/24 لغاية 2024/1/4 باستخدام 180 طيراً من طراز Ross (308 بعمر يوم واحد وبمعدل وزن ابتدائي بلغ 42 غم ووزعت الافراخ بصورة عشوائية الى ثلاث معاملات بواقع 4 مكررات لكل معاملة مع توفير البيئة الملائمة لتربية الافراخ من درجة حرارة ورطوبة وتهوية وبرنامج اضاءة والبرنامج الصحي، إذ قسمت المعاملات كما يأتي:

T1-1 نظام التربية الأرضية التقليدي باستخدام فرشة نشارة الخشب كأرضية

T2-2 نظام البطاريات باستخدام اقفاص معدنية ذات أربعة طوابق ابعاد القفص الواحد (80,120,40) وذات أرضية مشبكة معدنية مساحة فتحات الشبكة 1.5 سم

T3-3 نظام التربية الأرضية باستخدام الأرضية المشبكة البلاستيكية بارتفاع 7سم عن ارضية الحقل ومساحة فتحات هذه الشبكة 1.5 سم

أشارت النتائج الى انعدام الفروق المعنوية بين معاملات التجربة جميعها في معايير الدم الكيمياحيوية ووزن الأعضاء الداخلية المأكولة فضلاً عن انعدام الفروق المعنوية بخصوص قطيعتي الفخذ والصدر بين معاملات التجربة كافة وإن هذه النتائج تدل على عدم ظهور أية علامة من علامات الاجهاد على الطيور باختلاف أنظمة التربية المستعملة في التجربة.

الكلمات الدالة: فروج اللحم، الاوزان النسبية للأعضاء، الارضيات البلاستيكية، نظام الاقفاص

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