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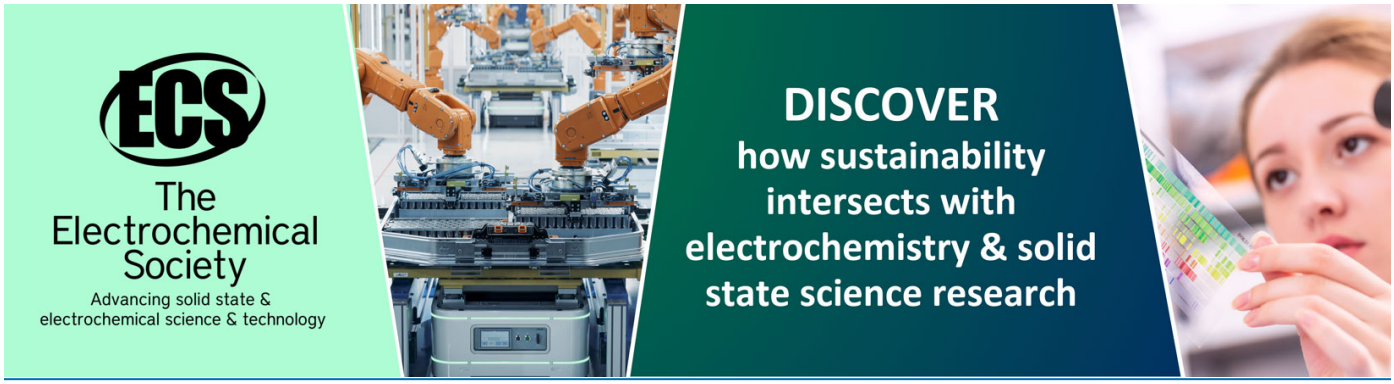

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Effect of Dietary Supplementation of Soybean Bioactive Peptides and Vitamin E on Productive Performance and Some Carcass Characteristics in Broiler Chickens

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Abstract. This study aimed at evaluating productive performance and some carcass characteristics of broiler chickens fed feeds containing different levels of soybean bioactive peptide (SBP), and vitamin E. 180 Ross-308 broiler chicks were divided equally into five treatments, each replicated three times, and twelve unsexed chicks were placed in each replicate in a completely randomized design. For a 35-day trial period, the basal diet was either supplied without supplements (control group), or it was supplemented with SBP at 2.5, 5.0, and 7.5 g/kg diet, or with vitamin E at 250 mg/kg feed. Results indicated that body weights at different ages were significantly ($p \leq 0.05$) higher in SBP groups during 2nd week (except 2.5 g/kg SBP), 3rd week, 4th week, and 5th week as compared with control and vitamin E groups. Gain in total body weight , ratio of feed conversion, and production index were improved significantly ($P \leq 0.05$) in SBP compared to other groups. The economic efficiency improved in the SBP and the vitamin E group than in control group. Feed intake, mortality rate, carcass yield, total giblets, total edible parts, liver, and heart yield were similar among groups. The highest ($P \leq 0.05$) carcass weight and breast yield were observed in the SBP than in other groups, while the gizzard relative weight in the vitamin E group achieved the highest significant value (3.22 %) as compared with SBP and control groups. Significant effect among treatment was observed in thigh yield. In compared to the control, 5 (g/kg) SBP showed the lowest ($P \leq 0.05$) abdominal fat percentage. The current findings suggested that the supplementation of broiler diets with SBP improved productive performance and some carcass traits.

Keywords. Broiler, Soybean bioactive peptide, Vitamin E, Performance, Carcass characteristics.

1. Introduction

The use of antibiotics in poultry feed as growth stimulants have become prohibited by many developed countries, due to the fear of the emergence of antibiotic-resistant bacterial strains and the accumulation of antibiotic residues in animal products [1], and the trend toward food additives began of plant origin and focusing on finding alternative growth promoters that are eco-friendly and have a vital effect in improving the productive performance of birds. Accordingly, peptides can be added as

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harmful antimicrobials due to their ability to bacterial resistance, and the fact that they do not produce toxic residues that harm environmental factors and human health [2].

The addition of peptides is one of the alternatives offered in poultry nutrition, since peptides' function in bird feed has drawn more attention recently. When a protein is hydrolyzed chemically, enzymatically, or microbiologically, it releases specific small protein molecules called peptides, which are described as specific small protein molecules (2–20 amino acids) that can be isolated from animal byproducts or feeds derived from plants[3], peptides are high-quality tiny or big proteins having physiological, regulatory, or nutritional functions in poultry. Peptides are described as chains of amino acids that demonstrate a favorable physiological effect or offer a situation for such an effect in an organism's physiology [4] .

Peptides may be naturally present in raw food ingredients or produced through various biological or chemical treatments [5]. These peptides can be produced in a number of ways, such as for gastrointestinal digestion through proteolytic enzymes [6], or they can be produced in their bioactive form by enzymatic, alkaline or acid hydrolysis in vitro [7], or by microbial fermentation [8]. Several peptides secreted by plants or animals have antibacterial properties[2], with antioxidant capacity [9, 10, 3], and immunomodulators [11, 12, 13]. Those peptides isolated from different protein sources that have biological properties in addition to their nutritional value are referred to as "bioactive peptides." [14]. It is reported that vegetable protein ingredients, particularly soybeans, often contain growth-inhibiting or anti-nutritional factors that could limit their use as a protein source in poultry diets [15]. However, through processing processes, soybeans have been processed. Using hydrolysis and microbial, which is not limited to the fermentation of proteins only, also contributes to the removal of anti-nutritional factors in the protein components. On the other hand, the peptides produced from the hydrolysis of plant proteins and added to poultry diets gave positive and effective results in terms of improving productive performance and intestinal health [15], feed efficiency, and dry matter digestibility, as well as improving gut morphology [16], and these peptides were prepared as a functional food that can be included to poultry diets [17]. All these properties motivated researchers to use bioactive peptides derived from soybean seeds, which have been shown to have the ability to improve productive performance and enhance bird immunity [17, 11] and it was found that biologically active peptides extracted from soybean seeds were important in enhancing the immunity of birds and improving nutrient digestibility when included in broilers' diets [11]. Accordingly, studies have concluded that soybeans are a protein-rich food and contain a variety of biologically active peptides.

On the other hand, vitamin E is one of the nutritional additives in poultry diets, as it is one of the vitamins that act as antioxidants and has a role in reducing oxidative stress for birds raised under stressful conditions and works to protect the body from free radicals [18, 19]. In this study, vitamin E was used as one of the commercial industrial antioxidants to compare it with biologically active peptides, to investigate the role of peptides in affecting the performance of broilers under one roof of environmental conditions. Therefore, the current study's objective is to evaluate the supplement of biologically active peptides derived from soybean and vitamin E to the diet and to demonstrate its effect on productivity performance and some carcass traits of broiler chickens.

2. Materials and Methods

2.1. Birds and Experimental Diets

The Poultry Field, College of Agriculture, University of Basrah, and with laboratories in Mosul university Ethical approval No. um.VET.2021.5. were the site of this experiment, for a period of 5 weeks (35 days) from 19th January 2022 to 25th February 2022. Commercial Ross-308 chicks of mixed sex that were one day old were randomly assigned to five treatment groups, each of which contained three replicates of 12 birds, and reared on similar managerial conditions. In all growth stages, starter (1–21 days), and grower until the completion of the trial, the chicks were given diets based on maize and soybean meal for 35 days. The dietary treatments include a base diet (control), a base diet supplemented with 2.5, 5.0, and 7.5 SBP (g/kg of feed), or a base diet supplemented with 250 mg of vitamin E per kilogram of feed. Soybean bioactive peptide (SBP) was obtained from Vanavaran Novin

Joestar Biotechnology, Tehran, Iran (in the form of yellow-brown powder). While vitamin E was obtained from American SOLGAR Company - Manhattan. According to the breed manual's suggestion of Ross 308 [20], the chicks were given free access to feed and water and fed a basal diet designed to suit their nutritional needs as they grew [20]. The basal diet's ingredient breakdown and chemical analysis are shown in Table (1).

Table 1. Composition of ingredients (%) and chemical analysis (%) of the basic diet.

Item	Starter (1 to 21 days)	Grower (22 to 35 days)
Yellow corn	53.0	54.0
Wheat	6.00	9.00
Soybean meal 48%CP	32.0	29.0
Broiler concentrate[1]	5.30	4.00
Sunflower Oil	1.00	1.50
phosphate of dicalcium	0.50	0.50
Limestone fine	0.50	0.50
DL-Methionine 99%	0.17	0.11
L-Lysine-HCl 98%	0.23	0.09
Premix[2]	1.00	1.00
Common salt	0.30	0.30
Total	100	100
	Calculated analysis[3]	
ME (kcal/kg)	2988.49	3054.29
C. protein	23.03	21.55
C. fiber	3.78	3.64
Calcium	1.24	1.10
Available phosphorus	0.46	0.40
Lysine	1.34	1.11
Methionine	0.50	0.42
Methionine + Cystine	0.78	0.72
Energy: protein	129.76	141.73

[1]Super concentrate contains the following: 40% CP, 3.8% CF, 10% calcium, 4.5% available phosphorus, 1.8% lysine, 0.55% methionine, 2.89% methionine + cysteine,. Metabolizable energy 2800 21.30kcal/kg, 0.14% Sodium. [2]premix supplied the following per kilogram of diet: Vitamin A, 6 mg; vitamin D3, 0.15 mg; vitamin E, 40 mg; vitamin K3, 4 mg; B1, 3 mg; B2, 12 mg; B6, 10mg; vitamin B12, 0.04 mg; niacin, 60mg; choline chloride, 700mg; calcium D-pantothenate, 20mg; folic acid, 2mg; Biotin, 0.2mg; Iron, 90mg; Copper, 30mg; Manganese, 120mg; Zinc, 140mg; Iodine, 4mg; Selenium, 0.8mg; Calcium, 30.8%. [3]Calculated analysis: NRC [21] feed ingredient tables were used for calculation.

2.2. Bird's Performance

During the starter and grower phases, live body weight was determined. The change in body weight from (1-35) days of age was used to determine body weight gain (BWG). Feed efficiency ratio (FCR) was determined after feed intake (FI) for the relevant periods was recorded. Using the equation Naji mentioned[22], the production index (PI) was calculated.

$$\text{Production index (PI)} = \frac{\text{Average of live weight in (gm)} \times \text{liveability percentage}}{\text{Age in days} \times \text{FCR} \times 10}$$

$$\text{Liveability percentage} = 100 - \text{mortality percentage.}$$

The Economic Figure (EF) was determined using the following method [22] after recording FCR :
Economic efficiency = cost of diet (IQD/kg) * food conversion factor
After the five-week trial

2.3. Assessment of Carcass Characteristics

After the five-week trial, three randomly selected birds from each feeding group were tethered for six hours [23], weighed, and murdered to whole bleeding before being eviscerated.The weights of the liver, gizzard, heart, and abdominal fat pad were recorded. The dressing percentage was determined

as: Dressed weight/live weight × 100 .The relative weight of carcass parts (breast and thigh) was calculated as percentage of dressed carcass weight.

2.4. Statistical Analysis

All data were analyzed using a one-factor ANOVA [24]. Using Duncan's multiple-range test, differences between treatment means were compared [25]. Statements of significance were based on P ≤ 0.05.

3. Results and Discussions

3.1. Growth Performance Parameters

The effect of using soybean bioactive peptide and vitamin E as feed additives on body weight development, body weight gain, feed intake, and FCR value of broiler chickens is presented in Table 2 and 3. It was noticed that body weights at different ages studied that soybean bioactive peptide (SBP) groups achieved the highest (p≤0.05) body weight during 2nd week (except 2.5 g/kg SBP), 3rd week, 4th week and 5th week as compared with control and vitamin E groups. While vitamin E supplementation had no discernible impact on body weight (except 3rdwks) as compared with the control. Concerning total body weight gain, SBP groups had the highest value as compared to other groups. The FCR values showed that SBP and vitamin E groups showed better FCR than the control group. On the other hand; the overall amount of feed consumed by birds was unaffected by the SBP and vitamin E supplement (P≥0.05). These results indicated that a broiler diet supplemented with 2.5, 5.0, and 7.5 5 g/kg SBP improved birds' BW, BWG, and FCR. This improvement could be related to the fact that adding bioactive peptides to a diet can boost the activity of intestinal enzymes, which could have contributed to the improvements in feed efficiency seen. [26, 27], and higher absorptive capability of the gut characterized by longer villi [16]. Or may be due to the ability of certain peptides to improve gut morphology and function (such as secretion, anti-inflammatory interactions, and motility) and endocrine status compared to an equivalent amount of free amino acids [4].

Table 2. Effects of soybean bioactive peptide and Vitamin E supplementation on body weight development (g/chick/week).

Body Weight	Control	Soybean bioactive peptide g/kg diets			VitE	SEM	*P*<
		2.5	5.0	7.5	250 (mg/kg)		
1st W	150.90	158.02	160.50	160.43	151.48	2.1855	0.488
2ndW	355.50^{b}	364.07^{b}	383.33^{a}	393.13^{a}	363.20^{b}	4.1015	0.001
3rdW	560.66^{c}	682.05^{a}	692.21^{a}	703.18^{a}	641.00^{b}	14.330	<0.001
4thW	993.96^{b}	1221.11^{a}	1162.78^{a}	1195.76^{a}	1051.03^{b}	26.374	0.002
5thW	1415.16^{b}	1758.45^{a}	1635.15^{a}	1707.00^{a}	1478.39^{b}	38.598	0.001

^{a,b} Means without common superscripts in the same row differ significantly (p≤0.05).

It has been demonstrated that some peptides extracted from plant sources (Plant peptides) or animal peptides possess antimicrobial activities [28,2,29], antioxidants [9,10,3], and immunomodulatory [11, 12], and all these characteristics improve the health status of birds, which is positively reflected in the improvement of their performance. Similar to our findings, Abdollahi et al. [16,17] reported that the addition of 5.0 and 6.0 g/kg SBP to broiler diets improved FCR. Furthermore, these studies showed that SBP inclusion in broiler diets has the potential to improve FCR and to be used as a novel functional protein in poultry diets. As well, our results concur with those obtained by Osho et al., [11] they revealed that diets containing 0, 1, 2, 3, 4, or 5 (g/kg) of commercial SBP supplemented caused a linear increase in the final BW, BW gains, and enhanced FCR when SBP levels in the feed for broiler chickens increased at days 15 and 22 post-hatching. This study confirmed that the biologically active peptides extracted from soybean seeds were of importance in enhancing birds' immunity and improving nutrient digestibility when included in the broiler chickens' diet. Wang et al., [30] and Mateos et al., [31] also reported that the inclusion of bioactive peptides resulted in higher weight gain and enhanced feed efficiency in broiler chickens. Previous studies did not find a significant effect of vitamin E supplementation on body weight, body weight gain, feed intake, or mortality rate, which is in line with our findings in broilers [32, 33]. Regarding production index, broilers fed diets with SBP

supplements with different levels had significantly ($p \leq 0.05$) better production index compared to the control and vitamin E groups. The highest values were recorded in 2.5 g/kg SBP (344.55), while the control diets recorded the lowest rate of PI (228.53), followed by vitamin E groups (265.03), which not significantly vary from one group to another. Concerning mortality (%), the different feed groups did not have any effect on this feature among all experimental groups (Table 5). As for the economic efficiency, it improved when peptides and vitamin E treatments were added. These results agree with, Zhao et al., [34] who found that by boosting growth rate and illness resistance, the economic value of growing hens was boosted by adding 0, 1.5, 3.0, 4.5, and 6.0 (g/kg) tiny peptides to their diet. As well, the authors indicating that best performance were recorded among the hens fed 4.5 (g/kg) level of small peptide. Additionally, in contrast to the result obtained in our study Abdollahi et al., [17] showed that the average mortality (%) during the whole grow-out (1- 42 d) period was 5.1 (%) when dietary supplementation with SBP at 0.0, 1.0, 2.0, 3.0, 4.0, 5.0 and 6.0 (g/kg) SBP in broiler diets, indicating that deaths were not related to any specific dietary treatment.

Table 3. Effects of soybean bioactive peptide and Vitamin E supplementation on growth performance of broiler chickens (1-35 d).

Parameters	Control	Soybean bioactive peptide g/kg diets			Vit. E 250 (mg/kg)	SEM	*P*<
		2.5	5.0	7.5			
Initial live weight (g)	150.90	158.02	160.50	160.43	151.48	2.1855	0.488
Final body weight (g)	1415.16^{b}	1758.45^{a}	1635.15^{a}	1707.00^{a}	1478.39^{b}	38.5983	0.001
Body weight gain(g)	1373.16^{b}	1716.45^{a}	1593.15^{a}	1665.00^{a}	1436.39^{b}	38.5983	0.001
Total feed intake (g/bird)	2586.35	2615.08	2452.87	2555.43	2397.19	49.0621	0.647
Efficiency Feed (g/g)	1.79^{a}	1.42^{b}	1.43^{b}	1.44^{b}	1.56^{b}	0.04545	.0140
Production Index (PI)	228.52^{b}	344.55^{a}	327.85^{a}	340.17^{a}	265.03^{b}	13.2233	<0.001
Economical efficiency	1661.18^{a}	1319.19^{b}	1329.20^{b}	1332.01^{b}	1445.04^{b}	41.896	0.013
Mortality (%)	2.77	2.77	0.00	0.00	2.77	0.8905	0.737

^{a,b} Means without common superscripts in the same row differ significantly ($p \leq 0.05$).

3.2. Carcass Charachrestics

The effect of soybean bioactive peptide and Vitamin E supplementation on carcass characteristics of broiler chickens is summarized in Table 4. There was no significant ($P \geq 0.05$) effect of SBP and vitamin E additives on carcass yield, total giblets, total edible parts, liver yield, and heart yield as compared to control. SBP supplementation in feed showed the highest ($P \leq 0.05$) carcass weight than vitamin E and the control group (Table 4). Birds with supplemented 2.5 and 5.0 (g/kg) SBP in their diet showed a significantly higher ($p \leq 0.05$) breast yield than other groups. The lowest thigh yield was observed in the vitamin E group, while the group with SBP had not changed as compared to the control. Results of gizzard relative weight (Table 4) showed that the vitamin E group had the highest significant value (3.22 %) as compared with other experimental groups. The abdominal fat percentage at 5 (g/kg) SBP groups was lower ($P \leq 0.05$) than control, while in the 2.5, 7.5 (g/kg) SBP and vitamin E the reduction was not significant compared to the control. Similar to our findings, Abdollahi et al., [17] stated that soybean bioactive peptide supplementation in broiler diets did not have any significant effects on carcass yield, or relative weights of liver, and heart. Mohammadrezaei et al., [35] reported that the relative weight of abdominal fat of broiler chickens was significantly lower for bioactive peptides derived from cottonseed meal (15 or 20 g/kg) than the control group. Differently from the current findings, Abdollahi et al., [17] reported no significant effects of SBP inclusion on the abdominal fat pad of broiler diets. Our results coincided with the finding of Mazur-Kusnirek et al.,

[18] who reported that broiler chicks fed on vitamin E performed higher than the control group in terms of gizzard weight and higher pH of gizzard digesta.

Table 4. Effects of soybean bioactive peptide and Vitamin E supplementation on carcass characteristic of broiler chickens.

Parameters (%)	Control	Soybean bioactive peptide g/kg diets			Vit. E 250 (mg/kg)	SEM	*P*<
		2.5	5.0	7.5			
Carcass weight (g)	1017.33^{c}	1291.66^{a}	1181.67^{ab}	1258.33^{a}	1106.66^{bc}	30.854	0.005
Carcass yield	71.33	72.95	71.69	73.16	74.23	0.5672	0.549
Breast yield	27.98^{b}	30.75^{a}	28.20^{b}	30.41^{a}	28.36^{b}	0.3678	0.005
Thigh yield	27.08^{ab}	27.81^{a}	28.45^{a}	26.74^{ab}	25.79^{b}	0.3153	0.045
[1]Total giblets	6.67	6.70	6.47	6.42	6.77	0.0926	0.767
[2]Total edible parts	78.00	79.65	78.17	79.58	81.00	0.5768	0.509
Liver yield	2.97	2.97	2.97	2.92	2.87	0.0702	0.992
Heart yield	0.68	0.68	0.66	0.67	0.68	0.0065	0.960
Gizzard yield	3.01^{b}	3.05^{b}	2.83^{c}	2.82^{c}	3.22^{a}	0.0436	0.001
Abdominal fat	1.24^{a}	1.02^{ab}	0.62^{b}	0.95^{ab}	0.96^{ab}	0.0794	0.050

^{a,b} Means without common superscripts in the same row differ significantly ($p \leq 0.05$), [1] Total giblets : (gizzard+ liver+ heart). [2] Total edible parts :(carcass yield + giblets).

Conclusion

This study indicates that the addition of soybean bioactive peptide resulted in better growth performance, production index, economic efficiency, and certain carcass traits for broiler chickens. Moreover, there was no significant impact on feed consumption or mortality.

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