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IMPACT OF DIETARY PROTEIN LEVEL AND FEED ADDITIVES ON GROWTH PERFORMANCE AND CARCASS TRAITS OF JAPANESE QUAIL

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ABSTRACT: A study was performed to investigate the effect of dietary protein level and addition of yeast or exogenous enzymes on growth performance and carcass characteristics of Japanese quail. A factorial completely randomized design (3×3), three dietary protein levels (24, 21.6 and 19.2%) without or with two feed additives was used. Five hundred and forty quails were randomly divided into nine groups, kept in cages, fed their respective experimental diets and managed similarly from 2 to 6 weeks of age. The obtained results illustrated that growth performance of quails did not affected by dietary protein level. Quails fed enzyme-enriched diets achieved better feed conversion than the control birds. Feeding yeast-supplemented diets improved the final body weight and weight gain of quails compared with the control birds. Economic efficiency of feeding (EEF) and carcass characteristics were not influenced by dietary protein level, feed additives and their interaction. In conclusion, decreasing dietary CP level from 24 to 19.2% does not compromise the growth performance, economic efficiency or carcass traits of quails. Dietary yeast supplementation has a beneficial effect on growth performance of quails, regardless of dietary CP level.

Keywords: Dietary protein, yeast, enzymes, growth performance, Japanese quail.

INTRODUCTION

In poultry industry, the feeding cost is around 70-80 % of the total cost of production. Dietary protein is the most expensive component of poultry diets. Thus, to achieve optimal performance and maximum profitability, poultry diets must be well-balanced in their amino acid pattern and other essential nutrients. On the other hand, the unutilized part of dietary nutrients may have an adverse effect on the health and performance of poultry and is a major source of eco-pollution. There are two ways to obtain optimal poultry performance: the first is to formulate well-balanced diets in terms of adequacy of all essential nutrients with ideal ratio of essential to non-essential amino acids, and the second is the enrichment of diets with natural growth promoters such as probiotics, prebiotics, synbiotics, phytobiotics, organic acids, enzymes, and antioxidants.

Quail is one of poultry species that can be raised for meat and egg production. Thus, it can contribute in solving the problem of animal protein shortage for humans. According to the National Research Council (NRC, 1994), the crude protein (CP) requirements of Japanese quail are tabulated as 24 and 20% for growing and laying periods, respectively. But because of the occurrence of newly created lines of Japanese quail with different rates of growth and productive performance, their CP and amino acids requirements may vary considerably. In this respect, Karaalp *et al*. (2009) reported that reducing dietary protein from 24 to 20% did not affect growth performance of growing Japanese quails. They concluded that dietary CP level for growing quails can be decreased to 20% concurrent with maintaining their recommended requirements of methionine, lysine and threonine. In a later study, Shayan *et al*. (2013) demonstrated that growth performance of Japanese quail was not affected by dietary CP level. El-Katcha *et al*. (2014) concluded that feeding dietary CP level of 21% could improve the growth performance and feed efficiency of Japanese quail chicks. While Rabie and Abo El-Maaty (2015) indicated that the ideal CP level is 24% for quail from 2 up to 6 weeks of age. But El-Damarawy *et al*. (2019) suggested that growth performance and carcass measurements of Japanese quail were not affected by reducing dietary protein level to 18%, under Egyptian conditions.

Nowadays, the use of probiotics and enzymes as growth promoters in poultry diets has become a common practice. In an excellent review, Mirza (2018) characterized the role of probiotics for poultry in four pathways: the 1st is maintaining normal intestinal microbial balance, the 2nd is changing metabolic pathways through improving activity of the digestive enzymes, the 3rd is improving feed intake and nutrient digestion, and the 4th is stimulating the immune system in poultry. Probiotic addition can prevent aflatoxicosis and enhance the growth performance and immunity of quails (Kasmani and Mehri, 2015), improve gut morphometric parameters and absorption capacity of broilers (Kan *et al*., 2020), can replace in-feed antibiotics and maximize broiler productivity (Ahiwe *et al*., 2021), can positively mitigate the stress applied to quail raised under high stoking density (Reda *et al.*, 2022), and can successfully enhance the growth performance and gross return of quails (Hossain and Momu, 2022). On the other hand, there are four major benefits of enriching poultry diets with exogenous enzymes: 1. To improve digestibility of nutrients, 2. To hydrolyze the antinutritional compounds naturally occurring in plant-derived feeds, 3. To minimize feed cost and 4. To reduce the environmental pollution (Nunes and Kumar, 2018).

Therefore, the present study was performed to study the effect of dietary protein level and supplementation of yeast or enzymes on growth performance, carcass characteristics and blood biochemical parameters of Japanese quail.

MATERIALS AND METHODS

Site and Date of Study:

The present research was performed at the Poultry Research Unit, Agricultural Research and Experimental Station, Faculty of Agriculture, Mansoura University, Egypt; during the period from the 6th of April, 2022 to the 4th of May, 2022.

Bird Management and Experimental diets:

In the starter period, unsexed 7-day-old Japanese quail chicks were put in floor pens and fed a common starter diet [containing 2900 kcal of metabolizable energy (ME) and 24% crude protein (CP)] for one week. At 14 days of age, 540 quail chicks were randomly divided into nine experimental groups, each contained four equal replications. Each replicate group (15 quails) was kept in a compartment of growing battery measuring 50 cm length, 50 cm width and 25 cm height. Three isoenergetic corn-soybean meal-based diets (CSMD) having a ME content of about 2920 kcal/kg and three CP levels (24, 21.6 and 19.2%: equivalent to 100%, 90% and 80%, respectively; of the recommended CP requirements of growing Japanese quail by NRC, 1994) were formulated. Other six diets were compounded by enriching the CSBD with two types of feed additives: Progut® (A yeast product) and Feedzyme (An enzyme preparation); thus, nine experimental diets were formulated and used. Each of the two feed additives was used at a level of 0.5 g/kg (0.05%) diet at the expense of corn. Progut® is new generation yeast feed ingredient provided by Suomen Rehu, Hankkija-Maatalous Oy, Helsinki, Finland. Feedzyme is an enzyme preparation containing high levels of xylanase and β-glucanase provided by Anpario Plc, Manton Wood Enterprise Park, Notting hamshire, UK. Each experimental group of quails was given its respective experimental diet from 2 to 6 weeks of age. Feed and fresh water were offered *ad libitum* and the birds were exposed to a photoperiod of 16 hours daily and managed similarly. The ingredient composition and calculated nutrient contents of the basal diets are given in Table 1.

Growth Performance Criteria:

The growth performance of Japanese quail chicks for the whole experimental period (2-6 weeks of age) was estimated as weekly live body weight (LBW), body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR; g feed: g gain), on a replication basis. Mortality was monitored and recorded daily throughout the whole experimental period. The economic efficiency of feeding (EEF) of growing quails was also measured for the entire experimental period. The EEF was calculated as net returns times 100 divided by the total feed cost (TFC). The latter was estimated as total FI multiplied by cost per kg feed. The total returns (EGP) was computed as total BWG multiplied by sale price of kg BWG (55 EGP). The net returns were determined as total returns minus TFC.

Carcass Measurements:

At 6 weeks of age, a slaughter test was carried out to determine carcass traits of quails. Six quail chicks (3 males and 3 females) were randomly selected from each treatment of approximately similar LBW and sacrificed after fasting for 12 hours. Just after complete bleeding, their carcasses were scalded, feather plucked and immediately processed. Individual weights of carcass yield (CY) and edible organs (liver, heart and gizzard) were determined. Thus, relative weights (% of LBW at slaughter) of CY, liver (LI), heart (HE) and gizzard (GI), and total edible parts (TEP) or dressing-out percentage (CY plus total giblets) were computed.

Experimental Design and Statistical Analysis:

A completely randomized design in a factorial arrangement of treatments (3×3), three dietary protein levels (24, 21.6 and 19.2%CP) and three levels of feed additives (0.0%, 0.05% Progut® and 0.05% Feedzyme) was used. The statistical processing of data was performed by using two-way analysis of variance of the General Linear Model (GLM) procedure of the Statistical Analysis System **(SAS Institute, 2006)**. When the main effects of dietary protein level and feed additives were significant ($P \leq 0.05$), means were separated by Duncan's new multiple range test **(Duncan, 1955)**. The following statistical model was used: $Y_{ij} = \mu + P_i + A_j + PA_{ij} + e_{ij}$. Where: Y_{ij} = observed traits; μ = the overall mean; P_i = effect of dietary protein; i= (1, 2 and 3); A_j = effect of additive; j = (0, 1 and 2); PA_{ij} = effect of interaction between dietary protein level and feed additives; e_{ij} = experimental random error.

RESULTS AND DISCUSSION

Growth Measurements:

First of all, no mortality was reported in Japanese quail chicks. The growth performance of quail as affected by dietary protein level and probiotic or enzyme supplementation is given in Table 2. Surprisingly, dietary CP level had no effect ($P>0.05$) on growth performance (LBW, BWG, FI and FCR) of quails, irrespective of applied feed additives. Aside from dietary protein level, it was observed that quails fed the enzyme-supplemented diets achieved slightly better final LBW and total BWG than the control birds and attained superior FCR ($P \leq 0.05$) to that of control ones which was insignificantly different from that of birds fed the yeast-enriched diets, but FI was unaffected. Although FI was not affected, feeding the yeast-enriched diets led to significant improvements ($P \leq 0.05$) in final LBW and cumulative BWG of quail chicks compared with the control ones but FCR was comparable to those of the control or quails fed the enzyme-supplemented diets, independently from dietary CP level. Also, dietary CP level, feed additives and their interaction did not affect the EEF. Quails fed the supplemented diets displayed slightly better EEF than did the non-supplemented birds. The dietary protein level by feed additives interactions had no effect on performance of quails.

The lack of significant effect of dietary CP level (24, 21.6 and 19.2%) on performance of growing quails, reported in this study, is an indication that dietary protein level can be reduced to 19.2% without any adverse effect on the performance of growing quails. In harmony with our results, Karaalp *et al*. (2009) found that reducing dietary CP from 24 to 20% had no effect on feed consumption, body weight gain and efficiency of feed utilization of growing Japanese quails. They concluded that dietary CP level for growing Japanese quails can be decreased up to 20% with maintaining their recommended requirements of methionine, lysine and threonine. Also, Shayan *et al*. (2013) demonstrated that growth performance of Japanese quail was not compromised when dietary protein level was reduced to 21%. Similarly, decreasing dietary CP level to 18% had no positive effects on growth performance but resulted in improvements in protein efficiency ratio and economic efficiency of feeding of Japanese quail (El-Damarawy *et al*., 2019).

Contrary to these results, Gheisari *et al*. (2011) investigated the growth performance of Japanese quails fed four dietary CP levels in each stage of growth period (26, 24, 22, 20%), (24, 22, 20, 18%) and (22, 20, 18 and 16%) for the starter (0-14 days), grower (15-28 days) and finisher (29-49 days of age), respectively. They found that increasing dietary CP level significantly increased growth rate of birds. At the same line, Rabie and Abo El-Maaty (2015) reported that lowering CP of the diet from 24 to 20% adversely affected the growth performance (LBW, BWG and FCR) of Japanese quails. Additionally, Reda *et al*. (2015) found that quail chicks fed 22% CP achieved significantly higher LBW and total BWG than did those fed the higher CP-diets (23.5 and 25%) from one to 5 weeks of age. In a later study, Hamid and Yassin (2018) found that quail birds fed the highest CP level (26%) gave the highest means of final LBW, BWG and the best FCR compared to those fed 24 and 22% CP-diets. In addition, Kouassi *et al*. (2020) evaluated five levels of dietary CP (18, 20, 22, 24 and 26%) for Japanese quails during the second three weeks of life and found that growth performance significantly improved as dietary CP level increased from 18 to 22% but dietary CP level beyond 22% had no beneficial effect.

In harmony with the current results, Sherif (2009) found that dietary enzyme supplementation to broiler chicks improved their marketing weight of chicks comparing with the control birds. Similar findings were obtained by Zahran *et al*. (2012), who found that Japanese quails fed Kemzyme Plus-supplemented diet achieved significantly higher FI, LBW, BWG and relative growth rate than those of the control group but FCR and protein efficiency ratio (PER) were not affected. In addition, Rabie and Abo El-Maaty (2015) reported that dietary enzyme supplementation positively affected quail performance compared with the controls but feed intake was unaffected. Furthermore, Arafa *et al*. (2019) reported a beneficial effect of phytase supplementation to Japanese quail diets on their growth performance (LBW, BWG, FCR, growth rate, performance index and mortality rate). On the contrary, Elangovan *et al*. (2004) found that dietary enzymes had no effect on growth performance of quails. Also, El-Damarawy *et al*. (2019) observed that growth performance of Japanese quail was not affected by dietary enzyme addition. In general, there is a consensus that the responsiveness to dietary enzyme supplementation in poultry may vary considerably based on many factors like kind of enzyme, its activity and specificity to substrate, its added dose, diet components, nutrient density, the experimental protocols, the managerial procedures and the avian factors.

The observed beneficial impacts of probiotic (Progut®) on growth performance of quails in this study agree with many published reports (Aliakbarpour *et al*., 2012; Bolacali and Irak, 2017; Bortoluzzi *et al*., 2018; Hajati *et al*., 2019; Sun and Kim, 2019; Abd El-Wahab *et al*., 2020). In this regard, Aliakbarpour *et al*. (2012) found that feeding diets supplemented with *Bacillus subtilis*- or lactic acid bacteria-based probiotics to broilers from one to 42 days of age resulted in significantly heavier final LBW than the control birds but feed intake was unaffected. They also indicated that broilers fed the *Bacillus subtilis*-based probiotic recorded better FCR than the control group but was not significantly different from those treated with the lactic acid bacteria-based probiotic. Similar beneficial effects of dietary probiotic addition for Japanese quail were observed by Bolacali and Irak (2017), who reported that female quails fed yeast autolysate-enriched diets (up to 4%) during the 6 weeks of life displayed superior final LBW to that of the control group. In the same study, the cumulative FCR was significantly improved when the supplemented diets contained up to 3.0% or 4.0% yeast autolysate in male and female quails, respectively compared with the control birds. They also indicated that dietary supplementation with yeast autolysate up to 4% significantly improved the total average daily gain of female quails comparing with the untreated birds. Similarly, Bortoluzzi *et al*. (2018) reported that dietary autolyzed yeast supplementation improved the broiler performance that vaccinated against coccidiosis coincided with the modification of the intestinal microbial balance and immune system. Also, Hajati *et al*. (2019) gave Japanese quails liquid probiotic-enriched drinking water from 1-6 weeks of age and found dramatic improvements in BWG and FCR concurrent with a significant decrease in FI compared with their control counterparts. In addition, Sun and Kim (2019) indicated that BWG and FCR of broiler chickens improved with increasing the mixed yeast culture in their diets (0.1 and 0.2%). Recently, Abd El-Wahab *et al*. (2020) demonstrated that dietary addition of yeast (1.5-3.5%) to Japanese quail from 14 to 35 days of age led to significant improvements in final LBW, BWG and FCR compared with the control birds, but total FI was not affected.

On the other hand, Rasheed and Al-Nuaimmi (2022) observed a significant reduction in LBW of Japanese quail at 7 weeks of age due to feeding yeast-enriched diet (2.5%) compared with their control counterparts. While, Tufan and Bolacali (2017) reported that the addition of synbiotic had no effect on LBW or BWG of quails but reduced FI and improved the FCR of quail chicks. Also, Mahrose *et al*. (2019) observed no positive effect of feeding probiotic-enriched diets (0.02 and 0.04g/kg diet) on growth performance (LBW, BWG, FI and FCR) of quails from1-6 weeks of age.

Carcass Characteristics:

Carcass traits of 6-week-old Japanese quails as affected by dietary CP level and probiotic (Progut®) or enzyme supplementation (Feedzyme) are presented in Table 3. It was evident that neither dietary protein nor applied feed additives affected carcass characteristics (the relative weights of carcass yield, liver, heart, gizzard, total giblets and total edible parts) of quail chicks. The interactions between dietary protein level and feed additives did not affect carcass traits of quails.

The lack of positive effect of dietary protein level on carcass traits, observed herein, concurs with the results of previous reports (Sharifi *et al*., 2011; Attia *et al*., 2012; Shayan *et al*., 2013; Reda *et al*., 2015; Rabie and Abo El-Maaty, 2015; Hamid and Yassin, 2018; El-Damarawy *et al*., 2019). In this respect, Sharifi *et al*. (2011) found that percentages of carcass yield, breast and thighs were not affected by dietary protein in Japanese quails. In addition, Attia *et al*. (2012) and Shayan *et al*. (2013) found that carcass traits of Japanese quail were not affected by dietary protein level. Similarly, Reda *et al*. (2015) demonstrated that relative weights of carcass yield and giblets of Japanese quails were not affected by feeding protein levels (22, 23.5 and 25%) from one up to five weeks of age. In the same context, Rabie and Abo El-Maaty (2015) showed that carcass characteristics were not significantly affected by dietary protein level (24, 22 and 20%) for 6-week-old Japanese quail. Also, Hamid and Yassin (2018) fed Japanese quails diets with three protein levels (22, 24 and 26%) from 3 to 6 weeks of age and found that the relative weights of breast, thigh, legs, wings and dressing-out percentage were not significantly affected by dietary protein level. Similarly, El-Damarawy *et al*. (2019) observed that diet protein level of Japanese quail had no positive effects on carcass characteristics.

In addition, our results revealed that carcass characteristics of Japanese quails were not altered by supplemental dietary enzymes. These results concur with the results of Rabie and Abo El-Maaty (2015) and El-Damarawy *et al*. (2019). In quails, carcass, and meat quality parameters were not affected by increasing dietary levels of fibrolytic enzymes (Mulaudzi *et al*., 2022). In broiler chickens, Sherif (2009) found that carcass traits (percentages of dressed carcass, liver, giblets, breast, legs, total edible parts and abdominal fat pad) were not affected by dietary enzymes. However, Chimote *et al*. (2009) found that carcass traits of Japanese quail were positively affected by dietary enzymes. In addition, Arafa *et al*. (2019) reported an improvement in carcass characteristics of Japanese quails due to dietary phytase supplementation.

Our results showed no beneficial effects of dietary probiotic supplementation (Progut®) on carcass traits. These results concur with those obtained by other investigators (Sahin *et al*., 2008; Tufan and Bolacali, 2017; Hajati *et al*., 2019). In this context, Sahin *et al*. (2008) determined the effects of feeding diets enriched with combiotics (probiotic + prebiotic, yeast cells) at 0.5, 1.0 and 1.5 g/kg, and found no beneficial effects on carcass traits (carcass yield and dressing percentage) of Japanese quails. In addition, Tufan and Bolacali (2017) evaluated the effects of different dietary levels of synbiotic on the carcass traits of Japanese quails and found that the addition of synbiotic had no effect on carcass characteristics (% of hot and cold carcass yield, wings, breast, back, legs, neck, liver, gizzard and breast skin) of quails. Also, Hajati *et al*. (2019) found that the relative weights of carcass yield, breast, thigh, liver, gizzard and spleen of Japanese quails were not affected by adding liquid probiotic to their drinking water. On the contrary, Bolacali and Irak (2017) found that female quails fed yeast autolysate-enriched diets displayed significantly higher hot and cold carcass weights compared with those of the control birds, whereas weights of heart, gizzard, legs, wings, back and neck were not affected. Similarly, Abd El-Wahab *et al*. (2020) reported that quail chicks fed yeast-enriched diets exhibited significantly higher carcass yield (%) and lower abdominal fat (%) than their control group but the percentages of liver, heart and gizzard were unaffected.

In conclusion, decreasing dietary CP level from 24 to 19.2% does not compromise the growth performance, economic efficiency or carcass traits of quails. Dietary yeast supplementation has a beneficial effect on growth performance of quails, regardless of dietary CP level.

Table (1): Diet composition and nutrient contents of the basal diets fed to Japanese quail chicks from 2-6 weeks of age

Ingredients (%)	**Dietary protein level (%)**		
	24	**21.6**	**19.2**
Ground yellow corn	55.29	60.90	64.40
Soybean meal (44% CP)	24.30	23.50	18.10
Corn gluten meal (60% CP)	12.10	8.00	6.50
Wheat bran	4.05	3.00	6.30
Ground limestone	1.30	1.40	1.40
Dicalcium Phosphate	1.80	1.80	1.80
NaCl (Common salt)	0.30	0.30	0.30
Vit. & Min. Premix[¶]	0.30	0.30	0.30
DL-methionine	0.10	0.20	0.20
L-Lysine.HCl	0.46	0.60	0.70
Total	100.00	100.00	100.00
Cost/kg feed (EGP)[ϴ]	8.29	8.03	7.76
Calculated analysis (NRC, 1994):			
ME (kcal/kg)	2917	2929	2917
CP (%)	24.02	21.62	19.22
Calorie: CP ratio	121.44	135.48	151.77
Ether extract (%)	2.72	2.79	2.94
Crude fiber (%)	3.52	3.41	3.46
Methionine (%)	0.54	0.57	0.53
Methionine plus Cystine (%)	0.94	0.94	0.87
Lysine (%)	1.31	1.35	1.31
Calcium (%)	0.96	0.99	0.98
Non-phytate phosphorus (%)	0.47	0.46	0.45

[¶]: Each 3 kg premix contains: Vit. A, 12,000,000 IU; Vit. D_3, 2,500,000 IU; Vit. E, 10 g; Vit. K, 2.5 g; Vit. B_2, 5 g; Vit. B_6, 1.5 g; Vit. B_{12}, 10 mg; Biotin, 50 mg; Folic acid, 1.0 g; Nicotinic acid, 30 g; Pantothenic acid, 10 g; Antioxidant, 10 g; Mn, 60 g; Cu, 10 g; Zn, 55 g; Fe, 35 g; I, 1.0 g; Co, 250 mg and Se, 150 mg.

[ϴ]: Cost/kg feed increased by 0.1 EGP due to supplementation with enzymes (Feedzyme) or probiotics (Progut®).

Table (2): Growth performance and EEF for Japanese quails as affected by dietary CP level and yeast (Y) or enzyme (E) supplementation from 2-6 weeks of age

Main effects:	Performance Criteria (g)					
	Initial LBW[1]	**Final LBW[1]**	**Total FI[2]**	**Total BWG[3]**	**Total FCR[4] (g:g)**	**EEF[5] (%)**
Dietary CP level (A):						
A1 (24%)	81.58	239.4	529.19	157.81	3.36	97.084
A2 (21.6%)	81.67	236.0	542.22	154.31	3.52	93.411
A3 (19.2%)	81.58	243.1	565.75	161.50	3.51	100.953
SEM	0.130	2.325	10.182	2.312	0.062	3.589
P value	0.8767	0.1155	0.0518	0.1078	0.1509	0.346
Feed additives (B):						
B1 = 0.0	81.47	234.2[b]	550.2	152.75[b]	3.607[a]	90.629
B2 = E (0.5 g/kg)	81.67	241.4[ab]	540.9	159.72[ab]	3.388[b]	100.427
B3 = Y (0.5 g/kg)	81.69	242.8[a]	546.1	161.14[a]	3.394[ab]	100.391
SEM	0.130	2.325	10.182	2.312	0.062	3.589
❖P value	0.4345	0.0317	0.8123	0.0359	0.0296	0.103
AB Interactions:						
A1×B1	81.08	232.5	536.8	151.42	3.55	87.463
A1×B2	81.83	240.9	528.2	159.09	3.32	98.297
A1×B3	81.84	244.8	522.6	162.92	3.22	105.490
A2×B1	81.84	225.0	526.2	143.17	3.68	86.719
A2×B2	81.67	239.8	545.3	158.17	3.45	96.461
A2×B3	81.50	243.1	555.2	161.58	3.44	97.052
A3×B1	81.50	245.2	587.5	163.67	3.59	97.706
A3×B2	81.50	243.4	549.3	161.92	3.40	106.522
A3×B3	81.75	240.7	560.5	158.92	3.53	98.631
SEM	0.226	4.027	17.636	4.005	0.108	6.216
P value	0.1396	0.0880	0.4522	0.0791	0.7606	0.688

❖: For feed additives, means within the same column having different superscripts differ significantly ($P \leq 0.05$).

[1-4]: Denotes to live body weight, feed intake, body weight gain and feed conversion ratio, respectively.

SEM: Refers to the standard error of the means.

Table (3): Carcass characteristics of 6-wk-old Japanese quails as affected by dietary CP level and yeast (Y) or enzyme (E) supplementation

Main effects:	**LBW[1] (g)**	**Carcass traits of quail chicks (%)**					
		CY[2]	**LI[3]**	**HE[4]**	**GI[5]**	**Giblets**	**TEP[6]**
Dietary CP level (A):							
A1 (24%)	240.8	70.19	2.62	0.87	1.59	5.07	75.26
A2 (21.6%)	238.9	69.86	2.49	0.89	1.77	5.16	75.02
A3 (19.2%)	242.5	70.61	2.65	0.88	1.61	5.13	75.75
SEM	6.186	0.578	0.112	0.036	0.078	0.159	0.609
P value	0.9184	0.6568	0.5891	0.8520	0.1861	0.9177	0.6934
Feed additives (B):							
B1=0.0	244.2	70.08	2.73	0.88	1.71	5.32	75.41
B2=E(0.5g/kg)	240.3	70.70	2.60	0.88	1.68	5.17	75.86
B3=Y(0.5g/kg)	237.8	69.88	2.43	0.88	1.57	4.87	74.76
SEM	6.186	0.578	0.112	0.036	0.078	0.159	0.609
P value	0.7643	0.5878	0.1744	0.9883	0.4003	0.1436	0.4438
AB Interactions:							
A1×B1	246.7	69.45	2.57	0.82	1.58	4.97	74.42
A1×B2	236.7	70.47	2.78	0.86	1.57	5.21	75.68
A1×B3	239.2	70.64	2.50	0.91	1.62	5.03	75.67
A2×B1	235.8	70.32	2.63	0.94	2.03	5.60	75.92
A2×B2	240.0	70.17	2.49	0.90	1.77	5.15	75.32
A2×B3	240.8	69.10	2.36	0.84	1.53	4.72	73.82
A3×B1	250.0	70.48	2.99	0.88	1.53	5.40	75.88
A3×B2	244.2	71.45	2.52	0.89	1.72	5.13	76.58
A3×B3	233.3	69.91	2.42	0.88	1.57	4.87	74.78
SEM	10.715	1.001	0.194	0.062	0.134	0.276	1.055
P value	0.8592	0.7631	0.4954	0.6221	0.2033	0.5192	0.5831

[1-6]: Denotes to live body weight at slaughter, carcass yield, liver, heart, gizzard and total edible parts, respectively.
SEM: Refers to the standard error of the means.

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الملخص العربى

تأثير مستوى بروتين العليقة والإضافات الغذائية على أداء النمو وخصائص الذبيحة للسمان الياباني

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اجريت هذه الدراسة لمعرفة تأثير مستوى بروتين العليقة وإضافة الخميرة أو الإنزيمات على الأداء الإنتاجي ومواصفات الذبيحة للسمان الياباني. في تصميم تجريبي عاملي تام العشوائية (3×3) ثلاث مستويات من بروتين العليقة (24، 21.6، 19.2%) بدون او مع اثنين من الاضافات الغذائية. تم توزيع 540 طائر سمان عشوائيا في تسع مجاميع تجريبية وزعت في اقفاص ، تمت التغذية على علائق تجريبية تحت ظروف رعائية متماثلة من اسبوعين حتى 6 أسابيع من العمر.

اوضحت النتائج المتحصل عليها أن الأداء الإنتاجي للسمان لم يتأثر بمستوى بروتين العليقة. السمان المغذى على علائق مزودة بالإنزيمات حققت معامل تحويل غذائي افضل من مجموعة الكنترول. التغذية على العلائق المزودة بالخميرة حسنت الوزن النهائي للطيور ومعدل الزيادة الوزنية مقارنة بطيور مجموعة الكنترول. الكفاءة الاقتصادية ومواصفات الذبيحة لم تتأثر بكلا من مستوى بروتين العليقة والاضافات الغذائية أو التفاعل بينهما.

من النتائج السابقة يمكن استنتاج خفض مستوى بروتين العليقة من مستوى 24% حتى 19.2% لم يؤثر سلبيا على الأداء الإنتاجي أو الكفاءة الاقتصادية أو مواصفات الذبيحة للسمان الياباني لكن اغناء العليقة بالخميرة كان له تأثير إيجابي على الأداء الإنتاجي للسمان الياباني بغض النظر عن مستوى بروتين العليقة.