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Growth Performance and Carcass Traits of Japanese Quails Fed on *Spirulina Platensis* Supplementation

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Abstract

THE AIM of this study was to investigate how different levels of dietary *Spirulina platensis* affected Japanese quail strains growth performance, carcass traits, and sensory meat evaluation. The addition of several distinct dietary *Spirulina platensis* had a substantial impact on growth traits, dressing, liver percentages, and sensory meat evaluation. A higher significant of growth traits were observed at concentration of 7.5g of *SP* in diet on final body weight (235.33g), and total body weight gain (189.86) compared to control one (221.20g, and 175.65). In terms of strain impact, the results showed that the brown strain had a considerable rise in FBW, and TBWG when compared with the white strain. The percentages of dressing, gizzard, spleen, and meat juiciness of white strain were noticeably greater than brown strain. All growth performance, carcass traits, and meat evaluation were significantly different, in terms of the interaction between treatment and strain. From a productive point of view, supplementation with 7.5g of *SP* is recommended for Japanese quail. It could be concluded that the addition of different levels of Spirulina platensis had significant impact on dressing percentage and improve sensory meat evaluation without negative influences on growth performance especially 7.5g of *Spirulina platensis* was the best one.

Keywords: Japanese quail strains, *Spirulina platensis*, Growth performance, Carcass traits, Meat evaluation.

Introduction

The poultry industry is one of the most profitable production sectors worldwide, producing high-biological value animal protein. Quail farming is gaining interest and has the potential to greatly help to alleviating the animal protein gap in Egypt and developing nations. From an economic standpoint, the Japanese quail (*Coturnix coturnix japonica*) is regarded as one of the most important species in the poultry industry due to its distinct physiological characteristics, which include rapid growth rate, effective reproductive potential, short life cycle, disease resistance, and early sexual maturity [1].

Quail meat is considered a nutritious meat due to its high protein content, low fat and cholesterol levels, fatty acid profile, and vitamin (pyridoxine, niacin, thiamin, pantothenic acid, and riboflavin) and mineral content (copper, iron, manganese, and zinc) [2]. It is also regarded as an alternative source of protein for human consumption, particularly in developing countries [3].

Concerns about food safety and the use of antibiotic growth promoters (AGPs) in animal feed have led to a demand for AGP-free products [4]. Spirulina platensis has been studied as a potential alternative to AGP in animal production. Spirulina contains numerous nutrients, including amino acids, protein, fatty acids, carotenoids, minerals, vitamins, xanthophyll phytopigments, phycocyanins, phenolic acids, chlorophyll, and gamma linoleic acid [5]. Previous research has demonstrated that Spirulina platensis's potent antioxidant, antibacterial, immunostimulant, and disease resistance qualities are caused by its bioactive components, which include phycocyanin, gamma-linolenic acid, beta-carotene, and phenolic compounds [6]. Spirulina, a highly nutritious, harmless, and nontoxic organism, is utilized as a supplementary food source and growth booster for livestock due to its high iron content,

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protein, phosphorus, and essential and nonessential amino acids [7].

The majority of previous research concentrated on the beneficial effects of Spirulina on immunology and development; nevertheless, these investigations did not discover any influence on the sensory quality of meat, especially in two strains of Japanese quails (Coturnix japonica). Consequently, the goal of this study is to investigate how S. platensis performs as a feed additive and substitute for antibiotics in terms of growth performance, carcass characteristics, and sensory meat evaluation.

The current study was therefore designed to assess the effectiveness of using different levels of Spirulina platensis as feed additive, growth performance, carcass traits, and sensory meat evaluation of two strains of Japanese quail.

Material and Methods

Experimental design, birds and management

The Mansoura University Animal Care and Use Committee (MU-ACUC) has approved the experimental protocol with code number (VM.MS.23.04.51). The present study was conducted at the poultry research farm at the Faculty of Agriculture, Mansoura University, Egypt.

A total of 300 one-day-old female chicks from two strains of Japanese quail, white strain (n = 150) and the brown strain (n = 150)—were used in a completely randomized factorial experiment. These birds were obtained from Research Center, Kafr El-Shaikh. They were divided into five equal groups/strain (30 quails/treatment), with three replicates (10 quail/R) for each treatment. The battery cages provided an identical environment for the birds' upbringing. Japanese quail, both brown and white varieties, were kept in battery cages (wire cages 40 x 40 x 30 cm), with each variety receiving one of four treatments and a control at random.

A reasonable relative humidity level was about 30-38% and the ambient temperature was kept at 30°C and was gradually decreased to 3°C per week until it reached a range of 24°C. A light intensity of 10 lux (one foot candle) was used for 24 hours each day. The air was exhausted by using large fans. Diets were formulated and prepared for Japanese quail that consisted of 24% Crude Protein (CP) and 2900 kcal ME/Kg (Table 1). Nutrients and energy concentrations of diets met National Research Council or exceeded minimum nutrient recommendations (NRC1994) [8]. Within the experimental set up, Japanese quail in the control group were provided. In contrast the other four experimental treatment supplemented with different level of Spirulina platensis listed in (Table 2).

Growth performance parameters

At the end of experiment, final body weight (FBW) was individually recorded. Body weight gain (BWG) was calculated by subtracting the body weight between two successive weights described by [9]. Feed intake (g) was calculated as the difference between the weight of offered food and the weight of remaining food. Feed conversion ratio (FCR) was estimated by diving the amount of feed intake (g) during the week by the weight gain (g) FI/ gain [10].

Carcass traits

At the end of the experiment (day 42 of age), nine quails from each group (3/replicate) were randomly selected, weighed, kept separately, fastened for 12hr before slaughtering to measure carcass traits. Slaughtering was done by cutting jugular veins and carotid arteries. Each bird was dipped in warm water bath for two minutes and feathers were removed by hand. Internal organs (liver, heart, gizzard, and spleen) were separated and weighed individually, with the calculation of their percentages in relation to live body weight. Carcass without any organs were weighed then dressing percentage was calculated as the formula according to (Kamel et al.,) [11].

$$Dressing\% = \frac{hot\ carcass\ weight}{live\ weight} \times 100$$

Sensory meat evaluation

Representative quails from each study group were prepared as home cooking without the use of any additives. Eleven skilled panelists evaluated and determined the color, aroma, taste, juiciness, tenderness, and overall acceptability of one breast cut. The panelists were employees of the Mansoura University faculty of veterinary medicine's departments of food safety and hygiene and husbandry and development of animal wealth. The samples were presented to the panelists in covered serving dishes labeled with random numbers after being chopped into uniform size pieces that could be picked up with a fork [12]. For meat color, aroma, and taste, a nine-point hedonic scoring system was used; for meat juiciness, tenderness, and general acceptability, an eight-point scoring system was used.

Statistical analysis

Data were tested for distribution normality, and homogeneity of variance. Statistical analyses were performed using SPSS software ver. 27.0 (IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp). The effects of treatment, strain, and interaction were analyzed using a general linear model. To investigate the effects of treatment, strain, and interaction on growth traits, carcass characteristics, and sensory meat quality, two-way ANOVA was used. Data are reported as means ± SE and the Duncan's multiple range test was used as a post hoc test to determine the nature of the significant effects. Differences were considered significant at the level of P≤ 0.05.

Results

Growth performance

The effect of Spirulina platensis levels on FBW, TBWG, TFI, and total FCR is displayed in (Table 3). The use of various inclusions of dietary Spirulina platensis had a significant impact on growth performance except for TFI, and total FCR. A higher significant of growth traits were observed at concentration of 7.5g of SP in diet on FBW (235.33g), and TBWG (189.86g) compared to control and other treatment groups (*P*=0.013, and *P*=0.004). However, the lack of significant noticed in TFI, and total FCR (*P*=0.785, and *P*=0.165). In terms of strain impact, the obtained results revealed that brown strain was showed significant increase in FBW, TBWG, and TFI compared with white strain (*P*=0.004, *P*=0.025, and *P*<0.001, respectively). While there were no significant differences between two strains for total FCR. Regardless of interaction between treatment and strain, a significant difference was found in all growth parameters (*P<0.001*).

Carcass traits

As described in Table 4, there was significant difference between treatment groups and the control group in dressing and liver percentages (*P*=0.033, *P<0.001*, respectively). On the other hand, heart, gizzard, and spleen percentages did not differ among control and treatment groups (*P*=0.375, *P=0.912*, *P*=0.488, respectively). Referring to the strain effect, the percentages of dressing, gizzard, and spleen of white strain were significantly greater than that of brown strain (*P=0.018*, *P=0.009*, *P*=0.021, respectively). However, lack of significant observed in liver, and heart percent among two strains of Japanese quail (*P*=0.702, *P=0.294*, respectively). The effects of interactions between genetic type and dietary SP levels were significant in all carcass parameters (*P<0.001*, *P<0.001*, *P*=0.019, respectively) except for gizzard, and spleen percentages (*P*=0.081, *P=0.491*, respectively).

Sensory meat evaluation

The impact of various concentration of dietary SP on sensory meat quality is presented in Table 5. Significant differences in all sensory meat evaluation such as aroma, taste, juiciness, tenderness, and overall acceptability (*P<0.001*) were found among different treatments and control group except for meat color. Regarding the strain effect, no significant effects in meat evaluation were demonstrated between two strains of Japanese quail except for juiciness. White strain had significantly(*P=0.019*) increase juiciness compared with the brown strain. A significant interaction effect between strain and treatment was exhibited (*P< 0.001*) for all parameters of meat evaluation except for meat color.

Discussion

The current study aimed to assess the effects of varying dietary Spirulina platensis levels on the growth performance, carcass characteristics, and sensory evaluation of meat in Japanese quail strains.

In this study, all growth traits were significantly impacted by the usage of different dietary Spirulina platensis inclusions, with the exception of total FCR and TFI. As a result, spirulina platensis microalgae are a natural source of numerous compounds, including high protein, minerals, fatty acids, polysaccharides, pigments, and essential vitamins, as well as having an antioxidant effect, it is possible to explain the observed increases in body weight and body gain of the treated groups.

These findings were consistent with those of Cheong et al. [13], who demonstrated a significant increase (p<0.05) in quail weight and weight gain when fed diets containing varying amounts of *Spirulina Platensis* (1, 2, 4, and 8%) in comparison to the control group. Similarly, Yusuf et al. [14] found that quail fed on diets containing 1, and 2 g of Spirulina Platensis/ kg VPD and 2 g of (SP)/ kg FMPD recognized boosted final body weight and weight gain (P<0.05). Our findings completely corroborate those of Dogan et al. [15], who found that adding Spirulina Platensis at doses of 0, 5, 1, and 2% significantly altered the quail's final body weight (p<0.05) in comparison to control groups while having no influence on FI or FCR. Comparability, these results were in line with those of Abouelezz [16], who found that the quail group fed a diet containing 1% of Spirulina powder in feed and 0.25% of it in drinking water (237.6, and 239.6g) had greater final body weights and weight gain than the control group (227.7g).These results concur with those of Amer [17], who reported that quail groups fed a diet containing Spirulina Platensis algea experienced increased body weight and weight gain than the control group fed a basal diet.

Nevertheless, the outcomes contradicted those of Hajati and Zaghari [18], who found that feeding quail with a diet of 20g *SP*/kg increased feed intake significantly (P<0.05) during the raising period, especially in the first week (43.80g compared to 38.16g) and second week (126.06g compared to 112.33g), and decreased feed conversion rate (FCR). Whereas Abd Elzaher et al. [19] reported a decrease in FCR, the study mostly aligns with the current findings that the increase in quail feed intake was not statistically significantly different across the different dosages of SP (P >0.05).

Referring to the strain effect, the Japanese quail of the brown strain outperformed the white strain in terms of final body weight, TBWG, TFI, and total

FCR. Our study conflict with those of Elkhaiat et al. [20], who observed notable variations between the brown and white strains of Japanese quail, with the white strain having a higher body weight than the brown strain, which may be related to the genetic composition of the strains and higher body weight of this genotype.

With respect to the interaction between treatment (SP) and strain (brown and white Japanese quail), there were significant changes in final body weight, total body weight increase, total feed intake, and total feed conversion ratio. *Spirulina platensis* microalgae concentration variations and genetic variations between the brown and white strains may be used to identify the interactions between treatment and strain that result in these discrepancies in results.

Regarding the impact of the treatment on carcass characteristics, the results showed a more notable distinction in dressing and liver percentages as compared to the control group. Conversely, there was no effect of varying *SP* levels on the percentage of the heart, gizzard, and spleen. These variations were linked weight of live and dressed carcass as well as *Spirulina Platensis (SP),* which has a high nutritional content and contains a variety of nutrients, including vitamins and minerals that may support the stimulation of growth.

The current results, in contrast to those of Cheong et al. [13], demonstrated that there was no appreciable effect of SP in the quail diet on dressing yields (P>0.05). In contrast, our results disagreed with Yusuf et al. [14] shown that a vegetarian diet of quail at 1, 2g SP/kg might not have a significant impact on the proportion of quail that is dressed (68.5%) and the quality of the flesh (68.5%). Furthermore, the outcomes agreed with Hajati and Zaghari [18] found that feeding quail with a diet of 2.5 or 5g SP/kg increased the carcass yield quantitatively (P<0.05) (69.06 and 68.33%) in comparison to the control (67.89%). Conversely, Abd Elzaher et al. [19] found that adding SP at doses of 0.25 or 0.5g/kg to the diet of growing quail increased the carcass yield in a non-significant (P >0.05) but quantitative (83.55, and 86.50 vs. 78.27%) manner. Alghamdi et al. [12] claimed that there were no appreciable variations in the proportions of quail carcass, liver, or total giblets among the various treatments of SP (P>0.05). The documented results, however, totally contradict their findings.

Concerning the strain effect, our findings demonstrated that the Japanese quail of the white strain had a greater increase in dressing%, gizzard%, and spleen% of various treatments than the Japanese quail of the brown strain. The liver and heart percentages of the two strains of Japanese quail, brown and white, do not significantly differ from one another. These findings were in disagreement with those of Sabow (2020) [21], who showed notable variations between the brown and white strains of Japanese quail. The brown strain showed higher dressing percentage (66.46%), slaughter weight (237.90g), and carcass yields than the white strain, which could be attributed to genotype variations in the strains as well as variations in slaughter weight and genetic factors.

In terms of the association between treatment and strain, there were notable variations in the percentages of the heart, liver, and dressing, with the exception of the spleen and gizzard. These variations in the outcomes of the treatment-strain interaction may be related to the combination of the genetic variations of the brown and white strains as well as the distinct inclusion of *Spirulina platensis* microalgae.

In related to the impact of the treatment on the evaluation of meat sensor quality, the present findings revealed that there were notable variations between the various *Spirulina platensis* levels, along with enhanced flavor and aroma and increased meat juiciness, tenderness, and overall acceptability (P< 0.001). The outcomes were validated by Cheong et al. [13], who demonstrated that quail flesh tenderness rose by up to 4% and meat toughness decreased (P<0.05) in diets containing spirulina. The main factor responsible for the increased meat quality was found to be spirulina. Nevertheless, Pestana et al. [22] found that dietary interventions had no effect on meat tenderness, flavor, off-flavor, or overall acceptability (P>0.05). These results are entirely at conflicts with their findings. The report also agreed with Alghamdi et al. [12], who found that quail meat quality was enhanced by the addition of *SP* extract at four different doses (1 ml, 2 ml, 3 ml, and 4 ml).

Considering the strain effect, the present study's findings revealed that the white Japanese quail strain had much more juiciness than the brown Japanese quail strain. The brown and white Japanese quail did not differ significantly in terms of color, aroma, taste, tenderness, or acceptance overall. The genetic variance between the brown and white strains was the cause of these variations.

Regarding the correlation between treatment and strain, there were notable variations in the sensory quality of the meat (P<0.001), with the exception of flesh color. Aroma, taste, juiciness, tenderness, and general acceptance were found to be more significant. *Spirulina platensis* microalgae incorporation differences and the genetic differences between the brown and white strains may be the cause of these variations in the results of the interaction between treatment and strain.

Conclusion

In conclusion, it can be assumed that the use of multiple unique dietary *Spirulina platensis* significantly affected the growth performance, dressing, liver percentages, and sensory meat evaluation. When comparing the brown strain to the white strain, the results indicated that the brown strain had a significant increase in final body weight, total body weight gain, and total feed intake in terms of strain impact. Whereas the juiciness of meat, and the proportions of dressing, spleen, and gizzard of white strain were noticeable higher than brown strain. Regardless of the interaction between treatment and strain, there were substantial differences in all growth performance, carcass traits, and meat evaluation. Productively, growth performance, and carcass traits were significantly increased in quails fed on 7.5 gram of dietary Spirulina platensis.

Conflict of interest statement

The authors have disclosed that they do not hold any conflicts of interest related to the publication of this article.

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Ethical approval

The research was ethically sanctioned by the Mansoura University Animal Care and Use Committee (MU-ACUC) resulting in the issuance of an ethical approval number, (VM.MS.23.04.51).

Author`s contribution

The authors confirm that the data supporting the findings of this study is available within the article. Authors' contribution Sally M. Ali Megahed designed the study protocol and supervised data collection procedures, Hanaa M. Ghanem, Azhar Eltanahy, and Mohammed M. Fouda finalized the experimental design, revised the manuscript, and contributed to, edited, and approved the final manuscript as submitted.

TABLE 1. Ingredients, composition, and calculated chemical analysis of basal diets for growing quail.

Ingredients	Growing diet
Yellow corn	52.2
Soybean meal	39.1
Corn gluten	4
Mixed oil	0.575
Limestone	1.75
Di-calcium phosphate	1.3
Salt	0.3
Vitamin and min. Premix	0.3
Lysine	0.18
DL-methionine	0.16
Calculated analysis	
Metabolizable energy (ME)	2900
Crude protein (CP%)	24
Ether extract	2.89
Crude fiber	3.61
Calcium%	0.912
Total phosphorus	0.691
Lysine%	1.345
Methionine	0.586

Each 3.0 kg of Vit. And Min. premix contains Vit. A=12000000 IU, Vit.D3=2500000 IU, Vit.E=10g. Vit.K=2.5g, Vit. BI=1.5g, B2=2.5, B6=1.5G, B12=1.5g, choline chloride=1050 g, Biotin= 50 mg, folic acid Ig, nicotinic acid=30g, calcium banthenate= 10g zinc=55g, cu=10g, Fe=35g, CO=250mg, Se=150mg, I=1g, Min=60g and antioxidant 10 g.

TABLE 2. Experimental design

Group	Treatment
Control	The standard basal diet and additive-free water.
T1	Received 2.5 grams of Spirulina platensis per kilogram of basal diet.
T2	Used 5 grams of Spirulina platensis per kilogram of basal diet.
T3	Included 7.5 grams of Spirulina platensis per kilogram of basal diet.
T4	Involved 10 grams of Spirulina platensis per kilogram of basal diet.

TABLE 3. Effect of different levels of experimental treatments of Spirulina Platensis in diet of two different commercial Japanese quail strains on growth performance.

Growth Performance(Means ± Standard Error)					
		FBW	**TBWG**	**TFI**	**Total FCR**
Treatments Effect (T)					
Control		221.20^{b}±0.42	175.65^{c}±0.12	574.80±1.66	3.27±0.01
T1		229.08^{ab}±1.52	183.73^{ab}±1.91	574.53±1.41	3.12±0.09
T2		226.66^{b}±2.92	180.98^{bc}±2.52	581.35±1.30	3.21±0.01
T3		235.33^{a}±3.47	189.86^{a}±2.94	586.01±3.19	3.08±0.03
T4		226.68^{b}±3.13	181.16^{bc}±2.68	583.91±4.55	3.22±0.07
Strain Effect (S)					
Brown		231.56^{a}±1.94	185.08^{a}±1.90	590.79^{a}±3.49	3.19±0.03
White		224.02^{b}±1.37	179.47^{b}±1.40	569.45^{b}±4.51	3.17±0.04
Treatment * Strain Interaction Effect (T*S)					
	Control	222.13^{c}±0.12	175.73^{c}±0.12	577.56^{c}±1.80	3.29^{bc}±0.01
	T1	225.66^{c}±0.14	179.46^{b}±0.32	599.90^{b}±2.74	3.33^{b}±0.01
Brown	T2	233.20^{b}±0.05	186.63^{b}±0.12	606.50^{b}±2.40	3.25^{c}±0.01
	T3	243.15^{a}±0.05	196.43^{a}±0.08	596.20^{b}±0.43	3.03^{c}±0.00
	T4	233.70^{b}±0.15	187.16^{b}±0.12	573.80^{c}±0.50	3.04^{c}±0.01
	Control	220.26^{c}±0.08	175.56^{c}±0.23	572.03^{c}±1.69	3.25^{c}±0.01
	T1	232.50^{b}±0.05	188.00^{b}±0.15	549.17^{d}±0.26	2.92^{d}±0.00
White	T2	220.13^{c}±0.17	175.33^{c}±0.23	556.20^{d}±1.10	3.17^{c}±0.01
	T3	227.56^{c}±0.14	183.30^{c}±0.36	575.83^{c}±0.38	3.13^{c}±0.05
	T4	219.66^{c}±0.12	175.16^{c}±0.20	594.03^{b}±1.00	3.40^{a}±0.01
P-value					
T		0.013	0.004	0.785	0.165
S		0.004	0.025	<0.001	0.798
T*S		<0.001	<0.001	<0.001	<0.001

The mean values with different superscript letters within the same column differ significantly at (P ≤ 0.05).
T1: 2.5g/kg SP in diet. T2: 5g/kg SP in diet. T3: 7.5g/kg SP in diet. T4: 10g/kg SP in diet. FBW: Final body weight, TBWG: Total body weight gain, TFI: Total feed intake, FCR: Feed conversion ratio.

TABLE 4. Effect of different levels of experimental treatments of Spirulina Platensis in diet of two different commercial Japanese quail strains on carcass traits.

Carcass Traits(Means ± Standard Error)						
Parameters		**Dressing %**	**Liver %**	**Heart %**	**Gizzard %**	**Spleen %**
Treatment Effect (T)						
Control		67.51^{ab}±0.57	2.71^{c}±0.07	0.81±0.02	2.01±0.12	0.07±0.01
T1		65.00^{b}±0.93	2.18^{d}±0.03	0.79±0.05	1.92±0.07	0.08±0.00
T2		69.94^{a}±0.86	2.86^{b}±0.04	0.91±0.04	2.00±0.10	0.09±0.01
T3		67.08^{ab}±1.68	2.69^{c}±0.03	0.88±0.02	1.90±0.18	0.08±0.01
T4		67.99^{ab}±0.56	3.06^{a}±0.01	0.90±0.09	2.06±0.17	0.08±0.01
Strain Effect (S)						
Brown		66.32^{b}±0.71	2.68±0.08	0.88±0.03	1.83^{b}±0.06	0.07^{b}±0.00
White		68.69^{a}±0.62	2.72±0.09	0.83±0.03	2.12^{a}±0.08	0.09^{a}±0.00
Treatment * Strain Interaction Effect (T*S)						
	Control	68.41^{bc}±0.73	2.66^{cd}±0.15	0.84^{b}±0.00	2.09±0.15	0.07±0.00
	T1	63.37^{d}±0.94	2.24^{e}±0.03	0.74^{b}±0.07	1.84±0.09	0.07±0.00
Brown	T2	68.51^{bc}±0.75	2.80^{bc}±0.02	0.89^{b}±0.08	1.87±0.14	0.08±0.00
	T3	63.36^{d}±0.62	2.62^{d}±0.01	0.87^{b}±0.02	1.64±0.15	0.08±0.02
	T4	67.96^{c}±0.90	3.07^{a}±0.01	1.07^{a}±0.00	1.72±0.07	0.07±0.01
	Control	66.62^{c}±0.55	2.76^{cd}±0.02	0.79^{b}±0.03	1.93±0.22	0.08±0.01
	T1	66.63^{c}±0.90	2.12^{e}±0.03	0.84^{b}±0.06	1.99±0.12	0.09±0.00
White	T2	71.38^{a}±1.04	2.93^{ab}±0.06	0.92^{ab}±0.03	2.13±0.12	0.09±0.01
	T3	70.79^{ab}±0.16	2.76^{b}±0.01	0.89^{b}±0.05	2.16±0.27	0.09±0.01
	T4	68.02^{c}±0.87	3.05^{a}±0.02	0.74^{b}±0.10	2.40±0.14	0.08±0.01
P-value						
T		0.033	<0.001	0.375	0.912	0.488
S		0.018	0.702	0.294	0.009	0.021
T*S		<0.001	<0.001	0.019	0.081	0.491

The mean values with different superscript letters within the same column differ significantly at (P ≤ 0.05). T1: 2.5g/kg SP in diet. T2: 5g/kg SP in diet. T3: 7.5g/kg SP in diet. T4: 10g/kg SP in diet.

TABLE 5. Effect of different levels of experimental treatments of Spirulina Platensis in diet of two different commercial Japanese quail strains on sensory meat evaluation.

Sensory Meat Evaluation (Means ± Standard Error)							
		Color	**Aroma**	**Taste**	**Juiciness**	**Tenderness**	**Overall acceptability**
Treatments Effect (T)							
Control		8.43±0.23	7.43^{ab}±0.25	6.50^{b}±0.29	6.50^{b}±0.25	6.36^{c}±0.25	6.71^{b}±0.22
T1		8.21±0.19	8.00^{a}±0.21	8.21^{a}±0.21	8.21^{a}±0.19	8.14^{a}±0.21	8.07^{a}±0.27
T2		7.93±0.22	5.93^{c}±0.32	5.21^{c}±0.26	4.71^{c}±0.24	5.14^{d}±0.25	4.43^{d}±0.27
T3		8.14±0.21	7.36^{ab}±0.27	5.93^{bc}±0.29	5.36^{c}±0.23	5.50^{d}±0.23	5.07^{cd}±0.25
T4		8.21±0.21	6.64^{bc}±0.43	6.43^{b}±0.33	6.71^{b}±0.44	7.36^{b}±0.25	5.64^{c}±0.55
Strain Effect (S)							
Brown		8.14±0.13	6.97±0.22	6.29±0.25	5.86^{b}±0.27	6.49±0.22	5.83±0.31
White		8.23±0.14	7.17±0.23	6.63±0.23	6.74^{a}±0.25	6.51±0.26	6.14±0.30
Treatment * Strain Interaction Effect (T*S)							
Brown	Control	8.43±0.30	7.29^{ab}±0.29	6.29^{bcd}±0.42	6.57^{b}±0.37	5.86^{c}±0.34	7.00^{ab}±0.22
	T1	8.29±0.29	8.29^{a}±0.29	8.29^{a}±0.29	8.14^{a}±0.26	8.29^{a}±0.29	8.14^{a}±0.34
	T2	8.00±0.31	6.71^{b}±0.36	5.29^{d}±0.42	4.43^{d}±0.37	5.43^{c}±0.37	4.57^{de}±0.37
	T3	8.14±0.26	7.29^{ab}±0.42	5.86^{cd}±0.51	4.86^{d}±0.26	5.86^{c}±0.26	5.43^{cd}±0.30
	T4	7.86±0.34	5.29^{c}±0.29	5.71^{cd}±0.42	5.29^{cd}±0.29	7.00^{b}±0.22	4.00^{e}±0.53
White	Control	8.43±0.37	7.57^{ab}±0.43	6.71^{bc}±0.42	6.43^{b}±0.37	6.86^{b}±0.26	6.43^{bc}±0.37
	T1	8.14±0.26	7.71^{ab}±0.29	8.14^{a}±0.34	8.29^{a}±0.29	8.00^{a}±0.31	8.00^{a}±0.44
	T2	7.87±0.34	5.14^{c}±0.34	5.14^{d}±0.34	5.00^{cd}±0.31	4.86^{c}±0.34	4.29^{de}±0.42
	T3	8.14±0.34	7.43^{ab}±0.37	6.00^{bcd}±0.31	5.86^{bc}±0.26	5.14^{c}±0.34	4.71^{de}±0.36
	T4	8.57±0.20	8.00^{a}±0.31	7.14^{ab}±0.34	8.14^{a}±0.26	7.71^{ab}±0.42	7.29^{ab}±0.36
P-value							
T		0.583	<0.001	<0.001	<0.001	<0.001	<0.001
S		0.651	0.531	0.316	0.019	0.934	0.462
T*S		0.759	<0.001	<0.001	<0.001	<0.001	<0.001

The mean values with different superscript letters within the same column differ significantly at ($P \leq 0.05$). **T1**: 2.5g/kg SP in diet. **T2**: 5g/kg SP in diet. **T3**: 7.5g/kg SP in diet. **T4**: 10g/kg SP in diet.

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أداء النمو وخصائص الذبيحة لطائر السمان اليابانى المغذى على طحالب سبيرولينا بلاتنسيس كمكملات غذائية

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الملخص

هدفت هذه الدراسة إلى التحقيق في كيفية تأثير مستويات مختلفة من سبيرولينا بلاتينسيس الغذائية على أداء نمو السمان الياباني البنى والابيض، وصفات الذبيحة، وتقييم اللحوم الحسية. كان لإضافة العديد من سبيرولينا بلاتينسيس الغذائية المميزة تأثيرًا كبيرًا على سمات النمو، وتصافى الذبيحة، ونسبة الكبد، وتقييم اللحوم الحسية. لوحظت صفات نمو أعلى بشكل ملحوظ عند تركيز 7.5 جرام من سبيرولينا بلاتينسيس في النظام الغذائي على وزن الجسم النهائي (235.33 جرام)، وزيادة وزن الجسم الكلية (189.86) مقارنة بالمجموعة الضابطة (221.20 جرام، و175.65 جرام). من حيث تأثير السلالة، أظهرت النتائج أن السلالة البنية شهدت ارتفاعًا كبيرًا في وزن الجسم الكلي ووزن الجسم الكلي عند مقارنتها بالسلالة البيضاء. كانت نسبة التصافى، والقانصة، والطحال، وعصارة اللحوم لسلالة السمان اليابانى البيضاء أكبر بشكل ملحوظ من السلالة البنية. كانت جميع سمات النمو، والتصافى، وتقييم اللحوم مختلفة بشكل كبير، من حيث التفاعل بين المعاملة والسلالة. من وجهة نظر إنتاجية، يوصى بإضافة 7.5 جرام من طحالب سبيرولينا بلاتنسيس للسمان الياباني. يمكن الاستنتاج أن إضافة مستويات مختلفة من سبيرولينا بلاتينسيس كان لها تأثير كبير على نسبة التصافى وتحسين تقييم اللحوم الحسية دون تأثيرات سلبية على أداء النمو، وخاصة أن 7.5 جرام من سبيرولينا بلاتينسيس كانت الأفضل.

الكلمات المفتاحية: السمان اليابانى، طحالب سبيرولينا بلاتنسيس، اداء النمو، صفات الذبيحة، تقييم اللحم.