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Effect of Dietary Azolla and Spirulina on Performance of Japanese Quails

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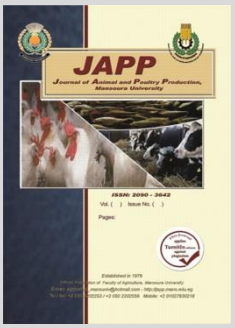

ABSTRACT

The main objective of the present work was to study the effect of feeding Japanese quails on diets containing some aquatic plants, (Azolla and Spirulina) on Japanese quail performance, carcass traits and some blood parameters. The experimental treatments were T_1 (control without additives), T_2 (4% Azolla), T_3 (8% Azolla), T_4 (12% Azolla), T_5 (16% Azolla), T_6 (T_1 + Spirulina 2.0 g/kg diet), T_7 (T_2 + Spirulina 2.0 g/kg diet), T_8 (T_3 + Spirulina 2.0 g/kg diet), T9 (T4 + Spirulina 2.0 g/kg diet) and T10 (T5 + Spirulina 2.0 g/kg diet). The obtained results showed that birds fed experimental diets in T5 and T10 achieved high significant values of final body weight, total weight gain and the best total feed conversion. Serum concentration of total protein, albumin, globulin. The experimental diets of T6 and T10 achieved the high significant values of carcass and total edible parts percentage. It is concluded that Japanese quails fed experimental diets containing Azolla and Spirulina improved bird's performance and carcass traits and did not negatively effect on blood serum characteristics.

Keywords: Aquatic plants, Azolla, Spirulina, Japanese quails

INTRODUCTION

Increase in the prices of conventional protein feedstuffs led to search for suitable alternatives to reduce the production cost. As the human population increases, the poultry industry continues to grow to meet the demand for poultry products in world markets. According to Bacerra *et al.* (1995) aquatic plant species (as Azolla and Spirulina), because of their growth habits, appear not to accumulate secondary plant compounds and therefore offer a greater potential than tree leaves as a source of protein for monogastric animals.

Azolla is a small aquatic fern belonging to the *Azollaceae* and *Pteridophyta* families that floats on the water's surface. There are at least eight species of *Azolla*, with *Azolla pinnata* being the most common (Mathur *et al.*, 2013). In the Azolla leaf cavities, the blue-green symbiotic cyanobacterial partner algae (*Anabaena azollae*) thrives (Becking, 1979). In exchange for a fixed high level of atmospheric dinitrogen as well as growth stimulants, Azolla supplies a carbon source, nutrients, and a protective cavity to *Anabaena colonies* (Pillai *et al.*, 2005).

Chemical composition of the Azolla, crude protein (25.78%), ether extract (3.47%), crude fiber (15.71%) and nitrogen free extract (30.08%) (Basak, *et al.* 2002).

Spirulina platensis is a cyanobacterium or blue - green alga that belongs to the Sylvonia family. It thrives in aquatic, alkaline, and nutrient-rich conditions, as well as in warmer environments. (Demisu and Benti, 2018). Spirulina is classified as generally recognized as safe (GRAS) by the US Food and Drug Administration and the European Food Safety Authority (Gong and Bassi, 2016). Due to its antibacterial properties, favorable influence on intestinal architecture, and immune system, Spirulina has been classified as a probiotic food (Shanmugapriya *et al.* 2015)

Spirulina contains unusually high amounts of protein, (55 and 70%) (Babadzhanov *et al.*, 2004), total lipid (6 – 6.5%) (Li and Qi, 1997), available energy (2.50-3.29 kcal/gram) (Yoshida and Hoshii, 1980).

Several research have been carried out to study the effect of supplementing Azolla and Spirulina in the diet of poultry. For instance, Alagbe *et al.* (2018) reported that Azolla could be incorporated up to 10% level in quails ration without any deleterious effect on the performance and health status of the birds. Jamil *et al.* (2015) found that feed conversion rate for broilers that fed on Spirulina (2, 4 or 8 g Spirulina/kg diet) was significantly (P<0.05) decreased.

The main objective of the study was to investigate the effect of feeding Japanese quails on diets containing some aquatic plants (Azolla and Spirulina) on productive performance, Carcass traits and some blood constituents.

MATERIALS AND METHODS

The current study was carried out at the private farm belonging to Dakahlia Governorate, Egypt during June and July 2020.

Birds and Management:

A total number of 600 one day old unsexed Japanese quail chicks were kept in cages and were allotted to ten dietary treatments 60 birds each. Each treatment was performed in three replicates 20 birds each as follows: T1 (control), T2 (4% Azolla), T3 (8% Azolla), T4 (12% Azolla), T5 (16% Azolla), T6 (T1 + spirulina 2.0 g/kg diet), T7 (T2 + spirulina 2.0 g/kg diet), T8 (T3 + spirulina 2.0 g/kg diet), T9 (T4 + spirulina 2.0 g/kg diet) and T10 (T5 + spirulina 2.0 g/kg diet).

Feed and water were offered *ad-libitum* during the experimental period. Chicks of all groups were kept under similar hygienic, environmental and managerial conditions during growth period.

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Preparation of aquatic plants (Azolla and spirulina):

Azolla was collected (media) from irrigation canals and were planted in ponds on the farm. After growth, they are collected and dried in the sun and prepared to be included in the diets.

Spirulina was obtained from the Research & Development Centre, (Faculty of Science Mansoura University). Chemical composition of Azolla (dry matter basis) that used in this study: 26.10% crude protein; 5.70% ether extract; 12.70% crude fiber; 0.075 % calcium% ; 2.00 % phosphorus% ; 4.70 % lysine% ; 0.28 % methionine and 0.32 % cysteine.

Chemical composition of Spirulina (dry matter basis) that used in this study: 56.50% crude protein; 1.03% ether extract; 3.56% crude fiber; 1.08 % calcium% ; 0.93% phosphorus% ; 2.35% lysine%; 1.24% methionine and 0.51% cysteine.

Chemical composition of the experimental diets:

Compositions and calculated analysis according to NRC (1994) of all dietary treatments are presented in Table 1.

Performance parameters:

The experimental birds were weighed at the beginning and weekly, body weight gain, feed consumption and feed conversion ratio for birds was also calculated as a replicate basis.

Blood parameters:

At the end of the experimental period, blood samples from three chicks / treatment were randomly taken to measure blood parameters (serum total protein (Doumas, 1975); serum glucose (Trinder, 1969), cholesterol (Allain *et al.*, 1974) and serum ALT and AST (Reitman and Frankel, 1957). All blood parameters were measured by commercial kits.

Table 1. Composition and calculated analysis of the experimental diets%.

Ingredients	Experimental treatments*				
	T1	T2	T3	T4	T5
Yellow corn (%)	56.15	54.35	52.45	50.55	49.05
Soybean meal (44%) (%)	30.00	28.00	26.00	24.00	21.50
Corn gluten Meal (%)	10.00	10.00	10.00	10.00	10.00
Azolla (%)	0.00	4.00	8.00	12.00	16.00
Mon calcium phosphate (%)	1.00	1.00	1.00	1.00	1.00
Limestone (%)	1.70	1.70	1.70	1.70	1.70
Vit. & min. premix** (%)	0.30	0.30	0.30	0.30	0.30
Common salt (Na Cl) (%)	0.35	0.35	0.35	0.35	0.35
DL-Methionine (%)	0.10	0.10	0.10	0.10	0.10
L-Lysine (%)	0.40	0.20	0.10	0.00	0.00
Total	100	100	100	100	100
Calculated analysis					
CP (%)	24.17	24.18	24.19	24.19	24.01
ME (Kcal/kg)	2912	2924	2923	2909	2924
EE (%)	2.62	2.76	2.90	3.03	3.17
CF (%)	3.47	3.79	4.11	4.44	4.76
Ca (%)	0.99	0.99	0.99	0.99	0.98
T. Ph. (%)	0.68	0.74	0.80	0.87	0.93
Lysine, (%)	1.36	1.34	1.39	1.44	1.55
Methionine (%)	0.55	0.54	0.54	0.53	0.53
Meth. + Cysteine (%)	0.93	0.93	0.92	0.91	0.90

***: Experimental Treatments, T6, T7, T8, T9 and T10 same experimental treatments from T1 to T5 with adding 2.0g spirulina/kg diet, respectively, Supplies per Kg of the diets instead of the same weight of yellow corn:**

**** kg. of premix Vit. A, 1000 I.U.; Vit D3, 2000 I.U.; Vit E, 10 mg; Vit K, 1 mg; Vit B1, 5mg; Vit B2, 5mg; Vit B6, 1.5 mg; Vit B12, 0.01 mg; folic acid, 0.35 mg; Biotin, 0.05 mg; Pantothenic acid, 10 mg; Niacin, 30 mg; Choline, 250 mg; Fe, 30 mg; Zn, 50 mg; Cu, 4 mg and Se, 0.1 mg.**

Carcass measurements:

At the end of the experimental period, three birds from each treatment were randomly taken, weighed, and slaughtered to complete bleeding, followed by plucking the feather and then reweighed. Dressing weight was determined weighed after removal of the head, viscera, and shanks. Liver, heart, gizzard and giblets weight were recorded and expressed as a percentage of the live body weight.

Statistical analysis:

Data were statistically analyzed (SAS, 1996) by the application of the least square producer. Significant differences among means of variables were separated according to Duncan (1955).

RESULTS AND DISCUSSION

Performance parameters:

Table (2) shows the data of live body weight, body weight gain (BWG), feed consumption (FC), and feed conversion ratio (FCR) of Japanese quail as affected by adding dietary Azolla and Spirulina. Analysis of variance showed that there were significant differences among the experimental treatments in final body weight, BWG, FI, and FCR. Feed additives improved final body weight of birds comparing with the control birds. The high final body weights were achieved by treatments T5 (16% Azolla) and T10 (16% Azolla + 1.5g spirulina /kg diet), followed by Treatments 9, 4, 3, 8, 2 and T7 in descending order however the lowest final body weight was achieved by the control treatment.

Feed additives improved the body weight gain of birds. The highest body weight gain was achieved by treatments T10 and T5, followed by T2, T3, T4, T8 and T9 without significant differences among them. The low weight gain was found of treatments T1, T6 and T7.

Feed additives (Azolla and Spirulina) improved the feed consumption (FC) of Japanese quail birds. The high feed consumption (FC) was achieved by the control treatment (T1). There are no differences among the experimental treatments T2, T3, T4, T7, T8 and T9 in feed consumption (FC). The low feed consumption (FC) was found of treatments T5, T6 and T10.

Dietary feed additives (Azolla and Spirulina) improved feed conversion ratio of Japanese quail. The best values in feed conversion ratio was found of treatments T5 and T10. No significant differences among the following experimental treatments T1, T2, T3, T6 and T7 in values of feed conversion ratio. Also, there are no differences among the experimental treatments T4, T8 and T9 in values of feed conversion ratio.

The obtained results agree with the finding of Abouelezz (2017) who used supplemented diet or drinking water with Spirulina platensis for Japanese quail. The author stated that higher BW and BWG of treated birds than that of the control group. With significant effects on feed consumption and overall FCR for quails treated with Spirulina platensis which were significantly better than the control group. Danny (2014) reported that Japanese quails fed 1, 2, and 4% dietary Spirulina showed a positive response in FCR. Also, Ibrahim *et al.* (2018) obtained best significant FCR by supplementing graded levels of Spirulina in drinking water for those Japanese quails compared to control. Furthermore, Hajati and Zaghari

(2019) found that adding 5 g/kg Spirulina to diet improved the efficiency of quails during 1–35 d of age. Cheong *et al.* (2016) reported that feed conversion to quails with 4 % Spirulina better than other treatment groups (control, 1% and 2% Spirulina) with healthy quails fed on Spirulina.

On the other hand, Shamna *et al.* (2013) fed Japanese quail on diets containing Azolla and showed significant (P <0.05) depression in body weight and body weight gain than the control. But Alagbe *et al.* (2018) found that quail's fed *Azolla pinnata* meal in diets didn't show any significant difference (P>0.05) in final body weights and feed conversion. Also, Montaha (2019) declared that feeding Sinai hens on spirulina did not showed any significant effect on feed consumption and feed conversion.

Table 2. Effect of dietary Azolla and Spirulina on performance parameters of Japanese quail from 1 to 42 days of age

Treatments	Initial weight, g	Final weigh, g	Total BWG, g	Total FC, g	Total FCR
T1 (Control)	9.97	197.83^{c}	187.86^{c}	770.25^{a}	4.10^{c}
T2(4% Azolla)	9.93	202.67^{bc}	192.74^{b}	760.25^{b}	3.94^{c}
3T(8% Azolla)	9.76	204.83^{b}	195.07^{b}	763.25^{b}	3.91^{c}
T4(12% Azolla)	10.13	205.16^{b}	195.03^{b}	754.25^{b}	3.87^{b}
T5(16% Azolla)	10.13	212.67^{a}	202.54^{a}	742.25^{c}	3.66^{a}
T6(T1 + 2.0g/kg spirulina)	9.91	197.50^{c}	187.59^{c}	740.25^{c}	3.95^{c}
T7 (T2 +2.0g/kg spirulina)	10.10	200.83^{bc}	190.73^{c}	750.25^{b}	3.93^{c}
T8(T3+ 2.0g/kg spirulina)	10.08	203.33^{bc}	193.25^{b}	750.25^{b}	3.88^{b}
T9(T4+ 2.0g/kg spirulina)	10.18	205.33^{b}	195.15^{b}	754.50^{b}	3.87^{b}
T10 (T5+ 2.0g/kg spirulina)	10.06	215.00^{a}	204.94^{a}	745.25^{c}	3.64^{a}
SEM	0.16	1.96	2.86	17.82	0.05
Sig.	NS	*	*	**	**

Means in the same column having the same superscripts were not significantly different., NS: not significant; *: significant at p≤0.05; **: significant at p≤0.01

Blood parameters:

Table (3) shows the data of the blood serum parameter of Japanese quails; feed additives (Azolla and Spirulina) significantly affect the serum total protein concentration of Japanese quail birds. The high total protein was achieved by treatments T4, T5 and T10. There are no differences among the experimental treatments T2, T3, T8 and T9 values of total protein. The lowest values of serum total protein were found in birds of treatments T1, T6 and T7.

Feed additives significantly affected in serum albumin of birds. The high values of Albumin were achieved by treatments T4, T5, T7, and T9 and T10. There are no differences among the experimental treatments T2, T3 and T8 in serum values of albumin. The low levels of albumin were found in treatments T1, T6. Azolla and Spirulina significantly affected in serum globulin of Japanese quail birds. The high values of globulin were achieved by treatments T2, T3, T4, T5, T8, T9 and T10. There are no differences among the experimental treatments T1 and T6 in serum globulin values. The lowest value of globulin was found in treatments T7. Feed additives did not effect on serum concentration of AST or ALT of Japanese quail birds.

Azolla and Spirulina significantly affected in serum glucose of Japanese quail birds. The high values of serum glucose were achieved by treatments T1and T6. There are no differences among the experimental treatments T2, T3, T4, T7, T8, T9 and T10 in serum glucose. The lowest value of glucose was found in birds of T5.

Table 3. Effect of dietary Azolla and Spirulina on serum blood parameters

Treatment	Total protein g/dl	Albumin g/dl	Globulin g/dl	AST IU/L	ALT IU/L	Glucose mg/dl	Cholesterol mg/dl
T1 (Control)	3.09^{c}	2.29^{c}	0.80^{b}	101.00	19.10	134.10^{a}	182.30^{a}
T2(4% Azolla)	3.19^{bc}	2.33^{b}	0.86^{a}	99.50	18.87	131.17^{b}	180.40^{a}
3T(8% Azolla)	3.21^{b}	2.33^{b}	0.88^{a}	99.50	18.30	130.40^{b}	178.50^{b}
T4(12% Azolla)	3.26^{a}	2.37^{a}	0.89^{a}	99.17	18.00	128.17^{bc}	174.27^{c}
T5(16% Azolla)	3.27^{a}	2.39^{a}	0.88^{a}	99.83	17.43	126.57^{c}	161.06^{e}
T6(T1 + 2.0g/kg spirulina)	3.07^{c}	2.29^{c}	0.78^{b}	99.93	17.60	133.70^{a}	176.93^{b}
T7 (T2 + 2.0g/kg spirulina)	3.12^{c}	2.39^{a}	0.73^{c}	100.10	17.70	131.70^{b}	173.40^{c}
T8(T3+ 2.0g/kg spirulina)	3.18^{bc}	2.34^{b}	0.84^{a}	99.67	17.70	131.33^{b}	171.47^{d}
T9(T4+ 2.0g/kg spirulina)	3.22^{b}	2.38^{a}	0.84^{a}	99.67	17.60	131.40^{b}	169.40^{d}
T10 (T5+ 2.0g/kg spirulina)	3.28^{a}	2.42^{a}	0.86^{a}	99.53	17.47	129.47^{b}	157.93^{f}
SEM	0.07	0.04	0.05	0.94	0.82	5.28	7.73
Sig.	*	*	*	NS	NS	**	**

Means in the same column having the same superscripts were not significantly different., NS: not significant; *: significant at p≤0.05; **: significant at p≤0.01

Feed additives significantly affected in serum concentration of cholesterol of Japanese quail birds. The high cholesterol values were achieved by treatments T1 and T2. There are no differences among the experimental treatments T3, T4, T5, T6, T7, T8 and T9 in the concentration of serum cholesterol. The low value of cholesterol was found in birds of T10.

Our results were in harmony with the finding of Paraselli (2013) who found that serum glucose concentration decreased significantly (P<0.05) with increased level of sun-dried Azolla up to 10% in the diet. Also, Fathi, *et al.* (2018) found that adding *Spirulina platensis* on broiler diets decreasing significantly the level of serum total cholesterol with broilers fed diets supplemented with *Spirulina platensis* at levels of 0.7, 0.9 compared with the control diets.

But Rekhate *et al*., 2010 reported that, no significant difference between the levels of Azolla inclusion in the diet on serum total protein, albumin and globulin content.

Carcass measurements:

Table (4) shows the data of carcass measurements of Japanese quails. Feed additives improved the dressing weight. The high dressing weight was achieved by treatments T6 and T10. There are no differences among the

experimental treatments T9 and T5 in dressing weight. The lowest was dressing weight found of treatments T1, T2, T3, T4 and T8.

Feed additives improved the percentage of gizzard. The high percentage of gizzard was achieved by treatments T5, T6 and T10. There are no differences among the experimental treatments T1, T3, T4, T7, T8 and T9 in percentage of gizzard. The lowest was the percentage of gizzard found of treatments T2. Feed additives improved the percentage of heart. The high percentage of the heart was achieved by treatments T1, T2, T3, T4, T6, T7 and T8. There are no differences among the experimental treatments T5, T9 and T10 in percentage of the heart.

Feed additives improved the percentage of liver. The high percentage of liver was achieved by treatments T6 and T10. There are no differences among the experimental treatments T5 and T9 in percentage of liver. The lowest was percentage of liver found in treatments T1, T2, T7 and T8.

Feed additives improved the percentage of giblets. The high percentage of giblet was achieved by treatments T5, T6 and T10. There are no differences among the experimental treatments T4, T7, T8 and T9 in percentage of giblet. The lowest percentage of giblet was found in birds of treatments T1 and T2.

The same trend our results, Basak *et al.* (2002) find a significant higher for dressing percentage in birds fed with 5% level of Azolla compared to control. Cheong et al., (2016) found that quails fed on 4 % Spirulina diet showed heaviest carcass weights.

On the other hand, Balaji *et al.* (2009) reported no significant difference in dressing percentage in broilers fed azolla at 0, 1.5, 3.0 and 4.5% levels in the diet. Also, Paraselli (2013) didn't find any significant difference between groups fed 0 and 5 % Azolla on the carcass yield and percent heart weight, liver weight, gizzard weight and giblet weight in quails.

Table 4. Effect of dietary Azolla and Spirulina on carcass measurements

Treatment	Live body weight	Dressing weight %	Gizzard %	Heart %	Liver %	Giblet %	Edible parts
T1 (Control)	202.67^{b}	69.11^{c}	1.90^{b}	0.90^{a}	1.72^{c}	4.52^{c}	73.63^{d}
T2(4% Azolla)	208.50^{b}	69.57^{c}	1.83^{b}	0.85^{a}	1.78^{c}	4.46^{c}	74.03^{c}
T3(8% Azolla)	209.83^{b}	69.67^{c}	1.90^{b}	0.85^{a}	1.90^{c}	4.64^{b}	74.31^{c}
T4(12% Azolla)	209.83^{b}	70.47^{c}	1.96^{b}	0.86^{a}	1.97^{c}	4.79^{b}	75.26^{c}
T5(16% Azolla)	212.50^{ab}	71.25^{b}	2.14^{a}	0.75^{b}	2.05^{b}	4.95^{a}	76.20^{b}
T6(T1 + 2.0g/kg spirulina)	209.97^{b}	72.94^{a}	2.13^{a}	0.80^{a}	2.24^{a}	5.13^{a}	77.97^{a}
T7 (T2 + 2.0g/kg spirulina)	205.13^{b}	69.65^{c}	1.96^{b}	0.88^{a}	1.82^{c}	4.67^{b}	74.32^{c}
T8(T3+ 2.0g/kg spirulina)	208.83^{b}	70.98^{c}	1.99^{b}	0.85^{a}	1.83^{c}	4.66^{b}	75.64^{c}
T9(T4+ 2.0g/kg spirulina)	210.73^{ab}	72.23^{b}	2.05^{b}	0.81^{b}	2.02^{b}	4.88^{b}	77.11^{a}
T10 (T5+ 2.0g/kg spirulina)	219.50^{a}	73.43^{a}	2.15^{a}	0.78^{b}	2.24^{a}	5.17^{a}	78.60^{a}
SEM	1.96	0.37	0.06	0.02	0.05	0.08	0.82
Sig.	*	*	*	*	*	*	*

CONCLUSION

It is concluded that, Japanese quails fed experimental diets containing Azolla and Spirulina achieved high values of final body weight, total weight gain, total fed intake, and improved feed conversion ratio. The experimental diets increased plasma concentration of total protein, albumin, globulin and dressing weight, gizzard, liver and giblet percentage of Japanese quails.

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تأثير التغذية على الأزولا والاسبيرولينا على الأداء الإنتاجي للسمان الياباني

خليل الشحات شريف[1] ، ترك محمد ابراهيم درة[1] ، ابراهيم الوردانى السيد حسن [2] و احمد قدرى محمود والى[1]

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تهدف هذه الدراسة لمعرفة تأثير تغذية السمان الياباني على علائق تحتوي على بعض النباتات المائية وهى الأزولا والاسبيرولينا على الأداء الانتاجى للسمان الياباني وصفات الذبيحة وبعض مقاييس الدم. و كانت المعاملات التجريبية كالتالى: المعاملة الاولى (الكنترول بدون اضافات) و المعاملة الثانية تحتوى على 4٪ أزولا والمعاملة الثالثة بها 8% أزولا والمعاملة الرابعة بها 12% أزولا والمعاملة الخامسة بها 16% أزولا والمعاملة السادسة بها مثل المعاملة الاولى + 2 جم اسبيرولينا/ كجم عليقة والمعاملة السابعة مثل المعاملة الثانية 2 جم اسبيرولينا/ كجم عليقة و المعاملة الثامنة مثل المعاملة الثالثة + 2جم اسبيرولينا/كجم عليقة والمعاملة التاسعة مثل المعاملة الرابعة +2 جم اسبيرولينا/كجم عليقة والمعاملة العاشرة مثل العليقة الخامسة +2جم اسبيرولينا/كجم عليقة. أظهرت النتائج أن العلائق التجريبية حققت أعلى قيم لوزن الجسم التسويقى و الزيادة الوزنية المكتسبة وكمية الغذاء المستهلكة و كذلك كفاءة تحويل العلف. كما لوحظ زيادة تركيز سيرم الدم من البروتين الكلي والألبومين والجلوبيولين. كما حققت المعاملات التجريبية قيم اعلى معنويا من مجموعة الكنترول فى الاجزاء الكلية المأكولة. يمكن استنتاج أن تغذية السمان الياباني على علائق تجريبية تحتوي على الأزولا والاسبيرولينا بالنسب المدروسة ادت الى تحسن فى الاداء الانتاجى وصفات الذبيحة ولم تؤثر سلبيا على مواصفات سيرم الدم.