Research Article

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Study the Effect of *Cordyceps militaris* Supplement in the Diet on Growth Performance of Japanese Quail

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Abstract

The study aims to investigate the impact of the Cordyceps militaris supplement in the feed on the growth performance of Japanese quail. This study used 180 unsexed Japanese quail chicks, one day old and with an initial weight of 10.3 - 8.8 grams. They were randomly distributed into 4groups. Each treatment was replicated three times, with each replicate containing 15 chicks in cages equipped with a battery. The current study included an experimental period of (1-42) days for the chicks. The transactions were as follows: T1: Control treated (without any addition), T2: treated of adding *Cordyceps militaris* 1 mg/kg feed, T3: treated of adding *Cordyceps militaris* 2 mg/kg feed. T4: treated of adding *Cordyceps militaris* 4 mg/kg feed. Production characteristics were measured, such as average weekly live body weight and average weekly feed consumption. The weekly and cumulative weight gain rate and the weekly and cumulative food conversion factor were measured. The highest significant difference ($P \leq 0.05$) was obtained for adding the *Cordyceps militaris* fungus 4 mg/kg feed in the average weekly live body weight. The cumulative weight gain rates, rate of cumulative feed consumption, the rate of feed conversion factor recorded a significant improvement of Japanese quail compared to the other treated and the control group that recorded the lowest levels in this trait.

Keyword: Growth, *Cordyceps militaris*, Quail.

Introduction

Animal production, especially poultry production, is considered an important source of protein due to the increasing demand for it throughout the world. Therefore, protein is considered an important source of nutrition. Feed is manufactured using modern technologies for this purpose of food requirements, but research continues in to find out new ideas covered the need of birds nutritional requirements to know the suitable additives in the feed, that improve productive performance and enhance immunity (1). Due to the harmful effects of antibiotics added as growth promoters in bird feeds, these antibiotics have been banned in many countries worldwide for several reasons, including their deposition in bird meat and the resulting health problems for the consumer. Another reason is the emergence of antibiotic-resistant bacteria strains (2). As a result, attention has turned to plant-based food additives, which are environmentally friendly and work to enhance bird growth and productivity (3). *Cordyceps militaris* is a type of fungus that was described for the first time by the Swedish scientist Car Linnaeus in 1753. In the year 1818, it was renamed and remains with this name until the present by the German scientist. Johann Heinrich Friedrich Link (4). *Cordyceps* mushroom is a medicinal plant product used as a nutritional supplement, as it works to strengthen the body's immunity as well as improve health in animals (5). Mushroom components include sugars, glycosides, alkaloids, volatile oils, and organic acids (6). The Cordyceps militaris fungus has proven its effectiveness in animal production, especially poultry production, by being added to rations as a nutritional supplement and decreasing egg cholesterol (7). *Cordyceps militaris* It is considered a nutritional supplement that may be beneficial to bird nutrition in terms of enhancing growth performance. As a result of these reasons, therefore, we concluded that *militaris* can be used as a good nutritional supplement for bird feeds and also a good for meat quality for human consumption

Materials and Methods

Birds Management:

When the birds reached the sixth week of age, we redistributed them again with a sex ratio of 2:1, meaning (4 females and 2 males). The ventilation system used fans installed on the hall walls to draw in air. The lighting was continuous throughout the day. As for ventilation, circular rubber feeders were used that raised the level of the bird's body as it grew older. Automatic water-drinking fountains were used. The chicks were fed with a growth diet (1-45 days) containing 22.26% crude protein and 3049 calories/kg of assimilated energy. as shown in Table (1).

Table 1: Feed Ingredients and chemical analysis

Ingredients	Growth diet (%) (1-45)day
Yellow corn	47
Wheat	13
Protein concentrated (50% protein)	5
Soybean meal (48% protein)	31
Limestone	1
Vegetable oil	1.5
Mixture of vitamins and minerals	1.5
Total	100
Metabolic energy (kcal/kg)	3049
Protein (%)	22.26
Calcium (%)	0.8
methionine%	0.50
Phosphorus (%)	0.58

***(8) 1994**

Design of Study

The research used one hundred eighty Japanese quail chicks, one day old, unsexed, with a starting weight ranging between 8.8-10.3 gm. *Cordyceps militaris* was added as a nutritional supplement to the feed for 6 weeks as follows:

1-Diet with no *Cordyceps militaris* added (Control.

2-Diet supplemented with 1.0 mg/kg feed of *Cordyceps militaris*.

3-Diet supplemented 2.0 mg/kg feed of *Cordyceps militaris* .

4-Diet supplemented 4.0 mg/kg feed of *Cordyceps militaris*.

The productive characteristics represented by weekly live body weight, weekly weight gain, weekly feed consumption and weekly feed conversion efficiency, body weight, and daily feed consumption were measured from (1-42) day.

Studied parameters

Productive performance

Weekly Living Body Weight (g):

At the beginning of the experiment, we collectively weighed the chicks at one day old, noting their weight of 42 grams. After that, the chicks were weighed at the end of each week for a period of six weeks, and a

sensitive electronic scale was used to weigh the birds based on the weight equation of (9).

Average live body weight (g) = Total weights of birds per replicate (g) / Total number of birds in the same replicate (g)

Weekly Weight Gain (g):
Weekly weight gain was calculated based on the equation provided by (10):
Weekly weight gain (g) = live body weight at the end of the week (g) for each replicate - live body weight at the beginning of the week (g) for each replicate

Weekly Feed Consumption (g):
The amount of feed consumed weekly for each replicate was calculated based on the equation (10).
Amount of feed consumed (g) = Amount of feed provided at the beginning of the week for each replicate - Amount of feed remaining at the end of the week for each replicate

Weekly Feed Conversion Factor (g):
According to the food conversion factor for each week based on (10)
Food conversion factor = Average amount of feed consumed per week (g) / Average weekly weight gain (g)

Statistical analysis

The results were analyzed using a completely randomized design (CRD) using the ready-made statistical program SPSS (11). To test the significance of the differences between the studied means, the Duncan (12) multinomial test was used, at the level of significance ($p<0.05$), and the mathematical model was used in data analysis.

Results

Effect of *Cordyceps militaris* to the diets on weekly living body weight:

Table (2) shows the effect of adding the *Cordyceps militaris* fungus to quail diets at different concentrations on the average weekly body weights from the age of one day to the age of 6 weeks. The table results showed that the group that added 4 mg/kg of Cordyceps militaris fungus had the biggest difference ($P\leq0.05$), with an average weekly live body weight of (32.75, 64.59, 100.51, 149.07, 180.11, and 225.44). g/kg feed in weeks (1, 2, 3, 4, 5, and 6), respectively, compared to the other treatments and the control group, which recorded the least significant difference in average weekly body weight in the sixth week, amounting to (200.46) g/kg feed, respectively, compared to the other treatments and the control group, which recorded the least significant difference in average weekly body weight in the sixth week, amounting to (200.46) g/kg feed. All groups' average weekly live body weight at one day old did not significantly differ, according to the results.

Table (2) Effect of *Cordyceps militaris* to the diets on weekly living body weight during Growth period (Mean ± Standard Error).

Group		*Cordyceps militsris* Group			Sig. 0.05
Week	Control				
		1mg/kg	2mg/kg	4mg/kg	
1 Day	8.89 ±0.09	8.90±0.19	8.93 ±0.06	8.94 ±0.05	N.S
1 Week	23.77±0.68^{d}	26.29±1.46^{c}	29.09±0.85^{b}	**32.75±1.38^{a}**	*
2 Week	53.00±1.00^{d}	56.06±2.09^{c}	61.60±1.33^{b}	**64.59±1.64^{a}**	*
3 Week	86.00±2.00^{d}	90.26±2.18^{c}	94.53±1.29^{b}	**100.51±1.57^{a}**	*
4 Week	126.03±2.51^{d}	131.99±2.41^{c}	136.58±1.69^{b}	**149.07±2.02^{a}**	*
5 Week	161.60±1.97^{d}	168.47±2.38^{c}	172.55±1.90^{b}	**180.11±0.84^{a}**	*
6 Week	200.46±2.17^{d}	206.42±2.78^{c}	219.33±1.52^{b}	**225.44 ±2.88^{a}**	*

Small letters referred to significant difference among groups at (p≤0.05). N.S referred to no significant difference .* Referred to significant difference

Effect of *Cordyceps militaris* to the diets on weekly weight gain:

Regarding the effect of adding the *Cordyceps militaris* fungus in different concentrations on the average weekly and cumulative body weight gain. The results in table (3) showed that there was the highest significant difference (P≤0.05) in the average weekly and cumulative body weight gain in the group of birds treated with the *Cordyceps militaris* fungus (4 mg/kg feed), which amounted to (23.81, 32.50, 48.55, 36.47, 46.78) g/kg feed for weeks (1, 2, 4, 5, 6) respectively. The cumulative body weight gain increase from (1-6) weeks amounted to (217.50) g/kg feed compared to the other treatments and the control group, which recorded the lowest cumulative body weight gain of (191.56) g/kg feed, while the third week did not record any significant difference in the rate of weekly and cumulative body weight gain.

Table (3) Effect of *Cordyceps militsris* to the diets on weekly body weight gain during Growth period (Mean ± Standard Error)

Group		*Cordyceps militsris* Group			Sig. 0.05
Week	Control				
		1mg/kg	2mg/kg	4mg/kg	
1 Week	14.87 ±0.60 [d]	17.40 ±1.57 [c]	20.15 ±0.91 [b]	23.81 ±1.34 [a]	*
2 Week	29.22±1.67 [b]	29.77±0.68 [ab]	31.84 ±1.32 [ab]	32.50 ±1.97 [a]	*
3 Week	32.93 ± 1.73	33.00 ± 1.05	34.19 ±0.82	35.92 ±2.68	N.S
4 Week	40.03 ±1.77 [b]	41.73 ±3.63 [b]	42.05 ±2.84[b]	48.55 ±3.58[a]	*
5 Week	31.03 ±3.21[b]	35.57±0.76[ab]	35.96±2.40[a]	36.47±2.64[a]	*
6 Week	37.95 ±1.22[b]	38.86 ±4.41[b]	46.33 ±3.42[a]	46.78 ±2.08[a]	*
(1-6) Week (Accumulative).	191.56±2.24[d]	197.53±2.82[c]	210.36±1.53[b]	217.50±2.92[a]	*

Small letters referred to significant difference among groups at (p≤0.05). N.S referred to no significant difference .

*** Referred to significant difference**

Effect of *Cordyceps militsris* to the diets on weekly feed consumption: -

There was no significant difference in the rate of feed consumption during the first week when *Cordyceps militaris* fungus was added to all treatments and the control group, while the treatment (4 mg/kg feed) of quail diet recorded the lowest significant difference (P≤0.05) for weekly feed consumption amounting to (60.86, 80.89. 90.66,119.06,158.72) g/kg feed for the weeks (2,3,4,5,6) respectively, and the cumulative feed consumption for (1-6) weeks, which amounted to (534.61) g/kg feed compared to the other treatments, and control group. The control that recorded the highest significant difference amounted to (598.43) g/kg feed in the cumulative feed consumption rate in table (4).

Table (4) Effect *Cordyceps militsris* to the diets on weekly feed consumption of during Growth period (Mean ± Standard Error)

Group		*Cordyceps militsris* Group			Sig. 0.05
Week	Control	1mg/kg	2mg/kg	4mg/kg	
1 Week	34.11 ±1.71	33.40 ±1.56	33.29 ±0.97	31.73 ±1.86	N.S
2 Week	67.69 ±1.62[a]	65.40 ±1.34[a]	62.49 ±1.01[b]	60.86 ±1.48[b]	*
3 Week	90.34 ±1.64[a]	88.33 ±1.93[a]	84.82 ±0.92[b]	80.89 ±2.07[c]	*
4 Week	103.33 ±1.52[a]	98.74 ±2.00[b]	95.00 ±1.09[c]	90.66 ±2.08[d]	*
5 Week	132.33 ±1.57[a]	127.44±0.74[b]	124.18±1.98[c]	119.06 ±1.52[d]	*
6 Week	173.00.±1.24[a]	166.28±1.52[b]	161.66±1.59[c]	158.72±2.00[c]	*
(1-6) Week (Accumulative	598.43±4.87[a]	579.50±5.94[b]	562.27±1.39[c]	534.61±4.94[d]	*

Small letters referred to significant difference among groups at (p≤0.05). N.S referred to no significant difference.

*** Referred to significant difference**

Effect of *Cordyceps militsris* to the diets on weekly feed conversion factor:

There was no significant difference in the rate of weekly feed conversion factor during the fifth week when *Cordyceps militaris* fungus was added to all treatments and the control group, while the treatment (4 mg/kg feed) to quail diet recorded the lowest significant difference (P≤0.05) for weekly feed conversion factor amounting to (1.40, 1.91,2.25,1.87&3.42) g/kg feed for the weeks (1,2,3,4, and 6) respectively, and the cumulative feed conversion factor for (1-6) weeks, which amounted to (2.49) g/kg feed compared to the other treatments, and control group. The control that recorded the highest significant difference amounted to (3.12) g/kg feed in the cumulative feed conversion factor rate in table (5).

Table (5) Effect of *Cordyceps militsris* to the diets on weekly feed conversion factor during Growth period (Mean ± Standard Error)

Group		*Cordyceps militsris* Group			Sig. 0.05
Week	Control	1mg/kg	2mg/kg	4mg/kg	
1 Week	2.13±0.13[a]	1.92±0.14[ab]	1.69±0.21[bc]	1.40 ±0.10[c]	*
2 Week	2.32±0.08[a]	2.19±0.10[a]	1.92±0.04[b]	1.91 ±0.10[b]	*
3 Week	2.74±0.12[a]	2.58±0.02[a]	2.57±0.05[a]	2.25±0.19[b]	*
4 Week	2.58±0.16[a]	2.37±0.18[a]	2.26±0.20[a]	1.87±0.06[b]	*
5 Week	3.46 ±0.32	3.49±0.20	3.73±0.07	3.85±0.30	N/S
6 Week	4.45±0.13[a]	4.41±0.23[a]	3.46±0.44[b]	3.42±0.10[b]	*
(1-6) Week (Accumulative).	3.12±0.03[a]	2.93±0.03[b]	2.67±0.04[c]	2.49±0.01[d]	*

Small letters referred to significant difference among groups at (p≤0.05). N.S referred to no significant difference.

*** Referred to significant difference**

Discussion

Effect of *Cordyceps militaris* on Body Weight & Body Weight Gain

The results of table (2) showed that the highest significant difference (P≤0.05) was obtained in the group adding *Cordyceps militaris* fungus (4 mg/kg feed), as the average weekly live body weight reached (225.44). g/kg feed in sixth week, compared to the other treatments and the control group, which recorded the least significant difference in average weekly body weight in the sixth week, amounting to (200.46) g/kg feed. The results showed no significant difference in the average weekly live body weight at one day old for all groups. The improvement in body weight in treatments of the *Cordyceps militaris* mushroom may be attributed to the mushroom's content of essential amino acids, which the bird urgently needs to carry out its productive and vital activities in order to increase the rate of growth and muscle building (10). On the other hand, perhaps the reason is due to the improvement in protein efficiency in *Cordyceps militaris* treatments, given that the source of protein efficiency, which provides the bird's body with amino acids, depends primarily on the digestibility of the protein in addition to its dependence on the chemical composition (13). The improvement that occurred in the length of the villi due to the increase in the surface area of the intestine, which may have been the reason for an increase in the average body weight of the bird (14). According to (15), the Cordyceps fungus could be used as an alternative antibiotic to growth stimulants that increase the live body weight of broiler

chickens. additionally, (16) used the stems of the *Cordyceps militaris* fungus as feed additives in the diets of broiler chickens to improve production performance, The study concluded that an increase in body weight occurs when using 1% *Cordyceps militaris* in the feed, which leads to an improvement in the bird's health.

In terms of average weekly and cumulative body weight gain, table 3 shows that there was a significant difference ($P \leq 0.05$) between the groups of birds treated with the Cordyceps militaris fungus (4 mg/kg feed). This group's average weekly and cumulative body weight gain increased from (1-6) weeks to (217.50) g/kg feed, while the control group's average cumulative body weight gain was the lowest (191.56) g/kg feed. There was no significant difference in the rate of weekly and cumulative body weight gain in the third week. This result may be attributed to the clear improvement in the rate of weight gain in the treatments of adding the *Cordyceps militaris* mushroom to the major role of this mushroom in increasing the number of beneficial bacteria in the small intestine that produce organic and fatty acids, lactic acid, and hydrogen peroxide, which would stop and inhibit the activity of pathogenic bacteria. In same line (17; 18; 19), who indicated that a significant weight gain was achieved when adding *Codeceps sinensis* to broiler chicken diets. They attributed the reason for this weight gain to components found in mushrooms such as sugars, cordycepin, and ergosterol, which work to activate antioxidants and immunity that improve the intestinal environment. And increase beneficial bacteria. Therefore, growth performance improves.

Effect of *Cordyceps militaris* on Feed Consumption & Feed Conversion Factor:

Table (4) indicated that the least significant difference was recorded in the rate of cumulative feed consumption from (1-6) weeks, as the rate of cumulative feed consumption reached (534.61) grams/kg of feed compared to the control group. The control with the most significant difference reached 598.43 grams/kg of feed.

In Table (5), the cumulative feed conversion factor for (1-6) weeks recorded the least significant difference of (2.49) g/kg feed compared to the control group. In control, the highest significant difference was recorded at (3.12) grams/kg of feed.

The increase in the food conversion factor may be because of the Cordyceps militaris mushroom addition treatments. This is because it is a type of fungus that has biological activity and antioxidant properties that stop the oxidation of many food elements needed for growth (20). Researchers think that the big boost in the food conversion factor of Cordyceps militaris mushroom treatments might be because the fungus increases good bacteria while decreasing bad bacteria. This makes the intestinal environment better, which lets the good bacteria absorb more nutrients to keep doing their important tasks. Additionally, the fungus may have a beneficial physiological and immunological effect on the bird's health (21). A study by (22) found that adding mushrooms to poultry diets improved food conversion efficiency without posing any health risks.

Also, a study (21) looked at what happened when Cordyceps sinensis extract and probiotics were added to the diet of broiler chickens and how that affected their growth. The study found that adding Cordyceps sinensis extract and probiotics led to better production performance and less feed being eaten by broiler chickens.

Conclusion

When Cordyceps militaris was added to quail diets from (1-45) days of age, growth performance improved. It was found that the Japanese quail is considered a good alternative to poultry meat in the event of obstacles in raising poultry.

Conflicts of interest

The authors declare that there is no conflict of interest.

Ethical Clearance

This work is approved by The Research Ethical Committee.

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دراسة تأثير إضافة الكورديسيبس ميليتاريس في العليقة على أداء النمو لطائر السمان الياباني

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فرع الصحة العامة البيطرية، كلية الطب البيطري، جامعة البصرة، العراق.

الخلاصة

الهدف من الدراسة هو بيان تأثير مكمل الكورديسيبس ميليتاريس في العلف على أداء النمو لطائر السمان الياباني. استخدمت هذه الدراسة 180 فرخ سمان ياباني غير مجنس، عمر يوم واحد ووزنها الأولي 10.3 - 8.8 جرام. وتم توزيعهم عشوائيا على 4 معاملات. كان لكل معاملة ثلاث مكررات، وكان لكل مكرر 15 كتكوت في أقفاص تحتوي على بطارية. شملت الدراسة الحالية فترة تجريبية من (1-42) يوم للأفراخ. وكانت المعاملات على النحو التالي: T1: معاملة الكنترول (بدون أي إضافة)، T2: معاملة إضافة كورديسيبس ميليتاريس 1 ملجم/كجم علف، T3: معاملة إضافة كورديسيبس ميليتاريس 2 ملجم/كجم علف. T4: معاملة إضافة كورديسيبس ميليتاريس 4. ملغم/كغم من العلف. تم قياس خصائص الإنتاج مثل متوسط وزن الجسم الحي الأسبوعي ومتوسط استهلاك العلف الأسبوعي. تم قياس معدل زيادة الوزن الأسبوعي والتراكمي ومعامل التحويل الغذائي الأسبوعي والتراكمي. أظهرت نتائج هذه الدراسة ما يلي: تم الحصول على أعلى فرق معنوي ($P \geq 0.05$) لإضافة فطر الكورديسيبس ميليتاريس 4 ملغم/كغم علف في متوسط وزن الجسم الحي الأسبوعي، ومعدلات الزيادة الوزنية التراكمية، ومعدل استهلاك العلف التراكمي. وسجل معدل معامل التحويل الغذائي تحسنا معنويا في طائر السمان الياباني مقارنة بمعاملته الاخرى ومجموعة السيطرة التي سجلت اقل مستويات في هذه الصفة.

الكلمات المفتاحية: النمو، كورديسيبس ميليتاريس , السمان.