J. Product. & Dev., 28(4): 299- 310(2023)

IMPACT OF FEEDING REGIMEN AND DIETARY SEAWEEDS SUPPLEMENTATION ON RELAIVE GROWTH RATE AND ECONOMICAL EFFICIENCY OF JAPANESE QUAIL

Samera Saeed, Mostafa I. Tawfeek, Diaa Abou-Kassem and Khalid M. Mahrose*

Animal and Poultry Production Department, Faculty of Technology and Development, Zagazig University, Zagazig 44519, Egypt.

**Corresponding author: ostrichkhalid@zu.edu.eg, mostawms@hotmail.com*

ABSTRACT

The contemporary study examined the relative growth rate(RGR), and economic efficiency of Japanese quail as influenced by feeding regimens and dietary supplementation with Spirulina platensis (Arthrospira) (SP). A total of 324 Japanese quail chicks at one-week old were haphazardly divided into 12 treatment groups in a factorial arrangement (4×3), involving four feeding regimens (ad libitum, feeding on 85% of the requirements, ad libitum within 16 hours/ day and feeding on 85% of the requirements within 16 hours/day) and three levels of dietary SP supplementation (0, 0.5 and 1%).

The obtained results revealed that *relative growth rate (RGR) during 1-3, 3-6 and 1-6 weeks of age of growing quails were influenced significantly (P<0.05 and 0.01) by feeding regimens. Birds consumed 85% showed the lowest relative growth rate, while feeding on ad libitum and ad libitum within 16 hours/day groups showed the highest relative growth rate, during 1-6 weeks of age. However, feeding regimes on 85% req. and 85% within 16 hrs./day was more economic efficiency (%) than others groups. However, feeding regimes on ad libitum within 16 hours/ day was lowest economic efficiency(%) than others groups during 1-6 weeks of age.*

During 1-3, 3-6 and 1-6 weeks of age, quails fed on Spirulina platensis suppl.at level 0.5 % were higher insignificantly in relative growth rate than other treatment groups. Quails fed on un-supplemented with Spirulina platensis at level 1.0 % were lower insignificantly in relative growth rate than other treatment groups, during different period studies. On the other hand, birds feeding un-supplementation with seaweeds (Spirulina platensis) atlevel 0.5% were highest economic efficiency (%) than others groups. While, birds feeding supplementation with seaweeds (Spirulina platensis) at 1.0% /kg die were lowest economic efficiency (%) than other groups.

Quails fed feeding on ad libitum and ad lib. within 16 hrs./ day *supplementation with seaweeds (Spirulina platensis) at level 0.5% showed the highest relative growth rate, during 1-6 weeks of age. While, Quails fed feeding on 85% of the requirements within 16 hours/day supplementation with seaweeds (Spirulina platensis) at 1.0% /kg diet were lowest economic efficiency (%) than other groups. However,* FR on 85% req. within 16 hrs/day *without supplementation with seaweeds (Spirulina platensis) were highest economic efficiency (%) than other groups, during 1-6 weeks of age.*

***In conclusion**, the present study exhibits that quail could be kept under a feed restriction regimen, on ad libitum within 16 hours/day groups with seaweeds (Spirulina platensis) at level 0.5% showed the highest relative growth rate during 1-6 weeks of age than other treatment groups.*

Keywords: Feed restriction; spirulina platensis, growth, economic efficiency, quail.

INTRODUCTION

Quail (*Coturnix coturnix Japonica*) has plentiful advantages as supplier of meat and eggs for human feeding in dissimilar countries (Mahrose *et al*., 2020; Farghly *et al.*, 2022). Quail agribusiness is increasing attractiveness since quails are simple to handle and small in size therefore they can be reared in small ground area (Attia *et al.* , 2012; Wafaa Abd El-Ghany, 2019). The enhancement in quail farming is being restrained by some management and environmental issues, infectious and non-infectious diseases (Wafaa Abd El-Ghany, 2019; Mahrose *et al.*, 2019 a & b; Michalak, and Mahrose., 2020). To attain the complete genetic growth ability, birds must be kept beneath ideal environmental circumstances, and any variation may damage their performance, produce immunosuppression, and substitute their physiological reactions, increasing their susceptibility to diseases (Qaid *et al*., 2016; Wafaa Abd El-Ghany, 2019; Mahrose *et al.*, 2021).

The principle of feed restriction regimens on poultry breeds chiefly proposes to reduce extra energy spending which commonly occurs when feeding is supplied *ad libitum* (Mahrose *et al.*, 2022). Quantities and qualitative feed restriction are ways that can be expended to impact the feeding strategies of poultry species to reduce metabolic ratio and growth performance to some limit. Soomro *et al.* (2019) concluded that growing quail might be kept under a quantitive feed restriction regimen, for 4–8 hr daily, along with dietary supplementation of probiotic as growth sponsor for improved growth.

Seaweeds have been used in poultry to advance poultry immune condition, to lessen microbial capacity in the digestive tract (Wang *et al.*, 2013

and Michalak and Mahrose, 2020). *Spirulina platensis* is a nature diet supplement and is valuable supply of high quality protein, vitamins, minerals, essential fatty acids, essential amino acids, carotenoids, and phenolic acids (Park *et al*., 2018; Michalak and Mahrose, 2020 and Ismail *et al.,* 2023). Different investigations indicated Spirulina augments growth performance since it has antioxidant, immunomodulatory, anti-inflammatory, antiviral, and antimicrobial activity in different animals (Michalak and Mahrose, 2020; Hassan *et al.,* 2021 and Ismail *et al.,* 2023).

Feed restriction regimens for an extended interval could cause a main stress on poultry species. Seaweeds have presented to alleviate the stress produced and augment the bird's immunity (Mahrose and Michalak, 2022). Tjhey theorized that SP addition would preserve the valuable bacterial population, and consequently clarify growth performance in this study.

Consequently, the current work was designed to explore the impact of different feed restriction regimens, with or without dietary SP supplementation, on relative growth rate and economic efficiency of Japanese quails.

MATERIALS AND METHODS

Birds and experimental design

This work was executed at the Research Farm belonging to Animal and Poultry Production Department, Faculty of Technology and Development, Zagazig University, Zagazig, Egypt. All trial practices respected the rules of the Ethical committee of Faculty of Technology and Development, Zagazig University, Egypt. A total number of 324 Japanese quail chicks at one week of age were haphazardly divided into 12 treatment groups (27 birds/ group) and each group had 3 replicates (9 chicks each). Each replicate was retained in one pen (35× 50 cm). A factorial arrangement (4 × 3) was applied involving four feeding regimens (*ad libitum*, feeding on 85% of the requirements, *ad libitum* within 16 hours/ day and feeding on 85% of the requirements within 16 hours/day) and three levels of dietary seaweeds supplementation (0, 0.5 and 1%).

Diet and management

The basal experimental diet was planned to involve the nutrient requirements of growing Japanese quails as suggested by NRC (1994) through 1 to 6 weeks of age as shown in Table 1.

Quail chicks were kept during experimental period under the same managerial, hygienic and environmental circumstances. Birds were subjected to

24h of light per day during first week, while during the experimental period, chicks were provided 16h light/ day, fresh water was accessible throughout the experimental period, while drinkers and feeding troughs were daily cleaned. A temperature of 34˚C was supported through the first 3 days and was lessened to 33˚C for four days after that it was reduced 3 ˚C/week until a stable temperature of 25 ˚C was realized.

Measurements

Relative growth rate (%) during1, 3 and 6 weeks of age, was calculated According to Broody (1945) as the following formula:

$$\text{Relative growth rate} = \frac{\text{Initial gain weight} - \text{Final gain weight}}{0.5\text{x}(\text{Initial gain weight} + \text{Final gain weight})} \times 100$$

Table 1: Composition and calculated analysis of experimental die.

Ingredients	**(%)**
Yellow corn	52.70
Soy bean meal	38.20
Corn-gluten 60%	4.30
Cotton seed oil	1.60
Di-calcium phosphate	1.60
Limestone	0.90
Nacl	0.30
Premix *	0.30
L-lysine	0.03
D- L methionine	0.07
Total	**100**
Calculated analysis **	
CP %	24.12
ME kcal/kg	2910.11
Ca %	0.85
P% Avail, P.	0.46
Lysine %	1.31
Methionine %	0.50
Met.+ Cys. %	0.82

*__Vitamin and mineral premix each 3 kg consists__ : Vit A 12000, 000 IU; Vit D3, 2000, 000 IU; Vit. E. 10g; Vit k3 2 g; Vit B1, 1000 mg ; Vit B2, 49g ; Vit B6, 105 g; Vit B12, 10 mg; Pantothenic acid, 10 g; Niacin, 20 g , Folic acid , 1000 mg ; Biotin, 50 g; Choline Chloride, 500 mg, Fe, 30 g; Mn, 40 g; Cu, 3 g; Co, 200 mg; Si, 100 mg and Zn , 45 g.

** Calculated according to NRC (1994).

Economic efficiency (EEF),%:

Economic efficiency of growth performance was calculated from the input-output analysis, which was calculated according to the price of the experimental diets and final body weight/unit. These values were calculated as the net revenue per unit of total cost.

Statistical analysis

The data was analyzed as factorial arrangement 4×3 (4 programs of feed regimens ×3 levels of seaweeds), according to **Snedecor and Cochran (1982)** using SAS (2011) program with adopting the following formula:

$$Y_{ijk} = \mu + F_i + S_j + FS_{ij} + e_{ijk}.$$

Where: Y_{ijk} = Observation for each dependent variable,
μ = Overall mean, F_i = Feed regimen effects (i = 1, 2, 3,4), S_j = Seaweed effects (J= 1 ,2 and 3), FS_{ij} = Interaction effect (ij=1,2 …..12), e_{ijk} = Random error.

Significant difference among means of treatments will be detected by Duncan's multiple range test procedures (Duncan, 1955). The differences will be considered significant at ($P \leq 0.05$). The percentage values were subjected to be arcsine transformation before performing the analysis of variance. Means were presented after recalculated from the transformed value to percentages.

RESULTS AND DISCUSSION

Relative growth rate(RGR)::

The obtained results revealed that relative growth rate (RGR), during 1-3, 3-6 and 1-6 weeks of age of growing quails were influenced significantly ($P<0.05$ and 0.01) by feeding regimens. Birds consumed 85% showed the lowest relative growth rate, while feeding on *ad libitum and ad libitum* within 16 hours/day groups showed the highest relative growth rate, during 1-6 weeks of age as shown in Table 2.

During 1-3, 3-6 and 1-6 weeks of age, quails fed on Spirulina platensis suppl.at level 0.5 % were higher insignificantly in relative growth rate than other treatment groups. Quails fed on un-supplemented with *Spirulina platensis* at level 1.0 % were lower insignificantly in relative growth rate than other treatment groups, during different period studies. Feed restriction regimens could enhance growth rate **(Soomro *et al.*, 2019)**.

Our findings show that birds consumed 85% of the requirements and those of 85% of the requirements within 16 h was less RGR than those of the control. Quails of the control group that fed *ad-libitum* ate greater feed than those

subjected to feed restriction groups and this may be owed to feeding frequencies and duration in the control group.

Similarly, **Rajat (2013)** stated that at marketing age, improved RGR was reported in feed limited birds. The latter author indicated that achievement of feed restriction regimen rely on compensatory growth, which is a retrieval from growth shortfall owing to lessened diet consumed. This exclusive capability of birds to recompense growth rate can greatest be exploited to augment feed efficacy at selling period.

The same results were obtained with **Karu *et al.* (2018)** indicated that dietary supplementation of seaweeds (SP) at level of 3% had no impact on growth performances of Japanese quail.

Preceding reports have showed that dietary supplementation with SP at different levels has optimistic influences on growth performance in poultry species. It has been stated that the amino acid shape of SP could be greater to the other plant feedstuffs, and that they have a high amino acid digestibility **(Alvarenga *et al.*, 2011; Evans *et al*., 2015).**

Furthermore, SP comprises physiologically vigorous ingredients such as carotenoid pigments, phycocyanin, polyunsaturated fatty acid, vitamins, macroand micro-mineral elements, and many other chemical complexes **(Maoka, 2011 and Michalak and Mahrose, 2020).** These complexes verify possible antimicrobial, antioxidant, and anti-inflammatory biological belongings, or perform as immune garnishes **(Abdel-Daim *et al.*, 2013; Shokri *et al.*, 2014).**

The interaction effect between feeding regime and dietary supplementation with seaweeds (*Spirulina platensis*) at different levels on relative growth rate of growing Japanese quails during 1-3, 3-6 and 1-6 weeks of age are presented in Table 2.

Data show that feeding regimen and dietary SP at different levels were influenced significantly ($P<0.05$ and 0.01) impact in relative growth rate (%), during 1to 6 weeks of age (Table 2).

Quails fed feeding on *ad libitum* and *ad lib.* within 16 hrs./ day supplementation with seaweeds (*Spirulina platensis*) at level 0.5% showed the highest relative growth rate, during 1-6 weeks of age (Table 2).

Economical efficiency:

However, feeding regimes on 85% req. and 85% within 16 hrs./day was more economic efficiency (%) than others groups. However, feeding regimes on ad libitum within 16 hours/ day was lowest economic efficiency (%) than others groups during 1-6 weeks of age.

Table(2) : Relative growth rate of growing Japanese quail as affected by feeding regimen , supplementation and their interactions from 1to 6 weeks of age.

Items		Relative growth rate (%), Weeks		
		1-3	**3-6**	**1-6**
***Feeding regimens* (FR)**				
ad libitum		120.18±1.25a	47.02±1.36c	146.54±0.51a
FR on 85% req.		110.62±1.34c	54.19±1.15b	143.33±0.94b
ad libitum within 16 hrs./ day		115.90±1.19b	52.33±1.25b	146.07±0.91a
FR on 85% req. within 16 hrs./day		107.40±0.67c	62.03±1.26a	145.24±0.67ab
Sig. test		**	**	*
FSSW. %				
Spir plat unsuppl, 0%		113.29±1.28	53.29±1.58	144.79±0.51
Spir plat suppl, 0.5%		113.50±2.05	54.99±1.78	145.84±0.91
Spir plat suppl, 1.0%		113.79±1.87	53.40±2.36	145.26±0.76
Sig. test		**NS**	**NS**	**NS**
Interaction(FRx FSSW) :				
ad libitum	*Spir plat* unsuppl, 0%	118.10±2.26ab	46.77±2.87c	144.91±0.31bc
	Spir plat suppl, 0.5%	121.40±2.67a	48.09±3.13c	147.96±0.39a
	Spir plat suppl, 1%	121.03±1.79a	46.18±1.93c	146.74±0.72b
FR on 85% req.	*Spir plat* unsuppl, 0%	112.83±1.74bc	52.59±1.47b	144.07±0.50b
	Spir plat suppl, 0.5%	108.26±3.33c	55.93±0.52ab	142.61±2.04c
	Spir plat suppl, 1%	110.77±1.47bc	54.06±3.27b	143.32±2.36b
ad lib. within 16 hrs./ day	*Spir plat* unsuppl, 0%	113.377±2.40bc	53.840±0.71b	145.05±2.04ab
	Spir plat suppl, 0.5%	116.94±1.85ab	53.29±1.93b	147.24±2.07a
	Spir plat suppl, 1%	117.37± 1.71ab	49.86±3.13c	145.91±0.34ab
FR on 85% req. within 16 hrs./ day	*Spir plat* unsuppl, 0%	108.84±0.90c	59.94±0.62ab	145.11±0.93ab
	Spir plat suppl, 0.5%	107.38±1.29c	62.66±0.85ab	145.54±1.12ab
	Spir plat suppl, 1%	105.99±0.99c	63.50±3.8a	145.06±1.78ab
Sig. test		****	****	*

Means are bearing different letters in each classification , different significance (P<0.05)
NS = Not significant,* (P<0.05).and ** = P ≤ 0.01
FR: Feeding regimens, FSSW: Feeding supplementation with seaweeds (*Spirulina platensis*), %,

On the other hand, birds feeding un-supplementation with seaweeds (*Spirulina platensis*) at level 0.5% were highest economic efficiency (%) than others groups during period from 1 to 6 weeks (Table 3). While, birds feeding supplementation with seaweeds (*Spirulina platensis*) at 1.0% /kg die were lowest economic efficiency (%) than other groups.

While, Quails fed feeding on 85% of the requirements within 16 hours/day supplementation with seaweeds (*Spirulina platensis*) at 1.0% /kg diet were lowest economic efficiency (%) than other groups. However, FR on 85% req. within 16 hrs/day without supplementation with seaweeds (*Spirulina platensis*) were highest economic efficiency (%) than other groups, during 1-6 weeks of age as shown in Table 3.

Table (3) : Economic efficiency on Japanese quail chicks as affected by feeding regimen , supplementation and their interactions, during during period from 1 to 6 weeks.

Items	Final No. of quails	1	2	3	4	5	6	7	8	9	10
Feeding regimens(FR)											
ad libitum	81	64.97	24	1559.26	403.98	15	1978.23	37.5	3037.5	1059.27	53.54
FR on 85% req.	81	55.02	24	1320.55	343.42	15	1678.97	37.5	3037.5	1358.53	80.91
ad libitum within 16 hrs./ day	81	65.21	24	1564.94	407.06	15	1987.01	37.5	3037.5	1050.49	52.86
FR on 85% req. within 16 hrs./day	81	54.58	24	1309.85	339.95	15	1664.80	37.5	3037.5	1372.70	82.45
FSSW, %											
0.0	108	80.21	24	1924.92	0.0	20	1944.92	37.5	4050	2105.08	108.23
0.5	108	79.96	24	1919.14	499.78	20	2438.91	37.5	4050	1611.09	66.05
1.0	108	79.61	24	1910.54	994.62	20	2925.17	37.5	4050	1124.83	38.45
Interaction effect between(FR x FSSW:)											
FR	**FSSW, %**										
ad libitum	**0.0**	**27**	21.78	24	522.696	0.0	5.0	527.70	37.5	1012.5	484.80	91.87
	0.5	**27**	21.74	24	521.644	135.85	5.0	662.51	37.5	1012.5	349.99	52.83
	1.0	**27**	21.45	24	514.896	268.13	5.0	778.02	37.5	1012.5	224.48	28.48
FR on 85% req.	**0.0**	**27**	18.41	24	441.864	0.0	5.0	446.86	37.5	1012.5	565.64	126.58
	0.5	**27**	18.28	24	438.672	114.24	5.0	557.91	37.5	1012.5	454.59	81.48
	1.0	**27**	18.33	24	440.016	229.18	5.0	674.19	37.5	1012.5	338.31	50.18
ad libitum **within 16 hours / day**	**0.0**	**27**	21.76	24	522.216	0.0	5.0	527.22	37.5	1012.5	485.28	86.93
	0.5	**27**	21.76	24	522.336	136.03	5.0	663.36	37.5	1012.5	349.14	52.63
	1.0	**27**	2168	24	520.393	271.04	5.0	796.43	37.5	1012.5	216.07	27.13
FR on 85% req. within 16 hrs/day	**0.0**	**27**	18.26	24	438.144	0.0	5.0	443.14	37.5	1012.5	569.36	128.48
	0.5	**27**	18.19	24	436.464	113.66	5.0	555.13	37.5	1012.5	457.37	82.39
	1.0	**27**	18.14	24	435.240	226.29	5.0	666.53	37.5	1012.5	345.97	51.91

FR: Feeding regimens, FSSW: Feeding supplementation with seaweeds (*Spirulina platensis*), %, EE(%):Economic efficiency percentage

FR on 85% req.= feeding on 85% of the requirements, FR on 85% req. within 16 hrs/day= feeding on 85% of the requirements in 16 hours, Spir plat unsuppl= *Spirulina platensis* unsupplementation, Spir plat suppl,

1 = *Spirulina platensis* supplementation (Kg), 2= Price of 1kg feed (LE), 3= Cost of feed (LE), 4: Cost of supply(LE), 5- Fixed cost(LE) ,6 =Total cost (LE), 7 = Price of one quail , 8= Total sale of quails (LE), 9= Net return (LE), 10= Economic efficiency(%)

In conclusion, *the present study exhibits that quail could be kept under a feed restriction* regimen, on *ad libitum* within 16 hours/day groups with seaweeds (*Spirulina platensis*) at level 0.5% showed the highest relative growth rate during 1-6 weeks of age than other treatment groups.

REFERENCES

Abdel-Daim, M. M., S. M. Abuzead, and S. M. Halawa. 2013. Protective role of *Spirulina platensis* against acute delta-methrin-induced toxicity in rats. PLoS One. 8:e72991.

Ahaotu, E.O.; De los Ríos, P.; Ibe, L.C.; Singh, R.R.(2019). Climate change in poultry production system. *A review. Acta Sci. Agric*. 2019, 3, 113–117.

Attia AI; Mahrose KHM; Ismail IE And Aboukasem DE. 2012. Response of growing Japanese quail raised under two stocking densities to dietary protein and energy levels. *Egypt J Anim Prod*., 47: 159-166.

Duncan, D.B., 1955. Multiple range and multiple F tests. Biometrics, 11:1-42.

Farghly,M.; Khalid Mahrose and Diaa E Abou-Kassem(2015). Pre and post hatch performance of different Japanese quail egg colors incubated under photostimulation**.** *Asian Journal of Poultry Science 9(1):19-30* See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/320707308. DOI:10.3923/ ajpsaj. 2015,19.30

Farghly, M.F.; Mahrose, K., Abougabal, M., Taboosha, M., Ali, R. (2022). Early heat acclimation during incubation improves Japanese quail performance under summer conditions. *Veterinary Research Communications*, 46(1), pp. 93–100.

Hassan, F., Mobarez, S., Mohamed, M., Attia, Y., Mekawy, A., & Mahrose, K. (2021). Zinc and/or selenium enriched Spirulina as antioxidants in growing rabbit diets to alleviate the deleterious impacts of heat stress during summer season. Animals: An Open Access Journal from MDPI, 11, 756. https://doi.org/10.3390/ani11030756 .

Ismail, F.; Sherif, K.; Rizk, Y.; Hassan, M.; Mekawy, A. and Mahrose, K. (2023). Dietary supplementation of spirulina and canthaxanthin boosts laying performance, lipid profile in blood and egg yolk, hatchability, and semen quality of chickens. *J. Anim. Physiol.& Nutr*., 107: 650-658.

Jeong, J. S., and I. H. Kim. 2014. Effect of Bacillus subtilis C-3102 spores as a probiotic feed supplement on growth performance, noxious gas emission, and intestinal microflora in broilers. *Poult. Sci*. 93:3097–3103.

Karu, P.; Selvan, S.T.; Gopi, H. and Manobhavan. M. (2018). Effect of macroalgae supplementation on growth performance of Japanese quails. *International Journal of Current Microbiology and Applied Sciences*, 7(2): 1039-1041.

Khalid M. Mahrose; Mohamed E. Abd El-Hack and Shymaa A. Amer.2019a Influences of dietary crude protein and stocking density on growth performance and body measurements of ostrich chicks. An Acad Bras Cienc (2019) 91(1) *Anais da Academia Brasileira de Ciências*, 91(1): e20180479 (Annals of the Brazilian Academy of Sciences) Printed version ISSN 0001-3765 / Online version ISSN 1678-2690 http://dx.doi.org/ 10.1590/0001-3765201920180479 www.scielo.br/aabc, www. fb.com/ aabcj ourna.

Khalid M. Mahrose , Mahmoud Alagawany , Mohamed E. Abd elhack , Samir A. Mahgouband Faten A. M. Attia. **2019b** Influences of stocking density and dietary probiotic supplementation on growing Japanese quail performance. *Biological Sciences*, *An. Acad. Bras. Ciênc*. 91 (02) https://doi. org/ 10.1590/0001 -3765201920180616

Mahrose, K.M.; Michalak, I.; Farghly, M.; Elokil, A.; Zhang, R.; Ayaşan, T.; Mekawy, A.; Fazlani, S. (2021). Role of clay in detoxification of aflatoxin B1 in growing Japanese quail with reference to gender. *Veterinary Research Communications* 45: 363 – 371.

Mahrose, K. M. and Michalak, I. (2022). Seaweeds for Animal Feed, Current Status, Challenges, and Opportunities. In: Sustainable Global Resources of Seaweeds, Vol.1, Rao, A.R. and Ravishankar, G.A. (Editors), Springer, Gewerbestrasse 11, 6330 Cham, Switzerland.

Mahrose, K.M., Abol-Ela, S., Amin, R.M., Abou-Kassem, D.E. (2022). Restricted feeding could enhance feed conversion ratio and egg quality of laying Japanese quail kept under different stocking densities. *Animal Biotechnology*, 2022, 33(1), pp. 141–149.

Michalak, I. and Mahrose, K. M. (2020). Seaweeds, intact and processed, as a valuable component of poultry feed. *Journal of Marine Science and Engineering*, 8(8), 620. https://doi.org/10.3390/jmse8080620.

Park, J.H.; Lee, S.I.; Kim, I.H. (2018). Effect of dietary Spirulina (Arthrospira) platensis on the growth performance, antioxidant enzyme activity, nutrient digestibility, cecal microflora, excreta noxious gas emission, and breast meat quality of broiler chickens. *Poultry Science*, 97:2451–2459.

Qaid aid, Mohammed; Albatshan, Hamad; Shafey, Tarek, Hussein, Elsayed and Abudabos, Ala, 2016. Effect of Stocking Density on the Performance and Immunity of 1-to 14-d-Old Broiler Chicks.**December 2016,** *Revista Brasileira de Ciência Avícola***,** 18(4):683-692. DOI: 10. 1590/1806-9061-2016-0289

Rajat B. (2013). Effects of feed restriction on compensatory growth period, nutrient digestibility and economics of japanese quails (*Coturnix coturnix japonica*). *International Multidisciplinary Research Journal*,3(1):04-07.

SAS (2011). Base SAS 9.3 Procedure Guide: Statistical Procedure. Cary, NC, USA.

Shokri, H., A. Khosravi, and M. Taghavi. 2014. Efficacy of Spirulina platensis on immune functions in cancer mice with systemic candidiasis. *J. Mycol. Res.*, 1:7–13.

Snedecor, G.W. and Cochran, W.G. (1982*)*. *Statistical Methods*. 7th Edition, Iowa State University Press, Towa, 511.

Soomro, R.N.; Abd El-Hack, M.E.; Shah, S.S.; Taha, A.E.; Alagawany, M.; Swelum, A.A.; Hussein, E.O.; Ba-Aawdh, H.A.; Saadeldin, I.; El-Edel, M.A.; and Tufarelli, V. (2019). Impact of restricting feed and probiotic supplementation on growth performance, mortality and carcass traits of meat-type quails. *Animal Science Journal*, 90: 1388–1395.

Wafaa A.Abd El-Ghany, 2019. A comprehensive review on the common emerging diseases in quails. *Journal of World's Poultry Research,* Vol. 9(4):160-174

Wang, S.; J. Y. Hui; W. L. Hua ; Z. F. Hua ; L. Y. Ting, 2013. *Entero-morpha prolifera* supplemental level: effects on laying performance, egg quality, immune function and microflora in feces of laying hens. *Chinese J. Anim. Nutr.*, 25 (6): 1346-1352.

تأثير النظام الغذائي ومكملات الأعشاب البحرية في بعض صفات الأداء النموي والكفاءة الاقتصادية لطائر السمان الياباني

سميرة سعيد – مصطفى ابراهيم توفيق – ضياء عراقى أبو القاسم - خالد محمد محروس*
قسم الإنتاج الحيواني والدواجنى-كلية التكنولوجيا والتنمية، جامعة الزقازيق- الزقازيق- مصر.

تناولت الدراسة المعاصرة أداء نمو طائر السمان الياباني متأثراً بأنظمة التغذية والمكملات الغذائية بمادة السبيرولينا *Arthrospira platensis* (SP). تم تقسيم إجمالي ٣٢٤ فرخ طائر السمان الياباني بعمر أسبوع واحد عشوائيًا إلى ١٢ مجموعة معالجة بترتيب عاملي (٤×٣)، يتضمن أربعة أنظمة تغذية (حسب الرغبة، التغذية على ٨٥% من المتطلبات،

حسب الرغبة خلال ١٦ ساعة / يوم ويتم التغذية على ٨٥% من الاحتياجات خلال ١٦ ساعة/يوم) وثلاثة مستويات من مكملات SP الغذائية (٠، ٠.٥ و١٪.(
اظهرت النتائج التي تم الحصول عليها أن معدل سرعة النمو عند عمر ١-٣، ٣-٦ و١-٦ أسابيع من عمر طيور السمان النامية قد تأثرت بنظام التغذية. استهلكت الطيور ٨٥% من احتياجاتها خلال ١٦ ساعة .
كنت أنظمة التغذية على ٨٥% من الطلب خلال ١٦ ساعة/يوم أكثر كفاءة اقتصادية (%) من المجموعات الأخرى. كانت أنظمة التغذية على ٨٥% من الطلب خلال ١٦ ساعة/يوم أكثر كفاءة اقتصادية (%) من المجموعات الأخرى. ومع ذلك، فإن التغذية على ٨٥% من الطلب خلال ١٦ ساعة/يوم أكثر كفاءة اقتصادية (%) من المجموعات الأخرى.
اظهرت النتائج ايضا أن الطيور التي تغذت على نظام *ad libitum* خلال ١٦ ساعة/يوم كانت الأقل كفاءة اقتصادية (%) من المجموعات الأخرى خلال ١-٦ أسابيع من العمر.
من ناحية أخرى، كانت الطيور التي تتغذى على الأعشاب البحرية (*Spirulina platensis*) بدون مكملات أعلى كفاءة اقتصادية (%) من المجموعات الأخرى .
كما أظهرت السمان التي تغذت على ٨٥% من المتطلبات خلال ١٦ ساعة أعلى كفاءة اقتصادية (%) مقارنة بمجموعات المعاملة الأخرى .
التوصية: اظهرت الدراسة الحالية أن السمان المربى تحت نظام تقييد التغذية، خلال ١٦ ساعة / يوم، مع المجموعات التي تحتوي على الأعشاب البحرية (*Spirulina platensis*) عند مستوى ٠.٥٪ أعلى معدل نمو نسبي خلال ١-٦ أسابيع من العمر مقارنة بمجموعات التجريبيةالأخرى.
الكلمات الافتتاحية: تقييد التغذية؛ سبيرولينا، النمو، الكفاءةالاقتصادية - السمان.