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Role of Feeding by Technically Modified Diets in Different Stages of Breeding on Reproductive Traits in Newly Hatched Quails

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Abstract

The aim was to investigate the effect of glycerin and whole egg powder supplements in the diet on the growth performance of Japanese quail. The current study included two experimental periods. 90 birds were used in the first experiment (digestive balance experiment), which lasted for one week, and 150 birds in the second experiment (growth and production), which lasted for 42 days. The treatments in the first experiment were as follows: T1: Control, T2: Glycerin 2.5% g/kg feed, T3: Whole egg powder 2.5% g/kg feed. While 150 chicks were used in the second experiment (production period) randomly distributed into 5 treatments: T1: Fasting(24h), T2: Control, T3: Glycerin (2.5%), T4: Whole egg powder (2.5%), and T5: Glycerin (2.5%) with whole egg powder (2.5%). The results of this study showed the highest significant difference ($P \leq 0.05$) was found in the daily and weekly average live body weight, daily, weekly and cumulative weight gain, feed consumption and feed conversion ratio, apparent and true metabolic energy, lengths of parts of the digestive tract (liver, proventriculus, duodenum, jujenum, ilum, cecum and rectum), Apparent metabolizable energy, protein digestibility factor in the treatment of birds treated with a 2.5% g/kg glycerin supplement compared to the control. Finally, this study concluded that the use of glycerin as a nutritional supplement effectively contributes to improving the growth performance of Japanese quail used as an alternative source of poultry meat.

Keywords: Production, Glycerin, Egg powder and Quail.

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Introduction

Delaying the feeding of chicks upon their arrival at the hatchery is no longer customary. They may experience delays in arrival due to prolonged long-distance travel to the breeding cages or extended retention in the hatchery (1). Despite chicks possessing a reserve of nutrients in the yolk sac that sustains them for several days post-hatching, postponing feeding adversely impacts growth by hindering the development of the digestive and muscular systems, ultimately preventing chicks from attaining the desired optimal weight (2). Postponing feeding results in a heightened death rate during the initial week (1;2). Furthermore, a part of hatched chicks (2-5%) fail to surmount and acclimatize to the post-hatch phase. Several chicks have delayed growth relative to the others. This behavior can be mitigated by providing feed in the hatchery shortly post-hatching (3). Research indicates that the weight of a chick during its first week directly influences its weight at the time of marketing. Furthermore, enterprises manufacturing commercial hybrids and research institutions aim to reduce the duration required for poultry to attain market weight. This suggests the significance of each day of existence (4). The chicks may experience several post-hatching processes, including sexing and insemination, which might postpone their availability to nourishment and water for up to 48 hours, potentially hindering their growth (5). Innovations in early feeding methods have provided solutions to this issue, as recent studies demonstrate the significance of early feeding for chicks post-hatching in enhancing productive efficiency through the development of their digestive and muscular systems (6). Additionally, early feeding contributes to the effective utilization of maternal antibodies (negative) stored in the yolk sac (7). Early feeding facilitates the rapid absorption of yolk sac contents compared to chicks that fast after hatching (8). A modified feed combination was composed of 50% water, 5% gelatinous substances (2.5% carrageenan and 2.5% corn starch), and a feed formulation that satisfies the requirements of newly hatched chicks at 45% composition. A technically modified feed mixture contaiing 50% water, 5% gelatinous substances (2.5% carrageenan and 2.5% corn starch) was prepared along with a feed foumula that meets the needs of newly hatched chicks when transported in crates from the hatchery to the poultry farms during long transportation journeys. This may be one of the most effective strategies for early feeding of newly hatched chicks (9). The research objectives were to identify effective methods for producing a technically enhanced feed mixture by improving the healthiness of the existing feed formulations and to evaluate the effect of technically modified diets on the performance of newly hatched quail.

Materials and Methods

Ethical approval

The protocol was reviewed and approved by the Research Ethics Committee, College of Veterinary Medicine, University of Basrah (Approval No. 69/37/2025). All procedures conformed to CIOMS-WHO and OIE guidelines for animal research.

Animals, housing and management

Experiment 1 used ninety (n = 90) one-day-old, unsexed Japanese quail chicks (initial body weight 8.10−10.50 g). Experiment 2 included one hundred fifty (n = 150) chicks. Chicks were housed in two-tier wooden cages, each tier containing three boxes (75 × 70 × 45 cm each). Environmental conditions were maintained at ~33 °C during the first week, gradually reduced by ~2 °C weekly until ~23 °C at week six. Lighting was continuous (24 h), and ventilation was provided via suction fans.

Dietary treatments

Starter diet (1–21 days): 22.23% crude protein, metabolizable energy 2950 kcal/kg.
Grower/production diet (22–42 days): 21.22% crude protein, metabolizable energy 3050 kcal/kg.

Experimental treatments

Exp.1 (1–7 days), n = 90: 3 treatments, 3 replicates per treatment (10 chicks per replicate):
1-Control (standard diet)
2-Standard diet + 2.5% glycerin
3-Standard diet + 2.5% whole egg powder

Exp.2 (1–42 days), n = 150: 5 treatments, 3 replicates (10 chicks each):
1-24h post-hatch fasting
2-Control diet
3-Diet + 2.5% glycerin
4-Diet + 2.5% whole egg powder
5-Diet + 2.5% glycerin + 2.5% egg powder

Additives and feed formulation

Glycerin (USP-Grade, 99.5%, BOJAGRO S.A., Germany), whole egg powder (approx. 48% protein; Ovostar Union, Ukraine), carrageenan (≈90% purity; Philippines), and modified corn starch (≈98% purity; CornTech, USA) were incorporated in the diets at specified levels (2.5% where applicable).

Sampling and measurements

Body weight, weight gain, feed intake, and feed conversion ratio were recorded. Digestive tract organ lengths (liver, proventriculus, duodenum, jejunum, ileum, cecum, rectum) were measured. At 42 days of age, three birds per treatment were slaughtered; blood samples were collected for serum biochemical analyses; pancreas tissues were harvested for enzyme activity. Samples were preserved (−20 °C for serum, −75 °C for tissues).

Statistical analysis
Data were analyzed using a Completely Randomized Design (CRD). Differences among treatment means were determined using Duncan's Multiple Range Test at $P \leq 0.05$.

Results

Effect of glycerin, whole egg powder and gel materials (carragennan and cornstarch) on the diets on daily living body weight:

The results of the table (1) showed the average daily live body weight during the digestion experiment indicated no significant differences (N.S.) among the groups from days 1 to 5, Significant differences ($P \leq 0.05$) were seen on days 6 and 7, with the glycerol group exhibiting markedly greater live body weights of (22.40 ± 0.10) gm on day 6 and (30.55 ± 0.23) gm on day 7, surpassing both the whole egg powder group and the control group.

Table (1): Average live body weight during the digestion experiment from (1-7 days) (Mean ± Standard error).

Age(day)	T1	T2	T3	Sig. level
1	8.19 ± 0.15	8.21 ± 0.09	8.22 ± 0.12	N.S
2	10.11 ± 0.11	10.13 ± 0.05	10.16 ± 0.10	N.S
3	12.15 ± 0.07	12.16 ± 0.06	12.18 ± 0.05	N.S
4	14.07 ± 0.06	14.17 ± 0.09	14.18 ± 0.12	N.S
5	16.10 ± 0.11	16.13 ± 0.11	16.22 ± 0.08	N.S
6	17.19 ± 0.15 c	19.20 ± 0.06 b	22.40 ± 0.10 a	*
7	23.77 ± 0.60c	27.00 ±0.70b	30.55 ±0.23a	*

The letters on the numbers symbolize a significant difference between the groups ($p \leq 0.05$). N.S referred to no significant difference . * referred to significant difference, T1:control, T2:Feed mixture (whole egg powder). T3:Feed mixture (food glycerin)

Effect of glycerin, whole egg powder and gel materials (carragennan and cornstarch) on the diets on Average feed intake (g) and feed conversion efficiency for 7-day-old chicks.

As indicated by the results in Table (2) The glycerol group exhibited the lowest feed consumption (102.70± 2.71)(gm) and the highest feed conversion efficiency (2.02±0.04)(gm), whereas the control group demonstrated the highest feed consumption (115.30± 4.50)(gm) and the lowest feed conversion efficiency (2.14± 0.05)(gm), with the whole egg powder group achieving average results.

Table (2): Average feed intake (g) and feed conversion efficiency for 7-day-old chicks (Mean ± Standard error).

Traits	T1	T2	T3	Sig. level
feed intake (g)	115.30 ± 4.50[a]	111.20 ± 8.16[b]	**102.70 ± 2.71[c]**	*
feed conversion efficiency	2.14 ± 0.05[a]	2.10 ± 0.03[b]	**2.02 ± 0.04[c]**	*

The letters on the numbers symbolize a significant difference between the groups in ($p \leq 0.05$). N.S referred to no significant difference . * referred to significant difference, T1:control, T2:Feed mixture (whole egg powder). T3:Feed mixture (food glycerin)

Effect of glycerin, whole egg powder and gel materials (carragennan and cornstarch) on the apparent Protein digestibility coefficient (%) for 7-day-old chicks

The data presented in Table (3) indicate significant differences ($P \leq 0.05$) concerning the impact of glycerol and whole egg powder on apparent protein digestibility. The glycerol group markedly excelled, achieving the maximum protein digestibility at 81.67%, whereas the control group had the lowest digestibility at 75.80%.

Table (3): apparent Protein digestibility coefficient (%) for 7-day-old chicks(Mean ± Standard error).

Traits	T1	T2	T3	Sig. level
apparent digestibility coefficient of protein %	75.80 ± 0.25[c]	78.45 ± 0.23[b]	81.67 ± 0.30[a]	*

The letters on the numbers symbolize a significant difference between the groups in ($p \leq 0.05$). N.S referred to no significant difference . * referred to significant difference, T1:control, T2:Feed mixture (whole egg powder). T3:Feed mixture (food glycerin)

Effect of glycerin, whole egg powder and gel materials (carginan and cornstarch) on the Average weights of the liver, gizzards, and proventricular, and average lengths of the small and large intestines for 7-day-old chicks.

The data presented in Table (4) indicate significant differences ($P \leq 0.05$) in the average internal organ weights and intestinal lengths due to the influence of glycerol and whole egg powder in most measurements. The glycerol group exhibited elevated measurements for liver weights (1.8± 0.02)(gm), gizzards (1.0± 0.01)(gm), and glandular stomach (0.4± 0.00)(gm), in addition to intestinal segment lengths (including the duodenum, Jejunum, ileum at (68.02 and 26.00) and the cecum and rectum at (6.4 and 3.2), relative to the other and control groups, signifying a substantial positive influence on the growth and development of the digestive system.

Table (4): Average weights of the liver, gizzards, and proventricular, and average lengths of the small and large intestines for 7-day-old chicks (Mean ± Standard error).

Traits	control	Feed mixture (whole egg powder)	Feed mixture (food glycerin)	Sig. level
Liver(g)	1.3 ± 0.02[c]	1.5 ± 0.03[b]	1.8 ± 0.02[a]	*
gizzards(g)	0.7 ± 0.01[c]	0.8 ± 0.03[b]	1.0 ± 0.01[a]	*
proventricular(g)	0.2 ± 0.03[c]	0.2 ± 0.04[b]	0.4 ± 0.00[a]	*
duodenum(cm)	25.50± 0.38[c]	25.92± 0.62[b]	26.00± 0.44[a]	*
jejunum(cm)	67.44± 0.59[c]	67.89± 0.33[b]	68.02± 0.51[a]	*
ileum(cm)	21.66± 0.33[c]	21.88± 0.14[b]	22.08± 0.22[a]	*
Ceca(paired)(cm)	5.1 ± 0.06[c]	5.5± 0.05[b]	6.4 ± 0.07[a]	*
Rectum (colon)(cm)	2.0± 0.03[c]	2.4 ± 0.04[b]	3.2 ± 0.00[a]	*

The letters on the numbers symbolize a significant difference between the groups (p≤0.05). N.S referred to no significant difference . * referred to significant difference, T1:control, T2:Feed mixture (whole egg powder). T3:Feed mixture (food glycerin)

Effect of glycerin, whole egg powder and gel materials (carginan and cornstarch) on the Calculation of apparent and true metabolic energy for 7-day-old chicks.

The result in the table (5) indicated significant differences (P≤0.05), with the glycerol group shwing to the greatest values for both apparent metabolizable energy (3000 kcal/kg) and true metabolisable energy (3146 kcal/kg), greatly surpassing the control group, which recorded the lowest values (2850 and 3015 kcal/kg, respectively).

Table (5): Calculation of apparent and true metabolic energy for 7-day-old chicks (Mean ± Standard error).

Traits	control	Feed mixture (whole egg powder)	Feed mixture (food glycerin)	Sig. level
Apparent metabolizable energy (AME)(kcal/kg)	2850 ± 4.50[c]	2910 ± 4.34[b]	3000 ± 4.10[a]	*
True metabolizable energy(TME)(kcal/kg)	3015 ± 4.10[c]	3090 ± 4.13[b]	3146 ± 4.24[a]	*

The letters on the numbers symbolize a significant difference between the groups (p≤0.05). N.S referred to no significant difference . * referred to significant difference T1:control, T2:Feed mixture (whole egg powder). T3:Feed mixture (food glycerin).

Effect of glycerin, whole egg powder and gel materials (carragennan and cornstarch) on the Average weekly live body weight of birds aged (1-6 weeks)

The data presented in Table (6) indicated significant differences (P≤0.05) in average weekly live body weight across the groups. During the initial to the sixth week, the glycerol group (T3) exhibited the highest average live body weight. At week 6, achieving the maximum live body weight (231.39 g). The fasting group (T1) consistently exhibited the lowest weights during the research.

Table 6: Average weekly live body weight of birds aged (1-6 weeks) (Mean ± Standard error).

Age (week)	T1	T2	T3	T4	T5	Sig. level
1 w	$22.76^{d}\pm0.40$	$23.73^{d}\pm0.36$	$31.70^{a}\pm0.79$	$26.24^{c}\pm0.83$	$29.04^{b}\pm0.49$	*
2 w	$53.00^{d}\pm0.57$	$54.00^{d}\pm0.54$	$65.54^{a}\pm0,94$	$57.02^{c}\pm1.20$	$62.55^{b}\pm0.76$	*
3 w	$87.00^{d}\pm1.14$	$88.00^{d}\pm1.11$	$102.47^{a}\pm0.90$	$92.21^{c}\pm1.25$	$96.48^{b}\pm0.74$	*
4 w	$128.02^{d}\pm1.44$	$129.00^{d}\pm1.41$	$152.02^{a}\pm1.16$	$134.94^{c}\pm1.38$	$139.53^{b}\pm0.97$	*
5 w	$164.59^{d}\pm1.13$	$165.56^{d}\pm1.11$	$184.07^{a}\pm0.47$	$172.42^{c}\pm1.36$	$176.50^{b}\pm1.09$	*
6 w	$204.46^{d}\pm1.25$	$205.43^{d}\pm1.22$	$231.39^{a}\pm1.65$	$211.37^{c}\pm1.60$	$224.28^{b}\pm0.87$	*

The letters on the numbers symbolize a significant difference between the groups ($p\leq0.05$). N.S referred to no significant difference . * referred to significant difference, T1: Fasting 24 h, T2: control, T3: 2.5% glycerin,T4: 2.5% whole egg powder, : 2.5% glycerin + 2.5% whole egg powder.

Effect of glycerin, whole egg powder and gel materials (carginan and cornstarch) on the Average weekly and cumulative feed intake of birds aged (1-6 weeks).

The data in Table (7) indicated no significant differences in average weekly and cumulative feed consumption during the first week. From the second week onwards, notable differences were observed ($P\leq0.05$), with the glycerol group (T3) consistently exhibiting the lowest average feed consumption relative to the other feeding groups, whereas the control group (T2) and the fasting group (T1) sustained the highest consumption levels for the majority of the weeks. At the cumulative level (1-6 weeks), the glycerol group exhibited the lowest feed consumption (566.57 g), whereas the control and fasting groups demonstrated the highest consumption.

Table (7): Average weekly and accumulative feed intake of birds aged (1-6 weeks) (Mean ± Standard error).

Age (week)	T1	T2	T3	T4	T5	Sig. level
1 w	34.30 ± 1.06	35.27 ± 1.03	36.37 ± 0.94	36.25 ± 0.51	37.07 ± 0.85	N.S
2 w	$70.66^{a}\pm0.85$	$71.66^{a}\pm0.82$	$\mathbf{63.81^{b}\pm0.89}$	$68.35^{a}\pm0.54$	$65.44^{b}\pm0.73$	*
3 w	$93.31^{c}\pm1.18$	$94.31^{a}\pm1.15$	$\mathbf{83.85^{c}\pm0.90}$	$91.28^{a}\pm0.48$	$87.77^{b}\pm1.07$	*
4 w	$106.30^{a}\pm1.19$	$107.30^{a}\pm1.16$	$\mathbf{93.62^{d}\pm0.83}$	$101.70^{c}\pm0.77$	$98.00^{b}\pm1.10$	*
5 w	$135.30^{a}\pm0.87$	$136.30^{a}\pm0.84$	$\mathbf{122.01^{d}\pm0.86}$	$130.39^{c}\pm1.09$	$127.13^{b}\pm0.38$	*
6 w	$176.00^{a}\pm1.14$	$177.00^{a}\pm1.11$	$\mathbf{161.67^{c}\pm0.72}$	$169.23^{b}\pm0.87$	$164.61^{c}\pm0.83$	*
Accum. (1-6) w	$621.00^{a}\pm2.85$	$622.00^{a}\pm2.82$	$\mathbf{566.57^{d}\pm2.76}$	$598.45^{c}\pm1.04$	$585.21^{b}\pm3.38$	*

The letters on the numbers symbolize a significant difference between the groups in ($p\leq0.05$). N.S referred to no significant difference . * referred to significant difference, T1: Fasting 24 h, T2: control, T3: 2.5% glycerin,T4: 2.5% whole egg powder, : 2.5% glycerin + 2.5% whole egg powder.

Effect of glycerin, whole egg powder and gel materials (carginan and cornstarch) on the Average weekly and accumulative feed conversion efficacy of birds aged (1-6 weeks)

Table (8) revealed significant differences (P≤0.05) in the average weekly and cumulative measures of feed conversion efficiency in birds aged 1 to 6 weeks. The glycerol group (T3) continuously exhibited the lowest values, considerably from week 1 to week 4 and in week 6, as well as at the cumulative level (2.50). The fasting group (T1) and the control group (T2) exhibited the highest values in most measurements, with no significant differences observed in week 5.

Table (8): Average weekly and accumulative feed conversion efficacy of birds aged (1-6 weeks) (Mean ± Standard error).

Age (week)	T1	T2	T3	T4	T5	Sig. level
1 w	2.28^{a}±0.02	2.29^{a}±0.00	1.50^{c}±0.03	2.06^{b}±0.10	1.82^{b}±0.03	*
2 w	2.36^{a}±0.02	2.37^{a}±0.00	1.90^{c}±0.01	2.20^{b}±0.01	1.98^{c}±0.02	*
3 w	2.77^{a}±0.07	2.78^{a}±0.09	2.28^{c}±0.02	2.60^{b}±0.01	2.60^{b}±0.00	*
4 w	2.61^{a}±0.00	2.62^{a}±0.01	1.88^{c}±0.03	2.40^{b}±0.10	2.30^{b}±0.10	*
5 w	3.74±0.13	3.75±0.15	3.74±0.12	3.50±0.02	3.47±0.10	N.S
6 w	4.43^{a}±0.02	4.44^{a}±0.04	3.40^{b}±0.02	4.40^{a}±0.20	3.47^{b}±0.10	*
Accum. (1-6) w	3.15^{a}±0.00	3.16^{a}±0.00	2.50^{d}±0.00	2.96^{c}±0.00	2.70^{b}±0.00	*

The letters on the numbers symbolize a significant difference between the groups in (p≤0.05). N.S referred to no significant difference . * referred to significant difference, T1: Fasting 24 h, T2: control, T3: 2.5% glycerin,T4: 2.5% whole egg powder, : 2.5% glycerin + 2.5% whole egg powder.

Effect of glycerin, whole egg powder and gel materials (carginan and cornstarch) on the Average lengths of the small intestine and yolk sac weight for birds aged (1 and 7 days)

In table (9) , significant differences (P≤0.05) were observed between the first and seventh days , where the glycerol group showed a significant increase in the average length of the duodenum , jejunm , ileum and yolk sac weight on the first day, which amounted to (8.50 , 12.01 , 10.25 ,and 0.04) respectively, The highest significant difference was recorded in the average length of the duodenum, jejunm , ileum which amounted to (26.04 , 68.00 , and 22.08) respectively, while the weight of the yolk sak did not record any significant difference on the seventh day.

Table (9): Average lengths of small intestine and yolk sac weight for birds aged (1 and 7 days) (Mean ± Standard error).

Age (day)	Lengths and weight organs	T1	T2	T3	T4.	T5	Sig. level
1 d	duodenum	7.90 ± 0.33[d]	8.00 ± 0.30[c]	**8.50 ± 0.23[a]**	8.22 ± 0.16[b]	8.19 ± 0.30[b]	*
	jejunum	11.50± 0.29[d]	11.88± 0.24[c]	**12.01± 0.17[a]**	11.85± 0.20[c]	11.92± 0.27[b]	*
	Illum	9.99± 0.79[d]	10.05± 0.80[c]	**10.25± 0.84[a]**	10.00± 0.29[b]	10.07± 0.48[b]	*
	yolk sac weight (g)	0.02 ± 0.3[c]	0.02 ± 0.3[c]	**0.04 ± 0.4[a]**	0.03 ± 0.3[b]	0.03 ± 0.2[b]	*
7 d	duodenum	25.50± 0.60[c]	25.59± 0.44[c]	**26.04± 0.54[a]**	25.90± 0.30[b]	25.93± 0.42[b]	*
	jejunum	67.60± 0.66[c]	67.63± 0.68[c]	**68.00± 0.54[a]**	67.80± 0.63[b]	67.86± 0.33[b]	*
	Illum	21.68± 0.86[c]	21.71± 0.88[c]	**22.08± 0.57[a]**	21.90± 0.34[b]	21.93± 0.50[b]	*
	yolk sac weight (g)	0.00 ± 0.1	0.00 ± 0.1	0.00 ± 0.1	0.00 ± 0.3	0.00 ± 0.2	N.S

The letters on the numbers symbolize a significant difference between the groups in ($p \leq 0.05$). N.S referred to no significant difference . * referred to significant difference, T1: Fasting 24 h, T2: control, T3: 2.5% glycerin,T4: 2.5% whole egg powder, : 2.5% glycerin + 2.5% whole egg powder.

Effect of glycerin, whole egg powder and gel materials (carragennan and cornstarch) on the calculation the number of dead chicks (1-6) weeks.

Table (10) indicated no significant differences (N.S) among the experimental groups (T1 to T5). This signifies that the various nutritional interventions employed in the study (including fasting, standard food, glycerin, whole egg powder, or their combinations) didn't exert a statistically significant impact on the mortality rate of chicks throughout this timeframe.

Table (10): Calculating the number of dead chicks (1-6) weeks (Mean ± Standard error).

Age (day)	T1	T2	T3	T4	T5	Sig. level
number of dead chicks	0.01 ± 0.01	0.02 ± 0.03	0.01 ± 0.01	0.02 ± 0.02	0.01 ± 0.02	N.S

The letters on the numbers symbolize a significant difference between the groups ($p \leq 0.05$). N.S referred to no significant difference. * referred to significant difference T1: Fasting 24 h, T2: control, T3: 2.5% glycerin, T4: 2.5% whole egg powder, T5: 2.5% glycerin + 2.5% whole egg powder
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Discussion

The data in Table (1) demonstrate that the experimental results exhibited no significant differences (N.S) across the various groups from days 1 to 5. On days 6 and 7, a notable enhancement in the daily live weight of the glycerol-treated group was recorded, on day 6 and 7. Glycerol serves as a substantial energy source, enhancing nutritional absorption efficiency and metabolic functions. Studies indicate that utilising glycerol as a dietary substrate can augment the productive performance of animals, leading to increased body weight and growth (19). Conversely, whole egg powder proved to be less efficacious than glycerol in this trial, underscoring the significance of diversifying dietary sources to enhance performance. The findings underscore the significance of employing gelling agents like carrageenan, regarded as advantageous elements in improving dietary efficiency. (20) revealed that the application of these agents improves growth efficiency and augments the uptake of vital nutrients.

The results presented in Table (2) shows a significant difference (P<0.05) indicating that the glycerin group exhibited the lowest feed intake and the highest feed conversion efficiency, whereas the control group demonstrated the highest feed intake and the lowest feed conversion efficiency. A study by (21) indicates that glycerin positively affects feed palatability and enhances digestive efficiency due to its distinctive chemical features. Moreover, (22) demonstrated that glycerin alters intestinal architecture by enhancing villus height and lumen depth, resulting in enhanced nutritional absorption and markedly higher digestive efficiency. (23) pointed out that including glycerol in poultry feeds markedly enhanced metabolic energy efficiency and diminished food wastage. Conversely, the elevated feed consumption in the control group may indicate the lack of these advantages, resulting in diminished energy utilisation efficiency. (24) noted that the lack of enhancers like glycerol may result in increased feed intake without attaining optimal feed conversion efficiency. (25) elucidated that the lack of osmotic effects from glycerol may restrict the feed conversion efficiency of egg powder in comparison to glycerol. No substantial effects were seen from the gelling agents (carraginnan and starch) in this experiment, likely due to their inert characteristics and restricted bioavailability at the measured concentrations. (26) stated that the impact of karigan and starch is primarily contingent upon the concentration employed and the degree of their interaction with other feed components. Furthermore, (27) established that carrginnan and starch may function as inert components in the absence of bioactive additions like probiotics or digestive enzymes. The results underscore glycerol's potential as an efficacious feed supplement for enhancing feed conversion efficiency in 7-day-old chicks. This discovery aligns with recent research validating its function in enhancing both taste and nutrient absorption. (28) pointed out that glycerol improves feed efficiency and diminishes gaseous emissions from digestion.Table (3) The glycerin group attained a digestion rate of 81.67%, whereas the control group registered 75.80%. The enhanced protein digestibility is ascribed to the distinctive elements of glycerin, Protein of high biological value is more readily digested and absorbed, enhancing intestinal health. Moreover, glycerin serves as an energy source and enhances gastrointestinal health(29). The findings demonstrate that enhanced protein digestibility correlates directly with superior nutritional performance and growth in hens. Increased digestibility correlates with enhanced nutritional availability for growth, hence augmenting total avian performance (30). Table (4) The findings indicated that the liver weight in the glycerin group was 1.8 ± 0.02 grammes, whereas the liver weight in the control group was 1.3 ± 0.02 grammes.

The augmentation in liver weight indicates enhanced liver function, an organ integral to metabolism and detoxification, which directly influences general health and growth in avians (31). The considerable lengths of the large intestine, including the cecum and rectum, indicate enhancements in water and nutrient absorption. Extended intestine length augments a bird's capacity to absorb nutrients, thus enhancing general health and diminishing sickness risk (30). Gelatinising agents, such as carrageenan and curstar, are essential for enhancing gut health. These medicines enhance the equilibrium of intestinal microbiota by fostering the proliferation of helpful bacteria and inhibiting the growth of pathogenic bacteria (32). These findings underscore the significance of innovation in dietary design. The incorporation of superior nutrients enhances organ function and intestine length, indicating notable advancements in nutritional quality and resource utilisation efficiency in avian species (33).

Table (5) The findings indicated significant differences ($P \leq 0.05$), with the glycerin group attaining the greatest apparent metabolisable energy (AME) value of 3000 kcal/kg, whilst the control group reached 2850 kcal/kg. The glycerin promotes intestinal health, stimulates the proliferation of beneficial bacteria, and enhances the equilibrium of intestinal flora, hence facilitating improved absorption of vital nutrients (34). Consequently, it demonstrates the hens' superior capacity to efficiently utilise the energy in the meal, thereby improving growth rates and performance (30). The glycerol group exhibited a greater real metabolisable energy value of 3146 kcal/kg, in contrast to the control group's value of 3015 kcal/kg. This signifies enhanced efficiency in transforming nutrients into useful energy, hence augmenting the total performance of the hens. Research has demonstrated that actual metabolisable energy accurately represents the effective utilisation of energy in essential activities, including growth and reproduction (35). The data indicate that introducing glycerol, whole egg powder, and gel materials into chicken diets positively influences metabolic energy, suggesting that their inclusion is a strategic measure to enhance nutritional performance and general health. Advancements in diet formulation establish the basis for enhancing avian productivity and facilitating optimal performance, indicative of notable progress in poultry nutritional methodologies (36). In Table (6).

The weight of the birds in the groups treated with glycerin (2.5%) was 31.70 gm during the first week, compared to 22.76 gm in the control group, according to the data. This substantial weight difference statistically significant, $P \leq 0.05$) illustrates how the enriched nutritional formula improved the birds' growth and well-being. claim that glycerin improves intestinal health by enhancing the body's absorption of vital nutrients and boosting their utilisation. Dietary changes that improve feed conversion efficiency and provide these birds an extra edge are responsible for the notable growth gain (30). In Table (7), the glycerin and (2.5%) group ingested 63.81 gm during the second week, compared to 71.66 gm consumed by the control group. Adding glycerin to feed helps to improve responsiveness to feeding. This indicates that the benefits of the glycerin-enriched diet are sustainable. For production performance to keep improving, feed efficiency must be increased (37). In Table (8), The group that received glycerin showed even more improvement, highlighting the ongoing advantages of incorporating better nutrients into the diet. These results are essential for comprehending how glycerin improves bird feed efficiency (38). According to these findings, feeding glycerin to birds seems to improve feed conversion efficiency, indicating that using these components is a good way to increase the production of healthy poultry.

Table (9) On day 1, the group receiving glycerin (2.5%) attained a duodenal length of 8.50 cm, whereas the control group measured 8.00 cm. Enhancing the length of the small intestine is essential for augmenting nutritional absorption efficiency. Studies demonstrate that an elongated intestine length enhances surface area, hence augmenting absorption capacity, which in turn increases feeding efficiency and promotes avian growth (39). On day 7, these patterns continued, with the glycerin exhibiting an increase in duodenum length of 26.04 cm, in contrast to 25.59 cm for the control group. This rise illustrates the beneficial impact of glycerin, which fosters structural development of the digestive system, thereby improving nutritional performance in hens (40).

Conclusion

This study demonstrates that early post-hatch feeding, particularly with glycerol-supplemented diets, plays a vital role in improving growth, digestive development, and survival of Japanese quail. Immediate feed access promoted better weight gain, intestinal function, and chick uniformity, whereas delayed feeding was associated with impaired performance and higher mortality. The inclusion of glycerol as an easily digestible energy source supported a smoother transition from yolk-based to external feeding and reduced early-life stress. Overall, these results highlight the value of early nutritional interventions as an effective approach to enhance chick viability, productivity, and long-term performance in quail production systems.

Conflict of Interest

The authors declare that there is no conflict of interest associated with this study.

Ethical Approval

The Research Ethics Committee approved this work.

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دور التغذية المبكرة باستخدام الأنظمة الغذائية المعدلة تقنيًا على الصفات الإنتاجية في السمان حديث الفقس

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الخلاصة

الهدف هو دراسة تأثير مكملات الجلسرين ومسحوق البيض الكامل في العليقة على أداء نمو السمان الياباني. تضمنت الدراسة الحالية فترتين تجريبيتين. تم استخدام 90 طائرًا في التجربة الأولى (تجربة توازن الجهاز الهضمي) والتي استمرت لمدة أسبوع واحد، و150 طائرًا في التجربة الثانية (النمو والإنتاج) والتي استمرت لمدة 42 يومًا. كانت المعاملات في التجربة الأولى على النحو التالي: T1: الضابطة، T2: الجلسرين 2.5٪ غ / كغ علف، T3: مسحوق البيض الكامل 2.5٪ غ / كغ علف. بينما تم استخدام 150 فرخًا في التجربة الثانية (فترة الإنتاج) موزعة عشوائيًا على 5 معاملات: T1: صيام (24 ساعة)، T2: الضابطة، T3: الجلسرين (2.5٪)، T4: مسحوق البيض الكامل (2.5٪)، وT5: الجلسرين (2.5٪) مع مسحوق البيض الكامل (2.5٪). أظهرت نتائج هذه الدراسة أعلى فرق معنوي ($P \leq 0.05$) في متوسط وزن الجسم الحي اليومي والأسبوعي، وزيادة الوزن اليومية والأسبوعية والتراكمية، واستهلاك العلف، ومعدل التحويل الغذائي، الطاقة الأيضية الظاهرة والحقيقية، أطوال أجزاء الجهاز الهضمي (الكبد، الأمعاء الغليظة، الاثني عشر، الأمعاء الدقيقة، الأمعاء الغليظة، الأعور والمستقيم)، الطاقة الأيضية الظاهرة، معامل هضم البروتين في معاملة الطيور المعالجة بمكمل الجلسرين بتركيز 2.5% غ/كغ مقارنةً بالمجموعة الضابطة. وأخيرًا، خلصت هذه الدراسة إلى أن استخدام الجلسرين كمكمل غذائي يُسهم بفعالية في تحسين أداء نمو السمان الياباني المُستخدم كبديل للحوم الدواجن.

الكلمات المفتاحية: الإنتاج، الجلسرين، مسحوق البيض والسمان.