Egypt Poult. Sci. Vol (26) (I): (1-15)

STUDY ON ROYAL JELLY IN POULTRY FEEDING 1- EFFECT OF ROYAL JELLY TYPE ON THE PERFORMANCE OF LAYING HENS AT THE END OF PRODUCTION SEASON

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Received:**03/11/2005** Accepted:**02/01/2006**

Abstract: *A total of 85 hens, 44 wks old, ISA brown were randomly assigned to five treatment groups (T1 to T5) and housed in six cages per treatment until 60 wks of age. Diet was formulated to have 17% CP and 2903 Kcal ME/kg. Lyophilized royal jelly (RJ) was given either in the diet (T2) at the level of 60 mg/kg diet or in drinking water (T3) at the level of 7 mg/hen/day. Frozen RJ from Egypt (T4) and China (T5) were given in drinking water at the level of 21 mg/hen/day. Control group (T1) fed the previous diet without any addition. All RJ treatments increased body weight. Eggs laid per hen were significantly ($P<0.05$) increased by 3.25, 3.31 and 3.57% with T2, T3 and T5 groups, respectively. Average egg weight was significantly ($P<0.05$) increased by 2.50% in T2 group, while decreased by 2.27 and 1.66% in T3 and T4 groups, respectively. Feed intake significantly ($P<0.05$) decreased by 2.25, 1.30 and 5.16% in groups received T2, T3 and T5 treatments, respectively. Feed conversion ratio was improved by 6.82, 1.82 and 8.64% with T2, T3 and T5 groups, respectively. On the other hand, feed conversion ratio of T4 group was the worst. Digestibility of CP was increased, while digestibility of EE was significantly ($P<0.05$) decreased by 12.49, 15.57 and 14.84% when birds received T2, T3 and T4 treatments, respectively. Digestibility of CF was significantly ($P<0.05$) decreased by 64.76, 61.74, 63.06 and 70.64% when birds received T2, T3, T4 and T5 treatments, respectively. ME value was significantly ($P<0.05$) increased by 3.68% with T5 treatment. RJ treatment in T2, T3 and T5 groups increased money return per house by 11.28, 7.00 and 18.68%, respectively. In conclusion, lyophilized RJ in diet at 60 mg/kg or drinking water at the level of 7 mg/hen/day, or Chinese frozen RJ in drinking water at the level of 21 mg/hen/day improved productive performance, body gain, CP digestibility, ME value, and economical efficiency of feed. However, Egyptian frozen RJ showed a dramatic effect on most of the measured traits.*

INTRODUCTION

Royal jelly (RJ) is a secretion of the cephalic glands of nurse bees and it is the food of the queen (the only fertile female in the colony) and the larvae that will become queen bees **(Kimura *et al.*, 2003)**. When a queen is lost in a colony, nurse bees feed some workers with RJ, these sterile workers start laying eggs **(Lin-HuaRog *et al.*, 1998)**. RJ is available in fresh, frozen, dried (Lyophilized) and processed states **(Yoshida and Matsuka, 1983)**. The average commercial production of RJ in Egypt is 150 g/colony/year **(El-Shehawy, 1989)**. More than one million kg of RJ are produced in China every year **(Chen *et al.*, 2002)**. RJ consists of an emulsion of protein, sugars and lipids having a creamy texture **(Sahinler and Sahinler, 2002)**.

The range measured for moisture, proteins, fat, carbohydrates and ash content of RJ were 59.4-66.5%, 12.8-15.1%, 7.9-9.9%, 11.0-12.3% and 0.9-1.5%, respectively. Potassium was the most abundant element, RJ was rich in minerals such as Na, P, Mg, Ca, Mn, Fe, and Zn. Measured amounts of vitamins in fresh samples were 6.3, 7.1, 12.4, 8.3, and 3.2 μg/g for B1, B2, B3, B6 and C, respectively. Fructose represented the major sugar fraction (52.6-54.4%) followed by glucose and sucrose being (28.6-29.6%) and (8.05-8.6%), respectively **(Ragab and Ibrahim, 2000)**. Fresh RJ contained 2% nitrogen, 89% of which was water-soluble. Proteins contributed 73.9% of total nitrogen, free amino acids 2.3% and peptides 0.16% **(Takenaka, 1984)**.

Amino acid analysis of fresh and stored frozen RJ revealed the presence of Lys, His, Arg, Asp, Thr, Ser, Glu, Pro, Gly, Ala, Val, Ile, Leu, Tyr, and Phe **(El-Berry *et al.*, 1989)**. RJ contained phospholipids, mono-, di-, and triglycerides, sterols, long-chain free fatty acids and hydrocarbons in various quantities **(Ivanov *et al.*, 1985)**. Carboxylic acids, present in the ether-soluble fraction, constituted 5.8% of RJ; of the 13 acids identified 10-hydroxydecenoic acid constituted 31.8% of total acids, 10-hydroxydecanoic acid 21.6%, and water-soluble gluconic acid 24.0% **(Takenaka, 1984)**. Benzoic acid content was 8-13 mg/kg in RJ **(Matsuka, 1993)**. Contents in freeze-dried (lyophilized) RJ were 2-3 times higher than in fresh RJ **(Wen-HweiMei *et al.*, 1994)**. The protein fractions in RJ have high antioxidative activity and scavenging ability against active oxygen species **(Nagai and Inoue 2004)**. Dietary RJ increased the average life span of mice, possibly through the mechanism of reduced oxidative damage **(Inoue *et al.*, 2003)**.

The effects of temperature stress were reduced on rats by administration of 1 g RJ/kg/day. A triglyceride level which had been increased by feeding fructose for 14 days was reduced by treatment with

100-300 mg RJ. Those properties may play an important role in the effects of RJ on aging processes and stress reactions **(Ikeda *et al.*, 1996)**. The amount of total cholesterol in rat plasma, which was increased by the fat plus high cholesterol diet, was decreased by RJ medication. This lowering effect is due to increase of the fecal excretion of cholesterol and bile acid **(Nakasa *et al.*, 2003)**. The haematological values revealed higher total leucocyte count and absolute lymphocyte count in chicks given RJ **(Kurkure *et al.*, 2000)**. Serum thyroxin levels of rats increased by 14.3% when RJ was given orally. RJ stimulated the production of serum luteinizing hormone, testosterone and progesterone **(El-Banby *et al.*, 1987)**. RJ significantly improved most of the studied reproductive characteristics **(Khattab *et al.*, 1989)**.

RJ showed good antifungal activity in vivo **(Nassis *et al.*, 1998)**. RJ has antiviral properties against viruses which cause influenza, herpes or human immunodeficiency virus infections **(Stangaciu, 2002)**. RJ contains a bactericidal substance, royalisin, that was found to have potent antibacterial activity **(Eshraghi, 2005)**. RJ appeared to reduce overall damage due to coccidiosis in chicks **(Kurkure *et al.*, 2001)**. Adding RJ to turkey diets, at the doses of 10, 15 and 20 ppm from 1 to 150 days of age, improved weight gain and feed utilization. At doses of 15 and 20 ppm, RJ also improved the carcass, the meat yields, the fat yield and the fat content of meat **(Bonomi *et al.*, 2001)**. RJ lyophilized, at the doses of 10 and 15 ppm, has positively influenced laying (resp. 10.50% and 11.00%), feed consumption for dozen eggs produced (resp. 21.00% and 22.00%), eggs weight (resp. 5.00% and 4.80%), weight gain of the hens (resp. 7.00% and 6.50%), yolk pigmentation (resp. 9.50% and 9.70%). RJ at the dose of 5 ppm did not have positive effects **(Bonomi *et al.*, 2000)**.

The objective of current work was to study the effect of RJ on the performance and economic efficiency of feed of laying hens at the end of production season.

MATERIALS AND METHODS

A trial was carried out in Ras Sedr Experimental Station South-Saini, using 85 ISA brown laying hens at 44 weeks of age. Birds were randomly assigned to five treatments (T1-T5) and housed in six cages per treatment until 60 wk of age. Diet was formulated to have 17% crude protein, 2903 Kcal, ME/kg diet, 3.40% Ca and 0.45% available phosphorus as shown in Table 1. Birds in control group (T1) received this diet without additive. Birds in T2 group received control diet with lyophilized RJ (60 mg/kg diet, which equal to 7 mg/hen/day). Birds in T3 group received control diet with lyophilized RJ dissolved in drinking water (7 mg/hen/day) using cups fixed in every cage. Birds in T4 group received Egyptian frozen RJ dissolved in drinking water (21 mg/hen/day). Birds in T5 group received Chinese frozen RJ dissolved in drinking water (21 mg/hen/day) as shown in Table 2. Mash diets and water were provided *ad libitum*. Number of eggs and egg weight were recorded daily. Feed consumption was measured weekly.

Table (1): Composition and calculated analysis of the experimental diet

Ingredients (%)		Calculated analysis		
Yellow corn	68.7	Crude protein.	%	17.0
Soybean meal (44%)	13.35	ME	(Kcal /kg)	2903
Concentrate *	10	Calcium.	%	3.41
Vegetable oil	0.7	Av. Phosphorus.	%	0.45
Limestone	6.75	Met + Cys.	%	0.58
Vit.-Mineral mix. **	0.25	Lys.	%	0.88
NaCl	0.25	Crude fiber	%	2.65
Total	100	**Feed price**	LE/100 kg	150

** Contains 51% CP. 2400 Kcal ME. 8% Ca. 3.51 Av. P. 1.69 % Met. 3.19% Lys and 1.66% CF per kg.*
*** To supply Kg diet by: Vit. A. 10000 IU; cholecalciferol. 3120 IU; Vit. E. 36 IU; menadione. 24 mg; Vit. B12. 0.02 mg; riboflavin. 7.2 mg; pantothenic acid. 14.4 mg; niacin. 60 mg; thiamine. 1.2 mg; pyridoxine. 2.4 mg; folic acid. 0.72 mg; biotin. 0.06 mg; choline. 250 mg; zinc. 100 mg; iron. 80 mg; manganese. 100 mg; copper. 12 mg; iodine. 1 mg; and selenium. 0.3 mg.*

Table (2): Experimental design

	Treatments				
	T1	**T2**	**T3**	**T4**	**T5**
Type of RJ	-	Lyophilized	Lyophilized	Frozen	Frozen
Produced in	-	USA	USA	Egypt	China
Included in	-	feed	Drinking water	Drinking water	Drinking water
Dose	-	60 mg /kg	7 mg/hen/day	21 mg/hen/day	21 mg/hen/day

Random samples of 12 eggs from each treatment were collected weekly to measure egg quality. Shape index was estimated as a ratio of maximum width of egg to their length using Vernier Calipers. Specific gravity of eggs was determined using the saline flotation method of **Voisey and Hamilton (1977)**. Salt solutions were made in incremental concentration of 0.005 in the range from 1.065 to 1.120. Eggs were weighed and broken onto a flat surface. Albumen and yolk height was measured by tripod micrometer. Yolk color was measured by Roche Color Fan. The ratio of yolk height and diameter was used to determine yolk index. Yolk, albumen and shell weights were recorded according to **Well (1968)**. Haugh units were calculated using the HU formula **(Eisen *et al.*, 1962)** based on the height of albumen determined by a micrometer and egg weight. Shell thickness was measured at the equator.

At the end of the feeding trial, three birds per treatment were randomly assigned to determine the retention and excretion of dietary nutrients. Nutrient retention was the amount of nutrient retained per hen, which was calculated based on the availability of nutrient and feed intake. Excreta of layers were totally collected for three days. Diets and excreta were analyzed according to chemical procedures of **A. O. A. C., (1990)** for proximate analysis. Urinary nitrogen was determined according to **Jakobsen *et al.* (1960).** Urinary organic matter was evaluated according to **Abou-Raya and Galal (1971)**. Metabolizable energy (ME) was calculated according to **Titus and Fritz (1971)**.

The feed economical efficiency of the formulated diets was calculated based upon the differences in both selling revenue and feeding cost. Costs of feeds used were calculated according to the price of feed ingredients available in the Egyptian market.

Data were subjected to one way analysis of variance using the General Linear Models (GLM) procedure of SAS **(SAS Institute, 1988)**. Significant differences among treatment means were determined at $P<0.05$ by Duncan's new multiple range test **(Duncan, 1955)**.

RESULTS AND DISCUSSION

Table 3 summarized the effects of RJ treatments on body weight gain, egg number, rate of egg production, egg mass, average egg weight, feed intake, feed conversion, and mortality rate. Compared to birds fed the control diet, the use of lyophilized RJ, with 7 mg/hen/day, in the diet (T2) or drinking water (T3) insignificantly increased average body weight gains by 40.99 and 66.31%, respectively. Similarly, the use of Egyptian (T4) or Chinese (T5) frozen RJ in drinking water, with 21 mg/hen/day, significantly ($P<0.05$) increased average body weight by 102.16 and 106.35%, respectively. This result is in agreement with that of **Bonomi *et al.* (2000)** who found that lyophilized RJ, at the doses of 10 and 15 ppm, has positively influenced weight gain of the hens by 7.00 and 6.50%, respectively.

Compared to birds fed the control diet, RJ treatments in T2, T3 and T5 groups significantly ($P<0.05$) increased egg number (Table 3), by 3.25, 3.31 and 3.57%, respectively, however RJ addition in T4 group significantly ($P<0.05$) decreased egg number by 1.72%. Egg production rate followed the same trend. RJ treatments in T2 and T5 groups significantly ($P<0.05$) increased egg mass (kg/hen) by 4.94 and 3.47%, respectively. Egg mass was not significantly affected by RJ addition in T3 group. However, RJ addition in T4 group significantly ($P<0.05$) decreased egg mass by 3.61%. The relative decrease of egg mass in T3 group was related mainly to the reduction of average egg weight (Table 3).

Average egg weight of T5 group was not significantly affected by RJ treatment. However, RJ treatment in T3 and T4 group significantly ($P<0.05$) decreased average egg weight by 2.27 and 1.66%, respectively. While, average egg weight of T2 group was significantly ($P<0.05$) increased by 2.50%. RJ treatment in T2, T3 and T5 groups significantly ($P<0.05$) decreased feed intake by 2.25, 1.30 and 5.16%, respectively. However, feed intake of T4 group was significantly ($P<0.05$) increased by 1.76%. RJ treatment in T2, and T5 groups significantly ($P<0.05$) improved feed conversion rate by 6.82, and 8.64%, respectively. However, feed conversion rate of T4 group was significantly ($P<0.05$) worse by 5.46%. Feed conversion rate of T3 group was not significantly affected by RJ treatment. Regarding to mortality rate, one bird died in T2 and T3 groups while no mortality was recorded in other treatments.

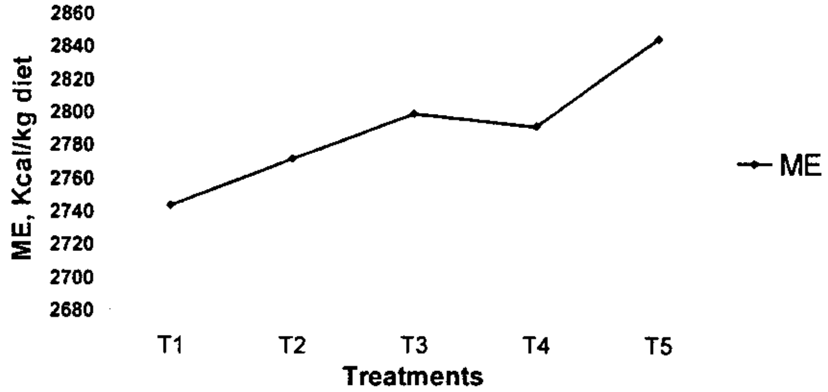
In general, adding lyophilized RJ in diet or drinking water, and Chinese frozen RJ in drinking water resulted in positive effect on egg production rate, egg mass, feed intake and feed conversion values. These results are in agreement with those of **Bonomi *et al.* (2000)** who found that lyophilized RJ at the doses of 10 and 15 ppm, have positively influenced laying performance by 10.50% and 11.00%, feed consumption for dozen eggs produced by 21.00% and 22.00%, respectively. Such positive influences may be due to the hormonal and reproductive effect of RJ. Whereas, **El-Banby *et al.* (1987)** found that serum thyroxin levels of rats increased by 14.3% when RJ was given orally. It also stimulated the production of serum luteinizing hormone, testosterone and progesterone. Similarly, **Khattab *et al.* (1989)** reported that RJ significantly improved most of the studied reproductive characteristics. On the other hand, Egyptian frozen RJ (T4) showed a negative effect that may be due to bad condition during the collection, handling and storing of this RJ type.

Percentage of eggs in each grade is shown in Table (4). In group of T2, percentage of jumbo eggs increased by 34.80%, while middle and large eggs decreased by 69.23 and 15.27%, respectively compared to hens fed control diet. Similarly, in group of T3, percentage of large eggs increased by 11.50%, while middle and jumbo eggs decreased by 10.26 and 11.37%, respectively. In T4 group, percentage of large eggs increased by 32.97%, while middle and jumbo eggs decreased by 47.86 and 21.58%, respectively. In group of T5, percentage of large eggs increased by 13.94%, while middle eggs decreased by 51.28%. It is clear that RJ treatments had a good effect on egg grading percentage, whereas middle eggs were reduced sharply while jumbo or large eggs were increased.

Egg quality characteristics as affected by RJ treatments are summarized in Table 5. Specific gravity, shape index, relative albumen weight, relative yolk weight, relative shell weight, yolk index, yolk color and shell thickness were not significantly influenced by RJ treatments. The result of yolk color disagree with those of **Bonomi *et al.* (2000)** who reported that lyophilized RJ at the doses of 10 and 15 ppm, have positive influence on yolk pigmentation by 9.50% and 9.70%, respectively. In fact, relative yolk weight (Table 5) insignificantly increased by 1.12, 2.16, 1.80 and 3.44% when birds received RJ treatments T2-T5, respectively. Haugh units significantly ($P<0.05$) decreased by 3.56% when birds received Egyptian frozen RJ (T4) in drinking water, while other groups were not different compared to the control group.

Digestion coefficients of nutrients and energy values as affected by RJ treatments are summarized in Table 6. Digestibility of nitrogen free extract, organic matter and dry matter were not affected ($P>0.05$) by RJ treatments. Digestibility of crude protein was significantly ($P<0.05$) increased by 2.25% when birds received Chinese RJ (T5), however it insignificantly increased with other RJ treatments. Digestibility of ether extract significantly ($P<0.05$) decreased by 12.49, 15.57 and 14.84% when birds received T2, T3 and T4 treatments, respectively. But, it insignificantly decreased by 1.54% with T5 treatment. Digestibility of crude fiber significantly ($P<0.05$) decreased by 64.76, 61.74, 63.06 and 70.64% when birds received T2, T3, T4 and T5 treatment, respectively. Chinese RJ treatment (T5) significantly ($P<0.05$) increased ME by 3.68% (Fig. 1). However, RJ treatments in T2, T3 and T4 groups insignificantly increased ME by 1.02, 2.00 and 1.75%, respectively.

Fig. (2): Metabolizable Energy as affected by RJ treatments



It is clear that RJ treatments increased ME value and digestibility of crude protein, however decreased digestibility of ether extract and crude fiber. In fact, RJ contains important amino acid such as Lys, His, Arg, Asp, Thr, Ser, Glu, Pro, Gly, Ala, Val, Ile, Leu, Tyr, and Phe **(El-Berry *et al.*, 1989)**, that may improve the biological value of consumed protein. The effect of RJ on ME may be due to its antioxidative activity **(Nagai and Inoue, 2004)**, or its capability to reduce temperature stress **(Ikeda *et al.*, 1996)**, or its influence on serum thyroxin levels **(El-Banby *et al.*, 1987).** The effect of RJ on digestibility of ether extract may be related to its role in reduced triglyceride level **(Ikeda *et al.*, 1996)** and total cholesterol in plasma, due to increase of the fecal excretion of cholesterol and bile acid **(Nakasa *et al.*, 2003)**. Finally, **Eshraghi (2005)** showed that RJ contains a bactericidal substance, royalisin that have a potent antibacterial activity. This finding may explain the reduction in crude fiber digestibility by RJ addition.

Table 7 shows the economical evaluation of feed per house as affected by RJ treatments (Fig. 2). Adding RJ increased total feed cost per house by 1.67, 2.59, 13.55 and 0.61%, for T2, T3, T4 and T5, respectively. However, RJ treatment in T2, T3 and T5 groups increased egg sales per house by 3.25, 3.31 and 3.57%, and increased money return per house by 11.28, 7.00 and 18.68%, and increased economic efficiency of feed by 9, 4, and 18%, respectively. On the other hand, Egyptian frozen RJ (T4) decreased egg sales, return, and economical efficiency of feed by 1.72%. 79.77 and 82.14%, respectively.

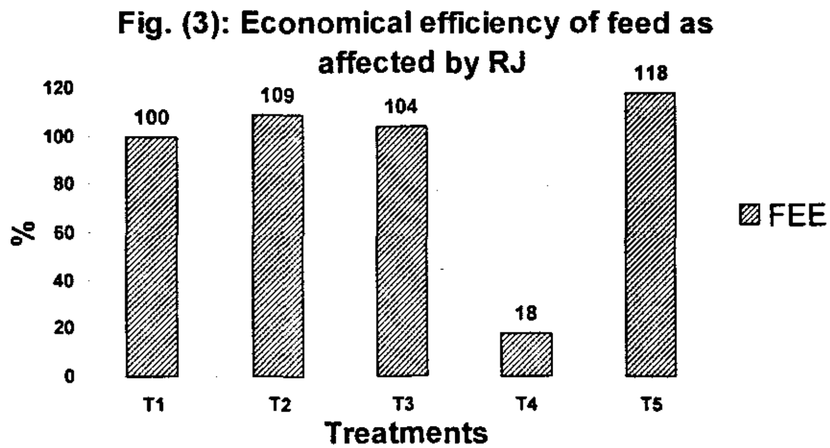


Fig. (3): Economical efficiency of feed as affected by RJ

It could be concluded that adding lyophilized royal jelly in diet at 60 mg/kg, or drinking water at the level of 7 mg/hen/day, or Chinese frozen royal jelly in drinking water at the level of 21 mg/ hen/day improved productive performance, body weight, feed conversion rate, protein digestibility, metabolizable energy, and feed economical efficiency. However, Egyptian frozen royal jelly showed a bad effect on most of the measured traits. This mystery substance needs more study about its effect on poultry performance.

Table (3): Productive performance of ISA brown laying hens during 44-60 weeks of age as affected by RJ treatments

Items		Treatments				
		T1	T2	T3	T4	T5
Initial body weight	g	1683	1722	1724	1750	1779
Final body weight	g	1853 ^{b}	1997 ^{ab}	1981 ^{ab}	1951 ^{cb}	2063 ^{a}
Total egg number	/hen	92.41 ^{b}	95.41 ^{a}	95.47 ^{a}	90.82 ^{c}	95.71 ^{a}
Egg production rate	%	82.51 ^{b}	85.19 ^{a}	85.24 ^{a}	81.09 ^{c}	85.24 ^{a}
Egg mass	kg/hen	5.852 ^{c}	6.141 ^{a}	5.886 ^{c}	5.641 ^{d}	6.055 ^{b}
Average egg weight	g	63.13 ^{b}	64.71 ^{a}	61.70 ^{c}	62.08 ^{c}	63.54 ^{b}
Total feed intake	kg/hen	12.857 ^{b}	12.568 ^{c}	12.690 ^{c}	13.083 ^{a}	12.194 ^{d}
Feed conversion	kg/kg	2.20 ^{b}	2.05 ^{c}	2.16 ^{b}	2.32 ^{a}	2.01 ^{c}
Mortality number		0	1	1	0	0

Means having different superscripts in the same row are significantly different (P<0.05).
T1: control
T2: Lyophilized RJ, 60 mg /kg diet.
T3: Lyophilized RJ, 7 mg/hen/day, in drinking water.
T4: Egyptian Frozen RJ, 21 mg/hen/day, in drinking water.
T5: Chinese Frozen RJ, 21 mg/hen/day, in drinking water.

Table (4): Percentage of eggs in each grade per house of brown laying hens during 44-60 weeks old as affected by RJ treatments

Treatments		Egg size S	M	L	J	Total egg number
T1	No.	0	28	108	103	239
	%	0	11.7	45.2	43.1	100
T2	No.	0	8	85	129	222
	%	0	3.6	38.3	58.1	100
T3	No.	2	25	120	91	238
	%	0.9	10.5	50.4	38.2	100
T4	No.	0	14	137	77	228
	%	0	6.1	60.1	33.8	100
T5	No.	0	13	118	98	229
	%	0	5.7	51.5	42.8	100

S: small class (<49.6 g); M: middle class (49.6-56.6 g); L: large class (56.6-63.7 g); J: jumbo class (>63.7 g).
T1: control
T2: Lyophilized RJ, 60 mg /kg diet.
T3: Lyophilized RJ, 7 mg/hen/day, in drinking water.
T4: Egyptian Frozen RJ, 21 mg/hen/day, in drinking water.
T5: Chinese Frozen RJ, 21 mg/hen/day, in drinking water.

Table (5): The variations in egg quality traits of ISA brown laying hens during 44-60 weeks of age as affected by RJ treatments

Items	Treatments T1	T2	T3	T4	T5
Specific gravity	1.0877	1.0855	1.0875	1.0882	1.0857
Shape Index*	0.756	0.742	0.759	0.756	0.749
Relative albumen Weight %	65.64	65.72	64.88	64.87	64.93
Relative yolk weight %	24.97	25.25	25.51	25.42	25.83
Relative shell weight * %	9.39	9.03	9.61	9.71	9.24
Haugh unit**	90.29^{ab}	90.21^{ab}	91.29^{a}	87.08^{b}	91.04^{a}
Yolk Index***	0.458	0.450	0.445	0.440	0.443
Yolk color	6.7	7.0	6.6	6.8	6.9
Shell thickness mm.	0.369	0.343	0.366	0.372	0.360

Means having different superscripts in the same row are significantly different (P<0.05).
*Shape index = short diameter / tall diameter
**Haugh units = $100 \text{ Log} (H + 7.57 - 1.7 W^{0.37})$
Where, H = albumen height (mm), W = egg weight (g)
***Yolk index = yolk height / yolk diameter

Table (6): Digestion coefficients of nutrients and energy values of layer diets as affected by RJ treatments

Items		Treatments				
		T1	T2	T3	T4	T5
Digestibility:						
Crude protein	%	91.39 ^{b}	92.36 ^{ab}	92.84 ^{ab}	92.54 ^{ab}	93.45 ^{a}
Nitrogen free extract	%	81.69	82.11	81.33	81.08	81.91
Ether extract	%	88.88 ^{a}	77.78 ^{b}	75.04 ^{b}	75.69 ^{b}	87.51 ^{a}
Crude fiber	%	31.78 ^{a}	11.20 ^{b}	12.16 ^{b}	11.74 ^{b}	9.33 ^{b}
Organic matter	%	81.96	81.71	81.19	76.03	82.25
Dry matter	%	76.09	75.69	77.62	76.00	76.68
Energy Values:						
Metabolizable energy	Kcal/kg	2744 ^{b}	2772 ^{ab}	2799 ^{ab}	2792 ^{ab}	2845 ^{a}

Means having different superscripts in the same row are significantly different ($P<0.05$).
T1: control
T2: Lyophilized RJ, 60 mg /kg diet.
T3: Lyophilized RJ, 7 mg/hen/day, in drinking water.
T4: Egyptian Frozen RJ, 21 mg/hen/day, in drinking water.
T5: Chinese Frozen RJ, 21 mg/hen/day, in drinking water.

Table (7): Feed economical evaluation of ISA brown laying hens as affected by RJ treatments during 44-60 weeks of age

Items		Treatments				
		T1	T2	T3	T4	T5
Price of royal jelly	LE /g	-	1	1	3	0.5
Cost of royal jelly	LE /house	-	13	13	40	20
Price of feed	LE /ton	1500	1500	1500	1500	1500
Feed intake	Kg/house	219	214	216	222	207
Feed cost	LE /house	328.5	321.0	324.0	333.0	310.5
Total feed cost	LE /house	328.5	334.0	337.0	373.0	330.5
Egg laid per house		1571	1622	1623	1544	1627
Price of egg	LE /egg	0.25	0.25	0.25	0.25	0.25
Egg sales	LE/house	392.75	405. 50	405.75	386.00	406.75
Return	LE/house	64.25	71.50	68.75	13.00	76.25
Economic efficiency of feed		0.196	0.214	0.204	0.035	0.231
Relative feed economic efficiency		100	109	104	18	118

Total feed cost = cost of royal jelly + feed cost
Return = egg sales – total feed cost
Economic efficiency = return / total feed cost
Relative E.E. = (E.E. of treatment / E.E. of control) × 100
T1: control
T2: Lyophilized RJ, 60 mg /kg diet.
T3: Lyophilized RJ, 7 mg/hen/day, in drinking water.
T4: Egyptian Frozen RJ, 21 mg/hen/day, in drinking water.
T5: Chinese Frozen RJ, 21 mg/hen/day, in drinking water.

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الملخص العربي

دراسة على استخدام الغذاء الملكي في تغذية الدواجن

١- تأثير نوع الغذاء الملكي على أداء الدجاج البياض في نهاية موسم الإنتاج

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أجريت هذه التجربة في محطة بحوث رأس سدر – جنوب سيناء لدراسة تأثير الغذاء الملكي على دجاج إيزابراون البياض. تم توزيع عدد ٨٥ طائر عمر ٤٤ أسبوع على خمس مجموعات وتم اسكان كل مجموعة في ٦ أقفاص حتى عمر ٦٠ أسبوع. أحتوت العليقة المقدمة لكل المجموعات على ١٧% بروتين خام ، ٢٩٠٠ ك ك طاقة ممثلة/كجم عليقة. قدم الغذاء الملكي المجفد في العليقة (T2) بمستوى ٦٠ ملجم/كجم عليقة ، أو في ماء الشرب (T3) بمستوى ٧ ملجم/طائر/يوم. قدم الغذاء الملكي المجمد المنتج في مصر (T4) أو المنتج في الصين (T5) في ماء الشرب بمعدل ٢١ ملجم/طائر/يوم. لم تحصل مجموعة التحكم (T1) على أي غذاء ملكي.

أوضحت النتائج زيادة الوزن الحي في كل معاملات الغذاء الملكي. أدت معاملات T2، T3 ، T5 إلى زيادة عدد البيض لكل طائر (بمستوى معنوية أقل من ٠,٠٥) بمقدار ٣,٢٥، ٣,٣١ ، ٣,٥٧% على الترتيب. زاد متوسط وزن البيضة (بمستوى معنوية أقل من ٠,٠٥) مقدار ٢,٥٠% في مجموعة T2 ، أدت المعاملات T3 ، T4 إلى نقص متوسط وزن البيضة بمقدار ٢,٢٧ ، ١,٦٦% على الترتيب. انخفض الغذاء المستهلك (بمستوى معنوية أقل من ٠,٠٥) بمقدار ٢,٢٥ ، ١,٣٠ ، ٥,١٦% في معاملات T2 ، T3 ، T5 على الترتيب. أدت المعاملات السابقة إلى تحسين معدل تحويل الغذاء بمقدار ٦,٨٢ ، ١,٨٢ ، ٨,٦٤% على الترتيب ، بينما ساء معدل التحويل بمقدار ٥,٤٦% عندما حصلت الطيور على المعاملة T4. زاد معامل هضم البروتين عند تقديم الغذاء الملكي للطيور، بينما انخفض معامل هضم مستخلص الأثير (بمستوى معنوية أقل من ٠,٠٥) بمقدار ١٢,٤٩ ، ١٥,٥٧ ، ١٤,٨٤% في معاملات T2 ، T3 ، T4 على الترتيب.

انخفض معامل هضم الألياف الخام (بمستوى معنوية أقل من ٠,٠٥) بمقدار ٦٤,٧٦ ، ٦١,٣٤ ، ٦٣,٠٦ ، ٧٠,٦٤% في المعاملات T2– T5 على الترتيب. زادت الطاقة الممثلة في العليقة (بمستوى معنوية أقل من ٠,٠٥) بمقدار ٣,٦٨% عند حصول الطيور على المعاملة T5. زاد الربح بمقدار ١١,٢٨ ، ٧,٠٠ ، ١٨.٦٨% في معاملات T2 ، T3 ، T5 على الترتيب.

نستنتج من هذا البحث أن الغذاء الملكي المجفد المقدم للدجاج في العليقة بمعدل ٦٠ملجم/كجم أو في ماء الشرب بمعدل ٧ ملجم/طائر/يوم ، وكذلك الغذاء الملكي الصيني المجمد المقدم في ماء الشرب بمعدل ٢١ ملجم/طائر/يوم يؤديان إلى تحسين الأداء الإنتاجي والوزن المكتسب والطاقة الممثلة ومعامل هضم البروتين والكفاءة الإقتصادية للغذاء. بينما أظهر الغذاء الملكي المصري المجمد تأثيرا سلبيا في أغلب الصفات المدروسة.