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# IMPACT OF ROYAL JELLY, GIBBERELLIC ACID AND TESTOSTERONE TREATMENTS ON SOME PRODUCTIVE, EGG QUALITY TRAITS AND ECONOMIC EFFICIENCY IN LOCAL CHICKEN STRAIN, DURING THE SUMMER SEASON OF EGYPT.

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## ABSTRACT:

*A total number of 128 laying pullets and 16 cocks of Matrouh local strain at 140 days of age (20-24 weeks) were randomly divided into four treatment groups (32 females and 4 males / group) in completely randomized design. The injections were carried out once a week for a month (4 times injection) before sexual maturity from 20 to 24 weeks of age. The $1^{st}$ treatment group of pullets was injected with a saline solution 0.9% and was considered as a control group. The $2^{nd}$ group, was administrated into the mouth, with 0.2 ml of distill water, which containing 200 μg royal jelly (RJ) /kg BW. While, the $3^{rd}$ and $4^{th}$ groups were injected subcutaneously with 0.2 ml of saline solution 0.9%, which containing 200 μg/Kg BW of each of gibberellic acid ($GA_3$) or testosterone (Ts), respectively.*

***The obtained results revealed that*** *the final body weight, daily feed consumption (DFC) and feed conversion ratio (FCR) of Matrouh pullets treated with 200 μg Ts, or $GA_3$, /kg BW, as well as egg production rate (EPR), egg mass (EM) and egg weight (EW) were improved significantly ($P \leq 0.05$) as compared with the control at the whole experimental period (24-48 weeks of age) compared to the control group. The lowest mortality rate (MR) 9.38 and 12.50% was significantly with Ts and RJ treated groups, respectively. While, the highest MR (%) was 18.75 and 15.63% recorded in $GA_3$ and control groups, respectively in laying pullets, during the total period (24-48 weeks of age). Moreover, egg shape index and egg albumin index were significantly ($P<0.05$) increased for pullets injected* *with 200 μg $GA_3$ and Ts/kg BW, respectively when compared to the control group, during the period from 24-48 weeks of age. However, results obtained revealed that treated pullets with Ts and RJ increased significant ($P<0.05$) egg albumin weight % than the control group in the same period. The best economic efficiency and the highest net return were recorded with $GA_3$ followed by the RJ group, while the control group recorded the lowest values during the whole experimental periods (20-48 weeks of age).*

***Conclusively,*** *pullets treated with 200 μg $GA_3$ or RJ /kg BW during pre-sexual maturity of age (20-24 weeks) were recommended for improving most of the productive performance, as well as egg quality, highest net return and economic efficiency of Matrouh local strain during summer season in Egypt.*

**Keywords:** Royal Jelly, Gibberellic acid, Testosterone, summer season, Productive performance, Matrouh laying pullets.

## INTRODUCTION

Globally, the poultry industry is gaining significant importance among the agricultural and its allied sectors. Heat stress reduces the growth, reproductive performance, and egg production in poultry. The reduction in the productive potential of poultry that exposure to heat stresses may be attributed to the deviation of energy resources from production to adaptation pathway (Vandana *et al.,* 2021). Also, high ambient temperatures have clear impacts on the behavior, feed and water intake, heat production, and physiological responses (body temperature, respiratory rate and heart rate) of poultry (Mutibvu *et al.,* 2017). Generally, the types of heat stress classification of birds are as follows: acute: 27–38 °C (1–24 h); moderate: 27–38 °C (up to 7 days); chronic or severe: 38–50 °C (7 days or more) (Guo *et al.*, 2008). However, any deviation from these ranges, especially in the upper critical temperature instigates heat stress response on poultry birds (Pawar *et al.* 2016).

Royal Jelly (RJ) is an item from honey bees that is utilized to take care of in the hive just as a main nutritional source for the queen honey bee. It is partially soluble in water and has a collar around whitish to yellow, with a density (1.1 g/ml). The RJ is a rich source of proteins (27%–41%), essential amino acids; carbohydrates (30%); fatty acids, lipids (8%–19%); phytosterols, carotenes, flavonoids, vitamins and minerals that aid the bee to stay alive, as well as some other unknown active compounds (Maghsoudlou *et al.,* 2019; Sabatini *et al.*, 2009). It has different significant hatchlings natural exercises, including anti hypercholesterolaemic (Guo *et al.,* 2007), anti-heat stress (El-Hanoun *et al.,* 2014; Elnagar *et al.,* 2010) and antioxidant abilities among others (Nagai *et al.,* 2004). RJ has been reported to have steroid and testosterone hormone-type actions (Hidaka *et al.,* 2006). Based on literatures in *vivo* and in *vitro* reports, it has been stated that RJ could inhibit lipid peroxidation (Hang *et al.,* 2008), and also, possesses antioxidant property and may play a noteworthy role on its influences on oxidative stress ageing process in animals (Ikeda *et al.,* 1996).

Gibberellic acid ($GA_3$) is a characteristic hormone found in plants and parasites and goes as a growth promoter (Silva *et al.,* 2013). In addition, Abdel-Azim (2017) announced that $GA_3$ is one of the plant development controllers that are generally utilized in Egypt, to increase the growth of fruits and vegetables. In addition, Gawienowski and Chatterjee (1980) reported that $GA_3$ has demonstrated in mammals a number of estrogenic hormones-like actions. Several studies showed beneficial effects of using $GA_3$ showing androgenic and estrogenic like actions in mammals and poultry (Elkomy, 2003; El-Sebai *et al.,* 2003; Abdel-Fattah *et al.,* 2007; Elkomy *et al.,* 2008). Abd-Elhamid *et al.* (1994) reported positive influences of $GA_3$ on body weights of poultry. Askar and IsmaeIl (2012) revealed that GA3 has a positive effect on product performance and fertility of laying hens.

Testosterone (Ts) is the most well-known male hormone (Goerlich *et al.,* 2010). The first Ts injections for stimulating ovulation were reported (Fraps, 1955). Injection of testosterone to laying hens, which have an active ovary, may stimulate ovulation, so it has been thought that the testosterone surge prior to ovulation causes LH surge, suggesting its important role in ovulation process. Furthermore, active or passive immunizations of testosterone effects lead to ovulation cease (Pehlivan *et al.,* 2001). A preovulatory increase of testosterone causes LH surge before ovulation by influencing hypothalamic-pituitary– ovarian axis (Pehlivan *et al.,* 2001). The mechanism of Ts was involved in ovulation, which was not straightforward. At physiological concentrations Ts does not seem to have an effect on the release of LH or ovulation in hens (Croze and Etches, 1980).

Therefore, the present study aimed to study the impact of injection of royal jelly, gibberellic acid and testosterone on some productive performance, egg quality traits and economic efficiency in Matrouh local strain, during summer season, Egypt.

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## MATERIALS AND METHODS

The present study was carried out in a Private Farm, near Inshas in Sharkia Governorate, Egypt, during the period from July 2019 to January 2020.

A total number of 128 laying pullets and 16 cocks of Matrouh local strain at 140 days of age were randomly divided into four treatment groups (32 females and 4 males) in each treatment group as a completely randomized design. Pullets in all treatments were nearly similar in the average initial body weight (936.72±8.40). Each treatment group was divided into 4 replicates each of 8 hens and one cock in the family's house. Birds were housed (open pens) in 16 floor pens (2 m × 2 m) furnished with wheat straw and fed *ad libitum* a basal diet. Fresh water was available all the time during the experimental period 7 months). The basal diet was formulated to meet the NRC (1994) recommendations as shown in Table 1. Birds were submitted to the same managerial condition in a window house with light cycle regimen (16 hours light: 8 hours darkness). Birds were examined against diseases and treated with antibiotics and vaccines to keep them healthy.

The 1$^{st}$ group of pullets was injected with a saline solution 0.9% and served as control. The 2$^{nd}$ group, was administrated into the beak, with 0.2 ml of distill water, which containing 200 µg RJ /kg BW (was purchased from the Khattab Company in Zagazig, Sharkia, Egypt). The 3$^{rd}$ and 4$^{th}$ treatment groups were injected subcutaneously with 0.2 ml of saline solution 0.9%, which containing 200 µg/kg BW of each of GA3 or Ts. Gibberellic acid ($GA_3$) was purchased from the Tiba Company in New Salhia, Sharkia, Egypt and Ts, was purchased from the CID Company in Tribal talbieh, Talbieh, Giza, Egypt. All treatment was injected once a week for a month (4 times injections) pre sexual maturity during 20-24 weeks of age.

The average minimum and maximum of ambient temperature (at 7 am and 1 pm) during the experimental period ranged between 26.61 and 36.97 $^0$C, relative humidity from 29.00 to 78.75 % and temperature-humidity index (THI) from 19.20 to 28.51 under Inshas, Sharkia Governorate, Egypt as shown in Table 2. THI was estimated according to the formula as follows: THI=db $^o$C-{(0.31-0.31 RH) (db $^o$C -14.4)}. Where db $^o$C = bulb temperature in Celsius and RH= RH%/100. The values obtained indicate the following: <22.2 = Absence of heat stress; 22.2 to <23.3 = Moderate heat stress: 23.3 to <25.6 = severe heat stress and 25.6 and more = Extreme severe heat stress (Marai *et al.,* 2000).

***Laying performance traits:***

Individual body weight (BW) of laying hens before sexual maturity was recorded at 20 weeks and at the end of the experiment (48 weeks). While, the egg number (EN) and egg weight (EW) were recorded daily. Feed consumption (FC) was calculated weekly. The egg production (EP) rate was calculated during the experimental period. Where:

**Table (1):** Composition and calculated analysis of the basal diet.

| **Ingredients** | **%** |
|---|---|
| Yellow corn | 61.80 |
| Soybean meal (44% CP) | 15.10 |
| Wheat bran | 8.28 |
| Corn gluten meal (60% CP) | 4.75 |
| Dicalcium phosphate | 1.35 |
| Salt | 0.30 |
| Limestone | 8.10 |
| Vit. + Min. premix* | 0.30 |
| DL-Methionine | 0.02 |
| **Total** | **100** |
| **Calculated analysis:** | |
| Crude protein (CP %) | 16.07 |
| ME; (kcal/kg) | 2691 |
| Ether extract % | 2.942 |
| Crude fiber % | 3.434 |
| Calcium % | 3.468 |
| Av. Phosphorus % | 0.304 |
| Lysine % | 0.653 |
| Methionine % | 0.314 |
| Methionine + cysteine % | 0.608 |

*__Vitamin and mineral premix: added to the 1 kg of diet including__: Vit. A 10000 I.U; Vit. D3 2000 I.U; Vit.E 15 mg; Vit.K3 1 mg; Vit.B1 1mg; Vit.B2 5 mg; Vit.B12 10 µg; Vit. B6 1.5mg; Niacin 30 mg; Pantothenic acid 10mg; Folic acid 1mg; Biotin 50 µg; Choline 300 mg; Zinc 50mg; Copper 4mg; Iodine 0.3 mg; Iron 30mg; Selenium 0.1mg; Manganese 60mg; Cobalt 0.1mg.

** Calculated analysis according to Feed Composition Tables for Animal and Poultry Feedstuffs used in Egypt **(2001)**.

**Table (2):** Microclimatic data during the whole experimental period under environmental condition..

| **Summer months** | **Average temperature ($^0$C)** | | **Average RH (%)** | | **Average (THI)** | |
|---|---|---|---|---|---|---|
| | **Min*** | **Max**** | **Min*** | **Max**** | **Min*** | **Max**** |
| **July** | 26.61±0.21 | 36.97±0.39 | 29.00±1.19 | 78.75±1.19 | 23.92 | 35.48 |
| **August** | 26.79±0.19 | 36.91±0.32 | 29.17±1.32 | 81.23±1.46 | 24.07 | 35.60 |
| **September** | 24.92±0.26 | 34.01±0.24 | 36.77±0.86 | 80.97±0.88 | 22.86 | 32.85 |
| **Means** | **26.10±0.22** | **35.96±0.31** | **31.64±1.12** | **80.31±1.17** | **23.61** | **34.64** |

$$\text{Egg production rate (\%) /Hen/ day} = \frac{\text{Number of eggs produced}}{\text{Number of live hen in each period}} \times 100$$

Egg mass was calculated by:

$$\text{Egg mass, g/day} = \text{Egg number/ Hen /day x Avergage egg weight (g).}$$

Feed conversion ratio (g feed / g daily egg mass) (FCR) was also calculated.

The mortality rate (%) was recorded daily for each treatment from 20 weeks of age to the end of the experiment.

***Egg quality measurements*:**

Egg quality measurements were determined at 32, 40 and 48 weeks of age, whereas eight eggs from each experimental group were randomly taken to measure egg quality traits and overall means. Egg quality (egg weight, egg shape index (%), yolk index (%), albumin index (%)

Percentages of egg components (yolk, albumin and shell weight) relative egg weight were determined. The Haugh score (relationship between egg weight and albumen height) for units and shell thickness in each egg were measured according to Haugh (1937).

***Economic efficiency*:**

The economic efficiency (EEf) of egg production was calculated from the input/output analysis according to the price of the experimental diets and egg produced during the experimental period. The price of the experimental diets was calculated according to the price of different administrated of doe's injections prevailing in the local market at the time of the experiment. The values of EEf were calculated as the net revenue per unit of total costs.

Relative economical efficiency was calculated assuming that the EEf (%) of the control = 100.

***Statistical analysis*:**

The experiment data were statistically examined by analysis of variance according to Snedecor and Cochran (1982) using ANOVA procedures of SAS (SAS, 2011). The statistical model was used as follows:

$$\mathbf{Y_{ij} = \mu + T_i + e_{ij}}$$

Where, $Y_{ij}$ = An Observation, μ= Overall mean, $T_i$ = Effect of the treatment groups, (i= 1, 2, 3 and 4), $e_{ij}$ = Random error.

The differences between means were tested by using Duncan's multiple range test procedures (Duncan, 1955).

## RESULTS AND DISCUSSION

### *Productive performance:*

The effects of royal jelly (RJ), gibberellic acid ($GA_3$) and testosterone (Ts) injected on some productive performance of Matrouh hens, during the experimental periods, under Egyptian summer conditions are presented in Table 3.

The significant decrease in body weight is possibly due to reduced feed intake as birds under heat conditions eat less feed in relation to the control ones (Mashaly *et al.,* 2004). The final body weight of Matrouh layers injected with 200 μg Ts, or $GA_3$, /kg BW were significantly ($P \leq 0.05$) increased as compared with the control at the end of the experimental period. While the highest values of the LBW and BWG were recorded in the groups injected with 200 μg Ts, or $GA_3$, / Kg BW followed by the same level of RJ (20-48 Wks of age) when compared to the control group (Table 3). The increase in weight due to RJ, GA3 and Ts has effects similar to that of estrogen on hen body weight (Hiba, 2010; Elkomy *et al*., 2007 and Mohammadi, 2015). From the oldest to the most recent they were showing that the LBW and BWG of the female chicks injected with 200 μg RJ, $GA_3$ and Ts increased compared to the control group. These results may be related to the active principles of RJ and $GA_3$, which was considered to be an excellent feed resource as it contains a wide range of biochemical and nutritionally important substances as: minerals, trace elements, wide range of carbohydrates, organic acids, lipids, sterols, nucleic acids, free amino acids, vitamins and over 100 kinds of enzymes and cofactors (Ismail, 2009 and Ezzat *et al*., 2020). Also, Hubert *et al*. (2011) and Mohammadi (2013) reported that testosterone hormone contents increase the resistance of tissues to toxicants and different harmful pathogens, also reported that increase number of goblet cells that acts as a defensive barrier against chemical or mechanical damage and to trapping invading pathogens (Guibert *et al*., 2012 and Possenti *et al.*, 2016).

Heat stress has been shown to decrease feed intake (from 3947.87 to 3678.23 g/bird), weight gain (2098.87–1786.77 g/bird), and the FCR (1.88–2.05) in broilers (Jahejo *et al.,* 2016). Results obtained revealed that the effect of RJ, $GA_3$ and Ts treatments on daily feed intake (DFI) and feed conversion per egg (FC) were improved significantly ($P<0.01$) at the end of the experimental period. The highest DFI was recorded with the laying hen administrated RJ. It was previously suggested that RJ administration could improve physiological function and immunity, and exert different pharmacological effects (Gabr *et al*., 2016). The best FC value (4.94) was recorded with laying hen $GA_3$ injected during the

**Table (3).** Effect of royal jelly (RJ), gibberellic acid (GA3), and testosterone (TS) treatments on some productive performance traits of Matrouh hens from 24-48 weeks of age

| Items | Treatments | | | | |
|---|---|---|---|---|---|
| | Control | 200 µg RJ /Kg BW | 200 µg GA3 /Kg BW | 200 µg TS /Kg BW | Sig. |
| Initial body weight (g) | 915.63±18.30 | 943.75±14.85 | 940.63±18.17 | 946.88±15.87 | NS |
| Final body weight (g) | 1370.77±22.34$^{b}$ | 1424.29±22.19$^{ab}$ | 1443.34±17.89$^{a}$ | 1464.14±22.65$^{a}$ | * |
| Change in body weight (g) | 465.00±21.77 | 492.15±21.89 | 506.30±19.94 | 510.69±23.74 | NS |
| Daily feed intake (g) | 118.87±0.59$^{c}$ | 121.07±0.18$^{a}$ | 120.32±0.28$^{ab}$ | 119.05±0.54$^{bc}$ | ** |
| Egg number | 121.63±4.08$^{c}$ | 145.50±4.10$^{ab}$ | 149.13±2.85$^{a}$ | 130.69±3.28$^{b}$ | ** |
| Egg production (%) | 41.89±1.87$^{b}$ | 46.76±1.31$^{b}$ | 52.13±2.19$^{a}$ | 43.45±1.22$^{b}$ | ** |
| Egg weight (g.) | 47.42±0.18$^{b}$ | 47.79±0.26$^{ab}$ | 47.99±0.14$^{a}$ | 47.78±0.18$^{ab}$ | * |
| Egg mass (g./hen) | 19.90±0.95$^{b}$ | 22.37±0.68$^{b}$ | 25.03±1.09$^{a}$ | 20.77±0.61$^{b}$ | * |
| Feed conversion ratio (g. / hen/ day) | 6.18±0.30$^{a}$ | 5.49±0.17$^{bc}$ | 4.94±0.20$^{c}$ | 5.81±0.18$^{ab}$ | ** |
| Total mortality (%) | 18.75 | 12.50 | 15.63 | 9.48 | NS |

a, b….. Means are bearing different letters in each rows, differ significant ($P < 0.05$).
NS = Not significant, * = $P < 0.05$, ** = $P < 0.01$

total experimental period (24-48 weeks of age). The present results are in agreement with the finding of El-Afifi and Abou Taleb (2002) reported that $GA_3$ injection improves the significant FC ratio in laying hen compared to control group. Also, Elkomy *et al*. (2008) showed that there was a significant differences FC, due to injection laying hens with 200 mg /Kg BW of $GA_3$, as compared with the control group.

***Egg production traits:***

Results obtained in Table 3 showed that the effect of $GA_3$ injection was significantly ($P<0.01$ and $P<0.05$) increased EN, EW, EM and EPR at the whole experimental period (24-48 weeks of age) compared to the control group. While, hens treated with 200 mg RJ and 200 mg Ts insignificantly increased EN, EW, EM and EPR when compared to the control group. These results may be due to $GA_3$ mimic estrogen effect. Whereas, estrogen increase sensitive granulose cells for follicle stimulating hormone (FSH) and estrogen synergist with FSH hormone due to increase volume of follicles also estrogen increase motility of oviduct and increase uterus activation (Kirunda *et al*., 2001) these factors due to increase egg volume and egg weight. This difference may be caused by an increase in FSH and LH hormones (Eriksson *et al.*, 2008) because RJ, $GA_3$ and Ts increase the activity of the anterior lobe of the pituitary gland responsible for the secretion of these hormones, which increased the ovarian activity and increases the number of mature ovarian follicles, which leads to an increase in egg production during the week and a hen day (HD) production increasing. The best EPR (52.13), EM (25.03) and EW (47.99) were recorded with $GA_3$ injected laying hen at the whole experimental period (24-48 weeks of age). Fariara *et al.* (2001) showed that there were significant differences in EPR due to injection laying hens with 200 mg $GA_3$/Kg BW, as compared with the control group. Mahmoud *et al.* (1996) Mohammadi *et al.* (2015) and Miran (2016) demonstrated that, EPR of birds treated with RJ, $GA_3$ and Ts were higher significantly at the whole experimental period than the control group. Similarly, Muiruri and Harrison, (1991) and Seven *et al.* (2016) reported that a significant effect ($P \leq 0.05$) in EM at levels 200 mg $GA_3$ /Kg BW treatments as well as, in general mean than the control group. $GA_3$ injection has been shown to increase energy, strengthen the immune system, give a positive sense of well-being, and possibly. Causes of all these proposed positive effects, $GA_3$ may be a very important supplement for improving performance of organs body. It has been proposed that $GA_3$ may also, play a significant role in nitric oxide production in the body. Nitric oxide plays an important role in immune system function, sexual health, muscular strength and hypertrophy, as well as other factors; $GA_3$ may therefore be a vital form of the supplementation

(Mahmoud *et al.*, 1996). The present results are in agreement with the finding of Khalid *et al.* (2017) observed that there was an improvement in EM due to GA3 injection laying hens as compared to control group. These results may be due to the increasing in egg number. Whereas, $GA_3$ had estrogenic effect and estrogen increase sensitive granulose cells for FSH and estrogen synergist with FSH hormone due to increase volume of follicles also, estrogen increase motility of oviduct and increase uterus activation (Khalil, 1997 and Hamdy *et al.*, 2002). These factors due to increase number of maturation egg and egg volume due to increase egg mass. Overall means that these may be caused to increase of estrogen effect on liver secretion of lipids proteins and this hormone caused increasing in growth of epithelium of the ovary (Mashaly *et al.*, 2004). All the experimental females reached the age of sexual maturity within six months, except for the testosterone group, which was about 15 days later than the rest of the group, which affected the number of eggs produced for injected hens with testosterone when compared to gibberellic acid and Royal jelly groups at the end experimental period.

The lowest mortality rate 9.38 and 12.50% was recorded with Ts and RJ groups, respectively. While the highest mortality rate 18.75 and 15.63% was recorded with $GA_3$ and control groups, during the total period (24-48 weeks of age). In birds, variable concentrations testosterone previously have been shown to influence offspring development and growth, metabolic rate, behavior, immune function, the ability to combat oxidative damage, and survival of embryos and nestlings (Tobler and Sandell, 2007; Cucco *et al*., 2008; Partecke and Schwabl 2008 and Tobler and Sandell, 2009). Testosterone exposure, clutch and sex all had additive effects on mortality. Testosterone enhanced survivorship could potentially increase lifetime reproductive success (Daan and Tinbergen 1997; Stearns, 1992). On the other hand, the present results may be related to the active principles of RJ which, is considered to be an excellent food resource as it contains a wide range of biochemical and nutritionally important substances as: minerals, trace elements, wide range of carbohydrates, organic acids, lipids, sterols, nucleic acids, free amino acids, vitamins and over 100 kinds of enzymes and cofactors which increased the immunity of chickens and reduce the mortality rate (Ezzat *et al*., 2020).

***Egg quality measurements traits*:**

Data presented in Table 4 showed that the effect of RJ, GA3 and Ts injection was significantly ($P<0.01$ and $P<0.05$) increased Egg shape index (%), Egg albumin index and Albumin weight (g) at the whole experimental period (32-48 weeks of age) when compared to the control group. While, it was not

**Table (4).** Effect of royal jelly (RJ), gibberellic acid (GA3), and testosterone (TS) treatments on some egg quality measurement of Matrouh hens at 32-48 weeks of age

| Items | Treatments | | | | |
|---|---|---|---|---|---|
| | Control | 200 µg RJ /Kg BW | 200 µg GA3 /Kg BW | 200 µg TS /Kg BW | Sig. |
| ***Egg quality measurement*** | | | | | |
| Egg weight, g | 47.00±1.31 | 49.67±1.34 | 50.20±1.55 | 47.74±1.61 | NS |
| Egg shape index, % | 74.26±1.7$^{b}$ | 77.31±0.48$^{ab}$ | 78.14±0.53$^{a}$ | 76.69±0.88$^{ab}$ | ** |
| Egg yolk index, % | 39.64±1.04 | 41.62±0.83 | 42.37±0.87 | 41.59±0.58 | NS |
| Egg albumin index, | 76.07±1.02$^{b}$ | 73.80±1.26$^{b}$ | 77.13±1.60$^{b}$ | 80.78±2.63$^{a}$ | * |
| Haugh unit( Score) | 82.62±1.63 | 88.21±1.66 | 86.83±2.31 | 87.52±2.33 | NS |
| Shell thickness (mm) | 0.3±0.004 | 0.31±0.004 | 0.31±0.005 | 0.3±0.005 | NS |
| ***Egg components (%)*** | | | | | |
| Yolk weight | 32.51±0.61 | 30.54±0.7 | 31.33±0.71 | 30.71±0.51 | NS |
| Albumin weight | 54.71±0.77$^{b}$ | 57.22±0.82$^{a}$ | 56.71±0.81$^{ab}$ | 57.71±0.64$^{a}$ | * |
| Shell weight | 12.47±0.48 | 12.43±0.38 | 11.91±0.27 | 11.7±0.35 | NS |

a, b….. Means are bearing different letters in each rows, differ significant (P< 0.05).
NS = Not significant, * = P< 0.05, ** = P< 0.01

significant (P>0.05) on Egg weight (g), Egg yolk index (%), Haugh units (Score), Shell thickness (mm), Yolk weight (g) and Shell weight (g) as compared to the control group.

Heat stress has been shown to a significant decrease in egg shell thickness, egg shell weight, Haugh unit and egg shell strength (Sahin *et al.,* 2018). The best egg weight quality (50.2), egg shape index (78.14), egg yolk index (EYI) (42.37) and egg shell thickness percentage (0.31 mm) were recorded in laying hen injected with $GA_3$ during period 32-48 weeks of age. $GA_3$ like estrogen effect, estrogen increase sensitive granulose cells for FSH and estrogen synergist with FSH hormone due to increase volume of follicles also estrogen increase motility of oviduct and increase uterus activation (Khalil, 1997) these factors due to increase egg volume and egg width, consequently the increasing in an egg shape index. El-Afifi and Abo-Taleb (2002) found that estradiol tends to save more blood calcium of laying quail for egg shell deposition. They observed that estradiol can increase intestinal calcium absorption and induce bone turnover, consequently improve egg shell quality and thickness.

Also, the best egg albumin index (80.78), (77.13) was recorded in laying hen treated with Ts and $GA_3$, respectively. While, the lowest value of egg albumin index (76.07), (73.80) was recorded in the control group and treated with RJ, respectively in laying hen during period 32-48 weeks of age. However, the best Haugh units of egg (88.21), (87.52) were recorded with RJ and Ts group, respectively. While, the lowest value of Haugh units of egg (86.83), (82.62) was recorded with $GA_3$ and control groups, respectively in laying hen during period 32-48 weeks of age. These results are in agreement with those obtained by (Mohammadi *et al.,* 2015) who treated laying hens strain with 500 μg Ts/Kg BW+50, 100 or 150 μg GH/ Kg BW and showed that the effect of this treatment with different doses on the monthly relative weight of egg albumin were significantly.

The best egg yolk weight (32.51%), (31.33%) was recorded with control and $GA_3$ groups, respectively. While the lowest value of yolk ratio (30.54 %), (30.71%) was recorded in group treated with RJ and Ts, respectively and the best egg shell weight percentage (12.47) was recorded with control group than the other treatments in laying hen during period 32-48 weeks of age. $GA_3$ has an estrogenic effect due to the increase in egg production and the increase in the number of yolk growth on the ovary, so the percentage of egg yolk was higher than the other groups, but it was not significant, and this effect may be due to the decrease in the weight of the yolk and thus the decrease in the percentage of yolk (Azza El-Sebai *et al.,* 2003). These results may be due to the increase in egg production due to treatment by 200 mg / kg BW RJ, $GA_3$ and Ts concentration (Mohammadi, 2013 and Ezzat *et al.*, 2020). However, results obtained revealed that the effect of Ts, RJ and $GA_3$ treatments on egg albumin weight was significant (P<0.05) increased than the control group in laying hen during period 32-48 weeks of age. These results are in agreement with those obtained by (Mohammadi *et al.*, 2015) who found that laying hens strain treated with 500 µg Ts/kg BW+50, 100 or 150 µg GH/Kg BW on the egg albumin weight during the treatment period was significantly. These results are in agreement with those obtained by Elkomy (2003) who add that 200 µg $GA_3$ / Kg had the highest egg albumin. $GA_3$ like estrogenic effect, estrogen induced motility of the oviduct may be due to increase albumen production within the oviduct.

***Economical Efficiency % (EE):***

Data presented in Table 5 showed economical efficiency % (EE) for the treated pullets with 200 mg / kg BW RJ, $GA_3$, and Ts during the experimental periods as shown in Table 5. Results obtained revealed that the effect of RJ, $GA_3$ and Ts treated on EE it was significantly (P<0.05) during at the end of the experimental period (24-48 weeks of age).

**Table 5:** Effect of royal jelly, gibberellic acid and testosterone treatments on economical efficiency of egg production of laying Matrouh hens strains, during the experimental period 24-48 weeks of age

| Items | Control | RJ | GA3 | TS | Sig. test |
|---|---|---|---|---|---|
| **Egg number** | $121.63^{c}$ | $145.50^{ab}$ | $149.13^{a}$ | $130.69^{b}$ | ** |
| **Price/egg (LE)** | 1.25 | 1.25 | 1.25 | 1.25 | NS |
| **Total revenue hen (LE)** | $152.03^{c}$ | $181.88^{ab}$ | $186.41^{a}$ | $163.36^{b}$ | ** |
| **Total feed intake/ hen(kg)** | 19.97 | 20.34 | 20.21 | 20.00 | |
| **Price/Kg feed (LE)** | 4.000 | 4.000 | 4.000 | 4.000 | |
| **Total feed cost/ hen (LE)** | 79.88 | 81.36 | 80.85 | 80.00 | |
| **Fixed hen (LE)** | 3.00 | 6.65 | 3.95 | 6.25 | |
| **Total cost hen (LE)** | 82.88 | 88.00 | 84.80 | 86.25 | |
| **Net revenue/hen (LE)** | **$69.15^{b}$** | **$93.87^{b}$** | **$101.61^{a}$** | **$77.11^{b}$** | * |
| **Economic efficiency (EEf)** | **$83.44^{b}$** | **$106.67^{b}$** | **$119.82^{a}$** | **$89.41^{b}$** | * |
| **Relative E.Ef. (%)** | 100.00 | 127.85 | 143.60 | 107.16 | |

a, b….. Means are bearing different letters in each rows, differ significant (P< 0.05).
NS = Not significant, * = P< 0.05, ** = P< 0.01

The best economic efficiency 119.82% and 106.67% was recorded with $GA_3$ and RJ groups, respectively. While, the lowest value of economical efficiency 89.41 % and 83.44% were recorded in the Ts and control groups, respectively in pullets during at the end of the experimental period (24-48 weeks of age). The same results were obtained by Ezzat *et al*. (2020), result showed that the clearer that Matrouh layers injected with 200 μg of $GA_3$ /kg BW were recorded the highest net revenue and the best economical efficiency followed by those 100 μg of $GA_3$/kg BW as compared with the control groups, while 50 or 100 μg of RJ/kg BW had the lowest net revenue and economical efficiency (%).

***Conclusively***, pullets treated with 200 μg $GA_3$ or RJ /kg BW during pre-sexual maturity of age (20-24 weeks) were recommended for improving most of the productive performance, as well as egg quality and had the highest net return and economic efficiency of Matrouh local strain under summer season conditions in Egypt.

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# تأثير المعاملة بالرويال جيلي وحمض الجبريليك والتستستيرون علي الصفات الإنتاجية وجودة البيض والكفاءة الاقتصادية في سلالات الدجاج المحلية خلال موسم الصيف فى مصر

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تم استخدام 128 دجاجة بياضه و 16 ديك من سلالة مطروح المحلية عند عمر 140 يوم (20-24 اسبوع) قسمت عشوائيا إلى 4 مجموعات تجريبية 32 أنثى و 4 ذكور في كل مجموعة في تصميم عشوائي تام. تم حقن الاناث مرة واحدة كل أسبوع لمدة شهر (4 مرات حقن) قبل النضج الجنسي من 24:20 أسبوعًا من العمر . تم حقن إناث المجموعة الأولى بمحلول ملحي9,. % والتى استخدمت كمجموعة مقارنة (كنترول)، تم تجريع إناث المجموعة الثانية في الفم بمعدل 0.2 مل من الماء المقطر والتي تحتوي على 200 ميكروجرام من رويال جيلي (RJ) / كجم من وزن الجسم. بينما تم حقن مجموعتي المعاملتين الثالثة والرابعة تحت الجلد بمعدل 0.2 مل من محلول ملحي 0.9٪ والتي تحتوي على 200 ميكروجرام من كلا من حمض الجبريليك (GA3) والتستوستيرون (Ts) على التوالي / كجم من وزن الجسم.

**وأظهرت النتائج** تحسن معنويا (عند مستوي احتمال 0,05) فى وزن الجسم النهائي لدجاج مطروح المحقون بمعدل 200 ميكروجرام /كجم تستستيرون أو حامض الجبريليك وكذلك الغذاء المستهلك اليومي ومعدل التحويل الغذائي للدجاج المعامل بمعدل 200 ميكروجرام /كجم رويال جيلي وكذلك معدل الانتاج وكتله ووزن البيض للدجاج المحقون ب 200 ميكروجرام/كجم حامض الجبريليك مقارنة بمجموعة المقارنة خلال الفترة الكلية (24-48 أسبوعًا من العمر). وكانت أقل نسبة نفوق 9,38، 12,50٪ لمجموعتي التستستيرون والرويال جيلى على التوالي. بينما كانت اعلي نسبه نفوق 15,63، 18,75٪ في مجموعتى الجبريليك والكنترول على التوالي في الدجاج البياض خلال الفترة الكلية (20-48 أسبوعًا من العمر). علاوة على ذلك ، زاد دليل شكل البيضة ودليل البياض معنويا (عند مستوي احتمال 0,05) للدجاج المحقون بمعدل 200 ميكروجرام /كجم حامض الجبريليك و التستستيرون علي التوالي عند المقارنه بالكنترول خلال الفترة من 24-48

أسبوعًا من العمر. وأظهرت النتائج أن معاملة الدجاج بالتستستيرون والرويال جيلي يزيد معنويا (عند مستوي احتمال 0,05) وزن بياض البيض عن مجموعة التحكم في نفس الفترة. وسجلت المجموعه المحقونة بحامض الجبريليك أفضل كفاءة اقتصادية واعلي عائد صافي يتبعها مجموعه الرويال جيلي بينما سجلت مجموعه المقارنة أقل قيم خلال الفتره التجريبيه الكليه (20-48 أسبوعًا من العمر).

**التوصية:** يوصى بالمعاملة بمعدل 200 ميكروجرام / كجم من وزن الجسم لكلا من حامض الجبريليك أو الرويال جيلي لتحسين معظم الأداء الإنتاجي وكذلك تحسين جودة البيض وإعطاء أعلى عائد اقتصادى وأفضل كفاءة اقتصادية لإناث مطروح تحت ظروف موسم الصيف في مصر.