J. Anim. and Poultry Prod., Mansoura Univ., Vol.7 (12): 457- 466 , 2016

Effect of Some Natural Antioxidants on Growth Performance, Blood Parameters and Carcass Traits of Growing Rabbits Under Egyptian Summer Condition

Gabr, Sh. A.[1]; G. E. Younan[2]; M. E. Hamad[1]; Rehab S. A. Ismail[3] and Mervat Sh. M. Zaky[1]

[1] Department of Animal Production , Faculty of Agriculture , Tanta University , Egypt.

[2] Animal Production Research Institute , Agricultural Research Center , Dokki , Giza, Egypt.

[3] Animal Production Department , Faculty of Agriculture , Mansoura University , Egypt.

ABSTRACT

The current study aimed to evaluate the effect of treatment with combination of royal Jelly (RJ) plus green tea (GT) or propolis (PR) plus GT on thermo-physiological response, growth performance, blood biochemicals and carcass traits. Total of 60 NZW weaned rabbits (5 wk of age and 703.03±11.59 g LBW) were assigned into three similar groups of 20 rabbits in each (10 males and 10 females). Rabbits in the $1^{st}$and 2^{nd} groups were fed complete feed diet (CFD) supplemented with 2 g GT/kg and orally treatment twice/week with 150 mg RJ/kg (G1) or 0.5 g PR/kg LBW (G2). However, rabbits in the 3^{rd} group were fed the same CFD without any supplements and orally treated with one ml saline and served as a control group (G3). Throughout the experimental period (August and September months), temperature humidity index (THI), rectal temperature (RT), LBW, feed intake (FI), viability rate and performance index (PI) were recorded, and daily weight gain (DWG) and feed conversion ratio(FCR) were calculated at 5-9, 9-13 and 5-13 age intervals. Blood samples were collected from three males from each group for determination of total proteins (TP), albumin (AL), glucose, cholesterol, triglycerides, high density lipoproteins (HDL), low density lipoproteins (LDL), creatinine, urea, triiodothyronine (T3) and tetraiodothyronine (T4) concentrations, as well as activity of aspartate (AST) and alanine (ALT) transaminases in serum. At 13 wk of age, three males from each group were slaughtered to evaluate carcass traits. Meat samples from hind limb were taken for chemical analysis. Results show that rabbits extremely severed from heat stress throughout all months studied. RT reduced in G2 ($P<0.05$) and G1 ($P\geq0.05$) as compared to G1, being better in males than in females. Both G1 and G2 showed marked improvement in LBW, DWG, RGR, FI, FCR and PI as compared to G3, being with the best G2, in particular, at 5-9 wk of age. VR was the highest in G1, and higher in females than females only in G2. Concentrations of TP, AL, GL, AL: GL ratio, total cholesterol, triglycerides, LDL, HDL, creatinine and urea as well as activity of ALT in blood serum were not affected by treatment. Serum glucose concentration was higher ($P<0.05$) in G2 than in G1, while both groups did not varied significantly from that in G1. Also, AST activity in serum reduced ($P<0.05$) in G1, but did not differ in G2 as compared to G3. Concentration of T3 and T4 was higher ($P<0.05$) in G1 than in G2 and G3. All carcass traits and meat composition were not affected significantly by treatments. Economic feed efficiency was the best in G1, followed by G2, and the lowest in G3. In conclusion, treatment of weaned rabbits during growing period under summer ambient temperature from 5 to 13 weeks of age with green tea in combination with royal jelly or propolis twice/week resulted in improving growth performance, viability rate and economic feed efficiency without adversely effects on rabbit health, in particular, at 5-9 wk age interval. A combination of royal jelly with green tea showed the best results.

Keywords: *Rabbit, green tea, royal jelly, propolis, growth performance, blood biochemicals, carcass traits.*

INTRODUCTION

Rabbits had high fertility, growth performance, small body unit and high meat producers. In recent years, much attention has been gaining towards commercial rabbit production (Basavaraj *et al*., 2011).

Heat stress which induces hyperthermia in rabbit is deleterious to any form of reproduction and occurs regardless of breed and stage of adaptation. In the subtropics, heat stress is a major problem that adversely affects rabbit's performance and physiological traits. High temperatures, as encountered in Egypt and in many other countries during the summer, is a major constraint factor for rabbit production, as it negatively affects production (Fouad, 2005).

At last years, there are international interests concerning application of natural sources in animal production field (Hashim *et al*., 2013). Using feed additives such as antioxidants like some vitamins (A, E and C) and trace elements (selenium) may participate in oxidative stress reduction (Agarwal *et al.,* 2004; Castellini, 2008; Mournaki *et al.,* 2010) and plays an important role in productivity and reproduction of rabbits (El-Shahat and Abdel-Monem, 2011).

Royal jelly (RJ) is a secretion product of the cephalic glands of nurse bees that has been used for centuries for its extraordinary properties and health effects (Pavel *et al*., 2011; Mărghitas, 2008). It is collected and sold as a dietary supplement, claiming various health benefits because of components like B-complex vitamins such as pantothenic acid (vitamin B_5) and vitamin B_6 (pyridoxine). It also contains many trace minerals, some enzymes, antibacterial and antibiotic components, and trace amounts of vitamin C. Vitamins A, D, E and K are completely absent from RJ (Graham, 1992). RJ has been used in animal research, with many benefits; it inhibits lipid peroxidation both *in vitro* and *in vivo* (Hang *et al*., 2008). It was reported that using RJ improved productive performance as an injection treatment in guinea-pigs(Afifi *et al*., 1989), as dietary supplement in rabbit diets (Bonomi *et al*.,2001). Generally, RJ administration to growing rabbits improved their performance as observed with better weight gain and feed utilization, which was associated with better feed utilization and without adversely effects on health status (Elnagar *et al*., 2010). Beneficial effects of RJ were reported on increasing protein metabolites in chickens (Kurkure *et al*.,2000) and serum high density lipoproteins (HDL) level, while reduced triglycerides and cholesterol (Pizzorno *et al.,* 2007) and low density lipoproteins (LDL) level, without affecting serum triglycerides in human (Munstedt *et al.,* 2009). Also, RJ reduced total cholesterol level by 14% and total lipids by 10% in rabbits (Vittek, 1995). Moreover, RJ administration to middle-aged female rats up-regulated thyroid-stimulating hormone β mRNA in the pituitary (Narita *et al*., 2009).

Tea is among the most highly consumed beverages worldwide. It is produced from the leaves of the plant

Camellia sinensis (Costa *et al*., 2002). It is considered to have beneficial effects on health due to his high content in polyphenols (PPH), e.g. epigallacathechin-3-gallate (EGCG), which is known to possess anti-oxidative properties (Basavaraj *et al.,* 2010). Polyphenolic compounds may contribute to the inhibitory effect of diets on oxidative stress (Sato *et al*., 2010). PPH in green tea (GT, *Camellia sinensis*) show 20 times more powerful antioxidant activity than vitamin C (Craig, 1999; Elhalwag *et al*., 2008). Polyphenols from tea could be of special interest in the metabolic syndrome because epidemiologic observations and laboratory studies have shown that GT has a variety of health effects, including antioxidant and hypolipidemic activities (McKay and Blumberg, 2002; Coimbra *et al*., 2006). Leaves of GT contain antioxidativecatechins (Miura *et al*., 2001; Varilek *et al*., 2001). Tea catechins have a variety of health benefits, *i.e.* antioxidative (Lin *et al.,* 1996), antimutagenic (Jain *et al*., 1989), anticarcinogenic (Sano *et al*., 1999), antimicrobial and hypolipidemic effects (Yoshino *et al*., 1996), and anti-inflammatory having many different physiological effects, *i.e.* antioxidant, antiallergen and anti-viral properties, its role in controlling high cholesterol and blood sugar and its ability to prevent cancer (Yoshino *et al*., 1994; Yamamoto, 2000 and 2002). Lipid and cholesterol content of layinghen significantly decreased when diet contained GT as feed additives (Al-Harthi, 2004). Adding GT leaves or GT extract to hen diets improved their productive performance (Abdo *et al*., 2010).

Propolis (PR) is a honeybee product with a very complex chemical composition (honey bee glue). It is an adhesive, dark yellow to brown colored balsam that smells like resin collected from the buds, leaves and similar parts of trees. Propolis is a most important dietary supplement as antioxidant compound (Seven et al., 2011), therefore it is used in poultry feeding because of their anti-stress effects (Seven, 2008). It has an antioxidant property owing to its high content of polyphenolic composites including flavonoids, tannins, terpenoids and phenolic compounds which have free-radical scavenging activity. Numerous biological and pharmacological properties of PR have been noted, including antibacterial, antifungal, anti-inflammatory, antioxidant, immunomodulatory, antiviral and anticarcinogenic properties (Sabuncuoglu *et al*., 2007). It is recently a most important dietary supplement as antioxidant compound (Seven *et al*., 2011). Researchers suggest that PR might be considered to prevent oxidative stress in the broilers exposed to heat stress (Seven *et al*., 2011).

Unfortunately, no available data onproductive performances of growing rabbits as affected by a combination of different sources of natural antioxidants administration under hot condition of Egypt. Therefore, the current study aimed to evaluate the effect of treatment with combination of royal Jelly plus green tea orpropolis plus green tea on rectal temperature, growth performance, blood biochemicals and carcass traits.

MATERIALS AND METHODS

The current experiment was conducted at a private farm of rabbit production, Gharbia governorate, during the period from August to October, 2016 in co-operation with Faculty of Agriculture, Animal Production Department, Tanta University.

Animals:

Total of 60 New Zealand White weaned rabbits were assigned randomly into three similar experimental groups of 20 rabbits in each group (10 males and 10 females). Rabbits used aged 5 weeks at the start of the experiment with average live body weight of 703.03±11.59 g.

All rabbits were kept in battery cages with 10 replicates (2 rabbits per cage), five replicates for each sex in25 x 50 x 35 cm wire cages, set up in a semi-close rabbit house with suitable ventilation. All rabbits were managed under the same conditions.

Feeding system and experimental groups:

Rabbits in three experimental groups were fed on complete feed diet (CFD); but differed in antioxidant source. Rabbits in the 1st and 2nd groups were fed CFD supplemented with 2 g green tea (GT)/kg and orally treated twice/week with 150 mg local Royal jelly (RJ)/kg LBW (G1) and 0.5 g propolis (PR)/kg LBW (G2). However, rabbits in the 3rd group were fed the same CFD without any supplements and orally treated twice/week with one ml saline (G3).

Both RJ and PR were administrated by dissolving each in distilled water in 1.5 ml dose/kg LBW. All groups were fed commercial pelleted diet contained 18% CP, 13% CF and 2800 Kcal/kg. Rabbits in all experimental groups were fed *ad. libitum* and water was available through water nipple in each cage. The experimental period lasted from 5 up to 13 wk of age.

Climatic conditions:

Means of estimating the severity of heat stress was proposed using both ambient temperature and relative humidity throughout the experimental period, termed as the temperature humidity index (THI) (Marai *et al*., 2007). When the temperature is expressed in 0C, the equation of Marai *et al*. (2001) changes as follows: THI = db0C − {(0.31 − 0.31 RH) (db0C − 14.4)} where db0C is the dry bulb temperature (0C) and RH is the relative humidity (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 = extreme severe heat stress.

Experimental procedures:

Growth performance parameters:

Both LBW and feed consumption were recorded at the 5th, 9th and 13th week of age. Weight gain and ration of feed conversion were daily computed at different intervals (5-9 wk), (9-13 wk) and (5-13 wk) of age. Number of dead bunnies throughout the experimental period was recorded and viability rate was calculated. Relative growth rate (RGR) and performance index (PI) were calculated as the following: RGR (%) = (W2-W1)/½ (W2+W1) x 100. Whereas: W1=initial LBW and W2 = final LBW.PI = (Final LBW (kg)/feed conversion ratio) x100.

Rectal temperature:

Throughout the experimental period, rectal temperature (RT) was weekly recorded afternoon at 12 a.m. using medicinal thermometer.

Blood sampling:

At the end of the experimental period (13 wk of age), blood samples were collected from three male rabbits from each group during slaughtering into centrifuge tubes without anticoagulant. Blood serum was separated by centrifugation of blood samples at 3000 rpm for 15 minutes and kept at -20oC till assayed. Concentrations of total protein, albumin, glucose, cholesterol, triglycerides, high density lipoproteins (HDL), low density lipoproteins (LDL), creatinine, urea, triiodothyronine (T3) and tetraiodothyronine (T4) were determined in blood serum. Aspartate (AST) and alanine (ALT) transaminases activities were also estimated in serum. Blood biochemicals were determined spectrophotometrically using commercial kits (Bio-Merieux, Laboratory Reagents and Products, France). Direct radioimmunoassay technique (RIA) was performed for serum triiodothyronine (T3) and thyroxine (T4) hormones using ready antibody coated tubes kits.

Carcass traits:

Three male rabbits from each group were randomly chosen, fasted for 12 h, weighed and slaughtered to evaluate carcass traits. Carcass parts and body internal organs were weighed as absolute and calculated relative to LBW of each animal. Meat samples from hind limb were taken, dried at 60oC for 2 days and grounded for chemical analysis.

Economic feed efficiency (EFE):

It was calculated based according to the following formula:

EFE (%) = Net revenue x VR x PI

Statistical analysis

Data of all growth performance parameters and economic feed efficiency were statistically analyzed using factorial design (effect of treatment x sex), while rectal temperature, blood parameters, carcass traits and meat composition were analyzed using one way design (effect of treatment).

General Linear Model Program (SAS, 2004) was used. Multiple Range test was performed (Duncan, 1955) to clear the significant variation between means. All significant differences were set at level of P<0.05.

RESULTS AND DISCUSSION

Temperature humidity index (THI):

According to THI values, rabbits in the experimental groups severed from heat stress during the whole experimental period, because THI values were>25.6 (Table 1) in this period. This indicated that rabbits extremely severed from heat stress throughoutall months studied, in particular during August and September months.

Table 1. THI values in different months of the experimental period (15 August-15 October) according to ambient temperature (^{o}C) and relative humidity (RH%).

Month	Temperature (^{o}C)		Relative humidity (%)		THI	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
15 August	33.81±1.36	26.41±1.66	79.29±9.99	49.00±13.85	32.56±1.46	24.56±1.89
September	33.61±1.00	25.17±0.98	82.83±2.78	44.67±7.57	32.59±1.08	23.33±0.91
15 October	32.91±0.60	25.34±0.53	80.38±0.96	50.85±10.13	31.78±0.59	23.68±0.78

Effect of antioxidant treatment on:

Rectal temperature (RT):

Effect of treatments on RT of rabbits was significant (P<0.05) during all age intervalss, except at 5-6 and 10-11 wk intervals. Only treatment of rabbits in G2 with PR and GT exhibited significant (P<0.05) reduction in RT, while RJ and GT treatment in G1insignificantly decreased RT of rabbits as compared to control rabbits (Table 2).

Table 2. Average of rectal temperature(^{o}C) of growing rabbits at different ages as affected by treatment at different experimental weeks.

Age (week)	Experimental group		
	G1(RJ+GT)	G2 (PR+GT)	G3 (Control)
5-6	40.02±0.15	39.63±0.17	40.21±0.16
6-7	39.86±0.09^{a}	39.52±0.11^{b}	39.91±0.11^{a}
7-8	39.85±0.10^{a}	39.44±0.11^{b}	40.04±0.06^{a}
8-9	39.91±0.08^{a}	39.51±0.13^{b}	39.98±0.09^{a}
9-10	39.72±0.13^{a}	39.32±0.12^{b}	39.95±0.14^{a}
10-11	39.73±0.12	39.39±0.14	39.85±0.14
11-12	39.70±0.12^{a}	39.24±0.13^{b}	39.94±0.08^{a}
12-13	39.85±0.09^{a}	39.47±0.16^{b}	39.96±0.10^{a}

a and b: Means denoted with different superscripts within the same column differ significantly at P<0.05. G1: Royal jelly + green tea. G2: Propolis + green tea. G3: Control

It was reported that rabbits are very sensitive to heat stress since they have few functional sweat glands, therefore they have difficulties in eliminating excess body heat under heat stress conditions (Marai *et al*., 2002; Balabel, 2004). Adult rabbits are homoeothermic and are provided with physiological mechanisms by which they can maintain their deep body temperature constant within the thermo neutral zone (Marai *et al*., 2001). In this respect, Marai *et al.* (2007) reported highly significant increase in thermoregulatory parameters, including ear, rectum and skin temperatures due to exposure of animals to severe heat stress.

In agreement with the present results, El Saidy *et al*. (2016) showed significant increase in RT in mature rabbits treated with honeybee than in untreated heat stressed group. In addition, Khalil *et al*. (2015) found that RT significantly increased following heat stress for rabbit bucks exposed to acute short term heat stress for 1 h at 37±0.5°C and 20±2% RH. The obtained results may indicate that PR in combination with GT had beneficial effect on eliminating the heat stress more than in case of a combination with RJ. This also, may be related to that RJ treatment may increase metabolic heat rather than propolis.

Growth performance parameters:

Live body weight (LBW):

Effect of treatment on LBW of growing rabbits was significant (P<0.05). LBW was higher significantly (P<0.05) in G2 and insignificantly in G1 than in G3. This means that PR and GT combination had beneficial effects on LBW of rabbits more than RJ and GT combination. The effect of sex or its interaction with treatment on LBW of growing rabbits was not significant, although there is a tendency of heavier males than females at 9 and 13 wk of age (Table 3).

Table 3. Effect of treatment, sex and their interaction on live body weight of growing rabbits at different ages.

Item	Live body weight (g)		
	5 wk (Initial LBW)	9 wk	13 wk (Final LBW)
Effect of treatment:			
G1 (RJ+GT)	701.05±11.52	1429.25±27.38[ab]	2174.00±30.92[ab]
G2 (PR+GT)	699.05±11.83	1458.25±22.81[a]	2197.89±32.89[a]
G3 (control)	708.00±11.42	1380.25±14.75[b]	2086.67±29.17[b]
Effect of sex:			
Male (M)	693.267±9.08	1432.67±18.88	2165.34±24.39
Female (F)	712.133±9.41	1412.50±18.91	2143.04±28.86
Effect of interaction (treatment x sex):			
G1 x M	707.7±17.80	1455.5±45.02	2179.5±44.02
G1 x F	694.4±15.30	1403.0±31.40	2168.5±45.76
G2 x M	681.1±15.39	1449.5±27.59	2215.5±33.01
G2 x F	717.0±16.81	1467.0±37.68	2182.0±56.40
G3 x M	691.0±14.25	1393.0±19.89	2106.0±43.51
G3 x F	725.0±16.84	1367.5±22.08	2062.5±38.16
Significance	NS	NS	NS

G1: Royal jelly + green tea. G2: Propolis + green tea. G3: Control

Average daily gain and relative growth rate:

Average daily gain (ADG) of growing rabbits was significantly (P<0.05) higher in G1 and G2 than in G3, at 5-9 and 5-13 wk intervals, and insignificantly at 9-13 wk interval. This may reflect positive effect of treatment on ADG of rabbits, being the best for a combination of PR plus GT. The ADG of rabbits was significantly (P<0.05) higher in males than in females only at 5-9 wk interval. However, treatment insignificantly interacted with rabbit sex for ADG at all age intervals (Table 4).

Table 4. Average daily gain (g/h/d) of growing rabbits at different age intervals as affected by treatment, sex and their interaction.

Item	Average daily gain (g/h/d) at age intervals		
	5~9 wk	9~13 wk	5~13 wk
Effect of treatment:			
G1 (RJ+GT)	26.01±0.88[a]	26.59±0.92	26.30±0.55[a]
G2 (PR+GT)	27.44±0.69[a]	26.13±0.86	26.78±0.55[a]
G3 (control)	23.82±0.65[b]	25.37±1.17	24.59±0.59[b]
Effect of sex:			
Male (M)	26.59±0.66[a]	26.01±0.75	26.30±0.45
Female (F)	24.96±0.64[b]	26.10±0.86	25.53±0.51
Effect of interaction (treatment x sex):			
G1 x M	26.70±1.50	25.85±1.32	26.28±0.83
G1 x F	25.30±0.94	27.33±1.32	26.32±0.76
G2 x M	28.17±0.76	26.80±0.92	27.48±0.58
G2 x F	26.78±1.11	25.53±1.45	26.16±0.89
G3 x M	25.07±0.86	25.46±1.61	25.26±0.80
G3 x F	22.25±0.73	25.26±1.82	23.76±0.85
Significance	NS	NS	NS

a and b: Means denoted with different superscripts within the same column for each effect significantly differ at P<0.05. G1: Royal jelly + green tea. G2: Propolis + green tea. G3: Control

Relative growth rate (RGR) of growing rabbits at 5-9 and 5-13 wk of age significantly (P<0.05) increased in G2 than in G3, but RGR of rabbits in G1 did not change significantly from that in G2 and G3. However, RGR at 9-13 wk of age was not affected significantly by treatment.

RGR was significantly (P<0.05) higher in males than in females only at 5-9 wk interval, but tended to be insignificantly higher in males than in females during the whole feeding period (5-13 wk). Insignificant effect was recorded for the interaction between treatment and rabbit sex on RGR at all age intervals (Table 5).

Table 5. Relative growth rate (%) of rabbits at different age intervals as affected by treatment, sex and their interaction.

Item	Relative growth rate (%) at age intervals		
	5~9 wk	9~13 wk	5~13 wk
Effect of treatment:			
G1 (RJ+GT)	68.17±1.72[ab]	41.44±1.474	102.37±1.46[ab]
G2 (PR+GT)	71.01±1.49[a]	39.92±1.161	103.55±1.43[a]
G3 (control)	63.99±1.73[b]	40.93±1.715	98.41±1.79[b]
Effect of sex:			
Male (M)	69.85±1.42[a]	40.46±1.132	103.01±1.26
Female (F)	65.67±1.34[b]	41.09±1.241	99.97±1.33
Effect of interaction (treatment x sex):			
G1 x M	68.85±2.942	40.03±2.23	101.86±2.35
G1 x F	67.50±1.942	42.85±1.93	102.89±1.85
G2 x M	73.72±1.808	40.79±1.33	106.47±1.80
G2 x F	68.56±2.122	39.14±1.88	100.92±1.88
G3 x M	67.37±2.202	40.61±2.26	101.04±2.12
G3 x F	59.77±2.032	41.32±2.79	95.13±2.76
Significance	NS	NS	NS

a and b: Means denoted with different superscripts within the same column for each effect differ significantly at P<0.05. G1: Royal jelly + green tea. G2: Propolis + green tea. G3: Control

Average daily feed intake (ADFI):

Average daily feed intake (ADFI) of growing rabbits was significantly (P<0.05) decreased in G1 than in G2 and G3 at all age intervals (Table 6). This may indicate that rabbits in G1 treated with RJ reduced ADFI as a result of receiving high energy from RJ rather than PR or/and RJ treatment may improve feed utilization of these animals. It is well known that body energy level is the major. In this respect, Elnagar *et al*. (2010) found that RJ given to heat stressed growing rabbits in Egypt can improve physiological strain resulted from heat stress, by increasing feed utilization.

Table 6. Average daily feed intake (g) of rabbits at different age intervals as affected by treatment, sex and their interaction.

Item	Average daily feed intake (g) at age intervals (week)		
	5~9	9~13	5~13
Effect of treatment:			
G1 (RJ+GT)	60.518±0.28[b]	102.73±0.17[b]	81.63±0.09[b]
G2 (PR+GT)	62.39±0.56[a]	105.31±1.04[a]	83.85±0.78[a]
G3 (control)	63.25±0.42[a]	107.51±1.20[a]	85.38±0.72[a]
Effect of sex:			
Male (M)	61.96±0.26	103.65±0.71[b]	82.81±0.410[b]
Female (F)	62.05±0.53	106.60±0.82[a]	84.32±0.669[a]
Effect of interaction (treatment x sex):			
G1 x M	61.43±0.26	102.25±0.25	81.84±0.00
G1 x F	59.59±0.27	103.21±0.07	81.40±0.17
G2 x M	61.38±0.29	102.31±0.27	81.84±0.00
G2 x F	63.31±0.96	108.02±1.52	85.66±1.24
G3 x M	63.01±0.53	106.27±1.80	84.64±0.97
G3 x F	63.55±0.72	109.07±1.43	86.31±1.04
Significance	0.0058**	NS	0.0267*

a and b: Means denoted with different superscripts within the same column for each effect differ significantly at P<0.05. G1: Royal jelly + green tea. G2: Propolis + green tea. G3: Control

The effect of rabbit sex on ADFI was significant (P<0.05) only at 9-13 and 5-13 wk interval, being significantly (P<0.05) higher in females than in males. However, significant (P<0.05) interaction was recorded between treatment and sex of rabbits on ADFI was significant (P<0.05) only at 5-9 and 5-13 wk of age (Table 6).

Feed conversion ratio and performance index:

Feed conversion ratio (FCR) of growing rabbits was improved in G1 and G2 than in G3 at all age intervals, being significant (P<0.05) at 5-9 and 5-13 wk of age, while insignificant at 9-13 wk of age. As a result of improving FCR in both treatment groups (G1 and G2), performance index (PI) was significantly (P<0.05) higher in treatment groups than in control (Table 7). The effect of rabbit sex on FCR was significant (P<0.05) only at 5-9 wk interval, being significantly (P<0.05) better in males than in females. This was reflected in higher PI of males than in female, but the difference was not significant. However, the effect of interaction between treatment and rabbit sex on both FCR and PI at all age intervals was not significant (Table 7).

Viability rate:

Viability rate (VR) of growing rabbits at 5-9 wk of age was 100% in males and females of all groups. However, at 9-13 wk or the whole experimental period 5-13 wk of age, VR was the highest in G1 (100%), followed by G2 (95%) and the lowest in G3 (90%). These results reflected higher VR in females than in males as overall and only in G2 as affected by the interaction between treatment and sex (Table 8).

Table 7. Feed conversion ratio (kg diet/kg gain) of growing rabbits at different age intervals as affected by treatment, sex and their interaction.

Item	Feed conversion ratio (kg diet/kg gain) at age intervals			Performance index (%)
	5~9 wk	9~13 wk	5~13 wk	
Effect of treatment:				
G1 (RJ+GT)	2.37±0.08[b]	3.96±0.15	3.13±0.06[b]	70.43±2.44[a]
G2 (PR+GT)	2.30±0.07[b]	4.10±0.14	3.16±0.08[b]	70.79±2.63[a]
G3 (control)	2.69±0.08[a]	4.44±0.26	3.51±0.10[a]	60.67±2.57[b]
Effect of sex:				
Male (M)	2.37±0.06[b]	4.10±0.15	3.17±0.06	69.25±2.03
Female (F)	2.53±0.07[a]	4.22±0.16	3.34±0.08	65.62±2.39
Effect of interaction (treatment x sex):				
G1 x M	2.37±0.14	4.05±2330	3.14±0.10	70.36±3.59
G1 x F	2.38±0.09	3.86±0.21	3.11±0.09	70.51±3.50
G2 x M	2.19±0.05	3.85±0.13	2.98±0.06	74.57±2.57
G2 x F	2.40±0.12	4.33±0.22	3.31±0.13	67.38±4.27
G3 x M	2.54±0.09	4.37±0.36	3.38±0.11	63.36±3.50
G3 x F	2.87±0.10	4.52±0.41	3.67±0.17	57.32±3.69
Significance	NS	NS	NS	NS

a and b: Means denoted with different superscripts within the same column for each effect differ significantly at P<0.05. G1: Royal jelly + green tea. G2: Propolis + green tea. G3: Control

Based on the foregoing results regarding the growth performance parameters, treatment of growing rabbits with both combinations of RJ+GT (G1) or PR+GT (G2) showed marked improvement in LBW, ADG, RGR, ADFI, FCR and PI, being with the best results for rabbits treated with PR+GT (G2), in particular, at 5-9 wk of age. It is of interest to observe that the noted improvement in growth performance parameters was associated with elimination of heat stress in term of reducing rectal temperature of rabbits in G2. These results may be due to action of the combined RJ with GT as antioxidants.

The recorded reduction in most growth performance parameters studied in the control group was mainly related to exposure of control rabbits to heat stress during the experimental period in comparing with rabbits in both treatment groups. Several authors indicated deleterious effect of heat stress on growth performance of rabbits (Ayyat *et al*., 2004; Villalobos *et al*., 2008).

Table 8. Viability rate (%) of growing rabbits at different age intervals as affected by treatment, sex and their interaction.

Item	Viability rate (%) at age intervals		
	5~9 wk	9~13 wk	5~13 wk
Effect of treatment:			
G1 (RJ+GT)	100	100	100
G2 (PR+GT)	100	95	95
G3 (control)	100	90	90
Effect of sex:			
Male (M)	100	93.3	93.3
Female (F)	100	96.7	96.7
Effect of interaction (treatment x sex):			
G1 x M	100	100	100
G1 x F	100	100	100
G2 x M	100	90	90
G2 x F	100	100	100
G3 x M	100	90	90
G3 x F	100	90	90

G1: Royal jelly + green tea. G2: Propolis + green tea. G3: Control

According to exposing rabbits in all groups to sever heat stress, the obtained results indicated improving most growth performance parameters of rabbits in G1 and G2 as compared to those in G3 treated with both combinations. Results of growth performance in G1 are in coincide with the observed weight gain improvement by about 11and 14% and feed utilization improvement by 8.5 and 12.5% in rabbits fed RJ at levels of 15 and 20 ppm during age interval 30-90 days, respectively (Bonomi *et al*., 2001).

Under Egyptian summer condition, Elnagar *et al*. (2010) concluded that RJ administration to growing rabbits can reduce physiological strain resulted from heat stress, by improving their performance as observed with better ADG. Moreover, Afifi *et al*. (1989) found that ADG of guinea-pigs was increased by increasing daily subcutaneously injection with RJ solution at doses of 100, 200 or 300 mg/kg LBW compared with the control, respectively.

Rabbits in G2 treated with PR with GT seemed to be slightly better in their growth performance than those in G1, but both groups still to be better than control rabbits. Feed additives in term of antioxidants play important role in productivity of animal. Addition of PR to diet of laying hens at a level of 5 g/kg increased feed consumption and digestibility coefficients of CP. Propolis improved protein biosynthesis to stimulate regeneration of the mammalian tissue (Gabrys *et al*., 1986). Researchers suggest that PR, at a levelof 3 mg/kg diet might be considered to prevent oxidative stress in the broilers exposed to heat stress (Seven *et al*., 2011).

There is a lack of information of the effect of dietary GT on productive performance of growing rabbit.

However, Abdo *et al*. (2010) reported that adding GT leaves or GT extracts to Inshas hen diets improved their productive performance. The GT contained many polyphenols, fluoride, vitamin K, caffeine, minerals and trace elements. However, GT extracts had strong anti – bacterial, -viral and -cancerous properties, as well as enzyme-inhibitory (Reto *et al.*, 2014). Concerning the sex differences, increasing body weight of royal jelly treated males may be due to the effect of higher concentration of testosterone which has anabolic effects (Khadr *et al*., 2015).

On the other hand, the results of the present study are in disagreement with those obtained in rats by Yang *et al*. (2012) who found that RJ did not impart a significant effect on the body weight of the male rats. Also, Kashkooli *et al*. (2011) showed that PR at levels of 0.5, 1.5, 4.5 and 9 g PR/kg diet for 8 weeks insignificantly affected growth parameters of fishes.

Blood constituents, enzyme activity and thyroid hormones:

Blood parameters, including concentrations of total proteins, albumin, globulin and albumin: globulin ratio, total cholesterol, triglycerides, LDL, HDL, creatinine and urea as well as activity of ALT in blood serum of rabbits were not significantly affected by treatment. On the other hand, serum glucose concentration was significantly ($P<0.05$) higher in G1 than in G2, but both groups did not significantly differ from that in G1. Also, AST activity in blood serum significantly ($P<0.05$) reduced in G1, but did not differ in G2 as compared to G3.Concerning the thyroid hormones, concentration of T3 and T4 was significantly ($P<0.05$) higher in G1 than in G2 and G3 (Table 9).

Table 9. Concentration of some biochemicals and activity of transaminases in blood serum of growing rabbits in control and treatment group at end of the experimental period (13 wk of age).

Parameter	Experimental group		
	G1 (RJ+GT)	**G2 (PR+GT)**	**G3 (control)**
Protein metabolism:			
Total proteins (g/dl)	7.23±0.29	6.67±0.27	6.93±0.13
Albumin (g/dl)	4.31±0.31	3.81±0.06	4.01±0.17
Globulin (g/dl)	2.92±0.27	2.86±0.24	2.92±0.04
Albumin/globulin ratio	1.41	1.33	1.37
Carbohydrate metabolism:			
Glucose (mg/dl)	56.00±4.16^{b}	88.67±8.353^{a}	72.00±8.326^{ab}
Lipid metabolism:			
Total cholesterol (mg/dl)	127.33±1.85	112.33±3.17	125.00±14.01
Triglycerides (mg/dl)	127.66±16.04	89.66±1.66	99.67±7.12
HDL (mg/dl)	59.86±4.13	59.03±7.57	49.80±2.10
LDL(mg/dl)	41.93±5.41	45.10±1.42	55.27±13.42
Kidney function:			
Creatinine (mg/dl)	1.51±0.19	1.49±0.12	1.53±0.14
Urea (mg/dl)	40.00±4.51	37.00±5.51	41.00±3.51
Liver function (activity of AST and ALT):			
AST(U/l)	39.00±5.50^{b}	45.33±2.90^{ab}	58.33±3.66^{a}
ALT (U/l)	60.33±13.93	66.33±8.00	71.00±12.76
Thyroid hormones:			
T3(ng/ml)	1.47±0.11^{a}	1.043±0.05^{b}	1.01±0.04^{b}
T4(µg/dl)	4.07±0.49^{a}	2.83±0.17^{b}	2.37±0.12^{b}

a and b: Means denoted with different superscripts within the same column for each effect significantly differ at P<0.05. G1: Royal jelly + green tea. G2: Propolis + green tea. G3: Control

These results cleared that treatment of growing rabbits with both combinations in G1 and G2 did not affect protein and lipid, but only treatment with a combination of RJ and GT reduced AST activity and increased thyroid hormones (T3 and T4).

In agreement with the present results, Gabr (2015) revealed that concentration of total proteins and their fractions as well as albumin/globulin ratio were not affected significantly by increasing PR level up to 1 g/buck. In growing rabbits, Elnagar *et al.* (2010) found insignificant effect of RJ on serum total proteins, albumin and globulin in blood plasma. Kashkooli *et al*. (2011) showed insignificant alterations in the levels of blood total proteins, albumin and globulin in fishes (Rainbow Trout) fed diet supplemented with PR for 8 weeks as compared to the control group. However, Elnagar *et al.* (2010) found an increase in glucose concentration in blood of heat stressed growing rabbits treated with 200 and 400 mg RJ/kg LBW as compared to controls. On the other hand, the present results of some biochemical parameters disagreed with those reported by El-Hanoun *et al*. (2014), who found that total proteins, albumin, globulin, and glucose concentrations significantly increased in blood plasma of male rabbit treated with RJ at levels of 50, 100 and 150 mg/kg LBW as compared to heat stressed control rabbits.

In contrast to the present results, Elnagar *et al*. (2010) observed that RJ treatment significantly reduced serum total lipids, cholesterol and triglycerides compared with the heat stressed control growing rabbits. Creatinine and uric acid concentrations were significantly affected by RJ treatments. Creatinine showed a reduction compared with the heat stressed control with RJ. Also, El-Hanoun *et al*. (2014) found that HDL concentrations significantly increased, while total lipids, cholesterol, triglycerides, LDL, creatinine and urea concentrations significantly decreased in blood plasma of male rabbit treated with RJ at levels of 50, 100 and 150 mg/kg BW as compared to heat stressed control rabbit. Several authors indicated that EGCG content in GT polyphenols could inhibit key enzymes involved in biosynthesis and absorption of lipids, triglycerides and cholesterol as well as energy expenditure stimulation, oxidation of fat, HDL concentration, and lipid excretion in feces (Hung *et al*., 2005; Reto *et al*., 2014). In rats, Xin Nan *et al*. (1995) found that treating rats with experimentally induced hyperlipaemia with 700 mg RJ/kg reduced serum cholesterol levels. Furthermore, a reduction in serum lipids in rats, rabbits and humans treated with RJ (Vittek, 1995) and in blood cholesterol concentration in chickens treated with 200 mg RJ (Al-Mufarrej and El-Sarag, 1997) were reported.

During heat stress, liver enzyme activities (AST and ALT) tend to rise in G3 than in G1 and G2, suggesting some liver damage in mammals and birds as mentioned by Faisal *et al.*, 2008). In accordance with results of G1, treatment of RJ and GT combination resulted in significant (*P*<0.05) decrease only in AST not in ALT activities, reflecting beneficial effects of RJ on liver function. Similar finding was observed by El-Hanoun *et al.* (2014). RJ had a dose dependent improvement on hepatic parameters (El-Nekeety *et al.*, 2007) by increasing oxygen flow to the liver (Vittek, 1995). However, Elnagar *et al.* (2010) recorded insignificant decrease in both AST and ALT activities in rabbits treated with RJ, which was occurred in G1 and G2 in our study.

It was indicated that concentration of plasma T3 was significantly reduced after submission to heat stress (Khalil *et al*., 2015). In accordance with the present thyroid hormones, Elnagar *et al*. (2010) showed that T3 levels increased significantly 8, 11 and 12% in growing rabbits treated with 200, 400 and 800 mg RJ/kg LBW as compared to control rabbits under heat stress conditions, respectively. In this way, Narita *et al*. (2009) stated that RJ administration to middle-aged female rats up regulated thyroid-stimulating hormone β mRNA in the pituitary. Such trend counteracted with the hypothyroid state resulted from heat stress (Elnagar, 2000).

Carcass traits:

All carcass traits were not affected significantly by treatment, although there was a tendency of higher relative testes weight and lower relative fat weight in G1 and G2 than in G1 (Table 10). Concerning meat composition (Table 11), also treatment had no significant effect on meat quality.

These finding may indicate positive effect of treatments on increasing testes weight and reducing effect on body fat weight.

Table 10. Carcass traits of male rabbits in different experimental groups slaughtered at 13 weeks of age.

Trait	Experimental group		
	G1 (RJ+GT)	G2 (PR+GT)	G3 (control)
Number of slaughtered animals	3	3	3
Pre-slaughter weight (g)	2151.7±89.08	2145.0±47.69	2133.3±37.11
Net carcass weight (g)	1111.0±45.90	1100.7±13.37	1135.3±24.63
Dressing(%)(1)	51.66±1.29	51.33±0.53	53.22±0.79
Edible internal organs (%):			
Relative head weight	5.17±0.38	5.039±0.11	4.98±0.39
Relative liver weight	2.71±0.08	2.47±0.27	2.65±0.26
Relative heart weight	0.28±0.005	0.31±0.050	0.27±0.015
Relative testes weight	0.17±0.016	0.14±0.001	0.11±0.022
Relative kidney weight	0.61±0.020	0.54±0.043	0.57±0.018
Relative spleen weight	0.051±0.0079	0.038±0.0056	0.042±0.0039
Relative total fat weight	1.017±0.13	0.92±0.43	1.47±0.08
Relative total weight of edible organs weight	10.91±0.301	10.16±0.865	10.94±0.330
Dressing (%)(2)	62.57±1.59	61.50±1.17	64.16±0.69
Relative Viscera weight (%)	16.4±0.96	16.9±0.75	15.2±1.30

(1):Based on net carcass weight.
(2): Based on weight of carcass and edible organs.
G1: Royal jelly + green tea. G2: Propolis + green tea. G3: Control

Table 11. Chemical composition of meat of male rabbits in different treatment groups slaughtered at 13 weeks of age.

Item	Chemical composition (%)			
	DM	CP	EE	Ash
G1 (RJ+GT)	80.61±1.09	68.78±1.18	7.73±0.52	4.08±0.29
G2 (PR+GT)	78.96±0.94	67.01±3.33	7.52±2.70	4.43±0.10
G3 (control)	78.53±0.36	66.85±1.02	7.28±1.19	4.39±0.13

G1: Royal jelly + green tea. G2: Propolis + green tea. G3: Control

Economic feed efficiency:

Total feed cost increased in G2 and G3 as compared to G1 by about 14 and 22%, respectively. This was due to marked increase in the cost of RJ, PR and GT, because rabbits in all groups consumed nearly similar feed amounts. It is of interest to note that net revenue showed nearly similarity in all groups. Therefore, economic feed efficiency (EFE) and relative EFE reached the highest values in G1, ranked the 2nd in G2 and the least in G3 due to decreasing mortality and increasing PI in G1 and decreasing PI in G3 as compared to G2 (Table 12).

Table 12. Economical efficiency of growing rabbits in different experimental groups.

Item	G1 (RJ+GT)	G2 (PR+GT)	G3 (control)
Total feed intake (kg/h)	4.571	4.695	4.781
Cost of feeding (L.E./h)	11.42	11.73	11.95
Cost of oral treatment (L.E./h)	1.83	2.53	-
Cost of dietary treatment (L.E./h)	0.4	0.4	-
Total feed cost (L.E./h)	13.65	14.66	11.95
Total weight gain (kg/h)	1.472	1.500	1.377
Total revenue (L.E./h)	32.384	33	30.294
Net revenue/h	18.73	18.34	18.34
Viability rate (VR, %)	100	95	90
Performance index (PI, %)	70.43	70.79	60.67
Economic feed efficiency (EFE)*	13.19	12.33	10.01
Relative economic efficiency (%)	131	123	100

Price of weight gain and feeds was 22.0 and 2.5 L.E., respectively based on market prices at 2016. Total revenue= Total weight gain x price of each kg gain. Net revenue= Total revenue - total cost.
*** Economic efficiency= Net revenue x viability rate x performance index. G1: Royal jelly + green tea. G2: Propolis + green tea. G3: Control**

CONCLUSION

In conclusion, treatment of weaned rabbits kept under Egyptian summer conditions during growing period (5-13 wk of age) with combination of green tea with royal jelly or propolis twice/week improved productivity and economic feed efficiency and decreased mortality rate without negative effects on rabbit health, in particular, at age interval from 5 to 9 weeks. A combination of royal jelly with green tea showed the best results.

REFERENCES

Abdo, Zeinab M.A.; Hassan, R.A.; Abd El-Salam, Amal and Helmy, Shahinaz A. (2010). Effect of adding green tea and its aqueous extract as natural antioxidants to laying hen diet on productive, reproductive performance and egg quality during storage and its content of cholesterol. Egypt. Poult. Sci. Vol 30 iv:1121-1149.

Afifi, E.A.; Khattab, M.M.; El-Berry, A.A. and Abdel-Gawad, A.A. (1989). Effect of royal jelly on guinea pig growth.In Proceedings of the 4th International Conference on Apiculture in Tropical Climates, Cairo, Egypt, 6-10 November 1988. International Bee Research Association, London, UK, pp. 42-45.

Agarwal, A.; Nallella, K.P.; Allamaneni, S.R. and Said, T.M. (2004). Role of antioxidants in treatment of male infertility: an overview of the literature. Reprod. BioMed. Online, 8: 616-627.

Al- Harthi, M.A. (2004). Responses of laying hens to different levels of amoxicillin, hot pepper or green tea and their effects on productive performance, egg quality and chemical composition of yolk and blood plasma constituents. Egypt. Poult. Sci., 24 (IV): 845-868.

Al-Mufarrej, S.I and El-Sarag, M.S.A. (1997). Effects of royal jelly on the humoral antibody response and blood chemistry of chickens. J. Appl. Anim. Res., 12: 41-47. doi:10.1080/09712119.19 97.9706186.

Ayyat, M.S.; Gad, H.A.M.; El-Aasar, T.A. and El-Monem, U.M.A. (2004). Alleviation of heatstressed growing rabbits using some feed additives under Egyptian conditions. Egyptian Journal of Nutrition and Feeds 7, 83–96.

Balabel, T.M.M. (2004). Effect of heat stress on New Zealand white rabbits behavior and performance. Minufiya Veterinary J., 3(1): 125-134.

Basavaraj, M.; Nagabhushana, V.; Prakash, N.; Appannavar, M. M.; Wagmare, Prashanth and Mallikarjunappa, S. (2011). Effect of dietary supplementation of curcuma longa on the biochemical profile and meat characteristics of broiler rabbits under summer stress. Veterinary World , Vol.4 (1):15-18.

Basavaraj, M.; Nagabhushana, V.; Prakash, N.; Mallikarjunappa, S.; Appannavar, M.M. and Prashanth, W. (2010). Effect of dietary supplementation of Pulvis Curcuma Longa on the voluntary feed intake, nutrient digestibility and Growth performance of Broiler rabbits under summer stress. Veterinary World Vol. 3(8): 369-372.

Bonomi, A.; Bonomi, B.M. and Quarantelli, A. (2001). Royal jelly in the feeding of rabbits. Annali della Facoltà di Medicina Veterinaria, Università di Parma 20, 115–132.

Castellini, C. (2008). Semen production and management of rabbit bucks. In Proc.: 9th World Rabbit Congress, 10-13, Verona, Italy, 555-559.

Coimbra S, Castro E.; Rocha-Pereira, P.; Rebelo, I.; Rocha, S. and Santos- Silva, A. (2006). The effect of green tea in oxidative stress. Clin Nutr 25:790–796.

Costa, L.M.; Gouveia, S.T. and Nobrega, J.A. (2002). Comparison of heating extraction procedures for Al, Ca, Mg and Mn in tea samples. Anal Sci., 18: 313-318.

Craig, W.J. (1999). Health-promoting properties of common herbs. Am J. Clin. Nutr., 70: 491-499.

Duncan, D.B. (1955). Multiple range and multiple. F. test Biometrics, 11: 1.

El-Hanoun, A.m.; Elkomy, A.E.; Fares, W.A.; Shahien, E.H. (2014). Impact of royal jelly to improve reproducti ve performance of male rabbits under hot summer conditions. World Rabbit Sci., 22: 241-248.

Elhalwagy, M.E.A., Darwish N.S. and Zaher E.M. (2008). Prophylactic effect of green tea polyphenols against liver and kidney injury induced by fenitrothion insecticide. Pesticide Bioch. Phys., 91:81-89.

Elnagar, Samar A.; Elghalid, O.A. and Abd-Elhady, A.M. (2010). Royal jelly: can it reduce physiological strain of growing rabbits under Egyptian summer conditions? Animal, 4: 1547-1552. doi:10.1017/S1751731110000753.

Elnagar, Samar A. (2000). Hypothyroid mediated changes in reproductive function during heat stress in laying hens at different stages of production. PhD, Alexandria University, Egypt.

El-Nekeety, A.A.; El-Kholy, W.; Abbas, N.F.; Ebaid, A.; Amra, H.A. and Abdel-Wahhab, M.A. (2007). Efficacy of royal jelly against the oxidative stress of fumonisin in rats. Toxicon, 50: 256-269. doi:10.1016/j.toxicon.2007.03.017.

El Saidy, Nagham R.; Allam, Fatma E.; Balabel, T.M. and El-Midany, S.A. (2016). Evaluation of Using Honey, Cool Water and Levamisole against Heat Stress on Different Traits of Rabbits under Egyptian Summer Conditions. World Vet J, 6(1): 10-18.

El-Shahat, K.H. and Abdel Monem, U.M. (2011). Effects of Dietary Supplementation with Vitamin E and/or Selenium on Metabolic and Reproductive Performance of Egyptian Baladi Ewes under Subtropical Conditions. World Applied Sciences Journal 12 (9):1492-1499.

Faisal, B.A.; Abdel-Fattah, S.A.; El-Homosany, Y.M.; Abdel-Gawad, N.M. and Ali, M.F.M. (2008). Immuno competence, hepatic heat shock protein 70 and physiological responses to feed restriction and heat stress in two body weight lines of Japanese quail. International J. Poultry Sci. 7: 174-183.

Fouad M.A. (2005). Some management practices to improve reproductive performance of New Zealand rabbit does in hot climate. J. Egypt. Med. Assoc., 65: 317-329.

Gabr, Sh.A. (2013). Effect of oral administration of Egyptian propolis on reproductive performance of rabbit bucks during summer in Egypt. Egyptian journal of rabbit science, 23 (2): 161-178.

Gabrys, J.; Konecki, J.; Krol, W.; Scheller, S. and Shani, J. (1986), Free amino acids in bee hive product (propolis) as identified and quantified by gas-liquid chrom atography. Pharmacol. Res. Commun. 18, 513-518.

Graham, J. (1992). The hive and the honey bee. revised edition. Dadant and Sons, Hamilton, Illinois, USA.

Hang, G.; Ekusa, A.; Iwai, K.; Yonekura, M.; Takahata, Y. and Moimatsu, F. (2008). Royal jelly peptide inhibit lipid peroxidation in vitro and in vivo. J. Nutr. Sci. Vitaminol., 54: 191-195. doi:10.3177/ jnsv.54.191.

Hashim, N.M.; Abd El-Hady, A. and Hassan, O. (2013). Effect of vitamin E or propolis supplementation on semen quality, oxidative status and hemato-biochemical changes of rabbit bucks during hot season. Livestock Sci.157 (2): 520-526.

Hung, P.F.; Wu, B.T.; Chen, H.C.; Chen, Y.H.; Chen, C.L. and Wu, M.H. (2005). Anti-mitogenic effect of green tea (epigallo catechin gallate) on 3 T3-L1 preadipocytes depends on the ERK and Cdk2 pathways. Am J Physiol Cell Physiol; 288: 1094–108.

Jain, A.J.; Shimoi, K.; Nakamura, Y.; Kada, T.; Hara, Y. and Tomita, I. (1989). Crude tea extracts decrease the mutagenic activity of N-methyl-N-nitro-N-nitrosoguanidine in vitro and in intragastric tract of rats. Muatat. Res., 210:1-8.

Kashkooli, O. B.; Dorcheh, E. E.; Mahboobi-Soofiani, N. and Samie, A. (2011). Long-term effects of propolis on serum biochemical parameters of rainbow trout (Oncorhynchus mykiss). Ecotoxicology and Environmantal Safety,74, 315-318.

Khadr, A. H. ; Abdou, A. and El-Sherbiny, A. M. (2015). Age of puberty and fertility of male new zealand white rabbits orally administered with royal jelly or/ and bee honey J. Animal and Poultry Prod., Mansoura Univ., Vol.6 (4): 201-217.

Khalil, H.A.; Yaseen, M.A. and Hamdy, A.M.M. (2015). Behavioral Activities, Physiological Body Reactions, Hematological Parameters and Hormonal Profiles for Bucks of New Zealand White and Baladi Red Rabbits Exposed to Short Term of High Temperature. Asian Journal of Poultry Science, 9 (4): 191-202.

Kurkure, N.V., Pawar, S.P.; Kognole, S.M.; Bhandarkar, A.G.; Ganorkar, A.G. and Kalorey, D.R. (2000). Ameliorative effect of turmeric (Curcuma longa) in induced aflatoxicosis in cockerels. Indian J. Vet. Pathol., 24: 26-28.

Lin, Y.L.; Juan, I.M.; Chen, Y.L.; Liang, Y.C.; and Lin J.K. (1996). Composition of polyphenols in fresh tea leaves and associations of their oxygen-radicalabsorbing capacity with antiproliferative actions in fibroblast cells. J. Agric. Food Chem., 272:1433-1436.

Marai, I.F.M.; Habeeb, A.A.M. and Gad, A.E. (2002). Rabbits productive, reproductive and physiological performance traits as affected by heat stress - a review. Livestock Production Science 78, 71-90.

Marai, I.F.M.; Ayyat, M.S. and Abdel-Monem, U.M. (2001). Growth performance and reproductive traits at first parity of New Zealand White female rabbits as affected by heat stress and its alleviation, under Egyptian conditions. Tropical Animal Health and Production 33, 1-12.

Marai, I.F.M.; Haeeb, A.A.M. and Gad, A.E. (2007). Biological functions in young pregnant rabbit does as affected by heat stress and lighting regime under sub-tropical conditions of Egypt. Tropical and Subtropical Agroecotimes, 7: 165-176.

Mărghitas, L.A. (2008). Produsele Apicole Şi Principalele Lor Însuşiri Terapeutice. In: Albinele şi produsele lor. L.A. Mărghitaş, second ed. Ceres, Bucharest, pp. 280-378.

McKay, D.L. and Blumberg, J.B. (2002). The role of tea in human health: An update. J. Am. Coll. Nutr., 21: 1-13.

Miura, Y.; Chiba, T.; Tomita,I.; Koizumi, H.H; Miura, S.; Umegaki, K. and Y.Hara, Y.; Keda, M.I. and Tomita, T.(2001). Tea catechins prevent the development of arteriosclerosis in apoprotein E-deficient Mice. J. Nut. 131:27-32.

Mournaki, E.; Cardinali, R.; Dal Bosco, A.; Corazzi, L. and Castellini, C. (2010). Effects of flaxseed dietary supplementation on sperm quality and on lipid composition of sperm subfractions and prostatic granules in rabbit. Theriogenology, 73: 629-637.

Munstedt, K.; Henschel, M.; Hauenschild, A.; Georgi, von R. (2009). Royal jelly increases high density lipoprotein levels but in older patients only, J. Altern. Complem. Med., 15: 329-330. doi:10.1089/acm.2008.0420.

Narita, Y.; Ohta, S.; Suzuki, K.M.; Nemoto, T.; Abe, K. and Mishima, S. (2009). Effects of long-term administration of royal jelly on pituitary weight and gene expression in middle-aged female rats. Biotechnology and Biochemistry 73, 431–433.

Pavel, C.I.; Mărghitas, L.A.; Bobiş, O.; Dezmirean, D.S.; Şapcaliu, A.; Radio, I. and Mădaş, M.N. (2011). Biological activities of royal jelly. Review. Anim. Sci. Biotechnol., 44 (2): 108-118.

Pizzorno, J.E.; Murray, M.T. and Joiner-Bey, H. (2007). The Clinician’s Handbook of Natural Medicine, 2nd ed. Churchill Livingstone, Elsevier, Philadelphia, USA.

Reto, M.; Cristina, A.; João, R.; Bruno, S. and Eduardo, Maria F. (2014). Green tea (Camellia sinensis): Hypocholesterolemic effects in Humans and anti-inflammatory effects in animals. Food and Nutrition Sciences, 5, 2185-2194.

Sabuncuoglu, M.Z.; Kismet, K.; Kilicoglu, S.S.; Kilicoglu, B.; Erel, S.; Muratoglu, S.; Sunay, A.E.; Erdemli, E. and Akkus, M.A. (2007).Propolis reduces bacterial translocation and intestinal villus atrophy in experimental obstructive jaundice. World J. Gastroenterol. 13(39): 5226-5231.

Sano, M.; Suzuki, M.; Miyase, T.; Yoshino, K.; and Maeda-Yamamoto, M. (1999). Novel antiallergic catechins derivatives isolated from oolong tea. J. Agric. Food Chem., 47:1906-1910.

SAS Institute, (2004). SAS/STAT User’s Guide. Relaase Version 7.00. SAS Institute Inc.,. Cary. North Carolina.

Sato, K.; Sueoka, K.; Tanigaki, R.; Tajima, H.; Nakabayashi, A.; Yoshimura, Y. and Hosoi, Y. (2010). Green tea extracts attenuate doxorubicin-induced spermatogenic disorders in conjunction with higher telomerase activity in mice. J. Assist Reprod. Genet. 27(8): 501–508.

Seven, I., Seven, Tatli P. and Silici, S. (2011). Effects of dietary Turkish propolis as alternative to antibiotic on growth and laying performances, nutrient digestibility and egg quality in laying hens under heat stress. Rev. Med. Vet. 162, 186–191.

Seven, Tatli P. (2008). The effects of dietary turkish propolis and vitamin Con performance, digestibility, egg production and egg quality in lay-ing hens under different environmental temperatures. Asian-Aust. J. Anim. Sci. 21, 1164–1170.

Varilek, G.W.; Yang, F.; Lee, E.Y.; Devilliers, W.J.S.; Zhong, J.; Oz, H.S.; Westberry, K.F. and McClain, C.J. (2001). Green tea polyphenol extracts attenuates inflammation in interleukin-2 deficient mice, a model of autoimmunity .J.of Nut.131:2034-2039.

Villalobos, O.; Guille´n, O. and Garcı´a, J. (2008). Effect of cage density on growth and carcass performance of fattening rabbits under tropical heat stress conditions. World Rabbit Science 16, 89–97.

Vittek J. (1995). Effect of royal jelly on serum lipids in experimental animals and humans with atherosclerosis, Experientia, 51:927-935. doi:10.1007/BF01921742.

Xin Nan, S.; Rui Fang, L. and Geng Sheng, H. (1995). Effects of lyophilized royal jelly on experimental hyperlipaemia and thrombosis. Zhonghua Yufang Yixue Zazhi 29, 27–29.

Yamamoto, Y. (2002). Anti-allergic and anti-cancer metastatic of green tea. J. Jan. Soc. Food Sci. Technol., 49: 631-638.

Yamamoto, Y. (2000). Inhibitory effect of tea polyphenols on cancer metastasis. J. Jan. Soc. Food Sci. Technol., 47: 567-572.

Yang, A.; Zhou, M.; Zhang, L.; Xie, G.; Chen, H.; Liu, Z. and Ma, W. (2012). Influence of royal jelly on the reproductive function of puberty male rats. Food And Chemical Toxicology 50: 1834-1840.

Yoshino, K.; Hara, Y.; Sano, M. and Tomita, I. (1994). Antioxidative effects of black tea theaflavins and thearubigin on lipid peroxidation of rat liver homogenates by tert-butyl hydroperoxide. Biological and Pharmaceutical bull., 17: 146-149.

Yoshino, K.; Tomita, I.; Sano, M.; Oguni, I.; Hara, Y. and Nakano, M. (1996). Effects of long term dietary supplement of tea polyphenols on lipid peroxide levels in rats. Age 17:79-85.

تأثير بعض مضادات الأكسدة الطبيعية على أداء النمو، خصائص الدم وصفات الذبيحة للأرانب النامية

شريف عبد الونيس جبر [١], جورج عزت يونان [٢] , محمد الفاتح حماد [١] , رحاب صديق عبد الفتاح أسماعيل [٣] و ميرفت شارلي منير زكى [١]

[١] قسم الإنتاج الحيواني - كلية الزراعة - جامعة طنطا – مصر.
[٢] معهد بحوث الإنتاج الحيواني - مركز البحوث الزراعية - دقي – جيزة – مصر.
[٣] قسم الإنتاج الحيواني - كلية الزراعة - جامعة المنصورة – مصر.

تهدف هذه الدراسة إلي تقييم تأثير المعاملة بخليط من غذاء ملكات النحل والشاي الأخضر أو البروبوليس والشاي الأخضر علي الاستجابة الفسيولوجية للحرارة والأداء الإنتاجي وتحليلات الدم وصفات الذبيحة. تم تقسيم ٦٠ من الأرانب المفطومة النيوزيلاندى الأبيض (٥ أسابيع من العمر و ٧٠٣.٠٣±١١.٥٩ جم وزن جسم) إلى ٣ مجموعات متماثلة (٢٠ في كل منهما، ١٠ من الذكور و ١٠ من الإناث). تم تغذية الأرانب في المجموعات الأولى والثانية علي عليقه تجارية مكعبه مضاف إليها ٢ جرام شاي أخضر/كجم وعوملت بالتجريع عن طريق الفم ب١٥٠ ملجم غذاء ملكات النحل/كجم من وزن الجسم أو ٠.٥ جم بروبوليس/كجم من وزن الجسم على التوالي. بينما تم تغذية الأرانب في المجموعة الثالثة على نفس العليقة بدون أي معاملات، وكانت بمثابة المجموعة الضابطة. وتحتوى العليقة على 18٪ CP، 13٪ CF و ٢٨٠٠ كيلو كالورى/كجم عليقه. تمت تغذيه الأرانب في كل المجموعات علي عليقه لحد الشبع وتوافر الماء في الحلمات في كل الأقفاص. كانت المعاملة عن طريف الفم والإضافة إلي العليقة مرتين أسبوعيا من عمر ٥ إلي ١٣ أسبوع للأرانب. تم تسجيل وزن الجسم الحي والغذاء المأكول وحساب متوسط الزيادة اليومية والكفاءة التحويلية الغذاء والنسبة المؤية لحيوية النتاج ومعدل النمو النسبي ودليل أداء النمو. في نهاية التجربة (١٣ أسبوع من العمر)، تم أخذ عينات دم من ثلاثة ذكور أرانب مذبوحة من كل مجموعة لتقدير تركيز البروتينات الكلية والألبيومين والكرياتينين واليوريا والكولسترول والبروتينات الدهنيه مرتفعه الكثافة والبروتينات الدهنيه منخفضة الكثافة والدهون الثلاثية ونشاط الأنزيمات الناقلة لمجموعة الأمين (ALT، AST) وتركيز هرمونات الغدة الدرقية (T3, T4) وتقييم صفات الذبيحة وأخذ عينات لحم للتحليلات الكيميائية. أوضحت النتائج أن الأرانب كانت معرضه للإجهاد الحراري في جميع أشهر التجربة، خاصة خلال شهري أغسطس وسبتمبر. انخفضت درجة حرارة المستقيم فى المجموعة الثانية بالمقارنة مع المجموعة الأولى وعلى نحو أفضل في الذكور أكثر من الإناث .أظهرت كل من المجموعتين الأولى والثانية تحسنا ملحوظا في وزن الجسم- الزيادة اليومية في الوزن – معدل النمو النسبي – المأكول اليومي – معدل الكفاءة التحويلية و دليل الأداء الأنتاجى بالمقارنة مع المجموعة الثالثة وكانت أفضلها في المجموعة الثانية على وجه الخصوص، خلال ٥-٩ أسبوع من العمر كان معدل الحيوية الأعلى في المجموعة الأولى، وأعلى في الإناث عن الذكور. كانت الاختلافات في تركيز جميع مقاييس الدم الكيمائية ونشاط الأنزيمات الناقلة لمجموعة الأمين غير معنوية. كان تركيز الجلوكوز في الدم أعلى معنويا في المجموعة الأولى عن المجموعة الثانية، ولم يختلف كل منهما عن المجموعة الأولى. أنخفض النشاط ل AST في مصل الدم معنويا في المجموعة الأولى ولكن لم يكن هناك اختلاف في المجموعة الثانية بالمقارنة مع المجموعة الثالثة. كان تركيز T3 و T4 أعلى معنويا في المجموعة الأولى عنها في المجموعة الثانية والثالثة. لم تتأثر صفات الذبيحة وتركيب اللحم بشكل كبير عن المعاملات، كان هناك اتجاه لزيادة وزن الخصيتين النسبي وانخفاض الدهون النسبي في المجموعة الأولى والثانية عن المجموعة الثالثة. كانت الكفاءة الاقتصادية للغذاء أفضل في المجموعة الأولى تليها المجموعة الثانية وأقلها في المجموعة الثالثة. وتوصى الدراسة إن معاملة الأرانب مفطوم خلال فترة النمو تحت الإجهاد الحراري (٥-١٣ أسابيع من العمر) بالشاي الأخضر مع غذاء ملكات النحل أو البروبوليس مرتين/أسبوع أدت إلى تحسين أداء النمو، معدل الحيوية والكفاءة الاقتصادية للغذاء دون تأثير سلبي على صحة الأرنب، وعلى وجه الخصوص، في الفترة من ٥ إلى ٩ أسابيع من العمر . أظهر المعاملة بغذاء ملكات النحل مع الشاي الأخضر أفضل النتائج.