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Response of Sudani Ducklings to Dietary *Echinacea purpurea* Addition on Growth Performance and Economic Efficiency

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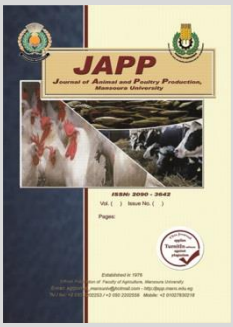

ABSTRACT

A 360 - Sudani ducklings (180 ♂+ 180 ♀) - 26 d-old, weighed and allocated for eight groups (four groups from each sex) to assess the impact of dietary Echinacea purpurea (EP) addition (0, 2.5, 5.0 and 7.50 g/kg diet) in a factorial design (4 × 2) on productive performance and economical efficiency during summer season. Results indicated that, all studied traits of growth performance were ($P \leq 0.01$) higher for ducklings males than females through the studied period (26-110 day). However, dietary EP addition resulted in a significant ($P \leq 0.01$) improvement in body weight gain and feed efficiency during the whole studied period than control. Dietary EP addition ($P \leq 0.01$) enhance lymphocytes (L) cells (%), decrease in heterophils (H) cells (%) and H/L ratio than the control. Serum triglycerides was significantly increased for females than males ducklings, whereas, it significantly attenuated by EP supplementation comparing with control. Antioxidant enzymes activity were significantly enhanced by different EP addition, while MDA was significantly decreased comparing with control group.Abdominal fat (%) was significantly attenuated by EP addition than the control, but total edible parts (%) was ($P \leq 0.01$) higher with 5.00 and 7.50 g EP/kg addition. Economic efficiency significantly enhanced by feeding 2.50 g EP/ kg diet than the control and other EP groups. So that, dietary EP addition with 2.5 g/ kg could be maximize and improve the growth, carcass traits and economical efficiency of Sudani ducklings especially males during growth period under Egyptian summer conditions.

Keywords : Sudani ducks, *Echinacea purpurea*, growth traits, carcass, antioxidants

INTRODUCTION

Poultry meat, including ducks, is one of the least expensive animal protein production sources. High environmental temperature in combination with high humidity causes heat stress leading to many problems in commercial poultry farms. Heat stress can prompt to different harmful impacts on livestock productivity, such as high animal morbidity, mortality, and growth reduction, directly resulting in dramatic economic losses to the livestock industry *(*Renaudeau *et al.,* 2012*).* Additionally, increasing heat stress may prompt reactive oxygen species (ROS) and cause anti-oxidant system disorders, which influence nutrient absorption and metabolism *(*Yang *et al.,* 2010*).*

Phytochemicals offer extraordinary expectation as a response for heat stress in poultry, due to their metabolic substances such polyphenols that broadly exist in a variety of plants, which that strong antioxidant ability *(*Crozier *et al.,* 2009*).* Polyphenols have pulled in much consideration as of recent years due to their antioxidant ability and thus, can be a powerful attenuator of heat stress *(*Ruizhi *et al.,* 2019*).* Phytogenic have a wide range of animals activities as physio-pathological (anti- inflammatory, anti-oxidative) and anti-microbial activities *(*Nasir and Grashorn, 2010). Echinacea purpurea is one of the most important phytobiotic and popular medical herb (Barrett, 2003). Echinacea and its derivatives contain spread active substances like alkamides, glycoproteins, polysaccharides, phenolic compounds, cinnamic acid, volatile oil, hydrocarbons and flavonoids. Echinacea is a very potent antioxidant due to their contents of rosmarinic, cichoric and caffeic acid derivatives which enhancement free radical scavenging activity (Jahanian *et al.,* 2017).

Sudani ducks is the most important breeds of local Egyptian ducks, and are considered very similar shape, meat quality and husbandry requirements but their growth performance is inferior comparing to Muscovy ducks. Sudani ducks, males differ from females in size, weight and feed consumption through the growth as well as carcasses fat percentage (Awad *et al.,* 2017). The producer prefer to raise Sudani males than females because they are rapidly growing and produce a high amount of meat at the same time. For this, the current work aimed to establish the dietary effect of Echinacea purpurea powder on Sudani ducklings productive through growth period under summer season in Egypt.

MATERIALS AND METHODS

Birds and management:

This work carried out at El – Serw Water Fowl Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt, during July to September months (summer conditions). Three hundred and sixty of Sudani ducklings (180 birds from each males and females), weighed and allocated for eight treatment groups (four groups from each sex of three replicates each) to assess the impact of dietary Echinacea purpurea (EP) addition (0, 2.5, 5.0 and 7.50 g/kg diet) in a factorial design (4 × 2) on productive performance and economical efficiency during Egyptian summer season. Ducklings reared in the same hygienic and environmental conditions. Diets and fresh water are available all the time through the studied period. Ducklings fed a starter diet from

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26 up to 50 day, and a grower diet from 50 – 110 day of age. Basal experimental diets were prepared and divided into four parts then, purple coneflower levels (Echinacea purpurea; 0.0, 2.50, 5.00 and 7.50 g / kg diet) were added. Diets composition and calculated analysis are presented in Table 1.

Table 1. Diets composition and calculated analysis.

Ingredients %	Starter (4-8 wks)	Grower (12-16 wks)
Yellow Corn	63.03	71.00
Soybean meal (44 %)	33.17	17.53
Wheat bran	0.00	7.67
Di-calcium phosphate	1.60	1.60
Limestone	1.50	1.50
Vit. & Min. premix[1]	0.30	0.30
NaCl	0.35	0.35
DL. Meth.	0.05	0.05
Total	100.0	100
Calculated Analysis [2]		
CP, %	20.00	15.00
ME, (Kcal / kg)	2850	2869
CF, %	3.71	3.63
EE, %	2.66	3.06
Ca., %	1.03	1.00
Av. Phos., %	0.44	0.42
Lys, %	1.06	0.70
Meth. %	0.37	0.30
Meth + Cyst, %	0.71	0.58
Sod.,%	0.15	0.16
Price, (LE/kg) [3]	5.357	4.575

1- Each 3 kg of the Vit and Min. premix contains: Vitamin A 10 MIU, Vit. D 2 MIU, Vit E 10 g, Vit. K 2 g, Thi 1 g, Rib 5 g, Pyrid 1.5 g, Nia 30 g, Vit. B12 10 mg, Panto acid 10 g, Folic acid 1.5 g, Biot 50 mg, Chol chlor 250 g, Man 60 g, Z. 50 g, Iron 30 g, Co 10 g, Iod 1g, Sel 0. 10 g, Cob 0.10 g. and carrier CaCO3 to 3000 g..

2- According to NRC, 1994

3- Price of one kg (LE) at time of experiment for different ingredients : yellow corn , 3.45 ; Soy bean meal, 8.25; wheat bran, 3.05; Di-calcium Phosphate,20.0 ; limestone, 0.50 ; Vit&Min.premx,25.0 ; Nacl,1.0 and Methio.,80.0 .

Throughout the experimental period, ambient temperature and relative humidity values were daily recorded inside the ducks building at 12.0 pm up to 6.0 pm, and temperature- humidity index (THI) calculated according to LPHSI (1990) by the following equation: THI = db 0C − {(0.31 − 0.31 RH) (db 0C − 14.4)} where db 0C is the dry bulb temperature (0C) and RH is the relative humidity (RH%)/100.

Duckling's body weight recorded at 26 and 110 day of age. Feed consumed recorded weekly for each replicate per treatment during the whole studied period, then expressed as feed consumption (FC, g) per duckling. Body weight gain (BWG, g) and feed conversion (FC g: BWG g) were calculated through the whole studied period (26–110 days of age).

At the 84th day of age, blood samples collected in vial tubes containing EDTA as anticoagulant from five duckling per treatment from each sex to evaluate hemoglobin, white blood cells count, heterophils (H) and lymphocytes (L) percentages (Gross and Siegel, 1986*)*.

At the 91th day of age, another blood samples collected in centrifugation tubes from five ducklings per each treatment from each sex without anticoagulant and kept for one hour at room temperature to clot. The samples centrifuged at 3500 rpm for 15 min. to serum separation for calorimetrically evaluation total protein, albumin, triglycerides, total cholesterol and HDL using commercial Kits. Also, superoxide dismutase (SOD) activity (Worthington, 1993), glutathione peroxidase (GPX) activity (Paglia and Valentine, 1967) and reduced glutathione (GSH) concentration (Beutler *et al.,* 1963*)*, while blood malondialdehyde (MDA) concentration was determined using the method described by Yagi (1984).

At 110 days of age, total 40 ducklings were taken (five ducklings per treatment from each sex), and fasted for 12 hours for to slaughter test. Relative weights of eviscerated carcass with head, liver, gizzard, heart and total giblets were expressed to fasted live weight.

Economical efficiency and net return calculated based on the prices of Echinacea mixture (150 LE/ one kg), one kg of live body weight (40.0 LE) and one duckling male and female price at 26 days of age (30 and 20 LE, respectively) which prevailing during the experimental time.

Obtained data were statistically analyzed using the general linear model of SPSS (2008). The model used was factorial design (2 × 4) by using two ducklings sex (S) and four Echinacea levels (EP) addition, the model used was: Yijk = μ + Si +Tj +(ST)ij+ eijk where: Yijf = an observation; μ = Overall mean; S = Effect of ducklings sex ; i= (1 and 2) ; T = Effect of EP level addition ; j = (1, 2,.. and 4) ; ST=Effect of interaction between S and T (EP level) ; eijk = Experimental random error. Differences among treatment means were estimated by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Temperature-humidity index

Table 2 reviled that ducklings exposed to very server heat stress through the studied period. The temperature-humidity index (THI) for ducks according to LPHSI (1990) explained that the values obtained are classified as follows: <27.8= no heat stress, 27.8 to <28.9= medium heat stress, 28.9 to <30.0= severe heat stress and 30.0 and more = very severe heat stress.

Table 2. Mean indoor ambient temperature (AT), relative humidity (RH) and temperature-humidity index (THI) during studied period.

Month	AT (^{0}C)	RH (%)	THI
July	36.16±1.85	58.32±3.44	33.35±1.64
August	35.84±1.77	56.27±2.76	32.93±1.49
September	33.27±1.31	49.70±2.35	30.32±1.09

Growth performance:-

Duckling's sex had significant effect on studied growth performance traits of Sudani ducklings (Table 3). Females body weight (BW) were significantly lighter by 35.10 and 44.16%, as compared with the male's ducklings at 26 and 110 day of age, respectively. Males weight gain (BWG), daily feed consumed (DFC) and feed conversion (FCR) significantly higher than female's ducklings during the whole studied period (26-110 days of age). These findings may be due to male ducklings have a greater growth rate than females and it tend to mature earlier as well as it consumed more amount of feed and better feed conversion ratio. The mentioned observations are in agreement with Awad *et al. (*2014 & 2017*)* who found males Sudani ducklings had higher BW, BWG, FC and better FCR than female duckling at the period of 4-16 wks of age.

Dietary Echinacea (EP) addition had significant effect on final LBW, daily BWG and FCR (Table 3). Ducklings fed EP diets had significantly higher LBW by

10.26, 4.64 and 5.16%, respectively for ducklings fed 2.5, 5.0 and 7.5 g EP/kg diet as compared with those fed control diet. Daily BWG was significantly improved by 12.55, 5.31 and 5.77% for the same groups during the whole studied period (26-110 day). The interaction between duckling's sex and EP addition had no effect on all studied growth traits , although males ducklings fed 2.5 g EP/kg diet recorded the best daily BWG and FCR during 26-110 days of age, while, females ducklings fed the control diet (0.0 g EP/kg) had the lowest values of these parameters than other interactions. This may be due to the effect of ducklings sex, which affects the quantity of the diet consumed and hence the live body weight and the increase in it. Growth performance improvement of ducklings by dietary treatments may be due to EP stimulating the secretion of digestive enzymes (lipase and amylase) and intestinal mucous which caused better nutrient digestion and absorption, also, the presence of active ingredients and phenolic compounds in it can reduce numbers of intestinal pathogens, thus minimizing wasting the nutrients (Lee *et al.*, 2003, Nasir and Grashorn, 2010).

Table 3. Effect of sex, dietary Echinacea addition and their interaction on growth traits of Sudani ducklings during the studied period.

Traits		LBW (g) at		Daily BWG	Daily FC	FCR
Main effects		26 day	110 day	(g)	(g)	
Sex effect (S)						
Male (M.)		522.8[a]	3027.3[a]	29.82[a]	128.2[a]	4.31[b]
Female (F.)		339.3[b]	1690.3[b]	16.08[b]	95.7[b]	5.96[a]
SEM		2.2	14.0	0.17	1.2	0.05
Sig.		**	**	**	**	**
Echinacea effect (EP, g/kg diet)						
0.0		425.7	2246.1[c]	21.67[c]	113.0	5.46[a]
2.5		427.9	2476.5[a]	24.39[a]	111.3	4.82[c]
5.0		433.8	2350.4[b]	22.82[b]	112.5	5.17[b]
7.5		436.8	2362.1[b]	22.92[b]	110.9	5.09[b]
SEM		3.2	19.8	0.24	1.6	0.07
Sig.		NS	**	**	NS	**
Interaction						
S.	EP					
Male	0.0	516.2	2890.6	28.27	131.5	4.66
	2.5	519.1	3181.6	31.70	125.8	3.97
	5.0	519.1	2999.3	29.53	128.7	4.36
	7.5	536.8	3037.4	29.77	126.6	4.25
Female	0.0	335.3	1601.7	15.08	94.4	6.27
	2.5	336.8	1771.5	17.08	96.9	5.68
	5.0	348.5	1701.4	16.11	96.2	5.98
	7.5	336.8	1686.8	16.07	95.1	5.93
SEM		4.4	28.3	0.34	2.3	0.10
Sig.		NS	NS	NS	NS	NS

LBW= live body weight; BWG= body weight gain; FC= feed consumption; FCR= feed conversion ratio;
a,b,c :means in the same column within each item bearing different superscripts are significantly different (P ≤ 0.05), SEM = stander error mean; NS = non-significant; ** = P≤0.01

Also, it could be due to morphological and histological modifications of the gastrointestinal tract, which elongation of villi and deepening of intestinal crypts, as well as activation of toll-like receptors, luminal capture by dendritic cells, or stimulation of epithelial cells in the mucosa (Kumar *et al.*, 2014). These findings are in agreement with Gharieb and Youssef (2014) who found a significant improvement (P≤ 0.01) in final BW, WG and FCR for broilers fed EP diets. Maass *et al.* (2005) reported that Echinacea purpurea supplementation improved feed conversion. Landy *et al.* (2011) found that daily WG was (P<0.05) enhanced for broilers fed 5.0 g EP/ kg diet than control. Also, Dehkordi *et al.* (2011) found that EP supplementation to broilers diet reduced feed consumption and increased BWG of broilers. In contrast, some studies found a negative effect of Echinacea purpurea on feed conversion where, Ma *et al.* (2009) found that Echinacea purpurea extract significantly lowered broilers feed conversion efficiency.

Hematological parameters:-

Duckling's sex had non-significant effect on all studied blood hematological parameters (Table 4).These observations are in agreement with Olayemi *et al. (*2003*)* who reported that H/L ratio was not significantly affected due to varying sex in ducks. Also, Awad *et al. (*2017*)* reported that blood hematological parameters were not significantly affected due to varying Sudani duckling's sex at 16 wks of age.

Moreover, dietary EP addition had significant effects on all studied blood hematological parameters (Table 4). Both blood hemoglobin content and lymphocytes (L) cell percentage were significantly elevated, while heterophils (H) cells percentage and H/L ratio significantly attenuated by feeding all EP diets comparing with the control group. The interaction between duckling's sex and dietary supplementing EP had no significant effect on all blood hematological parameters.

The increase in lymphocytes and the decrease in heterophils cells in EP groups represented a best indicator of increasing the immunity response (Wieslaw *et al.*, 2006). The positive effect of Echinacea may be related to its phytochemical active constituent's echinacoside, and cichoric acid as active compounds responsible for the immune-modulatory action of Echinacea extracts (Arafa *et al.*, 2010). The findings are agree with Böhmer *et al.* (2009) who found that hens fed Echinacea purpurea juice as feed additive had significant enhance total numbers of leukocytes and lymphocytes percent comparing to the control. Böhmer *et al.* (2009) reported that ethanolic juice of Echinacea purpurea elevated the number of lymphocytes and total leucocytes in hens. Also, Gharieb and Youssef (2014) found that birds treated with EP powder had a significant increase in total leucocytic and lymphocytic count as well as H/L ratio recorded the lowest value than the control, which suggests that EP are good anti stress factors when added.

Table 4. Effect of sex, dietary Echinacea addition and their interaction on hematological constituents of Sudani ducklings at 84 day of age.

Traits / Main effects		Hb, g/l	WBC, x 10^3	Heterophils (H), %	Lymphocytes (L), %	H/L ratio
Sex effect (S)						
Male (M.)		12.93	17.50	19.17	77.00	0.263
Female (F.)		12.43	18.58	19.83	76.33	0.275
SEM		0.12	0.40	0.58	0.56	0.11
Sig.		NS	NS	NS	NS	NS
Echinacea effect (EP, g/kg diet)						
0.0		11.63 ^{b}	17.25 ^{b}	32.67 ^{a}	63.33 ^{b}	0.518 ^{a}
2.5		13.28 ^{a}	19.75 ^{a}	15.00 ^{b}	80.33 ^{a}	0.187 ^{b}
5.0		12.88 ^{a}	17.83 ^{b}	15.83 ^{b}	81.17 ^{a}	0.195 ^{b}
7.5		12.92 ^{a}	17.33 ^{b}	14.50 ^{b}	81.83 ^{a}	0.177 ^{b}
SEM		0.18	0.57	0.82	0.80	0.02
Sig.		**	*	**	**	**
Interaction						
S.	EP					
Male	0.0	11.93	17.00	31.67	63.67	0.500
	2.5	13.67	19.67	14.67	81.00	0.181
	5.0	12.87	15.67	16.00	82.33	0.195
	7.5	13.23	17.67	14.33	81.00	0.177
Female	0.0	11.33	17.50	33.67	63.00	0.535
	2.5	12.90	19.83	15.30	79.67	0.193
	5.0	12.90	20.00	15.67	80.00	0.196
	7.5	12.60	17.00	14.67	82.67	0.177
SEM		0.25	0.80	1.16	1.12	0.02
Sig.		NS	NS	NS	NS	NS

a,b,: means in the same column within each item bearing different superscripts are significantly different (P ≤ 0.05), SEM = stander error mean; HB= hemoglobin ; NS = non-significant; ** = P≤0.01; * = P≤0.05

Blood serum constituents:-

All studied serum constituents except of triglycerides were not significant effected due to duckling's sex (Table 5). Serum triglycerides was significantly higher by 19.80% for female than male ducklings. These observations are in agreement with Awad *et al. (*2017*)* who stated that duckling's sex had non-significant effects on serum constituents except of total cholesterol which significantly decreased for male than female ducklings at 16 wk of age. These findings may be due to female birds tend to increase plasma total lipids concentration which resulted in abdominal fat formation prior to egg laying, which could be attributed to an estrogen increases (Simaraks *et al.*, 2004*).*

Table 5. Effect of sex, dietary Echinacea addition and their interaction on blood serum constituents of Sudani ducklings at 91 day of age.

Traits / Maineffects		T. protein	Album.	Glob.	A/G	Triglyc.	Cholest	HDL
Sex effect (S)								
Male (M.)		4.24	2.53	1.71	1.50	102.50 ^{b}	131.75	63.23
Female (F.)		4.25	2.59	1.66	1.68	122.79 ^{a}	124.50	61.65
SEM		0.82	0.45	0.09	0.11	3.71	3.88	2.14
Sig.		NS	NS	NS	NS	**	NS	NS
Echinacea effect (EP, g/kg diet)								
0.0		4.14	2.63	1.50	1.91	147.08 ^{a}	139.5 ^{a}	30.25 ^{b}
2.5		4.31	2.58	1.73	1.53	111.50 ^{b}	128.0 ^{ab}	76.22 ^{a}
5.0		4.30	2.53	1.77	1.48	96.75 ^{b}	126.3 ^{ab}	74.13 ^{a}
7.5		4.21	2.48	1.73	1.44	95.25 ^{b}	118.8 ^{b}	69.17 ^{a}
SEM		0.12	0.06	0.12	0.16	5.25	5.48	3.02
Sig.		NS	NS	NS	NS	**	*	**
Interaction								
S.	EP							
Male	0.0	4.23	2.45	1.78	1.41	141.50	146.00	28.50
	2.5	4.30	2.62	1.68	1.61	91.00	129.00	77.33
	5.0	4.28	2.58	1.70	1.53	86.50	128.00	77.03
	7.5	4.15	2.45	1.70	1.44	91.00	124.00	70.07
Female	0.0	4.05	2.82	1.23	2.40	152.67	133.00	32.00
	2.5	4.32	2.53	1.78	1.45	132.00	127.00	75.1
	5.0	4.33	2.48	1.85	1.42	107.00	124.50	71.23
	7.5	4.28	2.51	1.76	1.44	99.50	113.50	68.27
SEM		0.16	0.09	0.17	0.22	7.42	7.75	4.27
Sig.		NS	NS	NS	NS	NS	NS	NS

a,b,: means in the same column within each item bearing different superscripts are significantly different (P ≤ 0.05), SEM = stander error mean; NS = non-significant; ** = P ≤ 0.01

Moreover, feeding EP diets reveled non-significant change in serum total protein and globulins in comparing with the control group that indicate no harmful effect of EP on the liver, these results are agree with Abd-Allah *et al.* (2018) who stated that all broiler treated with EP showed had non-significant change in serum total protein levels and globulins at 4th week of age comparing with the control group. Ducklings fed EP diets had more serum globulin

level than control, this may due to EP acts as indicator to enhance immune response and immunoglobulins production which resulted in an improvement of bird immunity, this is agree with Abdel-Fattah *et al.* (2008).

Serum triglycerides significantly (P≤0.01) attenuated by 24.19, 34.22 and 35.24%, respectively for ducklings fed 2.50, 5.0 and 7.50 g EP/kg diet, while, serum total cholesterol constituent was significantly lowered by 14.83 % for ducklings fed 7.5 g EP/kg diet once than control (Table 5).. Furthermore, HDL cholesterol significantly elevated by all EP levels addition comparing to the control. These findings are in agreement with Bölükbasi *et al.* (2006), Gharieb and Youssef (2014), Abd-Allah *et al.* (2018) who concluded that total cholesterol and triglycerides were significantly lowered for broiler chicks fed EP than the control. A reduction in serum triglycerides concentration may be due to essential oils in EP which inhibit fatty acid synthetase (Jahanian *et al.*, 2017), furthermore, Lee *et al.* (2009) mentioned that thyme oil as a component of EP resulted in a decrease in blood concentrations of triglycerides in broiler chicks. Serum cholesterol reduction may be due to the inhibitory effect of bioactive components of Echinacea on β- hydroxy-βmethylglutaryl coenzyme A (HMG CoA) reductase activity, a key enzyme in cholesterol biosynthesis (Konjufca *et al.*, 1997).

Antioxidants status

A significant effects in blood reduced glutathione (GSH) and malondialdehyde (MDA) constituents, while glutathione peroxidase (GPx) and superoxide dismutase (SOD) were not affected due to ducklings sex (Table 6). Blood GSH was significantly higher, while MDA was significantly attenuated for female than male ducklings.

Table 6. Effect of sex, dietary Echinacea addition and their interaction on blood serum antioxidants constituents of Sudani ducklings at 91 day of age.

Traits Main effects		Glutathione (U/dl)	GPx (U/dl)	SOD (U/dl)	MDA (nmol/ml)
Sex effect (S)					
Male (M.)		31.43 ^{b}	40.13	30.47	4.18 ^{a}
Female (F.)		46.04 ^{a}	43.43	31.06	4.02 ^{b}
SEM		0.48	1.66	0.56	0.02
Sig.		**	NS	NS	**
Echinacea effect (EP, g/kg diet)					
0.0		30.68 ^{d}	29.95 ^{b}	25.17 ^{c}	4.47 ^{a}
2.5		47.25 ^{a}	46.17 ^{a}	30.92 ^{b}	3.96 ^{b}
5.0		41.50 ^{b}	47.33 ^{a}	33.10 ^{ab}	3.95 ^{b}
7.5		35.50 ^{c}	43.67 ^{a}	33.87 ^{a}	4.01 ^{b}
SEM		0.68	2.35	0.79	0.03
Sig.		**	**	**	**
Interaction					
S.	EP				
Male	0.0	22.20	28.17	23.80	4.75
	2.5	31.50	42.67	31.00	4.01
	5.0	34.50	47.00	32.20	3.97
	7.5	37.50	42.67	34.87	3.99
Female	0.0	39.15	31.73	26.53	4.20
	2.5	63.00	49.67	30.83	3.90
	5.0	48.50	47.67	34.00	3.93
	7.5	33.50	44.67	32.87	4.04
SEM		0.96	3.33	1.12	0.05
Sig.		**	NS	NS	**

a,b,c… d :means in the same column within each item bearing different superscripts are significantly different (P ≤ 0.05), SEM = stander error mean; NS = non-significant; ** = P≤0.01

GPX =glutathione peroxidase; GSH= glutathione; SOD=superoxide dismutase, MDA= malondialdehyde

On the other hand, dietary EP addition resulted in a significant effects on all studied antioxidant parameters (Table 6). Blood contents of GSH, GPx and SOD were significantly elevated by all EP levels in the diet comparing to the control group. Antioxidant enzymes like GSH, GPx and SOD play the first defense line (Ray and Husain, 2002). The results showed that, GSH, GPx and SOD enzymes were enhanced by EP treatments, these changes could be attributed to the presence of phenolic compounds, such as phenolic acids, flavonoids particularly echinacoside and caffeic acid in EP plant, which have strong antioxidant properties, and could protect organisms against oxidative stress (Shan *et al.*, 2005).

These findings are agree with Abd-Allah *et al.* (2018) who showed an increase in SOD and GSH levels in broiler treated with EP when compared to the healthy control group at both 4th and 6th weeks of age. Lee *et al.* (2012) found that serum SOD content (P < 0.05) higher compared with the control due to dried EP addition to broilers diets. Antioxidant SOD enzyme is synthesized as endogenously regulated antioxidant mechanisms, which is an important index of the antioxidant capacity of animal tissue, Superoxide dismutase catalyzes the dismutation of the superoxide anion (O^{2-}) into hydrogen peroxide and prevents the generation of free radicals (Jiang *et al.*, 2007). Also, Ghalamkari *et al.* (2011) demonstrated that supplementing EP inclusion to the diet (dried aerial par) by10 g/ kg could improve the total antioxidant activity in of broilers serum.

However, MDA significantly attenuated by feeding all EP diets comparing with the control group, this is agreed with the results of Abd-Allah *et al.* (2018), Bayraktar *et al.* (2011) and Erdogan *et al.* (2005) they found that adding antioxidant additive to broiler diets could prevent the oxidative stress and decrease MDA as lipid peroxidation marker.

Carcass traits:-

Sudani males ducklings had significantly heavier fasted slaughter weight than female ducklings by 73.01% at 110 days of age (Table 7). Eviscerated carcass with head and total edible parts (%) were approximately similar, while abdominal fat (%) was significantly higher for female than male ducklings. These findings are agree with Awad *et al.* *(*2014*)* who stated that slaughter females Sudani ducklings weight was significantly lighter than males, while total giblets and abdominal fat were significantly increased at 20 wks of age. Also, they found that eviscerated carcass and total edible parts (%) were similar for both females and males ducklings at 16 wks of age.

Table 7. Effect of sex, dietary Echinacea addition and their interaction on carcass parameters of Sudani ducklings at 110 day of age.

Traits		Fasted	%			
Main effects		weight, g	Eviscerated Carcass	Total giblets	Total edible parts	Abdominal fat
Sex effect (S)						
Male (M.)		2981.3 [a]	72.04	4.31 [b]	76.35	0.52 [b]
Female (F.)		1683.3 [b]	72.02	4.89 [a]	76.91	0.86 [a]
SEM		33.9	0.59	0.14	0.57	0.06
Sig.		**	NS	**	NS	**
Echinacea effect (EP, g/kg diet)						
0.0		2279.2	69.80 [b]	4.77	74.57 [b]	1.02 [a]
2.5		2370.8	71.91 [ab]	4.61	76.52 [ab]	0.59 [b]
5.0		2325.0	73.48 [a]	4.51	77.99 [a]	0.53 [b]
7.5		2354.2	72.92 [a]	4.49	77.41 [a]	0.63 [b]
SEM		24.0	0.83	0.19	0.80	0.09
Sig.		NS	*	NS	*	**
Interaction						
S.	EP					
Male	0.0	2891.7	70.50	4.42	74.92	0.94
	2.5	3025.0	71.52	3.99	75.51	0.37
	5.0	2975.0	73.33	4.43	77.76	0.25
	7.5	3033.3	72.79	4.40	77.19	0.51
Female	0.0	1666.7	69.10	5.13	74.23	1.09
	2.5	1716.7	72.30	5.23	77.53	0.80
	5.0	1675.0	73.63	4.60	78.23	0.81
	7.5	1675.0	73.05	4.59	77.64	0.75
SEM		34.9	1.18	0.27	1.14	0.13
Sig.		**	NS	NS	NS	NS

a,b,: means in the same column within each item bearing different superscripts are significantly different (P ≤ 0.05), SEM = stander error mean; NS = non-significant; ** = P ≤ 0.01

Moreover, all studied carcass traits were ($P \leq 0.01$ or 0.05) affected among the experimental groups due to dietary EP addition except of total giblets percent (Table 7). Eviscerated carcass and total edible parts (%) were ($P \leq 0.05$) elevated by adding 5.00 and 7.50 g EP/kg diet, while abdominal fat (%) was ($P \leq 0.01$) lowered by all EP levels addition to the diet as compared with control group. The elevation of eviscerated carcass and total edible parts (%) were reached 4.47-5.27 and 3.82-4.68 %, respectively, while, abdominal fat (%) was decreased by 38.23-48.04% than control group. The interactions between duckling's sex and dietary EP addition not ($P \geq 0.05$) affected for all studied carcass traits (Table 7). Both males and females ducklings fed 5.0g EP/kg diet recorded the best total edible parts percentage than other interactions. However, abdominal fat (%) was decreased by supplementing different EP levels for male ducklings than other interaction. Generally, the elevation of eviscerated carcass and total edible parts percentage may be due to enhancing the final live weight and lowering unedible parts by dietary EP addition. These findings are disagree with Landy *et al.* (2011) who concluded that carcass traits not significantly affected by EP in broilers diets.

Economical evaluation:-

Table 8 showed the calculations of economic efficiency (EE) values. Economic efficiency was significantly enhanced for males than female's Sudani ducklings during the whole studied period (26-110 day). These observation may be due to male ducklings have a heavier body weight, higher selling price and net return comparing to females ducklings. On the other hand, feeding and total cost were significantly increased by increased EP level addition to the diet compared to control group. Ducklings fed 2.50 g EP/kg diet recorded higher selling price, subsequently net return and EE than the control and other EP groups at 110 days of age (Table 8). However, net return and EE values significantly attenuated by fed 5.00 or 7.50 g EP/kg diet as compared with the control. It's clearly that adding 2.50 g EP/ kg diet recorded the best EE through the whole studied period for Sudani ducklings. Respecting to the interaction between duckling's sex and EP levels, there a significant differences in EP cost, net return and EE values. The highest value of EE observed for male ducklings fed 2.50 g EP/kg diet, while, the lowest value was occurred for female ducklings fed 5.00 or 7.50 g EP / kg diet.

Table 8. Effect of sex, dietary Echinacea addition and their interaction on economical efficiency serum constituents of Sudani ducklings at 110 day of age.

Traits / Main effects		Total feed consum.[1]	Echinacea price, LE	Feeding cost, LE	Total cost, LE[2]	Selling price, LE[3]	Net return, LE[4]	EE[5]
Sex effect (S)								
Male (M.)		10.77 [a]	6.01 [a]	57.61[a]	87.61[a]	121.09[a]	33.48[a]	0.385[a]
Female (F.)		8.04 [b]	4.53 [b]	42.86[b]	62.86[b]	67.61[b]	4.76[b]	0.078[b]
SEM		0.10	0.08	0.52	0.52	0.56	0.48	0.08
Sig.		**	**	**	**	**	**	**
Echinacea effect (EP, g/kg diet)								
0.0		9.49	0.0 [d]	45.37[d]	70.37[d]	89.85 [c]	19.48[b]	0.251[b]
2.5		9.35	3.51 [c]	48.25[c]	73.25[c]	99.06 [a]	25.81[a]	0.325[a]
5.0		9.45	7.09 [b]	52.27[b]	77.27[b]	94.01 [b]	16.75[c]	0.194[c]
7.5		9.31	10.48 [a]	55.04[a]	80.04[a]	94.49 [b]	14.45[d]	0.157[d]
SEM		0.14	0.11	0.73	0.73	0.79	0.67	0.01
Sig.		NS	**	**	**	**	**	**
Interaction								
S.	EP							
Male	0.0	11.05	0.00	52.90	82.90	115.63	32.73	0.395
	2.5	10.57	3.96	54.65	84.65	127.27	42.62	0.504
	5.0	10.81	8.11	59.93	89.93	119.97	30.04	0.334
	7.5	10.63	11.96	62.96	92.96	121.50	28.54	0.308
Female	0.0	7.93	0.00	37.84	57.84	64.07	6.23	0.108
	2.5	8.14	3.05	41.86	61.86	70.86	8.90	0.146
	5.0	8.08	6.06	44.61	64.61	68.06	3.45	0.053
	7.5	7.99	8.99	47.12	67.12	67.47	0.36	0.005
SEM		0.19	0.16	1.03	1.03	1.12	0.95	0.01
Sig.		NS	**	NS	NS	NS	**	**

a,b,c… d :means in the same column within each item bearing different superscripts are significantly different (P ≤ 0.05), SEM = stander error mean; NS = non-significant ; ** = P ≤ 0.01; LE= Egyptian pound; SEM = stander error mean.

1-Total feed consumption = starter diet was 3 and 2.0kg per male and female duckling, respectively, then the rest of the feed consumed is considered to be growing feed

2-Total cost = feed cost+ LC cost+ duckling price at 26 days of age (female, 20 LE and male , 30 LE)

3-Selling price = body weight (kg) x 40LE

4-Net return= Selling price- total cost;

5-Economic efficacy (EE) = net return / total cost.

CONCLUSION

Finally, supplementing Echinacea (EP) inclusion with 2.50 g/kg diet recorded a positive effects on growth and carcass traits as well as economical efficiency of Sudani ducklings especially males without any deleterious effects on any studied physiological parameters during Egyptian summer season.

REFERENCES

Abd-Allah, O.A.; Kilany, O.E. and Elhosiny, M.E., 2018. Biochemical and immunological studies on the effect of echinacea purpura in broilers. Global Animal Science Journal-GASJ 6(1):1-10-2018; DOI: 10.5281/zenodo.1069762

Abdel-Fattah, S.A.; El-Sanhoury, M.H.; El-Mednay, N.M. and Abdel-Azeem, F., 2008. Thyroid activity, some blood constituents, organs morphology and performance of broiler chicks fed supplemental organic acids. Int. J. Poult. Sci. 7: 215-222.

Arafa, N.M.S.; Salem, S.M. and Farid, O.A.H., 2010. Influence of Echinacea Extract Pre-or Postnatal Supplementation on Immune and Oxidative Status of Growing Rabbits. Italian journal of animal science. Vol.,9: 338-343

Awad, A. L.; Fahim, H. N. and El-Shhat, A.M., 2017. Effect of sex and L-carnitine addition on growth performance and carcass quality of Sudani ducklings. Egypt. Poult. Sci. Vol.,37: 1013-1032

Awad, A.L. ; Moustafa, K.M.El.; Ghonim, A.I.A. and Ramadan, N.A., 2014. Comparative study for different levels of energy and protein in Sudani ducklings diet during growth period. Egypt. Poult. Sci. Vol., 34: 537-560.

Barrett, B., 2003. Medicinal properties of Echinacea: A critical review. Phytomed., 10: 66-86.

Bayraktar, H.; Altan, Ö.; Açıkgöz, Z.; Baysal, S.H. and Şeremet, C., 2011. Effects of oxidized oil and vitamin E on performance and some blood traits of heatstressed male broilers. South African J. Anim. Sci. 41, 321-329.

Beutler, E.; Duron, O. and Kelly, B.M., 1963. Improved method for the determination of blood glutathione. J. Lab. Clin. Med. 61, 882-888.

Böhmer, B.M.; Salisch, H.; Paulicks, B.R. and Roth, F.X., 2009. Echinacea purpurea as a potential immunostimulatory feed additive in laying hens and fattening pigs by intermittent application. Livest. Sci. 122: 81-85.

Bölükbasi, S.C.; Erhan, M.K. and Özkan, A., 2006. Effect of dietary thyme oil and vitamin E on growth, lipid oxidation, meat fatty acid composition and serum lipoproteins of broilers. S. Afr. J. Anim. Sci. 36, 189-196

Crozier, A.; Jaganath, I.B. and Clifford, M.N., 2009. Dietary phenolics: Chemistry, bioavailability and effects on health. Nat. Prod. Rep., 26, 1001–1043.

Dehkordi, H.S.; Fallah, V. and Habibian, D.S., 2011. Enhancement of broiler performance and immune response by Echinacea purpurea supplemented in diet. African Journal of Biotechnology, 10(54), 1128011286.

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

Erdogan, Z.; Erdogan, S.; Aksu, T. and Baytok, E., 2005. The effects of dietary lead exposure and ascorbic acid on performance, lipid peroxidation status and biochemical parameters of broilers. Turk J. Vet. Anim. Sci. 29, 1053-1059.

Ghalamkari, G.; Landy, N.; Toghiani, M.; Modaresi, M. and Ghalamkari, Z., 2011. Efficiency of Echinacea purpurea on total antioxidant activity in serum of broiler chicks. Pages 167–170 in 2011 Int. Conf. Food Eng. Biotechnol. (ICFEB). Vol. 9. IACSIT Press, Singapore.

Gharieb, M.M. and Youssef, F.M., 2014. Effect of echinacea purpurea and garlic on growth performance, immune response, biochemical and hematological parameters in broiler chicks. Assiut Vet. Med. J. Vol. 60, 218- 228

Gross, W.B. and Siegel, P.B., 1986. Effects of initial and second periods of fasting on heterophil / lymphocyte ratios and body weight. Av. Dis., 30:345 346

Jahanian, E.; Rahman, J.; Hamid-Reza, R. and Masoud, A., 2017. Dietary supplementation of Echinacea purpurea powder improved performance, serum lipid profile, and yolk oxidative stability in laying hens. J. of Appl. Anim. Res., voL., 45 :45–51

Jiang, Z. Y.; Jiang, S. Q. ; Lin, Y. C. ; Xi, P. B. ; Yu, D. Q. and Wu, T. X. , 2007. Effects of soybean isoflavone on growth performance, meat quality, and antioxidation in male broilers. Poult. Sci., 86:1356–1362

Konjufca, V. H.; Pesti, G. M. and Bakalli, R. I., 1997. Modulation of cholesterol levels in broiler meat by dietary garlic and copper. Poult. Sci., 76:1264-1271.

Kumar, M.; Kumar, V.; Roy, D.; Kushwaha, R. and Vaiswani, S., 2014. Application of herbal feed additives in animal nutrition – a review. Int. J. Livest. Res., 4: 1–8.

Landy, N; Ghalamkari, Gh.; Toghyani, M. and Moattar, F., 2011. The effects of Echinacea purpurea L. (purple coneflower) as an antibiotic growth promoter substitution on performance, carcass characteristics and humoral immune response in broiler chickens. J. of Med. Plants Res. Vol., 5: 2332-2338

Lee, K. W.; Everts, H.; Kappert, H. J.; Frehner, M.; Losa, R. and Beynen, A. C., 2003. Effects of dietary essential oil components on growth performance, digestive enzymes and lipid metabolism in female broiler chickens. Brit. Poul. Sci., 44: 450-457.

Lee, T.T.; Chen, C.L.; Shieh, Z.H.; Lin, J.C. and Yu, B., 2009. Study on antioxidant activity of Echinacea purpurea extracts and its impact on cell viability. African J. Biotech., 8:5097–5105.

Lee, T.T.; Chen, C.L.; Wang, C.C. and Yu, B., 2012. Growth performance and ntioxidant capacity of broilers supplemented with Echinacea purpurea L. in the diet. Appl. Poult. Res. 21 :484–491. http://dx.doi.org/ 10.3382/japr.2011-00369

LPHSI, 1990. Livestock and poultry heat stress indices agriculture engineering technology guide. Clemson University, Clemson, SC 29634, USA.

Ma, A.; Shi, W.; Niu, X.; Wang, M. and Zhong, X., 2009. Effects of Echinacea purpurea extract on the immunological response to infectious bursal disease vaccine in broilers. Front. Agr. China. 3:1-5.

Maass, N.; Bauer, J.; Paulicks, B.R.; Böhmer, B.M. and Roth-Maier, D.A., 2005. Efficiency of Echinacea purpurea on performance and immune status in pigs. J. Anim. Phys. Anim. Nutr. 89: 244-252.

Nasir, Z. and Grashorn, M. A., 2010. Effects of intermittent application of different Echinacea purpurea juices on broiler performance and some blood parameters. European Poul. Sci., 74: 36-42.

NRC., 1994. Nutrient requirements of poultry. 9th rev. ed. National Academy Press, Washington, DC

Olayemi, F.; Oyewale, J.; Rahman, S. and Omolewa, O., 2003.Comparative assessment of the white blood cell values, plasma volume and blood volume in the young and adult Nigerian duck (*Anas platyrhynchos*). Vet. Arhiv. 73: 270 – 276.

Paglia, D.E. and Valentine, W.N., 1967. Studies on the quantitative and qualitative characterization of erythrocyte glutathione peroxidase. J. Lab. Clin. Med., 70 (1):158-169.

Ray, G. and Husain, S.A., 2002. Oxidants, antioxidants and carcinogenesis. Indian J. Exp. Biol., 40:1213-1232.

Renaudeau, D.; Collin, A.; Yahav, S.; de Basilio, V.; Gourdine, J.L. and Collier, R.J., 2012. Adaptation to hot climate and strategies to alleviate heat stress in livest. prod. Anim., 6: 707–728

Ruizhi, H.; Yujia, H.; Arowolo, M.A.; Shusong, W. and Jianhua, H., 2019. Polyphenols as Potential attenuators of heat stress in poultry production. Antioxidants J, 8, 67; doi: 10.3390/antiox8030067

Shan, B.; Cai, Y.Z. ; Sun, M. and Corke, H., 2005. Antioxidant capacity of 26 spice extracts and characterization of their phenolic constituents. J. Agric. Food Chem., 53:7749-7759.

Simaraks, S.; Chinrasri, O. and Aengwanich, W., 2004. Haematological, electrolyte and serum biochemical values of the Thai indigenous chickens (*Gallus domesticus*) in northeastern Thailand. Songklanakarin J. Sci. Tec., 26:425-430.

SPSS., 2008. SPSS User´s Guide Statistics. Ver. 17. Copyright SPSS Inc., USA.

Wieslaw, P.S.K.; Charon, M.; Winnicka, A. and Gruszczyñska, J., 2006. Relationship between blood lymphocyte phenotype, drb1 (MHC Class II) gene polymorphism and somatic cell count in ewe milk. Bull Vet. Inst. Pulawy, 50: 73-77.

Worthington, V., 1993. Superoxide Dismutase. Pages 368-369 - in Worthington Enzyme Manual. N.J. Freehold, ed. Worthington Biochemical Corp., Lakewood, NJ

Yagi, K., 1984. Assay for blood plasma or serum. Methods Enzymol. 105, 328– 331.

Yang, L.; Tan, G.Y.; Fu, Y.Q.; Feng, J.H. and Zhang, M.H., 2010. Effects of acute heat stress and subsequent stress removal on function of hepatic mitochondrial respiration, ROS production and lipid peroxidation in broiler chickens. Comp. Biochem. Physiol. Toxicol. Pharmacol., 151, 204–208

إستجابة كتاكيت البط السودانى لإضافة الإخناسيا للعليقة على أداء النمو والكفاءة الإقتصادية

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إستخدم فى هذه الدراسة عدد 360 كتكوت بط سودانى (180 لكل من الذكور والإناث) عمر 26 يوم وذلك لدراسة تأثيرالجنس وإضافة مستويات مختلفة من الإخناسيا (صفر ، 2.5 ، 5.0 ، 7.5 جم / كجم) للعليقة فى تصميم عاملى (4 ×2)خلال فترة النمو (26- 110 يوم من العمر) على أداء النمو وصفات الذبيحة وبعض محتويات الدم فضلا عن الكفاءة الاقتصادية. تم وزن وتقسيم الكتاكيت إلى اربعة مجموعات تجريبية وكذلك قسمت العليقة المستخدمة إلى اربعة أجزاء ليضاف إلي كل منها أحد المستويات المستخدمة من الإخناسيا وتم تقديمها للمجموعات التجريبية من الذكور والاناث خلال فترة التجربة. تم تسجيل وزن الكتاكيت فى بداية ونهاية التجربة و كمية العليقة المأكولة ، كما تم أخذ عينات دم لتقدير بعض صفاته ، كما تم إجراء تجربة ذبح لعدد من الذكور والاناث لتقدير فياسات الذبيحة ، كما تم حساب الكفاءة الاقتصادية خلال الفترة الكلية للتجربة (26-110 يوم) .وتوضح النتائج ما يلي :- تأثرت معنويا جميع صفات النمو المدروسة باختلاف جنس الكتكوت حيث سجلت الذكور أفضل القيم لها بالمقارنة بالإناث خلال فترة التجربة. بينما لوحظ أن إضافة المستويات المختلفة من الإخناسيا أدت إلى إرتفاع معدل الزيادة فى الوزن وتحسن معدل التحويل الغذائى بالمقارنة بالكنترول. لم يؤثر جنس الكتكوت على صفات هيماتولوجى الدم بينما إضافة الإخناسيا للعليقة ادى الى زيادة عدد الخلايا الليمفاوية ونقص عدد الخلايا المتعادلة معنويا مما ادى الى انخفاض النسبة بين الخلايا المتعادلة الى الخلايا الليمفاوية معنويا بالمقارنة بالكنترول . تلاحظ زيادة الجليسريدات الثلاثية معنويا فى دم الاناث مقارنة بالذكور بينما ادت إضافة الإخناسيا للعليقة الى انخفاضها معنويا فى السيرم كما ارتفعت معنويا انزيمات مضادات الأكسدة بالمقارنة بالكنترول .ارتفعت نسبة دهن البطن معنويا فى ذبائح الاناث مقارنة بالذكور بينما انخفضت باضافة الإخناسيا للعليقة كما تحسنت معنويا نسبتى الذبيحة المفرغة ومجموعة الأجزاء المأكولة باضافة 5.0 و 7.5 جم الإخناسيا /كجم عليقة بالمقارنة بالكنترول . كما تحسنت قيم صافى العائد والكفاءة الإقتصادية للذكور مقارنة بالإناث فضلا عن تحسنها بإضافة 2.5 جم إخناسيا / كجم عليقة بالمقارنة بالكنترول ومجموعات الإخناسيا الأخرى عند 110 يوم من العمر . وقد خلصت الدراسة إلى إمكانية إضافة الإخناسيا للعليقة بمستوي 2.5 جم / كجم لتحسين أداء النمو وصفات الذبيحة فضلا عن الكفاءة الاقتصادية لكتاكيت البط السودانى خصوصا الذكور خلال فصل الصيف.