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EFFECT OF TYROSINE , TRYPTOPHAN AND CANTHANTHIN EITHER ALONE OR IN COMBINATION ON PRODUCTIVE PERFORMANCE OF EGYPTIAN DEVELOPED LAYING HENS IN POST-PEAK EGG PRODUCTION PERIOD , IN PRESENCE OR ABSENCE OF SODIUM SULPHATE

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ABSTRACT: This study examines the hypothesis that tyrosine and tryptophan and canthanthin either alone or in combination in absence or presence of sulphate ion, can improve the performance of local laying hens in post-peak period (39-58 weeks). A total number of 360 hens plus 36 cocks 39 weeks old from Inshas strain were equally divided into 12 group with 3 replicates (10 hens+ 1 cocks each) and housed in wire cages . The experimental hens fed from 39 to 58 week of age the control diet without or with 6 ppm Canthaxanthin (CAN) , 0.05% tyrosine(TYR) , 0.05% tryptophan(TRY) , 6 ppm CAN + 0.05% TYR, 6 ppm CAN + 0.05% TRY . The rest of treatments from were fed the same previous treatments plus 0.5 % anhydrous sodium sulphate (SS). The most important results obtained were as follow:

1-All dietary feed additives used in this study increased egg number, egg mass and shell thickness .

2-The addition of SS increased the beneficial effect of CAN, TYR and TRY.

3- The carotenoids like CAN with TYR or TRY in presence or absence of SS can improve the egg production, fertility and hatchability of developed laying hens in post-peak period.

In conclusion, the mixture of CAN+TYR+SS was the most successful additive on productive performance.

Key words: Hen- canthanthin-tyrosine-tryptophan-sodium sulphate

INTRODUCTION

The reproductive performance decreases gradually in hens during aging, with a decrease in the length of clutch and an increase in the interval between ovulations. This already occurs at the end of the first year of production (Williams and Sharp, 1978) and is accompanied with endocrine changes, primarily with variations in levels of sex steroids hormone (Burger et al ., 2002).

Accumulating evidence suggests that the antioxidant capacity would be degenerated because of declining antioxidant levels in the aging process. As a consequence, the organs will lose normal physiological function (Ben-Meir et al., 2015; Okudan and Belviranli, 2016). Carotenoids are used in physiological processes as an antioxidants, but also have a protective and recycling role for other fat soluble antioxidants like vitamins E and A (Surai and Speake, 1998). Grashorn and Steinberg (2002) found that the deposition rate of canthaxanthin is of roughly 40% of dietary intake in yolks with strict linearity. The factors affecting absorption of carotenoids are fat content in feed (Han et al., 1987 ; Jayarajan et al., 1980), vitamins in feed (Surai and Sparks, 2001), breed of chickens (Jensen et al., 1998), and gender (Hinton et al., 1973 ; Twining et al., 1971). Polarity of carotenoids also affected absorption and accumulation in chickens. While, vast majority of the 732 recorded naturally occurring carotenoids are hydrophobic (Britton et al., 2004); water dispersibility has been reported for carotenoid sulfates (Liaaen-Jensen, 1996; Oliveiros et al., 1994).

Ali et al.(2012) examine the hypothesis that natural antioxidants can improve the Egyptian local laying hen productive and reproductive performance in late egg production period (48-60 week). They found that antioxidants like commercial canthaxanthin with or without sodium sulphate increased T3 hormone, estrogen, egg production , fertility and hatchability. They indicated that addition of sulphate to laying hen diets increased the utilization of canthaxnthin.

Tyrosine (TYR) and tryptophan(TRY) in egg yolk are known as the main active antioxidant (Nimalaratne et al., 2011) . Tyrosine is known as an antioxidants in seminal plasma (Van Overveld et al., 2000). Moreover, a number of studies have found tyrosine to be useful in animal or human under the conditions of oxidative stress (Deijen and Orlebeke 1994).The monoamine dopamine is a small signaling molecule that can be synthesized from the amino acid tyrosine by the enzyme tyrosine hydroxylase. In the absence of tyrosine hydroxylase, dopamine can be made inefficiently by tyrosinase (Elsworth and Roth, 1997 ; Rios et al., 1999). L-tyrosine and L-Dopa are found to be effective antioxidants in different in vitro assay including anti lipid peroxidation, reductive ability, ABTS, DPPH and superoxide anion radical scavenging, hydrogen peroxide scavenging and metal chelating activities when they are compared to standard antioxidant compounds, such as BHA, BHT, alfa-tocopherol, a natural antioxidant, and trolox which is a water-soluble analogue of tocopherol (Gulcin, 2007) . Commercial laying chicken is quite refractory to the development of broodiness and prolactin has been shown to inhibit estrogen production at the ovarian level and gonadotrophin stimulated ovulation in chicken, thus regulating egg production (Reddy et al., 2007).Dopamine (DA) has been known as an inhibitor of in vitro prolactin secretion (Xu et al., 1996).In humans, at least 95% of dopamine in plasma circulates in the sulfoconjugated form (Kuchel and Kuchel, 1991).Kirima et al. (2001) suggest that dopamine-4-O-sulfate seems to be a stable metabolite of dopamine and has resistance against autoxidation by free radical. In the the Golgi apparatus, sulfation of tyrosine residues is a common post-translational modification of proteins performed by two sulfotransferases (Danan et al., 2008; Huttner, 1982; Huttner, 1988; Moore, 2003).

Tryptophan (Trp) is an essential amino acid that participates in protein synthesis. Moreover, Trp is a precursor of serotonin [5-hydroxytryptamine(5-HT)].Serotonin (a neurotransmitter) has many functions in the central nervous system to inhibit aggression and modulates stress response, including social and environmental adaptability (Martin et al., 2000). Harms and Russell (2000) reported that egg production, egg weight, and egg content were significantly increased by the addition of TRY (from 0.12-0.20%) to the basal diet. Dong et al. (2012) suggested that 0.2 to 0.4 g/kg TRY may have beneficial effects on laying hens under conditions of high temperature and humidity. Dietary antioxidants can be classified as hydrophilic (e.g. vitamin C and polyphenols) and lipophilic (e.g. vitamin E and carotenoids), according to their chemistry. The mechanisms of action among different classes of antioxidants vary, but their ultimate function is the same, i.e. to neutralize the damaging action of free radicals (Pamplona and Costantini, 2011).

Correia-Da-Silva et al., (2014) showed that sulfated small molecules could be of value in therapeutics due to their hydrophobic nature that can contribute to improve the bioavailability. Ali et al. (2012) indicated that SS increased the activity of hydrophobic antioxidants and/ or protect its from free radical attach during circulation in the blood. On the other hand, in human, serum levels of estrone sulphate are 10 times higher than those of unconjugated estrone and estradiol, and the half life of estrone sulphate is much longer than unconjugated estrogen (Bhattacharyya and Tobacman, 2007). Also, Rees et al. (2008) indicated that sulfation confers resistance to oxidation. Besides, Ali et al.(2012) indicated that sulphate may protect hormones from free radicals .

Therefore, this study examines the hypothesis that TYR, TRY or CAN either alone or in combination without or with SS can improve the laying hens productive and reproductive performance in post-peak period (39-58 week).

MATERIALS AND METHODS

This study was carried out at Sakha Animal Production Research Station, Animal Production Research Institute, Agricultural Research Center, Egypt .A total number of 360 hens plus 36 cocks from Inshas a developed strain (39 weeks old). Birds of each strain were equally divided into 12 experimental groups of three replicates each (10 hens+ one cock each) and housed in cage (120 cm long×120 cm wide×60 cm height).Artificial light was used to provide 16 hours daily photoperiod and the water was available by pipe with nipple drinkers for each cage.

Twelve experimental diets were prepared from a hen control diet (Table 1).The experiment had a 2×6 factorial arrangement (two level of sulphate and six dietary treatments). The experimental diets were offered for hens from 39-58 weeks of age as follows**:**

1) The basal diet without any supplements and served as a control diet.
2) Control diet +6 ppm canthanthin(CAN).
3) Control diet +0.05% tyrosine(TYR)**.**
4) Control diet + 0.05% tryptophan(TRY) .
5) Control diet + 6 ppm CAN + 0.05% TYR.
6) Control diet + 6 ppm CAN + 0.05% TRY.

The previous 6 treatments were repeated (treatment 7-12) with Anhydrous Sodium Sulphate (SS) at 0.5% . Anhydrous Sodium Sulphate was supplied by the Egyptian Salt and Mineral Company. Canthaxanthin was provided by BASF Germany**.** Tyrosine and tryptophan were supplied by EVONIC Germany**.** Data collected included weight gain, egg weight and feed intake (g/hen/day). Egg mass (egg number x egg weight) and feed conversion (g feed /g egg) were calculated. Also, some reproductive performance parameters (fertility % and hatchability %) were measured. Total number of 120 eggs (10 eggs from each group) were collected twice (at the end of 54 of age) to determine the egg quality traits.

After 4 weeks from beginning of the experiment, a total number of 900 eggs (25 eggs from each replicate) were incubated to evaluate the fertility and hatchability percentage.

The data collected were subjected to two-way analysis of variance to clear the main effects (treatments, sulphate and their interaction).To obtain the differences among specific all 12 groups (six dietary treatments with two levels of SS) , data were analyzed as one-way analysis of variance. The statistical analysis was computed using the General Linear Models (GLM) procedure and the significant differences among treatments means were separated by Duncan's Multiple Range test as described in the SAS (SAS, 1990). Differences among treatments means were detected by using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Egg Production performance :

Results in Table (2) showed that there was a significant effect of both dietary treatments and sulphate on egg production performance of hens including egg number , egg mass , feed conversion and change in body weight. The analysis of variance derived from one way ANOVA indicate that there were significant differences between egg number recorded by groups fed different diets. Compared to control diet, the addition of CAN increased significantly egg number by 23.35% while TYR increased it by 36.7%. The beneficial effect of CAN have been reported before by Ali et al.(2012) who indicated that CAN may protect hormones like estrogen from free radical and consequently increased egg number. Also, CAN has been used as a feed additive to resist oxidative stress caused by numerous factors including but not limited to high environmental temperatures (Ma et al., 2005), high stocking densities (Simitzis et al., 2012), and pathological conditions (Georgieva et al., 2006). These results disagree with those obtained by others who found that

CAN supplementation had no effect on laying hens performance (Zhang et al., 2011; Rosa et al., 2012).

The beneficial effect of TYR may be due to its antioxidant capacity since TYR has a potential antioxidant capacity (Gulcin 2007). On the other hand, TYR is a precursor of dopamin which is known as an inhibitor of prolactin (Xu et al., 1996) which decrease egg production (Reddy et al., 2007) .The results of this study showed that TYR can increase egg production in post-peak hens by two different mechanisms. The first is its antioxidant capacity and the second is its ability to precursor of dopamine .However, decline of egg production in aged hens resulted predominantly from the ovarian aging, accompanied with endocrine changes (Buyuk et al., 2010), decreased yolk synthesis and accumulation (Zakaria et al., 1983), and the reduction in number of follicles selected into the preovulatory hierarchy (Lillpers and Wilhelmson,1993).

Addition of TRY significantly increased egg number by 18.4% compared to control diet .The beneficial effect of TRY on egg production can be explained on the base that TRY is a precursor of serotonin [5-hydroxytryptamine (5-HT)]. Serotonin (a neurotransmitter) has many functions in the central nervous system to inhibit aggression and modulates stress response, including social and environmental adaptability (Martin et al., 2000). On the other hand , TRY is a precursor of melatonin (MLT),which is a neuro hormone synthesized in the pineal gland that has been classically associated with neuro-immune endocrine activity. Furthermore, several lines of evidence suggest that MLT plays a role in the reduction of oxidative stress as a free radical scavenger and antioxidant molecule (Bitzer-Quintero et al.,2005).The beneficial effect of TRY in this study may be due to its antioxidant capacity or its metabolites. These results agree with those obtained by Harms and Russell (2000) who reported significant increase in egg production and egg weight by the addition of TRY (from 0.12-0.20%) to the basal diet.

These results disagree with those obtained by Koelkebeck et al. (1991), who found that L-Trptophane had no effect on laying performance. Addition of TYR+CAN significantly increased egg number by 31.63% while addition of TRY+CAN increased egg number by 25.25% compared to control diet. The results in this study indicated that addition TRY+CAN increased egg number more than TRY alone meaning that a synergistic effect has been shown between TRY and CAN .Addition of SS increased egg number by 22.89% compared to control diet .The beneficial effect of SS on egg production was explained by Ali et al.(2012) who indicated that SS may protect hormones from free radical and /or increase hormone circulation . For example, in human, serum levels of estrone sulphate are as much as 10 times higher than those of unconjugated estrone and estradiol, and the half life of estrone sulphate is much longer than the half-life of unconjugated estrogen (Bhattacharyya and Tobacman, 2007).Addition of SS+CAN increased egg number in this study by 29.61% compared to control diet. Ali et al. (2012) indicated that SS may increase solubility and polarity of CAN since water dispersibility has been reported for carotenoid sulfates (Liaaen-Jensen, 1996 ;Oliveiros et al., 1994) and consequently reached to all bird tissues. Addition of SS+TYR to control diet increased egg number by 40.82% compared to control diet . The results of this study indicated that SS increased the effect of TYR and /or its metabolites like dopamin. In this respect, Tyrosine sulfation also plays a role in proteine proteine interaction in the three glycoprotein hormone receptors, folliclestimulating hormone receptor (FSHr), luteinizing hormone receptor (LH), and thyrotrophin receptor (TSHr). Tyrosine sulfation has been detected in the C-terminus of these receptors. It was shown that tyrosine sulfation of the receptor is needed for efficient hormone binding (Bonomi et al.,2006). Further studies are needed to know the synergistic mechanism of SS with TYR. Addition of SS+TRY increased egg number by 27.39% compared to control diet meaning that there was a synergistic effect between SS and TRY. Addition of SS+CAN+TYR to control diet increased egg number by 56.00% meaning that SS increased the effect of both CAN and TYR and /or SS help bird to detoxify metabolite end product of both additives However, study reported that exogenous antioxidants at physiological levels are generally safe, while higher levels are detrimental in cellular redox state (Bouayed and Bohn 2010). The increase of egg production by the additives used in this study may due its ability to improve small environment of oocyte maturation . For example, over 12000 oocytes are present in the ovary at hatch but only a small percentage of these will ever reach maturity (Bain et al., 2016). On the other hand, these additives may decrease the lost of oocytes in internal ovulation . For example, in commercial egg-laying strains selected for reproductive performance, oocyte losses can reach as high as 20% (Wood-Gush and Gilbert, 1970). Also , loss of oocytes through internal ovulation likely underlies the low laying rates for broiler breeders fed ad libitum (Hocking et al., 1987).

In this study, TYR, TYR+ SS , TYR+CAN or TYR+CAN+SS succeeded in improving egg production in local laying hen .The beneficial effect of these additives may be due to its ability to protect sex hormone and /or increase dopamine level in blood. In this respect, several measures have been taken to reduce the secretion of prolactin through active and/or passive immunization especially in turkey (El Halawani et al., 1995) and bantam hens (Sharp et al., 1989) to prevent development of broodiness. It has been shown that prolactin inhibits gonadotrophin-stimulated ovulation and oestrogen production at the ovarian level in chicken and a decrease in prolactin is found before and during the preovulatory LH surge (Tanaka et al., 1971; Scanes et al., 1977 ;Zadworny et al., 1985). Reddy et al.(2005) concluded that the physiological pauses that occur during ovulatory sequences can be disrupted effectively using bromocriptine (prolactin inhibitor).All these methods were targeted through the dopamine system since dopamine inhibits prolactin secretion via hypothalamus. Further studies are needed to know the mechanism of increasing egg number by addition of tyrosine .There was significant effect of treatments, sulphate and their interaction on change in body weight. Also, The analysis of variance derived from one way ANOVA indicating that there were significant differences between weight gain recorded by different groups .The hen fed CAN +TRY recorded the highest value while hen fed CAN+ SS recorded the lowest value. In this respect, McDaniel et al. (1981) reported that broiler breeders hens recorded lower egg production when excessive body weight occur .

Further studies are needed with another birds have lower egg production like broiler breeders, duck, ostrich, turkey ……etc.

Egg quality:

The effect of dietary treatments on egg quality is shown in Table (3) .There was significant effect of treatments, sulphate and their interaction on shell thickness.

Also, the analysis of variance derived from one way ANOVA indicate that there were significant differences between shell thickness recorded by different dietary groups .The birds fed TRY+CAN+SS recorded the highest value while birds fed control diet the lowest value meaning that the additives used in this study improved shell thickness .These results agree with those obtained by Ali et al. (2007) who found that thyme (as a natural antioxidant) alone or with SS increased shell thickness . There was significant effect of treatments, sulphate and their interaction on yolk color score . Also, The analysis of variance derived from one way ANOVA indicate that there were significant differences between yolk color score recorded by different treatment dietary groups .The addition of CAN significantly increased yolk color score. The increase in yolk score may be due to increase in the CAN in the yolk . For example , Surai, (2012) reported that with laying hens, 80% of the total body CAN is located in the ovary **.** If so, dietary CAN supplementation should increase the CAN concentration and antioxidant status of the ovary.

The hens fed CAN+TRY+SS recorded the highest value while hens fed the control diet recorded the lowest value. The improve in yolk color by additives rather than CAN may be explained on the base that these additives like TYR may protect cartenoids in fat tissues from free radicals and consequently increase its deposition on yolk . The addition of CAN+ SS increased yolk score by 11.24 % compared to hen fed CAN alone meaning that SS increased the deposition of CAN in yolk .There was a significant effect of treatments and sulphate on Haugh unit percentage. The analysis of variance derived from one way ANOVA indicate that there were significant differences between Haugh unit percentage recorded by different treatment dietary groups . The hens fed TRY recorded the lowest value while those fed TRY+CAN+SS recorded the highest value.

Reproductive performance of hens:

The effect of dietary treatments on reproductive performance is shown in Table (4). There was a significant effect of treatments and interaction between SS and treatments on abnormal chicks percentage . Also, The analysis of variance derived from one way ANOVA indicate that there were significant differences between abnormal chick percentage recorded by different treatment dietary groups. The analysis of variance indicate that there were insignificant differences between fertility percentage recorded by different treatments . The analysis of variance derived from one way ANOVA indicate that there were significant differences between hatchability percentages of fertile eggs recorded by different groups.

The addition of CAN numerically increased the hatchability of fertile egg compared to control diet . These results agree with those obtained by Souza et al. (2008) who found that adding 6 mg/kg of canthaxanthin in broiler breeder diets reduced the number of infertile eggs and embryonic mortality while increased the hatchability . On the other hand, these results disagree with those obtained by Pizzey and Bedecarrats (2007) who found that there were insignificant differences in fertility, embryonic survival, or hatchability when evaluating dietary supplementation of lutein at 30 or 120 mg/kg. The beneficial effect of CAN on hatchability may be due to that female birds derive carotenoids to the egg in order to protect the developing embryo from lipid peroxidation (Surai, 2002). The addition of TYR numerically increased the hatchability percentage of fertile eggs compared to control diet .The hens fed CAN+SS recorded the highest value while hen fed SS alone recorded the lowest value . The addition of CAN+SS increased the hatchability of fertile eggs by3.22% compared to control diet.

The beneficial effect of CAN+SS can be due to ability of SS to increase antioxidants activity of CAN .In this respect; studies have shown that canthaxanthin can help effectively reduce lipid peroxidation in different tissues and in birds embryos (Surai et al., 2003). When present in the egg, canthaxanthin is transferred to the egg and can protect embryo against oxidative damage during the incubation and post-birth periods (Karadas et al., 2005). However, Ali et al. (2012) indicated that SS increased the activity of hydrophobic antioxidants and/ or protect its from free radical attack during circulation in the blood. There was a significant effect of treatments on hatchability percentage of total eggs .Also, there was a significant effect of interaction between treatment and sulphate on hatchability percentage of total eggs . The analysis of variance derived from one way ANOVA indicate that there were significant differences between dietary groups in hatchability percentage of total eggs. The hen fed TYR or TYR+SS recorded the highest values. In this study, the hens fed CAN+TYR+SS recorded the highest value of egg number (Table 2) while those fed CAN+SS recorded the highest value of hatchability of fertile eggs (Table 4). Rosa et al. (2012) showed that to maximize the profitability of breeding industry , it is necessary to produce as many eggs as possible, while optimizing the hatchability rate and the quality of 1-d-old chicks**.**

IN CONCLUSION

this study demonstrated clearly that cartenoids like CAN with either TYR or TRY in presence or absence of SS can improve the egg production, fertility and hatchability of developed laying hens in post-peak period.

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

Ingredients	%
Yellow corn	63.50
Soybean meal (44%)	24.57
Wheat bran	2.00
Lime stone	7.77
Di-calcium phosphate	1.50
NaCl	0.30
Vitamin& Min. Mix*	0.30
DL- methionine	0.06
Total	100
Calculated analysis**	
CP%	16.00
ME Kcal /kg	2703.3
Crude fiber%	3.47
Crude fat %	2.86
Calcium %	3.32
Available phosphorus %	0.406
Lysine %	0.88
Methionine %	0.35
Methionine + Cysteine%	0.62
Sodium%	0.13

* Vitamin and mineral mix contain per 3kg vit A 15 000 000, vit D_3 3 300 000 IU, vit E 80 000mg, Vit K3 4000mg , vit B1 2200 mg, vit B2 12 000mg, vit B6 5500 mg, vit B12 20 mg, pantothenic acid 20 000 mg, Niacin 40 000mg, Biotin 300 mg, Folic acid 1500mg, Cholinechloride 1000 gm, Selenium 300 mg, Copper 10000 mg, Iron 60 000 mg, Manganese 100 000mg, Zinc 80 000mg, Iodine 2000 mg, Cobalt 100 mg and $CaCO_3$ to 3000g

**According to Egyptian Feed Composition Tables for Animal and Poultry Feedstuffs (2001).

Table (2) : Effect of treatments, sulphate and their interaction on productive performance of Inshas developed laying hens.

Main effect		Egg number (egg/hen / period)	Egg weight (g)	Egg mass (g/hen/ period)	Feed Intake (g/hen/d)	Feed conversion (g feed/g egg)	Change in body weight (g)
Treatment effect							
	Control	58.70^{c}	47.54	2790.58^{c}	102.58	5.53^{a}	93.94^{b}
	CAN	66.62^{b}	48.26	3215.17^{b}	101.81	4.79^{b}	96.52^{b}
	TYR	73.08^{a}	47.00	3434.65^{b}	103.48	4.56^{b}	85.76^{b}
	TRY	64.75^{b}	47.82	3096.23^{bc}	101.43	4.95^{b}	95.91^{b}
	CAN+TYR	75.70^{a}	50.92	3837.4.3^{a}	100.38	4.13^{c}	88.18^{b}
	CAN+TRY	65.86^{b}	46.81	3083.67^{bc}	101.59	4.89^{b}	125.67^{a}
Sulphate effect							
	0	65.46^{b}	48.67	3152.49^{b}	102.77	5.07^{a}	117.95^{a}
	0.5 %	70.37^{a}	47.36	3333.42^{a}	100.98	4.54^{b}	77.37^{b}
Source of variation							
Treatment		0.0001	NS	0.001	NS	0.0001	0.005
sulphate		0.0001	NS	0.05	NS	0.0001	0.0001
Treatment *sulphate		0.01	NS	NS	NS	0.05	0.01
Significant levels derived from one-way ANOVA							
0 sulphate	Control	52.67^{f}	47.47	2498.34^{d}	102.27	6.10^{a}	110.91^{bc}
	CAN	64.97^{de}	48.63	3160.55^{c}	101.21	4.90^{bc}	125.45^{b}
	TYR	72.00^{bc}	47.63	3428.77^{bc}	106.21	4.76^{bc}	91.52^{bcde}
	TRY	62.40^{e}	47.80	2983.30^{c}	104.39	5.34^{b}	110.30^{bcd}
	CAN+TYR	69.33^{bcd}	53.77	3721.21^{ab}	101.21	4.51^{c}	101.52^{bcde}
	CAN+TRY	65.97^{cde}	47.33	3122.76^{c}	101.36	4.83^{bc}	168.00^{a}
0.5% sulphate	Control	64.73^{de}	47.63	3082.83^{c}	102.88	4.96^{bc}	76.97^{cde}
	CAN	68.27^{bcde}	47.90	3269.79^{bc}	102.42	4.67^{bc}	67.58^{e}
	TYR	74.17^{b}	46.40	3440.53^{bc}	100.76	4.37^{c}	80.00^{cde}
	TRY	67.10^{cde}	47.83	3209.16^{bc}	98.48	4.57^{c}	81.52^{cde}
	CAN+TYR	82.17^{a}	48.10	3953.65^{a}	99.55	3.74^{d}	74.85^{de}
	CAN+TRY	65.77^{cde}	46.27	3044.58^{c}	101.82	4.97^{bc}	83.33^{cde}
Pooled MSE		1.24	0.56	71.75	0.52	0.10	3.41
P value		0.0001	NS	0.0001	NS	0.0001	0.0001

a, b,..etc.: Means within the same column with different superscripts are significantly different ($P < 0.05$).

Table (3) : Effect of treatments, sulphate and their interaction on egg quality parameters of Inshas developed laying hens.

Main effect		Egg length (cm)	Egg width (cm)	Yolk height (mm)	White height (mm)	Shell weight (%)	Shell thickness (Mm)	Yolk colour	Haugh unit (%)
Treatment effect									
	Control	5.38	4.16	14.13	5.71	14.20	30.06^{d}	7.06^{e}	78.75^{b}
	CAN	5.46	4.09	14.45	5.69	14.03	31.80^{bc}	8.80^{b}	79.66^{a}
	TYR	5.34	4.02	14.16	5.63	13.94	31.08^{c}	7.60^{d}	79.17^{ab}
	TRY	5.37	3.96	14.11	5.73	13.73	31.75^{bc}	7.50^{d}	78.95^{b}
	CAN+TYR	5.50	4.04	14.08	5.77	13.68	32.70^{b}	8.30^{c}	79.70^{a}
	CAN+TRY	5.37	4.07	14.07	5.71	13.80	33.80^{a}	9.30^{a}	79.80^{a}
Sulphate effect	0	5.40	4.05	14.09	5.72	13.72	31.56^{b}	7.95^{b}	78.95^{b}
	0.5%	5.40	4.05	14.25	5.68	14.06	32.25^{a}	8.30^{a}	79.76^{a}
Source of variation									
Treatment		NS	NS	NS	NS	NS	0.0001	0.0001	0.0019
sulphate		NS	NS	NS	NS	NS	0.008	0.0005	0.0001
Treatment* sulphate		NS	NS	0.002	NS	NS	0.0002	0.0001	NS
Significant levels derived from one-way ANOVA									
0 sulphate	**Control**	5.35	4.18	13.93^{b}	5.66	14.50	28.33^{e}	6.66^{e}	78.66^{bc}
	CAN	5.46	4.09	14.00^{b}	5.71	14.17	30.72^{d}	8.36^{cd}	79.09^{bc}
	TYR	5.38	4.04	14.25^{b}	5.61	13.69	31.07^{cd}	8.00^{d}	79.07^{bc}
	TRY	5.35	3.88	14.12^{b}	5.71	13.58	32.60^{abc}	8.00^{d}	78.40^{c}
	CAN+TYR	5.48	4.06	14.04^{b}	5.85	13.30	31.90^{bcd}	7.20^{e}	79.10^{bc}
	CAN+TRY	5.40	4.10	14.11^{b}	5.81	13.37	33.70^{a}	8.90^{bc}	79.20^{bc}
0.5% sulphate	**Control**	5.41	4.15	14.25^{b}	5.74	14.03	31.10^{cd}	7.30^{e}	78.80^{bc}
	CAN	5.47	4.09	14.96^{a}	5.67	13.87	33.00^{ab}	9.30^{ab}	80.30^{a}
	TYR	5.29	3.99	14.04^{b}	5.66	14.27	31.10^{cd}	7.10^{e}	79.30^{bc}
	TRY	5.39	4.04	14.10^{b}	5.76	13.89	30.90^{d}	7.00^{e}	79.50^{ab}
	CAN+TYR	5.53	4.03	14.13^{b}	5.69	14.06	33.50^{a}	9.40^{ab}	80.30^{a}
	CAN+TRY	5.34	4.04	14.03^{b}	5.61	14.23	33.90^{a}	9.70^{a}	80.40^{a}
Pooled MSE		0.02	0.02	0.04	0.02	0.11	0.18	0.10	0.10
P value		NS	NS	0.001	NS	NS	0.0001	0.0001	0.0001

a, b,..etc.: Means within the same column with different superscripts are significantly different ($P < 0.05$)

Table (4) : Effect of treatments, sulphate and their interaction on some reproductive performance of Inshas developed laying hens.

Main effect		Abnormal %	Fertility %	Hatchability of fertile eggs%	Hatchability of total eggs%
Treatment effect					
	Control	2.00^{b}	87.33	89.28	78.00^{c}
	CAN	0.66 ^{ab}	86.66	92.30	80.00^{b}
	TYR	0.66 ^{ab}	89.99	90.37	81.33^{a}
	TRY	1.33^{b}	88.00	89.37	78.67^{c}
	CAN+TYR	0.00 ^{a}	88.00	91.67	80.66^{ab}
	CAN+TRY	2.00^{b}	87.33	90.05	78.66^{c}
Sulphate effect					
	0	1.11	87.55	90.58	79.33
	0.5%	1.11	88.22	90.43	79.77
Source of variation					
Treatment		0.01	NS	NS	0.0001
sulphate		NS	NS	NS	NS
Treatment*sulphate		0.007	NS	0.01	0.03
Significant levels derived from one-way ANOVA					
0 sulphate	Control	2.66^{b}	86.67	90.77^{abc}	78.67^{bc}
	CAN	1.33^{ab}	88.00	90.90^{abc}	80.00^{ab}
	TYR	0.00^{a}	89.33	91.04^{abc}	81.33^{a}
	TRY	0.00^{a}	86.67	90.70^{abc}	78.67^{bc}
	CAN+TYR	0.00^{a}	86.67	92.30^{ab}	80.00^{ab}
	CAN+TRY	2.66^{b}	88.00	87.80^{c}	77.33^{c}
0.5% sulphate	Control	1.33^{ab}	88.00	87.80^{c}	77.33^{c}
	CAN	0.00^{a}	85.33	93.70^{a}	80.00^{ab}
	TYR	1.33^{ab}	90.66	89.70^{bc}	81.33^{a}
	TRY	2.66^{b}	89.33	88.05^{c}	78.67^{bc}
	CAN+TYR	0.00^{a}	89.33	91.04^{abc}	81.33^{a}
	CAN+TRY	1.33^{ab}	86.67	92.30^{ab}	80.00^{ab}
Pooled MSE		0.22	0.37	0.41	0.26
P value		0.004	NS	0.02	0.0001

a, b,..etc.: Means within the same column with different superscripts are significantly different ($P < 0.05$).

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الملخص العربى

تأثير التيروزين والتربتوفان والكانزانثين كل على حده أو مخاليطها على الأداء الانتاجى للدجاج البياض المستنبط المصرى بعد فترة قمة انتاج البيض فى وجود أو عدم وجود كبريتات الصوديوم .

محمد نبيل على ، مجدى سيد حسن ، خليل عبدالجليل محمد عطية ، محمود حمزة الديب ، فوزى على عبدالغنى ، نصرة بدير عوضين

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تدرس هذة الدراسة فرضية أن التيروزين والتربتوفان والكانزانثين بمفردها أو فى صورة مخاليط فى غياب أو وجود أيونات الكبريتات يمكن أن تحسن من اداء الدجاج البياض المحلى فى فترة ما بعد قمة الانتاج من 39- 58 أسبوعا.

إستخدم فى الدراسة عدد 360 دجاجة + 36 ديك من عمر39 أسبوعا من سلالة انشاص وقسمت بشكل متساوى عشوائيا الى 12 مجموعة كل مجموعة قسمت الى 3 مكررات وكل مكررة تتكون من 10 دجاجات + ديك واحد لكل منهما وتم تربيتها فى أقفاص سلكية (120 سم طول – 120 سم عرض – 60 سم إرتفاع) ، وكانت المجاميع على النحو التالى :

(1)- غذيت الدجاجات على عليقة الكنترول بدون اى اضافات غذائية .
(2)- عليقة الكنترول + اضافة 6 جزء فى المليون كانزانثين
(3)- عليقة الكنترول + 0,05 % تيروزين
(4)- عليقة الكنترول + 0,05 % تربتوفان
(5)- عليقة كنترول + الكنترول + اضافة 6 جزء فى المليون كانزانثين + 0,05 % تيروزين
(6)- عليقة كنترول + الكنترول + اضافة 6 جزء فى المليون كانزانثين + 0,05 % تربتوفان

فى بقية المعاملات من 7 الى 12 تم تغذية الطيور على نفس المعاملات السابقة فى وجود 0,5 % كبريتات صوديوم لامائية .

وكانت أهم النتائج المتحصل عليها كما يلى :

- أدت جميع أضافات الاعلاف المستخدمة فى هذة الدراسة الى زيادة فى عدد البيض وكتلة البيض وسمك القشرة.
2- زادت اضافة كبريتات الصوديوم اللامائية من التأثير النافع لكلا من الكانزانثين والتيروسين والتربتوفان .
3- أثبتت هذة الدراسة بوضوح أن المواد الكاروتينية (المضادة للأكسدة) مثل الكانزانثين مع التيروزين والتربتوفان فى وجود أو غياب كبريتات الصوديوم اللامائية يمكن أن تحسن انتاج البيض والخصوبة ونسبة الفقس للدجاجات المحلية فى فترة ما بعد قمة الانتاج (فترة الذروة).

يستنتج من الدراسة أن خليط كبريتات الصوديوم اللامائية + التيروزين + الكانزانثين هو أكثر المواد المضافة فى تأثيره الإيجابى على الاداء الانتاجى للدجاج البياض المحلى المستنبط بعد فترة قمة إنتاج البيض .