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THE IMPACT OF SOME FEED ADDITIVES ON BEHAVIOR, WELFARE AND PERFORMANCE OF HEAT-STRESSED PIGEON SQUABS.

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Abstract:-
This study aimed to assessment the impact of supplementing pigeon squab's diets with different feed additives on behavior, performance and some blood parameters during heat stress. One hundred and forty four, 4 wk-old age, unsexed pigeon squabs were used and divided in two groups. Thermonatural group squabs (TG) reared in 22 ºC, were fed basal diet, while heat-stress group reared in 34 ºC, and subdivided into 5 groups; heat-stress group was allotted to basal diet (HG) and four groups allotted to basal diet supplemented with different feed additives as natural feed additives (Moringaolifera(H1G) or fenugreek seeds (H2G)) and chemical feed additives (premix (H3G) or yeast(H4G)). Results showed that, Fenugreed seeds group (H2G) had more potent effect to alleviate the negative effects of heat stress on squab behaviors, performance,biochemical parameters and growth hormone, whereas the Moringaolifera, yeast and premix groups also have beneficial impactin alleviation the negative effect of heat stress, but less than Fenugreed seeds.In conclusion we could recommended the usage of 2 % Fenugreed seeds as feed additives to improve pigeon squab behavior, performance, welfare and biochemical parameters during heat stress condition.

Keywords:- *Fenugreed seeds; MoringaOlifera; Premix and Yeast, pigeon squab, feed additives, performance, behavior*.

INTRODUCTION

Pigeon squab's exposure to high ambient temperature induce an oxidative stress condition which reflected by increase of protein oxidation (increased protein carbonyls) and lipid peroxidation (increased MDA). And, increases in leptin blood metabolite such as (glucose; cholesteroland triglycerides), and increase H\R ratio. (**Al-Azraqi, 2008**)

During heat stress bird reduced the heat production by decreasing locomotors activities **(Pereira et al., 2007**); and reducing the release of catabolic hormones (T_3 and T_4) (**Kusnadi and Rahim, 2009**) reducing of feed intake **(Bartlett and Smith, 2003)** resulting in decreasing weight gain **(Soleimani, 2008)**. On the other hand, the bird increase the heat loses by increasing the respiration rate **(Nadia 2003)** and spend more time in drinking **(Mack et al., 2013).** Also, yawing behavior may be involved in thermoregulation during heat stress condition and act as a brain cooling mechanism **(Gallup and Gallup 2008).**

MoringaOliferasupplementation significantlyimprove feed intake and averagebodyweight gain **(Melesse et al., 2011)** and increased total antioxidant capacity **(KoutElkloub et al., 2015)**. While, Fenugreek seeds having antimicrobial and antioxidant properties **(Adil et al., 2015), also** increase feed intake **(Tariq et al., 2014)** and improve broiler body weight **(Qureshi et al., 2015).**

The production and reproductionof Baladipigeons, were improvedby adding yeast to its commercial diets **(Mariey, 2013)**. Also, premix playsa potent role in body metabolism activity which controls some important production parameters as increase body weight and changes in carcass cuts. **(AbouKhashaba and Mariey, 2009)**

The aims for this study areassessment the role and effects of some feed additives to compensate the negative effects of heat stress on pigeon squab, monitoring behavior, performance, welfare and some blood parameters.

Materials and methods

Squabs and feeding

One hundred and forty four, 4 wk-old age, unsexed pigeon squabs were purchased from a pigeon fancier, and were fed the basal diet according to **AbouKhashaba and Mariey (2009**) for 28 days (Table I). Rations and water were offered to squab ad-libitum along the study period from 1/6/2017 till 29\6\2017 in Educational Hospital, facultyof Vet.Med., AssiutUniversity, Egypt.

Table I. Composition and chemical analyses of the basal diets.

Ingredients	Ingredients (%)	Chemical analyses	
Yellow corn	68.50	Crude protein, %	15.11
Soybean meal, 44 %	22.00	ME,Kcal/kg**	3201.36
Oil	5.20	Crude fiber,%	3.183
Limestone	1.40	Ether Extract,%	2.813
Bon meal	2.30	Calcium, %	1.346
Common salt (NaCl)	0.30	Available phosphorus, AP %	0.403
Vit. & Min. mix.*	0.30	Lysine, %	0.806
Total	100	Methionine,%	0.280
		Methionine + cysteine %	0.533
		C/P ratio	1/212

*premix provide vitamins and minerals according the recommendation of **AbouKhashaba and Mariey (2009).**
** Calculated according to **NRC (1994).**

Experimental Design

A) Group 1birds (Thermoneutral group) (TG)

Consist of 24 squabs (6squab X 4 replicate) were housed in temperature-controlled units at 22°: 24° C this done by using air cooler and fed basal diet.

B) Group 2 birds (Heat-stress groups)

Consist totally of 120 squabs divided into 5 groups each one (6 squabs X 4 replicate), that were kept in surrounding environmental temperature at 34°:36°C (summer season in Egypt) and fed basal diet only (heat-stress group) or fed basal diet containing natural feed additives groups (2% Moringaolifera leaves or 2% fenugreek seeds) or basal diet containing Chemical feed additives (0.4% premix or 0.2% yeast.)

Behavioral parameters

Behavioral parameter wereobserved after introduction of bird to the experimental unit by 2 days (i.e. from 30 to 56 days old) the behaviors of the experimented bird were recorded by using video tap**.** The observation of pigeon squabs behavior was carried out via scanning technique(**Fraser and Broom 1990).**Observation time was ten minutes for three times at morning (8: 9 am); then (12:1 pm) and late afternoon (4 : 5pm) per day for 3 days \ week. So each replicate was observed 30 minutes daily. According to behavior ethogram. Table (III)

Behavior	Definition
1)Ingestive behavior:-	**Spudeit et al., 2013)**
a) Feeding	Squab's head observed inside the feeder.
b) Drinking	squab's head in contact with water
2)Comfort behavior:-	**(Spiteri, 1975)**
a) Foot pecking	The pigeon pecks at its foot or the ground.
b)Wings and legs stretch	Upward and downward Stretchingof leg or wing.
c) Preening	
3) Movement activity	
a) standing	Gentle pecking or scratching its own feathers.
b) Sitting	Both feet are in contact with the floor; no other body part is in contact ed.
c) Walk	Most of the ventral region of the bird's body in contact with floor. No space is visible between the floor and the bird
4) Panting behavior	Bird is in the process of taking at least 2 steps, including scratching the litter.
5) Yawing behavior	Rapid movement of body wall or gasping during respiration.
6) Resting behavior	a large gaping of the mouth accompanied by a deep inhalation and a shorter expiration of air
a) Crouching	
b) Huddling	lying or sitting with breast on the floor, locking around with or without closed eyes with no other behavior
	Three or more birds over lapped in a crouching position in an allelomimetic pattern.

Squab performance
Live body weight (LBW), was measured in early morning (7 a.m) before feeding and drinking water. It is recorded weekly.

Body weight gain (BWG); calculated value of subtracting the average body weight at the beginning of study period from the body weight at end of the study period. In our work it is recorded weekly. Feed intake (FI); The amount of diet that was eaten by each bird, at certain period. It is recorded weekly. In our work the feed intake per each group was estimated then divided to the total number of squabs to get average FI.
Feed conversion ratio (FCR); was measured according this equation, = feed intake / body weight gain. It was calculated weekly.

Total aerobic microbial counts
The fecal contents of duodenum, jejunum, ileum and caecum were collected immediately after slaughter in screw capped sterile plastic cups, previously weighed and the total aerobic count was done according to method of **Awan and Rahman, (2005).**

Squab welfare
At the end of our study 9 squabs from each group were randomly selected and transported to a test arena to do the following four conventional welfare indicators.

Welfare indicators
a) Tonic Immobility (TI) test (Benoff and Siegel 1976)
1) Tonic immobility was induced by laying the bird down on its right side and gently restraining it by hand for 15 s. (Time of induction) When the bird straightened up in less than 10 s, it was restrained repeatedly. (Number of induction or attempts) when TI was not induced after three attempts, the duration of TI was considered 0 s.
2) Then the hand was withdrawn and the experimenter retreated approximately 1 meter and remained noiseless within the sight of the bird.
3) Duration of tonic immobility in second was measured from withdrawal of the hand until the bird straightened up. When the bird did not straighten up within10 min, it was removed and given the maximal duration of 600 s.

Each bird was caught and sampled, one immediately after another. It was assumed that the catching and returning of birds did not disturb the other members of the flock.

b) Dermatitis according to**Mayne (2005).**
Footpad and hock dermatitis and breast blisters were scored on the birds selected. On a fourpoint scale (score 0 = no lesion; score 1 = pinhead, superficial lesions; score 2 = large or deep lesions, score3 = ulcers, or scabs.) the scores of the left and right footpad were averaged, as were those of the hocks.
Data are collected as an aggregated index as summed all data and divided by four.

Blood parameters
At the end of experiment at 56 day old age blood samples were collected from birds for hematology. The rest of blood was centrifuged at 3000 g for 10 min and plasma was separated and stored at -20° C for further analysis.

1) Chemical blood analysis
Spectrophotometrically:- as Catalase activity; Total antioxidant capacity. (TAC); Glucose; cholesterol; triglyceride level and Malondialdehyde (MDA which Estimation of Lipid peroxidation). While, enzyme immunoassay kit was used to estimate level of Protein carbonyls. (Estimation of Protein oxidation), according to **(AOAC, 2002) 2)**

Hematological blood analysis:
The differential count of heterophils and lymphocytes percentage was carried out by light microscope using an immersion objective for blood smear stained by Gimsa stain.

Statistical analysis
The studydesigned as incomplete randomized block design. One way ANOVA procedure was used for analyzed our data, SPSS Program 13.00 Software (SPSS Inc., Chicago, IL, USA). Means were compared by Duncan's test when a significant difference ($P < 0.05$) was detected.

Results
Table (2) Effect of feed additives on some behavioral patterns of heat stressed squabs.

Items	No additives		Natural antioxidant		Chemical antioxidant	
	Control (-)	Heat stress	Moringaolifera	Fenugreeks seed	premix	Yeast
1) Ingestive behavior (act\30mint)						
Feeding behavior	4.7 ± 0.3^{a}	2.9 ± 0.1^{b}	3.9 ± 0.6^{a}	3.8 ± 0.1^{a}	$3.1 \pm 0.4^{a,b}$	$3.2 \pm 0.8^{a,b}$
Drinking behavior	3 ± 0.2^{b}	5 ± 0.4^{a}	2.4 ± 0.5^{b}	1.9 ± 0.7^{b}	2 ± 0.5^{b}	2.8 ± 0.5^{b}
F / D ratio	1.6 ± 0.1^{a}	0.6 ± 0.2^{b}	1.6 ± 0.5^{a}	2 ± 0.4^{a}	1.6 ± 0.3^{a}	$1.1 \pm 0.6^{a,b}$
2) Movement activity(act\30mint)						
Walk	7 ± 0.4^{a}	4.1 ± 0.4^{b}	5.8 ± 1.3^{a}	$5.2 \pm 1.4^{a,b}$	4.3 ± 0.6^{b}	6.9 ± 1.2^{a}
Standing	3.1 ± 0.3^{a}	$1.2 \pm 0.6^{b,c}$	2 ± 0.1^{b}	1.7 ± 0.1^{b}	1.6 ± 0.9^{b}	1.9 ± 0.3^{b}
3) Resting behavior(act\30mint)						
Crouching	0.8 ± 0.6^{c}	5 ± 0.1^{a}	2 ± 0.1^{b}	4.7 ± 0.1^{a}	4.2 ± 0.9^{a}	4.8 ± 0.3^{a}
huddling	0.4 ± 0.1	0.2 ± 0.1	0.3 ± 0.1	0.2 ± 0.1	0.3 ± 0.1	0.3 ± 0.1
4) Panting and Yawing behavior(act\30mint)						
Panting	1.3 ± 0.6^{c}	4 ± 0.1^{a}	2.8 ± 0.1^{b}	3.7 ± 0.1^{a}	3.2 ± 0.9^{a}	3.8 ± 0.3^{a}
Yawing	0.5 ± 0.1^{c}	1.5 ± 0.1^{a}	0.6 ± 0.1^{c}	$0.7 \pm 0.1^{b,c}$	$0.9 \pm 0.9^{b,c}$	$0.8 \pm 0.3^{b,c}$
5) Comfort behavior (act\30mint)						
Preening	9 ± 0.9^{b}	6.1 ± 0.6^{c}	8.7 ± 1.3^{b}	8.6 ± 0.8^{a}	$6.7 \pm 0.4^{b,c}$	$7.8 \pm 1.6^{a,b}$
Stretching(wing& leg)	3.3 ± 0.5^{a}	1.8 ± 0.2^{b}	2.8 ± 0.9^{a}	2 ± 0.4^{a}	$2.1 \pm 0.5^{a,b}$	3 ± 0.3^{a}
Head scratching	2.9 ± 0.9^{a}	0.9 ± 1.6^{b}	2.8 ± 1.1^{a}	2 ± 0.3^{a}	$1.7 \pm 0.6^{a,b}$	2.1 ± 1.6^{a}

[a,b,c]Values with different superscripts in the same raw differ significantly ($p < 0.05$).
Data are represented as means of behavior frequency for 30 mints per day for 12 days.

Table (3) Effect of feed additives on body performance and total aerobic count of heat stressed squabs.

Group / Items	22:24 °c	Heat stress				
	Basal diet					
	No additives		Natural antioxidant		Chemical antioxidant	
	Control (-)	Heat stress	Moringaolifera	Fenugreeks seed	premix	Yeast
1) Performance parameter of single squab						
Feed intake (gm)	590 ± 12[a]	540 ± 8.3[b]	560 ± 13.6 [a]	575 ± 9.1 [a]	545 ± 11 [a,b]	550 ± 0.6 [a,b]
Body weight (gm)	175.5± 7[a]	159 ± 6.4 [b]	166.3 ± 5.5 [a]	170 ± 9.5 [a]	162 ± 6 [a,b]	168 ± 3.9 [a,b]
Body gain (gm)	7.5± 0.3 [a]	6.4 ± 0.5 [b]	6.8 ± 0.7 [b]	7.2 ± 0.4 [a]	6.8 ± 0.3 [b]	7 ± 0.5 [a.b]
FCR	78.6±3.2[b]	84.4 ± 8.5 [a]	82.4 ± 9.2 [a]	79.9 ± 2.5 [b]	80.2± 5.9[a,b]	78.6 ±7.8 [b]
2) **Total aerobic count** (cfu\ gram)						
Small intestine	5 ± 1.15 [a]	6 ± 1.15 [a]	2 ± 0.58 [b,c]	0.002 ± 0.001 [c]	5 ± 1.18 [a.b]	3 ± 1.73 [b;c]
Large intestine	4 ±0.58 [a, b]	4 ± 0.5[a,b]	4 ±1.73 [a, b]	2 ± 1.15 [a, b , c]	6 ±1.73 [a]	2±0.58 [b,c]

[a,b,c] valueswith different superscripts in the same raw differ significantly at ($p < 0.05$).Performance parameters of single squab data are represented as means of 4 weeks (28 days).Total aerobic count data was multiplied by 108cfu. (Colony-forming units per gram).

Table (4) Effect of feed additives on welfare parameters of heat stressed squabs.

Group / Items	22:24 °c	Heat stress				
	Basal diet					
	No additives		Natural antioxidant		Chemical antioxidant	
	Control (-)	Heat stress	Moringaolifera	Fenugreeks seed	premix	Yeast
Tonic Immobility(s)	59 ±0.66 [c]	85 ± 2.88 [a]	71 ± 0.88 [b]	70 ± 0.56 [b]	77 ± 0.52[b]	65 ±0.42 [b,c]
foot pad dermities	0.5± 0.01[c]	2 ± 0.02[a]	1 ± 0.002 [b]	0.67 ± 0.005 [b]	2 ± 0.02[a]	1.33 ± 0.4 [b]
Hock dermatitis	0.6 ± 0.03 [c]	2 ± 00 [a]	1±0.09 [a,b]	0.67 ± 0.3 [b]	1.67 ± 0.4[a]	1 ± 0.75 [a,b]
Breast blisters	0.8 ± 0.05 [c]	2 ± 00 [a]	1.33 ± 0.33[a,b]	1 ± 0.15 [b]	1.33±0.3[a,b]	1 ± 0.75 [b]
welfare index	15.4 ± 0.01 [c]	22.8±0.05[a]	18.5 ± 0.08 [b]	18.1 ± 0.75[b]	20.5±0.57[a]	17.1±0.57[b,c]

a,b,cValueswith different superscripts in the same raw differ significantly at ($p < 0.05$).
Welfare parameters of squab data are represented as means of 9 squabs per treatment.

Table (5) Effect of feed additives on blood biochemical parameters of heat-stressed squabs.

Group / Items	22:24 °c	Heat stress				
	Basal diet					
	No additives		Natural antioxidant		Chemical antioxidant	
	Control (-)	Heat stress	Moringaolifera a	Fenugreeks seed	premix	Yeast
1) Blood oxidative markers						
Malondialdehyde(µmol/L)	0.8 ± 0.01[c]	2.7± 0.6 [a]	2 ± 0.9 [b,c]	1.9± 0.8 [c]	2.3± 0.05 [a,b]	2.2 ± 0.03 [a,b]
Protein carbonyls (nmol\L)	0.8 ± 0.03 [c]	1.8± 0.9 [a]	1.3± 0.7 [b]	1± 0.9[b,c]	1.6 ± 0.08 [a]	1.6 ± 0.04 [a]
Total antioxidant capacity	0.29±0.01[a]	0.06±0.002[c]	0.19± 0.001 [a]	0.21 ± 0.06 [a]	0.12±0.003[b]	0.13± 0.003[b]
Catalase	1 ± 0.06 [b]	3 ±0.01[a]	1.5 ± 0.01 [b]	1.33 ± 0.33 [b]	3.1 ± 0.57 [a]	1.66±0.33 [b]
2) Leptin metabolites						
Glucose (mg\dl)	233±13.8 [b]	280 ± 12 [a]	265 ± 12[a,b]	245 ± 8 [c]	271 ± 7 [a,b]	269± 13 [a,b]
Cholesterol (mg\dl)	176± 9.6 [b]	188 ± 17 [a]	182 ± 11[a,b]	169 ± 5 [c]	186 ± 8 [a]	181± 12 [a,b]
Triglyceride (mg\dl)	171± 6.7 [c]	189 ± 9 [a]	183 ± 9 [a]	181 ± 5 [b]	185 ± 9 [a,b]	183±16 [a,b]
3) Hormonal level						
T_3 levels	0.14± 0.02 [b]	0.07±0.01 [c]	0.5 ± 0.22 [b]	0.9 ± 0.001 [a]	0.25±0.07 [b,c]	0.14±0.03 [c]
T_4 levels	14 ± 2.3 [a]	10.7 ± 0.7[c]	11.5 ± 0.28 [b]	13.3 ± 0.33 [a,b]	10.9±2.8 [b,c]	12 ± 0.02 [b]
Growth hormone	0.36 ±0.01 [a]	0.11±0.03 [c]	0.13 ±0.001 [b,c]	0.21 ± 0.02 [a]	0.13± 0.01[b,c]	0.16± 0.03 [b]
4) Hematological blood parameters						
Heterophils (%)	42 ± 2 [b]	49 ± 3 [a]	47 ± 1 [a]	44 ± 2[a,b]	46 ± 3 [a]	45 ± 2 [a]
Lymphocytes (%)	58 ± 3 [a]	51 ± 1 [b]	53 ± 2[a,b]	56±2 [a]	54±1 [a,b]	55±1 [a]
H\L ratio	0.72±0.02 [c]	0.96± 0.02 [a]	0.89 ± 0.09 [a]	0.79 ± 0.03 [b]	0.85± 0.02 [a]	0.81± 0.07 [b]

[a,b,c]Values with different superscripts in the same raw differ significantly at ($p < 0.05$).
Data are represented as means of 6 blood sample for each treatment group.

Implication of feed additives on behavior, performance, welfare and some blood parameters of heat-stressed pigeon squabs

Data tabulated in Table (2&3&4) showed that, Feed additives used facing the negative impact of heat stress on drinking behavior; yawing and welfare index. While,Pigeon squab fed diet contain Moringaolifera leaves and fenugreek seeds facing the negative impact of heat stress on drinking behavior; feed \ drinking ratio; comfort behavior; feed intake; body weight; Total aerobic count of small intestine; blood oxidative markers; T_3 and T_4 level . Moreover,Using Fenugreek seeds only facing the negative impact of heat stress on body gain; FCR; leptin metabolite; growth hormone and H\R ratio. And Moringaolifera leaves only facing the negative impact of heat stress on walk activity, crouching and panting.

On the other hand, Premix only facing the negative impact of heat stress on F\D ratio. While, Yeast only facing the negative impact of heat stress onwalk**;** comfort; total aerobic count; catalase; T_4; growth hormone and H\R ratio.

From previous data we concluded that, fenugreek seeds were the more effective than Moringaolifera leaves than yeast than premix in facing the negative impact of heat stress on squab's behavior; performance; welfare and some blood parameters.

Discussion

The positive effect of Moringaolifera and fenugreek seeds on increasing feeding intake and body weight was agreed with previous finding of (**Melesse et al., 2011 &Mousa et al., 2017&AbouElezz et al., 2012Yatoo et al., 2012 &Kirubakaran et al., 2016**). While, disagreed with (**Onunkwo and George, 2015 &Juniaretal., 2008**, **El-Kaiaty et al., 2002 &Metin et al., 2013**). This finding may be related to some reasons such as; Moringaolifera leaves and fenugreek seeds facing the negative impact of heat stress on walk activity, crouching; panting; feed \ drinking ratio and yawing which reflected mainly by bird back to nearly normal behavior in feed intake leading to good body weight; also, Moringaolifera had low anti-nutritional compounds level and high total soluble protein makes it more suitable to feed by poultry (**Kakengi et al., 2007**); whereas Fenugreek seeds contain galactomannan which consider appetizer and stimulate digestion process (**Alloui et al., 2012**). Also, it was reported that it improve the feed intake and the body weight and broiler performance due to their content of both essential fatty acids and high quality proteins.**(Hind et al., 2013)**

The significant increase effect of fenugreek seeds on body gain was in agreement withfinding of **Magda Elbushra, (2012**) Moreover, the significant decrease effect of fenugreek seeds and yeast on feed conversion ratio was previously finding by **Tariq et al., (2014)** and **Abd El-Azeem,** (**2002**) respectively. Also, fenugreek seeds havea significant positive effects on digestibility and absorption of nutrients that is reflected as improvement in body weight gains. **(EL-Mallah et al., 2005)** also,its lead to significant increase in T_3 and T_4 and growth hormone level which in agreement with previous finding of (**Azouz, 2001**). This result may be related to the fenugreek seeds may stimulate the thyroid gland directly as T_3 and T_4 of serum increased significantly (**Hassan, 2000**).

On the other hand, the positive effect of fenugreek on FCR may be related to the effective content of the essential oil in fenugreek,trigonellinethat has antioxidant,antiviral, and antifungal activities**(Mazur et al., 1998)**. While yeast cell wall components (β-glucans and α-mannans) which provide greater villus height and size, alsoboth contents have protect intestinal mucosa through decrease pathogens load orpreventing it from attaching to villi this mainly decrease the pathogen load in intestine and guard the health status of mucosa, this mode of action lead to improved FCR. **(Zhang et al., 2005)**

Squabs fed diet containing Moringaolifera leaves or fenugreeks seed or yeast have the lowest number of total aerobic count of small intestine than the heat stress group this finding was agreed with previous finding of **Sahar et al., (2014); Adil et al., (2015) and Rima et al., (2012)** respectively.

This may be due its antibacterial and antifungal activities and hepatoprotective effect of Moringa (**Bennett et al., 2003**) or it may be due to, fenugreek seeds having many therapeutic effects like antibacterial, antimicrobial **(Adil et al., 2015**) and it contains pterygosperminthat has antibacterial and anti-fungal activities. While, yeasts mode of action ismainly depends on antagonismto microorganisms, through the nutrients competition;unsuitable medium for microorganisms growth viadecrease pH;ethanol production; and secretion of mycocinsthat has antimicrobial activity (**Rima et al., 2012**). A variety of indicators, including health, productivity, behavioral and physiological characteristics commonly used to reveal bird welfare. Behaviorally as drinking water, scratching, taking a dust bath and lying down are considered an important indicators of welfare of broiler. (**Pereira et al., 2005**).

All feed additives substance leading to improvement of squab's welfare during heat stressed conditionthis result may related to different reasons such as All feed additives leading to decrease duration of tonic immobility as a test of fear (the longer the more fearful more worse of bird welfare **(Jones, 1996)** andincrease A latency-to-lie (LTL) test which means decrease Leg weakness and decrease dermatitis which included because these represent 2 major welfare problems for broiler chickens, which can both be painful themselves and can lead to other welfare problems (**Bradshaw et al., 2002**).

Moringaolifera leaves and Fenugreek seeds facing the negative impact of heat stress on increased number of water intake and decreased number of feed intake and locomotors activity which resulted in worsening the welfare of birds (**Bozakova 2008**) so that, an increase in welfare index was seen.

Moringaolifera leaves and Fenugreek seeds facing the negative impact of heat stress on decreasing body weight which in linear relationship with resting and preeningbehavior **(Hocking et al., 1996)** which resulted in worsening the welfare of birds (**Bozakova 2008**) so that, an increase in welfare index was seen.

Moringaolifera leaves; Fenugreek seeds and yeast facing the negative impact of heat stress on comfort behaviors (A number of activities have been grouped together, these activities include wing / leg stretching, preening; body shaking and head scratching). These activities may serve functions as maintain plumage or stretch muscles in additional to improving physical comfort (**Black and Hughes, 1974**) which are important indicators of welfare of broiler breeders. (**Pereira et al., 2005**)

Moringaolifera leaves facing the negative impact of heat stress on increased catalase and decreasing cholesterol level and total antioxidant capacity.

Antioxidant effect of Moringaoleifera leaf may be due to the presence of polyphenols, tannins, anthocyanin, glycosides and thiocarbamates which remove free radicals, activate antioxidant enzymes and inhibit oxidase. (**Luqman et al., 2012**).while, cholesterol lowering effect due to its high fiber content (**Olugbemi et al., 2010**)

Fenugreek seeds facing the negative impact of heat stress on increasing of H\R ratio and leptin metabolites such as (glucose; cholesterol and triglycerides) which indicated to be a good quantitative measure of stress. (**Al-Azraqi, 2008**) this result was in agreement of **(Abdul-Rahman, 2012)**

The significant decreases in glucose and (cholesterol & triglycerides) level in fenugreek seeds were agreed with previous finding of (**Adil et al., 2015**). It may be due to the direct α- cell stimulation by amino acid (4-hydroxyisoleucine) present in fenugreek seeds, which increases insulin secretion, thus improves glucose tolerance (**Broca et al., 2000**). On other side, presence of saponins and resins in fenugreek which inhibit bile acid and cholesterol absorption from intestine, thereby, decreasing cholesterol level in blood (**Abaza, 2007**).

Fenugreek seeds facing the negative impact of heat stress on increased catalase and decreasing total antioxidant capacity. This result was agreed with (**Choudhary et al., 2001**) and (**Neetu et al., 2014**) respectively.

This may be due to the fenugreek seeds are rich sources of lipids, protein, mucilage, calcium, dietary fiber B vitamins, Iron, protease inhibitors and several steroid saponins, tiny amounts of alkaloid, furostanol glycosides; steroidal peptide and flavonoids, especially naringenin. So that, it possess hypocholesterolaemic, hypoglycemic and antioxidative properties. (**Ayah and Mahmoud. 2016)**

Premix facing the negative impact of heat stress on increased catalase and decreasing total antioxidant capacity.
A significance increase in total antioxidant capacity in premix group was agreed with (**Cheng et al., 2004**).This may due to external sources of antioxidant nutrients vitamins E and C and the mineral selenium. Organic selenium is a natural seleno-amino acid (seleno methionine) which possesses antioxidant properties and improves resistance against oxidative stress and It is essential for adequate functioning of many enzymes such as, the antioxidant enzyme, glutathione peroxidase, which protects the cell against free radicals. (**Schoonheere et al., 2009**)

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