GROWTH PERFORMANCE AND HEMATOLOGICAL CHANGES OF GROWING NEW ZEALAND WHITE RABBITS FED DIETS SUPPLEMENTED WITH SOME NATURAL ANTIOXIDANTS UNDER HEAT STRESS CONDITIONS

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SUMMARY

The present study was conducted to evaluate the effects of some natural antioxidants supplements (moringa dry leaves and rosemary) to growing rabbit diets on alleviating the negative impact of heat stress on growth performance and hematological changes. In a feeding experiment lasted 63 days, forty five growing New Zealand White (NZW) rabbits aged six weeks and weighed in average 750±5.8g were randomly blocked by weight into five groups (9 animals each) and each group consists of three replicates (3 animals each), where the 1st group fed a basal ration free of moringa or rosemary dry leaves (R_1-control), while the 2nd, 3rd, 4th and 5th groups were fed respectively, on the same basal ration supplemented with 0.5% moringa dry leaves (R_2), 1%moringa dry leaves (R_3), 0.5% rosemary dry leaves (R_4) and 1% rosemary dry leaves (R_5). Temperatures have been controlled artificially to be 33.1±0.5°C, and the level of relative humidity at 43±3%. Experimental rations were offered *ad lib*. Growth performance was recorded weekly and hematology examination was evaluated at the end of the feeding experiment. The results showed that, moringa dry leaves (MDL) composition was on DM basis; 19.52% CP, 7.51% EE, 7.23% CF, 53.08% NFE and 12.66% ash and rosemary dry leaves (RDL) composition was on DM basis; 4.10% CP, 16.32% EE, 18.97% CF, 52.37% NFE and 5.24% ash. Feeding rabbits on rations supplemented with MDL or RDL did not influence body weight, weight gain, feed intake, feed conversion and drinking water. Hemoglobin, hematocrit, MCV, MCH, WBCs and neutrophils to lymphocytes ratio were improved with rations contained MDL or RDL (0.5% or 1%) than control. In addition, platelets count, neutrophils and lymphocytes were not affected by feeding treatments. Under the conditions of the present study, it is concluded that, MDL and RDL supplementation might have positive effects on growing rabbits reared under heat stress conditions when supplemented to rations at 0.5% or 1.0%.

Keywords: *Moringa, rosemary, natural antioxidants, rabbits, growth performance and hematology.*

INTRODUCTION

Oxidative stress has been long recognized to endanger cell which is associated with increments of free radicals.Reactive oxygen and nitrogen species (free radicals) are essential to detoxification, chemical signaling and immune function. They are continuously produced in the animal body and they are controlled by endogenous enzymes (superoxide dismutase, glutathione peroxidase and catalase). When there is an over-production of these species, an exposure to external oxidant substances or a failure in the defense mechanisms, damage to valuable biomolecules (DNA, lipids, proteins) may occur (Aruoma, 1998). This damage has been associated with an increased risk of cardiovascular disease, cancer and other chronic diseases.Antioxidants are molecules that neutralize free radicals mainly by scavenging them and converting them to stable form, thereby preventing or slowing down the deleterious effect of these reactive species to the cellular components. The antioxidant hypothesis says that 'as antioxidants can prevent oxidative damages, increased intakes from the diet will also reduce the risks of chronic diseases' (Stanner*et al.*, 2004).Antioxidants also can control thedegenerative diseases where the oxidative damage has been implicated.

A major strategy to reduce the effect of heat stress on animals is to alter the environment through the use of sheds, fans or evaporative cooling (Bucklin *et al.*, 1991). Such practices are sometimes not possible or highly expensive. This necessitates trying other strategies to counteract the adverse effects of heat stress such as supplementation of natural antioxidants to animal diets. Several plant extracts and different classes of phytochemicals have been shown to have antioxidant activity (Zheng and Wang, 2001). The search for newer natural antioxidants, especially of plant origin, has ever since increased.

Moringa oleifera (The Miracle Tree) is the most widely cultivated species of the genus moringa. *Moringa oleifera* has the ability to prevent effectively, morphological changes and oxidative damage by enhancing the activities of antioxidant enzymes, reducing the intensity of lipid peroxidation and reducing generation of free radicals (Sreelatha and Padma, 2009).*Moringa oleifera* leaves have multiple antioxidants with high levels such as phenolic acids (Gallic, chlorogenic, ellagic and ferulic acid), glucosinolates and flavonoids (kaempferol, quercetin and rutin) Mbikay (2012).Furthermore, moringa dry leaves have been reported to be a valuable source of â-carotene (precursorof vit. A) and vitamins (B-complex, C, D and K) DorgaandTandon (1975). Moringa dry leaves have positive effects on hematological measurements of rabbits (ChinweandIsitua, 2010). Recently, El-Badawi*et al.* (2014) reported that improvement in nutrients digestibilities, dietary N utilization, growth performance and carcass dressing percentage have been recorded for growing rabbits fed diets supplemented with moringa dry leaves by levels 0.15% and 0.30%, while adverse effects have been established by using 0.45%.

Rosemary (*Rosmarinusofficinalis*) is herbal plant have needle-like leaves and white, pink, purple, or blue flowers, native to the Mediterranean region.Through natural antioxidants, rosemary has been clearly accepted as one of the species with the highest antioxidant activity (Peng *et al.*, 2005). The chemical analysis of rosemary showed that it has several types of antioxidants including flavonoids such as carnosol, carnosic and rosmarinic acid, and volatile oils (Okamura *et al.*, 1994; Angelini*et al.*, 2003).

So, this study was conducted to investigate the impact of supplementing diets of growing rabbit with natural antioxidants such as moringa or rosemary dry leaves on growth performance and hematological changes under heat stress conditions.

MATERIALS AND METHODS

The present study was carried out at the rabbits breeding farm (station) and the Poultry Physiology Laboratory, Poultry Production Department, Faculty of Agriculture, Ain Shams University, and Animal Production Department, National Research Centre, during the period from January to April 2014.

Plant Collection and Preparation:

Moringa oleifera leaves were collected from a private commercial farm cultivated solely with moringa shrubs over an area of 10 feddans (42000 m^2 area). The farm is located in Nubariaprovince (160 km North Western Cairo city, Egypt). Rosemary (*Rosmarinusofficinalis*) leaves were collected from private plantation located in Shubra El-Kheima (north of Cairo city, Egypt). The leaves of moringa and rosemary were harvested, air-dried under shade until the moisture of collected leaves reached almost 10%. The dry leaves were finally milled, sieved (1 mm mesh) and stored in a well tight polyethylene bags at room temperature 25°C. Composite samples of moringa and rosemary dry leavespowder were taken in sample plastic bag for chemical analysis.

Rabbit Rations:

Five batches of rabbits ration each of 100 kg were formulated to contain; 32% alfalfa hay, 21% soybean meal (44%), 16% ground yellow corn, 16% barley,9.2% wheat bran, 3% cane-molasses, 1% lime stone, 0.6% Di-calcium phosphate, 0.5% sodium chloride, 0.5% vitamin & mineral premix and 0.2% Methionine. Moringa and rosemary dry leaves powder were added and thoroughly hand mixed with other feed ingredients of each batch at 0, 0.5% moringa, 1.0% moringa, 0.5% rosemary and 1.0% rosemary for R_1 (control), R_2, R_3, R_4 andR_5 respectively. Experimental rations were pelleted at 0.3 cm diameter and packed in polyethylene bags until feeding. Maximum pelleting temperature was not more than 65°C.

Climatic Management:

Electrical heaters have been used to control the temperature inside the station at 33.1±0.5°C, and the level of relative humidity at 43±3%. Temperatures and relative humidity levels were recorded daily using digital Hygrometer.

Procedures of the Feeding Experiment:

In a feeding trial lasted 63 days, forty five male growing New Zealand White rabbits (NZW) aged six weeks old with an average body weight of 750.0±5.8g were distributed by weight in five equal groups. Experimental rabbits,within groups, have nearly similar initial body weights and they were housed in galvanized metal wire cages equipped with feeding and water troughs.The first group of animals was fed R_1 (free moringa or rosemary ration-control) while 2^{nd}, 3^{rd}, 4^{th} and 5^{th} groups fed R_2, R_3, R_4 and R_5, respectively. Feed was offered *ad-libtum*and water was free choice during the experimental period. Amounts of drinking water were daily measured and individual body weight was weekly recorded.

Slaughter Technique:

After termination of the feeding experiment, three representative rabbits randomly taken from each group were fasted for 12 hrs. then weighed and slaughtered. During bleeding, the drained blood was collected in heparinized tubes for hematology examination.

Chemical Analysis:

Chemical composition of experimental diet, moringa dry leaves and rosemary dry leaves were analyzed according to standard methods described by (AOAC, 2005) includes; moisture, organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE) and ash. While, the nitrogen free extract (NFE) was calculated by difference.

Statistical Analysis:

Collected data were subjected to the analysis of variance by using the General Linear Models Procedure (GLM) of the Statistical Analysis System (SAS, 1998) according to the following model:

$$Y_{ij} = \mu + T_i + \varepsilon_{ij}$$

Where: Y_{ij}= the j observation on the i^{th}treatments;

μ= overall mean;

T_i= a fixed effect of i^{th} treatments;

ε_{ij}= a random experimental error.

Differences among treatment means were detected by using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Weekly averages of temperature degrees and relative humidity are shown in Table (1). The relationship between temperature and relative humidity termed temperature-humidity index (THI). This parameter indicates the presence of heat stress or not. THI had been modified by **Marai*et al.* (2001)** to be suitable for rabbits (as small animals) and was calculated as

$$THI = db°C - [(0.31 - 0.31RH) (db °C - 14.4)]$$

Where db °C =dry bulb temperature in degrees Celsius and RH=relative humidity percentage/100. The values obtained are then classified as follows: <27.8=absence of heat stress, 27.8–28.9=moderate heat stress, 28.9–30.0=severe heat stress and 30.0 and more=very severe heat stress. In the present study, overall averages of temperature and relative humidity were 33.1°C and 43%, respectively. Calculated THI in present study was 29.80 indicated that the rabbits were reared under severe heat stress.

Table (1). Average of temperature degrees (°C), relative humidity (%) and THI through experimental period.

Period	Temperature	Relative humidity	THI
1st week	33.2	41	29.76
2nd week	32.8	44	29.61
3rd week	33.5	42	30.07
4th week	32.8	46	29.72
5th week	32.8	44	29.61
6th week	33.4	42	29.98
7th week	33.5	42	30.07
8th week	32.7	44	29.52
9th week	32.9	46	29.80
Overall	33.1	43	29.80

***Chemical Analysis**:*

Results of chemical analysis in Table (2) showed that moringa dry leaves had high contents of CP (19.52%), EE (7.51%), ash (12.66%) and NFE (53.08%) but low content of CF (7.23%). Also, the chemical composition of rosemary dry leaves had high contents of CF (18.97%), EE (16.32%) and NFE (52.37%) but low contents of ash (8.24%) and CP (4.10%). previous studies reported different chemical contents of moringa leaves. Ilyas*et al.* (2015) found that the moringa dry leaves had high percentage of CP (28.11%) and CF (19.61%) & low content of EE (2.82%) and NFE (38.97%). Also, El-Badawi*et al.* (2014) showed that moringa dry leaves had a high level of CP (31.68%), EE (8.78%) & ash (14.88%) and low content of CF (6.41%) & NFE (38.25%). Similar to the results of present study, Ogbe and Affiku (2011) showed that moringa dry leaves had CP (17.01%), CF (7.09%), EE (2.11%) and ash (7.93%). Different values of chemical analysis of moringa dry leaves in multiple studies could have been referred to the differences in climatic conditions, genetic reasons and the type of soil. Generally, previous studies confirmed that moringa leaves have a high content of CP and minerals needed by humans and animals for growth and better health.

Table (2). Chemical composition of experimental ration, moringa dry leaves and rosemary dry leaves.

Item	Experimental ration	Moringa dry leaves	Rosemary dry leaves
Moisture, %	9.04	7.92	7.69
DM composition, %			
OM	89.47	87.34	91.76
CP	16.81	19.52	4.10
CF	8.42	7.23	18.97
EE	3.79	7.51	16.32
NFE	60.45	53.08	52.37
Ash	10.53	12.66	8.24

As the present study, Ghazalah and Ali (2008) found that rosemary leaves had CP (5.12%), CF (19.40%), EE (15.40%), ash (7.06%) and NFE (44.52%). Few studies that analyzed the chemical components of rosemary leaves, given the most attention directed to the oils extracted from the leaves because it has a high content of antioxidants.

Chemical composition of experimental ration shown in Table (2) illustrated that the ration contained CP (16.81%), CF (8.42%), EE (3.79%) and ash (10.53%), and it was within the limits recommended by the NRC (1977) for rabbit's nutrition.

Growth Performance: Body weight gain, average daily gain (ADG), feed intake and feed conversion ratio of rabbits fed experimental rations are shown in Table (3). There are no significant differences between the experimental groups, but the data mentioned that there is a numerical increase in final weight and body weight gain of R_2 and R_3 groups compared with the control group (R_1), while there is a numerical decrease

in R_4 and R_5 groups compared with control. Feed intake and feed conversion ratio (FCR) had no significant differences among the experimental groups, howeverR_2 and R_3groups have the best numerical value of FCR compared with other groups. El-Badawi *et al.* (2014) showed that weight gain and average daily gain of rabbits fed 0.15 and 0.30% moringa supplemented rations were higher (P<0.05) than those fed 0% or 0.45% moringa rations, the feed conversion was of lower (P<0.05) values for rabbits fed 0.15% and 0.30% than those fed 0% and 0.45%. In the same trend, Banjo (2012) reported that inclusion of moringa significantly (P<0.05) enhanced weight gain of birds at 2% level of inclusion but did not affect feed intake or feed conversion ratio. El-Tazi (2012) showed that broiler chicks fed on 5% moringa oleifera leaves meal (MOLM) diet scored heaviest body weight, highest total feed intake with the best feed conversion ratio compared with birds fed on 0, 3 and 7% MOLM. The previous studies did not mention any adverse effect on growth rate with increasing moringa replacement levels. Currently we are in need of further studies so that we can know the exact contents of the moringa so we can understand the different effects on the animal's performance.

Table (3). Growth performance and water consumption of experimental groups.

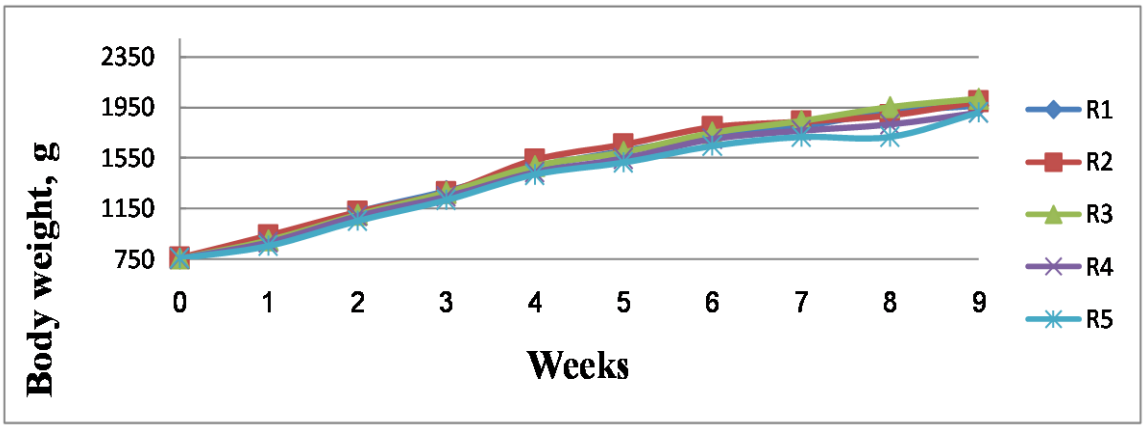
Item	Experimental groups					SEM	Significancy
	R1	R2	R3	R4	R5		
Initial weight, g	755	757	752	751	755	5.8	NS
Final weight, g	1962	2020	2020	1911	1907	142.5	NS
Body weight gain, g	1207	1263	1268	1160	1152	121.5	NS
Average daily gain, g	19.2	20.1	20.1	18.4	18.3	2.2	NS
Feed intake, (g/animal)	4502	4130	4603	4559	4378	340	NS
Feed conversion	3.73	3.27	3.63	3.93	3.80	0.30	NS
Drinking water, ml	340	378	444	350	415	80	NS
Drinking water of DM intake, ml/g	4.47	4.32	4.05	4.84	4.11	1.37	NS

SEM=Standard error of means
NS= non-significant

Ghazalah and Ali (2008) reported that broiler chicks fed 0.5% rosemary leaves meal exhibited higher body weights, greater weight gain and better feed conversion compared with chicks fed 1% or 2% rosemary leaves meal. Like our study findings, Erdelyi *et al.* (2008) showed that rosemary oil supplementation to growing rabbit diets by level of 0.15% showed some beneficial, but not statically significant effects. Although the large effect of rosemary leaves on hematological status asit will be shown later, there is no positive effect (or negative) on growth performance of growing rabbits.

The response of rabbit'sbody weight to rations supplemented with moringa or rosemary was observed during the last three weeks of feeding (Figure 1). Body weight development curve showed clear positive effect of feeding R_2 and R_3 (0.5% & 1% moringa, respectively), while with rosemary supplementation R_4 and R_5 (0.5% & 1% rosemary, respectively) there was slight decrease (non-significant) in body weight development especially in the last two weeks of the feeding experiment.

Figure (1): Body weight development of rabbits fed experimental rations.



Dietary treatments had no significant effect (P>0.05) on drinking water or drinking water relative to DM intake (ml/g), however there was a slight increase in volume of drinking water with the high levels of supplementation either moringa or rosemary (R_3& R_5). Studies about the effect of moringa or rosemary supplementation on water consumption are few. El-Badawi *et al.* (2014) mentioned that drinking water relative to DM intake (ml/g) was significantly (P<0.05) lower for rabbits fed 0.30% or 0.45% moringa supplementation in comparison to control (0% moringa) and 0.15% moringa ration.

Generally, values of drinking water in this study were higher than the normal rates of rabbits that reared under normal conditions. These results were in agreement with those reported by Marai *et al.* (2002) who found that rabbits exposed to environmentalorbiological stresses decreased their feed intake, feed utilization and increase water retention particularly in hot climatic conditions. Also, Habeeb *et al.* (1997) showed that the daily water consumption of New Zealand White rabbit recorded 331±6 ml/animal under summer conditions of Egypt.

Hematological Examination:

Hematological parameters ofslaughtered rabbits in experimental groups are presented in Table (4). Hemoglobin values showed significant (P<0.05) increase in R_3, R_4 and R_5groups (13.83, 14.60 & 15.53 g/dl, respectively) compared with the control one (R_1). The highest values of hemoglobin have been observed in rabbits fed diets supplemented with rosemary.The count of red blood cells (RBCs) has been differed significantly (P<0.05) among experimental groups. The lowest value of RBCs has been recorded in group fed diet supplemented with 1% rosemary (R_5), while the highest value was recorded for control group (R_1). Data showed in Table (4) indicated that hematocrit %, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), white blood cells (WBCs) and neutrophils to lymphocytes ratio (N/L) have been differed significantly (P<0.01) among experimental groups. Mean corpuscular hemoglobin concentration (MCHC), platelets count, neutrophils, lymphocytes, monocytes, basophils and eosinophilswere not significantly affected among experimental groups.

Table (4). Blood hematology of slaughtered rabbits in experimental groups.

Item	Experimental groups					Normal range***	SEM	Sig.
	R1	R2	R3	R4	R5			
Hemoglobin, (g/dl)	12.86^{c}	13.60^{bc}	13.83^{abc}	14.60^{abc}	15.53^{ab}	11.5–15.1	1.28	*
RBCs, ($\times10^6$/µl)	6.03^{a}	5.47^{ab}	5.06^{abc}	5.65^{ab}	4.28^{c}	3.7–7.5	0.62	*
Hematocrit, %	41.6^{d}	43.8^{cd}	44.5^{cd}	46.8^{bcd}	53.7^{a}	36.6–47.4	3.5	**
MCV, mm^3	69.36^{b}	80.13^{b}	91.13^{b}	82.83^{b}	125.53^{a}	58-79.6	11.65	**
MCH	21.43^{b}	24.86^{b}	28.30^{b}	25.83^{b}	36.30^{a}	19.2-29.5	3.85	**
MCHC	32.33	32.20	32.13	32.03	34.70	31.1-37.0	1.11	NS
Platelets	191	310	254	193	189	112-795	86	NS
WBCs ($\times10^3$/µl)	15.03^{a}	8.47^{bc}	8.40^{bc}	6.70^{c}	9.27^{bc}	5.2–16.5	1.45	**
Neutrophils, %	36.00	27.67	28.00	29.00	26.67	34-70	7.04	NS
Lymphocytes,%	60.67	68.67	67.00	68.00	70.00	43-80	6.93	NS
Monocytes, %	1.33	1.33	2.00	1.00	1.33	0-4	0.44	NS
Basophils, %	1.00	1.00	1.00	1.00	1.00	0-0.84	0.22	NS
Eosinophils, %	1.00	1.33	2.00	1.00	1.00	0-2	0.85	NS
N/L ratio	0.59^{a}	0.40^{b}	0.42^{b}	0.43^{b}	0.38^{b}	0.55	0.04	**

*a, b,c and d Means in the same row having different superscripts are significantly different; * P≤ 0.05, ** P≤ 0.01, NS= non-significant; SEM=Standard error of means; *** According to Hewitt et al., (1989) & Thrall et al., (2012).*

Unlike our observation, Nuhu (2010) stated that offering weaned rabbits a diet containing moringa leaf meal had no significant (P>0.05) effect on hemoglobin, packed cell volume, red blood cells and white blood cells.On the same side, Ewuola *et al.* (2012) reported that inclusion of MOLM to rabbit diets has no significant effect on hematocrit, RBCs, WBCs, MCV and hemoglobin.Also,European Food Safety Authority (2008) reported that the effect of adding rosemary leaves extract to diets of rats has no significance changes in hematology parameters, and no microscopic changes. In addition, Al-Shuwaili

(2014) did not find any significant difference in hematocrit, WBCs, RBCs and hemoglobin of broiler chickens that fed on diets supplemented with 0.5% rosemary dry leaves.

On the other hand, our findings werein agreement with Ebenebe *et al.* (2012) who reported that adding rabbit rations with MOLM resulted in obvious increase of hemoglobin and hematocrit, and significant decrease in WBCs. Onu and Aniebo (2011) stated that inclusion of MOLM in starter broiler diets resulted in improvement of hematocrit, MCV and hemoglobin.

It is possible that, the beneficial effect of supplementing moringa to rabbit diets due to the presence of a high content of phytochemical compounds acting as antioxidants, such asâ-carotene (precursor of vit. A) and vitamin C. Although the number of RBCs decreased among groups compared with the control one, the hemoglobin level has been increased and this is due to the impact of both of moringa and rosemary to increase the volume of red blood cells (MCV) which increases the synthesis of hemoglobin and transportation of oxygen necessary for the metabolism.

CONCLUSION

Under the conditions of the present study, it could be concluded that inclusion of *Moringa oleifera* dry leaves or rosemary dry leaves in growing rabbit rations as a natural source of antioxidants is recommended to improve hematological status without adverse effects on growth performance. More future studies are needed to understand complete effects and proper supplementation dosage of moringa and rosemary leaves in rations of rabbits.

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أداء النمو والتغيرات الهيماتولوجية للأرانب النيوزيلندي البيضاء النامية المغذاة على علائق مضاف اليها بعض مضادات الأكسدة الطبيعية تحت ظروف الاجهاد الحراري.

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أجريت هذه التجربة لتقييم تأثير إضافة بعض مضادات الأكسدة الطبيعية مثل مسحوق أوراق المورينجا ومسحوق أوراق اكليل الجبل الى علائق الارانب النيوزيلندي النامية والمرباة تحت ظروف الاجهاد الحراري وذلك على أداء النمو والتغيرات الهيماتولوجية. استخدم في هذه التجربة عدد 45 أرنب نيوزيلندي في عمر ستة أسابيع بمتوسط وزن جسم حي 750±5.8 جرام، تم تقسيم الحيوانات إلى خمس مجاميع تجريبية متساوية على النحو التالي: المجموعة الأولى كانت للمقارنة، المجموعتين الثانية والثالثة تم تغذيتهم على عليقة المقارنة مضافا اليها مسحوق اوراق نبات المورينجا بنسبة 0.5% و1.0% على الترتيب، المجموعتين الرابعة والخامسة تم تغذيتهم على عليقة المقارنة مضافا إليها مسحوق أوراق نبات اكليل الجبل بنسبة 0.5% و1.0% على الترتيب. التغذية تمت بحرية ومياه الشرب كانت متاحة بحرية للحيوانات طوال فترة التجربة التي استمرت لمدة تسع أسابيع، وتم التحكم في درجة الحرارة المحيطة باستخدام دفايات كهربائية لتصبح بمتوسط 33.1 ±0.5°م بالإضافة الى مستوى رطوبة نسبية 43±3% طوال فترة التجربة. تم تسجيل قياسات النمو أسبوعيا طوال فترة التجربة كما تم اجراء اختبارات فحص الدم في نهاية فترة التجربة. أظهرت النتائج أن مسحوق أوراق المورينجا يحتوي على 19.52% بروتين خام، 7.51% مستخلص ايثيرى و7.23% ألياف خام كما أن مسحوق أوراق اكليل الجبل يحتوي على 4.1% بروتين خام، 16.32% مستخلص ايثيرى و18.97% ألياف خام وذلك على أساس المادة الجافة. وأظهرت أهم النتائج المتحصل عليها أنه لم تؤثر المعاملات المختلفة في وزن الجسم الحي أو معدل الزيادة الوزنية للمجموعات التجريبية المختلفة. كما أظهرت النتائج وجود تحسن رقمي في معدل استهلاك الغذاء ومعدل تحويل العلف للمجموعات التجريبية المغذاة على علائق مضاف اليها أوراق المورينجا مقارنة بمجموعة المقارنة، كما أنه لم تؤثر المعاملات التجريبية على معدلات استهلاك مياه الشرب للمجاميع التجريبية المختلفة. وعلى مستوى التغيرات الهيماتولوجية فقد وجد ارتفاع معنوي في مستوى الهيموجلوبين للمجموعات التجريبية حيث تم ملاحظة أفضل المستويات للمجموعة المغذاة على مسحوق أوراق اكليل الجبل بنسبة 1%. كما أظهرت النتائج حدوث انخفاض معنوي في عدد كرات الدم البيضاء والحمراء للمجموعات التجريبية المختلفة مقارنة بمجموعة المقارنة، بالإضافة الى حدوث انخفاض معنوي في نسبة الخلايا المتعادلة الى الخلايا الليمفاوية للمجموعات التجريبية المختلفة حيث أن أعلى القيم تم تسجيلها في مجموعة المقارنة. نستخلص من هذه النتائج أنه تحت ظروف هذه التجربة فإن اضافة علائق الأرانب النامية بمساحيق اوراق المورينجا أو اكليل الجبل بنسبة 0.5% أو 1.0% من الممكن ان تستخدم لتحسين خواص الدم وبالتالي مقاومة اثار الإجهاد للأرانب النامية المرباة تحت ظروف الاجهاد الحراري، بدون أي آثار سلبية على مستوى الأداء الإنتاجي.