The 7th International Conference On Rabbit Production In Hot Climate, 8-12 September, 2014, 375-393

EVALUATION OF ADDING MORINGA AND ROCKET SEEDS OILS IN THE DIET ON PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF RABBITS UNDER HOT CLIMATIC CONDITIONS

W. Ezzat [1] ; Saher, M. M.[2] ; Ragaa E. Abd El-Karim[2] and M. M. Shehata[2]
1. Poultry Breeding Department, Animal Prod. Res. Inst., Agric. Res. Cent., Egypt.
2. Poultry Nutr. Department, Animal Prod. Res. Inst., Agric. Res. Cent., Egypt.

ABSTRACT:

A completely randomized design was conducted to investigate the effect of addition of moringa (Moringa oleifera) or rocket (Eruca Sative) seeds oils or mixture of these oils in the diet of New Zealand White (NZW) rabbits on their productive and reproductive performance traits under climate summer conditions of Egypt, started in June *to* August, *2013. Digestibility coefficients and nutritive values, milk yield, some blood serum constitutes and economic efficiency, semen characteristics of buck and their offspring performance were estimated. A total number of 48 NZW rabbit does (6 months old) and 12 bucks (6 month old) with nearly similar weights were divided at random into four groups (12 does and 3 bucks in each). Rabbits were fed either basal diet (Control) or basal diet supplemented with 1.5 g in each of moringa oil /kg diet, or rocket oil or combination of both oils. The experiment lasted during the hot summer conditions of Egypt.*

Results showed that *percentages of mono-unsaturated fatty acids were higher in moringa oil than in rocket oil. The percentage of saturated fatty acids was higher in rocket oil than moringa oil, while moringa oil had a minute content of polyunsaturated fatty acid (PUSFA), whereas rocket oil had a high content of PUSFA as linoleic acid. Does fed combination of moringa oil plus rocket oil diet recorded the highest ($P < 0.05$) values of feed intake, final body ,weight, gain, conception rate, number of parturition, litter size, litter weight, litter weight gain at birth and at weaning. Digestibility coefficients of CP and EE, nutritive value expressed as DCP, average daily milk yield during different lactation weeks and feed conversion ratio to milk production were the highest ($P \leq 0.05$) with rabbits fed combination of moringa plus rocket oils diet in most weeks of lactation. Bunny's weight at weaning, weight gains were the highest ($P < 0.05$) for does fed rocket oil diet. Mortality rate (%) at birth and during lactation period, blood serum cholesterol, triglycerid and LDL recorded the lowest ($P < 0.05$) values with does received combination of moringa and rocket oils diet. Sperm cell concentration, and percentages of sperm motility and dead spermatozoa improved significantly ($P < 0.05$) by feeding buck rabbits rocket oil diet or moringa plus rocket oils diet, being the best for those fed rocket oil diet when compared the control group. Rabbits fed moringa plus rocket oils diet recorded the highest net return and best economic efficiency followed by those fed moringa oil diet.*

Conclusively, *results of the experiment concluded that addition of 1.5 g/Kg diet mixture of moringa and rocket oils were more effective than other treatments for improving productive and reproductive performance traits, digestibility coefficients and nutritive values, milk yield of NZW doe and buck rabbits under hot climatic condition of summer season in Egypt.*

Keywords: Moringa oil, rocket oil, fatty acids, digestibility coefficients, blood & semen characteristics, economic efficiency.

INTRODUCTION

Rabbits are very susceptible to heat stress, since they have few functional sweat glands and have difficulty in eliminating excess body heat, when the environmental temperature is high (Marai *et al*., 2002). The endocrine system plays an integral part in the animal's response to stress (Ayyat *et al.*, 2004). Many studies have suggested that hyperthermia associated with heat stress (HS) has been proven that energy from nutrient intake is critical because of the decline in feed intake that occurs (Hahn *et al.*, 2003 and Al-Shukri , 2011), also milk has a lower solids content (Belic *et al.*, 2011) High environmental temperature induces physiological stress in rabbits leading to production losses (Marai *et al.*, 2001). Also because of poor thermoregulation ability of rabbits, some consequences of heat stress affect digestive system functions, with impaired appetite, growth and feed conversion, with increased disease incidence (Bani *et al.*, 2010). High mortality percentages and reduced fertility were recorded with rabbits exposed to high environmental temperature due to the heat stress which cause a weakness of rabbits and changes in their biological function (Okba *et al*., 2008) and disorders of spermatogenesis and semen quality, ejaculatory disturbances and reproductive failure in male. The male with reduced fertility posses serious problems and causes economical losses to breeders and artificial insemination industry. Failure to ovulate after copulation is one of the major factors in the rabbit's infertility. Unfortunately, rabbit productivity and reproductively are deleteriously affected by improper management, especially, during hot climates. (Rowida Riad *et al.*, 2010).

Several methods are available to alleviate the negative effects of high environmental temperature, such methods are mostly focused on the natural products since these products have served as an important source of drugs since ancient times and a significant part of today's drugs are somehow derived from natural sources, therefore, many people in developing countries use traditional drugs derived from medicinal plants to meet their primary health care needs (WHO, 2002). Moreover, many attempts have been done to overcome the adverse effects of heat stress by modifying environmental condition through nutritional, managerial and physiological manipulation of rabbits (Selim *et al.*, 2003). Some of them may cause unfavorable effects such as chemical products (antibiotics and hormones) and medicinal herbs. Moringa seeds oil is known for its Anti-bacterial, anti-inflammatory, antihypertensive, antiepileptic, antioxidant, antifungal and antipyretic (Rajib Singha, 2010).

Adding moringa seeds oil or rocket seeds oil as medicinal plant oils in the diet were found to be effective in alleviating the heat load of rabbits (Shehata *et al.*, 2011 and Ojiako and Okeke, 2013). Rabbits require fat and oil in its diet as sources of essential fatty acids and facilitate supply and absorption of the fat soluble vitamins (Clarke *et al.*, 1977). Moringa seeds oil contains all the fatty acids as in olive oil, except linoleic acid (Morton, 1991).

Therefore, the present study was carried out to determine the effect of adding 1.5 g/Kg diet of either rocket or moringa seeds oils or combination of both oils to commercial rabbit ration on productive and reproductive performance of NZW does and their offspring as well as productive performance of bucks under hot climatic conditions.

MATERIALS AND METHODS

The present study was carried out at Sakha Research Station, Animal Production Research Institute, Agricultural Research Center, Egypt. The experiment lasted from June to August, 2013. The aim of this study is to investigate the positive effects of moringa and rocket seeds oils or mixture of them as supplements in the diets on productive and reproductive performance traits of doe and buck adult New Zealand White (NZW) rabbits. Digestibility coefficients and nutritive values, some blood serum constitutements and economic efficiency and semen characteristics of bucks were also evaluated. Rabbits were fed either basal diet (Control) (T_1) or basal diet supplemented with 1.5 g moringa seeds oil /kg diet (T_2) , or rocket seeds oil (T_3) or mixture of both oils (T_4) , respectively on productive and reproductive performance traits of doe and buck adult New Zealand White (NZW) rabbits. A total number of 48 adult NZW rabbit doe and 12 NZW bucks (6 month old) with nearly similar weight, were divided at random into four equal experimental groups (12 does and 3 bucks in each).

The basal diet was formulated to be isonitrogenous (18.5% CP) and isocaloric (about 2401 kcal DE /kg) according to the recommendations of Agriculture Ministry Decree (1996) for pregnant does and bucks rabbits. Formulation and chemical composition of the experimental diets according to NRC (1977) are presented in Table 1. Rabbits in all experimental groups were fed *ad. Libitum* and water was available through water nipple in each cage. Urine and faeces dropped from the cages to the floor and were cleaned daily. Cage of each doe was provided with a metal nest box for kindling. Each buck was mated for 1-4 does of the same breed and each doe was palpated 10 days post-mating, to detect pregnancy. The doe rabbit, which failed to conceive was returned to the same mating buck. Bunnies were deprived from suckling for 24 h by separation between the mother and the litters, thereafter, the bunnies were allowed to suckle their mothers. Bunnies were weaned at 28 days of age.

All rabbits were kept under the same managerial and hygienic conditions in each period. The averages minimum and maximum ambient temperatures ranged between 23.93 and 34.84 ^{0}C, relative humidity from 31.77 to 81.22% and temperature-humidity index (THI) from 21.92 to 33.62% under Sakha, Kafr-El-Shikh Governorate located in the far north of Egypt (31.07°N) as show in Table 2. THI was estimated according to the formula by Marai *et al.* (2001) as follows:

Table (1): Formulation and chemical composition of the experimental diet.

Ingredient	%	Calculated analysis[2] (DM, %)	%
Berseem hay	34.00	Crude protein (CP)	18.55
Barley	11.09	Ether extract (EE)	2.70
Wheat bran	18.15	Crude fiber (CF)	12.21
Yellow corn	9.76	Calcium, %	1.10
Soybean meal 44%	22.00	Total phosphorus, %	0.60
Molasses	2.50	Methionine	0.42
Dicalcium phosphate	1.20	Lysine	0.84
Limestone	0.50	Digestible energy (kcal/kg)[3]	2402.60
DL-Methionine	0.20	Cost (LE) / 100 kg	230.00
Vit. and Min. Premix[1]	0.30	-	-
Salt (NaCl)	0.30	-	-

1**. Each 3 kg Vitamin and Mineral premix provides**: Vit. A 12000000 IU, Vit. D_3 750000 IU, Vit. E 10000 mg, Vit. K 2000 mg, Biotine 50 mg, Folic acid 1000 mg, Choline choloride 500 mg, Selenium 100 mg, Manganese 25 gm, Zinc 50 mg, Fe 60 mg, Cu 2.5 mg, Co 6 mg, Iodine 1 gm and Carrier $CaCo^3$ to 3000 gm.
2. According to feed composition tables for Animal and Poultry Feedstuffs used in Egypt (2001).
3. Calculated according to De Blas and Mateos (1998)

Table (2). Microclimatic data during the whole experimental period, under environmental condition.

Summer months	Averages temperature(^{0}C)		Averages RH (%)		Averages (THI)	
	Min*	Max**	Min*	Max**	Min*	Max**
June	23.37±0.32	34.90±0.61	30.20±1.45	80.67±1.84	21.30	33.34
July	23.67±0.10	33.87±0.22	31.33±1.21	81.47±1.07	21.79	32.85
August	24.77±0.11	35.77±0.26	33.77±1.30	81.53±1.35	22.67	34.68
Average	**23.93±0.13**	**34.84±0.25**	**31.77±0.78**	**81.22±0.84**	**21.92**	**33.62**

$$THI=db^0C-\{(0.31-0.31\ RH)\ (db^0C\ -14.4)\},$$

Where db^0C = Bulb temperature in Celsius and RH= RH%/100.

Samples of the different oils were taken to determine the fatty acids composition by using the gas-liquid chromatography (Model: Variant 3300; column ov. 101; temperatures of the column, injector and detector were 200, 280 and 240 °C, respectively). Fatty acids were identified by composition of retention times with standers and expressed as percentages of fatty acid methyl ester distribution. Percentages of identified fatty acids were determined by using of digital "Ushikata planimeter (Model DIGI PLAN 220P). The analysis of fatty acids was performed in the Laboratory of Department of Natural Products Chemistry, National Research Center, Dokki, and Cairo, Egypt.

Number of doe copulated, conception rate (%), parturition, litter size at birth (LSB) and litter size at weaning (LSW), litter weight at birth (LWB), litter weight at weaning (LWW), feed intake for does and bunny , bunny weight at birth (BWB), weaning (BBW), mortality rate at birth and pre-weaning mortality rate were recorded. Milk yield at 1^{st}, 2^{nd}, 3^{rd}, 4^{th} week of suckling was estimated using the weight-suckle-weight technique described by Lukefahr *et al.*, 1983. Separation of young from their does was carried out 12 hours before suckling according to dam litter separation method. After

that, the young were allowed for suckling their mothers. The differences between body weight of the young before and after suckling equal milk yield.

Feed conversion ratio was estimated as kg total feed intake/ kg total milk yield during lactation. During sucking weeks, milk intake at the first three successive days with each week was determined by the difference in LBW of bunnies before and after suckling.

Digestibility trial was conducted using sixteen male rabbits at 6 month of age, 4 male in each treatment group. The rabbits were individually housed in metabolism cages that permit to collect faeces and urine separately. The trial lasted 9 days, 3 days as a preliminary period, followed by 6 days to quantify the daily feed intake and faeces output. Samples of daily faeces of each animal were taken and oven dried at 65 ^{o}C for 24 hours, then ground and stored in plastic bags until the end of the trial. The composite samples of feed offered and faeces output were chemically analyzed according to A.O.A.C. (2000) for crude protein (CP), ether extract (EE), crude fibre (CF), nitrogen free extract (NFE) and ash. Metabolizable energy values of the basal diet were calculated according to the equation of Kalogen (1985) as follows:

$$ME\ (Kcal/kg\ diet\ DM) = (0.588+0.164x)\ 239.$$

Where, x is a dry matter digestion coefficient of the basal diet. The total digestible nutrient (TDN) value of the diet was calculated as the sum of multiplying the digestible ether extract (EE) by the factor 2.25 and multiplying each of digestible crude protein, crude fiber and nitrogen free extract (NFE) by the factor 1.0. Gas-liquid chromatography (GLC) was used for identification of fatty acids composition of moringa and rocket seeds oils in the Laboratory of Department of Natural Products Chemistry, National Research Center, and Cairo, Egypt.

Blood samples were taken from four female rabbits at the end of experimental period from each treatment to study the influence of experimental diets on some blood constituents. Blood samples were individually taken from ear vein of each female rabbit into dry glass tube (5 ml). Blood serum was separated by centrifugation at 3000 r.p.m. for 15 minutes. Serum was separated in plastic vials and stored frozen at -20 ^{o}C until the biochemical analysis. Stored serum samples were analyzed for total protein, albumin, cholesterol, triglycerides and HDL using the suitable commercial chemical kits. Globulins were estimated by subtraction of albumin value from total protein value of each sample.

Semen was collected from each buck rabbits, one week after natural mating of the females, twice a week for three times by means of an artificial vagina using a female teaser rabbit. At each semen collection (n=5 for each buck), ejaculate volume (ml), sperm-cell concentration (x10^6 /ml), percentage of sperm motility, percentage of dead and abnormal spermatozoa were determined according to Smyth and Gordan (1967).

The data were subjected to one- way statistical analysis applying SAS program (SAS, 2003) using the General Liner Model Program (GLMP). Percentage values were transformed to Arc. Sin values before being statistically analyzed. Significant differences among treatment means were separated by Duncan's New Multiple-Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Temperature-humidity index (THI):

The temperature-humidity index (THI) estimated in Table (2) indicated exposure of the rabbits to severe and very severe heat stress, during June, July and August, respectively.

Fatty acids composition of moringa and rocket seeds oils:

Results presented in Table (3) showed that moringa seeds oil had higher content of mono-unsaturated fatty acids (MUSFAs), especially oleic acid than rocket oil. Oleic acid and other MUSFAs were in part responsible for the increase of plasma HDL (high density lipoprotein)-cholesterol and apolipoprotein B. For this reason MUFA play a role in prevention of the cardiovascular diseases (arteriosclerosis, myocardium infarct ictus, etc.), which are the main causes of mortality in the industrialized countries. Oleic acid also, reduces thrombogenesis, VII haemostatis factor, and blood platelet aggregation, contributes to the stabilization of arterial pressure and glycaemia (hematic insulin level), and even stimulates the growth of bones. Therefore, monounsaturated become of interest in product development, where oxidative stability and nutritional value are important concerns (Samah 2001).

Percentage of mono-unsaturated fatty acids was higher in moringa oil (76.07 %) than in rocket oil (60.67%). The percentage of saturated fatty acids was higher in rocket oil (27.77%) than moringa oil (23.11%), while the later had a minute content of polyunsaturated fatty acid (0.82%), whereas rocket oil had a high content of PUSFA as linoleic acid (11.21%). These results are in agreement with those reported by Somali *et al.* (1994), Samah (2009) and Shehata *et al.* (2011). These results may indicated that either moringa oil or rocket oil are good source for the essential fatty acids in rabbit diets.

Table (3): Fatty acid composition of moringa and rocket seeds oils.

Type of fatty acids	Carbon atoms	Moringa oil	Rocket oil
Saturated fatty acids (%):			
Myrstic	14:0	-	0.24
Palmatic	16:0	6.58	4.83
Stearic	18:0	5.33	0.62
Arochidic	20:0	3.44	21.56
Behenic	22:0	6.69	0.52
Lignoceric	24:0	1.07	-
Total saturated fatty acids (TSFA)		23.11	27.77
Unsaturated fatty acids (%):			
Palmitoleic	16:1	1.66	0.39
Oleic	18:1	72.42	13.19
Linoleic	18:2	0.65	11.21
Linolenic	18:3	0.17	0.35
Eicosaenoic	20:1	1.99	0.52
Erucic	22:1	-	46.57
Total unsaturated fatty acids (TUSFAs), %		76.89	72.23
Monounsaturated fatty acids (MUSFAs), %		76.07	60.67
Polyunsaturated fatty acids (PUSFAs), %		0.82	11.56
Total fatty acids (TFAs), %		**100**	**100**

Does performance traits:

Results in Table (4) indicated that dietary supplementation with either moringa or rocket seeds oils or mixture of them had positive effect on productive and reproductive performance traits of doe rabbits during the period of high ambient temperatures. Doe rabbits received oils mixture diet recorded the highest ($P<0.05$) values of final body weight and weight gain as compared to the control group. The positive obtained results can be attributed to the antimicrobial and antioxidant activities effects of moringa and rocket seeds (Haristory *et al.*, 2005, Jabeen *et al.*, 2008 and Luqman *et al.*, 2012). The increase in body weight and weight gain of the rabbits fed moringa oil may be due to that linoleic acid is a precursor of prostaglandins which plays an important role in promoting hypothalamic release of growth hormone releasing factor(Makkar and Becker, 1996). On the other hand, El-Tohamy and El-Kady (2007) showed that live body weight and daily weight gain of rabbits significantly increased by feeding diet containing 50% rocket seeds meal of dietary CP. Also, Zeweil *et al.* (2009) reported that feeding rabbits diet contained 10.5% rocket seeds meal (RSM) during the whole experimental period resulted in significant ($P<0.01$) improvement in total weight gain by 15.1% as compared to the control (1042 vs.905 g), Moreover, addition of water-cress up to 3% in rabbit diets significantly ($P<0.01$) improved body weight gain (Soad Ahmed *et al*., 2005). This may be due to that rocket seeds contain health promoting agents, including carotenoids, vitamin C, fibers, glucoerucin and flavonoids (Barillari *et al*., 2005). The major constituent of rocket seeds volatile oil is isothiocyanates, which has antioxidant, antimicrobial and anticarcinogenic activities (Haristory *et al*., 2005). In general, rocket is one of the medicinal plants known as a phrodisiac (Zohara *et al*., 1998).

Conception rate, number of parturition as well as, litter size, litter weight and litter weight gain at birth and weaning were significantly ($P<0.05$) the highest for does fed mixture of moringa and rocket oils diet as compared with other groups studied. The observed improvement in reproductive performance in terms of conception rate and litter size at birth of does fed rocket oil diet may be attributed to the higher content of TUSFAs in moringa and rocket oils, which improved reproductive performance of does than those fed the control group (Table 3). In addition, improving litter weight at weaning produced from the same does may be due to the increase of doe milk yield (Table 6). Furthermore, does fed a mixture of moringa and rocket oils diet showed significantly ($P<0.05$) the highest digestibility coefficients of CP and consequently the highest DCP content. These results are in agreement with those reported by Bassuny (1999) who found marked increase in conception rate, litter size, litter weight and gain of bunnies at birth, 21 and 28 days with the increase of DE and CP contents of the diet. Similar results were obtained by Strucklec and Kermiouner (1995).

Data concerning of average weekly or total feed consumption during different weeks of the suckling period was highest significantly ($P<0.05$) for does mixture of moringa and rocket oils diet and the lowest for groups fed moringa oil and control diets. Similar results were observed by Ibrahim (2005) when the basal diet of rabbits was

Table (4). Some productive and reproductive performance of doe rabbits fed diet supplemented with moringa or rocket seeds oils or combination of them during experimental period.

Items	Dietary groups				Sig.
	Control	Moringa oil	Rocket oil	Moringa oil + Rocket oil	
Initial weight, g	2988.83± 18.09	2964.92± 14.56	2971.58± 17.10	2980.58± 16.34	NS
Final weight, g	3651.50± 24.96^{b}	3704.58± 20.80^{ab}	3705.58± 21.33^{ab}	3749.92± 28.00^{a}	*
Weight gain of doe, g	662.67± 14.63^{b}	739.67± 13.08^{a}	734.00± 14.17^{a}	769.33± 18.59^{a}	*
Conception rate, %	74.22± 1.38^{b}	77.26± 1.45^{ab}	75.20± 1.28^{b}	79.47± 0.92^{a}	*
No. of parturitions /doe	3.58± 0.14^{b}	3.95± 0.16^{ab}	3.69± 0.12^{b}	4.18± 0.11^{a}	*
Litter size: *at birth*	7.19± 0.14^{b}	7.90± 0.16^{a}	7.69± 0.21^{ab}	7.96± 0.24^{a}	*
at weaning	6.89± 0.13^{c}	7.38± 0.16^{ab}	7.14± 0.22^{bc}	7.81± 0.10^{a}	*
Litter weight at birth,g	399.45± 7.62	428.20± 8.77	413.91± 10.26	432.66± 12.31	NS
at weaning, g	5596.47± 133.17^{c}	6083.80± 151.33^{ab}	5850.52± 199.40^{bc}	6496.16± 112.67^{a}	*
Litter weight gain (g)	5197.02± 127.83^{c}	5655.60± 145.07^{ab}	5436.61± 190.83^{bc}	6063.50± 109.25^{a}	*
Weekly feed intake (g)/doe, during lactation period					
1st wk	262.75± 4.37	260.83± 3.84	265.25± 4.78	267.33± 4.56	NS
2nd wk	311.08± 3.68^{b}	309.83± 3.33^{b}	319.67± 3.76^{ab}	324.83± 3.74^{a}	*
3rd wk	354.08± 3.85^{bc}	345.50± 4.13^{c}	366.58± 4.06^{a}	361.25± 3.83^{ab}	*
4th wk	431.92± 3.63^{c}	433.17± 4.16^{bc}	448.42± 4.35^{a}	444.33± 3.84^{ab}	*
Total feed intake (g)	9518.83± 101.55^{ab}	9445.33± 97.95^{b}	9799.42± 110.81^{a}	9784.25± 104.02^{a}	*

Means having different letters within the same row are significantly different.
= ($P<0.05$) and NS= Not significant.

supplemented with 1% rocket seeds. Moreover, Magda El-Tohamy *et al.* (2010) declared that daily feed intake by rabbits showed a significant ($P<0.01$) variation and rocket diet revealed an increment by 10.9% compared to control diet. Increasing feed consumption of rocket oil diet may be due to its beneficial effect for stimulating and activating the digestive system by improving the diet palatability and enhancing appetite (Bardley, 1992). Also, moringa has been found to exposit hypolipidaemic, anti-inflammatory, antioxidant, antimicrobial, antifungal, anti-tuberculosis and

analgesic effects. It can be exploited as a most priority candidate, for its potential to treat disastrous diseases of the modern times (Hussain *et al.*, 2014).

Digestibility coefficients and nutritive values:

The effects of dietary supplementation with either moringa and rocket oils or mixture of them on digestibility coefficients of nutrients are presented in Table 5. The digestibility coefficient of CP and EE were affected significantly (P<0.05) by dietary addition, being the highest for moringa plus rocket, followed by moringa oil diet. However, digestion of DM, OM, CF and NFE was not affected significantly by dietary addition. Also, inclusion of moringa oil or combination with rocket oil in the diets of rabbits significantly (P<0.05) improved the nutritive value expressed as DCP compared with the other treatments and control diet. These results are in harmony with those of Belewu *et al.*, (2014) who found that moringa oil in the diet of West African Dwarf Goat improves feed intake and digestibility coefficient of the animal. While, Soliman *et al.* (2006) reported that feeding of rocket seeds meal diet had no adverse effect on digestibility coefficient and nutritive values. Also, Bassuny (1999) noticed significant (P<0.05) increase in EE and NFE, nutritive values (TDN and DCP) with the increase of digestibility energy (DE) and CP contents in the diet. Soad Ahmed *et al.* (2005) showed that addition of water-cress up to 3% in rabbit diets significantly (P<0.01) improved apparent digestibility coefficients of most nutrients.

Table (5): Digestion coefficient and nutritive values of rabbit as affected by dietary supplemented with moringa and rocket seeds oils or combination of them.

Items	Dietary groups				Sig.
	Control	Moringa oil	Rocket oil	Moringa oil + Rocket oil	
Digestion coefficient (%):					
DM	64.30± 0.82	66.53± 0.78	65.95± 0.73	67.44± 0.84	NS
OM	67.12± 1.17	70.35± 1.18	69.15± 0.78	71.37± 1.20	NS
CP	71.91± 0.64^{c}	74.62± 0.55^{ab}	73.40± 0.45^{bc}	75.51± 0.62^{a}	*
CF	30.38± 1.31	30.55± 1.01	31.99± 1.17	31.50± 1.32	NS
EE	74.70± 0.86^{c}	79.06± 0.80^{ab}	76.81± 1.19^{bc}	80.10± 0.87^{a}	*
NFE	72.40± 0.87	72.91± 0.73	73.90± 0.43	73.20± 0.91	NS
Nutritive values (%):					
TDN	66.72± 0.69	67.83± 0.53	68.26± 0.13	68.35± 0.73	NS
DCP	13.34± 0.12^{c}	13.84± 0.10^{ab}	13.62± 0.08^{bc}	14.01± 0.11^{a}	*
DE	2955.74± 30.50	3004.77± 23.26	3023.83± 5.61	3028.00± 32.21	NS

Means having different letters within the same row are significantly different.

* = (P<0.05) and NS= Not significant

Milk yield of does:.

The results presented in Table (6) showed that the average daily milk yield during the weeks of lactation was highest significantly (P<0.01) for does fed rocket oil diet, followed by does fed moringa plus rocket oils, followed by moringa oil only, while does fed the control diet recorded the lowest milk yield. Does fed moringa oil plus rocket oil diet ranked the second for milk production. Average daily milk yield (g/doe) increased during the third week of suckling by about 81.33% as compared with those at the first week. The increase in milk yield may be due to the highest feed intake and the higher TDN and DCP of does fed rocket oil and moringa oil diet (Table 5). Similarly, Xiccato *et al.* (2004) reported that the milk production increase is a response to the higher live weight and feed intake capacity of multiparous does. Also, Bassuny (1999) reported that high DE and/or DCP intake stimulate milk production. While, Estrella *et al.,* (2000) reported that moringa leaves have been shown to increase breast milk production. Also, there were significant differences in the total DM intake, litter size at weaning, average daily weight gain per kid and milk yield of does, on the different treatments (P<0.05) (Odeyinka *et al.* 2008).

Data in Table (6) clearly showed that feeding moringa oil plus rocket oils diet had the best feed conversion (P<0.01), followed by moringa oil, or rocket oil diet alone, whereas control group had the lowest feed conversion ratio, These results positively related to feed intake and milk yield of the experimental groups.

Table (6). Milk yield (MY) NZW of does rabbits as affected by dietary supplemented with moringa and rocket seeds oils or combination of them.

Items	**Dietary groups**				**Sig.**
	Control	**Moringa oil**	**Rocket oil**	**Moringa oil + Rocket oil**	
Average daily milk yield/doe:					
1st	112.25± 1.06^{c}	114.38± 1.00^{bc}	121.23± 0.92 ^{a}	115.83± 0.99^{b}	**
2nd	148.57± 2.21 ^{c}	158.18± 2.62 ^{b}	163.48± 2.19 ^{ab}	166.34± 2.00 ^{a}	**
3rd	201.16± 2.33 ^{c}	207.61± 2.98 ^{bc}	212.46± 2.83 ^{ab}	219.60± 2.36 ^{a}	**
4th	118.43± 1.31 ^{c}	125.30± 1.94 ^{b}	124.22± 1.78 ^{b}	130.75± 1.62 ^{a}	**
Overall means (all weeks)	**145.10± 1.54 ^{c}**	**151.37± 1.76 ^{b}**	**155.34± 1.74 ^{ab}**	**158.13± 1.48 ^{a}**	**
Total MY for weeks	4062.80± 43.24^{c}	4238.33± 49.35^{b}	4349.65± 48.84^{ab}	4427.68± 41.3^{a}	**
Feed conversion	2.35± 0.04 ^{a}	2.23± 0.04 ^{b}	2.26± 0.04 ^{ab}	2.13± 0.04 ^{b}	**

Means having different letters within the same row are significantly different.

- = (P<0.05) and NS= Not significant.

Some performance of bunny traits:

Data shown in Table (7) clear that average bunny weight at birth and relative growth rate were not affected significantly by dietary additives. These results are in agreement with those obtained by Ismeal *et al*. (1988) who found that the most important factor affecting bunny weight at birth was the bunny size and there was negative correlation between birth weight and bunny size. However, letter weight at weaning and weight gain of bunnies were higher for treatment groups than the control one and recorded highest significantly (P<0.05) for bunnies produced from does fed moringa plus rocket oils diet, followed by those fed moringa oil diet and rocket oil only, while the control group had the lowest values. Superiority of bunnies produced from does fed treatments diet may be associated with increasing milk yield of these does as compared to those in the control group.

In accordance with the present results, Kowalsk (2008) showed that oil supplemented diets increased kit weight at birth, 21 days and 35 days of age (P<0.01) in the three reproductive cycles. Results in Table (7), also revealed that mortality rate at birth and during the suckling period was lower significantly (P<0.05) in bunnies of does in all treated groups as compared to the control group, being the lowest for bunnies of does fed mixture of moringa plus rocket oils diet, followed by those fed either moringa oil diet or rocket oil diet, respectively.

Table (7): Productive performance traits of bunny produced from does fed diet supplemented with either oil of moringa , rocket or combination of them.

Items	Dietary groups				
	Control	**Moringa oil**	**Rocket oil**	**Moringa oil + Rocket oil**	**Sig.**
Bunny weight at birth,g	55.02± 0.42	55.24± 0.50	55.09± 0.47	55.77± 0.44	NS
Bunny weight at weaning, g	807.42± 2.37^{d}	827.42± 2.03^{b}	815.00± 1.94^{c}	835.75± 2.7^{a}	*
Bunny weight gain, g	752.40± 2.53^{d}	772.19± 2.17^{b}	759.90± 1.95^{c}	779.98± 2.8^{a}	*
Relative growth rate (%)	174.48± 0.21	174.97± 0.23	174.67± 0.20	174.98± 0.21	NS
Mortality rate at birth (%)	7.15± 0.19^{a}	5.30± 0.28^{bc}	5.97± 0.36^{b}	4.64± 0.34^{c}	*
Pre-weaning mortality rate(%)	10.85± 0.42^{a}	7.32± 0.46^{b}	7.66± 0.39^{b}	5.77± 0.34^{c}	*

Means having different letters within the same row are significantly different.

- = (P<0.05) and NS= Not significant

Effect of the experimental diets on blood biochemistry:

Data in Table (8) illustrated that values of serum total protein and albumin were improved significantly (P<0.05) when NZW rabbit does received mixture of moringa

plus rocket oils diet followed by moringa oil and rocket oil. However, control group recorded the lowest values. The change in globulin levels was not significantly

Table (8). Blood biochemistry of does fed diet supplemented with either oil of moringa, rocket or combination of them

Items	Dietary groups				
	Control	Moringa oil	Rocket oil	Moringa oil + Rocket oil	Sig.
Total Protein (g/dl)	5.43±0.22[b]	6.08±0.20[ab]	5.50±0.21[b]	6.31±0.25[a]	*
Albumen (g/dl)	2.75±0.11[b]	3.35±0.15[a]	3.17±0.16[ab]	3.38±0.19[a]	*
Globulin (g/dl)	2.68±0.15	2.73±0.17	2.33±0.23	2.94±0.40	NS
Cholesterol (mg/dl)	84.08±5.51[a]	62.65±4.59[b]	61.43±4.43[b]	60.61±6.94[b]	*
Triglyceride(mg/dl)	91.22±5.47[a]	72.23±5.22[b]	69.18±6.38[b]	66.13±7.10[b]	*
LDL (mg/dl)	92.79±6.31[a]	66.76±5.26[b]	70.13±6.27[b]	64.31±4.32[b]	*

Means having different letters within the same row are significantly different.

- = ($P<0.05$) and NS= Not significant.

affected by the treatments. Serum total protein and albumin showed significant increase in does fed either moringa or rocket oils diet indicating the ability of these oils to stimulate the regeneration of hepatic tissue which increase protein synthesis in liver and improvement of the functional status of the liver cells.

It is well known that, cholesterol is an important constituent of cell membrane and it is the precursor of steroid hormone and bile acids, high cholesterol level in the blood is Low density lipoprotein is a major component of the total cholesterol and is directly related to coronary heart disease as a major atherogenic lipoprotein and hence, appear to be the main target of any lipid lowering agent. LDL cholesterol increase the rate of triacylglycerol catabolism by mobilizing fat from the liver to the adipose tissue, it carries 60%-70% of the total cholesterol in the plasma (Beynen and Knchevsky, 1986). In the present results, does received combination of moringa oil or rocket oils diet recorded the lowest ($P \leq 0.05$) values of blood serum cholesterol, triglycerid and LDL followed by rocket oil. However, control group recorded the highest value (Table 8). These results were in agreement with Mehta *et al.* (2003) who showed that administration of rabbits for 120 days of moringa fruit, lowered the levels of serum cholesterol, phospholipids, triglyceride, very low density lipoprotein (VLDL), low density lipoprotein (LDL), cholesterol ratio and atherogenic index, and was able to increase the high density lipoprotein (HDL) ratio compared to the control group. One proposed mechanism of action is that moringa promotes gastrointestinal excretion of cholesterol. Naznin Ara *et al.* (2008) found lowering serum triglyceride($P \leq 0.05$) and cholesterol levels in rats fed leaves extract of moringa.

Semen characteristics of bucks:

Data concerning physical semen characteristics are presented in Table 9. Sperm cell concentration, and percentages of sperm motility and dead spermatozoa were improved

significantly (P<0.01) by feeding buck rabbits rocket oil diet alone or with moringa oil , being the best for those fed rocket oil diet when compared with moringa oil or control

Table (9). Some physical semen characteristics of buck rabbits fed diet supplemented with either oil of moringa , rocket or combination of them

Items	**Dietary groups**				
	Control	**Moringa oil**	**Rocket oil**	**Moringa oil + Rocket oil**	**Sig.**
Semen volume (ml)	0.86± 0.04	0.76± 0.06	0.90± 0.04	0.89± 0.05	NS
Sperm conc. ($x10^9$/ml)	232.00± 0.82 ^{bc}	230.75± 0.85 ^{c}	236.50± 0.65 ^{a}	234.50± 1.04 ^{ab}	**
Sperm motility (%)	78.75± 1.11 ^{ab}	74.25± 3.15 ^{b}	82.00± 1.08 ^{a}	81.00± 1.08 ^{a}	**
Sperm abnormality (%)	15.00± 0.71	15.50± 0.65	12.75± 0.85	13.50± 1.04	NS
Dead spermatozoa (%)	8.88± 0.52 ^{ab}	10.38± 0.55 ^{a}	7.38± 0.75 ^{b}	8.25± 0.63 ^{b}	**

Means having different letters within the same row are significantly different.
* = (P<0.05) and NS= Not significant

group. However, semen ejaculate volume and percentage of sperm abnormality were not affected significantly in buck by the treatments. Soad Ahmed *et al.* (2005) showed that using water-cress improved (P<0.01) semen ejaculate volume, sperm motility, sperm cell concentration and decreased the percentage of dead and abnormal spermatozoa compared with the control group. The same authors added that the tests of bucks fed diets containing water-cress had more mature somniferous tubules with mature spermatocytes than those of the control bucks. El-Tohamy and El-Kady (2007) using radish, rocket and black cumin meal in diets of adult male rabbits improved semen quality and gave the best results in case of reaction time, latency period, volume, motile sperm percentage, sperm concentration per ml, total sperm per ejaculate, total motile sperm and total function sperm fraction. Feeding radish or mixture meals significantly decreased free radicals production in the seminal plasma. On the contrary, Akwasi (2013) reported that moringa seeds contain bioactive chemicals capable of disrupting the gonad function, differentiation and sexual maturation of Mozambique tilapia. The same author added that, moringa seeds decreased sperm production and degeneration of testicular tissues. Similarly, Musa-Azara *et al.* (2014) showed significantly higher mean values of gonadal sperm reserve and daily sperm production for the control group compared to the moringa (P=0.05).

Economic efficiency:

Data shown in Table (10) clear that rabbits fed diet supplemented with mixture of moringa and rocket oils recorded the highest net return and best economic efficiency followed by those fed moringa oil diet, however control group had the lowest net return and economic efficiency.

Conclusively, from these results of the present study clear that addition of 1.5 g mixture of moringa and rocket seeds oils /kg diet was more effective than other treatments for improving productive and reproductive performance traits,

Table (10). Economical efficiency and relative economical efficiency of rabbits fed diet supplemented with either oil of rocket, Moringa or combination of them.

Items	Dietary groups			
	Control	Moringa oil	Rocket oil	Moringa oil + Rocket oil
Total FI/doe (Kg), during lactation	9.52	9.45	9.80	9.78
Price of Kg diet	2.30	2.51	2.45	2.48
Cost of FI (L.E) during lactation	21.89	23.71	24.01	24.26
LWW (Kg) doe	5.60	6.08	5.85	6.50
Selling price of Kg gain pups/doe **	100.74	109.51	105.31	116.93
Net return (L.E)	78.84	85.80	81.30	92.67
Economical efficiency	360.12	361.91	338.63	381.89

Price of kg live body weight was 18.0 L.E,
Price of kg moringa oil, rocket oil and moringa plus rocket oils diets were 140,100 and 120 L.E at experimental time. ** at weaning (28 days).

digestibility coefficients and nutritive values, milk yield of NZW doe and buck rabbits under the hot climate of summer season in Egypt. Hence, preferably adding moringa seeds oil to female rabbit while preferred adding rocket oil for males. Thus, several benefits might be gained by moringa only or plus rocket oil to the commercial rabbit diets, under heat stress conditions, in Egypt.

REFERENCES

Agriculture Ministry Decree (1996). *The Standard Properties For Ingredients*. Feed Additives and Feed Manufactured for Animal and Poultry, El- Wkaee El- Masria. No, **192** (1997) Amirria Press Cairo , Egypt, PP95.

Akwasi, A.Y. (2013). Effect of phytogenic feed additives on gonadal development in Mozambique Tilapia (Oreochromis mossambicus). PhD Thesis, Faculty of Agriscience, Stellenbosch University; Available: *www.netd.ac.za*

Al-Shukri, A.Y. (2011). Effect of supplementation betaine, vitamin C and local mixture with drinking water on alleviating heat stress in broiler chicken. Ph.D. Thesis, College of Agriculture, University of Baghdad.

A.O.A.C. (2000). *Association of Official Analytical Chemists***.** Official Method Of Analysis.942.05 (17th Edition) Volume I., Inc., Maryland, USA.

Ayyat M.S., God H.A.M., EL-Aasar T.A.and El-Monem U.M. (2004).Alleviation of heat-stressed growing rabbits by using some feed additives under Egyptian condition. *Egyptian J. Nutrition and Feeds*, **7**: 83-96.

Bani, P.; Piccioli Cappelli, F.; Minuti, A. and Abbatangelo, M. (2010). Variations of some blood parameters in rabbit reared under different environmental conditions. *Italian J. Anim. Sci.*, **4** (**2**) : 535-537.

Barillari, J. D.; Pedulli, G. F. and Valgimigli, L. (2005). Direct antioxidant activity of purified glucoerucin, the dietary secondary metabolite contained in rocket (*Eruca sativa mill*) seeds and sprouts. *Journal of Agriculture Food Che*., **6:** 2475-2482.

Bassuny, S. M. (1999). Performance of doe rabbits and their weanlings as affected by heat stress and their alleviation by nutritional means under Egyptian condition. *Egyptian Journal of Rabbit Sci.* **, 9** (1): 73-86.

Belewu, M. A.; Ahmed, M. A.; Badmos, A. H. A.; Esan, T. O.; Abdulsalam, K. O.; Odebisi, M. B. and Arise, A. K. (2014). Effect of different levels of moringa oleifera oil on performance characteristics of pregnant Goat. *Nigerian J. of Agriculture, Food and Environment.*, **10** (**2**):29-33.

Bradley P.R. (1992). *British Herbal Compendium*, Vol. **1**,. Boumemouth: British Herbal Medicine Association, 395-399.

Belic B., Cincovic M. , Popovic-Vranje A., Pejanovic R. and Krajinovic M. (2011). Metabolic changes and mammary uptake of metabolites in milk in heat stressed cows. *Mljekarstvo*, **61** (**4**): 309-318.

Beynen, A. C. and Knchevsky, D. (1986). Dietary fats and serum cholesterol in: nutritional effect on cholesterol metabolism (Beynen, A.C. Ed.) transmodial voorthuizen, pp. 10.

Bradley P. R. (1992). British herbal medicine association. British herbal compendium, Vol. 1. *Rolnic zych*., **434** : 395-399.

Clarke, H. E. ; Coats, M. F.; Eva, J. K.; Scott, P. P. and Whrd, R. J. (1977). Dietary standards for laboratory animals: report of the Laboratory Animals Center Diets Advisory Committee. *Lab. Animal*, **11**: 1-28

De Blas, J. C. and Mateos, G. G. (1998). *Feed Formulation*. In : The Nutrition of the Rabbits (De Blas, J. C. and J. Wiseman, Eds), CABI Publ. Wallingford, UK, PP. 241-254.

Duncan, D. B. (1955). The Multiple Range and Multiple F-Test. *Biometrics*, **11**: 1-42.

El-Tohamy, M. M. and El-Kady, R. I. (2007). Partial replacement of soybean meal with some medicinal plant seed meal and their effect on the performance of rabbits. *Inter. J. of Agric. Biology*., **2:** 215-219.

Estrella, M.C.P.; Mantaring, J.B.V. and David, G.Z. (2000). A double blind, randomized controlled trial on the use of (*Moringa oleifera*) for augmentation of the volume of breast milk among non-nursing mothers of preterm infant. *The Philippine Journal of Pediatric*, **49**: 3-6.

Hahn, G., Mader, T. and Eigenberg, R. (2003). Perspective on development of thermal indices for animal studies and management. In: *Interactions Between Climate And Animal Production.* EAAP technical series no.

Haristory, X. J.; Scholtus, I. and Lozniewski, A. (2005). Evaluation of the antimicrobial effects of several isothiocyanates on helicobacterpylori. *Plant. Med*., **71:** 326-330.

Hussain S., Malik F. and Mahmood S. (2014). An exposition of medicinal preponderance of Moringa oleifera (Lank.) *Pak. J. Pharm. Sci*., **27**, No.2:397-403.

Ibrahim Sh. A. M. (2005). Effect of some medicinal plants as feed additives on growth and some metabolic changes in rabbits. Egypt. J. Nutr. And Feeds, **8**: 207-219.

Ismeal A.M. (1988). Some physiological responses of certain breeds of rabbits to climatic change. M.Sc. Thesis, Am Shams Univ., Egypt.

Jabeen R.; Shahid, M.; Jamil, A.; Ashraf, M. (2008). Microscopic evaluation of the antimicrobial activity of seed extracts of *Moringa oleifera*. *Pak. J. Bot*., **40**: 1349–1358.

Kalogen U.A. (1985). *Rabbits Nutrition* (In Russian). Agropramozdat Publishing, Moscow, Russia.

Kowalsk, A. D. (2008). Effect of essential unsaturated fatty acids in fish oil on litters and composition of milk of rabbit does. *9th World Rabbit Congress, June 10-13.*

Lukefahr, S.; W. D. Nohenboken; Checke, P. R. and Patton, N. N. (1983). Breed, heterotic and diet effects on post weaning litter growth and mortality in rabbits. *Journal of Animal Science*, **57**(5): 1108.

Luqman, S.; Srivastava S.; Kumar, R.; Maurya, A.K. and Chanda, D. (2012). Experimental assessment of Moringa oleifera leaf and fruit for its antistress, antioxidant and scavenging potential using in vitro and in vivo assays. *Evi. Bas Compl. Alt. Med*. ,1-12.

Magda, M. El-Tohamy; El-Nattat, W. S. and El-Kady, R. I. (2010). The beneficial effects of Nigella sativa, Raphanus sativus and Eruca sativa seed cakes to improve male rabbits fertility, immunity and production. Journal of American Science, 6 (**10**): 1247-1255.

Makkar, H.P.S. and Becker, K.(1996). Nutritional value and antinutritional components of whole and ethanol extracted *Moringa oleifera* leaves. *Animal Feed Science Technology*, **63**: 211-228.

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

Marai, I.F.; Ayyat, M. S. and Abd El-Monem, U. M. (2001). Growth performance and reproductive traits at first parity of New Zealand white female rabbits as affected by heat stress and its alleviation under Egyptian conditions. *Trop. Animal Health . Prod*., **33**: 451-462.

Mehta K., Balaraman R., Amin A.H., Bafna P.A. and Gulati O.D. (2003). Effect of fruits of Moringa oleifera on the lipid profile of normal and hypercholesterolaemic rabbits. *J. Ethnopharmacol.* , **86** (2-3):191-5.

Morton, J. F. (1991). The Horseradish tree, Moringa Pterigosperma (Moringaceae)Fa boon to arid lands?. *Econ. Bot.* , 45: 318–333.

Musa-Azara, S. I. , Jibrin M., Ari M. M., Hassan D. I. and D. M. Ogah D. M. (2014). Effects of Moringa oleifera Linn seed administration on sperm production rate and gonadal sperm reserve in rabbits. *British Biotechnology Journal*, **4** (**7**): 801-805.

Naznin Ara, Mamunur Rashid and Shah Amran M.d. (2008). Comparison of Moringa oleifera Leaves Extract with Atenolol on Serum triglyceride, Serum Cholesterol, Blood glucose, heart weight, body weight in Adrenaline Induced Rats. *Saudi Journal of Biological Sciences*, **15** (**2**) 253-258.

NRC (1977). Nutrients Requirements of Domestic Animals. *Nutrients Requirements of Rabbits.* 2nd Edition. National Research Council, National Academy of Science. Washington, DC. USA.

Odeyinka, S. M.; Oyedele, O. J.; Adeleke, T.O. and Odedire, J. A. (2008). Reproductive performance of rabbits fed moringa oleifera as a replacement for Centrosema pubescens. In: *9th World Rabbit Congress*, June 10 – 13, 2008, Verona, Italy.

Okba, A. B.; El-Banna, S. G. and A. A. Koriem, A. A. (2008). Influence of environmental temperatures on some physiological and biochemical parameters of male New Zealand White rabbits. *Slovak J. Anim. Sci*., **41**: 12-19.

Ojiako, E. N. and Okeke, C. C. (2013). Determination of antioxidant of Moringa oleifera seed oil and its use in the production of a body cream. *Asian Journal of Plant Science and Research*, **3** (3):1-4.

RaJib Singha (2010) *Moringa oil.* Retrieved from www buzzle.com/articles/moringa oil. html. (2012, July 28).

Rowida, M. Riad; Seleem, T. S. T. and Dalal S.E. Mohamed (2010). The relation between type of mating and reproductive performance of rabbit under Egyptian condition. *The 6th Inter. Con .on Rabbit Prod. in Hot Clim*., Assuit, Egypt, 413 – 426.

Samah S. M. Allam (2009). Characterization of Moringa (ben) seed oil grown in Egypt. *Minia J. of Agric. Res. & Develop*. Vol. (**29**): 1– 21.

Samah, S.M. Allam (2001). Utilization of Some Untraditional Sources of High Oleic Acid Oils for Improving Vegetable Oils Stability. La Rivista Ital. De Sos. Grasse, Vol. **LXXVIII**, 337-342. 24th ISF, Berlin , Germany.

SAS (2003). SAS User's Guide: *Statistics*. Version 8.2, SAS Institute Inc., Cary, NC.

Selim, A. D.; Soliman, Z. M. and Abdel-Khalek, A. M. A. (2003). Effect of the introduction between drinking water temperature and some dietary feed additives on performance of heat stressed rabbits. Egypt. J. Nutr. Feeds., 231-244.

Shehata, M. A.; Saher M.Osman; Ezzat, W. and Raga E. Abd El- krim (2011). Using some oils of medical plants in diets of rabbits under hot climatic conditions. *J. Product. & Dev*., 16(**2**):267 – 285.

Smyth, P. and Gordan, L. (1967). Seasonal and breed variation in the semen characteristics of rams in Ireland. *Ir. Vet. J.*, **21**: 222-233.

Soad S. Ahmed; El-Gendy K. M.; Sarhan M. A.; Tawfeek, M. I. and El-Kelawy, H. M. (2005). Response of rabbits to diets containing water-cress (*Nasturtium officianale*) as a natural feed additives. *3rd International Poultry Conference*, 4-7 Apr., Harghada, Egypt.

Soliman, M. Z. A. ; Fatma G. Ahmed; El-Manylawi, M. A. F. and Fatma T. F. Abd El-Ghany (2006). Evaluation of using some Agro-industrial by-products in growing rabbit nutrition. *Egyptian J. Rabbit Sci*., **16**: 297-323.

Somali, M.A.; Bajneid, M.A. and Al-Fhaimani, S.S. (1994). Chemical composition and characteristics of Moringa peregrine seeds and seed oil. *J. Am. Oil Chem. Soc*.**, 61**: 85-86.

Strucklec, M. and Kermiouner, A. (1995). Influence of nutrition of lactating does and the young after weaning on production parameters of rabbits. *Zbornik-Biotechnisk Fakultete*, Univerze, **22**: 269-275.

World Health Organization (WHO) (2002). Traditional Medicine-Growing Needs and Potential, WHO Policy Perspectives on Medicines, 2. WHO, 1-6.

Xiccato, G.; Trocino, A.; Sartori, A. and Queaque, P. I. (2004). Effect of parity order and litter weaning age on the performance and body energy balance of rabbit does. Livestock Production Science., **85**: 239-251.

Zeweil, H. S.; Ahmed, M. H.; Adawy, M. M. and Zaki, B. M. (2009). Effect of substitution rocket seed meal as a source of protein for soybean meal in diet of New Zealand White rabbits. *Corresponding author: Hszeweil@yahoo.com*.

Zohara, Y.; Schafferman, D. and Amarisrael, Z. (1998). Traditional used and biodiversity of rocket (*Eruca sativa, Barassicaceae*) in Israel. Economic Botany, **52:** 394-400.

تقييم إضافة زيت بذور المورينجا وزيت بذور الجرجير للغذاء على الكفاءة الإنتاجية والتناسلية في الأرانب تحت الظروف المناخية الحارة

وحيد عزت ، سحر محمد حامد ، رجاء السيد عبد الكريم ، ممتاز محمد أحمد شحاتة
معهد بحوث الإنتاج الحيواني - مركز البحوث الزراعية – مصر.

أجريت تجربة ذات تصميم عشوائي تام لدراسة تأثير إضافة زيت المورينجا وزيت الجرجير أو خليط من هذه الزيوت للغذاء على الأداء الإنتاجي والتناسلي ، ومعاملات الهضم والقيم الغذائية، إنتاج الحليب، وبعض مكونات الدم والكفاءة الاقتصادية لأمهات الأرانب النيوزيلندي، وكذلك خصائص السائل المنوي للذكور وأداء نتاج الأرنب وذلك تحت ظروف الصيف الحار في مصر بداية من شهر يونيه- أغسطس ٢٠١٣. استخدم في التجربة عدد ٤٨ أم وعدد ١٢ ذكر أرنب نيوزيلندي أبيض (٦ أشهر من العمر) متساوية تقريبا في متوسط وزن الجسم قسمت عشوائيا إلي أربع مجموعات (١٢ أم ، ٣ ذكور لكل منها)، تم تغذيتها علي عليقه المقارنة (المجموعة الأولي) ، عليقه مقارنة مضاف إليها ١,٥ جرام زيت المورينجا / كجم عليقه (المجموعة الثانية) ، عليقه مقارنة مضاف إليها ١,٥ جرام زيت الجرجير /كجم عليقه (المجموعة الثالثة)، خليط من هذه الزيوت(المجموعة الرابعة).

أوضحت نتائج التجربة الأتي :

- النسبة المئوية للأحماض الدهنية الغير مشبعة الأحادية كانت اعلي في زيت المورينجا منه في زيت الجرجير .و كانت النسبة المئوية للأحماض الدهنية المشبعة في زيت الجرجير أعلى منه في زيت المورينجا ، بينما كان محتوي زيت المورينجا من الأحماض الدهنية الغير مشبعة المتعددة نسبة دقيقة في حين احتوي زيت الجرجير علي نسبة عالية من الأحماض الدهنية الغير مشبعة المتعددة مثل حامض اللينوليك.
- سجلت إناث المجموعة المغذاة علي خليط زيت المورينجا + زيت الجرجير اعلي قيم للغذاء المستهلك و لوزن الجسم النهائي، وللزيادة الوزنية، ومعدل الحمل، وعدد الولادات وعدد ووزن خلفه البطن والزيادة الوزنيه عند الميلاد والفطام وللعليقة المستهلكة مع تحسن معنوي (علي مستوي معنوية ٠,٠٥) فقط في معامل هضم البروتين الخام والدهون ومعامل هضم البروتين الخام في مجموعه زيت الجرجير.

- سجل معامل هضم البروتين الخام والدهون والقيم الغذائية في صورة DCP، متوسط إنتاج اللبن اليومي خلال أسابيع الرضاعة المختلفة ومعدل تحويل الغذاء بالنسبة لإنتاج اللبن كانت أعلى معنوية (علي مستوي معنوية ٠,٠٥) عند تغذية الأرانب علي خليط زيت المورينجا + زيت الجرجير في معظم أسابيع الرضاعة.
- سجل الوزن عند الفطام وزيادة الوزن للخلفات للإناث التي غذيت علي زيت الجرجير اعلي معدل (علي مستوي معنوية ٠,٠٥). بينما انخفض معدل النفوق عند الولادة وخلال فتره الرضاعة للنتاج وقيم كل من الكولسترول والجلسريات الثلاثية والكولسترول منخفض الكثافة في الإناث التي غذيت علي خليط زيت المورينجا + زيت الجرجير يتبعها مجموعه زيت الجرجير.
- تحسن تركيز الحيوانات المنوية الطبيعية والحركة التقدمية وانخفاض نسبة الحيوانات المنوية الميتة لذكور الأرانب التي غذيت علي زيت الجرجير فقط أو مع زيت المورينجا وكونه أفضل بالتي غذيت علي زيت الجرجير بالمقارنة مع مجموعه زيت المورينجا ومجموعه المقارنة.
- سجلت الإناث التي غذيت علي خليط زيت المورينجا + زيت الجرجير اعلي عائد وزن صافي وكذلك اعلي كفاءة اقتصادية يتبعها مجموعه زيت المورينجا بينما سجلت مجموعه المقارنة اقل القيم.

التوصية: توصي الدراسة بإضافة ١,٥ جم خليط من بذور زيت المورينجا و زيت الجرجير / كجم عليقه لتحسين أداء الصفات الإنتاجية والتناسلية ومعاملات الهضم والقيم الغذائية واتناج اللبن لإناث وذكور الأرانب النيوزلندي الأبيض المراباة تحت ظروف المناخ الحار في فصل الصيف في مصر. ومن هنا يفضل إضافة زيت المورينجا لأنثى الأرنب بينما يفضل إضافة زيت الجرجير لذكورها.