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EFFECT OF *NIGELLA SATIVA* AND *THYMUS VULGARIS* ON DIGESTIBILITY, NITROGEN BALANCE AND PERFORMANCE OF NEW ZEALAND WHITE RABBITS

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ABSTRACT: ***A study was carried out on forty growing NZW rabbits to test the effect of Nigella sativa and/or Thymus vulgaris as feed additives. Rabbits were fed on a control diet (C) and 3 experimental diets containing the medical herbs Nigella sativa seeds (NS)or Thymus vulgaris herb (TV)or mixture of both(MIX) for the experimental period of 10 weeks. Paramiters studied included digestibility,N balance, growth performance.***

The results obtained showed that supplementing the basal diet with herbs did not affect the digestion coefficients. The diet containing the mixture of NS and Tv were higher in their DCP. The MIX group recorded the best value TDN. Rabbits received the MIX ration retained more nitrogen (1.37g/d) than the other three groups. Rabbits in all the experimental groups grew at almost the same rate. The highest performance index was recorded with group fed diet MIX.

Key words: ***Nigella sativa*** **seeds,*Thymus vulgaris* herb, rabbits, digestibility, performance.**

INTRODUCTION

Using chemical products especially hormones and antibiotics as feed additives may cause unfavorable side-effects. There are evidence indicating that those products could be considered as pollution for human and threaten their health on the long-run. Yet, feed additives are important materials that can improve feed efficiency and animal performance (Salem and El-Mahdy, 2001). Magi and Sahk (2003) and Musa (2008) indicated that the medicinal plant is a growing area of alternative medicine nowadays.It is believed that plants are more natural, less toxic, and safer than chemical preparations. The use of natural products is becoming more popular, since drugs of synthetic origin may have a negative impact on the environment and parasite resistance to poisonous chemicals can develop after repeated applications. Using medicinal herbs and plants have been known since the old civilizations (Allam *et al*., 1999). Old drugs industry depended upon the raw material of medicinal herbs and plants and their extracts, which proved safe always. Attempts to use natural materials such as medicinal plants could be widely accepted as feed additives. However, little information is available about using medicinal plant by-products in rabbit diets. Recently, Musa (2008) reported the possibility of using medicinal plants by-products in rabbit

feeding. The natural materials as alternative growth promoters such as medicinal plants are widely accepted (Aboul-Fotouh *et al*., 1999; Abou-sekkin *et al*., 2008; Musa 2008). These medical plants have some properties as antiseptic, antibacterial activities against harmful microorganisms, treatment of gastro-intestinal complaints and tonic (Hmamochi *et al*., 1992; El-Amary, 1993 and Tozyo *et al*., 1994). Also, some studies indicated that such plants have favorable effects on live weight gain and feed efficiency with broiler chicken (Fritz *et al*., 1992 and Fritz *et al*., 1993) and with cows (Singh and Taparia, 1992).

Therefore, the present study was carried out in order to investigate the effectiveness of *Nigella sativa* and *Thymus vulgaris* meals in growing rabbit diets on nutrients digestibility, feeding values, nitrogen balance, productive performance, carcass traits.

MATERIALS AND METHODS

Forty weaning growing NZW rabbits of both sexes at 4 weeks of age ± 2 days (with an average weight about 476.2±28.4g) were kept under the same managerial and hygienic conditions. Rabbits were individually weighed and randomly distributed into four groups of ten rabbits in two replicates; under each group 5 males and 5 females. The rabbits were housed and fed for 10 weeks (2 weeks as a preliminary period and 8 weeks as the experimental period) in galvanized wire cages (50 x 60 cm) provided with feeds and automatic nipple drinkers. Feed and water were offered *ad libitum*. Four experimental *diets* were formulated according to National Research Council (NRC, 1977) to cover the nutrient requirements of growing rabbits. The first group was fed the control diet (c) (basal diet contained yellow corn, 10; wheat bran, 25; barley grain,14.6; soybean meal,15.5; berseem hay,30; molases,3; salt,0.4; permix,0.5 and limestone, 1%); the other three rations were the control diet supplemented with different sources of medical herbs; 2kg *Nigella sativa* seeds/ton,NS; 2Kg*Thymus vulgaris* herb/ton,TV; or a mixture of 1Kg *Nigella sativa*+1Kg of Thymus *vulgaris*/ton,MIX. diets were manufactured in pellets shape 4mm diameter at El- Safwa Factory – Meet Ghamr, Dakahleia.

The experimental diets and fresh water were available all the time during the preliminary- (2 weeks) and the experimental-period (8 weeks). Rabbits were individually weighed at weekly intervals. The traits under study included live body weight, daily weight gain, feed intake, feed conversion (g feed/g gain) and mortality rate.

The digestibility trial of the present study took place at the end of the experiment (at 10 weeks). three male animals from each experimental treatment were chosen randomly and housed individually in metabolic cages and were given *ad libitum* the experimental diet for 2 weeks as an adaptation period, after which the total fecal excretions were collected daily in plastic

bags for 7 days and stored at -10^{o}C. For nitrogen balance, urinary excretions during the same collection period were also collected daily in plastic bottles containing 0.1N H_2SO_4 and kept frozen up to the chemical analyses. Feed intakes were determined daily by subtracting the residual feeds from the daily allowance.

Growth performance index (PI) was calculated according to the equation described by North (1981) as the percentage of final body weight of feed conversion.

Samples of the ingredients, experimental diets and remainder feed (if any) were ground and subjected in duplicate to proximate analysis. Meet Samples and Samples of daily output of feces were taken after drying at 60 °C for 24 hr and then they were also ground. Dry matter (DM), crude protein (CP), ether extracts (EE), crude fiber (CF) and ash of the feedstuffs and feces samples were determined according to A.O.A.C. (1990). The nitrogen free extract (NFE) was calculated by difference.

Data were statistically analyzed according to SPSS (1997). The statistical model used was the one way analysis of variance as follows:

$$Y_{ij} = u + A_i + e_{ij}$$

Where: Y_{ij} = the observation on the ijth rabbit, u = Overall mean, A_i =the effect of the ith diet (i = 1, 2,...4), e_{ij} = experimental random error.

The significant differences between means were tested using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The chemical composition of the raw medical herbs under study (*Nigella sativa* seed and *Thymus vulgaris herb*) is presented in Table (1).Values obtained here are within those reported in the literature (Nasr *et al*., 1996; Sharobeem, 1996; Zeweil, 1996; Gabr *et al.,* 1998; Youssef *et al*., 1998; El-Ayek *et al.,* 1999 and 2000; Abaza, 2001; Daadar *et al.,* 2002). Data in Table (1) also present the proximate analysis of the experimental diets. All diets contained almost similar contents of CP, NFE, CF and ash; that was mainly due to the same ingredients used in the formulation of the experimental diet. The low level of supplementation of the medical herbs did not affect the proximate analysis. However, contents of EE were a little higher in the treated diets due to the content of the supplements of the oils.

Table 1: Chemical composition of the experimental rations

Item	Raw materials		Dietary treatments*			
	NS	*Tv*	C	NS	TH	MIX
DM, %	93.00	89.1	89.75	89.32	89.17	88.3
	---------- on DM basis ----------					
OM, %	91.40	84.69	91.57	91.68	91.29	91.90
CP, %	27.31	14.21	13.77	14.33	13.98	14.75
EE, %	7.11	4.10	3.44	3.99	3.95	4.22
NFE, %	47.97	49.18	54.66	52.31	52.86	52.24
CF, %	11.10	17.2	11.25	12.74	11.78	12.61
Ash, %	6.51	15.31	8.43	8.32	8.71	8.10
DE** *Mcal/kg DM*	2.59	2.39	2.63	2.91	2.61	2.59

***Raw materials are *Nigella sativa*, *NS*; *Thymus vulgaris*, *Tv*; dietary treatments are control, C; *Nigella sativa* supplemented ration, NS; *Thymus vulgaris* supplemented ration, Tv; ration supplemented with a mixture of both herbs, MIX.**

**** Digestible energy, DE *(Mcal/kg)* = 4.36 – 0.049 x NDF, NDF% = 28.924 +0.657 x CF% according to Cheeke (1987).**

It could be observed Table (2) that supplementing the basal diet with either herb (*Nigella sativa* and *Thymus vulgaris*) either alone or as a mixture did not affect the digestion coefficients of almost all nutrients. Nasr *et al*. (1996) and Taha (1997) working with rabbits, Zeweil (1996) working with Japanese quail and El-Ayek *et al.* (1998) working with sheep reported that supplementing diets with NS improved the digestibility of OM, CF and NFE. . In general the improvement in digestibility could be attributed to the improvements in digestive tract environment due to herbal content of biological constituents such as antioxidants (Bennett, 1992 and Ali *et al.,* 2007). Oil of thyme has phenolic components which are primarily responsible for its anti-oxidative activity(Farag *et al*., 1994).

The nutritive values of the experimental diets are presented in Table (2) The results indicated that the diet containing the mixture of NS and Tv were significantly (P<0.05) higher in their digestible crude protein (DCP) being 12.34% than control diet (10.48%). The other two groups were intermediates being 11.37 and 11.42 for NS and Tv, respectively. The MIX group recorded the best value (P<0.05) of total digestible nutrients (TDN, 68.42%); the other groups had TDN values of 62.57, 66.84 and 66.61 for C, NS and Tvgroups, respectively. The digestible energy values were 2772, 2961, 2951 and 3031 kcal/kg for groups C, NS, Tv and MIX, respectively. The higher feeding values were mainly due to the higher digestibility rather than the chemical

composition which was almost equal in all rations. These results indicated that, using medical herbs, especially in a mixture form in growing rabbit diets causes improvement in the digestion coefficients and feeding values more than using each alone. Similar trend was reported by Abousekken *et al*. (2007) using a dietary mixture of *fennel* and *marjoram* hay in growing rabbit diet. Also Musa (2008) using a mixture of parsley and basil came to a similar conclusion. These significant improvements in the digestion coefficients and nutritive values may be due to the effect of some flavonoids and essential oils which had beneficial effect for stimulation and activity of cecum fermentation (Ibrahim, 2005).

Table 2: Digestibility and nutritive values% of the experimental rations as affected by the tested medical herbs supplementation (Means ± SE)

Item**	Dietary treatments*				Sig
	C	NS	Tv	MIX	
OM	68.67[a] ± 1.74	72.90[b] ± 1.41	73.65[b] ± 1.47	76.55[c] ± 1.56	0.05
CP	76.09[c] ± 1.82	79.32[bc] ± 1.06	81.72[b] ± 1.81	83.65[ab] ± 1.09	0.05
CF	52.75 ± 3.44	53.47 ± 2.98	52.39 ± 2.21	53.19 ± 2.42	NS
EE	72.59[a] ± 2.18	78.52[b] ± 2.96	78.85[b] ± 2.66	81.82[c] ± 2.07	0.05
NFE	74.17[a] ± 2.40	79.54[b] ± 1.86	78.53[b] ± 2.31	79.65[b] ± 2.67	0.05
DCP	10.48[a] ± 0.43	11.37[b] ± 0.48	11.42[b] ± 0.51	12.34[c] ± 0.21	0.05
TDN	62.57[a] ± 2.52	66.84[b] ± 2.64	66.61[b] ± 2.32	68.42[c] ± 2.85	0.05
DE	2772[a] ± 97	2961[b] ± 115	2951[b] ± 119	3031[c] ± 108	0.05

*Dietary treatments are control, C; *Nigella sativa* supplemented ration, NS; *Thymus vulgaris* supplemented ration, Tv; ration supplemented with a mixture of both herbs, MIX.

**OM, organic matter; CP, crude protein; CF, crude fiber; EE, ether extract; NFE, nitrogen-free extract

**DCP, digestible crude protein %; TDN, total digestible nutrients %. DE (kcal/kg DM) = TDN x 44.3

[a, b,c]. Means in the same row with different superscripts differ significantly

Table (3) presents the nitrogen balance data. Nitrogen intake was 2.64, 2.79, 2.95 and 3.02 g, for groups fed C, NS, Tvand MIX diets, respectively. It was higher for diets MIX and Tvthan diets C and NS.

The treated rations excreted significantly (P<0.05) less N in feces (0.59, 0.54 and 0.49 g/d, for groups NS, Tv and MIX, respectively) than the control ration (0.63 g/d). The higher N intake with the lower FN led to a better N digestibility. The N excreted in urine followed the opposite pattern being higher for groups Tv (1.18g/d) and MIX (1.16g/d) than C (0.92g/d) and NS (1.03g/d) Rabbits received the MIX ration retained more nitrogen (1.37g/d) than the other three groups which retained almost equal amounts of N being 1.09, 1.17 and 1.23g/d for C, NS and Tv fed groups, respectively.

El-Manylawi (2005) illustrated that the nitrogen balance for rabbits fed on diets containing *Geranium* by-product at 6 or 9% increased significantly (P<0.05) compared with the control group. Abousekken *et al*. (2007) using a dietary mixture of *fennel* and *marjoram* hay in growing rabbit diet and Musa (2008) using a mixture of parsley and basil came to a similar conclusion.

Table 3: Nitrogen balance as affected by the dietary medical herbs supplementation (Means ± SE)

Item**	Dietary treatments*				Sig.
	C	NS	Tv	MIX	
NI(g/d)	2.64[a] ± 0.15	2.79[a] ± 0.13	2.95[b] ± 0.24	3.02[b] ± 0.17	0.05
FN(g/d)	0.63[a] ± 0.02	0.59[ab] ± 0.03	0.54[b] ± 0.04	0.49[b] ± 0.04	0.05
UN(g/d)	0.92[a] ± 0.12	1.03[a] ± 0.10	1.18[b] ± 0.11	1.16[b] ± 0.13	0.05
NB(g/d)	1.09[a] ± 0.38	1.17[a] ± 0.10	1.23[a] ± 0.24	1.37[b] ± 0.21	0.05
BV%	41.29[a] ± 7.06	41.94[a] ± 4.98	41.69[a] ± 5.53	45.36[b] ± 3.34	0.05

*Dietary treatments are control, C; *Nigella sativa* supplemented ration, NS; *Thymus vulgaris* supplemented ration, Tv; ration supplemented with a mixture of both herbs, MIX.

**NI, nitrogen intake; FN, fecal nitrogen; UN, urinary nitrogen; NB, nitrogen balance; BV, biological value.

[a, b], Means in the same row with different superscripts differ significantly.

The biological value of the dietary protein (BV) was calculated (NB/NI %) and presented in Table(3). It was significantly (P<0.05) higher (45.36%) for group of rabbits received MIX ration than the other three groups which was almost equal being 41.29, 41.94 and 41.69% for groups received C, NS and Tv, respectively; differences were significant (P<0.05). Musa (2008) reported that rabbits fed dietary mixture of parsley and basil recorded significantly (P<0.05) the best values of nitrogen balance as % of N intake compared to the other experimental diets or the control group. These results indicated that, using mixtures of such medicinal plants in growing rabbit diets causes improvement in digestion coefficients and feeding values more than using each alone.

Animal performance:

Results in Table (4) present the overall rabbit performance as affected by the dietary treatments. The initial body weight was almost equal in all groups (avg. 472g) in both sexes. Sex had no effect on the change in body weight at any interval of the experimental period.Data of change in body weight illustrated that rabbits fed the MIX diet recorded markedly heavier BW (2236g) than the other groups. Average daily gain (ADG) as affected by the dietary medical herbs is presented in Table (4) All animals in all the experimental groups grew at almost the same rate. During the experimental intervals, rabbits on the MIX ration revealed markedly but non-significantly better rate of growth. Values of ADG during the whole period of the experiment were 29.85, 29.62, 29.01 and 30.45g for both sexes of rabbits on diet C, NS, Tv and MIX, respectively.

It is worthy to note that rabbits receiving the MIX ration had better digestion coefficients, retained more N, and higher protein BV which should lead to a faster growth rate; differences in ADG, however, failed to reach a significant level.Data in Table (4) present the total feed intake of growing NZW rabbits as affected by dietary treatments. Total feed intake during the whole experimental period was similar with all the experimental groups. The average daily feed intake during the whole experimental period was 106.0, 106.8, 103.4 and 103.7g for the experimental groups of C, NS, Tvand MIX, respectively. Total feed intake during the whole experimental period ranged between 5.79 and 5.98 kg.

Feed conversion (kg feed/kg gain;) during the period of the study was not affected by the dietary treatments under which the experimental animals were kept. This was due to the equality of feed intake with the equality of ADG. The ratio of feed/gain was 3.55, 3.60, 3.54 and 3.42 kg feed/kg gain for the groups C, NS, TH and MIX, respectively.

Table 4: Overall growth performance of NZW rabbits as affected by dietary medical herbs (Means ± SE)

Item	The dietary treatments*				
	C	NS	Tv	MIX	Sig.
Initial weight (g)	474 ± 32	479 ± 26	461 ± 34	477 ± 29	NS
Final weight (g)	2147 ± 110	2138 ± 99	2100 ± 121	2176 ± 89	NS
Total BWG (g)	1673 ± 97	1659 ± 99	1639 ± 94	1699 ± 95	NS
Total FI (kg)	5.94	5.98	5.79	5.81	ND
Avg. FC (kg feed/kg gain)	3.55	3.60	3.54	3.42	ND
PI (%)	60.48[a] ± 3.19	59.39[a] ± 2.75	59.32[a] ± 3.41	63.63[b] ± 2.61	0.05

*Dietary treatments are control, C; *Nigella sativa* supplemented ration, NS; *Thymus vulgaris* supplemented ration, Tv; ration supplemented with a mixture of both herbs, MIX.

** a,b, Means in the same row with different superscripts differ significantly.

NS; not significant.

ND, not determined

PI, performance index: percentage of final BW relative to feed conversion (North, 1981)

No consistent effect of the medical herbs on animal performance was found in the literature. Amber *et al*. (2001) reported that *Nigella sativa* cake (NSC) reduced significantly the rabbit performance. Final live weight, daily live weight gain, feed intake and feed conversion ratio were significantly reduced by 13.2, 18.3 and 5.19% respectively, as the level of *Nigella sativa* cake increased from 0 to 25% in the diets. While, El-Wafa *et al*. (2002) showed that body weight; daily live weight gain and feed conversion were improved significantly by the addition of black seed *Nigella sativa* (BS). Radwan (2002) studied the effects of replacing soybean meal by Nigella seed meal for growing rabbits on growth performance and reported that the addition of NSM did not have beneficial effects on growth performance of growing rabbits. The use of *Thymus vulgaris* as feed additive increase significantly

(P<0.01) the feed intake, live weight, live weight gain in New Zealand White rabbits (Ibrahim *et al*., 2000). In this connection, El-Manylawi *et al.* (2005) reported that the final body weight and weight gain of growing rabbits fed diets containing 3, 6 or 9% of *Geranium* by-products were significantly (P < 0.05) higher than the control group. Earlier study on growing pigs (Teodorovic *et al.,* 1990) showed higher daily weight gain when thyme was added to pigs diets at 1-2 kg/ton diets than the control. Musa (2008) reported that rabbits on a mixture of parsley and basil revealed significantly (P<0.05) the heaviest body weight. He also reported that feed intake was almost equal with the control. Rawiha (1994) stated that using mixtures of medicinal herbs was preferable than using each alone.

The results of performance index (Table 4) indicated that the highest PI value was significantly (P<0.05) recorded with group fed diet MIX (63.63%); the other three groups had similar PI being 60.48, 59.39 and 59.32% for C, NS and Tv groups, respectively. It is obvious from the data presented herein that the best performance could be reached using a mixture of medical herbs rather than using each one alone (Rawiha, 1994). Abousekken *et al.* (2007) reported that growing rabbits fed mixture of medicinal plants recorded significantly (P<0.05) better PI value than each alone. Musa (2008) came to the same conclusion. On the other hand, Radwan (2002) reported that replacing soybean meal by Nigella seed meal for growing rabbits resulted in significantly (P<0.05) decreased in performance index.

CONCLUSION

Conclusively, from the results obtained in this study, it could be stated that *Nigella sativa* seeds and *Thymus vulgaris herb* as medical herbs either alone or as a mixture are good supplements for growing rabbits without any adverse effect on nutrient digestibility, feeding value or growth performance and blood constituents of rabbits. It is worthy to note that it is better to use the mixture of both herbs rather than using each one alone in order to obtain the best productive performance of growing NZW rabbits.

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تأثير كل من حبة البركة والزعتر علي الهضم والاتزان النيتروجيني والأداء الانتاجى للأرانب النيوزيلندية البيضاء

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الملخص العربي

استخدم في هذه الدراسة عدد أربعون أرنبا نيوزيلندي أبيضِ من الجنسين عند عمر ٤ أسابيعِ (بوزنِ متوسطِ ٤٧٦,٢ ±٢٨,٤جم) – تم تربية الأرانب تحت نفس الظروفِ الرعائية والصحّيةِ وقسّمتْ بشكل عشوائي إلى ٤ مجموعاتِ مقارنةِ، بكل منها١٠ أرانب (٥ ذكورِ و٥ إناث). غُذّيتْ الأرانب على عليقة مقارنة (م) و ثلاثة علائق تجريبيةِ تَحتوي على الأعشابَ الطبيةَ (حبة البركة – زعتر أو مخلوط منهما). لفترة تجريبية مدتها ١٠ أسابيعِ.

تمت دراسة تأثير هذه الإضافات على أداء النمو – تبعتها تجربة هضم تم خلالها دراسة معاملات الهضم والقيمة الغذائية وميزان النيتروجين.أشارت نتائج الدراسة إلى عدم تأثير معاملات الهضم معنويا نتيجة المعاملة .كانت كلا من العليقة المحتوية على الإعشاب الطبية وحدها أعلى في محتواها من البروتين الخام المهضوم حيث كان(١٢.٣٤%) من العليقة المقارنة (١٠.٤٨%).المجموعة المخلوطة سجلت أفضل قيمة للمركبات المهضومة الكلية (٦٨.٤٢%).الأرانب المغذاة على عليقة المخلوط احتجزت نيتروجين بكمية اكبر (١.٣٧جم/اليوم)من المجموعات الثلاثة الاخري التي احتجزت بكميات متساوية تقريبا .نمت كل الحيوانات في كل المجموعات التجريبية بنفس المعدل تقريبا .كان دليل الأداء الأعلى للمجموعة المغذاة على المخلوط (٦٣.٦٣%) .

يمكن استخلاص أن إضافة الأعشاب الطبية والعطرية تؤدى إلى تحسن معاملات الهضم – القيمة الغذائية – الاتزان النيتروجيني – وكذلك أداء الأرانب النيوزيلندية دون حدوث أية أثار جانبية ضارة علي وظائف الجسم.

واستخدام هذة الإضافات العشبية مخلوطة أعطت أفضل النتائج عن كونها منفردة.