EFFECT OF ANISE AND MINT EXTRACTS (VOLATILE OILS) SUPPLEMENTATION IN THE DIET OF WEANLING NEW ZEALAND WHITE RABBITS IN HOT CLIMATE

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Abstract - A total of 75 weanling New Zealand White rabbits aged 5 weeks were divided into 5 groups nearly equal in the average of body weight to study the effect of feeding commercial pelleted diet supplemented with two levels (1 or 2 cm^3/kg diet) of Anise or Mint extracts (volatile oils) as a mean to improve the feed utilization and digestion in the hot summer. The rabbits raised on this rations up to 14 weeks of age (the suitable marketing age in the summer of Egypt).
The rabbits which fed diet with Mint extract 1 cm^3/kg diet) showed significant difference ($P<0.01$) for weight gain from 13 to 14 weeks of age. A significant effect ($P<0.05$) was also detected for the digestibility coefficient of crude protein, TDN, N-retained, serum total protein, creatinine, total lipids and cholesterol for the same group when compared with control and control plus Anise extract (2 cm^3/kg diet) groups. Also, volatile oils inclusion surpassed significantly ($P<0.01$) control group in feed consumption and conversion from 5-14 weeks of age. Type of diet did not affect neither the digestibility coefficients of DM, OM, EE, CF and NFE nor any of the carcass traits studied. N-intake and faecal-N for control group were significantly ($P<0.05$ and $P<0.01$, respectively) higher than the other groups. The obtained weight gain in rabbits fed basal diet supplemented with Mint extract (1 cm^3/kg diet) could realize the highest economical efficiency at 14 weeks of age.

INTRODUCTION

Laboratory tests on growing rabbits showed temperatures increased from 5 to 30°C, intake of pelleted feed dropped from 180g to 120g a day (EBERHART, 1980).
Decreasing the feed consumed in summer affect the weight gain of the growing rabbits, therefore looking for methods to improve feed efficiency performance has an interest.
Anise crop (*Pimpinella Anişum* L.) and Mint plant (*Mentha spicata*) considered digestive, gastric activator and intestinal quieten are local plants for Mediterranean Sea countries such as Egypt (HYKEL and OMAR, 1988 ; TALAS, 1989).
The present work was carried out to study the effect of adding Anise or Mint extract (natural flavours) in two levels 1 or 2 cm^3/kg concentrate pelleted diet on New Zealand White (NZW) growing performance during the summer (June-August), in Egypt.

MATERIAL AND METHODS

The present study was conducted at the Rabbitry of the Department of Animal Production, Faculty of Agriculture, Zagazig University during the summer of 1995.
A total of 75 weanling NZW rabbits (5 weeks old), were divided into five groups (15 rabbits each) nearly equal in the average of body weight according to the pelleted concentrate basal diet supplemented with Anise or Mint extracts (volatile oils). Group I served as a control and was fed a basal pelleted diet without additives, group II and III were fed the basal pelleted diet supplemented with Anise extract (1 and 2 cm^3/kg diet), respectively and group IV and V were fed the basal pelleted diet supplemented with Mint extract (1 and 2 cm^3/kg diet), respectively.
The composition and chemical analysis of the experimental diet are shown in Table 1. The chemical routine analysis for basal diets, faeces and urine was done according to A.O.A.C. (1980). Digestible energy (DE) of one kilogram feed of each experimental ration was calculated according to the following equation described by MAERTENS and DE GROOTE, 1987:

$$DE\ (kcal/kg) = 7.1\ (CP, g/kg) + 12.0\ (EE, g/kg) + 5.59\ (NFE, g/kg) - 1801.$$

Table 1 : Ingredients and chemical analysis of the basal commercial pelleted diet.

Ingredients	%	Chemical analysis % (as fed)	%
Barley grain	32.00	DE (kcal/kg diet fed)	2451"
Wheat bran	21.00	Dry matter	90.79
Berseem hay	28.00	Crude protein	15.85
Soybean meal	10.00	Ether extract	3.11
Corn gluten (60% cp)	1.35	Crude fibre	12.84
Decorticated cotton seed meal	3.00	Nitrogen free extract	49.25
Molasses	3.00	Ash	9.74
Limestone	1.00	Calcium	0.85
Premix*	0.30	Phosphorus	0.59
Common salt	0.25	Lysine	0.82
Dl-Methionine	0.10	Methionine + Cystine	0.60
Total	100.00		

* One kilogram of premix provides: Vit. A 2000.000 IU, Vit. D_3 150.000 IU, Vit. E 8.33g, Vit. B_1 0.33g, Vit B_2 1.0g, Vit. B_6 0.33g, Vit B_{12} 1.7mg, Vit B_5 8.33g, Pantothenic acid 3.33g, Biotine 33mg, Folic acid 0.83g, Cholin chloride 200g, Zn 11.7g, Mn 5g, Fe 12.5g, Cu 0.5g, I 33.3 mg, Se 16.6 mg, Mg 66.7 g.

" Inclusion of the natural flavour oils to the basal commercial pelleted diet of the rabbits increased DE content from 2451 (kcal/kg) to 2461, 2487, 2472, and 2489 (kcal/kg), increased ether extract from 3.11% to 3.39, 3.67, 3.45 and 3.71% and slightly decreased NFE content from 49.25 to 48.84, 48.69, 48.91 and 48.65% for control, Anise extract (1 and 2 cm^3) and Mint extract (1 and 2 cm^3)/kgdiet respectively.

The determined amounts of volatile oils (Anise or Mint) were sprayed over the feed before supplement it to the rabbits.

All rabbits were kept under the same managerial and hygienic conditions and were housed in batteries provided with feeders and automatic drinkers. Each group (15 rabbits) was housed in five cages. The batteries were located in a conventional confined and windowed building, naturally ventilated by electric fans. The average of air temperature were 23.2, 25.0, and 26.0°C minimum and 30.0, 30.6 and 31.7°C maximum for June, July and August, respectively and the corresponding values of relative humidity ranged from 82.5, 94.2 and 99.4% at 8 a.m. to 50.8, 61.9 and 64.4% at 3 p.m.

All rabbits and feed were weighed at 5, 9, 13 and 14 weeks of age permitting calculations of average gain (g), feed intake (g feed/day) and feed conversion (g feed/g gain) for the whole interval from 5 weeks to slaughter at 14 weeks and for subintervals (5-9, 9-14 and 13-14 weeks of age) were performed. At the end of the experimental period, 3 rabbits from each group were randomly taken for slaughter after fasting for 12 hours. After complete bleeding the carcass and some non-carcass components, were weighed.

For the digestibility trial, 15 male rabbits aged 14 weeks (3 from each group) were housed individually in metabolic cages. Digestibility trial lasted 15 days (10 days as a preliminary period and 5 days as a collection period). Samples from both feed offered and faeces of each animal were taken daily during the collection periods for chemical analysis which were carried out according to A.O.A.C. (1980). Urine samples containing 10% H_2 $S0_4$ solution were collected from each animal over the entire collection period for nitrogen determination.

Blood samples were taken at the time of slaughter to estimate some blood constituents. Blood serum was separated during 1 hour by centrifugation and stored at 20°C until assay for total protein, total lipids, glucose, cholesterol and creatinine.

The data were analysed according to SNEDECOR and COCHRAN (1982) using the following model :
$Y_{ij} = U + t_i + e_{ij}$, where : U = overall mean, t_i = effect of treatment and e_{ij} = Random error.
Differences among treatments were statistically tested using the DUNCAN's New Multiple Range test (1955).
Mortality rates were analysed according to EVERITT (1977).
Economical efficiency (Y) of the experimental rations was calculated according to the following equation :
Y = [(A-B)/B] x 100, where : A is the selling cost of the obtained gain and B is the feeding cost of this gain.
The performance index (PI) was also calculated according to NORTH (1981) using the following equation:
PI = (live weight/feed conversion) x 100.

RESULTS AND DISCUSSION

Digestibility and nutritive value

Data concerning values of nutrients digestibility, nutritive value of the experimental diets and nitrogen utilization by growing rabbits are presented in Table 2. Addition of natural flavour oils to the basal commercial pelleted diet during summer generally improved digestibility coefficient of nutrients although the improvement was significantly ($P<0.05$) only for crude protein. It could be observed that addition of Mint in a level of 1 cm^3/kg diet was the most effective followed by Mint 2 cm^3, Anise 1 cm^3, Anise 2 cm^3/kg diet and control group, respectively. The feeding values of the experimental diet expressed as TDN and DCP, as well as N-retained (Table 2) showed that rabbits utilized the ration more efficiently when Mint was added either to the concentrate 1 or 2 cm^3/kg diet or when adding 1 cm^3 Anise/kg diet than the other two groups (Anise 2 cm^3/kg diet and the control diet). This might be due to that flavour oils considered a source of energy which increased ether extract content of the ration. Consequently flavour oils caused an improvement in nutrients digestibility coefficients and utilization of the ration. The rabbits fed control diet had significantly ($P<0.05$ and 0.01) higher values of N-intake and faecal-N than the other four treated groups. The results in the present study agreed with the results of FEKETE and LEBAS (1983).

Table 2 : Digestibility coefficients (%), nutritive values and nitrogen utilization ($\bar{X}$+SE) by growing NZW rabbits fed basal diet supplemented with flavour oils.

Items	Control group	Treated groups				Sign.
		Anise extract		Mint extract		
		1 cm^3/kg	2 cm^3/kg	1 cm^3/kg	2 cm^3/kg	
Digestibility coefficient (%):						
DM	69.56 ± 0.38	72.00 ± 0.83	70.66 ± 0.47	72.57 ± 1.10	71.40 ± 0.53	NS
OM	70.39 ± 0.34	72.40 ± 1.57	70.72 ± 0.61	73.74 ± 0.56	72.10 ± 0.75	NS
CP	70.30^{b} ± 0.40	72.42^{a} ± 0.55	71.36^{b} ± 0.67	74.60^{a} ± 0.59	72.83^{a} ± 1.19	*
EE	75.93 ± 0.82	77.62 ± 1.70	76.67 ± 1.80	78.20 ± 2.45	77.60 ± 1.10	NS
CF	30.72 ± 1.32	31.76 ± 1.81	30.96 ± 0.81	32.78 ± 1.55	32.57 ± 1.40	NS
NFE	72.16 ± 0.18	74.39 ± 0.54	73.36 ± 0.57	75.25 ± 0.84	74.98 ± 0.92	NS
Nutritive value:						
TDN (%)	55.92^{b} ± 0.19	57.89^{a} ± 0.39	57.33^{b} ± 0.55	58.74^{a} ± 0.99	58.67^{a} ± 0.71	*
DCP(%)	11.14^{b} ± 0.07	11.48^{a} ± 0.09	11.31^{b} ± 0.10	11.82^{a} ± 0.09	11.54^{a} ± 0.19	*
Nitrogen utilization:						
N-intake (g/day)	2.43^{a} ± 0.01	2.36^{b} ± 0.02	2.28^{c} ± 0.03	2.33^{bc} ± 0.01	2.35^{b} ± 0 02	*
Faecal-N (g/day)	0.65^{a} ± 0.01	0.52^{b} ± 0.01	0.47^{c} ± 0.01	0.44^{c} ± 0.01	0.50^{bc} ± 0.01	**
Urinary N (g/day)	1.12 ± 0.01	1.14 ± 0.01	1.17 ± 0.01	1.12 ± 0.01	1.13 ± 0.01	NS
N-retained						
(g/head/day)	0.66^{b} ± 0.02	0.70^{a} ± 0.01	0.64^{b} ± 0.02	0.77^{a} ± 0.01	0.72^{a} ± 0.02	*
(% of intake)	27.16a ± 0.75	29.66^{bc} ± 0.24	28.07^{c} ± 0.57	33.05^{a} ± 0.43	30.64^{b} ± 0.48	**

^{a,b,c} means in the same row with different superscripts significantly differ ($P<0.01$ and 0.05) ; ** ($P<0.01$) * ($P<0.05$)
NS = not significant.

Growth performance

Results presented in Table 3 show the effect of feeding growing NZW rabbits (from 5 to 14 weeks of age) pelleted diet supplemented or not with two levels of any Anise or Mint extract as natural flavour oils on growth performance, performance index and economic efficiency.

The weight gain obtained from 13-14 weeks of age increased significantly ($P<0.01$) for groups fed diet with Mint or Anise extract (1 cm^3) than the other experimental groups. These results might be due to the better digestion for crude protein and the better nutritive values (TDN and DCP) which were observed from these groups (Table 2). These results agreed with that results of FEKETE and LEBAS (1983). The significant ($P<0.001$) least amounts of the diet which were consumed by the treated groups either with Mint or Anise extract than control group might be due to the effect of increasing the percentage of ether extract in the diet which reflected in increasing the energy content of its diet. The significant ($P<0.001$) best feed conversion values were obtained from the rabbits fed diet supplemented with any of the two levels Anise or Mint extracts (1 or 2 cm^3/kg diet) when compared with control group during the whole period of the experiment. Mortality rate did not differ significantly among the experimental groups.

Table 3 : Mortality rate %, body weight gain, daily feed consumed, feed conversion performance index, and economical efficiency of growing NZW rabbits as affected by feeding pelleted diet supplemented with two levels of Anise or Mint extract (as volatile oils).

Traits	Control group	Treated groups			
		Anise extract		Mint extract	
		1 cm^3/kg diet	2 cm^3/kg diet	1 cm^3/kg diet	2 cm^3/kg diet
Initial number of rabbits	15	15	15	15	15
Final number of rabbits	13	12	12	13	13
Mortality rate %	13.33	20.00	20.00	13.33	13.33
Body weight (g) at 5 weeks:	749 ± 20	750 ± 39	754 ± 37	755 ± 48	749 ± 30
Weight gain (g):					
5-9 weeks	541 ± 45	498 ± 27	486 ± 44	577 ± 53	571 ± 32
9-14 weeks	656 ± 75	808 ± 50	684 ± 50	782 ± 41	710 ± 53
5-14 weeks	1196 ± 82	1235 ± 82	1205 ± 64	1382 ± 52	1280 ± 44
13-14 weeks	110^{c} ± 13	178^{a} ± 13	113^{c} ± 15	162^{ab} ± 11	132^{bc} ± 14**
Daily feed consumed:					
5-9 weeks	70.70^{a} ± 1.15	69.00^{ab} ± 0.76	62.79^{c} ± 1.04	66.30^{bc} ± 1.99	65.84^{bc} ± 0.81**
9-14 weeks	101.71^{a} ± 0.58	102.00^{a} ± 0.69	97.51^{b} ± 0.87	96.14^{b} ± 1.51	96.34^{b} ± 1.45**
5-14 weeks	87.92^{b} ± 0. 58	$87. 27^{a}$ ± 1.73	82.12^{b} ± 1 .23	82.80^{b} ± 0.10	82.69^{b} ± 0.54**
13-14 weeks	112.00^{a} ± 1.15	111.13^{ab} ± 0.99	107.30^{bc} ± 0.58	105.70^{c} ± 0.90	105.91^{c} ± 0.05**
Feed conversion					
5-9 weeks	3.66^{b} ± 0.01	3.88^{a} ± 0.05	3.61^{b} ± 0.01	3.22^{c} ± 0.01	3.23^{c} ± 0.05**
9-14 weeks	5.44^{a} ± 0.01	4.42^{d} ± 0.02	5.00^{b} ± 0.01	4.31^{e} ± 0.04	4.74^{c} ± 0.01**
5-14 weeks	4.63^{a} ± 0.01	4.45^{b} ± 0.03	4.30^{c} ± 0.01	3.78^{e} ± 0.04	4.07^{d} ± 0.02**
13-14 weeks	7.13^{a} ± 0.01	4.37^{e} ± 0.03	36.66^{b} ± 0.03	4.58^{d} ± 0.01	5.60^{c} ± 0.03**
Performance index (%)					
5-14 weeks	42.1	46.2	46.1	56.9	49.7
Economical efficiency					
5-14 weeks	174.9	153.5	136.3	199.1	149.2

^{a,b,c,d,e} means in the same row with different superscripts significantly differ (P<0.01 and P<0.05). The price of one kilogram of each of pelleted diet, Anise or Mint extracts and rabbit live meat were (0.55, 70.0 and 7.00 L.E., respectively).

All the treated group with Anise or Mint extracts showed higher values of performance index than the control group. However, only the group of rabbits fed pelleted ration plus Mint extract (1 cm^3/kg diet) surpassed in economical efficiency than control group. The reason that the other treated groups had lower economical efficiency values when compared with control may be due to the higher cost of their rations in spite to the higher obtained gain.

Physiological and blood biochemical changes

Physiological body reactions and blood metabolites ($\bar{X}$ + S.E) in the growing NZW rabbits as influenced by flavour oils (Anise or Mint extracts supplemented to the diet are presented in Table 4.

Physiological body reactions studied traits in the present study did not show any significant (P<0.05) difference among the experimental groups.

The rabbits fed with the diet supplemented with Mint extract (1 cm^3/kg diet) had the higher values for each of total protein, creatinine, total lipids, cholesterol and glucose than the other experimental groups. The differences among groups differed significantly (P<0.05), except in glucose level.

Table 4 : Physiological body reaction and blood metabolites ($\bar{X}$+SE) in growing NZW rabbits as influenced by feeding pelleted diet supplemented with two levels of Anise or Mint extract (flavour oils) under subtropical conditions.

Traits	Control group	Treated groups			
		Anise extract		Mint extract	
		1 cm^3/kg diet	2 cm^3/kg diet	1 cm^3/kg diet	2 cm^3/kg diet
Physiological body reactions					
Rectal temperature (°C)	39.30 ± 0.13	39.18 ± 0.12	39.18 ± 0.16	39.44 ± 0.14	39.47 ± 0.11
Respiration rate (Res./mm)	91.80 ± 5.66	90.50 ± 3.80	90.70 ± 6.35	105.20 ± 6.94	102.60 ± 5.17
Pulse rate (beats/mm)	103.60 ± 5.93	104.60 ± 6.39	105.20 ± 5.57	107.20 ± 5.66	121.00 ± 3.00
Blood metabolites:					
Total protein (g/dl)	5.31^{d} ± 0.07	5.60^{c} ± 0.09	5.71^{c} ± 0.04	6.50^{a} ± 0.09	6.11^{b} ± 0.10
Creatinine (mg/dl)	1.01^{d} ± 0.02	1.11^{c} ± 0.03	1.19^{b} ± 0.03	1.29^{a} ± 0.02	1.21^{b} ± 0.04
Total lipids (mg/dl)	283.00^{c} ± 10.13	335.67^{b} ± 18.88	345.00^{b} ± 11.60	394.00^{a} ± 9.25	351.67^{ab} ± 20.60
Cholesterol (mg/dl)	82.33^{c} ± 6.07	95.67^{bc} ± 10.69	109.00^{abc} ± 11.56	145.00^{a} ± 17.34	113.00^{abc} ± 8.67
Glucose (mg/dl)	121.33 ± 7.52	122.33 ± 6.37	128.33 ± 9.27	146.00 ± 8.40	144.67 ± 7.32

^{a,b,c,d} means in the same row with different superscripts, differ significantly (P<0.05).

Carcass traits

The results of carcass traits determination weights are presented in Table 5. All the traits studied in the present investigation did not show any significant ($P<0.05$) differences.

As a general conclusion from the previous results in the present study, it can be recommended to add Mint extract with the concentration of 1 cm^3/kg diet to the NZW growing rabbit rations during summer to improve digestibility coefficients and feed utilization which lead to increase the marketing weight on performance index and economic efficiency basis.

Table 5 : Carcass traits of growing NZW rabbits fed pelleted diet supplemented with two levels of Anise or Mint extract (flavour oils).

Traits	Control group	Treated groups			
		Anise extract		Mint extract	
		1 cm^3/kg diet	2 cm^3/kg diet	1 cm^3/kg diet	2 cm^3/kg diet
Pre-slaughter weight (g)	1930 ± 67	1068 ± 154	2005 ± 58	2093 ± 133	2050 ± 25
Blood %	2.24 ± 0.31	3.30 ± 0.06	2.66 ± 0.36	2.80 ± 0.11	2.44 ± 0.12
Head %	5.53 ± 0.11	5.36 ± 0.49	5.82 ± 0.40	5.49 ± 0.06	5.36 ± 0.34
Alimentary tract ± legs ± fur %	37.7 ± 1.0	35.7 ± 1.1	35.4 ± 0.5	36.6 ± 0.8	36.9 ± 0.1
Giblets (liver ± heart ± kidneys)	%3.54 ± 0.12	3.75 ± 0.24	3.99 ± 0.35	3.65 ± 0.12	3.34 ± 0.11
Carcass weight * %	51.7 ± 1.0	51.5 ± 0.5	52.6 ± 0.5	52.1 ± 0.5	51.8 ± 0.5

* carcass weight without head.

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