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ADDITIONAL ENERGY SUPPLEMENTS IN THE DIET FOR FATTENING RABBITS

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SUMMARY: *A total of 32 males weaned New Zealand White (NZW) rabbits (7 weeks of age) were divided into 4 groups (8 each) to be used in a study aimed to utilize the animal and vegetable fats (tallow and palm oil) and starch in pelleted diets as additional energy source in feeding growing rabbits compared with the basal diet (without additional energy source) in Egypt.*

Results obtained indicated that supplementation growing rabbit grower diets with tallow improved significantly (P< 0.05) the EE digestibility,Final body weight at markting age (13 wks), daily weight gain, serum total lipids and serum cholesterol than the other groups. Carcass traits and chemical composition of meat did not differ significantly among the studied groups. However the grower diet group were of less feed intake and of lower feed cost and gave the best economical efficiency %. The return from the improved performance by the additional tallow did not compensate the expensive diet. The results rejected the additional energy resources to the grower diet and concluded that 2500 kcal DE pelleted diet is adequate for growth and carcass performance in rabbits.

Key words: *Additional energy supplements, tallow, palm oil, starch, fattening rabbits, digestibility, nutritive value, growth performance, carcass traits, blood constituents, economical efficiency.*

INTRODUCTION:

King (1981) found increased gains and feed efficiency when 5 and 8% vegetable oil were added to a typical commercial type diet. Partridge et al.(1986) examined the effect of the addition of either 6 or 10% fat (both saybean oil and tallow were tested) to diets for growing rabbits and found a slight improvement in growth rate and an improved feed conversion efficiency. Added fat may increase feed palatability and tends to reduce the dustiness of feeds, which may increase the acceptability of high roughage diets (Cheeke, 1974).

It is well recognized that vegeteble oils are more digestible and have a higher energy value than do animal fats in poultry and in rabbits also (Maertens et al., 1986). The results indicated that tallow has lower digestibility and lower energy value than vegetable oils.

Adding fat to the diet can either increase performance (Besedina, 1977) or decrease it (Parigi Bini et al., 1977) or have no effect on it (Lebas, 1975).

The aim of the present work was to study the effect of the addition of either tallow and palm oil or starch to the diet of the growing rabbits on the growth performance, digestibility of nutrients, carcass traits, chemical composition of meat and some blood constituents of New Zealand White growing rabbits.

MATERIALS AND METHODS

This study was carried out on the rabbit flock, National Rabbit project, Animal Production Departement, Faculty of Agriculture, Zagazig University, from January to March, 1993.

A total number of 32 weanling NZW rabbits of seven weeks of age, were divided into four groups (8 each). The first group was used as a control and the other three groups were supplemented with different energy sources. The first group was fed on a commercial grower pelleted diet (the control), the second, the third and fourth groups were fed on the grower diet + 4% tallow, 3% palm oil and 10% starch, respectively.

Ingredients and chemical composition of these 4 rations are presented in Table 1.

The animals were raised in a flat deck battary system. All battaries were located in a windowed house, naturally ventilated and provided with electric fans. The batteries were also accomodated with feeders and automatic drinkers. The animals were allotted each four rabbits in a cage unit. All the experimental rabbits were kept under the same managerial and hygienic conditions.

Regarding digestibility trials, four NZW growing rabbits from each experimental group were taken at the end of the experimental period and were housed individually in metabolic cages with special modifications. The experimental diets were offerd twice daily at 9.00 and 18.00 hr. The collection period was five days. The collected samples of faeces and urine were analysed according to A.O.A.C (1980). All values of chemical analysis were experessed on dry matter basis. Digestible energy was calculated according to Cheeke (1987). The starch was determined by Bomb Calorimeter (Julius Peters, Berlin, West Germany).

Rabbits were individually weighed weekly from 7 to 13 weeks of age. Feed intake was recorded. Feed conversion and weight gain were estimated. Economical efficiency at 13 weeks of age was calculated according to the following equation:

$$Y = \frac{A - B}{B} X\, 100$$

Where:
A is the selling price of the obtained gain and B is the feeding cost of this gain.

By the end of the experiment three animals were taken randomly from each experimental group and were slaughtered to estimate the carcass traits and chemical composition of the meat. During the slaughtering procedure, about five millimeters of blood were collected into heparinized centrifuge tubes and centrifuged at 2000 r.p.m. for 15 minutes. The plasma was stored in a deep freezing at - 20°C until analysis for plasma chemical analysis.

Analysis of variance was carried out according to snedecor and cochran (1982). The following model was used:

$$Y_{ik} = U + t_i + e_{ik} \text{ where :}$$

Y_{ik} = An observation, U = Over all means, t_i = Effect of different additional energy source i (1-4), e_{ik}

=Random error. Significant differences were determined by Duncan's method (Duncan 1955).

RESULTS AND DISCUSSION

Results in Table 2 indicate that the dry matter intake was higher for the group fed on the grower diet without additional energy sources while the lowest feed intake was for the group fed on the grower diet + tallow although the average initial weight of this group on basal matabolic weight basis was the heaviest. The DM, OM, Cp, CF and NFE digestibility coefficient % for group 4 fed on the grower diet + starch were higher than the corresponding values in the other groups. The EE digestibility % was the highest for group 2 fed on the grower diet + tallow. Cheeke and Patton (1980) proposed that with diets high in starch, carbohydrate overload of the hindgut may occur, provoking enteritis. However, the present results (Table 3) and these of Wolter et al., (1980) do not seem to support this hypothesis as mortality was not affected. The carbohydrate stress was not appear as the rabbits were of 7 week-old at the start. In general, cereal, starch (in the present work) are more readily digested than other starch resources. Parigi-Bini et al. (1974) reported that the percentage digestibility of the fat in diets containing 5 to 10% beef tallow to be 85 - 89% in rabbits. Additional tallow (4%) to the grower diet in the present study resulted in 83.97% digestibility. The NFE digestibility % was the highest for the grower diet + starch of group 4 (86.54%) as it is the diet composed of starch, beside the sugars and the other readily digestible carbohydrates when compared with the other diets in the present study. Although the grower diet was of higher DCP digestibility than the other diets, the difference among the groups was not significant ($P \leq 0.05$) The nitrogen intake was the highest for the group fed on the grower diet only and the N-absorbed showed the same trend and N-balance was the highest for the group fed on the grower diet and the additional starch.

Results in Table 3 show the heavier final weight, the heavier daily gain and body gain/ 100 g body weight and the better feed conversion efficiency and the highest return from body gain, for the rabbits of group 2 fed on grower diet + tallow in comparison with the corresponding in the other three groups. The lower feed intake and the lower feed cost of the group 1 fed on the grower diet resulted in the best economical efficiency % among the four experimental groups of the study. It is worthy to note that the growth performance and the feed conversion values were similar among the grower diet; the grower diet + palm oil and the grower diet + starch groups in spite of the additional energy source in 3rd and fourth groups. It may be concluded that although the additional tallow to the grower diet resulted in better performance, the economical efficiency indicates the higher cost of the feed relatively to the return from body gain. The economical efficiency of the additional palm oil and starch did not show any advantage on the performance but were expensive from the economical point. The present results may support the findings of Besedina, (1977) that adding fat to the diet can increase the performance, but from the economic point it is not advantageous. Also, the present results may support the recommondation of Maertens (1992) that the fattening pelleted diet should composed of only 2350 - 2400 kcal DE/kg feed. The additional fat or any energy source above these levels is not advantageous and expensive for rabbits from the economical efficiency point of view.

Carcass traits and chemical

analysis of meat (Table 4) did not show any significant effect concerning the additional energy sources to the grower diet. While the blood analysis clarified the highest total lipids and cholestral (mg/100ml) in the blood of rabbits fed on additional tallow in the grower diet and the highest estimate of throxine (T_4) in the blood of the group fed on additional starch in the grower diet. The high total lipids and cholestrol lipids in blood is related with the high digestibility % of EE in the grower diet + tallow (83.97%) in comparison with the corresponding values in the other three groups. The higher value of thyroxine (T_4) content is related to the higher digestibility values of the other nutrients (Table 2) in the grower diet + starch and the higher TDN and DE values as well.

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Table (1): Ingredients and chemical analysis of the experimental diets.

Energy Sources	1	2	3	4
Items	Grower diet (control)	Grower diet + Tallow	Grower diet + Palm oil	Grower diet + Starch
Ingredients (%)				
Barley (ground)	32.00	32.00	32.00	32.00
Berseem hay	28.00	28.00	28.00	28.00
Cotton seed meal	3.00	3.00	3.00	3.000
Soybean meal	10.00	10.00	10.00	10.00
Wheat bran	21.00	21.00	21.00	21.00
Molasses	2.85	2.85	2.85	2.85
Mixture of vitamins and minerals*	0.30	0.30	0.30	0.30
Bone meal	2.50	2.50	2.50	2.50
Sodium chloride	0.25	0.25	0.25	0.25
DL-Methionine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Inclusion of:	-	-	-	-
Tallow	-	4.00	-	-
Palm oil	-	-	3.00	-
Starch	-	-	-	10.00
Chemical analysis:	-	-	-	-
Calculated DE (kcal/kg diet)	2525	2785	2780	2820
DM %	92.90	91.50	91.90	89.80
OM %	82.14	80.97	81.32	80.51
CP %	16.20	15.75	16.08	15.60
CF %	14.40	14.30	14.20	14.60
EE %	1.80	5.20	4.90	2.00
NFE %	49.74	45.72	46.14	48.31
ASH %	10.76	10.53	10.58	9.29
C/P ratio	155.86	176.82	172.89	180.77
Cost of each Kg/diet (L.E)	0.48	0.52	0.51	0.53

* Each 1Kg of the mixture contains: vit. A 2000.00 Iu-vit.D3 150.00Iu-VitE 8333.33 mg vit.K 333.3 mg-Vit.B_1,333.3mg-vitB2 1000.0 mg-vit B_6 333.3 mg-vitB12 1.67 mg pantothenic acid 333.3 g-Nicotinic acid 833.3 mg-Folic acid 833.3 mg-choline chloride 200.0 mg-Biotin 33.3 mg-Manganese 500 mg-Zinc 11666.67 mg-Iron 12500 mg-copper 500 mg-cobalut 16.b7 mg-Iodine 33.33 mg-Selenium 16.6 mg-Magnisum 66666.67 mg.

Table (2): Digestion coefficient, nutritive value and N-utilization of growing NZW rabbits (7-13 weeks of age) as affected by different energy sources.

Energy sources	1	2	3	4
Items	Grower diet (control)	Grower diet + Tallow	Grower diet + Palm oil	Grower diet + Starch
Average initial weight:				
Kg/h	1.36 ± 0.16^{bc}	1.89 ± 0.03^{a}	1.56 ± 0.13^{b}	1.13±0.06^{c}
$KgW^{0.75}$	1.26 ± 0.11^{bc}	1.61 ± 0.03^{a}	1.39 ± 0.09^{b}	1.09±0.05^{c}
Dry matter intake:				
g/h/d	109.39 ± 0.79^{a}	103.85 ±2.03^{a}	103.62±0.79^{a}	80.82±3.42^{a}
g/KgW 0.75	86.82 ± 8.28^{d}	64.50 ± 2.48^{b}	74.55±4.62^{d}	74.15±4.08^{a}
Digestion coefficient (%)				
DM	67.77 ± 1.04^{b}	63.59 ± 1.32^{c}	63.60±1.11^{c}	71.99±0.84^{a}
OM	68.49 ± 1.03^{b}	63.52 ± 1.33^{c}	63.35±1.17^{c}	72.70±0.79^{d}
CP	71.18 ± 0.62^{a}	70.28 ± 0.64^{a}	69.69±1.13^{a}	73.00±1.09^{a}
CF	23.03 ± 1.39^{ab}	24.68 ± 1.88^{a}	18.27±1.98^{b}	26.62±1.16^{a}
EE	68.99 ± 0.95^{c}	83.97 ± 0.53^{a}	79.61±1.17^{b}	65.60±1.25^{d}
NFE	80.71 ± 1.24^{b}	69.09 ± 2.94^{c}	73.12±1.13^{c}	86.54±0.84^{a}
Nutritive value:				
DE(Kcal)	2525	2785	2780	2820
TDN(%)	61.77±0.92^{b}	60.76 ± 1.82^{b}	60.94±1.06^{b}	66.54±0.72^{a}
DCP (%)	12.15 ± 0.11^{a}	11.59 ± 0.10^{a}	11.69±0.19^{a}	11.58 ±0.18^{a}
N-utilization:				
N-intake: g/h/d	3.11 ± 0.02^{a}	2.86 ± 0.06^{b}	2.90±0.02^{b}	2.14±0.09^{c}
$g/Kgw^{0.75}$	2.47 ± 0.24^{a}	1.78 ± 0.07^{b}	2.09±0.13^{ab}	1.96±0.11^{b}
N-ecxcreted: Fecal-N	0.90 ± 0.02^{a}	0.85 ± 0.03^{a}	0.88±0.03^{a}	0.58±0.04^{b}
Urinary-N	1.35 ± 0.02^{a}	1.01 ± 0.02^{c}	1.15±0.01^{b}	0.71±0.01^{d}
Total-N	2.25 ± 0.03^{a}	1.86 ± 0.04^{c}	2.03±0.04^{b}	1.29±0.03^{d}
N-Absorbed	2.21 ± 0.03^{a}	2.01 ± 0.04^{b}	2.02±0.06^{b}	1.56±0.06^{c}
N-balance: g/h/d	0.86 ± 0.03^{a}	1.0 ± 0.04^{a}	0.87±0.06^{a}	0.85±0.06^{a}
g/kgw 0.75	0.68 ± 0.14^{a}	0.62 ± 0.03^{a}	0.63±0.10^{a}	0.78±0.07^{a}

a, b, c, d, Means with different superscripts in the same row differ significantly ($p < 0.05$).

Table (3): Growth performance and economical efficiency of growing NZW rabbits (7-13 weeks of age) as affected by different energy sources.

Energ sources	1	2	3	4
Items	Grower diet (control)	Grower diet + Tallow	Grower diet + palm oil	Grower diet + Starch
Initial number of rabbit	8	8	8	8
Live weight (9)				
Initial (7 weeks of age)	841.0±51.0 [a]	835.0±47.0 [a]	826.0±38.0 [a]	872.0±23.0 [a]
Final (13 weeks of age)	1713.0±148.0 [a]	2061.0±62.0 [a]	1729.0±134.0 [a]	1778.0±90.0 [a]
Daily gain (g/d)				
7-13 weeks	20.8±2.7 [b]	29.2±1.9 [a]	21.5±2.6 [b]	21.6±1.8 [b]
Body gain (g) per 100 g body weight:				
7-13 weeks	68.29	84.67	70.68	68.38
Feed Intake (g/d)				
7-13 weeks	88.0±3.4	115.0±3.5	94.0±3.6	100.0±3.1
Feed conversion (g feed/g gain)				
7-13 weeks	4.2	3.9	4.4	4.6
Feed cost*				
7-13 weeks	1.76	2.49	2.03	2.21
Return from body gain **				
7-13 weeks	4.80	6.74	4.97	4.98
Economical efficiency %	172.73	170.68	144.83	125.34

a, b means with defferent superscripts in the same row differ significantly ($P < 0.05$)

* Price 1 Kg of ration, 0.48, 0.52, 0.51 and 0.53 L.E for groups 1, 2, 3, and 4, respectively.

** Price of selling 1 Kg rabbit live weight = 5.5 L.E.

Table (4): Carcass traits and chemical analysis of meat for growing NZW rabbits (7-13 weeks of age) as affected by different energy sources.

Energy sources		1	2	3	4
Items		Grower diet (control)	Grower diet + tallow	Grower diet + palm oil	Grower diet + Starch
Pre-slaughter weight	(g)	1911.7±132.1	1991.7±54.7	1916.7±164.9	1940.0±15.3
Dressing weight	(g)	1055.0±71.1	1113.3±3.3	1048.3±127.2	1030.0±26.5
	(%)	55.2±0.5	55.9±1.3	54.7±2.1	53.2±0.5
Liver weight	(g)	53.3±4.4	56.7±1.7	51.7±3.3	53.3±3.3
	(%)	2.8±0.2	2.8±0.1	2.7±0.1	2.7±0.2
Forlimbs weight	(g)	250.0±23.6	281.7±14.8	245.0±36.2	248.3±4.4
	(%)	13.1±0.3	14.1±1.0	12.8±0.9	12.8±0.1
Trunk weight	(g)	296.7±33.7	305.0±10.4	283.3±23.8	266.7±21.8
	(%)	15.5±0.7	15.3±0.6	14.8±0.5	13.7±0.8
Hindlimbs weight	(g)	388.3±13.0	405.0±7.6	396.7±48.4	381.7±1.7
	(%)	20.4±0.7	20.3±0.2	20.7±0.9	19.8±0.1
Clemical analysis (%)					
Moisture		69.7±0.1	69.5±0.3	69.6±0.3	69.9±0.1
CP		20.5±0.3	20.2±0.1	20.0±0.1	20.4±0.4
EE		6.2±0.5	6.6±0.4	6.3±0.2	6.3±0.2
Ash		2.6±0.1	2.7±0.2	2.6±0.2	2.4±0.3

All the differences between means were not statistical significant ($p<0.05$).

Table(5): Blood components of growing NZW rabbits (7-13 weeks of age) as affected by different energy sources.

Energy sources	1	2	3	4
Items	Grower diet (control)	Grower diet + tallow	Grower diet + palm oil	Grower diet + Starch
Thyroxine (T_4) (mg/ml)	1.40 ± 0.06^{b}	1.40 ± 0.17^{b}	1.20 ± 0.06^{b}	2.05 ± 0.14^{a}
Total Protein (g/100ml)	5.91 ± 0.03^{a}	5.57 ± 0.12^{b}	5.90 ± 0.01^{a}	6.02 ± 0.05^{a}
Albumin (A) (g/100ml)	3.02 ± 0.04^{a}	2.85 ± 0.06^{b}	2.97 ± 0.03^{ab}	3.05 ± 0.03^{a}
Globulin (G) (g/100ml)	2.89 ± 0.05^{a}	2.72 ± 0.07^{a}	2.93 ± 0.04^{a}	2.97 ± 0.02^{a}
A/G ratio	1.04 ± 0.01^{a}	1.05 ± 0.01^{a}	1.01 ± 0.01^{a}	1.03 ± 0.01^{a}
Total lipids (mg/100ml)	249.0 ± 4.62^{d}	333.0 ± 3.74^{a}	305.0 ± 2.31^{b}	288.30 ± 0.88^{c}
Cholesterol (mg/100ml)	89.0 ± 0.58^{b}	125.0 ± 6.93^{a}	79.0 ± 6.94^{b}	89.0 ± 1.15^{b}
Creatinine (mg/100ml)	0.96 ± 0.03^{a}	0.91 ± 0.01^{a}	0.87 ± 0.05^{a}	1.0 ± 0.06^{a}

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