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EFFECT OF PROTECTED FAT SUPPLEMENTATION ON PRODUCTION AND SOME PHYSIOLOGICAL CHANGES OF NEW ZEALAND WHITE RABBITS

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SUMMARY

A total number of 30 mature New Zealand White doe rabbits (NZW) were used to study the effect of protected fat supplementation (Magnapac)® on some physiological changes and production. Does were randomly divided into three diet treatment groups. The 1st group (control) was fed the basal diet without Magnapac, groups 2 and 3 were fed the basal diet supplement by 2% and 4% Magnapac, respectively. Blood samples were taken from does and bunnies.

Does fed diet supplemented with 2% Magnapac had the best values of litter weight at weaning and feed intake decreased by around 11% from the case of control diet by either 2% or 4% Magnapac. Growth rate of bunnies fed 4% Magnapac was higher by 10% and 20% than those fed 0% or 2% Magnapac, respectively. Daily growth rates were 0.67, 0.77 and 0.88% in control, 2% and 4% Magnapac, respectively. The heaviest value for carcass weight was recorded with 2% followed by 4% Magnapac and control group.

The results showed that the does in group (1) have the highest level of blood glucose. Addition of 4% Magnapac gave the highest levels of total protein, albumin and globulin. Level of cholesterol increased as the percentage of Magnapac supplement increased. The highest concentration of T_3 was found in does fed 4% Magnapac followed by 2% and control. The highest level of calcium was found in does fed 2% Magnapac. Sodium in serum of does decreased as the Magnapac in the diet increased. While, the level of potassium increased with the increase of Magnapac. T3, glucose, cholesterol, calcium and potassium for bunnies was increased with the increase of Magnapac and the highest levels of total protein, albumin and globulin was found in bunnies fed 4 % Magnapac.

Keywords: *doe rabbits, protected fat, magnapac, production, blood metabolites.*

INTRODUCTION

Rabbit feed intake can be extremely low during heat stress and the energy restriction severely impairs rate of growth. So, the use of fat addition to the diet has been one of the means to alleviate thermal stress, although the interaction of diet and temperature is very rarely especially in growing rabbits. From a nutritive point of view fats were recognized as having three main properties, high metabolisable energy with almost zero heat increment, improved utilization of dietary protein and supply of essential fatty acids. The addition of fats to the diet has been relevant for the past twenty years. Increasing of energy content of the diets was called "high-energy density" between the chemical structure of fats and the lipid content and profile of blood and adipose tissue is recognized to have maximum importance (Fernandez-Carmona *et al.*, 2000).

The objective of the present study was to determine the effect of protected fat supplementation (Magnapac) with various level (2 and 4%) on production and some physiological changes of NZW rabbits.

MATERIALS AND METHODS

This study was carried out in the Rabbitry Unit of Animal Production Department, Faculty of Agriculture, Cairo University. The laboratory works was carried out in Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, during winter (from November 1999 till January 2000) and summer (from July till September 2000).

Experimental animals:-

A total number of 30 mature New Zealand White doe rabbits (NZW) were used in this study. The does weighed 2500- 3000g and aged 6-7 months.

Management and feeding:-

Rabbits were reared in semi-closed rabbitry house system. Does were kept in individual cages (60×50×33cm). The nest boxes (40×30×27cm) were provided for kindling and nursing youngs. The rabbits were fed ad libitum and clean fresh water was available by nipple drinker all the time. Pregnancy was diagnosed by abdominal pulpation at 10-14 days after service. Does were remated 1-7 days post-partum. All the experimental animals were reared under the same environmental conditions (28.8±0.44 °C, 56.6±3.72% RH).

Experimental design:-

The does were randomly divided into three diet treatment groups (Table 1), 10 does each. The three groups were the control group (basal diet), group 2 (2% Magnapac supplement) and group 3 (4% Magnapac supplement). The offspring of each group were reared for 6 weeks post weaning on the same diet of their dams.

Magnapac, a commercial product obtained from Pharma Serve Ltd, Egypt was used. Analysis of Magnapac (palm oil fatty acid calcium salt) was shown in Table 2. Magnapac (M) was added to the rabbits pellets diet using molasses (5 ml molasses/1kg pelleted diet).

Measurements and experimental procedure:-

The practical work was carried out to assess the; physiological reaction with Magnapac supplementation. Blood samples were withdrawn from the ear vein of does before mating (1), at 14 and 28 days of pregnancy and from bunnies at 6 weeks age. Serum samples were prepared by centrifugation (3000-rpm for 15 minutes) and stored at –20°C until the determination of blood hormones and metabolites. Where the procedures of glucose level (mg/dl), total protein (g/dl), albumin (g/dl) and Calcium concentration (mg/dl) were determined by colorimetric method using kits of Sentinel Co. (Italy) according to the methods of Trinder (1969), Weissman *et al.*, (1950), Dumas and Biggs (1972) and Gindler and King (1972), respectively. Globulin (g/dl) was calculated by the difference between total protein and albumin. Cholesterol (mg/dl) was determined by colorimetric method using kits of Dialab Co. (Viena, Austria) according to the methods of Richmond (1973). Quantitative measurement of T3 in serum was carried by DSL-3100-USA ACTIVETM Triiodothyronine coated tube radioimmunoassay kits. The sensitivity, calculated by interpolation of mean minus two standard deviations of 20 replicates of the 0 ng/dL T3 standard, is 4.3 ng/dL (Tietz, 1995). Sodium and potassium concentrations (mEq/L) were determined by colorimetric method using kits of Bio-Analytics Co. (U.S.A) according to the methods of , Henry *et*

al., (1974) and Sunderman Jr. and Sunderman (1958), respectively.

The kits (30 males, 10 for each group) were weaned at 30-35 days of age, then transferred to the collective cages, and fed the same diets of their mothers in the different three groups. The kits were slaughtered at 6 weeks post weaning to evaluate their carcass traits.

Statistical analysis :

Data were statistically analyzed using Least Square Means, according to SAS (1995). Means were compared ($P<0.05$) using Duncan's multiple range test (Duncan, 1955). The factors the measurements were assessed using the following model:

$$Y_{ij} = \mu + G_i + e_{ij}$$

Where : Yij = observation of the ij^{th} rabbit, μ = overall mean, common element to all observations, G_i = effect of i^{th} group, e_{ij} = random error component assumed to be normally distribute.

RESULTS AND DISCUSSION

Productive performance

- Litter size and weight at weaning

Litter size and weight at weaning under the effect of M supplementation are presented in Table (3). Results showed that does fed diet supplemented with 2% M had the best values of litter size and weight at weaning. This result may be due to positive effect of M supplementation on milk production which is associated by good litter growth rate as suggested by (Fortun-Lamothe, 1997).

- Feed intake and weight change of does

The effect of M supplementation on feed intake is presented in Table (4). Feed intake in does ingested the diets containing 2 and 4% M was decreased by about 11% than that of control diet. The effects of M supplementation on doe's weights increment from the beginning (W1) till the end of experiment (W2) is presented in Table (4). Doe's weight increment was greater with 4% M than 0 and 2% M supplement. This result is in agreement with Papp *et al.* (2000), who reported that the energy supplementation 12.7 DE/MJ/Kg improved the weight gain of does (+16.5%).

- Offspring response

Feed intake of bunnies significantly decreased when the percentage of M increased in the diet (Table 5). Live body weight of bunnies M 4% fat supplementation in the diet was significantly heavier than those fed 0% or 2% M and feed conversion were improved by the diet content of 2% or 4% M (Table 5). These findings are in agreement with Abdel-Malak and Hamouda (2000), they found that live weight, daily weight gain and feed conversion were improved. This results may be due to increase of energy intake (Partridge *et al.*, 1986).

Growth increment of bunnies fed 4% M was higher by 10% and 20% than the increment of bunnies fed 0% or 2% M, respectively. This result is in agreement with several reports (Tawfeek *et al.*, 1994; Yamani *et al.*, 1994; Marai *et al.*, 1994; Ayyat and Marai, 1996; and Fernandez *et al.*, 2000). Where the effect of addition of fat to diets for growing rabbits, it was improvement in growth rate (Partridge *et al.*, 1986).

Carcass characteristics

Live and carcass weights have the same trend, in response to diet treatments. Live weight values were 817, 931 and 1172g while carcass weights were 771.85, 883.75 and 1124.25 in control, 2% and 4% M supplementation, respectively. Abdel-Monem (1995) reported that carcass weight was lower by 0.4% , kidney fat weight was lower by 28.4% and the dressing percentage increased slightly in rabbits treated with 10% palm oil than untreated group.

Table (1): Chemical composition of the experimental diets*.

Item	Diets		
	Basal	Magnapac (%)	
		2%	4%
Crude protein (CP) %	18	18	18
Crude fiber (CF) %	13	13	13
Fat %	2.5	4.2	5.9
Ether Extract (EE)	3.0		
Digestible Energy (DE), kcal/kg	2700		

* **Diets ingredients:- clover hay 40.5%, wheat bran 25%, yellow corn 14%, soybean meal 11%, molasses 3%, vinass 3%, bon meal 1.75%, calcium carbonate 0.7%, sodium chloride 0.55%, vitamins & minerals premix 0.35%, DL-methionine 0.15%.**

Table (2): Analysis of Magnapac (palm oil fatty acid calcium salt)

Item	%
Pure fat	84.00
Calcium	9.05
Protein	0.00
Fiber	0.00
Humidity	3.40

Table (3): Litter size and weight at weaning of NZW rabbits as affected by dietary Magnapac supplementation of diet (Mean ± SE).

Item	Magnapac supplementation (M%)			SE
	0 %	2%	4%	
Litter size	2.10^{ab}	2.75^{a}	1.60^{b}	0.32
Litter weight (g)	788.75	1041.50	619.50	144.76
Average weight/ kit (g)	375.60	378.7	387.19	

^{a,b} **Values having different superscripts in the same row are significantly different (P< 0.05).**

Table (4): Effect of M supplementation in diet on doe's weight development from the start (W1) to the end of experiment (W2).

Item	Magnapac supplementation (M)*			SE
	0%	2%	4%	
Feed intake (g/doe/day)	152.40	135.30	134.60	7.40
W1 (g)	2736	2722	2726	100.45
W2 (g)	3111	3141	3218	96.89
Weight increase (%)	12	13	15	

* **Numbers of does were 10 in each group.**

Carcass characteristics of slaughter rabbits at 6 weeks of age are shown in Table (6). The heaviest value for carcass weight was recorded with rabbits fed the diet containing 2% M followed by the rabbits fed the diet containing 4% M and then the control rabbits. Value of carcass weight in 2 and 4% M groups was significantly higher than control by 15% and 13%, respectively. There were no significant differences in dressing percentages among all groups. These results were in agreement with the findings of Hemid *et al.* (1995) who reported that using 5 or 7 and 9% palm oil were insignificantly affected in dressing percentage. Abdel-Khalek (1999) reported that there was no significant differences in percentage of dressed weight, heart, liver and kidney of rabbits fed diets with fat supplemented. The heaviest values for dressing percentages in rabbits fed on 4% M. This result may be due to the increase in fat content in the diets. Although, the heaviest values for relative weights of liver, heart and kidney were recorded in rabbits fed on 4% M, but the difference with the other two groups was insignificant. These results were in agreement with findings of Abdel-Rahim *et al.* (1994) who found that using 1% palm oil was insignificantly affected in percentages of liver, kidneys and heart. In contrast Hemid *et al.* (1995) found significant differences ($P<0.01$) between all rabbits group (5 or 7 and 9% palm oil added) in liver weight percentage.

Blood metabolites:

- Glucose

Data presented in Table 7 showed that the highest level of glucose was found in the blood the control group. The levels of glucose were higher in the control group (0% M) at all stages of pregnancy than that in 2% or 4% M supplementation groups. However, the does fed 4% M have blood higher glucose concentration at the first and the last stage of pregnancy than does fed 2% M, but 2% M supplementation showed higher concentration of glucose in serum in the mid stage of pregnancy than that in group 4% M.

Level of blood glucose increased as dietary fat supplementation increased in the blood of bunnies (Table 8).This result is in agreement with findings of Abel-Rahim *et al.* (1994) and Marai *et al.* (1994). With low energy diets, the blood glucose levels are homeostatically maintained by mobilization of liver glycogen. When glycogen is depleted, the blood glucose level fals. This is detected by chemoreceptor cells in the appetite center (hypothalamus), which through neural stimulation initiates feed intake. It is assumed that blood glucose operates in this manner in rabbits (Cheeke, 1987).

- Total protein

The effect of M supplementation on total protein concentration is illustrated in Table (3). The highest level of total protein was found in the serum of does fed 4% M. Total protein concentration showed similar trend to that of glucose throughout pregnancy, that does in all groups (0, 2 and 4 dietary M supplementation) have high level of protein at the start of pregnancy then a decrease was detected at mid of pregnancy and slightly increase was observed from the 14^{th} day to the end of pregnancy.

The effect of M supplementation on total protein concentration in serum of NZW bunnies was illustrated in Table (8). The highest level of total protein was found in the serum of bunnies fed 4 % supplemented M. This result is in agreement with the findings of Abed-Rahim *et al.* (1994). This may indicate that the supplementation of protected fat (palm oil calcium salt) in rabbit diets led

Table (5): The effect of Magnapac supplementation on growth performance of bunnies.

Items	Magnapac Supplementation (M)		
	0%	2%	4%
Feed/bunny/6wks (g)	1899.00^{a}±162.5	1590.60^{b} ± 25.58	1535.60^{b} ± 34.44
Initial weight (g)	435.5+80.08	468.5 + 87.11	453.1 + 85.03
Final weight (g)	980.75^{ab}±123.09	1181.13^{b}± 162.83	1189.88^{a}± 162.83
Growth rate %	0.77^{a} ± 0.06	0.86^{a} ± 0.06	0.89^{b} ± 0.06
Feed conversion (FC) (Kg feed /Kg B.w.)	3.48	2.23	2.08

[a, b] Values having different superscripts in the same row were significantly at (P< 0.05).

Table (6): Effect of M supplementation on carcass characteristics of bunnies in NZW.

Items	Magnapac Supplementation (M)		
	0%	2%	4%
Carcass weight (g)	468.90^{b} ± 82.89	551.0^{a} ± 80.41	539.73^{a} ± 76.04
Dressing %	52.19 ± 3.84	53.35 ± 5.08	54.64 ± 5.18
Relative weight of liver	6.96 ± 0.66	7.18 ± 0.91	7.40 ± 0.91
Relative weight of heart	0.64 ± 0.04	0.78 ± 0.06	0.85 ± 0.06
Relative weight of kidney	1.45 ± 0.12	1.85 ± 0.15	1.95 ± 0.15

[a, b] Values having different superscripts in the same row are significantly different (P< 0.05).

Table (7): Effect of Magnapac (%) on serum metabolites in NZW rabbit does throughout pregnancy.

Item	Magnapac (M%)			SE
	0	2	4	
Glucose (mg/dl)				
1st	121.16^{a}	103.13^{b}	118.31^{a}	4.21
14th	118.36	108.45	104.37	5.37
28th	106.07^{a}	90.51^{b}	99.44^{ab}	4.06
Total protein (g/dl)				
1st	4.00	3.94	4.13	0.15
14th	3.75	3.69	3.76	0.12
28th	3.86	3.72	4.16	0.12
Albumin (g/dl)				
1st	1.55	1.50	1.56	0.14
14th	1.28	1.24	1.30	0.12
28th	1.51	1.48	1.57	0.12
Globulin (g/dl)				
1st	2.45	2.44	2.57	0.15
14th	2.47	2.45	2.46	0.13
28th	2.35	2.24	2.59	0.16
Cholesterol (mg/dl)				
1st	53.56^{b}	70.79^{a}	73.53^{a}	1.96
14th	51.61^{b}	68.61^{a}	72.86^{a}	2.21
28th	51.06^{b}	68.02^{a}	72.92^{a}	1.74

[a, b] Values having different superscripts in the same row are significantly different (P< 0.05).

to improve the efficiency of utilization of the amino acids in protein synthesis.

- Albumin and globulin

The effect of M supplementation on serum albumin and globulin concentrations is shown in Table (7). The highest levels of albumin and globulin were found in the serum of does fed 4% M supplement. The highest levels of albumin were found at the first and the last stages of pregnancy. The differences between groups treated with the three levels of M were not significant. The level of globulin in does fed 4% M decreased from the first to the mid stage of pregnancy, then it increased towards the end of pregnancy. The opposite trend was observed with the levels 0 and 2% M, where the level increased from the 1st to the 14th day of pregnancy and decreased from the 14th to the 28th day of pregnancy.

The effect of M supplementation on albumin and globulin concentration in serum of NZW bunnies was illustrated in Table (8). The highest levels of albumin and globulin were found in serum of bunnies fed 4% supplemented fat. These results were in agreement with those obtained by Abdel-Rahim *et al.* (1994) and Tawfeek *et al.* (1994), who added 1% palm oil to diet.

- Cholesterol

The level of cholesterol in does serum increased as the percentage of M supplementation increased (Table 7). This result is in agreement with the findings of Tawfeek *et al.* (1994), who found that addition of 1% palm oil increased the levels of total cholesterol. Almost, there were no significant changes in cholesterol level throughout pregnancy.

The level of cholesterol in blood serum of NZW bunnies increased as the percentage of M supplementation in the diet increased (Table 8). Similar findings were obtained by Marai *et al.* (1994) and Tawfeek *et al.* (1994) who reported that addition of palm oil to basal diet increased cholesterol level. Abdel-Rahim *et al.* (1994) found that addition 1% palm oil to the diet increased cholesterol level by 56.2%. However, Paul *et al.* (1980) classified the hypocholesterolaemic effect of the unsaturated fatty acid as being due to reduced absorption of cholesterol, redistribution of cholesterol from blood to tissue, reduced cholesterol synthesis and increased excretion of cholesterol or its metabolites. Additionally, El-Gendy (1993) reported that addition of oil to basal rabbits diet decreased the blood cholesterol.

- Triiodothyronine (T_3)

The effect of M supplementation on T_3 concentration is illustrated in Table (9). The highest concentration was found in does fed 4% M followed by does fed 2 and 0% M. The level of T_3 hormone increased from the 1st up to the 14th days of pregnancy, then it decreased from the 14th to the 28th day. There were no significant differences between the three treatments of M in the T_3 hormone concentration in serum of does.

Means value of T_3 as affected by fat supplement for NZW bunnies from weaning to 6 weeks are presented in (Table 9). The blood analysis clarified the highest T_3 concentration in the serum of bunnies fed on M supplementation. This result is in agreement with the findings of Fekete *et al.* (1989) and Marai *et al.* (1994) who found that higher T_3 concentration in the blood of young rabbit fed with 5% and 7% palm oil supplementation.

Minerals

The effect of M supplementation on does serum calcium concentration is illustrated in Table (10). The highest level was found in does fed 2 % dietary M, and the differences with the other groups were significant. Fluctuated trend was observed for the effect of M

Table (8): Effect of Magnapac supplementation on serum metabolites of NZW bunnies.

Item	Magnapac supplementation (M)			SE
	0	2%	4%	
Glucose (mg/dl)	115.33[b]	136.68[a]	145.32[a]	5.60
Total protein (g/dl)	3.07	3.11	3.54	0.29
Albumin (g/dl)	1.02	1.03	1.26	0.60
Globulin (g/dl)	2.05	2.07	2.28	0.14
Cholesterol (mg/dl)	57.33[b]	64.75[b]	83.73[a]	3.37

[a, b] Values having different superscripts in the same row are significantly different (P< 0.05).

Table (9): Effect of dietary Magnapac supplementation (%) on the level of T_3 hormone in does throughout pregnancy and bunnies of NZW rabbit.

Item	Magnapac supplementation (M%)			SE
	0	2	4	
T_3 (ng/dl) in does				
1st	60.23	58.12	62.02	2.21
14th	89.43	85.10	84.64	4.40
28th	70.34	77.31	76.49	3.67
Average	73.33	73.51	74.38	
T_3 (ng/dl) in bunnies	53.49	61.67	62.45	3.06

Table (10): Effect of M supplementation in diet on blood minerals throughout pregnancy in NZW.

Item	Magnapac Supplementation (M%)			SE
	0	2	4	
Calcium (mg/dl)				
1st	9.49[b]	11.76[a]	9.39[b]	0.66
14th	9.05[b]	11.43[a]	9.99[ab]	0.64
28th	9.23	10.62	9.87	0.62
Sodium (meq/l)				
1st	160.70[a]	156.68[b]	152.24[b]	7.16
14th	185.37[a]	165.53[b]	157.00[b]	5.13
28th	151.92[a]	145.96[b]	140.03[b]	7.65
Potassium (meq/l)				
1st	6.15[b]	6.51[ab]	6.96[a]	0.24
14th	6.72[b]	7.11[ab]	7.38[a]	0.29
28th	6.58[b]	6.87[ab]	7.49[a]	0.28

[a, b] Values having different superscripts in the same row are significantly different (P< 0.05).

Table (11): Effect of M supplementation on minerals in serum NZW bunnies.

Items	Magnapac Supplementation (M%)			SE
	0	2%	4%	
Calcium (mg/dl)	11.07	11.94	12.05	0.82
Sodium (meq/l)	154.15[a]	138.65[b]	124.04[b]	10.39
Potassium (meq/l)	5.45[b]	7.26[a]	8.01[a]	0.40

[a, b] Values having different superscripts in the same row are significantly different (P< 0.05).

supplementation on calcium concentration during the days of pregnancy. The dietary calcium level is increased the blood calcium level rises (Cheeke, 1987). Plasma calcium was a drop from normal value occurred at parturition (Barlet, 1980). Sodium concentration decreased as the M in the diet increased (Table 10). Sodium level in serum of does significantly increased from the 1st up to the 14th day, then it significantly decreased until the 28th day of pregnancy. Potassium concentration increased with the increase of M in the diet of does (Table 10). The level in all groups have similar trend, that it increased from the 1st to the 14th day of pregnancy then it decreased at the 28th day except in the three group (4% M) it continued to increase from the 14th to the 28th days of pregnancy.

The effect of M supplementation on serum calcium, sodium and potassium concentration in NZW bunnies was illustrated Table 11. Level of calcium and potassium increased in the serum of bunnies fed dietary fat supplementation, but levels of sodium concentration decreased in the serum of bunnies fed dietary fat supplementation. This result in agreement with Tawfeek *et al.* (1994), who reported that serum calcium was increased by addition of 1% palm oil to diet.

CONCOLUSION

It could be concluded that 2% Magnapac is recommended for doe rabbits, where we got the best in litter size and weight at weaning, but 4% Magnapac is much better and recommended than 2% for weaning rabbits.

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تأثير إضافة الدهن المحمي علي الإنتاجية وبعض التغيرات الفسيولوجية في الأرانب النيوزيلندي

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استخدم في هذا البحث عدد ثلاثون أرنب نيوزيلندى أبيض تتراوح أوزانهم بين ٢٥٠٠-٣٠٠٠ جم وأعمارهم بين ٦-٧ شهور. تم تقسيم الإناث عشوائيا إلى ثلاثة مجاميع متساوية – المجموعة الأولى (كنترول) والمجموعتان الثانية والثالثة أضيفت فيهما دهن محمي (زيت النخيل المعامل بالكالسيوم) بنسبة ٢% ، ٤% علي التوالي.

تم دراسة تأثير إضافة الدهن المحمي علي كل من كمية الغذاء المأكول وحساب معدل النمو والكفاءة التحويلية للخلفات ، كما تم دراسة صفات الذبيحة في الخلفات والاستجابات الفسيولوجية والإنتاجية لإناث الأرانب وخلفاتها وأخذت عينات دم من الإناث الحوامل على فترات (بداية الحمل – منتصف الحمل – ونهاية الحمل) والنتاج عند التسويق (٦ أسابيع)لقياس تركيز هرمون التراي أيودوثيرونين وتركيز الجلوكوز وبروتينات الدم والكوليسترول وعناصر الكالسيوم والصوديوم والبوتاسيوم.

وتتلخص أهم نتائج هذه الدراسة في الآتي:-

انخفضت كمية الغذاء المأكول لإناث الأرانب النيوزلندى بنسبة ١١% تقريبا عند التغذية علي الدهن المحمي. كما حدثت زيادة في وزن الجسم عند التغذية علي علائق ٤% دهن محمي يليها مجموعة ٢% ثم الكنترول بنسبة ١٢،١٣،١٥ % علي التوالي. وقد أدت التغذية علي الدهن المحمي بنسبة ٤% إلى انخفاض كمية الغذاء المأكول للخلفات وكذلك زيادة الوزن ومعدل النمو ، كما تحسن معدل التحويل الغذائي عند التغذية علي علائق ٢% أو ٤% دهن محمي. وكذلك إضافة ٢% دهن محمي لعلائق الخلفات أدي إلى زيادة الوزن عند عمر ٦ أسابيع وجودة في صفات الذبيحة .

إضافة الدهن المحمي (زيت النخيل المعامل بالكالسيوم) بنسبة ٤% لعلائق الإناث أدي إلى ارتفاع نسبة كل من البروتين الكلي والالبيومين والجلوبيولين وهرمون التراي أيودو ثيرونين.كما ثبت أن اضافه الدهن المحمي بنسبة ٢% أدي إلى ارتفاع نسبة الكالسيوم في السيرم .

لوحظ ارتفاع معنوي في نسبة الجلوكوز لمجموعة الكنترول في جميع مراحل الحمل ، كما لوحظ أن البروتين الكلي والألبيومين والجلوبيولين سجلت تركيزات عالية في سيرم الأمهات المغذاة عل علائق تحتوي علي ٤% دهن محمي يليها مجموعة الكنترول عن الإناث في مجموعة ٢% دهن محمي في مراحل الحمل المختلفة ، ولكن تلك الفروق كانت غير معنوية. كما لوحظ أن تركيزات الكوليستيرول كانت في المجاميع التي تغذت علي دهن محمي أعلي من مجموعة الكنترول وكانت تلك الفروق معنوية خلال فترات الحمل الثلاث. لم يكن هناك فروق معنوية بين المجاميع الثلاثة في تركيز هرمون التراي أيودو ثيرونين في السيرم.

عند تحليل السيرم للخلفات وجد أن تركيزات كل من الجلوكوز والبروتينات والكوليستيرول والكالسيوم أعلي في المجاميع المعاملة عن الكنترول بينما لوحظ انخفاض في تركيز البوتاسيوم في سيرم الخلفات كلما ذادت نسبة الدهن المحمي.