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THE EFFECT OF SOURCES AND INCLUSION LEVEL OF FAT ON GROWTH PERFORMANCE.

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INTRODUCTION

During the period of growth, rabbits are capable to maintain a growth rate (GR) raised by a high range in fiber level. As regards to the limit and according to de Blas et al.(1986) result, to raise the fiber content in the diet above 20% of acid-detergent fiber (ADF), produces a linear drop in GR and a linear rise in feed conversion rate (FCR). The addition of fats to diets, which increases the energy concentration of the diet and decreases the FCR (Santomá et al.1987), can be interesting to enlarge the range of fiber levels recommended.

On the other hand, the global weight of the organism is the result of the growth of each of its components and the carcass is influenced by the composition and quality of the diet (Ouhayoun et al.1986). For example, the fatty deposits have a double importance from the economic point of view in reference to meat production. First of all because of its total mass, these fats deposits add to production cost and secondly because depending on its distribution the quality of the carcass will be affected. In any case, it is difficult to predict affects of adding fat on different characteristics of the carcass especially all when the slaughter liveweight (LW) and the sex is taken into account.

The objetive of this work is try to determine the possible influence of the type and its level of fat when it is added to a diet with high fiber content (19% crude fiber (CF) and 24% ADF both on dry matter), keeping in mind the effects of three slaughter weight (2.0, 2.25, 2.50 kg LW) and of the sex of the rabbit over; i)growth performances, ii)fatty deposits, iii)technological division.

MATERIAL AND METHODS

DIETS.- The diets were formulated to study the effect of different fats added to growing rabbit diets on growth performances. Seven diets were studied; a control diet with a high level of fiber and without added fat, three diets with similar chemical composition with tallow, oleins and soya oil, added at 3%, and other three more diets now containing the same level and types of fat plus 18% heated whole soybean in order to reach 3% more of fat and allow a good quality and texture of pellet (see table 0). For balance of diets were used the recommendation values of Lebas (1979) for essential amino acid, calcium, phosphorus, sodium and clorine, and de Blas et al.(1981) recommendation for digestible energy : digestible protein ratio. Formulation and chemical composition of diets is shown in table 0.

GROWTH TRIAL.- Thirty Californian*New Zealand White growing rabbits per diet, weaned between 28 and 32 days of age, were used. Daily GR and food intake (FI) from weaning to slaughter at 2.0, 2.25,and 2.50 kg LW were recorded. Groups of ten rabbits were individualy distributed per slaughter LW and within each diet.

FATTY DEPOSITS AND TECHNOLOGICAL DIVISION.- The measurements (perirenal and scapular fat,intermediate portion, hindlegs and forelegs) were achieved according

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to Blasco, Ouhayoun and Masoero recomendation (conference of Zagazig, Egypt 1990).

STATISTICAL ANALYSIS.- Factorial (diet*slaughterLW*sex) analysis of variance, means multiple comparation and the contrast test, were performed using the Statistical Analysis System Institute (1985).

RESULTS

GROWTH PERFORMANCE

The effect of diet, slaughter LW and sex on growing is shown in tables 1, 2 and 3 respectively.

EFFECT OF DIET.- both, the type and the level of fat did not affect significantly neither the GR nor the digestible energy (DE) intake. When the DE intake was expressed in kcal/d, we found significant differences ($P<0.001$), but despite more precision of ortogonal contrast no differences were found between diets. Daily LW gain was significantly influenced by weaning weight ($P<0.001$) thus so results were adjusted to initial weight. FI decrease significantly ($P<0.001$) when the level of fat increases. FI decreases was 139.73, 132.97 and 124 g/d for control diet, 3 and 6% of fat respectively. Thus, FCR improves significantly ($P<0.001$) with the added fat to diet (3.81 vs 3.51 control and means diets with fat respectively). By ortogonal contrast the previous results it was confirmed ($P<0.001$), and it was found significant differences ($P<0.05$) between fats levels; 3.57 vs 3.54 for 3 and 6% of fat respectively, but not between types. Neither type nor level of fat had a significant effect on dressing percentage (DP)(mean value 62.69%). There was not significant influence of fat in mortality (mean value 3.33%).

EFFECT OF SLAUGHTER LW.- the GR decreased with slaughter LW but no significant differences were found (37.19,36.06, 35.70 g/d for 2.0, 2.25, 2.50 kg LW respectively). DE intake (kcal/g) increased but it was not significant (8.93, 9.61,10.18 kcal DE/g for 2, 2.25, 2.50 kg respectively). FCR, FI and ED intake (kcal/d), increased significantly when the LW was higher, and the values obtained were; 3.38, 3.64 and 3.86 for FCR, 124.30, 129.65 and 136.29 g/d for FI and 332.25, 346.50 and 363.26 kcal/d, all these to 2.0, 2.25 and 2.50 kg LW.

EFFECT OF WEIGHT AND DIET ON FCR.- as it is signed in the table 5, at 2.0 kg LW there is an improvement of level of fat on FCR ($P<0.01$), and it was confirmed by contrast (3.59 vs 3.40 vs 3.28 to control, 3 and 6% fat respectively). When the LW was 2.25 kg, the effect of level of fat is not so marked ($p<0.05$), but by contrast test we can see an improvement in diets 5 and 6 respect the other diets with added fat and the control diet (3.45 vs 3.67 vs 3.89 respectively). And at 2.50 kg LW only was found significant differences by contrast ($P<0.01$) and for control diet comparatively with diets with added fat (4.24 vs 3.80 respectively).

EFFECT OF SEX.- GR was significatly higher ($P<0.05$) better in male than female (37.18 vs 35.45 g/d) and FI was much higher ($P<0.001$) in male than in female (131.86 vs 128.30 g/d). Consecuently sex did not influence significantly on FCR (mean value was 3.56), and DE intake too.

TECHNOLOGICAL DIVISION

Tables 1, 2 and 3 show the effect of diet, weight and sex.

EFFECT OF DIET.- neither level nor type of fat affected these three important parts from commercial point of view. Only in hindlegs and intermediate portion (which include shoulder, thoracic cavity and abdominal wall) slight increasing with addition fat can be appreciated, but never significant.

EFFECT OF LIVEWEIGHT AND SEX.- the three portions increased when the slaughter LW rised ($P<0.001$). Sex did not influence on these parameters.

FATTY DEPOSITS

The influence of these factors over the variables were shown in tables 1, 2 and 3.

EFFECT OF DIET.- scapular fat was influenced significatly ($P<0.05$), where as perirenal fat was $P<0.001$. This last difference not only was found between control diet and diet with fat, but also among levels as well (21.91 vs 25.88 vs 34.89 g to control, 3 and 6% of added fat respectively). By the contrast test it is possible to realize the same effect for level of fat but not to type of fat.

EFFECT OF WEIGHT AND SEX.- all fatty deposits weight determinate in this trial, were increasing significant ($P<0.001$), according to slaughter LW rising. Sex did not affect variables studied.

DIET*WIEIGHT INTERATION ($P<0.05$).- variations of the perirenal fat can be observed in the table 4. For 2.0 kg LW diet influenced significantly ($P<0.001$) over perirenal fat. By the contrast test differences ($P<0.01$) between fat levels (18.46 vs 23.1 g for 3 and 6% of fat respectively) were found.It was noticed that there were differences between types of fats at level 3% ($P<0.05$); 16.75 vs 21.89 g for diets 1 and 2 comparatively with 3. Relatively to 2.25 kg LW, perirenal fat weight was higher than 2.0 kg LW, comparing the control diet and diets with fats we have noticed differences ($P<0.01$) (20.55 vs 29.1 g) and if we compare level 3 and 6% the results were $P<0.001$ (24.30 vs 33.89g). Respectively to 2.50 kg LW, weight was higher than 2.0 and 2.25 kg LW, and these differences were significant ($P<0.001$). By contrast we obtained differences between control and with added fat ($P<0.01$); 26.68 vs 38.37g respectively. Also between 3 and 6% of fat ($P<0.001$); 32.60 vs 44.14 g, and finally between the diets ($P<0.01$) 5 and the means of 4 and 6 (52.67 vs 39.88 g respectively).

DISCUSSION

GROWTH PERFORMANCE.- None of the performance parameters is influenced by the type of fat. There is not a clear effect of the fat level on the GR as found by Lebas (1975) and Partridge et al (1986). The GR slightly improved when fat was added to the diet but this improvement was not significant. Same results were obtained by Partridge et al.(1986) and Santomá et al (1987). However, other authors, Tacker (1956), Arrington et al (1974), did found an improvement in the GR as well as FCR when fat was added to the diets. However, these authors used laboratory breeds (Dutch) holding a GR of 10-20 g/d, instead of commercial breeds, like New Zealand White, of an average GR of 40-45 g/d. Fat addition to the diet holds an increase of the energetic density of the diet which means a decrease of the intake (from 139.73 to 119.8 g/d for the control diet and for the oleins+heat whole soybean diet, in our study) as animals need less amount of food to satisfy their energetic needs. Moreover, if we analyse the amount of energy required to increment in one gram the lifeweight (9.36, 9.31 and 9.59 kcal DE/g for animals having the control diet and the diet with a 3 and 6% added fat respectively), it seems to be independent of the fat level of the diet (as observed by Lebas (1975) and Partridge et al (1986)). Besides, it is confirmed that the rabbit's response to an increase of the energetic concentration of the diet is a decrease of their FI in order to keep their energy intake constant. This explain the lack of differences in the GR as well as the improvementof the FCR of the diet with fat. In this sense, the addition of 6% fat improve in 10% the FCR with respect to the control diet (no added fat and same fiber level (24% ADF on DM)). This figure is quite similar to the obtained by other authors, although they used more concentrate diets. Parigi-Bini et al (1974), for instance, obtained a 9% improvement of the FCR when added 5% tallow to a 14,2% CF on DM diet. Santomá et al (1987), using more concentrate diets (20% ADF on DM), obtained a 12% improvement when a 6% fat was added to the diet. To sumarize, it seems that a fat supplement in growing rabbits feeds decreases the FI and improves the FCR whereas it has not an importanteffect on the GR. Chiericato and Lanari (1972), Pote et al (1980), Lang (1981), Partridge et al (1986) and Santomá et al (1987). Even though no differences in the GR are observed, an increase of the FI is noticed as the slaughter LW is lengthered. Therefore, an increase in the FCR also occurs. This, for the most infavorable case (2.50 kg LW), is 12% higher than for 2.0 kg. Taking this fact into account it is questionable if to lengthen the slaughter LW would be profitable to the economy. This is because a more than 2.0 kg fattening implier not only an increment in the FCR but also a more fatty carcass that could be make it less acceptable for the market. This is in accordance to Deltoro and López (1986). Nevertheless, as shown in table 4, the addition of fat holds an improvement of the FCR with respect to the control diet independient to the slaughter LW considered. So, for instance, for the 6% added fat diet with respect to the control diet, there would be an improvement of 9 and 12% (for 2 and 2.50 kg LW respectively). It would be interesting to study how the FCR is influenced (lean or adipose tissue). Considering the results of table 3, no differences should be expected in growing performance between both sex for although the GR and FI are higher for males than for females, the FCR is not affected (average 3.56).

TECHNOLOGICAL DIVISION OF THE CARCASS

Neither diet or sex influenced the three technological portion and when the animal is bigger, the body weight more.

FATTY DEPOSITS

The DP was not influenced either by level or type of fat or by sex. The slaughter LW did have an influence, although a phase of general stabilization was reached from 2.25 kg (from 60.97 to 63.3% for 2kg and mean 2.25 and 2.50kg LW) onwards, correspondingto and age somewhere between 12 and 16 weeks. According to Rao et al (1978) this phase of general stabilization is around 12-16 weeks whereas for Deltoro and López (1986)it is from 11 weeks on. The diet influenced the scapular fat. However, the effect of added fat is not very well defined with respect to the effect of the fat included in the raw materials of the control diet, themselves, when observing scapular and perirenal fat, males and females have the same amount so sex does not seem to have an influence on this parameters. Similar conclusion were obtained by Vezinhet and Proudhon in 1975. Rabbit meat is meat with a low fat content (Ouhayoun et al 1986), and the perirenal fat deposits represent 2% of the weight of the carcass, in comparison with 0.62% which represents scapular fat.Perirenal fat is the most important fat deposit in the rabbit and as works of Varewyck and Bouquet (1982) show, it can be considered as a reasonable predictor of the total dissectable fat R^2=0.80. For diets with fat the weight of perirenal fat increased 4g (average diets 3% fats) and 13g (average diets 6% of fat) respect control diet. When the slaughter LW is made longer, the weight of perirenal fat rise too. If weight at 2kg LW (reached between 8 and 10 weeks of age) is 20.24g, at 2.25 kg LW (between 10 and 12 weeks of age)is 1.38 times higher than 2kg and 1.81 times the weight at 2 kg when reach 2.50 kg LW (12-14 weeks of age). The fat added to the diet and the prolongation of the slaughter LW are two factors which benefit the accumulation of fat in the body and the accumulation of perirenal fat. However, the effect of the type of fat added to the diet for each level is not as marked in respect to the weight of the perirenal fat (see table 4). It is expected that the composition in fatty acid of the perirenal fats if it is affected by the type of diet (alimentary lipid), as some author refer (Ouhayoun et al 1986), that the fatty acid are absorbed intact from the small intestine and are incorporated directly into the fat tissue as what happens with other monogastric.

To conclude, we can say that the addition of fat to the diets with a high fiber content, seems interesting because improve the FCR. This has certain relevance to the commercialization of meat and despite the fact that fat type seems irrelevant, perirenal fat deposits (that represent after birth an important percentage of the total fat) are influenced by the added fat, and when the consumption of the insaturated fatty acid is high the carcass fat is softer.This has an effect on thermic and chemical stability of the lipids and result in poorer quality from the conception that the consumer has, who invariably prefers firmer meat.

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TABLE 1.

EFFECT OF DIET ON GROWTH PERFORMANCES				
DIET	G.R. (g/d)	F.I. (g/d)	F.C.R.	D.P. (%)
control	36.44	139.73^{a}	3.81^{a}	62
1	36.76	132.20^{b}	3.56^{bc}	62.49
2	36.81	133.30^{b}	3.59^{b}	62.37
3	36.88	133.40^{b}	3.56^{bc}	62.81
4	36.09	127.60^{c}	3.53^{bc}	62.82
5	34.71	119.80^{d}	3.42^{bc}	63.28
6	36.51	124.60^{c}	3.40^{c}	63.09
S.E.	0.69ns	1.59***	0.06***	0.35ns
A			***	
B			*	

Means in the same column with different superscripts are significatly different.
G.R. = growth rate F.I. = food intake
F.C.R. = feed conversion rate D.P. = dressing percentage
3% fat. 1-tallow 2-oleins 3-soya oil
6% fat: 4-tallow + toast soybean(t.s.) 5-oleins + t.s.
6-soya oil + t.s.
A: contrast control vs others
B: contrast 3% fat vs 6% fat

EFFECT OF DIET ON FATTY TISSUE				
DIETS	S.F. (g)	P.F. (g)	kcal DE/d	kcal DE/g
control	8.59^{ab}	21.91^{c}	341.05^{ab}	9.36
1	7.77^{b}	23.78^{bc}	338.87^{b}	9.22
2	8.07^{b}	25.83^{bc}	353.90^{a}	9.61
3	9.26^{ab}	28.10^{b}	335.86^{b}	9.11
4	9.8^{a}	32.85^{a}	353.03^{a}	9.78
5	9.34^{ab}	37.57^{a}	322.40^{c}	9.30
6	10.27^{a}	34.25^{a}	353.63^{a}	9.69
S.E.	0.54*	1.63***	0.77***	0.24ns
A		***		
B		***		

S.F. = scapular fat P.F. = perirenal fat
D.E. = digestible energy intake

EFFECT OF DIET ON TECHNOLOGICAL DIVISION (g & %)				
DIETS	FORELEG	HINDLEG	I.P.C.	MORTALITY
control	125.6	177.2	807.74	4.76
1	125.1	179	807.88	2.43
2	129	178.5	808.83	2.43
3	127.3	180.1	818.13	6.66
4	128.1	179.5	818.37	2.38
5	126.2	180.5	825.12	0
6	127.6	182.3	827.55	4.65
S.E.	1.92ns	1.76ns	1.12ns	2.02ns

I.P.C. = intermediate part of the carcass.

TABLE 2. SLAUGHTER LIVEWEIGHT				
	2.0	2.25	2.50	S.E.
GROWTH PERFORMANCES				
growth rate (g/d)	37.19	36.06	35.70	0.50ns
food intake (g/d)	124.30^{a}	129.65^{b}	136.29^{c}	1.14***
feed conversion rate	3.38^{a}	3.64^{b}	3.86^{c}	0.04***
dressing percentage	60.97^{b}	63.09^{a}	63.51^{a}	0.24***
DE intake (kcal/d)	332.25^{c}	346.50^{b}	369.26^{a}	0.55***
DE intake (kcal/g)	8.93	9.61	10.18	0.32ns
FATTY DEPOT				
scapular fat (g)	6.59^{c}	8.95^{b}	10.78^{a}	0.36***
perirenal fat (g)	20.24^{c}	27.92^{b}	36.70^{a}	1.09***
TECHNOLOGICAL DIVISION				
foreleg (g)	105.41^{c}	125.47^{b}	143.08^{a}	1.29***
hindleg (g)	154.47^{c}	179.50^{b}	197.27^{a}	1.18***
intermediate part of the carcass(g)	703.61^{a}	808.36^{b}	902.80^{a}	0.74***

Means in the same row with different superscripts are significatly different (P<0.05)

TABLE 0.

FORMULATION (%) AND CHEMICAL COMPOSITION (% D.M.) OF DIETS			
INGREDIENT	CONTROL	3%FAT	6%FAT
barley	22	16	14
wheat bran	8	6	3
soya-bean meal	11	14	-
heated whole soybean	-	-	18
sunflower meal	7	9	13
lucerne hay	30	30	27
straw	20	20	20
fat	-	3	3
methionine	0.1	0.1	0.08
min.-vit. suppl.	1.9	1.9	1.92
COMPOSITION			
dry matter	93.69	93.81	94.49
ash	9.11	9.02	8.86
acid-detergent fiber	22.34	24.16	25.27
crude protein	18.06	18.75	19.13
ether extract	1.87	5.17	8.38
crude fiber	18.25	19.22	19.05
gross energy (kcal/kg DM)	4349.24	4474.25	4654.81

TABLE 3. SEX			
	MALE	FEMALE	S.E.D
GROWTH PERFORMANCES			
growth rate (g/d)	37.18^{a}	35.45^{b}	0.38*
food intake (g/d)	131.86^{a}	128.30^{b}	0.86***
feed conversion rate	3.53	3.58	0.03ns
dressing percentage (%)	62.81	62.54	0.08ns
digestible energy intake (kcal/d)	345.61	339.05	0.41*
digestible energy intake (kcal/g)	9.30	9.56	0.22ns
FATTY DEPOT			
scapular fat (g)	9.23	8.74	0.29ns
perirenal fat (g)	29.51	28.78	0.88ns
TECHNOLOGICAL DIVISION			
foreleg (g)	127.64	126.16	1.04ns
hindleg (g)	179.46	179.76	0.96ns
intermediate part of the carcass (g)	817.40	814.73	0.60ns

a,b, within rows, means not sharing a common superscript differ significantly ($P<0.05$)

TABLE 4. PERIRENAL FAT				
DIET		SLAUGHTER LIVEWEIGHT		
		2.0	2.25	2.50
control		17.03^{bc}	20.55^{c}	26.68^{c}
3% FAT	tallow	15.99^{c}	25.05^{bc}	27.97^{c}
	oleins	17.50^{bc}	23.13^{c}	34.35^{bc}
	soya oil	21.89^{abc}	24.71^{bc}	35.49^{bc}
6% FAT	tallow+toast soybean	21.13^{abc}	37.08^{a}	36.82^{bc}
	oleins+toast soybean	22.53^{ab}	32.99^{a}	52.67^{a}
	soya oil +toast soybean	25.63^{a}	31.61^{ab}	42.93^{ab}
S.E.		0.85**	0.81***	1.04***
A			**	**
B		**	***	***
C		*		
D				**

Means in the same column with different superscripts are significantly different ($P<0.05$).
A: contrast control vs others
B: contrast 3% fat vs 6% fat
C: contrast tallow, oleins vs soya oil
D: contrast tallow(6%), soya oil(6%) vs oleins(6%)

TABLE 5. FEED CONVERSION RATE			
DIETS	SLAUGHTER LIVEWEIGHT		
	2.0	2.25	2.50
control	3.59^{a}	3.89^{a}	4.24
1	3.42^{ab}	3.59^{ab}	3.89
2	3.42^{ab}	3.70^{ab}	3.84
3	3.37^{ab}	3.67^{ab}	3.86
4	3.32^{b}	3.73^{ab}	3.68
5	3.25^{b}	3.47^{b}	3.80
6	3.26^{b}	3.43^{b}	3.73
S.E.	0.32**	0.41*	0.21ns
A	**	*	**
B	*		
C		*	

Means in the same column with different superscripts are significantly different ($P<0.05$).
A: contrast control vs others diets
B: contrast 3% fat vs 6% fat
C: contrast 5 6 vs 4
3% fat, diets 1, 2 and 3.
6% fat; diets 4, 5 and 6.
1.- tallow, 2.- oleins, 3.- soya oil.
toast soybean + tallow (4)
+ oleins (5)
+ soya oil (6)