FRUCTO-OLIGO-SACCHARIDES[1] IN RABBIT DIET. STUDY OF EFFICIENCY IN SUCKLING AND FATTENING PERIODS.

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Abstract - A study to evaluate the effects of fructo-oligo-saccharides (FOS) in two rabbit meat production contexts: suckling and fattening was conducted. Two feeds control and supplemented with FOS (.24%) were used. In the suckling period two groups were made, according to feed consumed. A total of 377 births were controlled. Reproductive parameters were studied in does, and evolution parameters were studied in litter. No significant differences were found ($p>.05$) between both groups for any of the parameters studied. Four groups were prepared in fattening (120 rabbits/group) according to a combination of 2X2 factors: doe group and feed type. Main effects and interaction between the factors was studied. Not significant differences between treatments ($p>.05$) were found for viability, feed efficiency and carcass yield. However final body weight, average daily gain, feed intake, production index and caecal content pH level were affected by the treatment ($p<.001$). Both groups fed FOS supplemented diet obtained higher values than the other two groups fed non supplemented feed. Block effect due to the repetitions was also found to be significant. No evidence of doe group or interaction ($p>.05$) were found. After grouping values by only one factor (type of feed consumed) the fattening group fed FOS had higher growth (+118.75 g or +3.75 g/day) and higher production index (1.09 vs .96) than the non supplemented group.

INTRODUCTION

In the last years studies directed to evaluate the efficiency of the fructo-oligo-saccharides (FOS) to control microbial activity in the digestive tract of the rabbit have taken place. FOS seems to improve parameters of digestive physiology (MORISSE *et al.*, 1991) specially in those situations in which a context of digestive pathology has previously been created (MORISSE *et al.*, 1992).

The present work was conducted to study the incidence of FOS supplementation in the environment of a modern rabbit meat production farm. The experimental design allowed to analyse the influence of FOS at each productive stage: in *suckling period*, studying reproductive parameters in does and the evolution of their litters, and in *fattening period* studying the zootechnical indexes of rabbits.

MATERIAL AND METHODS

The experimental design (Figure 1) for the suckling period was to create two groups of does (97 does/group) according to the diet: fructo-oligo-saccharides supplement (FOS) and control (CTL). The fattening period was carried out, according to the group of suckling period the rabbits came from (f=FOS group of the suckling period or c=CTL group of the suckling period) and the feed intake (FOS=diet with fructo-oligo-saccharides supplement or CTL=diet without fructo-oligo-saccharides supplement), with four groups of rabbits (120 rabbits/group) in accordance with the possible combinations: f/FOS, c/FOS, f/CTL and c/CTL.

The reproductive rhythm of does was semi-intensive, with an approximate interval between births of 39 days and weaning of kits at 33 days old. The data of the suckling period were obtained during four months, with a total of 377 births out of 205 does. Birth control and checking of litters was carried out every day. Size and weight of the litter were controlled in selective moments of development: after standardising the litters after birth (transferring of kits among litters) -day 0-, after finishing the *strict* suckling period on -day 21- and at the weaning on -day 33-. The parameters studied corresponding to this period are listed in the table 1.

The four groups of fattening rabbits was composed by 480 rabbits, identified individually and housed in flat-deck wire cages of .40 m^2 with a density of 8 rabbits/cage. The rabbits were individually weighted, the feed intake by cage and the daily mortality were controlled. At 32 days of fattening (65 days old) the rabbits were slaughtered.

[1]PROFEED® R 34 of Beghin-Meiji Industries. 7 Kg PROFEED/Tn feed (.24% FOS in feed).

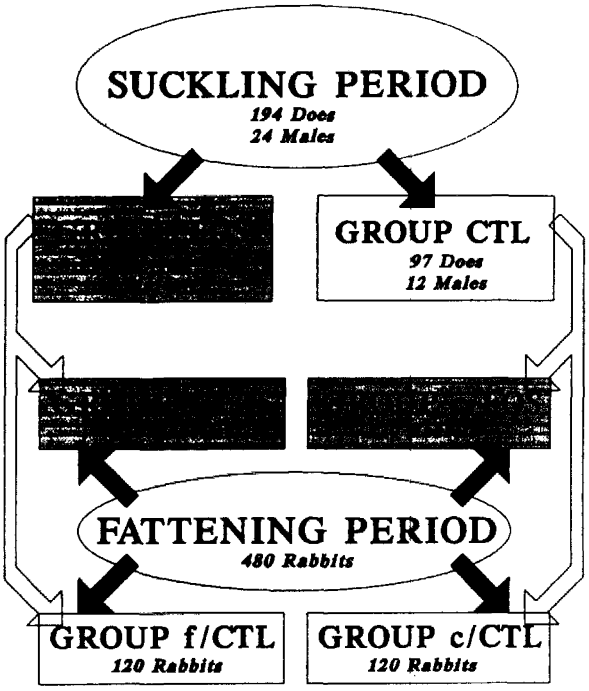
The slaughter weight was measured and caecal content samples were obtained to determine the pH. The study included the Production index (Pr), that is an indicator of the technical profitable management in the fattening period. This index is obtained as follows:

$$Pr=ADG*V*FE^{-1}$$

ADG=Average daily gain (Kg/day), **V**=Viability (%) and **FE**=Feed efficiency (g/g). Taking 1.00 as the threshold of technical profitability, from which a profit margin can be obtained.

With the obtained results analysis of variance were carried out using the GLM procedure and the Student-Newman-Keuls means comparison test through the SAS® program (SAS Institute, 1985). A one factor (*the feed type*) lineal model was used in the suckling period parameters; and a two factor (the first one was *the group of suckling period the rabbits came from* and the second one was *the feed type*), interaction and blocks lineal model were used in the fattening period parameters. In all fattening parameters under study a "block effect" was introduced to analyze the weight differences among the different repetitions, which were done along the time.

Figure 1 : Experimental design in the suckling and fattening periods.



RESULTS AND DISCUSSION

Suckling period

The suckling period parameters did not make distinctions between the two groups submitted to test (Table 1). The does reproductive parameters and the litters evolution parameters did not show meaningful differences ($p>.05$) between treatments. The feed intake estimated by birth also gave a similar result: 26.18 vs 26.34 kg/birth.

The does fed with FOS didn't improve the reproductive parameters like: births/copulating (95.55 vs 96.82), alive newborn kits/copulating (7.3 vs 7.2), alive newborn kits/birth (7.7 vs 7.4) or viability at birth (91.98 vs 92.63%) any more than CTL did.

The does milk yield, reflected in the viability and growth of their breedings during the exclusive days of suckling (first 21 days of life), didn't succeed in being better in the FOS group. In both groups (FOS and CTL) were concentrated most of the litter mortality (100-viability) during the first three weeks of life. The annual weaning kits productivity by doe (WY) turned out to be slightly better in the FOS group than it was in the CTL one, although not significantly (67.18 vs 65.77).

Table 1 : Means (±SD) of the parameters during the suckling period using a feed with (FOS) and without (CTL) supplementation.

Parameter	Sig†	FOS	CTL
No. of births		191	186
Interval between births (days)		41.0±7.5	40.6±6.8
Births/copulating (%)	NS	95.55±15.49a	96.82±13.52a
No. of total newborn kits/birth (TN)		8.2±2.7	7.9±3.0
No. of alive newborn kits/birth (AN)	NS	7.7±3.0a	7.4±3.2a
No. of alive newborn kits/copulating	NS	7.3±3.1a	7.2±3.2a
No. of kits after standardisation/doe (S0)		7.9±.9	7.8±1.2
No. of kits at day 21/doe (S21)		7.4±1.3	7.4±1.5
No. of kits at weaning/doe (S33)		7.4±1.4	7.3±1.5
Viability§ at birth (AN/TN) (%)	NS	91.98±20.90a	92.63±19.79a
Viability§ during the strict suckling period (S21/S0) (%)	NS	93.01±13.53a	93.65±14.73a
Viability§ during the birth-weaning period (S33/S0) (%)	NS	92.65±13.01a	94.02±11.13a
No. of weaning kits/doe/year (WY)	NS	67.18±13.69a	65.77±15.07a
Weight of kit after standardisation (WO) (g)		70.7±10.7	73.0±12.5
Weight of kit at day 21 (W21) (g)		381.1±63.1	390.3±63.6
Weight of kit at weaning (W33) (g)	NS	764.3±117.9a	786.0±112.5a
ADG during the strict suckling period (W0↔W21) (g/day)	NS	14.78±2.87a	15.11±2.78a
ADG during the birth-weaning period (W0↔W33) (g/day)	NS	21.06±3.51a	21.62±3.28a

ADG= Average daily gain. ; Sig†= Level of significance between treatments: NS p>.05. Different letters indicate means with significant differences (p<.05). ; Viability§= 100-mortality.

Fattening period

The four fattening groups obtained unequal results in the several studied parameters (Table 2). The f/FOS and c/FOS groups reached better values as a whole, while the f/CTL group obtained the worst values (except in carcass yield).

The *viability* was very different among groups (from 97.5% in f/FOS up to 90.8% in c/FOS) although there were not significant differences among treatments (p>.05). The *final live weight* and the *average daily gain* (ADG) presented differences among treatments (p<.001) due to: the origin factor (p>.05), feed factor (p<.001), blocks (p<.001) and without interaction between factors (p>.05). The groups that consumed different feed presented different weight and ADG means (p<.05). The groups that more grew also were those that more feed consumed, finding in the *feed intake* significant differences of the same nature. The correspondence between more feed intake to more growth provided a *feed efficiency* without significant differences among treatments (p>.05).

The *production index* (Pr), obtained as a result of conjugating: ADG, viability and feed efficiency, presented important significant differences among treatments (p<.001) due to: origin factor (p>.05), feed factor (p<.001), blocks (p<.01), without interaction between factors (p>.05). Pr means were different to each other (p<.05) except between those groups with better values -f/FOS and c/FOS-. The *carcass yield* didn't show differences among treatments (p>.05). *pH of the caecal content* revealed differences among treatments (p<.001) due to: origin factor (p>.05), feed factor (p<.001), blocks (p<.05); without interaction (p>.05); groups means were different according to the feed intake (p<.05). The groups fed with FOS presented values of pH centred in the value 6.

Table 2 : Means (±SD) of the parameters in the fattening period according to the groups: f/FOS, c/FOS, f/CTL and c/CTL.

Parameter	Sig†	*f/FOS*	f/CTL	*c/FOS*	c/CTL
Viability§ (%)	NS	*97.5 ± 6.8a*	91.7 ± 11.8a	*90.8 ± 9.6a*	95.8 ± 7.5a
Final live weight (g)	***	*1879.5 ± 193.9a*	1755.0 ± 200.3b	*1910.2 ± 211.9a*	1797.2 ± 221.8b
ADG (g/day)	***	*35.6 ± 6.0a*	31.5 ± 6.4b	*36.3 ± 6.7a*	32.9 ± 6.7b
Feed intake (g/day)	***	*110.6 ± 8.9a*	100.5 ± 8.7b	*112.1 ± 8.0a*	103.8 ± 7.9b
Feed efficiency (g/g)	NS	*3.11 ± .09a*	3.17 ± .19a	*3.09 ± .15a*	3.15 ± .14a
Production index (Pr)	***	*1.12 ± .12a*	.91 ± .09c	*1.07 ± .13a*	1.00 ± .09b
Carcass yield (%)	NS	*59.48 ± .90a*	59.64 ± 1.33a	*59.07 ± 1.19a*	58.02 ± 1.19a
pH of the caecal content	***	*6.00 ± .14a*	5.90 ± .17b	*5.99 ± .15a*	5.88 ± .15b

f/FOS= Rabbits group coming from the FOS group of suckling period fed with a fructo-oligo-saccharides supplement.
f/CTL= Rabbits group coming from the FOS group of suckling period fed without a fructo-oligo-saccharides supplement.
c/FOS= Rabbits group coming from the CTL group of suckling period fed with a fructo-oligo-saccharides supplement.
c/CTL= Rabbits group coming from the CTL group of suckling period fed without a fructo-oligo-saccharides supplement.
ADG= Average daily gain.
Sig†= Level of significance among treatments:*** p<.001, NS p>.05. Different letters indicate means with significant differences (p<.05).
Viability§= 100-mortality.

After studying the variation sources, the fattening period data were assembled according to only one factor (*the feed type*) and blocks lineal model (table 3); the FOS group got a greater ADG, the same feed efficiency and a better Pr than the CTL group.

Table 3. Means (±SD) of the parameters in the fattening period according to the rabbit feed groups: a feed with a supplement (FOS) and without supplement (CTL) of fructo-oligo-saccharides.

Parameter	Sig†	FOS	CTL
Viability§ (%)	NS	94.29.0a	93.8 ± 10.1a
Final live weight (g)	***	1894.3 ± 203.3a	1776.6 ± 212.6b
ADG (g/day)	***	35.9 ± 6.3a	32.3 ± 6.6b
Feed intake (g/day)	***	111.3 ± 8.5a	102.1 ± 8.5b
Feed efficiency (g/g)	NS	3.10 ± .09a	3.16 ± .14a
Production index (Pr)	***	1.09 ± .13a	.96 ± .10b
Carcass yield (%)	NS	59.27 ± 1.08a	58.83 ± 1.50a
pH of the caecal content	***	5.99 ± .14a	5.89 ± .16b

ADG= Average daily gain. ; Sig†= Level of significance between treatments:*** p<.001, NS p>.05. Different letters indicate means with significant differences (p<.05). ; Viability§= 100-mortality.

These results differed from the ones found in other similar tests (Lebas ,1993; ROCA, 1994) deduced a reduction of feed intake and feed efficiency in rabbits fed with FOS (.34% and .24% of FOS in feed respectively); MENDEZ *et al.* (1993) obtained a greater growing for equal feed intake and reduction of feed efficiency (.24% of FOS).

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Many works have demonstrated the interest of the use of fructo-oligo-saccharides (FOS) in rabbit feeding, not only in the production area but also in health status area.

In our case, the experimental farm was in a good health status state as it was confirmed by the viabilities and the pH level in the caecal content. The expected bioregulation action of the FOS in the caecal content pH level, as described by other authors (MORISSE *et al.*, 1992), could not be appreciated because of a normalised index.
In the suckling period no significant differences or tendencies were observed for any of the parameters studied. In this study the *"variety"* of the reproductive population didn't allow to determine advantages of the FOS group in relation to the CTL group. However the annual productivity (WY) of the FOS group was numerically higher and the feed intake estimated by birth was lower.

In the fattening period, as the other authors state, we observed significant improvements in the FOS group in relation to the CTL group. The final live weight of the rabbits of the FOS group was superior to the weight of the rabbits of the CTL group (+118.75g or +6.75%). ADG of the FOS group was 3.75 g/day (+10.43%) better than ADG of the CTL group. Assuming same mortality and feed efficiency in both groups, FOS group presented a production index higher than 1 (1.09) and the CTL group didn't reach the profitability threshold (.96).

These advantages can offer an important economic improvement in spite of the feed cost increase due to supplementing FOS to the rabbit meat producer (ROCA, 1994). Therefore, in commercial fattening, the addition of FOS could contribute to an economic improvement in the results.

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