

EFFECTS OF THE INCREASE OF THE FEED ALPHA-LINOLENIC ACID LEVEL ON THE PERFORMANCES OF REPRODUCTION OF THE RABBIT DOES.

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ABSTRACT

Three experimentations carried out in 3 different places and involving 777 does have compared a control feed with low omega 3 level (0.09 to 0.16 % of alpha-linolenic acid) to one containing extruded flax Tradilin® (Flax) in order to increase its alpha-linolenic acid level between 0.61 and 0.68 %. The fertility at birth, the number of “4 days old” rabbits / litter, the number of weaned rabbits / litter, the mortality before weaning and the weight at weaning (individually and for the litters) were measured on 1 221 cycles of reproduction. No differences were observed on the fertility. The “4 days old rabbits” / litter number was very highly significantly increased from 10.07 to 10.96 in average when the flax is incorporated in the feed, in agreement with the results observed for the piglet. This improvement can be explained by the high content in alpha-linolenic acid and in lignans of the flax seed. The number of rabbits at weaning / litter had the same evolution and went up very highly significantly from 8.69 to 9.67. The mortality before weaning dropped highly significantly from 11.2 to 9.7 % with the incorporation of flax in the feed as for the piglet, probably as a consequence of the increase of the omega 3 level in the colostrum and in the milk, improving the immunity of the rabbits and their inflammatory status. The individual weights and the litter ones increased very highly significantly respectively from 811 to 912 grams and from 7 044 to 8 026 grams, on the same way than from the piglet. Consequently, the extruded flax Tradilin® appears as an important source of omega 3, enabling an improvement of the performances of reproduction of the rabbit, particularly in a context of reducing the alfalfa content of the rabbit feeds, creating a decrease of the level of this fatty acid in the feed if not compensated. It brings too the lignans which probably explain partly the increase of the number of rabbits at birth.

Key words: Rabbit, omega 3, alpha-linolenic acid, flax, lignans

INTRODUCTION

If the interest of increasing the alpha – linolenic (ALA) acid level brought by the extruded flax Tradilin® to improve the performances and the meat quality of the growing finishing rabbits is now well documented (Teillet *et al.*, 2012; Minetto *et al.*, 2019), few information are available of its effects on the performances of reproduction. Muniz *et al.* (2004) and Castellini *et al.* (2004) have demonstrated an increase of the omega 3 fatty acids content in the milk and in the carcass of suckling rabbits when adding fish oil or flax seed in the feed but without references to the zootechnical performances. Rodriguez *et al.*, (2016) observed a higher fetal development and a higher placenta efficiency associated with heavier newborns when the does receive omega 3 PUFA (Rodriguez *et al.*, 2018). On the same way, D’ambola *et al.* (1991) show a better resistance of the neonatal rabbits to *Staphylococcus* but without zootechnical indications too. Only Maertens *et al.* (2005) study simultaneously the influence of the content of the feed in alpha-linolenic acid on the milk composition and the viability of the rabbits before weaning. They don’t see significant differences with and without flax but they have worked on a limited number of does (82) and used a control

feed already high in alpha-linolenic acid, making difficult a definitive conclusion. In the same time, a lot of benefits of the incorporation of extruded flax rich in alpha-linolenic acid have been demonstrated in the sow (De Quelen *et al.*, 2010; Guillevic *et al.*, 2011). The objective of this work is to research if same phenomena's can be found on does using a higher number of animals and with more difference between the omega 3 level of the control feed and the flax one than Maertens *et al.*, (2005).

MATERIALS AND METHODS

Animals

Hyplus hybrid does were used in to compare a control feed with low omega 3 level to one containing extruded flax Tradilin® (Flax). Experiments were carried out in three farms: the first one involving 57 does during one cycle of reproduction in the experimental center of EARL 3L, the second and the third ones gathering respectively 310 and 410 does took places in 2 commercial farms during 3 cycles of reproduction. The final distribution of the does between the different numbers of parturitions was approximatively the same between the 2 treatments.

Experimental feeds and measured parameters

The feeds of the 2 treatments were identical for the proteins (18 %), the crude fiber (15 %), the fat (4 %) and the digestible energy (2 500 kcal). The alpha-linolenic acid level was increased in the feeds by incorporation of 5 % of *omegalest*, a mix of extruded flax Tradilin®, of carob and of flax straw containing 10,5 % of alpha-linolenic acid. It was introduced in substitution of bran, rapeseed meal and oil of soya or of palm. The percentages of ALA were for the 3 experiments:

- For the first experimentation, 0.09 % in the control feed and 0.61 % in the flax one.
- For the second one, 0.12 % in the control feed and 0.64 % in the flax one.
- For the third one, 0.16 % in the control feed and 0.68 % in the flax one.

The alfalfa level was identical in the 2 feeds (Respectively 5 %; 10 %; 18 %). The experimental feeds were distributed from the artificial insemination corresponding to the first studied cycle of each experimentation and during the complete milking period. The measured parameters were:

- Number of artificial inseminations (AI) and of parturitions to calculate the fertility at birth. The results of fertility are available only for the farms 2 and 3.
- Number of rabbits alive at 4 days and at weaning enabling to calculate the number of "4 days old rabbits" / litter, the number of weaned rabbits / litter and the mortality 4 days – weaning.
- Individual and total litter weight at weaning taking place at 35 days in the first and third experimentations and 36 in the second one.

Statistical analysis

The data were analyzed by ANOVA for the number of rabbits at 4 days and at weaning and for the individual and litter weights at weaning; after bolean transformation of the individual data for the fertilities (1 for a positive insemination – 0 for a negative one) and for the mortalities (1 for a dead rabbits – 0 for a live rabbits) according to the method already described (Colin *et al.*, 2008). These statistical analyses were carried out for every single farm and for the complete data including the study of interaction and the influence of the age at weaning.

RESULTS AND DISCUSSION

Fertility

No statistical difference was observed (Table 1). These observations are in agreement with Maertens *et al.* (2005) but different of the ones of Rebollar *et al* (2014) who observed a higher fertility of primiparous does when supplementing the feed with EPA + DHA brought by fish oils. A complementary and additive explanation is the high content in lignans of the flax which improve fertility by the cow (Zachut 2015).

Number of rabbits / litter and mortality before weaning.

The number of rabbits / litter at 4 days is very highly significantly higher with the feed containing extruded flax Tradilin® in the 3 farms : + 0.89 “4 days old rabbit” / litter in average (Table 1) without interaction flax / farms ($P = 0.43$). This result is in contradiction with Maertens *et al.* (2005) observing a low and not significant difference for this criterion (+ 0.24 “4 days old rabbits” / litter) but in agreement with Guillevic *et al.* (2011) in the sows. It is coherent with the actions of omega 3 at reproductive physiological level (Rodriguez *et al.*, 2019) having beneficial effects on embryonal survival: supplying of available energy, synthesis of prostaglandins...

Table 1: Fertility, number of “4 days old” and weaned rabbits and mortality before weaning

Treatments	Farm 1		Farm 2		Farm 3		Total		P flax	P Inter farm / flax
	Control	Flax	Control	Flax	Control	Flax	Control	Flax		
Nb of AI	NA ⁽¹⁾	NA ⁽¹⁾	224	211	496	629	720	840		
Nb of parturitions	25	32	165	145	361	493	551	670		
Fertility (%)	NA ⁽¹⁾	NA ⁽¹⁾	73.7	68.7	72.8	78.4	73.1	76.0	0.49	0.001
Nb of “4 days old” rabbit	259	356	1 630	1 515	3 660	5 472	5 549	7 343		
Nb of “4 days old” rabbit / litter	10.36 ^{ab}	11.13 ^c	9.88 ^a	10.45 ^b	10.14 ^{ab}	11.10 ^c	10.07	10.96	<0.001	0.439
Nb of weaned rabbits	207	272	1 327	1 229	3 254	4 980	4 788	6 481		
Nb of weaned rabbits / litter	8.28 ^a	8.50 ^a	8.04 ^a	8.48 ^{ab}	9.01 ^b	10.1 ^c	8.69	9.67	<0.001	<0.001
Mortality 4 days – weaning (%)	20.1	23.6	9.9	8.9	11.1	9.0	11.2	9.7	0.006	0.054

(1) Not available data

The number of rabbits / litter at weaning is very highly significantly higher with the extruded flax Tradilin® for the complete results: + 0.98 weaned rabbits / litter in average (Table 1) mainly due to the farm 3. The interaction flax / farms is very highly significant: no significant difference in the farm 1 ($P = 0.78$); trend to the signification in the farm 2 ($P = 0.066$). Globally, the mortality between 4 days and the weaning is highly significantly lower with the flax feed (-1.5 %), mainly in the farm 3: the differences are not significant in the farm 1 and 2 (Respectively $P = 0.36$ and $P = 0.44$). This global improvement of the mortality of the rabbits before weaning is in contradiction with Maertens *et al.* (2005) who found an increase of 1.5 % of this criterion but in agreement with D’Ambola *et al.* (1991) showing a better resistance of the neonatal rabbits to *Staphylococcus* and of Muniz *et al.* (2004) and Castellini *et al.* (2004) who demonstrated an increase of the omega 3 fatty acids content of the milk when distributing high level of omega 3 feeds. De Quelen *et al.* (2010) observed too a reduction of the piglet mortality when extruded flax Tradilin® is distributed to the sows.

Weights at weaning.

Globally, the individual weights at weaning are higher with the Flax feed in the 3 farms (+ 102 grams); this difference is very highly significant only in the farm 3 and no significant in the farms 1 and 2 (Table 2). The Interaction flax / farms is very highly significant. The weights at weaning are highly significantly heavier in the farm 2 due to the older age at weaning. The weights of the total litter are also increased as a consequence of a higher number of weaned rabbits and of the heavier individual rabbit weights: + 1 783 grams in average. This difference is highly significant in the farm 2 and very highly significant in the farm 3. The Interaction flax / farms is very highly significant. These increases of the individual and litter weaning weights disagree with those obtained by Maertens *et al.* (2005) who did not find any difference on the weight at weaning between the control feed and the flax but are similar to the ones of Guillevic *et al.* (2010) in the piglet.

Table 2: Individual and litter weights at weaning

Experimentation	Farm 1		Farm 2		Farm 3		Total		P Flax	P inter flax / farm
	Control	Flax	Control	Flax	Control	Flax	Control	Flax		
Indivi. weight (g)	828 ^{ab}	848 ^b	954 ^c	961 ^c	751 ^a	904 ^{bc}	811	912	<0.001	<0.001
Litter weight (g)	6 856 ^a	7 208 ^a	7 672 ^a	8 145 ^b	6 769 ^a	9 132	7 044 ^c	8 826	<0.001	<0.001

CONCLUSIONS

The incorporation of extruded flax Tradilin® in the does feed improves the prolificacy, the viability of the rabbits before weaning and their weight at weaning. These positive effects of the flax on the mortality can be mainly explained by the increase of the omega 3 level in the colostrum and in the milk, improving the immunity and the inflammatory status. In the same time, the lignans contained in the flax seed are probably an important factor of improving the prolificacy by increasing the ovulation rate or/and by reducing the embryonic mortality. These benefits of the extruded flax as source of alpha-linolenic acid becomes important in the current context of reduction of the alfalfa in the rabbit feeds, creating a decrease of its level in the feed if it is not compensated by another source.

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