Original Scientific paper
10.7251/AGRENG2001030B
UDC 631.6:636.92]:665.213
631.6:636.92]:633.521

EFFECT OF OMEGA 3 ON THE REPRODUCTIVE PERFORMANCE OF THE ALGERIAN SYNTHETIC RABBIT IN ARTIFICIAL INSEMINATION

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ABSTRACT

In the present work of the pubescent and immature rabbit does of the Algerian synthetic strain (ITELV 2006), the animals received a supplement of omega 3 of animal origin (fish oil) or vegetable origin (linseed) for 3 months (2 months before AI and 1 month during pregnancy). The females were followed until parturition in order to study the effect of omega 3 on their reproductive performance (fertility, prolificacy and stillbirth). Comparison of data between the six lots (Control puberts (CP), Control peripubertal (CPE), Linen grains pubertal (LGP), Linen grains peripubertal (LGPE), Fish oil puberts (FOP) and Fish oil peripubertal (FOPE)) for parameters of born deaths (BD), fertility and stillbirth rates showed no significant difference ($P>0.05$). Whereas for total births (TB), live births (LB) and weaner births (WB), the differences are significant ($P<0.05$). A very marked improvement in prolificity has been achieved by the incorporation of fish oil and flaxseed into the feed of the rabbits. In fact, the females of these two lots recorded the highest values (10.37 TB, 9.87LB, 9.3 WB and 10.44 TB, 9.77LB, 8.77WB respectively for FOPE and LGPE), as opposed to the unpunished rabbits of the control lot which gave the lowest numbers (7.14TB, 6.57LB and 6.57WB).

Keywords: *Fish oil, linseed, fertility, prolificacy, stillbirth.*

INTRODUCTION

In Algeria, numerous scientific research axes have been drawn up by several institutions (Institutes, universities, National School of Agricultural Sciences) in order to carry out work on the synthetic strain ITELV 2006. The majority of this work focused on describing characteristics from characterization work at experimental and research stations, such as Zerrouki and al. (2005); Mefti and al. (2010), Cherfaoui and al. (2013). This work on characterizing the reproductive

performance of this strain has revealed a relatively high level (Gacem and al. 2009; Bolet and al., 2012; Sid and al. 2018). Nevertheless, a minority of scientific work had focused on the use of different biotechnologies for this strain. Within this framework, the research project carried out by the laboratory of natural bio-resources of the University Hassiba Benbouali of Chlef which deals with biotechnologies applied to livestock farming and in which the present study. To enable the rabbit to express its performance, it is necessary to control its conduct and optimize the conditions of its rearing, in particular feeding and reproduction. The management of the reproduction has changed from natural projection to artificial insemination and the conduct in strip, thus facilitating the management of the farms and ensuring a better profitability (Lebas, 2002; Theau-Clément 2005 and Theau-Clément 2008). At the same time, the control of AI has enabled the establishment of a new production system which is defined by the «duct en bande» and a better organization of the farms. As in other animals, feeding can have multiple influences on rabbit performance. Changes in these may be achieved by changing the composition of the food (Lebas, 2010). Several authors have studied the effects of increasing levels of omega-3 fatty acid in foods on the quality of rabbit meat both qualitatively and quantitatively (Colin et al, 2005; Benatmane F., 2012; Lebas F, 2007). However, little work has been done on the effect of omega-3 fatty acid supplementation on reproductive performance in this animal. The objective of our work is to study the comparative effect of supplementation of Omega-3 fatty acids of animal (fish oil) or vegetable (extruded flaxseed) on reproductive performance (receptivity, fertility, prolificacy and embryonic mortality) of pre-pubescent and pubescent rabbits conducted in AI.

MATERIALS AND METHODS

The experiment was carried out on pubic nulliparous females aged 4 to 5 months and peripubertal aged 2 months. Three males of the same 7-month-old strain used for semen collection are used in the experiment. All females are housed in a hard-built building, have windows providing ventilation and natural lighting and conducted 2 extractors for ventilation.

A cooling system is insta. The rabbit cages, made of wire mesh, are 100 cm long by 43 cm wide and 31 cm high. All cages are equipped with a feeder and a semi-automatic water trough in the form of a nipple.

During the experimental period, all females receive 150g/d of commercial standard feed in the form of pellets, containing alfalfa bran, forage wheat, corn, soybean meal, molasses, anticoccidien, phosphate, amino acid, trace elements and salt. The chemical composition of the food is given in Table 1. For the experimental lots, the basic ration is supplemented by flaxseed or fish oil. Females receive omega-3s for 3 months (2 months before AI and 1 month during gestation).

Table1. Chemical composition of standard food

Dry matter DM (%)	91,42
Minerals matter MM (%)	7,51
Crude protein CP (%)	14,5
Crude cellulose CC (%)	9,49
Fat matter FM (%)	3.38
Calcium (%)	0,89
Phosphorus (%)	0,6

The sixty-six rabbits used in the study were divided into 6 homogeneous lots (n=11) with 2 pubic (P) and peripubertal (PE) control groups and 4 groups for which the diet is enriched either with fish oil, or with extruded flaxseed for P and PE females for the supply of polyunsaturated fatty acids. Thus the 66 rabbits are distributed as follows:

Lots CP and CPE (control puberts, n=11 and control peripubertal, n=11) receive the basic ration of 150g/d of the standard feed.

Lots LGP and LGPE (flaxseed pubères, n=11 and flaxseed peripubertal, n=11) receive a basic ration of 150 g/d to which 3% flaxseed per day was added.

The FOP and FOPE batches (puberts fish oil, n=11and peripubertal fish oil, n=11) received a basic ration of 150 g/d to which was added 2% fish oil per day.

After two months, the rabbits of the six lots were artificially inseminated with semen collected and analysed at the laboratory level. The gestation diagnosis was made by abdominal palpation, performed on the 11th day of AI.

The reproductive parameters of the rabbits in the six lots, based on the diet and age of the females, were evaluated using fertility, birth and weaning prolificity and stillbirth rates. The means and standard deviations of the identified reproduction parameters were calculated using the Excel software (descriptive statistics). Comparison between batches for reproduction performance was done by variance analysis using the Xlstat 2016 software.

RESULTS AND DISCUSSION

Overall and far from the effect of n-3 fatty acid supplementation, the three treatments studied allow for consistent performance with those reported by the bibliography for rabbit of the Algerian synthetic strain (Chibah, 2016; Sid et al., 2018).

Comparison of the data for the six lots for fertility and stillbirth rates showed no significant differences (P>0.05). While for total born (TB), live born (LB) and weaned born (WB), the differences are significant (table 2).

Table 2. Reproductive performance of rabbits in the 6 lots (mean standard deviation)

	CP	CPE	LGP	LGPE	FOP	FOPE	p
Fertility rate (%)	54.54 (n=6)	63.63 (n=7)	54.54 (n=6)	81.81 (n=9)	63.63 (n=7)	72.72 (n=8)	0.74
Stillbirth rate (%)	4.23 ±6.05 (n=6)	8.84 ±14.04 (n=7)	6.11 ±8.69 (n=6)	5.42 ±7.37 (n=9)	6.71 ±6.82 (n=7)	4.96 ±6.55 (n=8)	0.96
Number of total births (TB)	$7.33^{©}$ ±1.49 (n=6)	$7.14^{©}$ ±2.03 (n=7)	$8.00^{©}$ ±2.30 (n=6)	$10.44^{(a)}$ ±1.57 (n=9)	$8.43^{(b,c)}$ ±1.59 (n=7)	$10.37^{(a,b)}$ ±1.93 (n=8)	0.004
Number of live births (LB)	$7^{(b)}$ ±1.41 (n=6)	$6.57^{(b)}$ ±2.38 (n=7)	$7.50^{(b)}$ ±2.06 (n=6)	$9.77^{(a)}$ ±0.91 (n=9)	$8.00^{(a,b)}$ ±1.85 (n=7)	$9.87^{(a)}$ ±1.96 (n=8)	0.006
Number of deaths born (DB)	0.33 ±0.47 (n=6)	0.57 ±0.90 (n=7)	0.5 ±0.76 (n=6)	0.66 ±0.94 (n=9)	0.43 ±0.49 (n=7)	0.5 ±0.70 (n=8)	0.98
Number of born weaned (BW)	$6.66^{(b,c)}$ ±1.97 (n=6)	$6.57^{©}$ ±2.38 (n=6)	$6.5^{©}$ ±1.89 (n=6)	$8.77^{(a,b)}$ ±1.22 (n=9)	$7^{(b,c)}$ ±1.77 (n=7)	$9.37^{(a)}$ ±1.79 (n=7)	0.02

CP: Control puberts. CPE: Control peripubertal. LGP: Linen grains pubères, LGPE: Linen grains peripubertal, FOP : Fish oil puberts, FOPE : and Fish oil peripubertal. p: statistical significance. On each line, the numbers affected by different letters (a,b,c,) are significantly different at the 5% threshold.

We find that the fertility rate has been improved by the addition of omega-3 in the diet of the peripubertal rabbits for both the diet enriched with flaxseed (81.81%) and the diet enriched with fish oil (72.72), although the statistical analysis showed no significant differences between the six treatments (P>0.05).

Colin et al. (2012) show improved fertility through incorporation of flaxseed extruded into food in a synthesis of work on 2179 rabbits. These same authors note that this improvement was achieved with low fertility levels in the control diet. In our study the control lots have the lowest fertility rates, 54.54% for CP).

For the birth mortality rate, no statistically significant differences were found (P>0.05). The diet enriched with polyunsaturated fatty acids (PUFA) does not result in any difference for rabbits in the six lots. Overall and apart from the effect of the incorporation of n-3 fatty acids in the food, our animals have very satisfactory stillbirth rates and much lower than the value of 17.5 found by Moumen in 2017 on rabbits of the local population of the region of Aurès, Algeria.

Sid et al. (2018) reported slightly higher in ours (9.8%) for the same synthetic strain but a much higher rate for the white population (18.2%).

A very clear improvement on the components of prolificity was achieved by incorporating fish oil and flaxseed into the food. In fact, the diet enriched with omega 3 of animal origin allowed, in young and adult females, the most important means for the majority of the prolificity parameters studied: 8LB and 7BW for elderly females; 9.87LB and 9.36BW for young females).

Our results are consistent with those of Colin et al. (2012), which showed an improvement in prolificity through extruded flaxseed supplementation in food in a synthesis of work on 2179 rabbits.

Overall, the prolificity results obtained in this study are close to those of the bibliography for the synthetic strain ITELV 2006, indeed, Zerrouki et al. (2014) published comparable values for rabbits reared at two stations: Baba Ali (8.76) and Lamtar (8.02).

In terms of LB, the results recorded during the study show a response of the rabbits to the diets tested. This finding is consistent with that of Colin et al. (2005) who confirm that the incorporation of 7% omega-3, in the form of flaxseed extruded into the food, significantly improves the number of live rabbits born per litter. For infant deaths, statistical analyses showed no significant difference (P> 0.05) between the six lots.

The number of DB ranges from 0.33 to 0.66. This finding is consistent with that of Gacem et al.(2009), which reported a value of 0.58 for the white population and 0.7 for the synthetic strain. Conversely, Sid et al. (2018) report higher values for the synthetic strain (0.8) and the white population (1.3).

The highest number of weaned lapereaux (9,37) is obtained in unpunished rabbits receiving the feed containing fish oil, followed by the unpunished rabbits receiving the feed enriched with flaxseed (8,77). I assumed that the lowest value is 6.5 at the level of the pubic lot receiving the feed with the flaxseed and the impudent lot checking. The withdrawal prolificity values obtained in the pubic lots receiving flaxseed in the diet and control lots for young and adult rabbits are very close to those recorded by Zerrouki et al. (2014) for the same strain are: 6.85 at Baba Ali and 6.61 at Lamtar. The improvement in the number of pupae weaned following the incorporation of omega-3s in the food, highlighted in this experiment, was reported by Colin et al. (2017), which confirm that the incorporation of algae rich in docosahexaenoic acid (DHA) into food significantly improves the viability of rabbits. This is explained, according to the same authors, by the fact that the level of omega 3 fatty acids in the milk of rabbits receiving food containing extruded flaxseed is 2 to 3 times higher than that of control rabbits. This result is very interesting since omega-3s play a very important role in immune development. However, Maertens et al. (2005) indicate that the performance of the control and extruded flaxseed concentrate rabbits was not significantly different between the two diets, but overall the females in lot omega-3 weaned 3.5 more pups during the experimental period. The Omega 3 feed produced higher milk fat (+1.3%; P0.05) and the dietary profile of Pufas was very well reflected in the milk.

CONCLUSIONS

In this study, we investigated whether an increase in omega 3 fatty acid content in the diet of breeding rabbits, either by the addition of extruded flaxseed or fish oil could improve reproductive performance. Our results suggest a significant improvement in reproductive performance due to the addition of flaxseed and fish oil. There was no significant improvement in fertility or stillbirth rates in the experimental lots compared to the control lot. Nevertheless, it was clear, although not significant, that the addition of fish oil or flaxseed resulted in better rates than the control lots. It should be noted that the standard feed constituting the basic ration for the control lot contains a significant amount of dehydrated alfalfa high in n-3 GA. The enrichment of the food by Agpin-3 made it possible to obtain, in young females (impubeers), better fertility rates and litter sizes at birth and weaning compared to adult females. These preliminary results point us towards an interest in studying young rabbits of this very prolific strain and preparing them to ensure better productivity with better body condition.

It should be noted that in our study, the incorporation rates are minimum, 3% flaxseed and 2% fish oil. It would be interesting, therefore to start trials with higher levels of omega 3, with a better balanced food and a larger number of females that will be monitored over a higher number of breeding cycles.

It is interesting to conduct studies with diets with a low intake of omega 3, so that the effects of n-3 PUFA are more marked. Indeed, in the absence of information indicating the exact levels of the food marketed in omega-3 fatty acids, the effect of the intake must be confirmed by in-depth analyses determining the quantity and quality of omega-3 fatty acids in the standard food.

The results obtained, at the end of this modest work, show that AI provides encouraging fertility and prolificacy rates for the synthetic strain.

ACKNOWLEDGEMENT

The authors express their thanks to the Directorate-General for Scientific Research and Technological Development (DGRSDT), for the financing of this research.

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