EFFECT OF SPIRULINA (*SPIRULINA PLATENSIS*) ON GROWTH PERFORMANCE AND RABBIT HEALTH (*ORYCTOLAGUS CUNICULUS*)

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ABSTRACT

Spirulina is a cyanobacterium that is one of the oldest known life forms on Earth. This blue-green filamentous alga has been consumed for centuries by certain populations. Thanks to its complete nutritional qualities, including a high protein value, amino acids and essential fatty acids, vitamins and minerals, combined with high digestibility, spirulina is the subject of much research around the world. With this work we aimed to evaluate the effect of spirulina *Spirulina platensis* on growth performance and health of the rabbit (*Oryctolagus cuniculus)* in order to evaluate its subsequent use in cuniculture. Four batches of 14 rabbits weaned at 35 days weighing 500 ± 70 g were reared in individual cages. Thus, in addition to control (**T)**, which was fed without spirulina, there treatments containing spirulina at different doses in the drinking water were used (10 mg/L of water for **D1**, 50 mg/L for **D2** and 100 mg/L for **D3)**. The study found that the intake of *Spirulina platensis* did not result in significant differences in growth performance: average daily feed intake (ADFI), average body weight (ABW), average daily gain (ADG), and feed conversion rate (FCR). The health risk index (HRI) was particularly high in the first two weeks in all different groups, but no differences were observed among the four treatments.

Key words: Rabbits, Spirulina, Growth performance, Animal health

INTRODUCTION

The delay in rabbit production in Côte d'Ivoire can be explained by several reasons. In addition, the lack of knowledge about rabbit rearing techniques, what is above all, is the quality and high cost of industrial feed (Kadi, 2012). The food is an essential factor in rabbit breeding. It accounts for more than 70% of the production costs of rabbit farming (Gidenne, 2003).

The development of this breeding would therefore be through increasing the quality of diet and reducing cost. The formulation of food products inedible in humans and also the use of additives including probiotic microorganisms such as yeast and Spirulina could help solve this problem. Indeed, many studies have shown the role of probiotics on the digestive system health.

More and more, spirulina is the subject of several scientific researches. However, the works carried out concerned essentially fish and poultry production. In the case of rabbits, most scientific work has focused only on the effect of spirulina on hematological parameters (Bleyere et al., 2015, Kambou et al., 2015). Data on growth parameters are still patchy.

Hence the interest of this study, which aims to evaluate the effect of Spirulina (*Spirulina platensis*) on the growth and health performance of the rabbit (*Oryctolagus cuniculus*).

MATERIALS AND METHODS

Animals and experimental design

Four batches of 14 rabbits (*Oryctolagus cuniculus*) weaned at 35 days of age and with the same average weight 500 ± 70 g were used. Sex was not taken into account. The constitution of the batches was done according to the phenotypic diversity observed in the breeding; the colours of dresses were distributed in the four batches. All groups received the FACI® brand industrial pelleted diet (Table 1). Thus, in addition to control (**T)**, which was fed without spirulina, there treatments containing spirulina at different doses in the drinking water were used (10 mg/L of water for **D1**, 50 mg/L for **D2** and 100 mg/L for **D3)**. Chemical composition of spirulina is shown in Table 2. The different lots were thus heterogeneous within them and homogeneous with each other. The dimensions of cages were 0.5m² x 25 cm, mounted in batteries with 4 compartments per level.

Table 1: Ingredients and chemical composition of control diet (provided by the Ivory Coast Factory Company (FACI))

Ingredients (%)	Control diet
Corn	4
Soybean oil cake	9
Palm kernel cake	20
Copra meal	2
Wheat bran	11
Corn bran	25.5
Rice bran	5
Brewery drake	21
Oyster shell	1
lysine	0.5
Premix[1]	0.5
salt	0.5
TOTAL	***100.00***
Chemical composition (%)	
Dry matter	90.3
Ether Extract	2.40
Nitrogen	2.94
Neutral Detergent Fibre	51.1
Acid Detergent Fibre	36.0
Acid Detergent Lignin	9.50
NFE	23.7
Gross Energy (Kcal/kg)	1811

[1]Mineral and vitamin composition (mg/kg of final diet): Co, 0.10; Cu, 3; Fe, 40; Mn, 60; Zn, 40; I, 0.5; Se, 0.1; Choline Chloride, 100; Riboflavin, 1.5; Niacin, 15; Vitamin B6, 0.8; Vitamin K, 1.5; Vitamin E, 20 IU/kg; Thiamine, 0.5; Vitamin A, 10,000 IU/kg; Vitamin D3, 2,000 IU/kg; Anti-oxidant, 30.

Table 2: Chemical composition of Spirulina (J. Falquet, J.-P. Hurni, 2006)

Chemical composition	
Nutritional elements, %	For 10 g of spirulina
Protein	55-70
Carbohydrates	15-25
Lipids	4-7
Minerals	7-13
Fibres	2-8
Vitamin B2	0.3-0.46 mg
Vitamin K	0.2 mg

Body weight was individually controlled every Monday and Friday to determine the average body weight (ABW), average daily gain (ADG) and feed conversion rate (FCR).
Average daily feed intake (ADFI) was evaluated in each group by the difference between the amount of food dispensed and the refusals using an electronic scale from mark TERRAILLON®, 1g precision and 5 kg maximum capacity.
The health monitoring was done by the daily control of the morbidity and the mortality of the animals each morning (7h-8h) and evening (16h-17h). Thus, the Health Risk Index (HRI) was determined by adding the number of morbid to the number of deaths.

Statistical Analysis
Data of ABW, ADFI, ADG and FCR were processed using the statistical software R version 3.1.0. An analysis of variance (ANOVA) was used to test the effect of the treatments on the means. The probability threshold of 0.05 was considered. When a significant difference was found, the DUNNETT post-hoc test was performed to determine significant differences between the control and the other groups. The impact of the treatments on the morbidity, mortality rate and the health risk index was analysed and compared using the Chi-square test.

RESULTS AND DISCUSSION

Animals fed with 10, 50 and 100 mg spirulina did not show differences in ADG and FCR (Table 3). The animals had a similar ADG and FCR (24 g and 4.6, respectively). This absence of difference in ADG and FCR among the different batches of animals in this work would be the consequence of the absence of variation in the amount of feed ingested. The results of Gerencsér et al. (2013) go in the same direction as those we obtained. These authors also recorded a similar ADG (38.6 g) and a similar FCR (3.5) between animals supplemented with a 5% of spirulina and the control.

Table 3: Effect of spirulina doses on average daily feed intake (ADFI), average daily gain (ADG), feed conversion rate (FCR) and average body weight (ABW)

	DOSES (D)				**SEM**	**P value**
	T	**D1**	**D2**	**D3**		**D**
ADFI, g	82	84	86	91	2.91	0.47
ADG, g	23	28	24	21	2.10	0.52
FCR, g/g	4.7	3.9	4.5	5.4	0.40	0.43
ABW, g	1019	1045	967	991	58.7	0.83

T: control group, D1: 10 mg/L spirulina, D2: 50 mg/L spirulina, D3: 100 mg/L spirulina; SEM: Standard Error of Means (n=14).

All the animals had a mean body weight similar to 70 days of 1005 g (Table 3). This result is logical because no difference was detected on ingestion and feed efficiency in this study. These results are consistent with those of Peiretti and Meineri (2008) who also found no significant differences when rabbits were supplemented with Spirulina at 5%, 10% and 15% in the diet.
Regarding health risk index (HRI), the results of this study showed a significant difference between the different batches of animals at the age interval 35-50 d (Table 4). The highest rate of HRI was observed in animals in lot D2 with 21.4% morbidity, 50% mortality and 71.4% HRI. In contrast, the lowest rate of health risk index was identified in the control group, which presented 21.4% of mortality and any case of morbidity. These health problems could be due to the fact that we did not carry out any vaccine or preventive treatment before the beginning of the experiments. One of our objectives was to evaluate the effect of spirulina on the health of animals; most of the deaths were due

to either diarrhoea or bloating, which could have been prevented by treatments before the beginning of the experiment.
The results of Gerencsér et al. (2013) confirm that morbidity and mortality rates are high in the first weeks after weaning although they have observed lower rates than those of our study. In fact, the latter recorded morbidity and mortality rates of 9.5% and 2.4%, respectively, during the 35th to 56th days of age.

Table 4: Effect of spirulina doses on morbidity, mortality and health risk index (HRI).

	Treatments				
	T	**D1**	**D2**	**D3**	**P value**
35 to 50 days	14	14	14	14	
Morbidity (%)	0(0.0)	1(7.1)	3(21.4)	1(7.1)	0.24
Mortality (%)	3(21.4)	5(35.7)	7(50)	3(21.4)	0.31
HRI (%)	3(21.4)	6(42.9)	10(71.4)	4(28.6)	0.04
51 to 60 days	11	9	7	11	
Morbidity (%)	0(0.0)	0(0.0)	0(0.0)	1(9.1)	0.47
Mortality (%)	1(9.1)	2(22.2)	0(0.0)	1(9.1)	0.51
HRI (%)	1(9.1)	2(22.2)	0(0.0)	2(18.2)	0.39
61 to 70 days	10	7	7	10	
Morbidity (%)	0(0.0)	1(14.3)	0(0.0)	1(10)	0.51
Mortality (%)	0(0.0)	1(14.3)	0(0.0)	0(0.0)	0.26
HRI (%)	0(0.0)	2(28.6)	0(0.0)	1(10)	0.17
35 to 70 days Effective	14	14	14	14	
Morbidity (%)	0(0.0)	2(14.3)	3(21.4)	3(21.4)	0.32
Mortality (%)	4(28.6)	8(57.1)	7(50)	4 (28.6)	0.28
HRI (%)	4(28.6)	10(71.4)	10(71.4)	7(50)	0.16

T: control group, D1: 10 mg/L spirulina, D2: 50 mg/L spirulina, D3: 100mg/L Spirulina.

CONCLUSIONS

According to these results, the intake of spirulina, whatever the dose (10 mg/day, 50 mg/day and 100 mg/day), did not cause any significant variation in rabbit growth performance. Spirulina does not cause the reduction of ingestion either. The health risk index was particularly high during the first two weeks but over the entire duration of the experiment no significant difference was observed.
In view of the results obtained, Spirulina platensis should not be recommended for feeding of growing rabbits for the improvement of growth and sanitary performance.

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