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Research Article

A study on the reduction of antibiotic use by introducing organic acids in broiler chicken feed in the district of Abidjan - Ivory Coast

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Abstract

The use of organic acids in the diet of animals is potentially beneficial for maintaining intestinal hemostasis and controlling the growth of pathogenic bacteria. The objective of this study was to experiment with organic acids as additives to antibiotics used by farmers. A total of 490 broilers were studied in this study and were divided into 5 lots of 98 subjects. The experimental core consisted of Fysal, Fysal-Selko, Selko, Patheryl (reference antibiotic) and Control. The experimental products were introduced in the drinking water (Selko pH) and in the feed (Fysal MP). A high feed consumption was noticed in the Fysal lot with 80.44±44g/chicken followed respectively by the Pteryl lots with 79.48 ± 42.25g/chicken, Fysal-Selko with 79.34 ± 43.62g/chicken, Selko with 77.27 ± 41.39g/chicken and finally Control with 76.01 ± 39.41g/chicken. The weight gain was high in the Fysal lot with 1770 ± 623.38g followed respectively by the Fysal-Selko lots with 1709 ± 606.05g, Pteryl with 1619 ± 577.70g, Selko with 1607 ± 567.90g against the Control lot with 1550 ± 544.41g. A mortality rate of 3.06% was recorded only in the Selko lot. Economically, the lots (Fysal, Fysal-Selko and Selko) that consumed the feed and water containing organic acids recorded higher profits compared to the Control and Pteryl batches. The organic acids such as Fysal MP and Selko pH could be used as alternatives to antibiotics in poultry farming.

Keywords: Broiler, growth performance, organic acids, antibiotics

INTRODUCTION

Antibiotics are drugs used to treat and prevent infections of bacterial origin. In animal husbandry, they are used for prophylactic, metaphylactic, therapeutic purposes or as growth promoters. Nowadays, antibiotics constitute a real threat to public health, which is reflected in allergies, intoxications and antibiotic resistance. Antibiotic resistance is a problem in both human and veterinary medicine [1]. In recent years, it has become a matter of increasing concern to the general public. Indeed, on a global scale, antibiotic-resistant infections are responsible for 700,000 deaths per year. In France, according to a study conducted by the Institut de Veille Sanitaire, it is the cause of 5,543 deaths per year for 158,000 infected [2]. In Ivory Coast, a study conducted by the National Antibiotic Reference Center indicates that antimicrobial resistance has increased from 9% in 2002 to 46% in 2018 [3]. Antimicrobial resistance could cause more than 10 million deaths worldwide by 2050; the productivity losses it causes amount to more than 1.5 billion euros in Europe, and more than 55 billion dollars in the United States. Worldwide, it could cost more than $100 trillion by 2050[2]. In animal health, the same observation is made and the potential effects of antibiotic resistance circulate between humans and animals. Therefore, the use of antibiotics as feed additives in animals is regulated in some European countries [4]. Faced with this problem, it is necessary to find alternatives to remedy it. Among these alternatives, organic acids are used. In fact, organic acids are used in poultry feed for nutritive actions (reduction of the pH of the gastrointestinal tract, improvement of protein digestibility, reduction of the risk of diarrhea, improvement of the quality of the litter, increase of feed consumption), antimicrobial action (although not antibiotics, they are able to inhibit or block the growth and proliferation of pathogenic bacteria as well as undesirable fungi or yeasts). In this context, this study was initiated to test the incorporation of organic acids in broiler feed in order to contribute to the reduction of antibiotic use in livestock and in poultry farming in particular.

MATERIALS AND METHODS

A-Description of the study area

This study was conducted in Ivory Coast, specifically in the District of Abidjan, the country's economic capital (Figure 1), which encompasses 80% of the country's modern poultry industry[5].

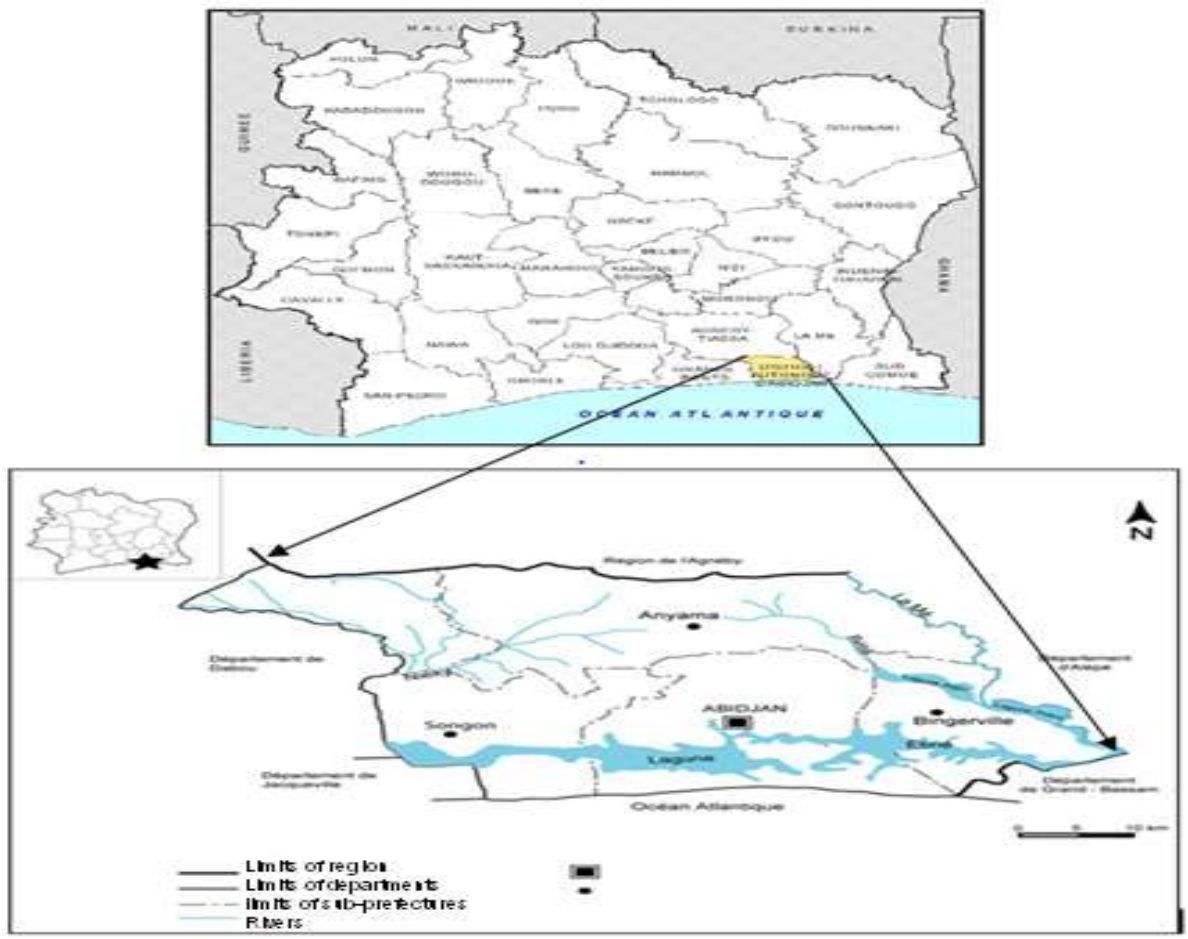

Figure 1: Presentation of the autonomous district of Abidjan

B-Methods

1- Field Investigation

The study consisted of a survey of the classes of antibiotics commonly used in 15 broiler farms in the district of Abidjan.

2- Experimental phase

We have tested organic acids as feed additives to substitute antibiotics used by farmers. It is based on the principle of "single-band" breeding, which consists of managing lots of animals of the same age, the same species and the same type of production.

Preparation of the building

It consisted in the disinfection of the building and the construction of a chick house with a surface of 12.5 m^2, at a rate of 40 chicks/ m^2.

A foot bath containing water and concentrated tripuricide (disinfectant) was installed at the entrance of the building. Three (3) hours before the arrival of the chicks, the drinkers and feeders were placed in the brooder, after having been thoroughly washed with diluted bleach.

2.1- Arrival and batching of chicks

The chicks from the hatchery (Golden ivory) were collected after their first vaccination at the hatchery and then transported in a vehicle to the trial site.

2.2.1- Constitution of the experimental groups

At the reception in the henhouse, we proceeded to an individual control of the sanitary state of the chicks and to a grouped weighing to determine the average weight of the chicks.

The trial involved 490 broilers of the ROSS 308 strain. These chicks were divided into five lots, 98 chicks per lot. These are:

Fysal lot (that received the organic acid (Fysal MP) incorporated in the feed;

Fysal-Selko pH lot (that received both organic acids "Fysal MP and Selko pH);

Selko pH lot that received the organic acid (Selko MP) administered in the drinking water;

Pteryl lot (that received the vitamin antibiotic administered in the water);

Control lot (that did not receive any experimental product).

During the whole rearing period, feed and water were distributed ad libitum. Food intake, weight evolution, parameters influencing broiler growth (temperature, humidity, feed consumption, daily water consumption, average daily gain and feed conversion ratio) and mortality rate were monitored et evaluated.

2.2- Statistical analysis of results

The variables were entered into the **"EXCEL® "** spreadsheet. The calculation of means, standard deviations, analysis of variance and comparison of means were performed using **R Studio** software. The means are compared at the 5% threshold (for P values lower than 0.05, the difference is considered significant).

RESULTS

1- Results of the field investigations

Animal health workers in the district of Abidjan have knowledge of the concepts of alternatives to antibiotics, waiting times, and state that the misuse of antibiotics is a public health problem. A survey of farmers was conducted to identify the antibiotics commonly used for the prevention of avian infections (Figure 2).

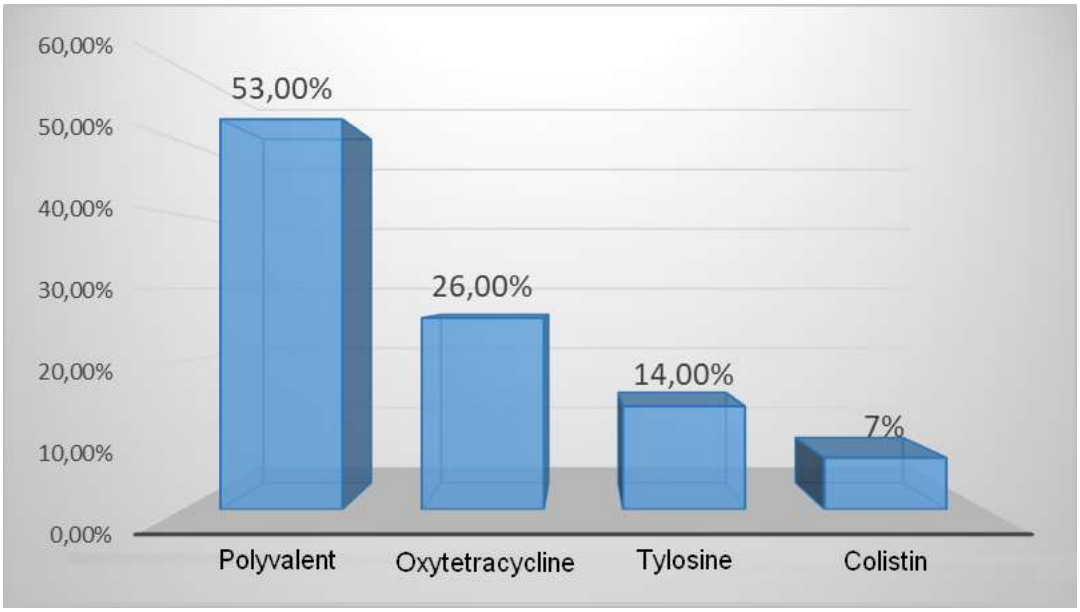

Figure 2: Classification of antibiotics commonly used in antibiotic prevention by the farmers

2- Results of the environmental parameters evolution (Table 2)

Table 2: Temperature and hygrometry in the poultry house.

Rearing period	Temperature (ºC)		Hygrometries (%)	
	Minimum	Maximum	Minimum	Maximum
Startup	25	34	55	65
Growth	23	31	50	70
Finishing	24	31	55	70

3- Results of Fysal, Selko pH and Pteryl effects on the growth performance of broilers

3.1. Food consumption (Table 3)

Table 3: Daily food consumption/subject/lot

Cumulative weekly food consumption (g)/lot						
	Fysal	Fysal-Selko	Selko	Pheryl	Control	Standard
S1	19,51	19,51	19,51	19,51	19,51	24
S2	51,94	51,76	52,63	54,81	54,08	53
S3	87,76	86,52	84,76	92,2	86,51	92
S4	124,16	120,6	119,6	125,07	117,76	134
S5	118,84	118,3	109,84	105,83	102,19	145
Average	80,442	79,338	77,268	79,484	76,01	89,6
Deviation Type	44,62	43,62	41,39	42,25	39,41	51,69

3.2. **Individual water consumption** (Table 4)

Table 4: Individual daily water consumption (ml)/chicken/batch.

Daily water consumption						
	Fysal	Fysal-Selko	Selko	Pheryl	Control	Standard
S1	64	64	64	64	64	64
S2	130	130	127	135	121	121
S3	242	245	240	243	238	193
S4	293	290	285	300	284	264
S5	345	335	330	318	303	319
Average	214,8	212,8	209,2	212	202	192
Standard deviation	115,91	112,83	110,82	109,28	104,67	103,36

3.3.**Weight evolution and average daily gain** (Table 5, 6 and Figure3)

Table 5: Evolution of the average live weight of the birds

Average weight (g)/week						
	FYSAL	FYSAL-SELKO	SELKO	Pheryl	Control	Standard
1	224	216	215	221	222	220
2	511	511	509	513	505	535
3	846	834	822	875	824	929
4	1340	1340	1303	1356	1280	1501
5	1770	1709	1607	1619	1550	2050
Standard deviation	623,38	606,05	567,90	577,69	544,41	736,91

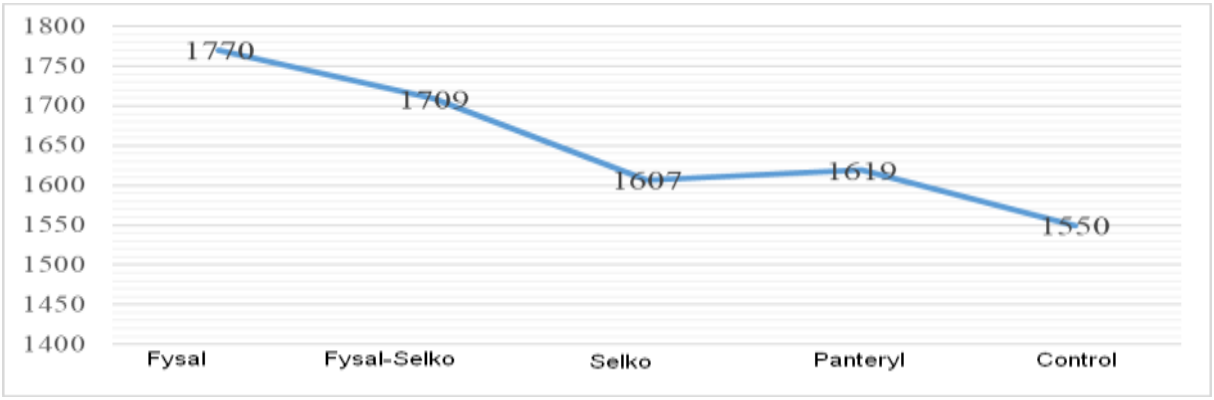

Figure 3: Live weight of patients on week 35

Table 6: Average Daily Gain

Average Daily Gain (g/d)/week						
	FYSAL	FYSAL-SELKO	SELKO	Pheryl	Control	Standard
S1	25,8	24,66	24,54	25,36	25,6	26
S2	41,04	42,2	42,03	41,85	40,39	48
S3	47,93	46,17	44,78	51,71	45,52	70
S4	70,53	72,2	68,66	68,71	65,18	86
S5	71,66	61,17	50,66	43,83	45	93
Average	51,39	49,28	46,13	46,29	44,34	64,6
Standard deviation	17,61	16,32	14,23	14,11	12,67	24,73

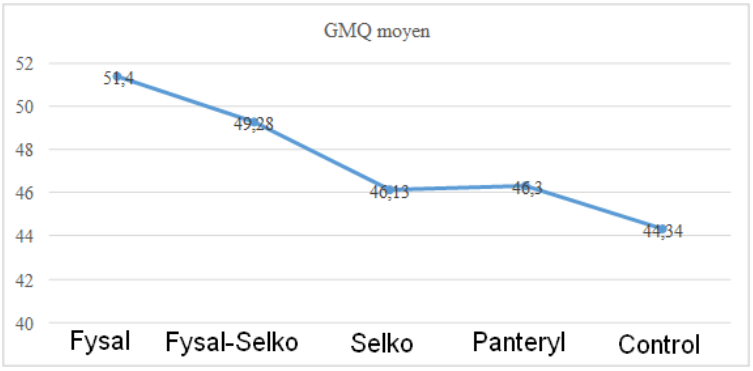

Figure 4: Average Daily Gain by lot

3.4. Monitoring and determining consumption indices (Table 7 and figure 5)

Table 7: Consumption **indices** of the different lots

CONSUMPTION INDEX /WEEK						
	Fysal	Fysal-Selko	Selko	Panteryl	Control	Standard
S1	0,61	0,63	0,64	0,62	0,61	0,93
S2	0,98	0,98	0,99	1,01	1,02	1,19
S3	1,32	1,3	1,34	1,33	1,36	1,37
S4	1,48	1,42	1,42	1,5	1,52	1,53
S5	1,59	1,55	1,69	1,72	1,72	1,65
Average	1,20	1,18	1,22	1,24	1,25	1,33
Standard deviation	0,40	0,37	0,41	0,43	0,448	0,28

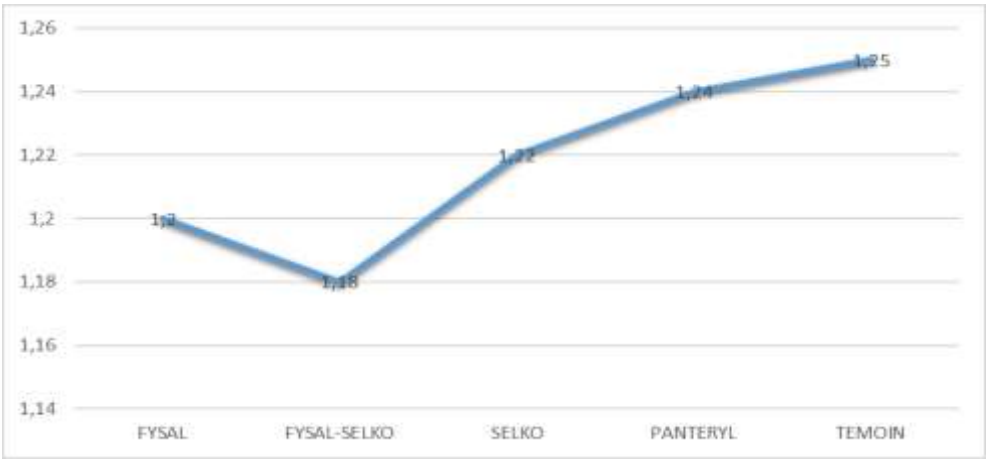

Figure 5: Consumption Index/Lot

3.5. Effects of Fysal MP, Selko pH and pteryl on the health of patients

3.5.1. Mortality (Figure 6)

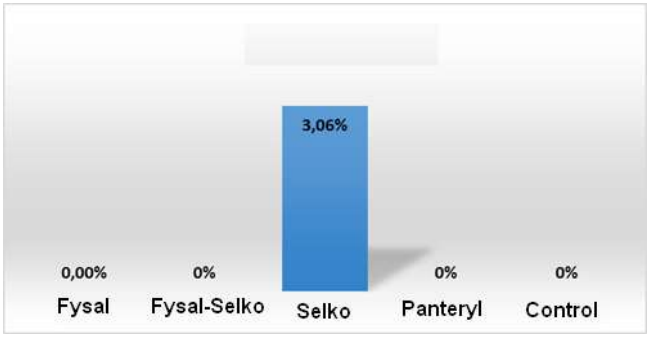

Figure 6: Mortality rate according to the lots.

3.5.2. Anatomical and pathological signs observed (Figure 7)

Figure 7: Signs and lesions observed (in the Selko lot on day 30)

4- Economic study

We evaluated the financial side of the study (Table 8)

Table 8: Analysis of the economic profitability of broiler production

LOTS	Production cost per chicken (FCFA)	Average live weight (Kg)	Price of one Kg of chicken (FCFA)	Price of a chicken (FCFA)	Net profit per chicken (FCFA)
Fysal	1368	1 ,77	1300	2301	933
Fysal-Selko	1429	1,71	1300	2223	794
Selko	1426	1,61	1300	2093	667
Pheryl	1500	1,62	1300	2106	606
Witness	1391	1,55	1300	2015	624

DISCUSSION

At the end of our research on the trial on the incorporation of organic acids as additives to substitute antibiotics used by farmers in broiler feed in the District of Abidjan (Côte d'Ivoire), it is important to note that the District of Abidjan is an area in which the use of antibiotics in broiler chickens is significant. Indeed, the polyvalent antibiotics (oxytetracycline, erythromycin, streptomycin, colistin) are the most widely used antibiotics in poultry farms. The results of the trial obtained at the zootechnical level showed that the organic acids did not prevent the birds from consuming, however, the Fysal and Fysal-Selko lots recorded the best feed and water consumption compared to the other lots, as well as their weight gains were higher. Indeed, the Fysal lot had the best average daily gain followed by the Fysal-Selko lot, the Pteryl lot, the Selko and finally the Control lot. This improvement in weight with the lot (Fysal and Fysal-Selko) could be due to a decrease in the pH of the gastrointestinal tract, an increase in proteolytic enzymatic activity, and the digestibility of nutrients.This hypothesis is in agreement with who considers that organic acids could potentially have activities that reduce the pH of the gastrointestinal tract and stimulate the digestion [6].

From a sanitary point of view, the results showed that organic acids seem to have an impact on pathogens through the birds' feces, which are the main source of microbial contamination of the poultry litter. Over the entire rearing period, only the Selko flock had a mortality rate that appeared to be lower than that recorded in the trial conducted by Parent et al. (1989) [7].

Taking into account the entire production cycle and expenses, the profit margin per lot and per chicken was 933 F CFA for the Fysal lot, 794 F CFA for the Fysal-Selko lot, 667 F CFA for the Selko lot, 606 F CFA for the Pteryl lot and 624 F for the Control lot. Economically, the organic acids had a positive impact on the profitability of the lots that consumed the organic acids.

CONCLUSION:

In sum, the best growth performance of broilers was obtained with the organic acid Fysal MP. In this study, it appeared that organic acids (Fysal MP and Selko pH) could be used as alternatives to antibiotics in broiler feed.

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