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Combined effect of feed presentation and Sogobalo supplementation on the Zootechnical performance of broilers in the start-up phase.

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Abstract

This study consisted of optimizing the growth performance of broilers by combining feed presentation and sogobalo supplementation. To do this, four (4) types of feeds (A, B, C, D) different by their format (pellet or flour) and their proportion of sogobalo were tested on 400 strain chicken which are unsexed and having an average weight of 53 g ± 1.52. The nutritional profile of the feeds, the average weight, the weight gain, the consumption index and the mortality rate were determined. The results showed that the starter feed and sogobalo are energetic (2100 kcal -3443 kcal), rich in protein (21 - 23.19%) and mineral elements. Also, the chickens which received the feed presented in pellet form and supplemented with sogobalo were the heaviest (1003 g ± 12.58).Their consumption index was lower (1.31 ± 0.02) compared to the other animals. Their weight gain was significantly high (480 g ± 14.64). Themortality rate of 0% was recorded for this chickens. This study has shown that sogobalo is an excellent supplement for broilers in the start-up phase when it is incorporated into a feed presented in granular form.

Keywords: Chicken, Consumption index, Feed format, mortality, Sogobalo, weight

Introduction

The intensification of production of broilers in Côte d'Ivoire makes it possible to guarantee self-sufficiency in animal proteins and ensure food security for the populations. Broiler breeding is a short cycle rearing that can provide good quality of protein with lower cost in 45 days. But, the cost of broiler feed is a constraint that limits the viability of the sector. It represents 60 to 70% of the cost of producing chicken (Kouadio et al., 2019). Also, the importation of certain feed supplements puts a financial strain on poultry farmers. Faced to these difficulties, different approaches have been considered for feed formulations. These are among others the use of co-products, enzymes and probiotics. These approaches could make it possible on the one hand to reduce the cost of production and on the other hand to provide essential nutrients for broilers. Generally, the main ingredients used for the formulation of chicken's feeds are cereal brans (wheat, corn), corn kernels, cotton, wheat and soybeans (Lessire et al., 1995; FAO, 2014). Among these agroindustrial products, the wheat grain is the source of several derivatives including wheat bran and sogobalo. Wheat bran is made up exclusively of the outer shell of the wheat grain. It is rich in protein and phosphorus. As for sogobalo, it is wheat bran reinforced with nutrients. This product is generally used in livestock feed in the sub-region of Africa (Lota et al., 2015). It allows the cattle to grow.

In cattle, it is used in the form of granules. Its use in poultry feed has not been the subject of any scientific study. Its use in chicken feed could allow chickens to externalize their growth performance. However, before any supplementation, it is important to know the format (granule or flour) of the feed in which to supplement sogobalo in order to maximize its effectiveness. Indeed, the feed of broilers is presented either in flour or in granules (Maliboungou et al., 2007).

The objective of this study is to optimize the growth performance of broilers by combining feed presentation and sogobalo supplementation. Specifically, it will be a question of determining the combined effect of the presentation of the feed and the supplementation of sogobalo on the average weight, the weight gain, the index of consumption and the mortality rate of broilers in start-up phase of breeding.

Material

The study took place in the district of Abidjan precisely in the locality of Bingerville (Côte d'Ivoire). This locality is characterized by a humid tropical climate which has a very high temperature and humidity respectively 33 ° C and 68%.

Housing: the animals were kept inside a modern livestock building which is built in the open air and oriented on an axis perpendicular to the winds. The building is characterized by a length of 10 m, a width of 5 m and a height of 3.5 m.At the entrance of the building is installed a footbath which served as disinfectant.

Animals: animals used for the study are flesh chicks Cobb 500 strain which come from a hatchery situated in the district of Abobo (Abidjan). Four hundred (400) unsexed day-old chicks divided into four groups of 100 chicks were used. The mean weight of the animals was 53 g ± 1.52 at the start of the study.

Feeds: Four types of starter feed (A, B, C and D) were used for animal husbandry.These feeds differed by their presentation and their composition. The first feed (A) is a starter feed supplemented with sogobalo and presented in granules. The first feed (A) is a starter feed supplemented with sogobalo and presented in granules. The third feed (C) is a starter feed presented in granulated form without sogobalo. The fourth feed (D) is a starter feed presented in flour without sogobalo. The sogobalo supplementation was made at 2.5%.Sogobalo, it is a wheat bran reinforced with nutrients. This product is generally used in livestock feed in the sub-region of Africa

Balance: A 20 kg range scale was used to weigh the feed distributed and feed refusals. For the weekly weighings of the chickens, a 5 kg scale was used.

Methods

Technical monitoring

The study was conducted over a period of four weeks. Upon arrival, the chicks were weighed to determine their weight. Within the chickens, four wire mesh boxes are installed to contain each batch. The boxes have a length of 2.45 m, a width of 1.22 m and a height of 90 m. distribution of chicks in each batch was made randomly. After two weeks of heating, the hatchery was enlarged. Thus, four new compartments were made on land to replace the boxes. These four compartments housed the four batches to allow good ventilation. The same experiment was repeated three times.

Feeding and weighing chicks: During the experiment, the chicks were given starter feed presented either in pellet or in flour. Each batch received a specific type of feed. Thus, feed A, was distributed to batch A, feed B to batch B, feed C to batch C and feed D to batch D. The feed is distributed two (2) times by day. The first service is carried out at 7: 30 AM and the second in the afternoon at 16 PM. Every morning at the same time, the feed refusals were removed from the feeders and weighed to determine the performance parameters (average weight, weight gain and consumption index).The drinking water is distributed at will. This water comes from the national water distribution network. The weights of the chicks at different ages were recorded weekly from day 1 up to four weeks. The weighings are carried out before the distribution of feed and water. Weights are carried out individually.

Sanitary and prophylactic management: The adopted sanitary prophylaxis program is that of Cobb (2008). The breeding equipment was soaked in water containing 0.25% of potassium sulphate and persulphate (VIRUNETND) to be disinfected, then washed thoroughly with drinking water. Table 1 shows the prophylaxis program used.

Table 1: Prophylaxis used during the trial

Age (days)	Products used	Actions
1	Sugar water	Anti-stress
2-3-4	Tylodox	Antibacterial
5-6	Amin total	Stress prevention
7	HB1 + H120 (drinking water)	Vaccination against New castel disease and Infectious Bronchitis
8-11	Amin total	Stress prevention
12	1st Recall IBL Gumboro (drinking water)	Vaccination againstGumboro
13-15	Amin total	Stress prevention
16	2nd IBL Gumboro recall (drinking water)	Vaccination against Gumboro
17-19	Vetacox	Anticoccidial
20	Amin total	Stress prevention
21	H120 / Sota (drinking water)	Vaccination against plague
22-26	Amin total	Stress prevention
27-29	Vetacoxrecall	Antibacterial

Determination of physico-chemical composition of feeds

Feeds and supplements were analyzed for energy values, protein, crude fiber, fat, ash and minerals. The chemical analyzes were carried out at the Central Analysis Laboratory (LCA) of the University Nangui Abrogoua (UNA).

The metabolizable energy (ME) value is obtained by calculation from the fat, cellulose and ash levels of the sample. This value is determined by the equation of Sibbald (1980).

The total nitrogen content (MAT) is determined by KJEDAHL according to the method of BIPEA (2005). The nitrogen rate obtained is affected by the conversion coefficient (6.25) in order to estimate the total protein content.

The dosage of the cellulose is carried out according to the method of Van Soest et al. (1973).

The fat content (MG) was determined using the soxhlet apparatus according to AOAC (1995).

The crude ash content is determined by subtracting from the dry matter (DM) rate, the organic matter (OM) content.

The quantification of the minerals was done by Atomic Absorption Spectroscopy (AAS) in accordance with AFNOR (1991) instructions.

Determination of growth performance parameters:

Average weight

The average weights of the chickens were determined according to the formula of Bouatene et al. (2011).

$$\mathbf{AW\ (g) = TWS / NS}$$

AW: Average weight of chickens (g);
TWS: Total Weight of the Subjects of a given batch;
NS: Number of subjects of this batch.

Weight gain

The calculated average weights were used to determine the average weight gains of the chickens per week. The calculation was made according to the formula of Bouatene et al. (2011).

$$\mathbf{AWG = AW_2 - AW_1}$$

AWG: average weight gains (g);
$\mathbf{AW_1}$: Average weight of the previous week (g);
$\mathbf{AW_2}$: Poids Moyen de la semaine suivante (g).

Consumption index (CI)

It represents the relationship between the amount of feed eaten and weight gain. It was evaluated from the formula of Mingoas et al. (2017).

$$CI = \frac{\text{Amount of feed consumed during the week (g)}}{\text{Weight gain of the week (g)}}$$

Mortality Rate

The mortality rate (MR) corresponds to the ratio between the total number of dead subjects and the initial number of subjects of this batch during a period considered. It was determined according to the method of Bouatene et al. (2011).

$$MR = \frac{\text{Total number of dead subjects}}{\text{Total number of dead subjects}} \times 100$$

Statistical analysis: The data collected was entered using the Excel® 2007 computer spreadsheet, Microsoft Corporation. Statistical analysis was performed using STATISTICA software, StatSoft, version 7.0 (2009). The average values were subjected to an analysis of variance (ANOVA) and compared to a factor according to the multiple range test of Duncan at the 5% threshold. It was used to calculate the average and make a ranking based on performance. The mean value is accompanied by the standard error on the mean (Mean ± SEM).

Results

Chemical characteristics of feed and sogobalo

Chemical composition of feed

Tables 2 present the starter feed profile. It emerges from this table that the starter feed is energetic (3443 kcal), rich in protein (23.19%) and mineral elements such as sodium (1.73 g/kg ± 0.04) and calcium (1.19 ± 0.52g/kg).

Chemical composition of starter feed

Tables3 presents the sogobalo profiles. It emerges from this table that sogobalo is energetic (2100 kcal), rich in protein (21%) and minerals such as Calcium (14.8 g / kg) and Magnesium (3 g / kg).

Table 2: Nutritional profile of the starter feed

Components	Contents
Metabolisable energy(kcal)	3443 ± 2.57
Crude protein (%)	23.19 ± 0.28
Crude fiber(%)	6 ± 0.71
Fat (%)	5.7 ± 0.42
Crude ash(%)	7.5 ± 0.63
Phosphorus (g/kg)	0.35 ± 0.42
Potassium (g/kg)	0.32 ± 0.01
Magnesium (g/kg)	0.04 ± 0.00
Iron (g/kg)	0.08 ± 0.01
Sodium (g/kg)	1.73 ± 0.04
Calcium (g/kg)	1.19 ± 0.52

Table 3: Nutritional profile of sogobalo

Components	Contents
Metabolisable energy(kcal)	2100 ± 2.43
Crude protein (%)	21 ± 0.31
Crude fiber(%)	7.5 ± 0.01
Mineral matter(%)	9 ± 0.34
Fat (%)	3± 0.01
Crude ash(%)	7.5 ± 0.03
Phosphorus (g/kg)	7.5 ± 0.03
Calcium (g/kg)	14.8 ± 0.17
Magnesium (g/kg) (g/kg)	3 ± 0.02
Iron (mg)	35 ± 0.04
Copper (mg)	25 ± 0.11
Zinc (mg)	160 ± 0.37
Manganese (mg)	21 ± 0.02
Iodine (mg)	0.7 ± 0.00
Cobalt (mg)	1.05 ± 0.00
Selenium (mg)	0.2 ± 0.00

Average weight

Figure 1 shows the change in average weight per week. The analysis shows that the average weights all have an increasing pace. From day zero to week 2, the different average weights do not show significant differences. From the 2nd week until the end of the start-up phase, the average weights of granulated feeds (feed A and feed C) start to stand out from other types of feed. Outside the 3rd week, the chickens which consumed the granulated feed supplemented with sogobalo (feed A) had the best average weights, respectively 139 g ± 1.52; 353 g ± 12.01; 1003 g ± 12.58. However, the low average weight was recorded by the chickens which received the feed in floury form from the 2nd to the 4th week respectively 311 g ± 10.00 and 869 g ± 3.51.

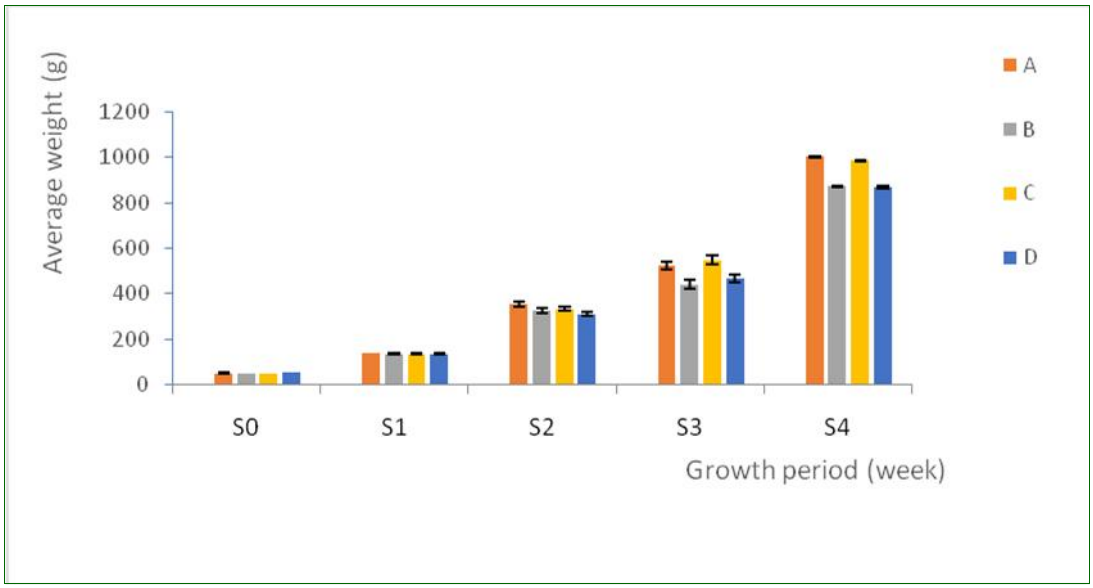

Figure 1: Evolution of average weights during the start-up phase

A= chickens having consumed the granulated feed + sogobalo ; B= chickens having consumed the floury feed + sogobalo ; C= chickens having consumed the granulated feed without sogobalo D= chickens having eaten the floury feed without sogobalo.

Weight Gains

Figure 2 shows the evolution of weight gain. The analysis shows that the weight gains are irregular. From week 1 to week 2 and from week 3 to week 4, the weight gains are increasing. From the 2nd week to the 3rd week, there is a drop of the weight gains except for batch C which experienced a slight increase in weight gain. In general, the weight gains are higher for chickens given feeds A, C and B. the best weight gain was obtained with feed A (granulated + sogobalo) which showed weight gains of 87 g ± 3.51; 214 g ± 10.59 and 480 g ± 14.64 respectively at the 1st, 2nd and 4th week.

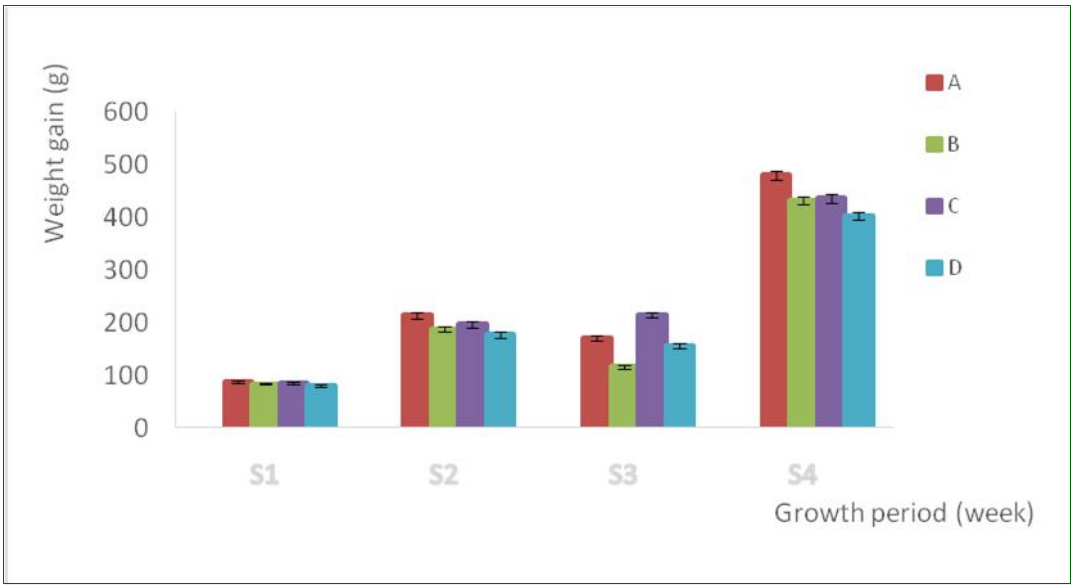

Figure 2: Evolution of weight gain during the start-up phase
A= chickens having consumed the granulated feed + sogobalo ; B= chickens having consumed the floury feed + sogobalo ; C= chickens having consumed the granulated feed without sogobalo D= chickens having eaten the floury feed without sogobalo.

Consumption index

Figure 3 shows the evolution of consumption index (CI). From week 1 to week 2, there is a regression of the consumption index. From week 2, the consumption index increases until week 3. The large consumption index is observed with the floury feed (3.1 ± 0.06). After the 4th week, the consumption index resumes a descending pace. The small consumption index are obtained with the chickens having consumed feeds A, B and C. In general, the batch which received the granulated feed + sogobalo presented the low consumption index (1.36 ± 0.02; 1.03 ± 0.01 and 1.1 ± 0.01 respectively at the 1st, 2nd and 4th week).

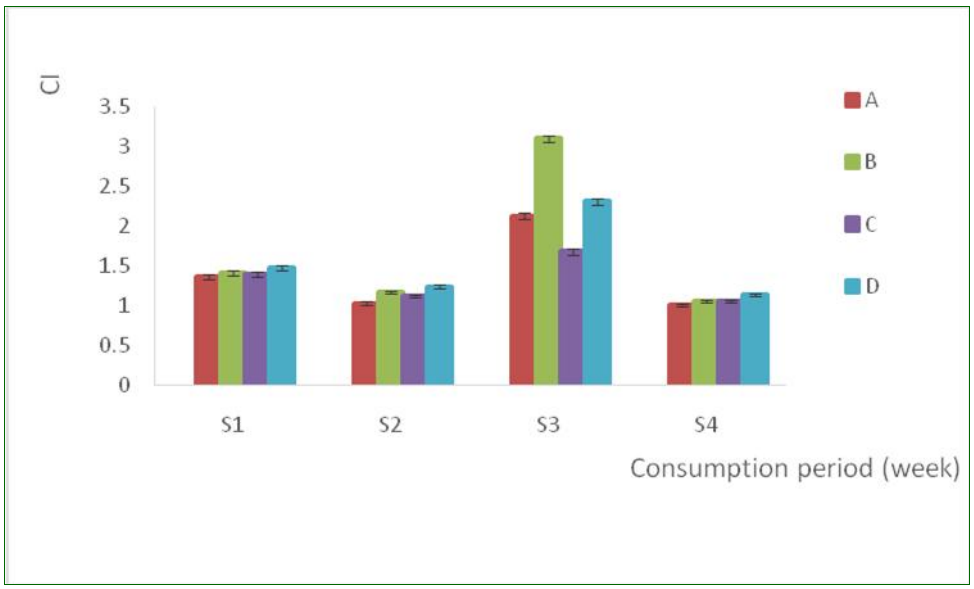

Figure 3: Evolution of the consumption index during the start-up phase
A= chickens having consumed the granulated feed + sogobalo; B= chickens having consumed the floury feed + sogobalo ; C= chickens having consumed the granulated feed without sogobalo D= chickens having eaten the floury feed without sogobalo.

Mortality

Table 4 shows the mortalities recorded in the different batches during the start-up period. Batches A, B and C recorded no mortality. As for batch D which was fed with the floury feed, it recorded a mortality rate of 3%.

Table 4: Mortalities during start-up

Parameters	Batch A	Batch B	Batch C	Batch D
Number of deaths	0	0	0	3
Total number of chickens at the start of the experiment	100	100	100	100
Mortality rate (%)	0	0	0	3

A= chickens having consumed the granulated feed + sogobalo ; B= chickens having consumed the floury feed + sogobalo ; C= chickens having consumed the granulated feed without sogobalo D= chickens having eaten the floury feed without sogobalo.

Discussion

Chickens fed a pellet diet supplemented with sogobalo exhibited high body weight, increased weight gain and better consumption index compared to those fed the other diets. These results could be explained by the presentation of the feed and the contribution of sogobalo. The presentation of the feed in pellet form compared to flour have influenced consumption and feed efficiency. The nutritional quality of the feed is improved by the heat treatment associated with the granulation. Indeed, the heat treatment is known to improve feed digestibility by gelatinization of the fibers and the destruction of certain anti-nutritional factors thermosensitive (Clavé *et al*., 2011). Also, the granulation by its compacting action, improves the efficiency of feed intake by the beak in rapidly growing chickens and also feed efficiency (Quentin *et al*., 2004). The granulated feed induces mechanical effects compared to the feed in the form of flour.

This is due to the reduction in particle size during the process involved by granulation (Svihus *et al*., 2004). Lecalve (2017), underlines that the fact of presenting a diet in the pellet form contributes to a better bacteriological quality, to a reduction of the consumption time as well as to a less mixing of the feed compared to the presentation in flour. The results of this study agree with those of Ribeiro et al. (2004) who compared a granulated feed to a feed of large homogeneous particles and a heterogeneous floury feed, showed that the granulated feed presented the best profile. According to Ribeiro et al. (2004), the size of the flour is closely linked to the growth of broilers from 1 to 21 days. The size of the feed particles has an effect on the growth performance of broilers. The granulation makes nutrients available. It contributes to the breakdown of the cell walls of the ingredients which allows to release the nutrients and make them accessible to the enzymes of the digestive system (Medel *et al*., 2004; Lahaye *et al*., 2008).

The superiority of the pelleted feed supplemented with sogobalo compared to other feeds could be explained by the nutritional value of sogobalo. Indeed, the sogobalo is a supplement rich in several nutrients (metabolisable energy, crude protein, crude fiber, mineral matter, dry matter, fat and minerals). These different elements have several roles in the organism of animals. They stimulate the appetite and provide good growth. They also optimize immune defense, bone mineralization and resistance to infections (INRA, 2001; Dayon and Arbelot, 2001). Thus, the synergistic action of these different elements and the granulation of the feed had a positive effect on the weight development of the chickens having consumed this feed. These results are in agreement with the work of Maliboungou et al. (2007). These authors having compared two diets subjected to broilers, one based on cotton and the other based on soya, found that the best performance was attributed to the soya feed because of its more favorable composition than cotton.

The average feed efficiency of feed pellets was significantly higher ($p<0.05$) to other feeds.Which is in agreement with INRA (2000). According to INRA (2000), during the growth period, a correlation can be made between weight gain and the concentration of nutrients of the feed. The growth is more important for the feed with the highest nutritional value and less important for the feed with a low nutritional level. This hypothesis joins that of Bouvarel et al. (2010). According to them, the nature of the ration and its composition (energy, protein, minerals) affect feed efficiency. In fact, in poultry, changes of ingestion are observed depending to the protein content of the feed when the energy supply is kept constant. In addition, supplementation with certain essential amino acids such as lysine increases feed efficiency (Cissé et al., 2001).

The average consumption index obtained during this study is below 2.5 ± 0.05. This is in accordance with the standard indicated in broiler breeding for the first four weeks (Quentin et al., 2004; Mingoas et al., 2017). The results of this study are part of the same direction as the work of Chagneau et al. (2009). They have obtained the best consumption index for feed pellets. In breeding, the consumption index is best when it is the smallest possible. However, the results of this study are in contradiction with those of Phocas et al. (2014). They have done work on pelleted feed compared to the feed mealy, indicated that the results of the floury feed were better compared to the results of the pellets.

During the study, no mortality was observed in the batches containing sogobalo and in the batches of granulated feed.This can reflect the efficiency of granulation and also the nutrient composition of these feeds. Indeed, by their design (dense feed, no separation of ingredients), these feeds provide better bacteriological quality to deal with any form of bacterial infection. Also, the various components optimize the immune system and provide resistance to all infections (INRA, 2001; Dayon and Arbelot, 2001; Hubbard, 2017).

Conclusion

The presentation of the pallet feed combined with the supplementation of sogobalo in the broiler start-up feed had a beneficial effect on broilers. This combination made it possible to obtain at the end of the study, a good average weight, a better weight gain and a reduced consumption index. It also helped to ensure the health of chickens (zero mortality). Also, this study showed that sogobalo is an excellent supplement for broilers in the start-up phase. Its positive impact on the growth performance of broilers is more marked when the food is in the form of granules.

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