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EFFECT OF CAPSICUM ANNUM, ALLIUM SATIVUM AND THYMUS VULGARIS ON THE ZOOTECHNIC PERFORMANCE OF BROILER IN GROWTH PHASE

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ABSTRACT

This research was conducted to evaluate the effect of the spices (*Capsicum annum*, *Allium sativum* and *Thymus vulgaris*) used as feed diet for broiler. A total of five hundred broiler chicks (Cobb 500) aged one day, not sexed were distributed from the third week in four experimental groups. The chickens were fed with four diets. The first group (A) is fed with a diet without feed additives (control diet). The other groups (B), (C) and (D) were fed respectively with growth basal diets supplemented with respectively 1 g / kg of *Thymus vulgaris*, 1 g / kg of *Allium sativum* and 1 g / kg of *Capsicum annum*. The chickens were fed with these different diets during the four week of growth period. The feed consumption, the weight gain, the feed conversion and the mortality were recorded. Also the chickens' meats from the different batches underwent a sensory analysis. At the end of the experiment, the results showed that the diet supplemented with *Capsicum annum* was significantly ($P < 0.05$) the higher of body weight gain ($1.68 \pm 1738g$), the best of consumption index (1.46 ± 0.03), the high feed consumption (2.42 ± 0.03) and the best firmness of the meat. No significant difference at the level of the mortality rates was observed between the supplemented feed. But a significant difference ($P < 0.05$) was obtained between the control diet and supplemented rations. The *Capsicum annum* is one of spices contributing to improve the growth of broilers.

Keywords: spices, weight gain, feed consumption, mortality rates, organoleptic quality

1. INTRODUCTION

In Ivory Coast, poultry farming occupies a dominant position and is an essential link of the animal's production system. As elsewhere, the poultry is an important source of animal protein and generates income for rural and urban populations. In addition, the chicken meat is less costly. This meat can be produced even by weakly capitalized farmers for which it can be a take-off lever. In order to respond to growing needs of the populations in animal protein, the Government of Côte d'Ivoire initiated a relative stimulus policy. However, with the recrudescence of avian diseases such as the Newcastle, the Gumboro, the infectious bronchitis, the Marek's disease and the coccidiosis, the use of anti-infectives and the development of prophylaxis is essential. Also, the use of vaccines,



antibiotics in veterinary medicine is essential for the treatment of bacterial infections and control of secondary infections in case of viral attack (Ben et al., 2010). Thus, for many years, antibiotics are used to prevent and treat infectious diseases. These drugs allow to control the health standard and ensure the quality and productivity in farms (Dehaumont et al., 2005). But their use abusive manner and unsuitable causes in chicken meat, hazardous waste for the consumer. These residues can lead to intoxication by promoting the selection of bacteria resistant to any subsequent treatment (Bada-alamedji et al., 2008). The use of alternatives to antibiotics in the diet is one way to contribute to improving the productivity of poultry production. Thus, the use of vegetable origin compounds such as chilli pepper (*Capsicum annum*), garlic (*Allium sativum*) and thyme (*Thymus vulgaris*) were considered. These spices and herbs are plants that can be incorporated in the feed (Windshis et al., 2008). They have antibacterial properties, digestion stimulating properties, anti-inflammatory properties and also antioxidant properties (Nakatani, 2000; Lambert et al., 2001; Ruberto et al., 2002; Wei and Shibamoto, 2007). *Thymus vulgaris* is rich in essential oils. It has a strong odor and possesses antiseptic, antibacterial, antifungal, antiviral, analgesic, digestive, tonic and stimulating properties. This large antibacterial activity could be mainly due to its major compounds. The major compounds are γ -terpinene and thymol (Nakatani, 2000). Concerning *Allium sativum*, research has demonstrated that allicin is one of the main components responsible for its antimicrobial effects (Sarica et al., 2005). In addition, Gorinstein et al. (2005) and Kim et al. (2009) reported that *Allium sativum* products have anti-oxidant properties on broiler chickens and laying hens. As for the *Capsicum* fruit, they are used in traditional medicine for their antimicrobial properties due to secondary metabolites that they contain (Hernandez et al., 2010; Kouassi et al., 2010). This study aims to evaluate the effect of the use of these spices on the growth performance of the broilers from these diets.

2. MATERIAL AND METHODS

2.1 Site study

The study was conducted in the research farm of Africa Labograin located in the village of Abatta in the town of BINGERVILLE. The farm is located at 5 ° 19 north latitude and 3 ° 55 longitude west of the village. The experiment lasted for 49 days.

2.2 Spices and herbs

The pepper (*Capsicum annum*) dried and milled was bought at the Forum market located in the town of Adjamé. Garlic powder (*Allium sativum*) and thyme (*Thymus vulgaris*) were purchased directly in a hyper-market (SOCOCE). All these products were stored separately in a dry place away from light.

2.3 Animals

A total of five hundred chicks (Cobb 500) aged one day were used for the study and were purchased from FIRGI Côte d'Ivoire. Each chick weighed 50 g.

2.4 Experimental treatments

On their arrival the chicks were kept in the same conditions of management and hygiene. The starting temperature in the chicken coop was 35°C and then decreasingly from 33°C to 28°C on the day 21. During the entire test period, the animals were fed and watered at will. A streaming lighting program was also provided during the experiment. During the first three weeks the set of chicks was continuously fed with starter feed pellets. In the 21st day after the weekly weighing, the chicks are separated and put by batches of 100 chicks. The experimental composition of the basic feed is presented in Table 1.

As for spices, chili pepper (*Capsicum annum*), thyme (*Thymus vulgaris*) and garlic (*Allium sativum*) were added to the basic diet growth at a proportion of 1g of spice to 1kg of basic diet.

During the four weeks of the experiment, the spices were added to the basic feed. These preparations have been properly mixed in order to ensure a homogeneous distribution of the previews.



Table 1: Chemical composition of the basic diet

composition	Feed of boot	Feed of growth
Fat %	5.7 ± 0.42	4.28 ± 0.02
PO4 (g/kg)	0,35±0,007	2,11±3,21
Protein %	23.19 ± 0.28	18 ± 2.00
Cellulose brute	6 ± 0.71	3.75 ± 0.07
MetabolizableEnergy(kcal)	3443 ± 2.57	3069 ± 63.74
K (g/kg)	0.32 ± 0.01	17.65 ± 0.75
Mg (g/kg)	0.04 ± 0.00	2.27± 3.79
Fe (g/kg)	0.08± 0.01	0.41± 14.63
Na (g/kg)	1.73± 0.04	9.23± 0.67
Ca (g/kg)	1.19± 0.52	3.57± 1.38
P (g/kg)	0.35 ± 0.00	2.11 ± 3.21

2.5 Data collection

At the end of every week the feed intake, the average weight and the mortality rate were registered and that at every week of the experiment. The feed consumption index was also calculated. It is the ratio between feed consumption and the weight gain for a specified period.

The feeds were chemically analyzed according to AOAC (2005).

The chickens' meats from the different batches underwent a sensory analysis. This sensory analysis was performed by the method of Watt. The parameters studied were the firmness, juiciness, aroma, flavor and tenderness.

2.6 Statistical analysis

Statistical analysis was performed using STATISTICA software StatSoft, version 7.0 (2009). The average values have been the subject of a variance analysis (ANOVA) at one factor and matched according to the multiple range test of Duncan at the level of 5%. It has also established an average for each batch and make a classification based on performance.

3. RESULTS

3.1 Feed consumption

The results of the figure 1 show that the chickens which have received the feed with spices have the best feed consumption compared to the control diet. Indeed, from the beginning of the experiment corresponding to the fourth week, a significant difference ($P < 0.05$) was observed between the consumption of the control batch ($54.50g \pm 0.43$) and those of the lots supplemented with *Allium sativum* ($56.95g \pm 0.08$), *Capsicum annuum* ($59.03g \pm 1.03$) and *Thymus vulgaris* ($82.13g \pm 0.13$). Ultimately the chili batch is the batch where feed consumption was highest with a value of $105.55g \pm 0.51$.

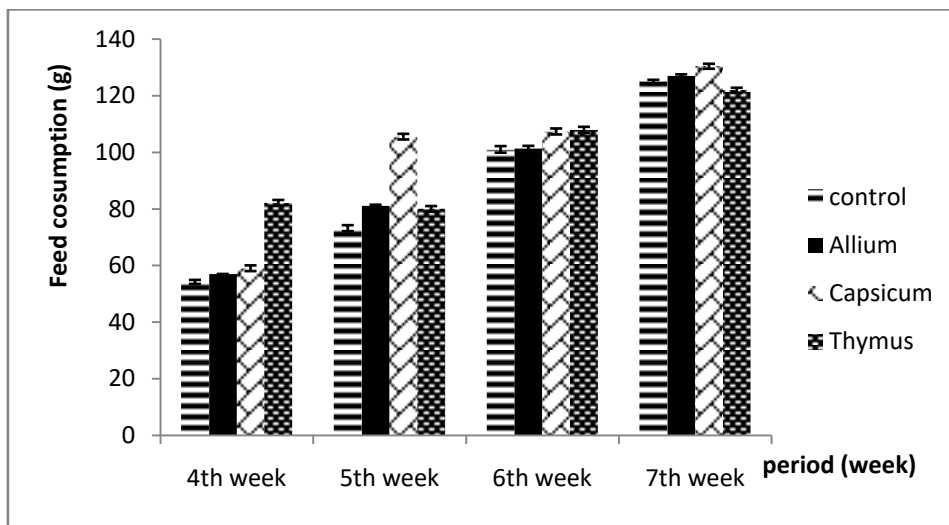


Figure 1: Variation of feed consumption

3.2 Body weight gain.

The results of figure 2 show that the weight gain of the chickens with spices in the diet, are the highest. Thus from the outset of the tests, the control batch had the lowest weight gain ($163.47g \pm 1.50$). At the sixth week, the batch of *Capsicum annum* has obtained the highest weight gain ($516.53g \pm 2.02$). It is followed by thyme batch ($435.5g \pm 2.02$) and that of garlic batch ($418.5g \pm 1.04$). As for the control batch, it recorded the lowest weight gain ($407g \pm 2$).

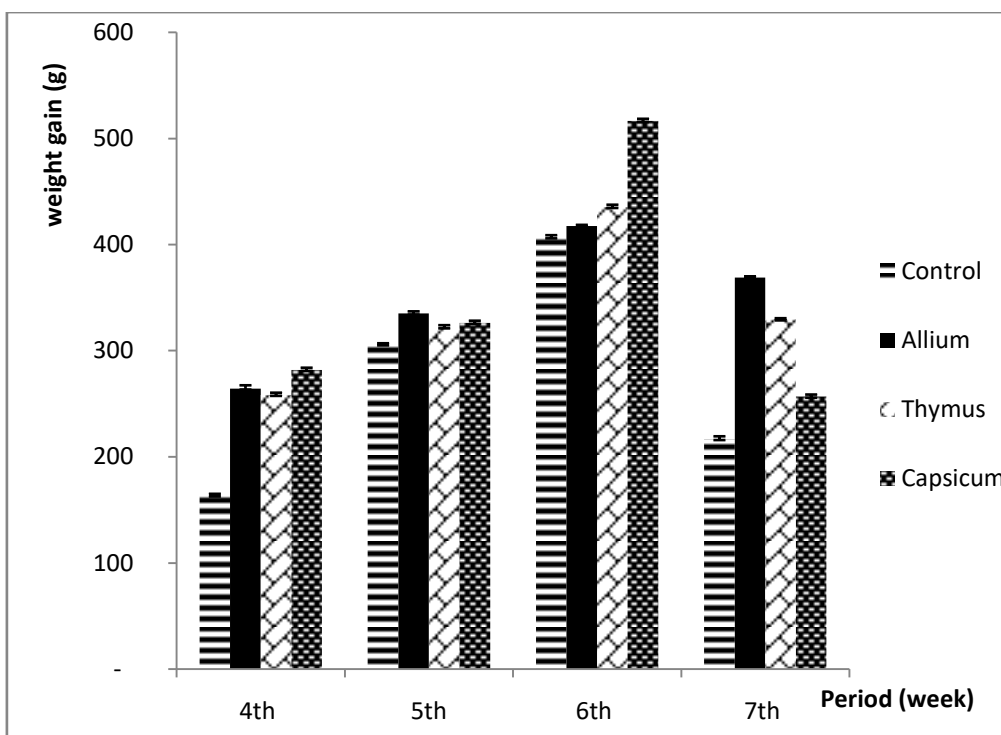


Figure 2: Variation of the weight gain



3.3 consumption Index

The variation of the consumption index is presented by **figure 3**. During the four weeks of the test, the consumption index obtained generally in the 4 groups was low, except the control group where it is 4.04 at the week 7. The batch of *Capsicum annuum* recorded the best index (1.46).

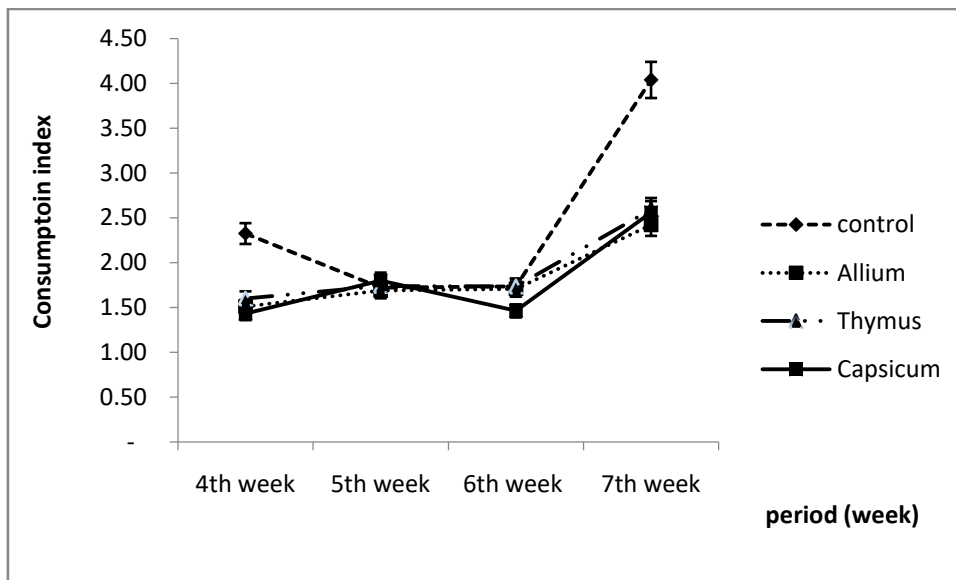


Figure 3: Variation of the consumption index

3.4 Mortality rate

It appears from the analysis of **figure 4**, that there is no significant difference between the mortality rates of batches supplemented with spices. But there is a significant difference ($P < 0.05$) between the mortality rate of the control group and those of the batches supplemented with spices. However, at the sixth week, the control group recorded high mortality rates (2%).

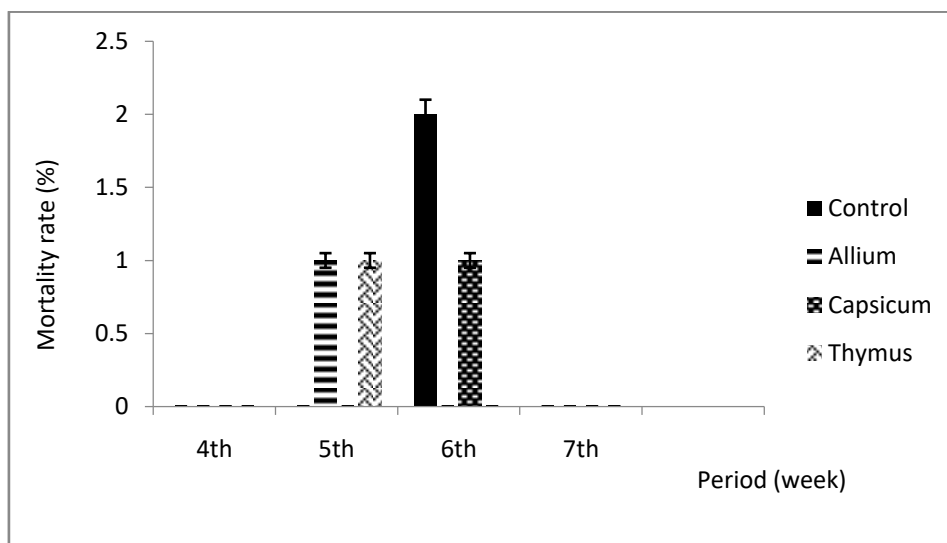


Figure 4: Variation of mortality rate



4. DISCUSSION

4.1 Feed consumption

The high consumption of feeds fortified with spices could indicate a preference for these feeds by the subjects. The phytobiotiques contain many volatile compounds that are characterized by a marked taste and smell. They also contain pigments which change the color of the feed (Ismaili et al., 2001; Bouvarel et al., 2010). These parameters have positively influenced the consumption of the feed by animals. The inclusion of spices and herbs in the diet could have changed the visual and sensory properties. In poultry, the active principles of the plants and the spices act as activator of digestibility, the regulator of the intestine (microbial ecosystem), the stimulator of the secretion of endogenous digestive enzymes and thus improved the growth performance (Williams and Losa, 2001 ; Cross et al., 2007). This action is explained by the presence within them of flavonoid compounds, triterpenoids and other phenolic compounds or free hydroxyl groups. These compounds are classified as highly active antibiotic compounds (Cross et al., 2007).

Also, the best feed consumption of subjects which received spices, could be due to their active ingredients. *Thymus vulgaris* contains thymol and carvacrol. The *Allium sativum* contains alicin. About the *Capsicum annuum*, it is rich in capsaicin. These active ingredients are potent antimicrobial, antiseptic, antioxidant and anti-spasmodic which stimulate, inhibit and promote the development of friendly bacteria in the digestive tract of the subjects (Cross et al., 2007).

The high feed intake of *Capsicum annuum* batch could be explained by the effect of capsaicin that acts as a stimulant of the digestive tract. According to the work of Kawada et al. (1988), *Capsicum annuum* increases appetite. It has an effect on energy metabolism, because it activates the sympathetic nervous system by capsaicin. According to Alaoui (2011), the addition of phytobiotiques agents such as *Thymus vulgaris* (1.0g / kg) and red pepper (1.0g / kg) have a stimulatory effect on the secretion of intestinal mucus of chickens. Similarly, Lewis et al. (2003) showed a positive effect of *Allium sativum* used at 1.0 g / kg on feed consumption of chickens. These phytobiotiques prevent the adhesion of pathogens and thus contribute to stabilizing the microbial balance in the intestine of animals (Jamroz et al., 2006).

4.2 Body weight gain.

The weight gain of chickens that have spices and herbal supplements in the diet, are the highest. In fact, the essential oils present in spices and herbs promote weight gain. This increase is due to the ability of the active ingredients present in essential oils to destroy pathogenic microorganisms of the digestive system. This results in the production of digestive enzymes. These enzymes improve the digestibility of the subjects (Hernández et al., 2004). Thus, from the fourth week, subjects receiving the spice as a supplement, had the highest weight gains. This increase of weight gain of the batch supplemented with *Capsicum annuum* is explained by the action of its active ingredient which is the capsaicin. In fact, capsaicin contributes firstly to prevent oxidation of feed and also to stimulate appetite and promote animal growth (Alloui, 2011). Our results agree with those obtained by Al-Kassie et al. (2011). These results present a high weight gain and a better feed consumption index with the use of *Capsicum annuum* powder at 1 g / kg. This positive effect of *Capsicum annuum* powder has been supported by Cowan (1999). He noted that *Capsicum annuum* powder is rich in secondary metabolites such as terpenes. These compounds have antimicrobial properties. It is also an extremely rich source of vitamin C and E. In addition, the organic acids contained in the spice contribute to inhibit the growth of bacteria (*Bacillus cereus*, *Staphylococcus aureus* FRI-S6 monocytogenes) and promote weight gain (Lazarevic et al. 2000, Abdo et al., 2003; Lee et al, 2010). This high presence of vitamins and capsaicin thus promotes the increase of immunity of the animal and allows a resistance to disease.

4.3 consumption index

During the test period, the consumption index of the control group was highest. The high values of the control group can be due to the presence of diseases (bacterial and parasitic) that occurred during the last week of the trial. The presence of disease in the control group caused growth retardation and poor conversion of the feed. In fact this batch was devoid of supplements, therefore devoid of compounds which are that can increase the immunity of chickens. These phytobiotiques supplements have a stimulating effect on the secretion of intestinal mucus of chickens (Alloui, 2011).

4.4 Mortality rate

The high mortality rate in the control batch could be due to the low immunity of the chicken of this batch. In fact the chickens of this batch did not receive supplements capable to confer immunological properties. According to Hernández et al. (2004), the active ingredients of herbs and spices, promote increased immunity of the animal and allow it a disease resistance. As for the low mortality



recorded in the batch supplemented with spices, it can be explained by the actions of these spices. The essential oils present in these spices and herbs have the power to destroy pathogenic microorganisms of the digestive system (Simsek et al., 2007; Alloui, 2011).

However the use of spices in chicken feed should be moderate. Because at excessive doses, the inhibitors present in spices can affect the organoleptic aspect of the feed, thus leading to inefficiency of the feed (Lazarevic et al., 2000; Al-Sultan, 2003; Thieme et al, 2010).

5. CONCLUSION

From the results of this study, it can be concluded that phytobiotiques (*Allium sativum*, *Capsicum annum* and *Thymus vulgaris*) are good growth promoters. Because their supplementation has produced a better feed conversion, a high weight gain and a high feed consumption. In addition, the sensory analysis performed on the meat of chickens indicated a better appreciation of chickens whose feeds were supplemented with spices compared to the batch control. Of all the diets used, the diet containing *Capsicum annum* is the one that got the better feed conversion, the best weight gain, the best feed consumption and the firmness of the chicken meat. So these phytobiotiques and mainly *Capsicum annum* could be used as a growth promoter to replace antibiotics. Considering individual effect of each phytobiotique, a combination of these phytobiotiques could be envisaged in order to create synergic actions

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