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*Full Length Research Paper*

# Mode of anticoccidial drug utilization and their financial cost in Benin litter-based exotic layer rearing system

**Hervé Brice DAKPOGAN[1]*, Sahidou SALIFOU[1], Armand GBANGBOTCHE[2], Frédéric HOUNDONOUGBO[2] and Issaka YOUSSAO[1]**

[1]Applied Biology Research Laboratory of Polytechnic School of Abomey-Calavi, University of Abomey-Calavi, P. O. Box 2009, Benin.
[2]Faculty of Agronomic Sciences, University of Abomey-Calavi, 01 P. O. Box 526, Benin.

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Anticoccidial drug mode of utilization and their financial cost in Benin litter-based commercial layer system were investigated on 81 layer farms with a total of 120 poultry flocks consisting of 81 adult and 39 young bird flocks. The collected data include bird age category, coccidiosis control program, the anticoccidial molecules, theirs financial prices and their mode of administration. Most of the farmers adopted the preventive mode of coccidiosis control. Six anticoccidial molecules were identified as regularly used by farmers to control coccidiosis, administrated through drinking water. Amprolium is the most prevalent anticoccidial molecule used for young birds (84.6%), followed in a very less extent by sulfadimidine (15.3%) which is the most used anticoccidial molecule in adult birds (74% of the flocks). The entire sulfa-based drugs in use in the production system accounted for 88.8%. Poultry producers in Benin spend 137 FCFA or 0.30 $ per layer chicken in litter-based system to control coccidiosis with the use of anticoccidial drug during the bird lifespan.

**Key words:** Coccidiosis, sulfa-based drugs, amprolium, sulfadimidine, prevention.

## INTRODUCTION

Coccidiosis in bird is a gastrointestinal parasitic disease caused by *Eimeria* genus, with the most pathogenic species including *Eimeria tenella, Eimeria acervulina, Eimeria maxima* and *Eimeria brunetti*. The economical incidence of the disease is world widely estimated at 2.3 billion € with 70% of the lost ascribed to the unapparent subclinical form of the disease that depress considerably weight gain and feed conversion ratio (Sørensen et al., 2006). Coccidiosis treatment and prevention measures are based on the use of anticoccidial drugs or chemoprophylaxie and the use of live vaccines. There are two groups of anticoccidial drugs known to be in use: ionophorous antibiotics known as ionophores and synthetically produced drugs known as chemicals (De Gussem, 2005). Polyether ionophores such as monensin, lasalocid, salinomycin, narasin and maduramycin act through general mechanism of altering ion transport and disrupting osmotic balance of the parasite and chemicals such as amprolium, clodipol, halofuginone decoquinate act against the parasite metabolism (Badran and Lukešová, 2006). Chapman (1994) reported that some degree of resistance to all anticoccidial drugs, including ionophores has developed. The use of drugs in rotational basis upon consecutive flocks (McDougald, 2003) or in a shuttle or dual drug using program reported by Williams, (1998) and recommended by Chapman et al. (2005), is purportedly directed against the establishment of drug-resistant parasite strain that can jeopardize the

*Corresponding author. E-mail: dakpogan2002@yahoo.fr. Tel: 00229 94 62 58 36.

effectiveness of bird coccidiosis control. The drugs are also associated to drug-resistant live vaccine to augment the efficacy of the vaccine, by controlling the side effect of vaccine parasite replication phase, in the intestinal epithelial cells. The recombinant vaccine developed lately consisting of coccidian antigens and many otherimmunogenic molecules (micronemes and cytokines) proved to be very efficient (Lee et al., 2009; Tewari et al., 2010; Berezin et al., 2010). Layer chicken intensively reared for table egg production in Benin is a growing activity and the current lack of information about coccidiosis control in this bird population estimated at 13,690,940 heads (FAO, 2011) can in the future jeopardize its development.

This study reports for the first time, the anticoccidial products used to control coccidiosis and their financial cost in Benin litter-based high stocking density exotic layer rearing system.

## MATERIALS AND METHODS

### Field survey and data collection

This study is an observational cross-sectional study with anticoccidial molecules, their mode of utilization and their financial cost as the main investigation outcomes. The sample size was obtained by considering the theoretical coccidiosis prevalence in litter-based layer rearing system, which is 31% (Lunden et al., 2010). A minimum of 20% as null proportion and an alternative proportion of 40% were considered, with 90% of power and under 0.05 significant levels. The power procedure in Statistical Analysis System (SAS; version 9.2) with Z test applied to the aforementioned estimates, gave an optimal sample size of 42 laying hen farms included in this study. The sampling method used the weighted technique and the random selection of the surveyed farms with a total of 81 farms consisting of 120 flocks (39 young bird flocks and 81 adult flocks) enrolled in the survey. The survey was carried out in the Northern, Central and Southern regions of Benin (6° 28′ N 2° 36′ E; 114 763 $km^2$). The collected data include bird age category, coccidiosis control program (preventive or curative mode of control), the anticoccidial molecules used by the farmers, theirs financial prices and their mode of administration.

### Statistical analyses

Frequency procedure in SAS (version 9.2) was used to estimate and compare proportions. General Linear Model (GLM) was applied to the period interval between two coccidiosis treatments (estimation of mean value ± standard error and comparison with F test).

### Economical analyses

The financial cost of anticoccidial drugs used to control coccidiosis in one layer chicken from day 0 to the end of its laying period (18 months) was accessed as follow: anticoccidial drug financial cost = (anticoccidial drug cost in preventive mode + anticoccidial drug cost in curative mode in young bird form 0 to 4 months of age) + (anticoccidial drug cost in preventive mode + anticoccidial drug cost in curative mode in adult bird from 4 to 18 months of age).

## RESULTS

### Mode of anticoccidial drugs utilization

Table 1 shows that an overwhelming majority of young layer chicken flocks from 0 to 4 months of age were submitted to the preventive mode of coccidiosis control ($p < 0.05$), while in adult layer flocks from 4 to 18 months of age, the proportions of farms which adopted the preventive or the curative mode of coccidiosis control were more or less the same ($p > 0.05$). The frequency of drug administration recorded in the preventive mode of coccidiosis control was twice that observed in the curative mode of control ($p < 0.05$).

### Anticoccidial molecules used by producers

Two anticoccidial molecules were found to be at great utility in the production system, among the 6 anticoccidial molecules identified as regularly used by farmers to control coccidiosis (Figure 1) and all of them were administrated through drinking water.

Amprolium is the most prevalent anticoccidial molecule used for young layer chicken from 0 to 4 months of age (84.6%) followed in a very less extent by sulfadimidine (15.3%) which is the most used anticoccidial molecule to control the disease in adult birds in a proportion of 74%. Amprolium is not at all used for laying hen coccidiosis control in the surveyed farms. The entire sulfa-based drugs that were used in adult layer flocks account for 88.8% of the total anticoccidial drugs identified in adult layer flocks.

### Financial cost of drugs used in one layer chicken from day 0 to 18 months of age

In one treatment phase, an average of 0.57 and 0.37 g of anticoccidial drugs were administered in drinking water for the account of each young (Table 2) and adult layer chicken (Table 3) respectively. These quantities were given in an average interval period of 30.7 days in prevention model and in an average interval period of 60.8 days in curative model (Table 1) during the lifespan of the bird.

The financial cost of anticoccidial drug was 136.9 FCFA or 0.30 $. In other words, poultry producers in Benin have to spend approximately about 137 FCFA in minimum to control coccidiosis in one layer chicken from chick age (Day 0) to the end of its laying period (18 months).

## DISCUSSION

Preventive medication against coccidiosis is the most observed disease control model in exotic layer chicken in Benin. According to McDougald (2003), early emphasis in chemotherapy was centered on the treatment of outbreaks

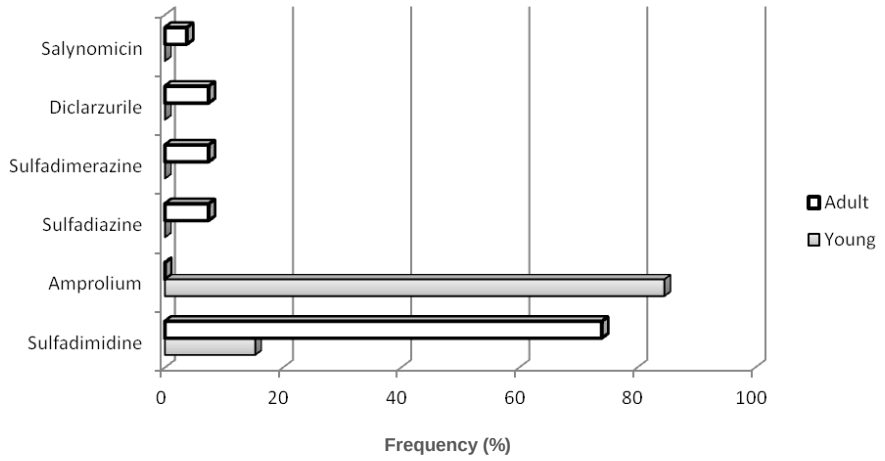


**Figure 1.** Frequency (%) of the identified anticoccidial molecules.

**Table 1.** Mode of anticoccidial drugs utilization.

| Mode of control | Preventive mode | Curative mode |
|---|---|---|
| Young layer flocks (%) | 92.3 | 7.6 |
| Adult layer flocks (%) | 48.1 | 51.8 |
| Interval of ATC administrations (day) | $30.7^{a} \pm 2.1$ | $60.8^{b} \pm 2.7$ |

ATC: Anticoccidian; M: mean; SE: standard error. Values in the same line that do not share the same superscript are significantly different, $p < 0.05$.

**Table 2.** Cost of drug per young layer in one treatment phase (C1).

| Anticoccidian | Drug price/g (FCFA) | % | Drug quantity (g) | Cost (FFCA) | Cost ($) |
|---|---|---|---|---|---|
| Amprolium | 19.5 | 84.6 | 0.53 | 10.33 | 0.02 |
| Sulfadimidine | 20.5 | 15.4 | 0.04 | 0.82 | 0.002 |
| Total (C1) | | 100 | 0.57 | 11.15 | 0.024 |

%: Proportion of flock that use the different anticoccidial drugs; FFCA: West African French speaking country currency; $: US Dollar; g: gram.

**Table 3.** Cost of the drug per adult layer in one treatment phase (C2)

| Anticoccidian | Drug price/g (FCFA) | % | Drug quantity (g) | Cost (FFCA) | Cost ($) |
|---|---|---|---|---|---|
| Sulfa-based drugs | 20.5 | 88.8 | 0.32 | 6.56 | 0.016 |
| Diclazuril | 16.05 | 7.4 | 0.027 | 0.43 | 0.0009 |
| Salynomicin | 21 | 3.8 | 0.01 | 0.21 | 0.0004 |
| Total (C2) | | 100 | 0.37 | 7.2 | 0.017 |

%: Proportion of flock that use the different anticoccidial drugs; FFCA: West African French speaking country currency; $: US Dollar; g: gram.

outbreaks with sulfonamides or other compounds after signs of infection were apparent; but, soon the concept of preventive medication emerged with the realization that most of the damage is done once signs of coccidiosis are widespread in a flock. Coccidiosis prevention also called chemoprophylaxis is by far the most used control measure in broiler chicken sector, where 95% of the farms prevent coccidiosis from day 0 to slaughter with anticoccidial drugs as feed additive (Chapman et al., 2005). The findings revealed that in adult layer birds, a slight majority of poultry producers adopted the curative mode of controlling coccidiosis. The main reason could

be the economical incidence of coccidiosis prevention that could oblige poultry producers to wait for the disease in the flock, before having recourse to anticoccidial drugs. As shown by the current study, the anticoccidial drug administration frequency in preventive mode is higher than that in curative model of coccidiosis control.

Anticoccidial drugs administered in drinking water are the only means of coccidiosis prevention and treatment encountered in Benin commercial layer chicken. Among the 6 anticoccidial drugs known by poultry farmers which are used in some extent, only two of these compounds were importantly utilized by the latter. The first anti-coccidial product is a chemical compound: amprolium, exclusively used in young birds at the starting rearing period, up to the pullet stage. This drug act by impeding the metabolism of the parasite (Badran and Lukešová, 2006), especially the absorption of thiamine (McDougald, 2003) and has no drug withdrawal period restriction (Feed Additive Compendium, 1989). The second most important anticoccidial drug is sulfadimidine, massively used in adult bird. It competes for metabolism of the parasite folic acid (McDougald, 2003). This control model used by two different anticoccidial drugs during the bird production cycle is a sort of shuttle or dual drugs using program applied in broiler poultry production industry, reported by Williams (1998) and recommended by Chapman et al. (2005). This preferential use of two chemical: amprolium and sulfadimidine could be due to their proved efficacy and their lower inducing coccidial drug-resistance potential expression or merely the ineffectiveness of the other marketed anticoccidial products. The amprolium drug has no withdrawal period restriction. But on the contrary, sulfadimidine, a sulfa-based drug, used to prevent or cure coccidiosis in a continual egg-producing bird, irrespective of it withdrawal period restriction of about 5 to 10 days (Feed additive Compendium, 1989) represents a great jeopardy for public health. Anticoccidial drug residues might be present in eggs.

Producers spend 137 FCFA per chicken, tantamount to 0.30 $ per chicken to control coccidiosis with the use of anticoccidial drug from the starting day 0 to the end of the laying period (18 months) in Benin exotic layer chicken production system. This is certainly the much heavier economical incidence in diseases control financial cost in this system and it is in line with several previous reports on the expensiveness of coccidiosis control cost in broiler or exotic layer flocks (Williams, 1999; McDougald, 2003; Sørensen et al., 2006).

These findings revealed an intense use of anticoccidial drugs, principally amprolium and sulfa-based drugs (sulfadimidine) with consequently some drug residue presence in eggs (Cannavan et al., 2000; Mortier et al., 2005; Danaher et al., 2008) in the administration period and the 10 days period following administration period, prejudicial to consumer health.

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