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Effects of rice water (*Oryza sativa*) as an adjuvant treatment of poultry coccidiosis

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Abstract

Rice water is widely used for its anti-diarrheal properties. The aim of this study is to evaluate its effectiveness, as an adjuvant treatment in experimental coccidial infection with *Eimeria tenella*. One hundred twenty broilers divided into 4 equal groups were used : G1: Negative control, uninfected untreated; G2: Positive control, infected untreated ; G3: Infected treated with a curative anticoccidial drug alone (Toltrazuril); G4: Infected treated with rice water associated to Toltrazuril. The infected groups : G2, G3 and G4 received by gavage 10^5 sporulated oocysts/subject. Weight gain, water and feed intake and feed conversion ratio were studied. Lesion score and oocysts output were evaluated after the infection. 7days post-infection, among the infected groups, the one treated with rice water (G4) showed an important reduction in their oocyst shedding, ($19.26\pm12.63\times10^6$ OPG<$37.21\pm19.10\times10^6$ OPG<$77.77\pm72.44\times10^6$ OPG respectively for groups 4, 3 and 2). 10 days post-infection the least sever lesion score was also recorded for group 4 ($0.33\pm0.58<1\pm0<1.67\pm1.53$ for groups 4, 2 and 3 respectively). At the end of the experiment, (G4) animals showed a better weight gain and feed conversion ratio (1890g, 1751g and 1617g for groups 4, 2 and 3 respectively). Rice water when used in combination with anticoccidial drugs can correct the disturbances caused by coccidial infection and minimize the losses in the affected farms.

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Introduction

Coccidiosis is a protozoan infection caused by various species of the genus *Eimeria*. It results from the presence and proliferation in epithelial cells of the intestinal mucosa (Hadipour *et al.*, 2011) of pathogenic, usually very specific, coccidia (Fontaine and Cadoré, 1995). The most dangerous parasitic diseases in broiler, is characterized by dysentery, enteritis, drooping wings, poor growth, low production (Awais *et al.*, 2012) with high rates of morbidity and mortality (Shirzad *et al.*, 2011). Coccidiosis is responsible, worldwide, of large economic losses (Bussiéras and Chermette, 1992a), which are estimated at over two billion dollars (Williams, 1999). Due to higher stocking densities and intensive husbandry practices, its incidence is being increased in poultry (Nnadi and George, 2010). The caecal coccidiosis due to *Eimeria tenella*, is highly pathogenic and causes loss of appetite, characteristic bloody diarrhea and homeostatic disturbances that can lead to death. During coccidiosis, losses are directly connected to diarrhea. Since the 50's anticoccidial drugs (etiological treatment) are still the main means of control (Naciri and Brossier, 2009). To the knowledge there are no specific antidiarrheal drugs used for avian species. In this study an experimental infestation in broilers with *Eimeria tenella* was conducted. An adjuvant therapy (symptomatic treatment) based on rice water was used to fight diarrhea, which is the main syndrome observed during coccidial infections. Rice water, widely used for its antidiarrheal properties (Pizarro *et al.*, 1991; Tavarez *et al.*, 1991; Ho and Yip, 2001), is administered in combination with an anticoccidial treatment (Toltrazuril) to assess its efficacy as adjuvant therapy, through studying its effects on feed and water intake, live weight gain, feed conversion ratio, lesion score and post infection oocyst shedding.

Material and methods

Experiment procedures used in the study, were approved by the scientific council of the Institute of veterinary sciences (University Mentouri of Constantine. Algeria), and were conformed to international guidelines of animal care and use in research and teaching *(NIH publications no 85-93 revised 1985)*.

Animals

One hundred twenty day-old mixed sexed broiler chicks (ISA15 strain) were used in the study. Animals were housed in floor pens and fed *ad libitum* throughout the experiment, first with starter diets offered from 1 to 14 days of age. Then a growth and finisher diets offered from 15 to 45 and 46 to 53 days of age respectively. All diets were formulated to cover the nutrient requirements of chicken (NRC, 1994). Standard management practices of commercial broiler production were applied.

Animals were assigned into 4 groups containing 30 subjects each. First group served as a control (G1), while groups 2, 3 and 4 were inoculated with *Eimeria tenella* to produce coccidiosis infection: G1: Negative control, uninfected untreated; G2: Positive control, infected untreated; G3: Infected treated with a curative anticoccidial drug alone (Toltrazuril); G4: Infected treated with rice water associated to Toltrazuril.

Infection of chickens

Each animal of the groups 2, 3 and 4 received by gavage, on day 18 of age, 1 ml of a suspension containing 10^5 sporulated oocysts of *Eimeria tenella* conserved in a 2.5% potassium dichromate solution. The oocysts were isolated and maintained in our research laboratory PADESCA (Institute of Veterinary Sciences, University Mentouri of Constantine. Algeria).

Treatments

From the onset of coccidiosis symptoms (bloody diarrhea characteristic of *Eimeria tenella* coccidiosis) treatments were introduced for groups 3 and 4.

Group 3: The animals received in drinking water 0.025g/l of Toltrazuril (Baycox® 2.5% oral solution). This anticoccidial is a coccidicide drug active on

various intracellular stages of coccidia (Bussiéras and Chermette, 1992a; Villate, 2001). The treatment was installed during two consecutive days.

Group 4: In addition to Toltrazuril (0.025g/liter for 2 days) animals received 1.5 liter of rice water, distributed before the animals get access to drinking water. Rice water was prepared by boiling 50g of polished rice (*Oryza sativa*), into 1 liter of water for 15 minutes. After cooling off the whole is well blended and then mixed with 2 liters of water. The treatment was installed for five consecutive days.

Studied Parameters

For the four experimental groups feed and water intake, and live body weight gain were quantified.

Feed and water intake

Were measured during the period of infection (day 0 to day 6 post-infection corresponding to age 18 days to 24 days).

Live body weight gain

Ten chicks from each group were randomly selected and weighted to obtain live body weight. Weighings were made at age 17 days, 29, 33, 36, 39, 42, 45, 49 and at age 53.

For the three infected groups, lesion score and oocyst output were studied.

Lesion score

Determined at days 7, 10 and 12 post-infection for 6 chicks of each infected group, according to the method described by Johnson and Reid (1970).

Oocyst output

Quantification in each infected group was measured daily during four days, from 5 to 8 days post-infection using McMaster cell according to the method described by Bussieras and Chermette (1992b).

Statistical analysis

Data obtained were expressed as mean±SEM. Statistical analysis was performed using Kruskal-Wallis Test followed by Mann-Whitney Test, using XLSTAT 2010 statistical analysis software (Addinsoft SARL). *p. value* < 0.05 was considered as significant.

Results

Clinical observations

On day 5 post-infection, corresponding to age 23 days, the first symptoms appeared on infected animals: immobility, depression, nervousness, haemorrhagic diarrhea. Mortality rates until day 6 post- infection were 13.79%, 20.69% and 6.90% respectively for group 2, 3 and 4. No mortality was recorded in the negative control group (G1).

Feed and water intake

During the infection period (day 0 to day 6 post-infection) the quantity of consumed water has fluctuated for all groups, especially the infected ones (Fig. 1). The cumulative quantities of consumed water were more important for the infected groups in comparison with the control one.

Concerning feed intake, consumption was initially the same for all groups, but from day 3 to day 6 post-infection we witnessed a progressive reduction of feed intake for all infected groups (Fig. 2). These groups showed less cumulative quantities of consumed feed compared with the control one (Table 1).

Table 1. Cumulative consumption of feed and water during the period of infection.

Group	G1	G2	G3	G4
Water (ml/chick)	891.07	1071.63	898.52	812.39
Feed (g/chick)	380.46	332.33	319.82	353.34

Table 1 shows the cumulative consumption of feed and water during the period of infection.

Evolution of live body weight

Animals of the negative control group (G1) had at age

53days the best mean weight (2192g). Among the three infected groups, animals of group 4, receiving rice water had the highest one (1890g) compared to the other two : 1751g and 1617g respectively for groups 2 and group 3 (Fig. 3).

Table 2 shows the average weight at the beginning (Day 17) and the end of the experiment (Day 53).

Feed conversion ratio (FCR)

At age 53 days, FCR recorded in our study are 1.83 > 2.08 > 2.16 and 2.33 respectively, for groups 1, 4, 3 and 2. Among the infected groups, the one receiving rice water (G3) showed the best FCR (2.08), but remains lower than the one recorded for the uninfected group.

Table 2. Average weight of animals at day 17 and day 53 (g/chick).

Group	G1	G2	G3	G4
Body weight at day 17	313	292	293	292
Body weight at day 53	2192	1751	1617	1890

Lesion scores

From day 7 post-infection, an improvement of lesion score was observed in all infected groups. The less important lesions were found in group 4.

Oocyst output

In all infected groups, a gradual increase in oocysts shedding was observed starting from day 5 and reaching its peak at day 7 post-infection, then decreasing at day 8 post-infection. At the peak, excretion was lower in group 4 compared with the infected untreated group and the one treated by toltrazuril. Considering the entire period studied and in comparison with group 2 infected untreated, oocysts shedding showed an important reduction in all treated groups. Compared to group 3 treated with toltrazuril, excretion of oocysts was greater in group 4 receiving rice water associated with toltrazuril (Table 4).

Table 3. Lesion scores in the infected groups.

Days post-infection	Untreated group	Treated groups	
	G2	G3	G4
7	2.83±0.98[a]	2.33±0.82[a]	2.33±0.52[a]
10	1±0[a]	1.67±1.53[a]	0.33±0.58[a]
12	0.67±0.58[a]	1±1[a]	0.33±0.58[a]

Values are expressed as mean ± SEM (n=6).

[a, b] : Values in the same row with a superscript in common do not differ significantly ($p > 0.05$).

Discussion

The onset of clinical signs of caecal coccidiosis on day 5 post-infection corresponds to the incubation period, which lasts generally 4 days (Bussiéras and Chermette, 1992a). The caecal coccidiosis caused by *Eimeria tenella* is highly pathogenic and is causing significant mortality in infected animals (Yvoré, 1992; Villate, 2001; Conway and McKenzie, 2007).

In infected groups, the lowest mortality was recorded for group 4. This could be explained by the antidiarrheal effect of rice water, which helped to a faster correction of digestive and homeostatic disturbances (Wapnir *et al.*, 1991; Pironi *et al.*, 2000; Atia and Buchman, 2009). Paradoxically, the highest mortality rate has not been registered for group 2 (infected untreated animals), but for group 3

consisting of animals treated only with toltrazuril. Resistance of the inoculation strain could be the cause. According to Yvoré (1992), all currently known anticoccidials induce more or less rapidly resistance phenomena or at least show a reduced efficiency.

Table 4. Oocyst output in infected groups (10^6OPG).

Days post-infection	Untreated group	Treated groups	
	G2	G3	G4
5	2.45±0.94[a]	2.25±2.29[a]	4.52±3.03[a]
6	15.54±6.34[a]	6.72±3.44[b]	15.55±11.31[a]
7	77.77±72.44[a]	37.21±19.10[a]	19.26±12.63[a]
8	27.57±17.82[a]	5.32±2.20[b]	23.12±16.20[a]
Total for studied period	123.33	51.50	62.45

Values are expressed as mean ± SEM (n=6).

[a, b] : Values in the same row with a superscript in common do not differ significantly ($p > 0.05$).

The increase in water consumption in the infected groups is due to thirst, consequential to diarrhea. Thirst is one of the main signs accompanying coccidial infections (Bussiéras and Chermette, 1992a). During the infection period, the decrease in feed intake coincides with the phase of intracellular multiplication of oocysts, which causes destruction of intestinal epithelial cells (Bussiéras and Chermette, 1992a). Loss of appetite and reduced feed intake are among the most important signs of coccidial infections, whatever is the affected enteric segment (Yvoré *et al.*, 1982). Low feed intake during acute infective stage may lead to secretion of adrenal cortisones/corticosteroids promoting glycogenolysis (Patra *et al.*, 2010).

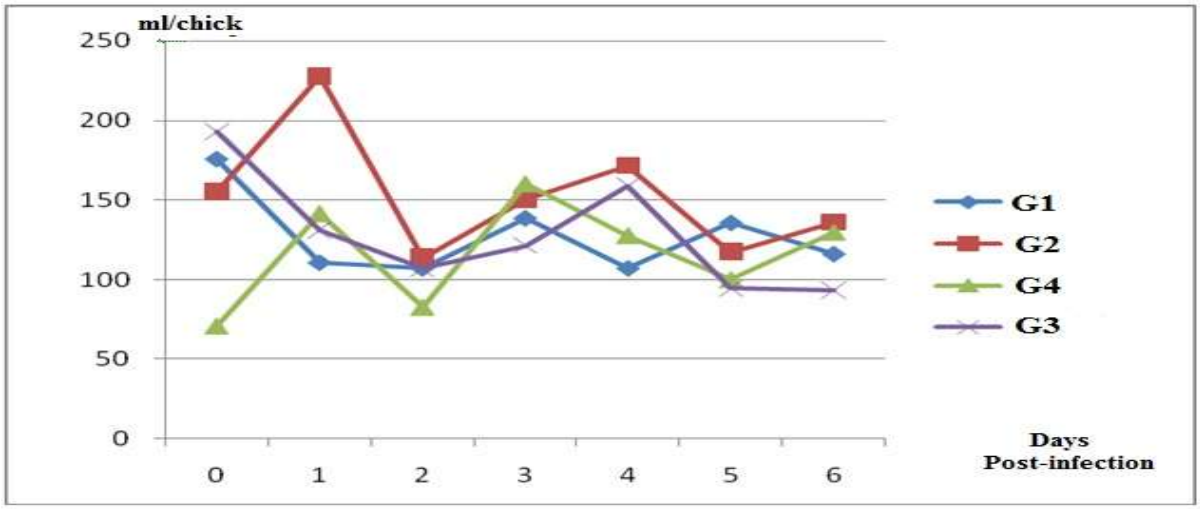

Fig. 1. Amount of water (ml/chick) consumed during the period of infection.

At the end of the experiment (Day 53), none of the infected groups had reached the weight of the uninfected control group. Coccidiosis in chicken is characterized by dysentery, enteritis, emaciation, drooping wings, poor growth and low production (Rehman *et al.*, 2010; Sharma *et al.*, 2013). Weight loss is mainly due to the decrease in food intake (Pascalon-Pekelniczky *et al.*, 1994; Patra *et al.*, 2010). In addition, coccidial infections cause massive destruction of epithelial cells, which leads to a

decreased intestinal absorption, causing a nutritional and hydromineral imbalances (Yvoré *et al.*, 1982; Bussiéras and Chermette, 1992a). Moreover, dehydration and malnutrition negatively affect the weight of the animals.

The better body weight recorded for group 4, receiving rice water, could not only be explained by the fact that rice is a rich energy feed (Larbier and Leclercq, 1992) but also, by the antidiarrheal effect of rice water, which could have helped restoring normal transit necessary for a better feed use (Pizarro *et al.*, 1991 ; Pironi *et al.*, 2000).

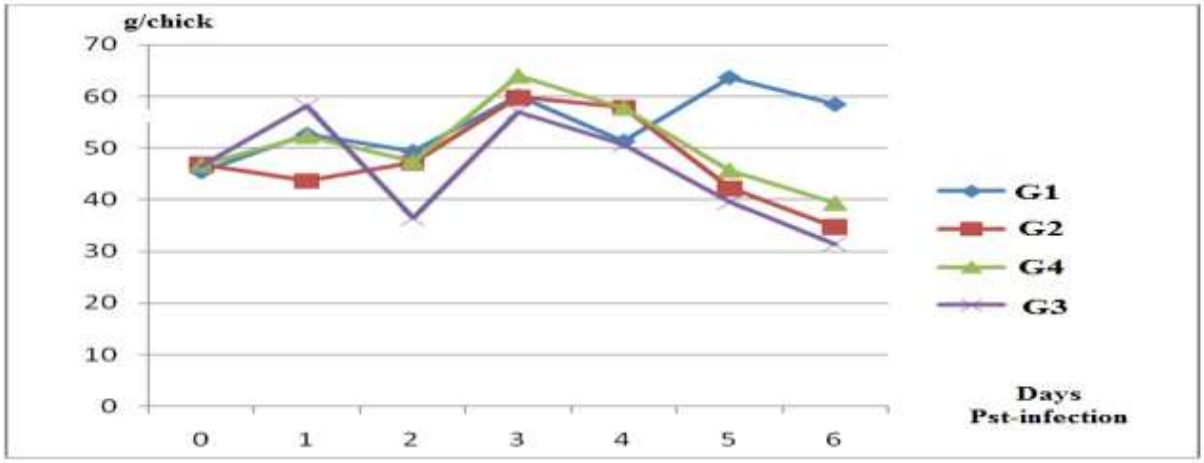

Fig. 2. Amount of feed (g/chick) consumed during the period of infection.

FCR values, superior to 2, recorded for the infected groups, confirm their lesser feed use efficiency, which is a direct consequence of digestive disorders, responsible of growth slowing down and an increased FCR (Bussieras and Chermette, 1992b). Coccidiosis is responsible for a huge global economic loss due to impaired feed anticonversion and retarded growth (Brugere-Picoux, 1992).

The lesion score (0.33 ± 0.58) observed in group 4 treated with toltrazuril associated to rice water was numerically much better than that observed in group 3 (1.67 ± 1.53). The improved lesion score observed in group 4, reflects the role of rice water in the fast regeneration of the intestinal mucosa which suffered damage induced by the multiplication of coccidia.

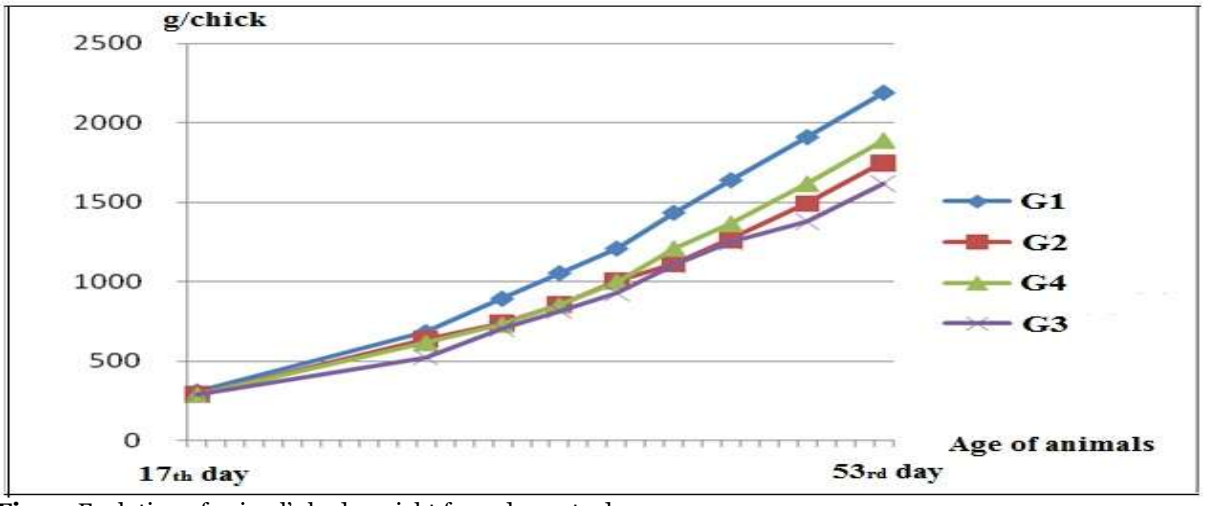

Fig. 3. Evolution of animal's body weight from day 17 to day 53.

Compared to group 2 infected untreated (123.33× 10^6 OPG), reduction of oocysts excretion for group 4 (62.45 × 10^6 OPG) could be attributed to the beneficial antidiarrheal effect of rice water, which helped restoring a normal transit (Pizarro *et al.*, 1991 ; Atia and Buchman, 2009) leading to a longer contact time between cecal mucosa and toltrazuril allowing this anticoccidial to act more efficiently. On the other hand, compared to group 3 (51.5 × 10^6 OPG), the raising of oocysts shedding in group 4 could be linked to the consistency of the faeces examined. The number of oocysts contained in liquid faeces is less important than in faeces less hydrated.

Conclusion

It appears from this preliminary study that rice water, used as adjuvant therapy in a caecal coccidiosis in broilers, has several beneficial effects in the fight against the disease. Due to its antidiarrheal effect, rice water helps to a rapid correction of digestive function affected by the parasite development. Allowing by this correction, a better use of feed and reducing weight loss, thus improving the feed conversion ratio necessary for the profitability of the farm. This study is worth pursuing with larger samples and with other species of coccidia, to elucidate the mechanisms by which rice water acts, and to enable the practical implementation of this treatment in poultry farms.

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