Anticoccidial activity of the methanolic extract of *Musa paradisiaca* root in chickens

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**Abstract** The study was designed to evaluate the anticoccidial activity of the methanolic extract of *Musa paradisiaca* root in chickens. The chickens were divided into six groups of 12 chickens each. Each chicken in five groups was infected with 8,000 infective coccidia (*Eimeria tenella*) oocysts at day 28 of age while one group served as uninfected control. At day 7 post-infection, two chickens remaining in each group were sacrificed for postmortem examination to confirm coccidiosis. Also at day 7 post-infection, each chicken in four infected groups was given graded doses (250, 500 and 1,000 mg/kg b.w.) of the extract or amprolium (conventional drug). Two groups (an infected and uninfected group) did not receive treatment. Parameters used to assess progress of infection and response to treatment included clinical signs typical of coccidiosis, oocyst count per gramme of faeces (OPG) and packed cell volume (PCV). Treatment of previously infected chickens with *M. paradisiaca* root extract resulted in a progressive decrease in severity of observed clinical signs, marked reductions in OPG and a gradual increase in PCV. In each case, the changes were dose dependent. There was no significant difference in mean OPG and mean PCV of the extract (at 1,000 mg/kg b.w.) and amprolium-treated groups at termination of the study (at day 50 of age). In the acute toxicity study, the extract was found to be non-toxic to the chickens even at the highest dose of 4,000 mg/kg b.w. The results of this study demonstrated that the extract has anticoccidial activity in a dose-dependent manner and at a dosage of 1,000 mg/kg b.w. had similar efficacy with amprolium in the treatment of chicken coccidiosis.

**Keywords** Anticoccidial activity · Chickens · Extract · *Musa paradisiaca*

**Introduction**

Coccidiosis is one of the most important diseases of poultry worldwide (Lee et al. 2009). The disease is often characterized by marked morbidity, mortalities and reductions in productivity and feed conversion efficiency of affected chickens (Jang et al. 2007). In Nigeria, commonly used coccidiostats include sulphaquinoxaline and pyrimidine derivatives such as amprolium (Oladoja and Olusanya 2007). However, the toxic effects of these chemicals on poultry (Singh and Gupta 2003; Calo et al. 2005), the development of resistance to it by target parasites (Fanatico 2006; Guo et al. 2007) and the problem of drug residues in poultry meat (Ogbe et al. 2008) suggest herbal remedies as a reasonable alternative.

In Nigeria and other developing tropical countries where a large percentage of the population is unemployed, cheap food production is necessary. If the control of the coccidian parasite could be made more economical, these savings could be passed on to the consumers thus making poultry products more affordable to resource poor Nigerians. A solution to this problem could be the use of plant products which are cheap and easy to acquire and also have the added advantage of being of natural origin. The use of herbal remedies in the management of coccidiosis is not a new concept. For example, halofuginone, a quinazolinone alkaloid derived from *Dichroa febrifuga*, has been used as a coccidiostat, and the original extract from *D. febrifuga*, known as febrifugine, possesses antimalarial and
anticoccidial activity (Naidoo et al. 2008). The investigation of herbal remedies as anticoccidial remedies therefore holds promise as an alternative in the control of coccidiosis. Plants native to Nigeria have been shown to posses anticoccidial activity (Fajimi and Taiwo 2005; Nweze and Obiwulu 2009). These plants may serve as a source of foreign revenue when exported to Europe and other developed economies where people are becoming more aware of the potential dangers of using chemotherapeutic agents in producing animal protein.

*Musa paradisiaca* has been reported to have some coccidiostatic properties (Tafara et al. 2005) and hypoglycemic effects (Ojewole and Adewumi 2003). In traditional (human) medicine, the leaves are used for cough and bronchitis, inflammation, rheumatism, and as an anthelmintic. In this study, the anticoccidial activity of the methanolic extract of *M. paradisiaca* root was investigated in chickens experimentally infected with *Eimeria tenella* oocysts.

**Materials and methods**

**Experimental plant**

*M. paradisiaca* roots were obtained from Nsukka, south-eastern Nigeria, in the month of June 2008 and identified and authenticated in the herbarium of the Department of Botany, University of Nigeria, Nsukka where a voucher specimen is deposited.

**Extraction of plant material**

The roots were chopped into small pieces and dried under the sun. The dried materials were reduced to a fine powder by grinding with a milling machine and cold-extracted with methanol at room temperature for 72 h with intermittent shaking. The extract was concentrated in a rotary evaporator to afford a dry residue which was stored at 4°C until use. The percentage yield of the extract was 12% (w/w).

**Experimental animals**

(Anak) broiler chickens purchased at day old from a reputable hatchery (Zartech) were used for the study. They were kept in standard open-sided houses in suspended wire meshed (battery system) cages. Each bird in each group was kept in a separate cage. The birds were fed ad libitum on a proprietary broiler ration (AMEn=2,900 kcal/kg, CP= 19%) and also given access to water ad libitum. They were routinely vaccinated against Newcastle and Gumboro diseases. The birds were kept in accordance with the recommendations in the Guide for the Care and Use of Laboratory Animals (DHHS, NIH publication no. 85-23; National Research Council (NRC) 1985).

**Test organism**

A suspension containing infective *E. tenella* oocysts was obtained from the National Veterinary Research Institute, Vom, Nigeria.

**Preliminary acute toxicity study**

Twenty-five 4-week-old broiler chickens were divided into five groups of five chickens each. Groups A–D were given graded doses (500, 1,000, 2,000 and 4,000 mg/kg b.w., respectively) of the methanolic extract of *M. paradisiaca* root. Group E (control) was given distilled water. The chickens were observed for 24 h for any sign of toxicity including change in behaviour or death.

**Evaluation of extract for anticoccidial activity**

Birds were randomly divided into six groups (I, II, III, IV, V and VI) of 12 chickens each. At day 28 of age, each one of the chickens in groups I–V was infected orally with 8,000 *E. tenella* infective oocysts. Group VI chickens (uninfected control) were not infected. At day 35 of age (i.e. day 7 post-infection (P.I.)), two birds were sacrificed from each group for postmortem examination. On confirmation, following observation of typical lesions of coccidiosis (McDougald and Reid 1997) at day 7 post-infection, chickens in groups I, II, and III were dosed orally with (250, 500 and 1,000 mg/kg b.w., respectively) of the extract once daily for a period of 2 weeks. Groups IV chickens received amprolium as a 0.025% solution (250 mg/l) in drinking water for 2 weeks. Groups V and VI chickens did not receive treatment. The study was terminated at day 50 of age.

Clinical signs typical of coccidiosis (McDougald and Reid 1997), oocyst count per gramme of faeces (OPG) and packed cell volume (PCV) were the parameters used to evaluate the anticoccidial activity of *M. paradisiaca* root extract. Faecal droppings from each bird in all the groups were collected a day 7 P.I. and subsequently at 3-day intervals until termination of the study. The modified McMaster technique as described by Vassilev (2002) was used to estimate OPG. Blood samples were collected by jugular venipuncture from each chicken in all groups at 3-day intervals until the termination of the study. The modified McMaster technique as described by Vassilev (2002) was used to estimate OPG. Blood samples were collected by jugular venipuncture from each chicken in all groups at 3-day intervals until the termination of the study. The PCV was determined by the micro-haematocrit method (Campbell and Coles 1986). All the chickens that died during the study were subjected to necropsy.

**Statistical analysis**

The data obtained from the study were summarized as means ± standard error of means. Statistical comparisons between the treatment groups were made by one-way analysis of variance.
Means were considered significant at $P<0.05$ and the means separated using Duncan’s multiple range test.

### Results

The LD$_{50}$ was not determined as mortalities were not recorded in any of the five groups of chickens including those drenched with the highest dose of 4,000 mg/kg b.w. of the extract. Clinical signs typical of coccidiosis including inappetance, depression, wing drooping, huddling, ruffled feathers, pasted vents and bloody droppings were observed in all the infected groups of chickens at day 7 P.I. Following treatment, there was a progressive reduction in severity of observed clinical signs in groups I–IV chickens. In contrast, there was a progressive increase in severity of clinical signs observed in group V chickens with a mortality of 20% by day 13 P.I. Mortalities were not recorded in groups I–IV chickens.

The gross lesions seen in birds sacrificed from groups I, II, III, IV and V were pallor of pectoral muscles, ballooning of the large intestine and petechial haemorrhages of the serous surface of the large intestine. On opening the caeca, the walls were thickened and the lumen filled with blood and tissue debris. There were no lesions seen in the large intestine and caeca of group VI birds. Histopathological examination of the sacrificed chickens in groups I–V revealed merozoites in the epithelial layer of the caeca.

At day 35 of age (day 7 post-infection), the mean OPG of the six groups of chickens were as depicted in Table 1. At day 50 of age, there were marked reductions in mean OPG in all the treated groups (I–IV). In contrast, there was a progressive increase of mean OPG in group V chickens throughout the duration of study. At the termination of the study, there was no significant difference ($P<0.05$) between the mean OPG of groups III and IV chickens.

The mean PCV of chickens in the six groups are as presented in Table 2. At day 7 P.I., the mean PCV of groups I–V chickens were significantly lower than that of group VI chickens. Following treatment, there was a gradual increase in mean PCV in groups I–IV chickens unlike in group V where there was a gradual fall throughout the duration of

### Table 1 Oocyst count per gramme of faeces ($10^{13}$) of chickens infected with *E. tenella* oocysts and treated with graded doses of *M. paradisiaca* root extract

<table>
<thead>
<tr>
<th>Age (in days)</th>
<th>Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Extract at 250mg/kg</td>
<td>II Extract at 500mg/kg</td>
</tr>
<tr>
<td>35</td>
<td>135±(4.28) a</td>
</tr>
<tr>
<td>38</td>
<td>90±(4.10) a</td>
</tr>
<tr>
<td>41</td>
<td>55±(1.92) a</td>
</tr>
<tr>
<td>44</td>
<td>22±(0.72) a</td>
</tr>
<tr>
<td>47</td>
<td>14±(0.51) a</td>
</tr>
<tr>
<td>50</td>
<td>5±(0.25) a</td>
</tr>
</tbody>
</table>

Different letters in a row indicate significant difference between the means, abcd: $p<0.05$. Standard error in brackets

### Table 2 Packed cell volume (percent) of chickens infected with *E. tenella* oocysts and treated with graded doses of *M. paradisiaca* root extract

<table>
<thead>
<tr>
<th>Age (in days)</th>
<th>Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Extract at 250mg/kg</td>
<td>II Extract at 500mg/kg</td>
</tr>
<tr>
<td>35</td>
<td>22.40±(0.64) a</td>
</tr>
<tr>
<td>38</td>
<td>22.40±(0.52) a</td>
</tr>
<tr>
<td>41</td>
<td>23.80±(0.74) a</td>
</tr>
<tr>
<td>44</td>
<td>24.80±(0.82) a</td>
</tr>
<tr>
<td>47</td>
<td>25.20±(1.12) a</td>
</tr>
<tr>
<td>50</td>
<td>26.50±(0.85) a</td>
</tr>
</tbody>
</table>

Different letters in a row indicate significant difference between the means, abcd: $p<0.05$. Standard error in brackets
the study. There was no significant difference (P<0.05) in the mean PCV of groups III and IV chickens at the termination of the study.

Discussion

The absence of mortality in any of the groups of chickens employed in the acute toxicity study supports the findings of previous workers (Tafara et al. 2005).

The clinical signs, gross and histological lesions, mean PCV and OPG of the infected groups of chickens at day 7 P.I. were consistent with findings in chickens experimentally infected with coccidia (Guo et al. 2007; Naidoo et al. 2008; Nweze and Obiwulu 2009). Anaemia due to intestinal destruction and resulting blood loss is a consistent finding in Eimeria species infections in chickens (McDougald and Reid 1997).

Following treatment, there was a progressive reduction in severity of observed clinical signs in the extract and amprolium-treated groups unlike in the untreated but infected group V chickens which manifested increasingly severe clinical signs until death or termination of the study. This is consistent with the earlier reports of the anticoccidial effects of amprolium in chickens (Michelle 1994) and M. paradisiaca root in rabbits (Tafara et al. 2005). Similarly, there was a progressive decrease in OPG and increase in mean PCV in the extract and amprolium-treated groups. This was at contrast with the infected/untreated group V chickens in which there was a progressive increase in mean OPG and a decrease in mean PCV. The absence of statistical difference (p<0.05) in the mean OPG and mean PCV of groups III and IV chickens at the termination of the study proposes the M. paradisiaca root extract at 1,000 mg/kg b.w. to be similar in efficacy to amprolium (at 0.025%) in the treatment of coccidiosis in chickens.

The results of this study demonstrate the dose-dependent anticoccidial activity of M. paradisiaca root extract which at a dose of 1,000 mg/kg b.w. had similar efficacy with amprolium in the treatment of chicken coccidiosis. M. paradisiaca root may be recommended to poultry famers in the absence of conventional anticoccidial drugs.

Ethical standards

The experiments conducted in our work comply with current laws in Nigeria where they were performed.

Conflict of interests    There are no conflicts of interests related to this work.

References


