The Efficacy of Banana Plant (*Musa paradisiaca*) as a Coccidiostat in Rabbits

Tafara Matekaire, MS[1]
John F. Mupangwa, PhD[2]
Emily F. Kanyamura[1]

[1]*Biological Sciences Department*
Bindura University of Science Education
Bindura, Zimbabwe

[2]*Faculty of Agriculture and Environmental Science*
Bindura University of Science Education
Bindura, Zimbabwe

KEY WORDS: banana plant, *Musa paradisiaca*, sulphadimidine sodium, coccidiosis, coccidiostat, rabbits

ABSTRACT

Coccidiosis is a significant health and performance problem in modern rabbit production. It affects productivity by negatively affecting voluntary feed intake, and digestive and reproductive performance. A comparative study was conducted in the Mashonaland Central district of Zimbabwe with tamed rabbits to investigate the efficiency of using banana roots (*Musa paradisiaca*) in treating rabbits infected with coccidiosis. Over a 2-week period, rabbits received control with no intervention, rabbit pellets mixed with sulphadimidine sodium, or rabbit pellets mixed with dried crushed banana roots. Rabbits receiving sulphadimidine sodium (a recommended coccidiostat) and banana root treatment had a lower fecal egg count than those in the control group. Weight loss was highly significant in rabbits treated with sulphadimidine sodium. There was a significant decrease in oocysts output in both banana root treatment and sulphadimidine sodium treatment ($P \leq 0.05$). The banana root has a mild effect on coccidiosis.

INTRODUCTION

The indigenous technical knowledge regarding animal husbandry is considered as old as domestication of various livestock species. Unfortunately, these practices, which are in vogue throughout the smallholder sector of Zimbabwe, are inadequately documented, and there is danger of extinction of this knowledge. Thus, it has become imperative to collect, assess, validate, and document these practices. Harnessing of the indigenous knowledge base and resources in solving local veterinary problems is paramount to present-day Zimbabwe, which is almost under a siege economy and virtually with no foreign currency reserves to talk about. This dire situation compounds the already existent problems of availability, accessibility, and affordability of modern veterinary drugs (MVD) to the already impoverished rural and smallholder livestock farmer.

Farmers, particularly in the rural and isolated regions of Zimbabwe, have developed their own ways of keeping their livestock

healthy and productive. They treat and control livestock diseases using local remedies and surgical manipulative techniques associated with magic/religious practices. This indigenous and/or animal care constitutes ethnoveterinary medicine.[1] Various parts of plants, such as leaves, bark, rhizome, roots, and sap, constitute these home remedies. These plants are readily available, have little or no apparent side effects to animals, and are cheaper than conventional veterinary drugs. Preparation of ethnoveterinary medicine on a large scale can provide local income, employment opportunities, and also can help to keep valuable local knowledge on animal healthcare.

Sulphur drugs have been proven to be most effective in the treatment of coccidiosis.[2] Oxytetracycline at a level of 10 g/metric ton can be used as an aid in stimulating growth and improving feeding efficiency in rabbits infected with coccidiosis.[3] However, long-term medication with such drugs is not necessary if there is proper management and good hygiene in rabbitry. Good sanitation, including keeping the litter dry, so that oocysts cannot sporulate breaks the life cycle of coccidian. Cages with suspended floors and bottled or automatic drinking water systems prevent and limit the contact of rabbits with contaminated fecal matter.[4]

The study of rabbits is very important, particularly for Zimbabwe, given that varieties of rabbit are raised commercially for meat, skins, and wool; the rabbit is also a popular pet. The rabbit has been used in a wide variety of research studies in genetics, nutrition, toxicology, physiology, immunology, and reproduction. Classically, the rabbit has been utilized in human medicine to determine pregnancy in women by injecting the serum from the patient into the rabbit and thereby inducing ovulation in the doe. The pharmaceutical industry uses the rabbit widely to test toxic effects of cosmetics and pharmaceuticals in their evaluation for new drugs (greatly on the decline now), and the rabbit is the standard animal for pyogen testing of all solutions for human medical use. The rabbit also is used by the research community for the production of antibodies and antiserums. Due to its large size, it can be of great benefit in the production of fairly substantial amounts of these materials. As a result of the significant amount of time required to produce antibodies, the ability to continually collect these materials from the rabbit necessitates long-term holding facilities for these animals and, therefore, turnover rates are slow and investigator studies may be restrained to some extent by the amount of rabbit holding spaces available in a given facility.

The banana plant (*Musa paradisiaca*) has been reported to have some coccidiostatic properties.[5] The family *Musacea* is greatly used as a source of food. Most of the work that has been done tends to focus more on its nutritional than its medicinal value. Bananas are a good source of vitamins A, B, and C, a-nd they also have a high content of carbohydrates and potassium. In East Africa, an intoxicating drink is prepared from the banana fruit.[6]

The modern veterinary sector is plagued with numerous constraints, including erratic supply of expensive veterinary drugs, poor communication facilities, and shortage of manpower. In a particular case of Zimbabwe (especially with its perceived controversial land redistribution exercise exacerbated by close to nil inflow of foreign currency due to lack of foreign direct investment), drugs that were once available locally and cheaply are now scarce or, when available, are out of reach of resource-poor communal farmers. The banana roots can be used as an alternative cheap coccidiostat. This research also is meant to promote the complementary use of indigenous and conventional veterinary medicine for sustainable livestock production and to promote the protection and the conservation of medical plant resources. Results from this project also could reduce the cost burden to the farmers as well as be useful to ethnobotanists who investigate pharmacological activities of natural plants.

Literature Review

Medicinal plants constitute one of the most important groups of wild plants in terms of their contribution to the economy and well-being of farm households. They are commonly grown in home gardens and harvested from common lands, and their growth near habitations is often encouraged.

Medicinal and aromatic plants are in fact obtained from a wide range of habitats: tropical forests, temperate forests, secondary forests, scrubland, meadows, swidden fallows, agricultural crop fields, home and house gardens, and any areas where human societies (both urban and rural) grow, manage, and harvest useful plants.

It has been estimated by the World Health Organization (WHO) that 80% of the developing world's population meets its primary healthcare needs through traditional medicines. In China for example, about 1 billion people, both in urban and rural areas, depend largely on plant-based medicinal aids while 800 million inhabitants of South Asia rely on herbal medicines.[7] In India, traditional healthcare systems, such as Ayurvedic, Unani, Siddha, and Tibetan medicine, run in parallel with the modern healthcare sector while the Sri Lankan government has a Ministry of Indigenous Medicine that has set up medicinal plant nurseries.[8]

Despite the acknowledged importance of medicinal plants for both the global economy and local household economies, their use is generally poorly organized and poorly regulated, and most plants are still exploited with little or no regard to the future.[9] Many medicinal and aromatic plants are wild collected, usually without any control or regulation. In West Africa for example, the vast majority of drug plants grow only in the wild (rather than being cultivated) while in China, more than 80% of the 7,000,000 metric tons of medicinal plants that are reportedly used each year for direct decoction in traditional medicine and as ingredients in official medicine comes from wild sources.[10,11]

Since time immemorial, through trial-and-error methods, African indigenous farmers have managed to observe that some plants can be used to cure some diseases in livestock. Research in ethnoveterinary botanicals suggests that many plant species display pharmacological activities against microorganisms, such as viruses and bacteria.[12] Of the 10% (25,000–75,000) of the higher plants that are used in traditional medicines, only 1% has been acknowledged through scientific studies to have therapeutic value.[13] Scientific validation of traditional medicines present some problems for a variety of methodological reasons; formal pharmacological and clinical studies have not always been accurate in their assessment on activity, efficiency, and safety of these remedies.[14]

Rabbits and Coccidiosis

Domestic rabbits, also referred to as tamed rabbits, are generally maintained in cages, pens, or other enclosures. All breeds and varieties of rabbits have their origin from the European rabbit (*Oryctolagus cuniculus*).[15] Man has domesticated rabbits for meat, wool production, research, as pets, and as a hobby. At one time, wool production from Angora rabbits was popular, but presently there is little commercial production of angora wool.[15]

Domestic rabbits are primarily herbivorous and feed on grains, greens, and hay. Commercial pelleted feed is also available. Since rabbits practice coprophagy, that is, consuming fecal matter directly from the anus, they are highly susceptible to coccidial infection.[16]

Coccidiosis is a protozoal disease responsible for deaths and lowered production in domestic rabbits and poultry. The clinical signs of the disease depend on its location. Intestinal coccidiosis results in weight loss, soft to watery feces, blood in feces, dehydration, increased thirst, and sometimes death. When located in the liver, it causes inappetence, diarrhea, and death. The severity of the disease depends on the number of coccidia eaten, age of the rabbit, and the strength of its immune system.[16]

Rabbits are susceptible to about 8 species of coccidial parasites, which belong to genus *Eimeria*. Commonly encountered species that cause intestinal coccidiosis are *E. irresidua*, *E. magna*, *E. media*, and *E. perforans*. *Eimeria stiedae* causes coccidiosis in the hepatic form.[17]

All age groups of rabbits are susceptible to coccidial infection, but the most vulnerable are the weaned bunnies and young ones aged 2 to 3 months.[18] Sulphamerazine, sulphaquinoxaline, and sulphamethazine are the most effective drugs for the treatment and prevention of lower coccidiosis.[19] Intestinal coccidiosis has been successfully treated with sulfamonomethoxine and sulphadimethoxine.[17] These drugs only act as coccidiostats. Coccidiostatic agents in rabbits prevent coccidial development by retarding multiplication of coccidian until the host's immunity develops sufficiently to be effective.[16] Research has shown that, in general, adult animals act as carriers without showing signs and symptoms and pass the coccidiosis to their offspring.[4] Sulphamerazine sodium administered in drinking water inhibits the development of *E. stiadae*. Sulphamethoxine in pelleted feeds given for 7 consecutive days to ensure a dose of 75 mg/kg of body weight was found to be effective in treating hepatic and intestinal coccidiosis.[3]

Despite the problems associated with scientific validation, traditional medicines offer an advantage during times of economic hardships. However, emphasis must be placed on prevention of coccidiosis in rabbitry (good husbandry and sanitation) since coccidiosis is difficult to eliminate.

MATERIAL AND METHODS

Research was carried out at the Veterinary Research Centre in Harare. The *Musa paradisiaca* roots used in this research were collected from banana plants in the Chiweshe district of Mashonaland Central Region of Zimbabwe. The roots were left to dry in the sunshine for 3 weeks and were then crushed into small powdery bits, which were mixed with commercial pelleted feeds.

Experimental Animals

Eight New Zealand white male rabbits (3 weeks of age) were randomly selected. The rabbits were kept in individual suspended wire cages inside a building. Water was available ad libitum for all the rabbits.

Experimental Design

The rabbits were classified into 3 groups: the test group, which received the banana treatment, and 2 control groups (1 receiving commercial veterinary drug treatment and 1 receiving no treatment).

Treatment 1

A commercial pelleted feed was mixed with crushed banana roots. Twenty grams of dried *Musa paradisiaca* were crushed and mixed with 135 g of commercial rabbit pellets.

On average, a rabbit can consume 135 g of the pelleted feed per day.[19] The rabbits were only given more after exhausting their initial allocation to ensure that they had eaten the crushed banana roots. The rabbits received the banana treatment for 14 consecutive days.

Treatment 2

Sulphadimidine sodium was administered at a level of 10 g/metric ton of rabbit pellets. Each rabbit received 135 g of rabbit pellet feed. They were only given more after having finished, thus ensuring the rabbit had eaten all the food. The procedure was repeated for 14 consecutive days.

Control

These were infected rabbits with no treatment.

Data Collection

The rabbits were observed for 14 consecutive days. Fecal samples were collected on Days 0, 7, and 14 from each group. Oocyst count was done using the McMaster method.[20] The oocysts number was expressed as an average number of oocysts per gram per treated group. A triple-beam

balance was used to measure the weight in grams for each rabbit on Days 0, 7, and 14. The mass was expressed as live mean mass per group (kg). The information was recorded on forms allocated to individual rabbits.

Table 1. Average Number of Coccidia Oocysts per Gram of Fecal Matter per Treatment (Oocyst Density).

Treatment	Day 0	Day 7	Day 14
Banana root	1180	1053	850
Sulphadimidine sodium	4150	3803	1030
Control	650	2520	1377

Table 2. Mean Live Mass (kg) per Group of Coccidiosis-Infected Rabbits Treated With Banana Roots and Sulphadimidine Sodium.

Treatment	Day 0	Day 7	Day 14
Banana root	2.2	2.5	3.1
Sulphadimidine sodium	3.5	2.9	3.2
Control	2.3	2.5	2.5

Statistical Analysis

The 2-sample *t*-test statistical model was applied to test significant differences in live mass and oocysts output when using banana roots and sulphadimidine sodium as recommended coccidiostat in rabbits infected with coccidiosis.

RESULTS

There was a significant decrease in oocysts output in both banana root and sulphadimidine sodium treatments (Table 1). There was an increase in live mass in rabbits treated with banana roots and a decrease in rabbits treated with sulphadimidine sodium (Table 2). Weight loss was highly significant in rabbits treated with a recommended coccidiostat ($P \leq 0.05$).

DISCUSSION

A significant reduction in oocysts production demonstrates that the banana roots have some coccidiostatic properties. Coccidiostatic agents in rabbits prevent coccidial developments by retarding reproduction of coccidian.[19] Weight loss, which was highly significant in rabbits treated with sulphadimidine sodium, was probably due to heavy infection since the rabbits receiving sulphadimidine sodium produced watery diarrhea on Day 5. Most of the nutrients meant for growth and development were probably directed towards repair of damaged tissues.

Eimeria stiedae is confined to the liver but induces loss of any fat absorbed; hence, it produces disturbances of food utilization.[3] Method of preparation probably affected the efficiency of banana roots, since the banana roots were administered dry. Farmers in rural areas use the banana roots mixed with other remedies like gavakava (aloe vera).[5] Extraction of active ingredients from the banana roots can improve the efficiency of banana as a coccidiostat.

Although oocysts count in rabbits treated with banana roots and sulphadimidine sodium in the groups decreased after Day 7, the rabbits were still shedding oocysts at the end of the experiment. This shows even the commercially prepared coccidiostat cannot totally eradicate coccidiosis in rabbits. Coccidiostatic agents in rabbits only prevent coccidial development by retarding the process of reproduction.[16] This makes coccidiosis a significant economic factor in rabbit production.

More research should be done to develop coccidiostatic agents, which totally eradicate coccidiosis in poultry and rabbit production. The results in this case are in conformity with those generally observed in India on other common ailments treated with ethnoveterinary medicine and validated by the QuIK (Quantification of Indigenous Knowledge) method developed by de Villiers[21] whose basis lies in that farmers know and understand the environment in which they farm and that answers to many questions can be found in the collective experience of the farming community and doing informal experiments over years.

On this strength, all the indigenous tech-

nical knowledge was found to be effective against the respective ailments. However, these were perceived to be comparatively less effective than the modern veterinary drugs in numbers of animals cured and quickness of healing. The indigenous practices were perceived better than the modern veterinary drugs in respect of their availability, lesser side effects, and lower cost.[22]

CONCLUSION

The banana root has a mild effect on coccidiosis. This shows that banana roots have some coccidiostatic properties and therefore there is need to make extracts of banana roots and identify the active ingredients as well as the structures of the extracts so as to provide scientific rationality for use

Sulphadimidine sodium in this particular case appeared to be ineffective in controlling coccidiosis while banana root performance was less than that of the sulphur drug. There also is a need to investigate the presence or absence of side effects of *Musa paradisiaca* in rabbits.

The study was confined to a few villages of the Chiweshe district of Mashonaland Central region of Zimbabwe; therefore, generalization of the study cannot be made elsewhere.

REFERENCES

1. McCorkle CM: Back to the future: Lessons from ethnoveterinary research, development and extension for studying and applying local knowledge. *J Agric Food Human Val Soc* 1995;22:52–80.
2. Banerjee GC: *A Textbook on Animal Husbandry*. 8th edition. Oxford Publishing Company: Culcutta; 1998.
3. Weisbroth SH, Flatt RE, Kraus AL: *The Biology of the Laboratory Rabbits*. Academic Press: London; 1974.
4. Sandford JC: *The Domestic Rabbits*. Granada Publishing Ltd: New York; 2000.
5. Intermediate Technology Development Group and International Institute of Rural Construction (ITDG and IIRR): *Ethnoveterinary Medicine in Kenya*. 1996.
6. Grieve M: *A Modern Herbal*. Available at: http://www.botanical.com/botanical/mgmh/mgmh.html.
7. Bizimana N: Scientific evidence of efficacy of medicinal plants for animal treatment. *Ethnoveterinary Medicine: Alternatives for Livestock Development: Proceedings of an International Conference*. November 4–6, 1997: Pune, India; 1997;2:11–12. Abstract.
8. Food and Agriculture Organization of the United Nations: *Use and Potential of Wild Plants in Farm Households*. 1999.
9. Srivastava J, Lambert J, Vietmeyer N: *Medicinal Plants: An Expanding Role in Development*. World Bank: Washington, DC; 1996:Technical Paper No. 320.
10. He SA, Cheng ZM: The role of Chinese botanical gardens in conservation of medicinal plants. In: Akerele O, Heywood V, Synge H, eds. *Conservation of Medicinal Plants*. Cambridge University Press: Cambridge, UK; 1991:229–237.
11. Xiao PG: The Chinese approach to medicinal plants—their utilization and conservation. In: Akerele O, Heywood V, Synge H, eds. *Conservation of Medicinal Plants*. Cambridge University Press: Cambridge, UK; 1991:229–237.
12. Roepke DA: *Traditional and Reapplied Veterinary Medicine in Africa. Ethnoveterinary Research and Development*. Intermediate Technology Publications: London; 1996.
13. Hiemshra W, Haverkot B, Binders J: *Biotechnology Building on Farmers' Knowledge*. MacMillan Education Ltd.: Busingstoke; 1996.
14. Farnsworth NR: *Traditional Medicines and Health Coverage*. Nairobi, Kenya; 1983.
15. Smith WT: *Extension Poultry Science Specialists*. Acts of Congress: Mississippi; 2003.
16. Miller RE, Fowler ME: *Zoology and Wild Animal Science*. McGraw-Hill: London; 2003.
17. Fox JG: *Laboratory Animal Medicine*. Academic Press Inc.: New York; 1984.
18. Arnoudiev D, Kotsova T, Mulchevisk M, Sherkov SN, Khalacheva M: Etiopathogenesis and epizoology of coccidiosis in rabbits. *Vet Med Nauki (Bulgarian)* 1986;7–11.
19. Debuf MY: *The Veterinary Formula Handbook of Medicines Used in Veterinary Practice*. 2nd edition. The Pharmaceutical Press: London; 1984.
20. Vassilev DG: Special modification of McMaster method. In: Cumming B. *Central Veterinary Laboratory of Manual Veterinary Parasitology Techniques*. London; 2002.
21. De Villiers AK: *Quantifying Indigenous Knowledge: A Rapid Method for Assessing Crop Performance without Field Trials*. Agricultural Research and Extension Network: Agren; July 1996.
22. Amitendu D, Arya HPS, Tudu B, Goswami A: *Indigenous Technical Knowledge in Animal Husbandry Livestock Research for Rural Development*. Volume 4, Number 8. 2004.