Comparative efficacy of three medicinal plants as feed additives for control of coccidiosis and broiler performance

Smallholder poultry production is very important in developing countries and it seems that it will be important for many years to come, because of the high population densities and the enormous number of small farms (Ellis, 1992). In India, the most commonly reared poultry species is chicken, the domesticated indigenous fowl **Gallus domesticus**.

Free-range production systems are cheap in terms of feed cost, but on the other hand they expose the birds to many disease agents. Birds kept under these husbandry systems are subject to high loss resulting from accidents, predation or diseases (Gueye, 2002).

In the face of these problems it becomes imperative to undertake action to increase productivity through reduction of loss due to diseases and predators. Keeping chicks in protective enclosure is salutary against predators as recommended by Safalaoh (2002) and Farrell (2000); but this system may predispose the birds to direct parasitic infection such as coccidiosis, for,
coccidiosis may strike any type of poultry in any type of facility (McDougald, 2003). In addition Kusina et al. (1999) indicated through a survey on village chicken losses in Zimbabwe that aside from predators and New Castle Disease, coccidiosis, directly or indirectly, represents an important cause of chick mortality during the first three weeks of age.

The use of conventional medicine and vaccine in coccidiosis control constitutes one of the costliest expenses in commercial poultry production. McDougald, (2003) reported that the current expense for preventive medication exceeds $90 million in the United States and more than $300 million worldwide. Moreover, the side effect of the routinely use of anti-coccidial drug (Youn et al. 2001) unavoidably left room for alternative coccidiosis control.

In many tropical and subtropical countries, numerous traditional medicinal plants have been used for centuries (Perri, 1980). According to Lal et al (1976), preparation of Carica papaya, Momordica charantia, and Sapidus trifoliatus have been found effective in vitro against poultry Ascandia galli. In Senegal, farmers have traditionally used such plants to treat their chickens against endoparasites, for example, Capsicum sp. extracts and the leaves or barks of Azadirachta indica are added to drinking water and given to birds. In Cameroon, Agbédé et al. (1995) reported good results from the use of plants such as Kalanchoe crenata for coccidiosis, and papaw (Carica papaya) leaves for diarrhea, while the use of human medicines (especially antibiotics, Ampicillin, Tifomycin) achieved no success.

The objective of the present study was

- To determine the comparative efficacy of three medicinal plants for control of coccidiosis
- To determine the comparative efficacy of three medicinal plants on broiler performance.
Description of the three experimental medicinal plants

1. *Psidium guajava*

Family: Myrtaceae

**Common names**

Bengali: goaachhi, peyara, piyara

English: common guava, guava

Hindi: amrud, goaachhi, safed safari

**Botanic description**

*Psidium guajava* is a large dicotyledonous shrub, or small evergreen tree, generally 3-10 m high, many branches; stems crooked, bark light to reddish brown, thin, smooth, continuously flaking; root system generally superficial and very extensive, frequently extending well beyond the canopy, there are some deep roots but no distinct taproot. Leaves opposite, simple; stipules absent, petiole short, 3-10 mm long. Calyx splitting irregularly into 2-4 lobes, whitish and sparsely hairy within; petals 4-5, white, linear-ovate, 2 cm long, delicate; stamens numerous, filaments pale white, about 12 mm long, erect or spreading, anther straw coloured, ovary inferior, ovules numerous, style about 10 cm long, stigma green, capitate. Fruit an ovoid or pear-shaped berry, 4-12 cm long, weighing up to 500 g; skin yellow when ripe. The exterior of the fruit is fleshy, and the centre consists of a seedy pulp.

**Geographic distribution**

Native: Colombia, Mexico, Peru, United States of America

Exotic: Australia, Bangladesh, Brunei, Cambodia, Cameroon, China, Costa Rica, Cote d'Ivoire, Cuba, Dominican Republic, Ecuador, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Greece, Guyana, Haiti, India, Indonesia, Israel, Kenya, Laos, Malawi, Malaysia, Myanmar, Nigeria, Pakistan, Panama, Philippines, Puerto Rico, Samoa, Senegal, South Africa, Sri Lanka, Sudan, Tanzania, Thailand, Togo, Uganda, Venezuela, Vietnam.
**Medical importance**

All parts of the young fruit are astringent. Guava exhibits antibacterial action against intestinal pathogens such as *Staphylococcus*. The dried ripe fruits are recommended as a remedy for dysentery, while the leaves and fruits are used as a cure for diarrhoea.

Oil contains bisabolene and flavinoides that exhibit anti-inflammatory properties. A decoction of the leaves or bark is taken externally as a lotion for skin complaints, ringworm, wounds, and ulcers.

The leaves of the guava tree in decoction are recommended for gastrointestinal, uterine hemorrhage, chronic diarrhea, swollen legs, etc. The young leaves and shoots are used for dysentery, inflammation of the kidney, and diarrhea. The same decoction is good as a wash for ulcers, vaginal and uterine problems, and where an astringent remedy is needed. It heals wounds and cuts. It has been used for spasms, fevers, worms, kidney problems, epilepsy, and diabetes and even for cerebral infections.

2. *Murraya koenigii*

Family: Rutaceae

**Common names**

Bengali: Barsanga, Kanphulli

English: Indian Curry Leaf Tree

Hindi: Kathnim, Mitha neem, Curry or kurry patta, Gandhela, Bareanga

**Botanic description**

These are large shrubs or small evergreen or deciduous trees with a short trunk, thin smooth, grey or brown bark and a dense shady crown. Most parts of the plant are covered with fine down and have a strong peculiar smell. Leaves pinnately compound, fifteen to thirty cm long, arranged spirally crowded on the ends of branchlets, rachis terete, pubescent, petioles 1.2 to 1.5 cm long; leaflets eleven to twenty-five, alternate on rachis, ovate-lanceolate with an oblique base,
margins irregularly crenate, pubescent beneath, petiolules two to three mm long
Flowers white, numerous in broad terminal clusters. Fruits (berries) ovoid to
subglobose, wrinkled or rough with glands, to 2.5 cm long and 0.8 cm in
diameter, purplish-black when ripe; two seeded.

**Origin and Distribution**
Curry leaf is found almost throughout India up to an altitude of 1500 mtrs. It is
much cultivated for its aromatic leaves.

**Medical importance**
The leaves, bark and root of the plant are used in the indigenous medicine as a
tonic, stimulant, carminative and stomachic. Stimulates the cardiovascular
system and on the nictating membrane (root); hypoglycemic, Hair tonic (leaf),
alleviates spasms (aerial part), antiprotozoal (root and aerial part).

3. *Syzygium cumini*
Family: Myrtaceae

**Common names**
Bengali: Kalajam
English: Black plum or Java plum
Hindi: Jamun

**Botanic description**
These are large glabrous evergreen trees with ash-brown smooth bark
Their leaves are oblong or elliptic-oblong, ten to fifteen cm long, acute or
acuminate, shining, with numerous, close spreading secondary nerves and
intermediate nearly as strong. Flowers are pale green white, sessile, mostly in
threes in trichotomous panicles with terete branches, Hypanthium turbinate,
petals calyptrate. Fruits are berries which are ellipsoid or oblong and often
curved. Seeds are nearly always solitary with thick, rounded, fleshy cotyledons.
**Origin and Distribution**

Java plum is native to India and Burma, but has naturalized throughout Southeast Asia and the Pacific Islands.

**Medical importance**

Myrtaceae is a plant family widely used in folk medicine in different countries and *Eugenia* and *Syzygium* are among its most important genera. Species of this family are often used for several medicinal purposes, including the treatment of diarrhea (Caceres et al. 1993) and pain. Experimental data also suggest the action of these species on inflammatory processes, respiratory diseases (Muruganandan et al. 2001), and allergic disorders (Kim et al. 1998). The seeds of *Syzygium cumini* (L.) Skeels (SC, Myrtacea, syn. *Eugenia jambolana* Lamk) have been reported to be useful as astringents in diarrhea as well as dysentery (Chopra et al., 1958). Other parts of the plant have been reported to possess anti-diabetic (Chakraborty et al., 1986), bactericidal (Prince et al., 2004) and anti-mutagenic (Matsuo et al., 1994) properties. The ethanolic bark extract has been reported to have anti-inflammatory activity in carrageenan and formaldehyde paw edema (Muruganandan et al., 2001). The same extract was also shown to inhibit histamine-, serotonin (5 HT) - and prostaglandin 2-induced paw edema. (Muruganandan et al., 2002).
Figure 15: Three experimental medicinal plants

Psidium guajava

Murraya koenigii

Syzygium cumini

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Experimental animals

Twenty five one-day-old coccidia-free Rhode Island Red chicken (45 ± 3.5 gm) were collected from a local hatchery, reared for one week in standard poultry cages for acclimatization, providing proper environmental conditions (stress free) and given non-medicated feed and water. During the first week the chicken were kept together and brooder lamps were supplied for all chickens. After one week of rearing, the birds were randomly distributed into five equal groups of five birds and housed in separate wire suspended cages (2.5 sq ft) equipped with all suitable facilities.

Study design and duration

After one week, the chickens were randomly divided into five groups (five treatments) under a completely randomised design (Steel and Torrie, 1981) The chickens were managed under the same conditions with the same bedding as that used by farmers. This should give the same coccidiosis pressure as on other farms However, to assure that the chicken were heavily infected; coccidia were collected from a flock of domestic chicken where coccidiosis was diagnosed by a veterinarian. The bedding of these chickens with faeces from seven days were collected and used as inoculum The study was designed as a factorial design with anticoccidials and oocysts doses as group factors The duration of the experiment was two months with three replications.

Eimeria tenella

Eimeria tenella infective oocysts (three thousand oocysts doses in 2.5% potassium dichromate solution) were isolated from the faeces collected from a flock of domestic chicken where coccidiosis was diagnosed by a veterinarian
Chicken in three cages were orally challenged with three thousand *E. tenella* oocysts doses on day twenty-one.

**Experimental feed and feeding procedure**

All chicken were fed *ad libitum* with a basal diet of formulated feed divided in two phases: starter phase (0-3 weeks) and the finisher phase (4-6 weeks) (Table X). Fresh leaves of *Murraya koenigii*, *Psidium guajava* and *Syzygium cumini* were collected from a garden, washed under running tap water, air dried, homogenized to fine powder. Each leaf powder was mixed with conventional feed at the rate of fifteen percent. Fresh leaves were collected and dried in rooms. The exposure to the sun was avoided in order to ensure the leaf chemical constituents conservation.

**Table X: Feed composition of broiler feed in the experiment**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Starter phase</th>
<th>Finisher phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice grain, polish &amp; broken</td>
<td>45.50</td>
<td>46.65</td>
</tr>
<tr>
<td>Rice bran</td>
<td>10.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>33.00</td>
<td>27.00</td>
</tr>
<tr>
<td>Fish meal</td>
<td>6.00</td>
<td>6.00</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Shell meal</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>Palm oil</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Normal salt</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Vitamin-mineral mix(Premix)</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Methionine</td>
<td>0.25</td>
<td>0.10</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

**Treatment**

Of the five groups, three groups were reared with feed mixed with *Murraya koenigii*, *Psidium guajava* and *Syzygium cumini* (treatments known as MK, PG and SC) and among remaining two groups one was reared with conventional feed and treated with a coccidiostat (Sulfamethazine) in drinking water (CS) and another was employed as control (C) which received only conventional feed from seven days of age.
**Data collection**

The body weight gain, the cumulative feed intake, the feed conversion ratio, the survival rate, the number of animals with bloody diarrhea, and the lesion score were investigated during the four weeks following the *E. tenella* experimental infection. Feces were collected and the oocyst excretion was daily monitored during the fourteen days patent period.

**Body weight gain**

The initial body weight of experimental animals was recorded per group. Weight of all birds was measured weekly at 10.00 am before feeding after which body weight gain for each replication were calculated per week as follows:

\[
\text{Body weight gain} = \frac{\text{Final group weight (g)} - \text{Initial weight (g)}}{\text{Total number of birds}}
\]

**Feed conversion ratio (FCR)**

Feed consumption of each group of broiler was measured every week. Feed conversion ratios were determined weekly to evaluate effect of diets:

\[
\text{FCR} = \frac{\text{Final weight (g)} - \text{Initial weight (g)}}{\text{Feed consumed (g)}}
\]

**Mortality rate**

Death of broilers was recorded throughout the experiment. Mortality rate per week was calculated as:

\[
\text{Mortality (\%)} = \frac{\text{Total number of dead birds}}{\text{Initial number of birds}} \times 100
\]
**Laboratory examination**

**Lesion scoring in intestinal tract**

After all chickens were slaughtered at six weeks of age, six broilers from each treatment (two per replication) were sampled randomly for lesions scoring. The lesions and infections of the intestines were given scores from zero to four, (Johnson and Reid, 1970). A lesion score was assigned from zero to four, where zero corresponds to the normal status with no gross lesions, one to small scattered patches, two to numerous patches, three to extensive haemorrhage, and four to extensive haemorrhage that gives a dark colour to the caecal intestine. Dead birds were given the score of four.

**Determination of level of bloody diarrhoea**

Bloody diarrhoea of each bird was determined according to Youn and Noh (2001) by assigning it one of the five levels, where the zero level is the normal status, one corresponds to less than twenty five percent, two to twenty-six to fifty percent, three to fifty-one to seventy-five percent, and four to over seventy five percent bloody faeces in total faeces over each twenty-four hours. Bloody diarrhea was determined daily from day nineteen to day twenty one of age.

**OPG calculation**

Fecal samples were taken to count the oocysts using the Mc Master technique (Permin and Hansen, 1998). The number of oocysts counted from the McMaster chamber multiplied by two hundred gave the OPG. This number of oocysts is the mean of the oocysts found in the cells in the Mc-Master Chamber.
Results

Coccidia were found in faeces of broiler chickens in all cages one week after infection. Some birds looked ill, the appetite was lowered, the birds sat still instead of moving around and some birds developed hemorrhagic diarrhea.

Oocyst count

The mean count of oocyst (0 - 47 x 10^5 OPG) shows significant difference (ANOVA, $P < 0.05$) in all treatments. Treatment dependent mean count of oocyst exhibited a following order of variation: CS<MK<PG<SC (Table XI).

Growth and survivability

The average weight of bird ranged from eighty-five to two hundred and sixty three grams in all treatments (Table XI). A significant treatment dependent growth response was observed (ANOVA, $P < 0.05$). Though there was no marked difference in the average weight of C and SC but CS, MK and PG showed higher growth responses of following order: CS>MK>PG (Table XI). The daily growth rates gradually increased with time. Survivability of birds was eighty four percent, seventy two percent, sixty four percent and sixty one percent in CS, MK, PG and SC, respectively (Table XI).

Feed consumption rate

Feed consumption rate varied from 15 to 50 gm per day per bird in different treatments of bird. There was no marked difference in the feed consumption rate of C and SC but CS, MK and PG showed remarkably higher rate of feed consumption rate (ANOVA, $P < 0.05$) than that of the rest two treatments and showed order of variation as follows: CS>MK>PG (Table XI). On a temporal scale, feed consumption rate is gradually increased.
Feed conversion ratio

The values of feed conversion ratio ranged from 0.156 to 0.458 in all treatments. There was a marked difference in the mean values of feed conversion ratio of all treatments (ANOVA, \( P < 0.05 \)) (Table XI). The maximum value 0.453 was observed in CS treated group.

Caecal lesions and bloody diarrhea

There was a significance difference in the caecal lesion score of different treatments. The caecal lesion score was one in the birds of MK and PG treatment groups but SC and control (C) groups showed four score of caecal lesion. No caecal lesion was observed in CS treated group (Table XI). Bloody diarrhea was observed from sixth day of inoculation with \( E. \) tenella in all treatment groups. Though there was no bloody diarrhea in CS, but level one of bloody diarrhea was found in the MK and PG groups, whereas remaining groups (SC and C) exhibited an intensity at level four (Table XI).
Table XI: Mean (± S.E.) values of oocyst count, growth, survival, feed consumption rate, feed conversion index, caecal lesion score and bloody diarrhea level of chicken infected with *Eimeria tenella* in response to different treatments employed

<table>
<thead>
<tr>
<th>Parameter</th>
<th>C</th>
<th>CS</th>
<th>MK</th>
<th>PG</th>
<th>SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oocyst count (x 10^5 OPG)</td>
<td>43±4</td>
<td>0</td>
<td>20±1</td>
<td>28±2 2</td>
<td>45±2.5</td>
</tr>
<tr>
<td>Growth (g)</td>
<td>90±5.2</td>
<td>250±10</td>
<td>193±6</td>
<td>160±5</td>
<td>96±4 5</td>
</tr>
<tr>
<td>Survivability (%)</td>
<td>59±1 6</td>
<td>84±2.8</td>
<td>72±1.5</td>
<td>64±1.3</td>
<td>61±2</td>
</tr>
<tr>
<td>Feed consumption rate (g d⁻¹bird⁻¹)</td>
<td>19±3</td>
<td>43±0.5</td>
<td>37±1</td>
<td>28±2</td>
<td>17±2.1</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td>0.161±0 03</td>
<td>0.453±0.04</td>
<td>0.391±0 05</td>
<td>0.282±0.06</td>
<td>0.182±0 032</td>
</tr>
<tr>
<td>Caecal lesions (Score)</td>
<td>4±0.1</td>
<td>0</td>
<td>1±0.05</td>
<td>1±0.02</td>
<td>4±0.011</td>
</tr>
<tr>
<td>Bloody diarrhoea (Level)</td>
<td>4±0.08</td>
<td>0</td>
<td>1±0.03</td>
<td>1±0.01</td>
<td>4±0.06</td>
</tr>
</tbody>
</table>
Conclusion

In the present study, mean growth of the birds were one ninety three, one hundred and sixty and ninety and six grams in the treatment of Murraya koenigii, Psidium guajava and Syzygium cumini, respectively whereas coccidiostat exhibited maximum growth. It clearly revealed that Murraya koenigii pronounced higher (twenty to one hundred one percent) growth response than that of rest three treatments groups of plant leaf. The survival of Psidium guajava (sixty four percent), Murraya koenigii (seventy two percent) and Syzygium cumini (sixty one percent) treated chicks were statistically similar; but significantly lower than the coccidiostatic group survival (eighty four percent) and higher than survival of the control group (fifty-nine percent). Murraya koenigii reduced the infected untreated control OPG down to fifty-three percent and Psidium guajava, down to thirty-five percent. Syzygium cumini treatment did not show significant decrease in the OPG count. Relationship between occurrence of oocyst and body weight in different treatments also indicated that the body weight was declined with increasing number of oocyst (Figure 16). Tandon et al. (1977) and Wright (1980) proposed that some intestinal parasitoses, viz. coccidiosis, are accompanied by a malabsorption syndrome which leads to loss of body weight. In another study by Bandyopadhyay et al. 2008, four fruits, Aegle marmelos, Syzygium cumini, Punica granatum and Carica papaya, were selected to investigate the effect of their extracts on the performance of Rhode Island Red poultry chicks experimentally infected with Eimeria tenella and was found that there was a response of Punica granatum and Carica papaya fruits extract to reduce the severity of infection to chickens by exerting a coccidiostatic effect against E. tenella.

So, it is obvious that leaf of Murraya koenigii exerted inhibitory effects on E. tenella which significantly improved body weight gain and feed conversion ratio compared to the rest of the treatment groups. Reduced values of body
weight gain, survival, feed intake, feed conversion index, caecal lesions and bloody diarrhea were apparent in *Psidium guajava* and *Syzygium cumini* treated groups than that of the *Murraya koenigii* treatment group, which may be implied that the feed with *Murraya koenigii* leaves as feed additive, showed comparatively higher inhibitory effects on *E. tenella* than the rest two groups of treatment.

Therefore, on the basis of these results, *Murraya koenigii* leaves have shown a positive effect on OPG reduction compared to the *Syzygium cumini* and *Psidium guajava* leaves. Their action might be ascribed to the bitterness or toxicity. Some researches need to be carried out to precise the oocyst reduction mechanism in the ceaca as well as the acceptable incorporation level of dry leaves powder.

\[
y = -30286x^2 + 17391x - 308 \\
R^2 = 0.7406
\]

\[
y = 7.7143x^2 - 43.086x + 71.6 \\
R^2 = 0.6885
\]

**Figure 16:** Relationship between oocyst count and body weight in different treatments