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Performance of Goats Fed on Graded Levels of Syringa (Melia Azedarach) Based Pellets Fattening Diets

Passmore Temba Mudhanganyi*, Irvine Denis Tapera Mpofu, James Madzimure

Department of Animal Production and Technology, Chinhoyi University of Technology, Chinhoyi, Zimbabwe

Email address:

pmudhanganyi@gmail.com (P. T. Mudhanganyi), impofu66@yahoo.com (I. D. T. Mpofu), jmadzimure@gmail.com (J. Madzimure)
*Corresponding author

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Abstract: Melia azedarach, commonly known as Syringa is a potential forage tree that has a relatively high crude protein and mostly used in feeding ruminant animals. Twelve Small East African goats were used in this experiment in a completely randomised design. Each goat was randomly allotted to four different treatments. This was done to evaluate the effects of graded levels of Melia azedarach-based pellets on feed intake, daily weight gain, feed conversion ratio and nematode egg count per gram during feeding for 56 days at Chinhoyi University of Technology farm. Feed formulation was done using I. D. T Try and Error Iteration software. Air dried Syringa leaves were used to produce four iso-nitrogenous and iso-energetic treatment diets with 0%, 5%, 10% and 15% *M. azedarach* in pellet form. Each treatment had 3 goats and each goat was a replicate. Increase in the inclusion level of had a negative effect on feed intake *(P<0.05)*. Feed conversion ratio and average daily weight gain had no significant differences across all treatments. Increase in *M. azedarach* reduced egg count per gram of nematodes. At 15% the nematode egg count per gram decreases significantly when compared with other treatments *(P<0.05)*. Egg count per gram was highest in 0% *M. azedarach* diet showing the inability of soya-based pellets to act as anthelmentic in goats. The present study indicates the beneficial anthelmentic action of the leaves of the *M. azedarach* tree on gastrointestinal nematodes in goats. This makes *M. azedarach* a candidate for the natural control of nematodiasis.

Keywords: Melia Azedarach, Nematodiasis, Anthelmentic

1. Introduction

Goat production in Zimbabwe occurs in two categories: that is subsistence farming and commercial production [1]. About 98 percent of goats in Zimbabwe are indigenous breeds and owned by smallholder farmers [2, 3]. Most of them are kept in the drier agro-ecological zones that are Natural Ecological Regions IV and V which experience rainfall as low as 600mm per year with periodic droughts and extended dry spells. Overall, the importance of goats increases as the rainfall amount decreases due to their unique ability to survive and maintain reasonable production performance even in adverse climatic conditions [4]. Seasonal variations play a potential role in the nutrient composition of common browse [5]. During the rainy season, the nutritional composition of browse improves and so as availability. Goat production is limited by seasonality of feed availability as well as the presence of gastrointestinal parasites [6]. The presence of nematodes in the intestines reduces the feed conversion efficiency of goats [7]. The synthetic commercial drugs used to control parasites are expensive; and out of reach for many resource-poor farmers, especially the small-holder farmers [7-9]. The use of synthetic dewormers in organic farming is negatively affected by heavy loads of nematodes and anthelmentic resistance [10]. This creates a need for low cost and locally available feed ingredients with anthelmintic properties. One such plant is Melia azedarach, commonly known as Syringa. Syringa is an evergreen plant, fast growing in popularity in Southern Africa, where it has been declared invasive in countries like South Africa. *M. azedarach* can form dense foliage and extensive clonal stands in very short periods, thus preventing the entry of native woody species [11]. The speed and effectiveness of the invasive process achieved by *M. azedarach* are strongly influenced by the abundance and the variety of disseminators that feed on its fleshy drupes, i.e. small mammals for short distances, or birds and bats for longer distances [11]. Despite being a nuisance in forests and farmlands, Syringa has potential feeding and anthelmintic value, owing to its nutritional composition and ethnoveterinary properties. The crude protein of Syringa ranges from 15-29DM% [12]. Plants rich in condensed tannin seeded in pastures reduced shedding of eggs by goats [8]. Therefore, the use of Syringa foliage as an alternative feed can work as a control method of the invasive plant. This study aimed at finding the effects of different inclusion levels of Syringa leaves based pellets on gastrointernal nematodes and fattening of goats. Commercial fattening meals are beyond the reach of farmers [13] and Syringa based pellets provides a cheaper alternative since it is a local feed resource.

2. Materials and Methods

2.1. Research Site

The study was carried out at Chinhoyi University of Technology Farm, goat unit. The farm is situated in Chinhoyi, Makonde District, Mashonaland West Province in central northern Zimbabwe its geographical coordinates are 17° 21' 0.00"s, 30° 12' 0.00"e (latitude: 17.3500; longitude: 30.2000). Most of the laboratory work was done at Chinhoyi University of Technology's Animal Production and Technology Nutrition laboratory.

2.2. Syringa Processing, Diet Formulation and Goat Pellets Preparation

Syringa was harvested from the trees at the Chinhoyi University farm and air dried to avoid bleaching and loss of nutrients. Milling was done using a hammer mill (Lyluodate SFSP56 series capacity 2 tonnes per hour; Power 37kw). A sample was taken for proximate analysis at Aglabs in Harare. Feed formulation was done using the IDT Trial and Error (Iteration) Software to produce four iso-nitrogenous and iso-energetic diets at 0%, 5%, 10% and 15% inclusion levels of Syringa meal. Soya meal based (0% Syringa inclusion) was used as a positive control diet as represented in *Table 1*. The nutritional composition of the formulated goat pellets is represented in *Table 2*. Fattening meal rations were formulated and the results validated by way of proximate analysis.

Table 1. *Inclusion levels of feed ingredients in goat pellets.*

Ration	0% Syringa	5% Syringa	10% Syringa	15% Syringa
Syringa	0	5	10	15
Soya meal	10.62	10.8	9.9	9.7
Wheat bran	34.2	25.25	46	20.2
Lucerne	20	20	20	20
Molasses	5	4.2	4.45	4
Wheat straw	28.18	30	28.4	29.1
Mono-calcium phosphate	0.5	0.5	0.5	0.5
Rock salt	0.5	0.5	0.5	0.5
Vitamin mineral premix	0.5	0.5	0.5	0.5
Limestone flour	0.5	0.5	0.5	0.5

Table 2. *Nutritional Composition of the Formulated Goat Pellets.*

Treatment	DM%	CP%	EE%	CF%	M. E/ KG DM
0% Syringa	90.74	16.00	2.03	31.2	8.24
5%Syringa	87.74	16.03	2.16	35.8	8.26
10%Syringa	85.01	16.05	2.41	40.7	8.23
15%Syringa	82.10	16.10	2.58	45.04	8.23

DM- dry matter percentage, CP- Crude protein, EE-ether extracts, CF -crude fibre, ME- Metabolizable energy per kg dry matter.

Feed ingredients for each treatment were weighed using a digital scale and thoroughly mixed in a concrete mixer so as to achieve a uniform mix. Feed ingredients were conditioned at 17% moisture content to facilitate pelleting. Pellets were produced for each treatment using a 7.5 KW (10 Horse Power- Rotex Master /YSKS-200) pelleting machine with 5mm die size.

2.3. Experimental Design

12 female Small East African goats from a population of 72 goats with an average body weight of 23.1 kg were randomly allocated to four treatments in a completely randomised design. Each treatment was replicated thrice.

2.4. Animal Management

The housing pens were disinfected 2 weeks before the animals were brought in. Goats were tagged for identification and housed in well-ventilated pens. They were left for two weeks to adapt to the housing conditions and experimental diets. The goats were fattened for 56 days and received equal treatment during the trial period including feeding times and handling. Each goat received 1kg of pellets daily. Clean water was supplied at all times in plastic drinkers.

2.5. Data Collection

The weight of animals was measured using an animal weighing belt. The initial live weight of each goat was taken at the beginning of the experiment. Thereafter, goats were weighed weekly and results were recorded. The weight of feed offered and feed left was weighed using a digital scale. The feed intake (FI) was calculated as follows:

FI=Feed offered – feed left

Average Daily Body weight gain was calculated from the data as follows:

BWG=(Final weight – initial weight)/56 days

The feed conversion ratio (FCR) was calculated as follows:

$$FCR = Total\ Feed\ consumed\ (kg) \div average\ weight\ gain\ (kg)$$

FCR=Total feed (kg) consumed by goats in 56 days

Average weight gain (kg) of goats over 56 days

The initial egg count per gram was recorded at the beginning of the experiment before Syringa based pellets were offered to the goats. Thereafter the egg count per gram was done weekly. Data on Egg Count per Gram (EPG) was collected from fresh faeces of goats. Collection was done using plastic gloves and sealed tightly to avoid external contamination. The samples were examined in the Animal Production Laboratory using a light microscope. MC Master Technique [14] was used. Two grams of faeces was weighed using a digital scale and placed in a 50 ml beaker and 28ml of floated solution was also added. The contents of the beaker were thoroughly stirred. Then, the faecal suspension was filtered through a double layer of cheesecloth into the second container. The filtrate was stirred with a Pasteur pipette. A sub-sample was withdrawn with the same pipette and the filtrate was stirred. The first compartment of the MC Master chamber was filled with the sub-sample. The fluid was stirred again and the second chamber was filled. The chamber was allowed to stand for five minutes to allow the eggs to float to the surface and debris to go to the bottom. The samples were examined under light microscope magnification of X10. The eggs were identified and counted within the engraved area of both chambers. Using the formula below

ECG=(Eggs seen on chamber 1 + eggs seen on chamber 2) X 50

2.6. Statistical Analysis

Analysis of variance was done using Generalised Linear Model (GLM) procedure using the Statistical Analysis Software (SAS, 2006), at 5% significance level. When significant differences were detected, means were tested by Turkey HSD range test at 5% significance level. The results were expressed as means. The statistical significance of the effect of the Syringa levels on the feed intake, feed conversion ratio, average daily weight gain and egg count per gram, analysis of variance (ANOVA) was done to evaluate the differences among treatments means and standard errors of means.

3. Results

The proximate composition of the experimental diets, *M. azedarach* leaf meal used in this study is presented in *Table* 3. The analysis shown in *Table* 3 revealed the presence of dry matter, crude protein, crude fibre, ether extract, and ash. Proximate analysis of *M. azedarach* leaf meal revealed the presence of dry matter (93.4%) crude protein (19.3%), crude fibre (10.98%), ether extract (1.85), ash (12.8%), calcium (3.79%), phosphorous (0.36%), and sodium chloride (less than 0.10%).

Table 3. *The proximate composition for M. azedarach leaf meal.*

	DM	CP%	CF%	NDF%	Fat%	Ash%	Ca%	P%	*NCl*%
Syringa	93.4	19.3	10.98	29.63	1.85	12.8	3.79	0.36	<0.10

DM- Dry Matter, CP- Crude Protein, NDF- Neutral Detergent Fiber, Ca- Calcium, P- Phosphorus, *NCl*- Sodium Chloride.

Table 4. *The performance of goats fed graded levels of Syringa based pellets.*

Treatment	Voluntary feed intake (kg/day)	Feed conversion ratio	Average daily weight gain (ADG) (kg/day)	Egg Count per Gram (EPG)
0% Syringa	1.06±0.0 1[a]	10.18±1.81[a]	0.11±0.04[a]	2165.9±23.5[a]
5% Syringa	0.84±0. 01[bc]	5.56±1.81[b]	0.16±0.04[a]	1673.2±23.5[b]
10% Syringa	0.85±0.01[c]	4.99±1.81[b]	0.18±0.04[a]	1399.7±23.5[c]
15% Syringa	0.8±0.01[d]	5.00±1.81[b]	0.16±0.04[a]	1219.5±23.5[d]

[a, b, c, d] means on the same column with different superscripts are significantly different at p<0.05.

Table 4 shows the feed intake and body weight of Mashona doelings fed pellet diets containing *M. azedarach* leaf meal. The diet containing 15% Syringa had lowest voluntary feed intake (VFI) while the control diet (0% Syringa) had the highest VFI (*Table* 4). The 5% and 10% treatment diets had no significant difference in VFI (P>0.05). However, VFI means for 0% were significantly different with 5%, 10% and 15% treatment diets *(P<0.05)*. The VFI for the 5% treatment diet differed from that of control (0%) and 15% treatment diets *(P<0.05)*. The highest feed conversion ratio (FCR) was recorded in 0% treatment diet and was significantly different from the other treatment diets (*Table 4*). Treatment means for FCR had no significant difference across 5% 10%, and 15% treatment diets (p>0.05). Treatment means for average daily gain (ADG) had no significant difference across 0%, 5% and 10% and 15% treatment diets

(*Table 4*).

Egg count per gram mean (ECG) for goats under 15% Syringa treatment diet was lower than those of the other three treatment means *(P<0.05)*. ECG mean was highest under 0% treatment diet. ECG means were significantly different among all dietary treatments (*Table* 4). ECG mean was highest in 0% followed by 5%, 10% and 15% was the lowest.

4. Discussion

The observed high DM and relatively low CP and high fiber content of Melia azedarach leaves used in this research could be due to time of harvest April. These results were supported by Azim *et al*. [15] who reported that variations in Italian rye grass varied in dry matter yield from 18.8-75.5% mainly due to different harvesting time. The observed CP in *M. azedarach* leaves was similar to Bakshi and Wadhwa [12], who observed that Syringa leaves had 19.3% CP.

The highest voluntary feed intake in treatment with 0% Syringa level could be due to relatively less heat s*table* anti-nutritional factors in soya meal. This observation is supported by the findings of Peisker [16] who observed that heat s*table* anti-nutritional factors (ANFs) except for oligosaccharides and the antigenic factors are low in soybeans and not quite likely to cause problems under practical feeding conditions. The lowest voluntary feed intake recorded in 15% Syringa could be due to poor palatability of Syringa leaves, caused by the presence of ANFs (for example triterpenoids). Dry matter intake (DMI) is an important factor in the utilization of feed by ruminants and is a critical determinant of energy intake and performance [17]. The poor voluntary feed intake recorded in Syringa diet could also be attributed to a relatively increased fiber in the Syringa based diets compared to control diet. This was in line with Marini *et al* [18], an increase in NDF content of the diet such as found in this study, has a direct impact of increasing volume of gastrointestinal tract; while limiting consumption due to more time spend on fiber fermentation. These results were not in agreement with Ngo *et al*. [19] observed that total DM intake increased by 29% by raising the feeding level of Melia azedarach foliage from 0.9% to 2.1% of live weight (DM basis) with the foliage accounting for 77% of total DM intake at this higher level. Ngo *et al*. [19] observed that leaves of *M. azedarach* can comprise up to 70% of the diet of goats without causing toxicity. However, these authors also reported that there were no benefits on growth rate by increasing the level of *M. azedarach* from 25 to 70% of the diet.

The best feed conversion observed in treatment fed with 15% might be due to the decrease in internal parasites level as well as the condensed tannins in Syringa. This was in line with Sokerya and Preston [20], who reported the effect of condensed tannins in cassava on reduction of nematodes as well as improving feed conversion ratio of goats. Poor feed conversation ratio recorded in 0% Syringa based diet might be due to gastrointestinal parasites infection. This was in line with Cardia *et al*. [21] who observed that, sheep gastrointestinal tract infection caused severe reduction in daily weight gain and demonstrated awful feed conversion. The results were also supported by San *et al*. [22] who reported a low feed conversion ratio in old and young lamb groups naturally infected with nematodes. Shaw *et al*. [23] had similar results from grazing goats artificially and naturally infected with *H. contortus* while receiving a protein supplement. the animals did not show any signs of sickness and did not gain any significant weight.

The highest egg count per gram (EPG) in control diet (0% Syringa inclusion) was due to low doses of tannins and other compounds responsible for destruction of internal parasites. The observed lowest egg count per gram (EPG) recorded in 15% Syringa based diet could be due to anthelmentic activity of tannins in Syringa. Tannins are substances described as possessing anthelmentic activity. They can act through two mechanisms; connection to free proteins, thus reducing the availability of nutrients resulting in death by starvation or connection to the larval cuticle, rich in glycoprotein causing death. The last mechanism suggests that tannins in extracts may be the active ingredients on eggs and larvae of *H. Contortus* [24].

The observed results were in line with the in vivo anthelmentic activity which was demonstrated by Akhtar and Riffat [25] on *Ascaridiagalli* and by Falbo *et al*. [26], on sheep gastrointestinal nematodes. According to Squires *et al*. [27] the rumen may serve as a reservoir, showing the passage of anthelmentic product, thus prolonging the exposure of *H. contortus* to the active substances. On the other hand, Cala *et al*. [28] reported inefficiency of *M. azedarach* and suggested this may be due to the destruction of active substances by ruminal flora and other aspects such as ruminal pH. The observed better anthelmentic properties recorded in treatments with Syringa based pellets could be as a result of levels of condensed tannins in the feed. The observed results support the findings of Madibela and Kelemogile [29], though condensed tannins were not studied in the present study. The potency of Syringa leaves were also shown elsewhere. For example, the extracts from leaves, unripe fruits and bucks of Syringa have been announced to be insecticidal and fungicidal [30], and acaricidial [31, 32]. Therefore, these results are consistent with the general remedial effects of *M. azedarach*. The dose dependent fecal egg count reduction found in this research was in line with Cala *et al*. [28], Chandrawathani *et al*. [33], who reported a reduction in fecal egg count and worm burdens in animals fed with different inclusion levels of fresh neem. This agreed with the findings by Akkol *et al*. [34] where water extracts of leaves and fruits on larvae development showed a significant difference in the larvae recovery rate of nematodes among the treatments and both 50 and 100% water extracts of *M. azedarach* leaves reduced the development of larvae, suggesting in vitro anthelmentic activity. In a research done by Mlungisi [35], where he found out that the egg hatch inhibition (%) of the different plant extracts at varying concentrations (mg/mL) with distilled water as extraction medium showed that the at highest concentration the highest inhibition of egg hatching was observed. The results showed a dose dependent response, this could be due to increased tannin concentration therefore increasing the effect of active ingredients in the Syringa leaves.

5. Conclusion

Supplemental diets based on Melia azedarach leaves rich in nutrients and anti-parasitic properties can solve the problem of poor goat nutrition in African livestock farming systems especially during droughts and winter periods. *M. azedarach* is a declared invasive plant in some countries like South Africa (and not yet in Zimbabwe) and thus finding its value to manufacture livestock feed pellets will help control its spread and invasion of natural ecosystems and agricultural lands. Livestock feeds that are manufactured using cheap, locally and abundantly available natural resources will lead to a reduction in feed costs. Productivity of goats can be improved by supplements of protein, energy, and minerals that are produced using locally grown /available resources which are affordable for example Syringa based feed supplements in a form of pellets that can be fed from the ground. Goats can easily pick pellets from the ground due to their split mobile tongues. Syringa based pellets may increase the options of feeds available for farmers and probably increase the profitability of their goat enterprises.

6. Recommendations

Based on the fact that the 15% Syringa inclusion level had the lowest egg count per gram and was the highest inclusion level in this study it is recommended that more researches with high inclusion level needs to be done to determine the optimum level to use in goat feeds. It is recommended that Syringa leaves should be processed to increase the intake by reducing anti-nutritional factors like saponins which can be removed through soaking.

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