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Assessing the potential of Calotropis gigantea leaves as ruminant feed: Based on the nutrient content

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Abstract
This study was conducted to assess the acceptability of the leaves of *Calotropis gigantea* as feed for ruminants. Its acceptability is assessed by the nutrient content of the leaves, and discussed in comparison to other fodders that have been widely known and used in ruminants, either basal diet or supplementary feed. The study was undertaken in Tondo Village, Palu Valey, Sulawesi Tengah, Indonesia. Leaf samples were taken from three sampling sites, with three sampling plants as replicates. Each sample consists of all developed leaves of an entire sampling plant. All the collected samples were individually marked and dried under the sun to gain air-dry samples, then proceeded the procedure to lab analyses. The concerned nutrients are organic matter (OM), crude protein (CP), crude fiber (CF), fat/ether extract (EE), ash (total mineral), nitrogen-free extract (NFE), and two macro minerals (Ca & P), all on a percent of dry matter basis (% DM). Each nutrient parameter was statistically analysed by Analysis of Variance using the software of Satistix 10, and the mean value was obtained from sampling sites' comparison at 0.95 confidence level of the least significant differences (LSD). Results show there were some differences attributes between sites of collection, such as CP, CF, NFE, and the minerals. The mean values of each nutrient parameter (% DM) are as follows: OM, CP, EE, CF, NFE, ash, and the minerals calcium and phosphorus, which are recorded as 79.65; 23.43; 4.03; 10.47; 41.71; 20.35; 1.86, and 0.50, respectively, with the calcium to phosphorus ratio exhibiting a range from 7.59:1 to 2.80:1.The conclusions are: i) leaves of *C. gigantea* have potentially been used as a good fodder for ruminants; ii) Since NFE is not a result of lab analyses, It is only a subtraction of 100 DM with the sum of CP, EE, CF, and ash; therefore, it is needed to be determined in energy value, as well as on the potential digestible part of CF as a carbohydrate energy source for animals; and iii) individual minerals are necessarily to be identified to confirm the potential as a rich mineral source feed.

Keywords: Giant milkweed, fodder, proximate analyses, minerals, ruminant

Introduction

Plants have been revered by humans as a genetic resource since the beginning of civilization and have been preserved for many uses, such as feed, fiber, food, fuel, even ornamental, and in other ways since then. Nowadays, plants as fodder resources are increasingly more and more important to support ruminant farming livestock, due to many reasons. Some of the reasons are concerning the continuous increase in human population that is indeed followed by an increment in live supporting requirements that is facilitated by ruminants on one side. On the other side, however, supporting lands are continuously decreasing (Singh and Ghosh, 1993; Fischer *et al*. 2011; Tuan 2021; Brain *et al*. 2023; Ranjithkumar, 2025; FAO 2025) [13, 23, 24, 45, 53, 58]. The latest has maintained that between 2001 and 2023 the total cropland area per person decreased by about 20 percent, from 0.24 to 0.19 hectares per capita.

Diversification of plant resources to ensure the fulfillment of ruminant livestock needs requires various approaches. One among the ways is utilization of available plant genotypes in a particular environment which is potentially as feed source (Clements 1996; Tarsono *et al*. 2009; Amar *et al*. 2020; Amar *et al*. 2023; Chen *et al*. 2025) [16, 19, 56]. In addition, reducing pressure on increasingly scarce land resources is through the utilization of naturally available and adaptive plant genetic resources. Among the potentially genetic resources is a shrubby weed, also well-known as a medicinal plant, the giant milkweed *Calotropis gigantea* Linn (Kiew 2001; Carol *et al*. 2012; Divya and Singh 2021; Handoyo and Rahman. 2024) [15, 21, 29, 33].

The giant milkweed (*C. gigantea*) has a wide range of environmental adaptation and distribution. It has been used in many ways in human life, and has become a multipurpose plant. This study proposes its use as a fodder source. The reason for this is based on some reasons: i) it has a wide environmental adaptation, and evergreen means readily available at any time of the year; ii) It has been mentioned in some articles for its use as fodder; iii) As a shrub plant, it has deep taproot suggesting that it has the capacity to extract minerals from the deep soil layer, resulting in high mineral concentrations in its tissues (such as in leaves, etc.), and soil moisture for sustains growth into the dry season; iv) Traditionally, it has been known to be eaten by goats and used as fodder in some regions in Indonesia such as in Palu Central Sulawesi, and in Alue Naga Banda Aceh (Akhir and Tarman 2020) [6]; and v) it has been studied for its use in farm animals (Ginting 2000; Kumar *et al*. 2013; Ayemele *et al*. 2020; Fotsidie *et al*. 2023; Ayemele *et al*. 2024) [9, 10, 25, 27, 35].

This study is aimed to explore the giant milkweed (*C. gigantea*) as a fodder source in ruminant farms based on some of its nutritive chemical properties, compared and discussed along with common well-known fodder trees/shrubs.

Material and methods

Site and collection of leaf samples

Location of this reported study is in Kelurahan Tondo, subdistrict Mantikulore, Palu City (0.36º - 0.56º South latitude and 119.45º - 121.1º East longitude) at an average height of 0 -700 meters above the sea level (Sarapang, Rogi, & Hanny, 2019) [50], Central Sulawesi Province, of Indonesia. It has a tropical climate with daily air temperatures that are consistently warm, ranging from 23ºC to 32ºC throughout the year, and more or less 1000 mm rainfall annually, with high air humidity most of the year.

Tondo area was mostly covered by rangeland on sandy soils; and before the 1980s, this area was dominated by shrub land with sparse trees. Tondo area is covered by entisols soil that has a sandy texture, low in organic matter and water holding capacity (Thaha *et al.* 1996; Ramli *et al.* (2016) [44, 57]. This shrubland is dominated by shrubby species, such as: *Acacia* spp., *Calotropis* spp, *Jatropha gossypiifolia,* and *Leucaena leucocephala* (local leucaena). The well-known shrubby weed, giant milkweed (*Calotropis gigantea*) is stands out to sight, locally called 'roviga' (Indonesian: biduri or widuri), whose then used as one of cluster area name, Bumi Roviga, in the village. In addition to residential areas and various public facilities, much of Kelurahan Tondo area was used as a grazing area for local livestock during the day. Although much of the land has been converted into residential areas, offices, and various other facilities, however, much of the remaining land is still used by the community to graze their livestock, mainly cattle, goats, and sheep.

This study uses three (3) different positions for sample collections of *C. gigantea* leaves; they are: *Position-1* Kampung Vatutela (sub-village of Kelurahan Tondo); *Position-2* Tadulako University Campus & surroundings; and *Position-3* Tondo Bawah (the western part of Tondo village that is close to the sea). Table 1 shows the geographical position of the sites.

Table 1: The three sites of 'roviga' (*Calotropis gigantea*) leaves sample collections

Sites/positions		Located at
1	Kampung Vatutela	0.84º – 0.85 º S, 119.91º - 119.92ºE; at altitude range 194 -282 m above sea level
2	Tadulako University & surroundings	0.84º – 0.85 º S, 119.90º - 119.91º E; at altitude range 96 - 112 m above sea level
3	Tondo Bawah	0.82º – 0.85 º S, 119.88º - 119.89º E; at altitude range 10 - 54 m above sea level

Studied material is leaf of the roviga plant (milkweed; *Calotropis gigantean*). Leaf samples were collected from three (3) different plants at each of the sites mentioned above. All developed leaves (from the bottom to the tip), old remaining attached leaves to the open young leaves near the tip of each branch were taken for sample purposes. These samples of 3 plants are treated as replicates. Therefore, there were 9 samples from 3 collection sites with 3 replicate samples each.

Sample preparation and nutritive attributes

Each of the 9 collected samples was dried under the sun to achieve constant weight that suggested air-dry samples. This base is giant milkweed leaves that were offered by Prima Breed Farm, a local goat farm in Palu, to the kept livestock, while another goat keeper, Fachry offers this kind of fodder freshly. The air dry samples were then ground to pass a 1 mm sieve, and each mixed thoroughly every sub-sample taken for analysis as a homogenising representative of each sample. Dry matter was used as the base of each nutrient concentration of the studied fodder.

Considered nutrient contents are the crude protein, crude fiber, crude fat (*ether extract*), ash, nitrogen-free extract, and mineral calcium (Ca) and phosphor (P).

Nutritive and statistical analyses

Proximate analysis method (Weende's System) was applied to determine the crude protein, crude fiber, crude fat (*ether extract*), ash, and calculate the *nitrogen-free extract*. The content of calcium (Ca) was determined by atomic absorption spectrophotometry (AAS) method, and P was determined by the auto analyser (AA) method (Perkins, 1982; AOAC., 1995). The nutritive properties were determined in duplicates at the Feed Nutrition Laboratory of the Faculty of Animal Husbandry and Fishery, Tadulako University, while minerals (Ca and P) determination was undertaken at the Chemistry Lab., Faculty of Mathematics and Natural Sciences of the same University.

Data analysis was done by analysis of variance (ANOVA), using *Statistix 10 software*. This aimed to determine the effect of the site of sample collection, and further the mean of each of the fodder attributes at P=0.05 of '*the least significant differences*' (LSD).

Results

Nutrient components are presented and discussed in two groups, i.e., organic matter and proximate components; and Ash and macro minerals (Ca & P) as follows.

Organic matter and proximate components

Total organic matter is derived from the total proximate dry matter components, but ash (Table 2). This shows no difference in total organic matter contents among the 3 sites of sample origin. Similar trend is indicated by the fat (ether extract) concentrations. Three other components, however, have shown differences between sampling positions. The trends of differences are:

- Crude protein of leaves from the second sampling position (Tadulako University & surroundings) is lower than the first and the third, but the two do not differ significantly;
- Crude fiber from the second sampling position is again the lowest but has only differed significantly with those from the third position, and the sample from the first position has neither differ significantly to the third (the highest) nor to the second sampling position (the lowest) in fiber contents; and

Nitrogen-free extract has a similar trend to the fiber, but the highest to the lowest are leaves from second position followed by those from the first and from the third.

Table 2: Nutrient concentration of *C. gigantea* leaves obtained from Proximate Analyses

Nutritive attributes (% on DM bases	*C. gigantea* leaves			Overall mean	Other fodder* (Range, %)
	Position 1	Position 2	Position 3		
Organic matter (100% – Ash)	79.81 a	80.22 a	78.93 a	79.65	83.30 – 92.50
Crude protein (CP)	23.84 a	22.35 b	24.11 a	23.43	16.08 – 34,00
Fat/ether-extract (EE)	3.88 a	4.39 a	3.83 a	4.03	3.25 – 13.40
Crude fiber (CF)	10.48 ab	9.58 b	11.35 a	10.47	13.42 – 30.50
Nitrogen free Extract (NFN)	41.62 ab	43.89 a	39.63 b	41.71	36.36 – 46.62

Means in the same row for each site with different superscripts are significantly different (P<0.05).

*Based on a number of references (such as Osti *et al*. 2006; Azim *et al*. 2011; Haftay and Kebede 2014; Gaikwad *et al*. 2017; Zapata-Campos *et al*. 2020; Darma *et al*. 2023; see also Discussion) [11, 26, 28, 43, 62].

The slight differences indicated from these results, indeed, are the impact of many individuals and interacting agronomic and environmental factors. Further presentation in discussion would be based on each overall mean of the fodder nutrients, which are presented side by side with references from previous reports and/or publications (Table 2).

Ash and macro minerals (Ca & P)

Calcium and phosphor are considered the most prevalent macro minerals in the ruminant diet in the tropics. But in addition to those elements, ash as a component of the total mineral constituent is presented (Table 3), and will be discussed along with those 2 macro minerals. The effects of sampling position on mineral contents are similar to those of organic matter constituents, except for the total organic matter.

Table 3: Mineral Ca and P concentration (% on DM bases) of *C. gigantea* leaves, and other fodder

Nutritive attributes (% on DM bases	*C. gigantea* leaves			Overall mean	Other fodder* (Range, %)
	Position 1	Position 2	Position 3		
Ash (total minerals)	20.19 ab	19.78 b	21.07 a	20.35	8.00 – 14.80
Ca	1.72 b	2.20 a	1.67 b	1.86	1.16 – 2.56
P	0.48 b	0.79 a	0.22 c	0.50	0.15 – 0.60
Ca:P ratio	3.58: 1	2.80: 1	7.59: 1	4.65: 1	3.72: 1

Means in the same row for each site with different superscripts are significantly different (P<0.05)

*Based on a number of references (such as Osti *et al*. 2006; Azim *et al*. 2011; Abdullah *et al*. 2013; Gaikwad *et al*. 2017; Zapata-Campos *et al*. 2020; Darma *et al*. 2023; see also Discussion) [11, 26, 43, 62].

The trends can be differentiated as follows:

- Ash (total mineral content) of leaves from the third sampling position (Tadulako University & surroundings) is the highest followed in subsequent with those from the first and second positions;
- Calcium (Ca) is clearly higher in the leaves from the second position than the other two that have not differed among the latter; and
- Phosphor (P) has indicated significant differences among the samples from the 3 positions that leave from the second position subsequently followed by the first and the third.

The similarity has strengthened the suggestion that those who mostly rely on environmental responsibility, particularly edaphic factors including land topography and contour. Following discussion is going to be on the evaluation of *C. gigantea* leaves as ruminant feed based on the overall mean of each presented nutrient concentration above.

Discussion

Dry matter of the giant milkweed (*C. gigantea*) leaves consists of 79.65% organic matter and 20.35% ash (total mineral). This indicates quite low organic matter compared to many other browse (83.30% – 92.50%), but it contains high nutrients, particularly in crude protein and NFE (Table 2), and total mineral, as well as Ca and P (Table 3). High mineral content is indicated by its ash content average 20.35% that higher than 8.00% – 14.80% of references other browses fodder. These suggested that chemically, fodder leaves of this plant is potentially as a good fodder with high nutrient contents. However, it is suggested that determining each of the macro and micro elements would be a stronger evident, more meaningful and useful.

Addressing as potentially as a good high quality fodder is shown in Table 2, that its overall main chemical nutrient contents are comparable with some of the most common fodders from trees/shrubs well known a quality feed. Firstly, leaves of the giant milkweed possess high crude protein comparable to such as leguminous fodder of *Acacia* spp., *Calliandra calothyrsus*, *Gliricidia* spp., *Indigofera* spp., *Leucaena leucocephala*, and *Sesbania* spp. (Osti *et al.* 2006; Azim *et al*. 2011 [11, 43]; Fadiyimu *et al*. 2011; Jayanegara *et al*. 2011; Ogunbosoye and Babayemi, 2012; Ogunbosoye *et al*. 2015; Zapata-Campos, *et al*. 2020; Koura *et al*. 2021; Chisoro *et al*. 2025) [18, 22, 31, 34, 41, 42, 62]; non-leguminous fodder of *Artocarpus heterophyllus*, *Ceiba pentandra*, *Lannea grandis, Morinda citrifolia*, *Moringa oleifera*, and *Schleichera oleosa* (Amar and Muliati, 2007; Jayanegara *et al*. 2011; Haftay and Kebede, 2014; Ogunbosoye *et al.* 2015; Gaikwad *et al.* 2017; Koura *et al*. 2021; Mudau *et al*. 2021; Amad and Zentek, 2023; Chisoro *et al*. 2025) [2, 18, 26, 28, 31, 34, 37]. Feed crude protein content of close to 24% is suggested very high level (Broderick *et al*. 2009).

This study has confirmed that crude protein of *C. gigantea* leaves well satisfies ruminants need. It has been well documented that a minimum of 7.0% to 7.5% dietary crude protein is the general requirement for ruminants. Though, crude protein content of 12% to 19% CP of diet dry matter is generally recommended, but NRC (2000) [40] has listed varies between 6.0% – 13.2% among different body weight, physiological status and maturity of beef cattle; further it was indicated a range of 12.5% - 14.5% on dry matter basis for a stressed calf. Sampaio *et al*. (2009) [48] have maintained that level of 7% of crude protein on feed dry matter basis is required to facilitate the full capacity of rumen microorganisms in using low-quality diet. Feeds bearing crude protein less than 7% significantly impairs microbial activities in ruminants due to lack of nitrogen (N), as N serves as an essential substrate for microbial protein synthesis (Sampaio *et al*., 2009; Cammack *et al*. 2018; Dias *et al.* 2025) [14, 20, 48], which then optimize the ability of ruminants quality food (meat and milk) by converting fibrous low-quality feed (Ross *et al*., 2012) [46]. Recommended diets may range from 12% to 19% CP or more, depending on the animal's needs and the protein source's digestibility. Overall mean crude protein concentration of 23.43% (ranges 22.35 to 24.11) has potentially to fulfill the general recommended crude protein range of 12% – 19% of dry-matter diets in ruminants. *C. gigantea* can serves all of the in regard to the level of protein concentration in dry matter basis.

Protein and energy are urgent in animal growth and production. Therefore, nitrogen free extract (NFE) is the **second** discussion focus since it is calculated to estimate as highly digestible carbohydrates. It is suggested represents sugars, starches, and other water-soluble carbohydrates as major energy source for livestock that are easily and rapidly fermented by microbial in the rumen. However, it is considered inaccurate because is derived by difference so its concentration is highly dependent on the contents of other nutrient components i.e. CP, CF, EE, and ash. Therefore, any error value of these components will indeed be resulting in false NFE value. Nevertheless, more precise measures of carbohydrate need by ruminants (Hall 2001; Ma *et al*. 2015) are balancing non-fiber carbohydrates (NFC) and neutral detergent fiber (NDF); for instances; in small ruminants (Ma *et al.* 2015; Truong *et al*. 2025); and large ruminant (Huang *et al*. 2019; Villalba *et al*. 2021; Chen *et al*. 2022). Though percentage of NFE is an imprecise value, derived from subtraction of 100% dry matter with the sum of CP, CF, CF and Ash, it is a good indicator for feed readily energy (highly digestible carbohydrates). The overall mean NFE content 41.71% (ranges 39.63 - 43.89) of the studied fodder suggested a high level in comparison to many well known comventional fodder tree/shrub leaves. Nevertheless, NFE value is remain useful as estimated as source of readily available energy before having the latter approaches.

Thirdly, the leaves of *C. gigantea* have high in mineral concentration parameters (% of dry matter) with means (ranges) of ash, Ca, P, respectively, 20.35 (20.19 – 21.07), 1.86 (1.67 – 2.20), and 0.50 (0.22 – 0.79). Then, it indicates that means of Ca:P ratio is 3.72 : 1 (varied between the 3 sampling sites 2.78:1, 3.58:1 and 7.59:1), in other words it ranges 2.78:1 to 7.59:1. There is no doubt that this fodder has highly valuable mineral source to fulfill the needs of animals in common, but futher study however is necessary to determine individual element, macro- and micro-minerals, especially to a particular feeding purpose, such as; different types of animals, and physiological conditions/stages.

In respect to recommended Ca and P in ruminant diets, fodder leaves of this giant milkweed (roviga) have been indicated to satisfy the level of ruminant requirements. Recommended levels of Ca and P in ruminant vary according to, such as animal types, body weight, stages of production, and body weight. For instance, beef cattle require Ca and P, respectively, at minimum ranges (% of DM) that are 0.15 – 0.38% and 0.11 – 0.23% (NRC, 2000; Wright *et al*. 2010; Beef Cattle Nutrition Series 2018) [12, 40, 61]. In small ruminants, Vyas (2024) [60] has stated that 0.41 – 0.48% Ca should satisfy the animal need, and 0.40% P dietary level in sheep has been suggested as an optimal level (Zhao *et al*. 2025) [63]. All of these varied references fall in the ranges of Ca and P contents of the leaves in the current study. Further, Ca:P ratio 3.72 is highly acceptable for ruminants, as it falls in the common range between 1:1 to 7:1. Although this result has shown that the widest ratio (7.59:1) is fairly out of the range of the suggested ratio. Refer to Ca and P mineral requirements in ruminant range values based on various stages of production, and body weight, respectively, Ca 0.18 – 0.31 and P 0.18 – 0.27 (NRC. 2000; Beef Cattle Nutrition Series 2018) [12, 40] are well satisfied with this reported fodder. But, it would be good to note that commonly, a Ca:P ratio of 1:1 to 2:1 is recommended in ruminant diets and some studies have shown that ratio in the diet is not critical unless it is out of the range 7:1 to 1:1 (McDowell, 1992) [39]; Martz *et al.* 1999) [38]. Nevertheless, the high total mineral content requires further individual determination of minerals, since available data from the current study are only limited on Ca and P. In addition, Cherian (2019) [17] has suspected that high ash content may be due to contamination; therefore, it is recommended that figuring out each type of mineral could be more helpful and valuable.

The last discussion focuses on fat (EE, ether extract) and crude fiber (CF). Present study has indicated fair level fat content at the overall mean around 4% DM (ranges 3.83% to 4.39%). This level of nutrient content, though at the lower range, is in the range of most fodder trees/shrubs' fat content, 3.25 – 13.40 (Azim *et al*. 2011; Haftay and Kebede 2014; Zapata-Campos *et al*. 2020; Darma *et al*. 2023) [11, 28, 62]. For maximum performance, cows generally should not be fed diets with more than 7 percent of the DM as FA, and the economic return may be considerably less. Feeding higher concentrations of fat can result in reduced DMI (The eighth revised edition of the *Nutrient Requirements of Dairy Cattle,* 2012). In general, *diets with greater than 7 percent total dietary FAs are not recommended* (NRC, 2001). Drackley (2007) has suggested that total dietary fat ought not to surpass 7% of the DM, and generally will be satisfactory at 6% or less. So, it could be highlighted that leaves of *C. gigantea* shrubs contain fairly enough fat (EE), and obviously fall below the avoided high level at more than 7.0% fat in the diet.

Quite different from other nutrients, crude fiber (CF) in the present study showed an average (10.47) that is apparent below the range 13.42% – 27.60%, the common contents in other tree/shrub fodders (such as Azim *et al*. 2011; Gaikwad *et al*. 2017; Darma *et al*. 2023) [11, 26]. While the fiber content in the present study is obviously below the others, Ganovski and Ivanov (1982) stated that crude fibres should be in the range of 22% – 25% of the dry matter to gain best results from digestion.

Finally, a short general discussion about the plant of *Calotropis gigantea*, which is locally called '*roviga*', Indonesian named *biduri* or *widuri* (Sukardan *et al*. 2017; Widyatun 2023; Setyaningsih *et al.* 2024) [51]. It is a wide range of environmental adaptation, particularly enabling it to persis and spread in dry areas, arid and semiarid regions, sandy soils, and dry uncultivated land, with periodic dry periods (Carol *et al*. 2012; Kumar *et al*. 2013; Divya and Singh, 2021; Kumar and Devi 2024) [15, 21, 35, 36]. It is an evergreen shrub that persists in prolonged dry conditions suggesting as a good “fodder bank” for forage sources in the period of lack of available feed from other sources that are seasonally available. This may be one reason. It retains as an unconventional feed source and has limited usage as fodder only in very sparse locations. Publications on the use of the plant as fodder are also very rare, almost invisible. Three quoted published study reports here are Ginting (2000) [27], Ayemele *et al*. (2020) [9], and Ayemele *et al*. (2024) [10].

In addition to the study objective stated above, it is partly the way of proposing the use of *C. gigantea* as, particularly in the regions of harsh environment with seasonally lack feed available for livestock, such as Palu Valey in Sulawesi Tengah, Indonesia. This condition requires diversification of feed sources that are environmentally adapted and ensure feed retain availability. Similar conditions are well spread in many regions (Smith 1994; Jamala *et al*. 2013; Sannagoudar *et al*. 2023) [30, 49, 54], such as in the region of the current study, in Ghana (Avornyo *et al*. 2018) [8], in Ethiopia (Abraham *et al*. 2022) [1], in India (Sahoo and Gautam 2024) [47], and many other regions on different continents. It is imperative, therefore, that naturally available non-food plant genetic resources are valuable to be identified for potential uses as fodder, along with the needs for plant introduction where necessary.

Last but not least, there are however, ample studies which have shown that *C. gigantea* contains many secondary compounds that may be harmful to those who consume it, in addition to the various benefits of these compounds in other uses. Some recent publications give the proven, for example: Khasanah *et al*. (2021) [32], Singh and Veluri (2022) [52], Ayemele (2024) [10], Ullah and Wiedmer (2025). Therefore, its beneficial role in securing feed shortages and the safety of its consumers requires much further study and details of various sides such as concerns in agronomic aspects and traits of its use as a fodder source plant.

Conclusion

By the first sight, leaves of the giant milkweed (*Calotropis gigantea*) indicate its capacity as crude protein and mineral sources. In general, the present study shows the potential of the *C. gigantea* to be used as a fodder source based on its leaves’ nutrient contents. The leaves possess fairly organic matter that constitutes high contents of crude protein and minerals, i.e., ash (total minerals) and especially macro minerals Ca and P. It contains high energy due to NFE, but needs to be confirmed due to low CF (fiber carbohydrates), and NFE concentration is not a lab analysis result but gained from a calculation. Ca:P ratio indicates fairly good. Therefore, it is highly acceptable to maintain that leaves of *C. gigantea* are a valuable fodder for ruminants, though many studies are required to deeply understand the potential and limitations of its uses.

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