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Short Communication

Mineral and nutritional potential of *Clitoria ternatea* L. variants as forage

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Abstract

Mineral and nutritional analysis for seven variants of *Clitoria ternatea,* including single blue, single white, single light blue, single violet, double blue, double pink and double white, collected from Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Thiruvananthapuram was conducted in 2018. 'Light blue' variant contained highest protein (18.2 g) and considerable amounts of β-carotene (0.241 g), iron and phosphorus. The 'violet' variant possessed greatest amount of carbohydrate (7.1 g), and protein (14.1 g), and also good amounts of calcium, iron and phosphorus. The 'double white' variant also possessed high amount of carbohydrate (7.1g) and β-carotene (0.25 g), along with considerable amounts of protein, calcium and phosphorus. 'Double pink' was unique with highest content of β-carotene (0.45 g) and possessed high carbohydrate, and also calcium, iron and phosphorus. The relatively good growth performance of *C. ternatea* and the reasonable forage yield and quality, suggested that *C. ternatea* could be a good forage crop, and that four variants, *viz.,* 'light blue', 'violet', 'double white' and 'double pink' were nutritionally good in one way or the other.

Key words: Calcium, Iron, Phosphorus, Protein.

Clitoria ternatea L. is a perennial, tall, branched, slender climber. Leaves are typically imparipinnate with 5-7 leaflets. Flowers are showy, chasmogamous or infrequently cleistogamous. Calyx is infundibular, 10 veined, 5 lobed, and persistent in fruit. Corolla is papilionaceous, zygomorphic, standard enlarged, short clawed, pubescent; wings longer than keel, both long clawed. The stamens are free in all the 'double' forms and typically diadelphous in the zygomorphic ('single') variants. In all forms the ovary is 6-9 mm long, style geniculate; pods flattened, nearly straight, sharply beaked and hairy, seeds brown to black often mottled, compressed.

Clitoria ternatea L. comprises two varieties, *C. ternatea* var. *ternatea* and *C. ternatea* var. *pleniflora* Fantz, where the former is with typically zygomorphic flowers and the latter possesses uniform five petals. The present study included four variants of var. *ternatea*, termed as 'single blue' (*C. ternatea* var. *ternatea* f. *ternatea*), 'single light blue', single white' (*C. ternatea* var. *ternatea* f. *albiflora* (Vought) Fantz) and 'single violet'. The three variants of var. *pleniflora* included in the study were termed as 'double blue' (*C. ternatea* var. *pleniflora* f. *pleniflora*), 'double pink' and 'double white' (*C. ternatea* var. *pleniflora* f. *leucopetala* Fantz).

As a high quality protein rich legume *C. ternatea* is often referred as 'tropical alfalfa', a protein bank that can be grown at low cost (Cook et al., 2005). It is a much valued pasture legume used as hay and silage (Gomez and Kalamani, 2003). In Australia, *C. ternatea* is particularly valuable as

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protein-rich forage in very heavy and shallow soils (Cook et al., 2005). Up to eight cuts per year can be performed (at 45 days intervals) and the plant shows good recuperation after defoliation (Barro and Ribeiro, 1983). This legume is considered as one of the early producing and more productive forages in tropical regions. Animal production provides livelihood to a large number of people in the tropics; nearly one fifth of the world population are smallholder livestock keepers (McDermott et al., 2010), and hence the availability of the quality fodder is of prime importance.

In India *C. ternatea* is an under exploited forage crop. Livestock production is a major component of the economy of the country which accounts for 15 to 17 % of total Gross Domestic Product (GDP) and 35 to 49% of agricultural GDP (Consultants on Economic Development and Environmental Protection, 1999). Among the major livestock production constraints, feed shortage is the important one (Desta et al., 2000). To increase the availability of good quality feed, the promising forage legume, *C. ternatea* was analyzed in the present study conducted in 2018 for its nutritive content and potential as a forage crop.

The aerial portion (leaves, stem and flowers together) was collected from each of the seven variants grown at Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Thiruvananthapuram, chopped, shade dried and stored for mineral and nutritional analysis as per standard procedures.

Total fat was estimated by extraction with petroleum ether. The residue obtained showed negative results to the confirmatory test for fat, indicating its absence. Forage quality of a plant is an expression of its potential in livestock to produce meat, milk and other products through the utilization of available nutrients. The forage quality may be defined as the type and amount of digestible nutrients available to the animal per unit time (Barnes and Marten, 1979).

In 'single blue', percentage of carbohydrate was determined as 6.7 g and total protein content was 11.5 g. The quantities of β-carotene, calcium, iron and phosphorus were 0.0096 g, 0.2 g, 0.02 g and 0.2 g respectively (Table 1). In 'single light blue', percentage of carbohydrate was very low, only 0.5 g. Total protein content was 18.2 g which was the highest value compared to the other variants. The quantities of β-carotene, calcium, iron and phosphorus were 0.0241 g, 0.1 g, 0.02 g and 0.4 g respectively. Calcium content was lowest whereas phosphorus content was highest in this variant (Table 1). In 'single white', percentage of carbohydrate was 3.9 g and total protein content was 13.4 g. The quantities of β-carotene, calcium, iron and phosphorus were 0.0165 g, 0.1 g, 0.006 g and 0.2 g respectively. Calcium content was lowest in this variant similar to 'single light blue' (Table 1). In 'single violet', percentage of carbohydrate was 7.1 g which was the highest value in the seven variants. Total protein content was 14.1 g. The amount of β-carotene, calcium, iron and phosphorus were 0.008 g, 0.3 g, 0.03 g and 0.2 g respectively. β-carotene was considerably less in this variant compared to the rest (Table 1). In 'double blue', percentage of carbohydrate was 3.6 g and the total protein content was 13.4 g. The amounts of β-carotene, calcium, iron and phosphorus were 0.0081 g, 0.8 g, 0.01 g and 0.1 % respectively. Content of β -carotene was less (0.0081 g) in this variant. Calcium content was highest, whereas phosphorus content was lowest in this variant (Table 1). In 'double pink', percentage of carbohydrate was 5.4 g. The total protein content was 11.1g which was lowest compared to the other variants. Amounts of β-carotene, calcium and iron were 0.045 g, 0.8 g, 0.05 g respectively, which were comparatively high. Amount of phosphorus was 0.2 g (Table 1). In addition to 'single violet' the amount of carbohydrate was highest in 'double white' (7.1 g). Total protein content was 13.4 g. The quantities of β-carotene, calcium, iron and phosphorus were 0.0252 g, 0.2 g, 0.005 g and 0.2 g respectively. Iron content was lower in this variant compared to

Table 1. Mineral and nutritional composition in seven variants of *C. ternatea*

Variant	Carbohydrate (g)	Total protein (g)	Beta carotene (g)	Calcium (Ca) (g)	Iron (Fe) (g)	Phosphorus (P) (g)	Total fat (g)
Single blue	6.7	11.5	0.096	0.2	0.02	0.2	Nil
Single light blue	0.5	18.2	0.24	0.1	0.02	0.4	Nil
Single white	3.9	13.4	0.17	0.1	0.006	0.2	Nil
Single violet	7.1	14.1	0.08	0.3	0.03	0.2	Nil
Double blue	3.6	13.4	0.08	0.8	0.01	0.1	Nil
Double pink	5.4	11.1	0.45	0.8	0.05	0.2	Nil
Double white	7.1	13.4	0.25	0.2	0.005	0.2	Nil

the rest (Table 1).

The genus *Clitoria* L. was circumscribed by Fantz (1979, 1988) into three sub-genera *viz.,* Subg. *Bractearia* (Mart. Ex Benth). Fantz with 31 Neotropical species; Subg. *Clitoria* with five species including *C. ternatea* L.; Subg. *Neurocarpum* (Desv.) Baker emend. Fantz with 24 species, mostly distributed in the New World. Fantz and Predeep (1995) reported a detailed intraspecific classification of *C. ternatea* L., considering its floral polymorphism. They circumscribed two varieties of the species: *C. ternatea* var. *ternatea* representing typically papilionaceous and zygomorphic flowers and *C. ternatea* var. *pleniflora* Fantz in which flowers were actinomorphic. The terminology actinomorphic used by them may be due to the five similar petals, but not justifiable since the flowers can be in equal halves only in one plane with respect to its papilionaceous gynoecium. *C. ternatea* var. *ternatea* was again sub divided into two forma: *C. ternatea* var. *ternatea* f. *ternatea* which represented the most common, zygomorphic form with blue coloured flowers, and *C. ternatea* var. *ternatea* f. *albiflora* (Vought) Fantz (1990) which represented the zygomorphic form with white flowers. *C. ternatea* var. *pleniflora* f. *pleniflora* was also sub divided into two. *C. ternatea* var. *pleniflora* f. *pleniflora* by Fantz (1990) represented the variant with blue flowers (in which all the 5 petals are of same size, shape and colour) and *C. ternatea* var. *pleniflora* f. *leucopetala* Fantz (2005) represented the variant with white flowers (again with 5 similar petals). Thus, out of the seven variants included in the present study, only four were taxonomically designated taxa. The other three, 'single light blue', 'violet' and 'double pink' still remain as variants.

Highest content of carbohydrate was observed in 'single violet' and 'double white' (7.1 g) whereas lowest was in 'single light blue' (0.5 g), but total protein content was highest in this variant (18.2 g) (Table 1). According to Kosai et al. (2015), the amount of carbohydrate was 64.1% and protein was 14.4 %. Deshmukh and Jadhav (2014) pointed out that carbohydrate content in 'single blue' and 'white' was 0.08 g, and crude protein content was 14.99 % and 17.36 % respectively. These results were contradictory to the results obtained in the present study. The nutritive value of forages is often expressed in terms of their crude protein concentration and digestibility; both are closely associated with dry matter consumption (Minson, 1990). In the present study, it was observed that the crude protein concentration in *C. ternatea* was much higher than the minimum requirement (7%) for maintenance of beef cattle (National Academy of Sciences, 1984).

Highest Beta carotene was observed in 'double pink' (45.0 mg), whereas minimum was seen in 'single violet' (8.0 mg), followed by 'double blue' (8.1 mg) (Table 1). Abreu et al. (2014) reported that *C. ternatea* had potential as green forage under irrigation with good nutritive value when compared to known forage crops like alfalfa. The relatively good growth performance of *C. ternatea*, and the reasonable biomass yield and quality, suggested that *C. ternatea* could be a good candidate as forage crop.

The cultivation of *C. ternatea* may be suggested to fill the gap between the demand and supply of forage legumes for livestock production in India. Since, it has high nutritive value, it would be a good solution to poor quality ruminant diets.

The results revealed that four variants of *C. ternatea viz.,* 'light blue', 'violet', 'double white' and 'double pink' were nutritional in one way or other, and being under exploited, were potential quality forage crops.

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