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Antioxidant and functional attributes of maritime legume pastures of southwest India

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Abstract: This study documents the antioxidant and functional properties of pasture legumes belonging to the genus *Canavalia* DC., which occur in coastal sand dunes and mangroves in southwest India. The organs of these legumes possess adequate bioactive components such as total phenolics, tannin, flavonoids and vitamin C. These components were higher in methanol than in chloroform extracts. The total antioxidant activity was higher in chloroform extract than in methanol extract, while it was the opposite for reducing power. The ferrous ion-chelating capacity of *C. cathartica* was higher in chloroform than in methanol extract, while it was reversed for *C. rosea.* The DPPH radical-scavenging activities were higher in chloroform than in methanol extract. The bulk density was highest in *C. cathartica* for mangroves with the least gelation capacity. The water absorption capacity was highest in *C. cathartica* from the coastal sand dunes, while the oil-absorption capacity was highest in *C. cathartica* from the mangroves. The foam capacity as well as emulsion stability was highest in *C. cathartica* from the coastal sand dunes, while foam stability and emulsion stability were almost the same in all *Canavalia* spp. Given the high content of minerals, bioactive components and functional properties, *Canavalia* spp. can serve as a valuable feed for livestock.

Keywords: *Canavalia, coastal areas, dunes, fodder, mangroves, pasture, xeric soils*

INTRODUCTION

Significance of underutilized legumes in agriculture gaining immense value to improve the rural economy [Mabhaudhi et al., 2017]. J. Poppala et al. [2019] documented the importance of less known wild legumes in agriculture (e.g., edibility, bioactive potential and adaptability). The importance of tropical legumes in livestock management in various agroclimatic regions of the Indian subcontinent has been reviewed by R.P. Singh et al. [2019]. Climate change owing to global warming has forced us to explore and domesticate forage crops that resist unfavorable environmental conditions for the sustenance of livestock in the tropics [Schultze-Kraft et al., 2018]. Wild legumes grown on the dunes of the southwest coast of India have desired traits to adapt to extreme climatic conditions (high temperature, increased salinity, alkaline pH, wind abrasion, sand burial) [Arun et al., 1999; Bhagya, Sridhar, 2009]. Members of the Fabaceae dominated (24 spp.) among the plant species that adapted to the sand dunes of the southwest coast of India [Arun et al., 1999; Bhagya, Sridhar, 2009; Rao, Sherieff, 2002]. Many Fabaceae members (species of Canavalia, Derris Lour., Sesbania Scob.) are well known for their nutritional value along with their bioactive potential to be considered food, forage and fodder [Bhagya, Sridhar, 2009; Shreelalitha et al., 2019; Shreelalitha, Sridhar, 2023; Sridhar, Bhagya, 2007].

Wild legume landraces (e.g., *Canavalia cathartica* Thouars and *C. rosea* (Sw.) DC.) are widely dispersed in the pantropical region [Vatanparast et al., 2011]. They have adapted to the coastal regimes of Southwest India and show swift growth, high yield, tolerance to high salinity and disease resistance [Seena, Sridhar, 2006]. They serve as soil binding, nitrogen fixation with rhizobia and forage sources for livestock in the coastal region. In many reports, the seeds of *Canavalia* spp. have documented nutritional (proteins, amino acids, fatty acids, fiber) adequacy [Seena, Sridhar, 2006; Sridhar, Bhagya, 2007]. *Canavalia* spp. of maritime habitats have many ethnonutritional and ethnomedicinal applications [Bhagya, Sridhar, 2009]. Seeds of *Canavalia* are utilized after processing by the coastal population of Southwest India (e.g., boiling, soaking, seed coat removal and eliminating the testa of ripened beans). Seeds, leaves and roots of *Canavalia* are traditionally used to cure skin diseases and skin

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burns [Chock, 1968; Bhagya, Sridhar, 2009]. The powder of roasted seeds of *C. rosea* substitutes coffee powder, while leaves contain L-betonicine and roots are used to treat ciguatera poisoning [Bourdy et al., 1992; Bhagya, Sridhar, 2009]. Various pharmacological activities of *C. rosea* have been documented by R. Vasanthi and V. Balamurugan (2022). Food, forage and fodder importance of *Canavalia* spp. was also reported [Mendoza-Gonázlez et al., 2014]. In addition, their roots, leaves and seeds are ethnically used for medicinal purposes to treat or cure skin diseases (and burns), purify the blood, to treat rheumatism and to treat leprosy [Bhagya, Sridhar, 2009]. A qualitative assay of *C. mollis* leaves extracted in different solvents revealed the occurrence of alkaloids, tannins, saponins, steroids, glycosides and flavonoids [Prabhu et al., 2011

The coastal population of southwest India uses *Canavalia* as a major source of pasture for ruminant livestock, along with other fodder grasses or alone. *C. cathartica* expanded its territory to the mangroves of southwest India and has potential use as fodder [Bhagya, Sridhar, 2009; Sridhar, Bhagya, 2007; Sridhar, Seena, 2006]. Similarly, the leaves of *C. brasiliensis* Mart. ex Benth. and *C. ensiformis* (L.) DC. have also been considered potential feed supplements owing to their high content of proteins and minerals and low levels of anti-nutrient components [Emiola et al., 2019]. Leaves of maritime-adapted *Canavalia* spp. possess adequate proximal components (proteins, total lipids, carbohydrates, minerals and energy) along with minerals and bioactive components [Abhisheka et al., 2022; Vasanthi, Balamurugan, 2022]. To expand the usefulness of maritime *Canavalia* pasture, the current study envisages addressing its bioactive compounds, antioxidant potential and functional properties.

MATERIAL AND METHODS

Legume pastures and processing. Vines of *C. cathartica* from coastal sand dunes and mangroves; *C. rosea* from the coastal sand dunes with leaves, inflorescence and tender pods were sampled from three locations, as detailed in G. Abhisheka et al. [2022]. They were chopped, spread on paper sheets and sun-dried until attaining a moisture content <10%. They were pulverized and used to analyze bioactive components as well as their functional properties.

Bioactive components. The total phenolics of pasture samples were determined based on J. Rosset et al. [1982]. To pasture samples (0.1-0.3 mg), chloroform and methanol (50%, 10 ml) were added separately, mixed, kept in a hot waterbath at 95°C for 10 min, cooled and centrifuged at 2000 rpm, for 20 min to retrieve the supernatant. Repeated extraction and pooled volume of extract were made to 20 ml. Aliquots of extract of 0.5 ml were diluted with distilled water of 0.5 ml, sodium carbonate in 0.1N NaOH was added (5 ml). The mixture was incubated for up to 10 min at laboratory temperature (LT). Diluted in the ratio of 1:2 Folin-Ciocalteau's [1927] reagent was added (0.5 ml) and absorbance was measured at 725 nm by a UV-VIS spectrophotometer (118, Systronics, Ahmedabad, Gujarat, India). Instead of solvents, distilled water was added to pasture samples and processed, which served as a blank. Gallic acid dissolved in methanol served as a standard to quantify total phenolics in mg gallic acid equivalents (mg GAEs/g).

The tannin content of pasture samples was determined [Burns, 1971] by adding 0.1-0.3 mg chloroform and 10 ml methanol (50%) to a pasture sample, separately on a shaker at 28°C (24 hr) and centrifuged at 1500 rpm to separate the supernatant. To the extract of 1 ml, vanillin (4% vanillin in methanol + 8% concentrated HCl in methanol), hydrochloride of 5 ml, in the ratio of 1:1 was added, incubated for 20 min at LT and the absorbance was determined at 500 nm. Instead of solvents, distilled water was added to pasture samples and processed, which served as a blank. Tannic acid dissolved in methanol served as a standard to quantify tannin content in mg tannic acid equivalents (mg TAEs/g).

The flavonoids content of pasture samples was determined by an aluminium chloride colorimetric procedure [Chang et al., 2002]. Pasture samples about 0.1-0.3 mg were extracted in chloroform and methanol (1.5 ml) separately, an aliquot of extract of 0.5 ml was mixed with aluminium chloride of 0.1 ml (10%) and 1M potassium acetate of 0.1 ml. The volume was made up to 3 ml with distilled water and incubated for 30 min at LT. Instead of solvents, distilled water was added to pasture samples and processed as a blank. The standard used was quercetin dihydrate absorbance determined at 415 nm to quantify flavonoids content in mg equivalents per g of pasture sample (mg QEs/g).

The vitamin C content in pasture samples was quantified according to J.H. Roe [1954]. The pasture sample of 0.1-0.3 mg was extracted by chloroform and 10 ml methanol (10%) separately. A 0.2 ml aliquot of the extract was made up to 2 ml in 5% TCA and after mixing, 1 ml of chromogen was added (dinitrophenyl hydrazine thiourea copper sulphate solution: 5% thiourea + 0.6% copper sulphate + 2% 2,4-dinitrophenylhydrazine in

H_2SO_4 at the ratio, 5:5:9). The reaction mixture was incubated for up to 10 min in a boiling waterbath, cooled, of 4 ml (65%) H_2SO_4 was added and incubated at LT for up to 10 min and the absorbance was read at 540 nm. Instead of solvents, distilled water was added to pasture samples and processed as a blank. Ascorbic acid used for vitamin C quantification in mg ascorbic acid equivalent per g (mg AAEs/g).

Antioxidant activities. Samples of pastures (0.01-0.05 mg) were extracted using methanol (40 ml) and chloroform (30 ml) on a shaker at 150 rpm for 48 hr. After centrifuging, the supernatant was transferred to a pre-weighed Petri plate and allowed to evaporate at LT. The mass of the extract was determined gravimetrically and the extract was dissolved in a known quantity of chloroform and methanol (1 mg/ml) to assess different antioxidant properties.

The total antioxidant activity (TAA) was assessed based on P. Prieto et al. [1999].

To chloroform and methanol extracts of pasture samples with a concentration of 0.01-0.05 mg/ml (28 mM sodium phosphate + 4 mM ammonium molybdate in 0.6 M sulphuric acid) was added 0.1 ml of a mixture of reagents and incubated at 95°C, 90 min. The absorbance was read at 695 nm and the TAA was recorded in µM equivalents of ascorbic acid per g (µM AAEs/g).

The reducing power (RP) of the extracts was determined based on M. Oyaizu [1986] with minor modifications. The chloroform and methanol extracts in varied (0.01-0.05 mg/ml) concentrations were prepared in 0.2M phosphate buffer (pH 6.6), 1% potassium ferrocyanide (2.5 ml) was added and the mixture, incubated at 50°C for 20 min. Later, 2.5 ml TCA (10%) was added, mixed and centrifuged at 3000 rpm for 10 min. The supernatant (2.5 ml) was mixed with an equal volume of double distilled water and 0.5 ml $FeCl_3$ (0.1%). Absorbance was read (700 nm) and higher absorbance denotes increased RP.

The ferrous ion-chelating capacity (FCC) of extracts was determined based on C.L. Hsu et al. [2003]. Chloroform and methanol extract of 0.01-0.05 mg/ml were mixed with 2 mM 0.1 ml ferrous chloride and 5 mM 0.2 ml ferrozine. The final volume was made to 5 ml with methanol and incubated at LT for 10 min and the absorbance was read (562 nm). The reagents devoid of extract served as control to determine the FCC:

$$\text{Ferrous ion chelating capacity (\%)} = \left(1 - \frac{A_{s562}}{A_{c562}}\right) 100$$

where, A_s is the sample absorbance; A_c is the control absorbance.

The DPPH radical-scavenging activity (RSA) of extracts was evaluated based on R.P. Singh et al. [2002]. Different pasture concentrations (0.01-0.05 mg/ml) were made up to 1 ml using chloroform and methanol extract, followed by the addition of reagent [0.001 M 2,2-diphenyl-1-picrylhydrazyl (DPPH) in methanol] (4 ml). The contents were mixed, followed by incubation in the dark at LT for 20 min. The reagents devoid of extract served as control and the absorbance was read (517 nm) to quantify the RSA:

$$\text{Free radical-scavenging activity (\%)} = \left(\frac{A_{c517} - A_{s517}}{A_{c517}}\right) 100$$

where, A_c is the absorbance of the control; A_s is the absorbance of the sample.

Functional properties. The bulk density (BD) of pasture flour was determined based on S.L. Kanwar and J.S. Chopra [1981]. Pasture powder (m) of 100 g were transferred into a 250 ml graduated glass cylinder without compacting. The cylinder gently tapped up to several times until there was no change in the volume and the compact volume (v) was noted to calculate the BD:

$$\text{Bulk density (g/ml)} = m/v$$

where, m is the weight of the flour; v is the compact volume.

The method proposed by C.W. Coffman and V.V. Garcia [1977] was adapted to determine the least gelation concentration (LGC) in pasture flours. Slurries of flour were diluted (2-20%) in distilled water (w/v). Homogenized slurry (10 ml) of each concentration was transferred into test tubes, incubated in a boiling water bath (1 hr) and cooled at 4°C (2 hr). The tubes with pasture gel were inverted and concentration at which the gel did not slip down was considered LGC.

The procedure by L.R. Beuchat [1977] was adapted to determine the water-absorption capacity (WAC) of pasture flour. Samples of pasture flour (0.5 g) were transferred to graduated centrifuge tubes and mixed with 10 ml of distilled water, followed by incubation at the laboratory temperature (30 min), centrifuged (5000 rpm) and the volume of supernatant measured to record the amount of water absorbed in ml per g of flour.

The same procedure followed for WAC was adapted to assess the oil-absorption capacity (OAC) [Beuchat, 1977]. To the pasture flour (0.5 g) in graduated centrifuge tubes, 5 ml of edible oil (Surya coconut oil, Supreme Feeds (I) Private Limited, Udupi, Karnataka, India)

was added and kept at the LT (30 min). Tubes were centrifuged (5000 rpm) for 30 min. The supernatant was measured to record the amount of oil absorbed in ml per g of flour.

The method by C.W. Coffman and V.V. Garcia [1977] was followed to assess the foam capacity (FC). Pasture flour of 2 g were mixed in distilled water (w/v), dispensed into a measuring jar to note the volume. The contents in the jar were dispensed into a blender for vigorous whipping for up to 2 min and transferred into a measuring jar to note the volume after whipping to calculate the FC:

$$\text{Foam capacity (\%)} = \left(\frac{V2 - V1}{V1}\right) \times 100$$

where, V1 is the volume in ml before whipping; V2 is the volume in ml after whipping.

The same procedure followed to calculate FC was adapted to measure foam stability (FS). The foam developed was kept in the measuring jar without disturbance for up to 8 hr at the laboratory temperature to calculate the FS:

$$\text{Foam stability (\%)} = \left(\frac{V2}{V1}\right) \times 100$$

where, V1 is the volume in ml before whipping; V2 is the volume in ml after whipping.

To determine the emulsion properties, the method by V.Q. Neto et al. [2001] was adapted. For determining emulsion activity (EA), 50 mg of pasture flour was dispensed in 5 ml distilled water, mixed with 5 ml edible oil and centrifuged at 1100 rpm for 5 min. The height of the emulsified layer was recorded to calculate the EA:

$$\text{Emulsion activity (\%)} = \left(\frac{El}{Tc}\right) \times 100$$

where, El is the emulsified layer in ml; Tc is the total content in ml.

To determine the emulsion stability (ES), the pasture flour suspension was heated up in a water bath at 80°C for up to 30 min prior to centrifugation. The height of the emulsified layer was recorded to calculate the ES:

$$\text{Emulsion stability(\%)} = \left(\frac{Elh}{Tc}\right) \times 100$$

where, Elh is the emulsified layer after heating in ml; Tc is the total content in ml.

Data analysis. To ascertain the difference in bioactive components and antioxidant potential of pastures extracted in chloroform and methanol, a Student t-test was adopted [StatSoft Inc., 2008]. The significance of functional properties among the pastures was assessed by one-way ANOVA [StatSoft Inc., 2008].

RESULTS AND DISCUSSION

Bioactive components. Total phenolics content was high in all *Canavalia* spp. at 0.3 mg/ml in both extracts (Fig. 1). It was higher in methanol extract than chloroform extract in all *Canavalia* spp. with a significant difference in *C. cathartica* from the sand dunes as well as mangroves between the extracts ($p<0.01$). Similar to total phenolics, tannin content was high in all *Canavalia* spp. at 0.3 mg/ml in both extracts without significant differences between the extracts (Fig. 1). Flavonoid content was high in all *Canavalia* spp. at 0.3 mg/ml in both extracts (Fig. 2), which was higher in methanol extract compared to chloroform extracts *Canavalia* spp. with a significant difference in *C. cathartica* from mangroves and C. rosea collected on sand dunes between the extracts ($p<0.05$). The content of vitamin C was also high in all *Canavalia* spp. at 0.3 mg/ml concentration in both extracts without significant differences between the extracts (Fig. 2).

Antioxidant Potential. Total antioxidant activity (TAA) was high in all *Canavalia* spp. at 0.05 mg/ml concentration in both extracts (Fig. 3). They differed between the extracts of *C. cathartica* from sand dunes and mangroves ($p<0.01$) and *C. rosea* from sand dunes ($p<0.05$). Similar to TAA, the RP was higher in all *Canavalia* spp. at 0.05 mg/ml concentration in both extracts (Fig. 3). They differ in *C. cathartica* from sand dunes ($p<0.001$), mangrove ($p<0.05$) and *C. rosea* from sand dunes ($p<0.05$). The FCC was higher in all *Canavalia* spp. at 0.05 mg/ml concentration in both extracts (Fig. 4). It differed only in *C. cathartica* from the sand dunes between the extracts ($p<0.05$). The RSA was higher in all *Canavalia* spp. at 0.05 mg/ml concentration in both extracts (Fig. 4). It differed between the extracts only in *C. rosea* from sand dunes ($p<0.05$).

Functional properties. The BD was higher in *C. cathartica* from the mangroves and *C. rosea* from the sand dunes compared to *C. cathartica* from the sand dunes ($p<0.05$) (Fig. 5). The LGC was lower in *C. cathartica* than *C. rosea* ($p<0.01$). The water-absorption capacity (WAC) was higher in *C. cathartica* from the sand dunes, followed by *C. rosea* from the sand dunes ($p<0.01$). The OAC was higher in *C. cathartica* from the mangroves, followed by *C. cathartica* from sand dunes ($p<0.05$).

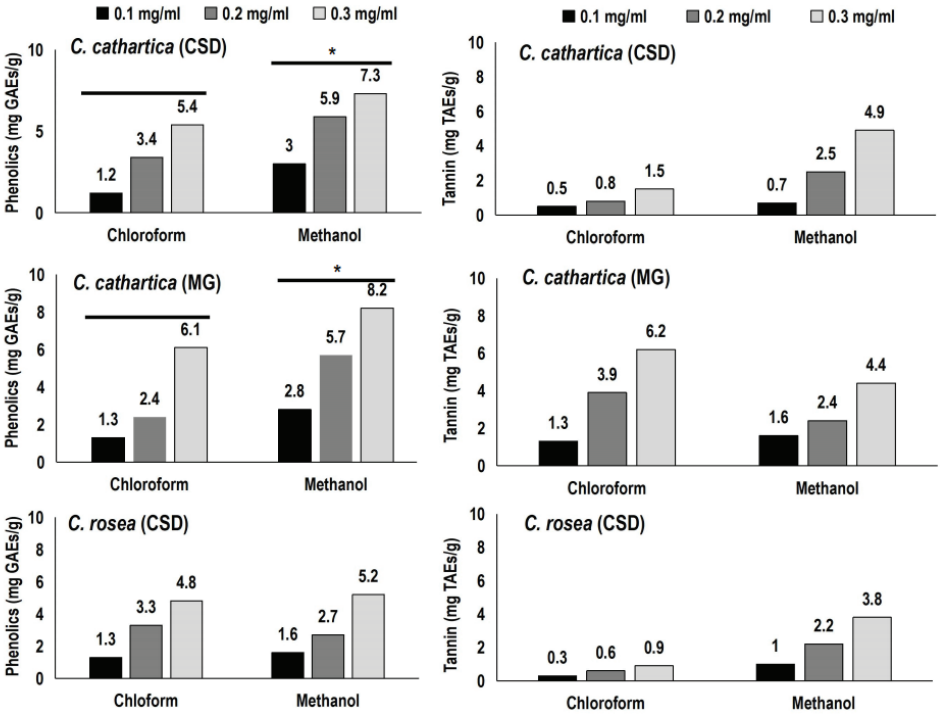

Figure 1. Total phenolics and tannin contents in three landraces of *Canavalia* (CSD, coastal sand dunes; MG, mangroves) (*, $p<0.01$).

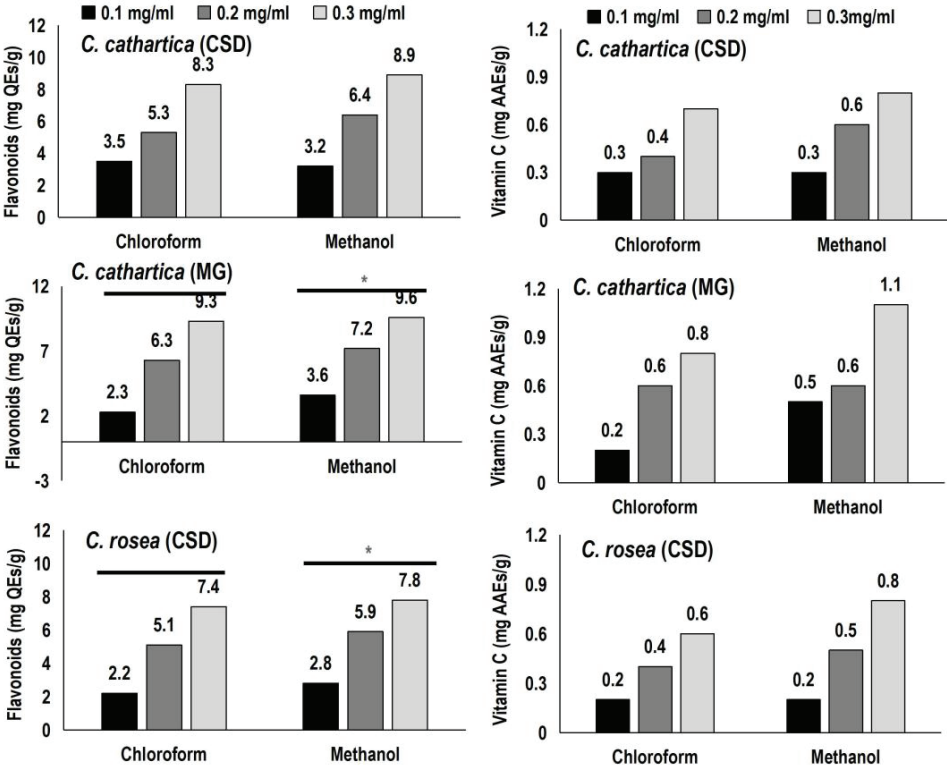

Figure 2. Flavonoids and vitamin C in three landraces of *Canavalia* (CSD, coastal sand dunes; MG, mangroves) (*, $p<0.05$).

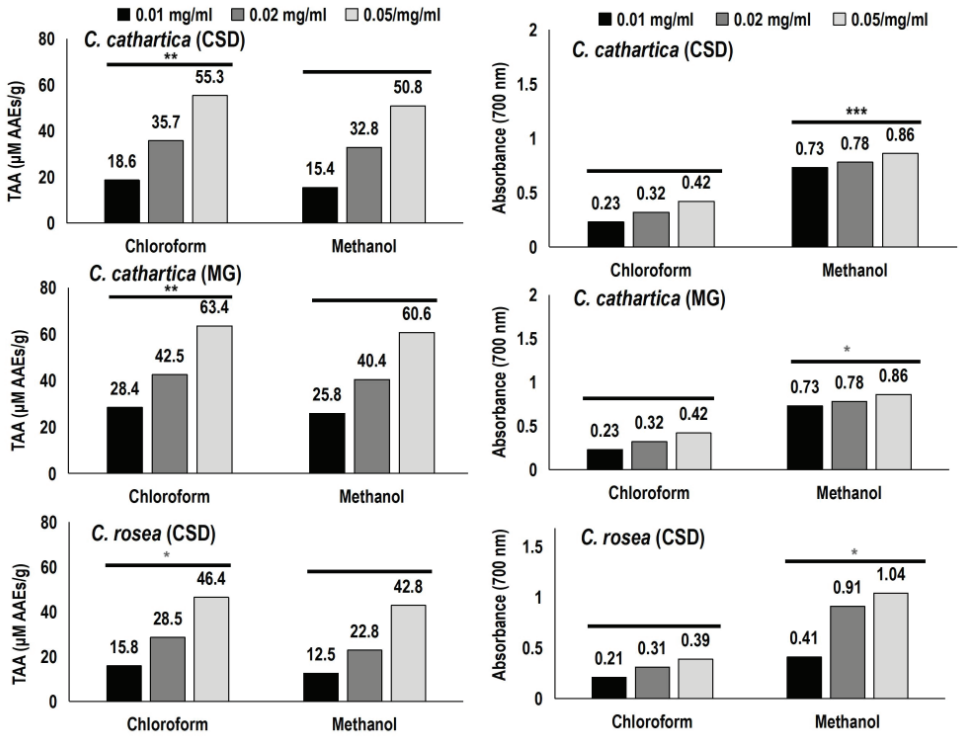

Figure 3. Total antioxidant activity (TAA) and reducing power (RP) in three landraces of *Canavalia* (CSD, coastal sand dunes; MG, mangroves) (*, p<0.05; **, p<0.01; ***, p<0.001).

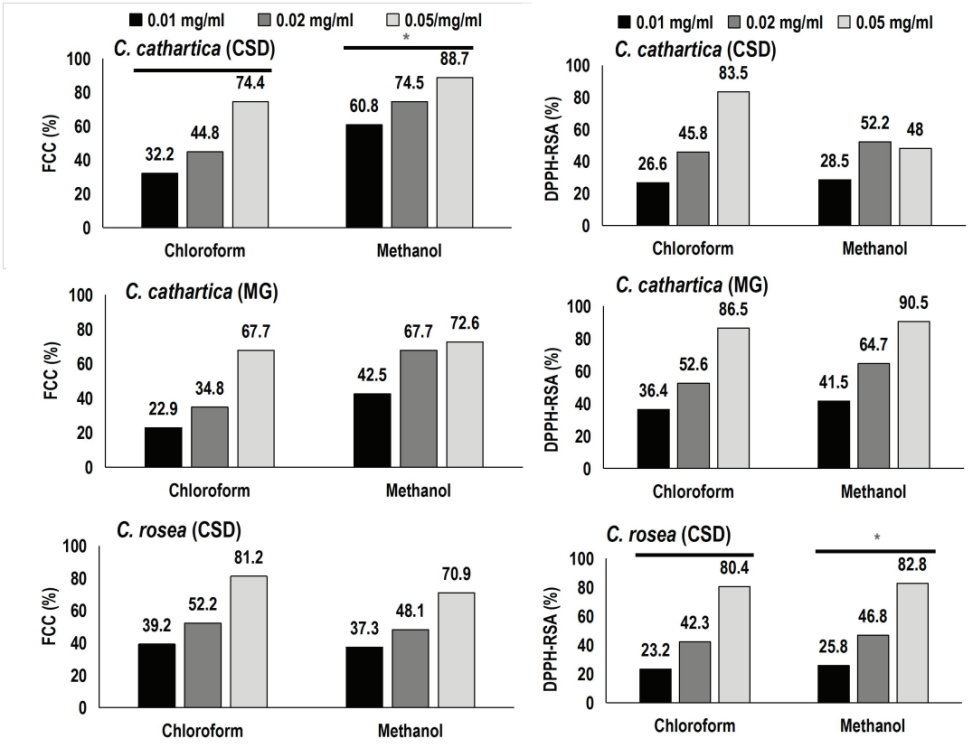

Figure 4. Ferrous ion-chelating capacity (FCC) and DPPH radical-scavenging (RAS) activity in in three landraces of *Canavalia* (CSD, coastal sand dunes; MG, mangroves) p. (*, p<0.05).

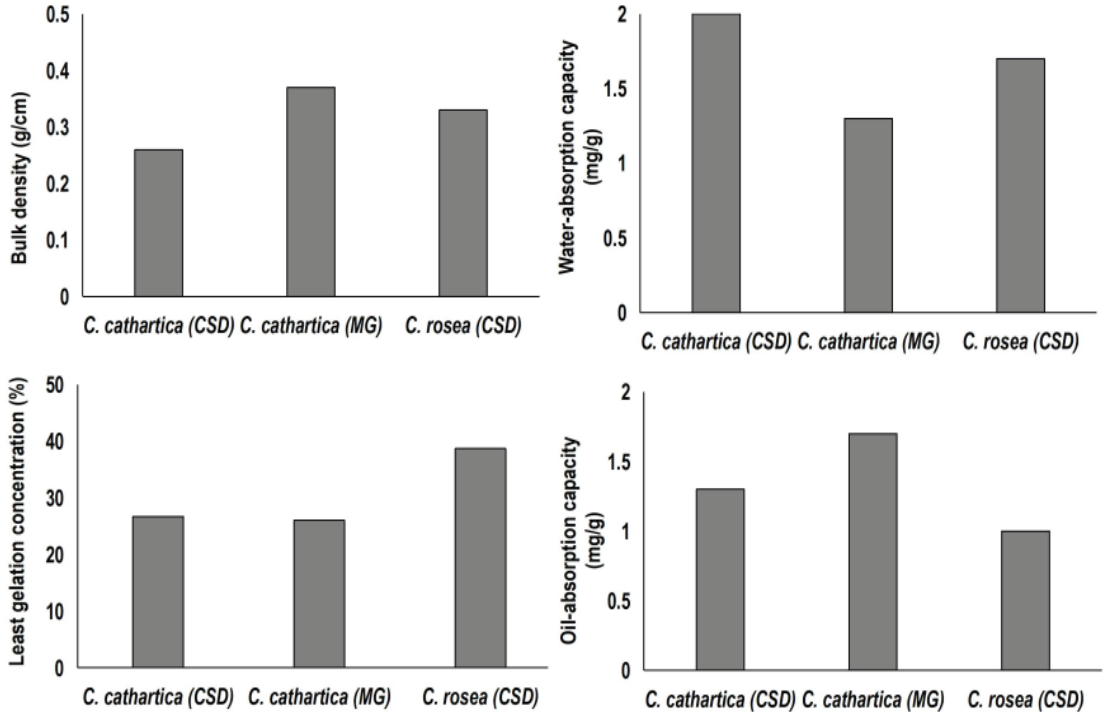

Figure 5. Bulk density (BD), least gelation capacity LGC), water-absorption capacity (WAC) and oil-absorption capacity (OAC) of three landraces of *Canavalia* (n=3, mean) (CSD, coastal sand dunes; MG, mangroves).

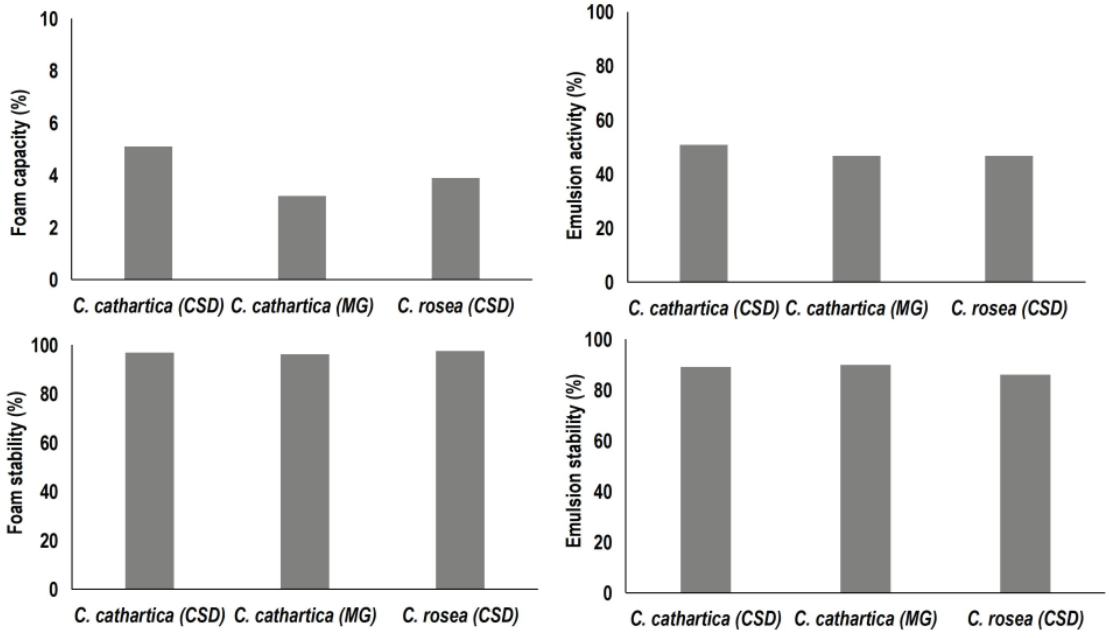

Figure 6. Foam capacity, foam stability, emulsion activity and emulsion stability of three landraces of *Canavalia* (n=3, mean) (CSD, coastal sand dunes; MG, mangroves).

The foam capacity (FC) was higher in *C. cathartica* from sand dunes, followed by *C. rosea* from the sand dunes, than in *C. cathartica* from the mangroves ($p<0.05$) (Fig. 6). The FS, EA and ES were almost constant in all the landraces.

Bioactive potential. Leaves of *C. cathartica* collected from Thiruvanmalai (a non-coastal region of Tamil Nadu, India) possess total phenolics of only 84.93 µg/mg [Saraswathi et al., 2018], which is substantially lower than the pastures of *Canavalia* spp. in our study. Similarly, the leaves of *C. cathartica* of Thiruvanmalai possess flavonoids up to 18.5 µg/mg [Saraswathi et al., 2018], which is also lower compared to the coastal *Canavalia* spp. of our study. It is likely that the xeric soils of coastal sand dunes might be a possible reason for the higher contents of total phenolics as well as flavonoids in *Canavalia* spp., which might have resulted in substantial antioxidant potential.

Similar to the pastures from the coastal sand dune *Canavalia* spp., the leaves of *C. cathartica* collected from Thruvannamalai showed good radical-scavenging activities with good ferric-reducing power [Saraswathi et al., 2018] anticipated this based on the chemical composition of the leaves of *C. cathartica* of Thirunelveli, a potential source of traditional medicine against infections caused by bacteria and fungi. The current study also demonstrated substantial antioxidant activity in coastal *Canavalia* spp. supports the use in ethnomedicine [Bhagya, Sridhar, 2009].

The above observations have been substantiated by studies on leaf extracts of *C. mollis* from Kolli Hills (non-coastal region of Tamil Nadu, India) (ethanol, methanol and acetone) that showed significant RSA as well as antibacterial activities [Prabhu et al., 2011]. The most susceptible bacteria were *Bacillus cereus*, *B. subtilis*, *Escherichia coli*, *Staphylococcus aureus* and *Streptococcus faecalis*. The authors predict that the presence of phenolic compounds (e.g., alkaloids) is responsible for good radical scavenging and antibacterial activities. The leaves of *C. mollis* could be used to prevent human infections based on their antioxidant activity as well as their inhibition of Gram-positive and Gram-negative bacteria. A qualitative assay of *C. mollis* leaves extracted in different solvents revealed the occurrence of alkaloids, tannins, saponins, steroids, glycosides and flavonoids as reported some of these compounds in the present study [Prabhu et al., 2011].

Qualitative analysis of chloroform and methanol extracts from *Canavalia* spp. of the coastal region also showed the presence of phenols, cardiac glycosides. saponins, terpenoids, flavonoids, alkaloids and quinone glycosides [Abhisheka et al., 2022]. Previous studies as well as the present study substantiate that the coastal *Canavalia* spp. are potential source of ethnomedicine and also serve as a prospective pasture for livestock.

Functional attributes. Canavalia landraces of the coastal regions are useful as valuable pastures for livestock, their concentrates could be prepared owing to their proximate, minerals, bioactive compounds and antioxidant properties. In addition, the bulk density was higher in mangrove *C. cathartica* in our study as it grows in mangrove habitats with rich nutrients and minerals. Besides, coastal *Canavalia* spp. fulfil many nutrient requirements as they are colonized by rhizobia and arbuscular mycorrhizae [Arun, Sridhar, 2004, 2005; Sridhar et al., 2011]. As the two landraces of *C. cathartica* possess low gelation concentrations, they could be used to prepare fabricated foodstuffs for livestock. Similarly, water and oil absorption capacities are desirable for the production of suitable nutrient rich foods for livestock. The foam and emulsion properties (capacity and stability) of *Canavalia* pastures facilitate the production of suitable livestock foodstuffs.

CONCLUSION

The pasture from the coastal *Canavalia* landraces in southwest India is known for adequate quantities of proteins, minerals, fibre, carbohydrates and calorific value. Based on the results of the current study, they also possess value-added bioactive compounds, antioxidant potential and functional attributes useful for developing suitable livestock nutritional and medicinal products. Maritime *Canavalia*, being adapted to drought, salinity, alkaline pH and burial, caters to the nutritional needs of livestock throughout the year. There is ample scope to perform fermentation of *Canavalia* foliage using yeast or filamentous fungi (e.g., Saccharomyces and Rhizopus) for additional nutritional values in functional foods for livestock.

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Cənub-Qərbi Hindistanın dənizkənarı paxlalı otlaqlarının antioksidant və funksional xüsusiyyətləri

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Bu tədqiqat işində Hindistanın cənub-qərbində dənizkənarı qum təpələrində və manqrov kolluqlarda rast gəlinən *Canavalia* DC. cinsinə aid otlaq paxlalılarının antioksidant və funksional xüsusiyyətlərini sənədləşdirilir. Bu paxlalı bitkilərin orqanlarında ümumi fenollar, taninlər, flavonoidlər və C vitamini kimi səciyyəvi bioloji fəal komponentlər vardır. Bu komponentlər çıxarışı xloroform ekstraktlarına nisbətən daha çox metanol ekstraktlarında müşahidə olunmuşdur. Ümumi antioksidant aktivlik metanol ekstraktı ilə müqayisədə xloroform ekstraktında daha yüksək olmuşdur, lakin sərbəst radikalların söndürmə qabiliyyətinə görə əks reaksiya müşahidə edilmişdir. *C. cathartica* növünü dəmir ionlarını xelatlaşdırmaq qabiliyyəti metanol ekstraktı ilə müqayisədə xloroform ekstraktında daha yüksək, *C. rosea* üçün isə nisbətən aşağı olmuşdur. Xloroformda DPPH-nin radikal təmizləmə aktivliyi metanol ekstraktı ilə müqayisədə daha üstün olmuşdur. Köpük tutumu və emulsiya sabitliyi bütün *Canavalia* spp. nümunələrində eyni olduğu halda dənizkənarı qum təpələrindən toplanmış *C. cathartica* növündə ən yüksək göstərici əldə edilmişdir. Mineralların, bioaktiv komponentlərin və funksional xassələrin yüksək tərkibini nəzərə alaraq, *Canavalia* spp. heyvandarlıq üçün qiymətli yem kimi istifadə oluna bilər.
Açar sözlər: *Canavalia, sahilyanı ərazilər, qum təpələri, yemlik, manqrovlar, otlaqlar, quru torpaqlar*

Антиоксидантные и функциональные свойства прибрежных бобовых пастбищ юго-западной Индии

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Это исследование документирует антиоксидантные и функциональные свойства пастбищных бобовых, принадлежащих к роду *Canavalia* DC., которые встречаются в прибрежных песчаных дюнах и мангровых зарослях на юго-западе Индии. Органы этих бобовых содержат характерные биологически активные компоненты, такие как общие фенолы, дубильные вещества, флавоноиды и витамин С. Содержание этих компонентов в метанольном экстракте были выше, чем в хлороформном экстракте. Суммарная антиоксидантная активность была выше у хлороформного экстракта, чем у метанольного, в то время как наблюдалась обратная реакция у данных экстрактов в способности гасить свободные радикалы. Способность *C. cathartica* к хелатированию ионов железа была выше в хлороформном по сравнению с метанольным экстрактом, в то время как для *C. rosea* наблюдался обратный эффект. Активность DPPH по гасению радикалов в хлороформном была выше, чем в метанольном экстракте. Пеноемкость, а также стабильность эмульсии были самыми высокими у *C. cathartica* из прибрежных песчаных дюн, в то время как стабильность пены и стабильность эмульсии были почти одинаковыми у всех *Canavalia* spp. Учитывая высокое содержание минералов, биоактивных компонентов и функциональных свойств, *Canavalia* spp. может служит ценным кормом для скота.

Ключевые слова: *Canavalia, прибрежные районы, песчаные дюны, корма, мангровые заросли, луга, засушлевые почвы*