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Research Article

Physicochemical evaluation of common purslane (*Portulaca oleracea* L.) accessions through correlation and regression

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Abstract
It is important to look at the physicochemical qualities of Portulaca, a weed species used as a vegetable and a herb for medical and therapeutic purposes. India has a wide range of variations in this species' morphology and nutraceutical value. This study aimed to evaluate the physicochemical properties of various purslane accessions from different regions of Tamil Nadu. A total of 15 purslane accessions (PA 1, PA 2, PA 3, PA 4, PA 5, PA 6, PA 7, PA 8, PA 9, PA 10, PA 11, PA 12, PA 13, PA 14 and PA 15) were collected and evaluated. Physical traits like colour of the leaves and stems were quantified as hue angle and chroma value, which showed a degree of variation. Estimates suggested that phytochemical properties related the hue and chroma of leaf and stem to the pigments in plants. Among the accessions, PA 3 has recorded the highest phytochemical properties *viz.*, leaf total chlorophyll content 1.43±0.16 mg g^{-1}, leaf total carotenoid content 0.24±0.03 mg g^{-1}, stem total chlorophyll content 0.49±0.05 mg g^{-1}, stem total carotenoid content 0.12±0.01 mg g^{-1} and total anthocyanin content 19.25±1.54 µg g^{-1}. The multiple regression model suggested that the values can predict the estimated values. The evaluation of physicochemical properties along with the regression model helps in the breeding programme to select the traits; phytochemical analysis proved the ample supply of chlorophylls, carotenoids and anthocyanins, so these wild species could be a cheap source to alleviate several diseases.

Keywords: Anthocyanin, Carotenoid, Chlorophyll, *Portulaca oleracea*, Purslane

INTRODUCTION

The plant, purslane, or *Portulaca oleracea* Linnaeus, (Portulacaceae family), is an essential part of the human diet, primarily found in tropical and subtropical areas. Purslane is one of the most popular medicinal herbs, according to the World Health Organization (WHO), and is known as a "Global Panacea" (Xu *et al.*, 2006).Chlorophyll concentrations in frequently consumed green vegetables can be up to five times higher than in carotenoids (Giuliani *et al.*, 2016).A green pigment in leaves called chlorophyll absorbs light energy for photosynthesis. A plant's health status may be determined by the amount of chlorophyll in its leaves, and healthier plants contain more chlorophyll (Kurniawan *et al.*, 2021).Cardiovascular disease (CVD) affects everybody and is a major cause of death, regardless of age or economic background. Many chronic diseases, including CVD, can be prevented mainly by proper nutrition. Vegetables contain antioxidants such as vitamin C, carotenoids, and flavonoids that may reduce the incidence of CVD(Voutilainen *et al.*, 2006). A class of phytochemicals called carotenoids oversees the various hues(Rao and Rao, 2007). Colour is an important aspect of identification and morphological differentiation for evaluation studies. With numerous roles of carotenoids in photosynthesis, photoprotection, pigmentation, phytohormone production, and signalling, carotenoids are crucial for plants. They are also essential for humans as dietary antioxidants and precursors to manufacture vitamin A(Sun *et al.*, 2022). Anthocyanins are natural plant pigments that give flowers, leaves, fruits, and some vegetables their red, blue, and purple hues (Burton *et al*., 2016). A family of polyphenolic pigments known as anthocyanins is ubiquitous throughout the plant kingdom. Anthocyanins help plants resist a variety of biotic and abiotic challenges in addition to aiding in reproduction by luring pollinators and seed dispersers. Anthocyanin metabolism is an intriguing research topic for breeders and scientists since there is mounting evidence that anthocyanins have health-promoting characteristics (Liu *et al*., 2018). Due to the catechol, pyrogallol, and methoxy groups present in their chemical structure, which confer notable scavenging, anti-apoptotic, and anti-inflammatory activities, anthocyanins have been the subject of numerous studies. They are already advised as supplements to mitigate or even attenuate certain disorders, such as diabetes, cancer, cardiovascular disease, and neurological pathologies (Gonçalves *et al.,* 2021). Despite extensive studies on the chemical and bioactive properties of this species throughout the world, less information is currently available on the physicochemical characterization of this species in India. With this objective the present study was carried out to evaluate the physicochemical traits of various purslane accessions.

MATERIALS AND METHODS

Plant material and experimental design

The experiment was conducted in the summer (March to May) of 2022 in Tiruchegode, Namakkal district of Tamil Nadu. The portulaca accession sample codes and location of sample collection are given in Table 1. The seeds (wild and weed type) and stems (ornamental type) were used as propagating materials of the purslane and were planted in plastic pots filled with 1:1:1 ratio of sand, soil and coco peat. The experiment was organized in a completely randomized design with three replications.

Data collection

All the physicochemical traits (physical traits– *viz*., chroma value and hue angle; phytochemical traits– *viz*., total chlorophyll content, total carotenoid content and total anthocyanin content) data were collected before flowering on tagged plants of each replicate from all the accessions.

Colour determination

Colour measurement was done on adaxial portion of leaf (third pair of leaf from terminal bud),top and bottom portion of stem(1cm below the terminal bud and above the ground respectively) by Colorimeter model - AC-CU310 / NH310 to acquire colour values L*, a* and b* used to calculate the colour saturation and shadiness. According to McGuire (1992) chroma(C*) for colour saturation and hue angle (*h*°) for colour shadiness (0° = red-purple, 90° = yellow,180° = bluish-green and 270° = blue) can be calculated from the following formulas:

$$C^{*} = \sqrt{a^{*2} + b^{*2}} \qquad \text{Eq.1}$$

$$THETA = \left\{\frac{\left(arc\tan\frac{b^{*}}{a^{*}}\right)}{2\pi}\right\} * 360 \qquad \text{Eq. 2}$$

If a* > 0and b* > 0, then *h*° = THETA
If a* < 0and b* > 0, then *h*° = THETA + 180
If a* < 0and b* < 0, then *h*° = THETA + 180
If a* > 0and b* < 0, then *h*° = THETA + 360

Total chlorophyll and carotenoids content

Total chlorophyll and carotenoid content were analyzed on leaves and stem separately. The samples were extracted with 80% of acetone and absorbance were recorded at 470, 645 & 663 nm with triplicates in UV-VIS spectrophotometer model Shimadzu-UV 1800(Dabbou *et al*., 2020). The readings were calculated by the previously proposed formula (Lichtenthaler, 1987) and the values were calculated and expressed in mg g^{-1} FW basis.

Total anthocyanin content

Total anthocyanin content was analyzed for the whole plant, the samples were extracted with acidified methanol and absorbance were recorded at 530 and 657 nm with acidified methanol (HCL) as a blank and cyanidin-3-gluciside for calibration. The readings were calculated by the previously proposed formula Mancinelli et al. (1975) and the values were plotted in the standard curve, calculated and expressed in µg g^{-1} DW basis. The increase of absorbance at 530 nm was about one-third of the absorbance at 657 nm. Therefore, the absorbance readings at 530 nm were corrected by subtracting one-third of the absorbance at 657 nm.

Regression model

The regression for predicting the value of the response variable was multiple linear regression and expressed according to following equation

$$Y = b_0 + b_1{*}x_1 + b_2{*}x_2 + b_3{*}x_3 + \ldots\ldots + b_n{*}x_n \qquad \text{Eq. 3}$$

Where Y is the response variable or dependent variable, b_0 is an intercept, b_1, b_2,…b_n are regression coefficients and x_1, x_2,…. x_n are the independent variables.

Statistical analysis

Comparisons among accessions means were tested for significance using analysis of variance (ANOVA) and the means were compared by Duncan multiple range test. Pearson's correlation coefficient was used to cor-

Table 1. Accessions code and locations of the *P. oleracea* accessions used in the present study

S. No	Accessions	Latitude	Longitude	Description
1	PA 1	11.11º	78.80º	Weed (Onion field)
2	PA 2	11.12º	78.82º	Weed (Onion field)
3	PA 3	11.73º	78.39º	Wild
4	PA 4	11.78º	78.47º	Weed (Cassava field)
5	PA 5	11.75º	78.51º	Weed (Cassava field)
6	PA 6	11.09º	77.47º	Ornamental
7	PA 7	11.10º	77.43º	Ornamental
8	PA 8	11.45º	79.68º	Weed
9	PA 9	11.72º	79.62º	Weed
10	PA 10	11.17º	77.78º	Wild
11	PA 11	10.70º	77.54º	Weed (Spinach field)
12	PA 12	8.87º	77.52º	Weed
13	PA 13	9.93º	78.13º	Weed (Orchard)
14	PA 14	8.22º	77.56º	Weed
15	PA 15	11.69º	78.94º	Weed (Spinach field)

relate the parameters. In regression, t-test and F-test were used to determine the regression coefficient's significance and variable significance, respectively. Throughout the experiment, 95% confidence level was defined for significance. Studentized residuals were used to calculate the residuals between observed and predicted values, and Cook's D was used to calculate the distance. For analysis, SAS online cloud service was used.

RESULTS AND DISCUSSION

Physical properties

The colour values of the adaxial portion of leaves are shown in Table 2. The highest *h* (°-) was observed in PA 1 followed by PA 3 (129.71º) and the lowest C* was calculated in PA 3 (13.49) followed by PA 1 (32.98), whereas the highest C* was found in PA 7 (52.00). The differences could be due to the different genotypes used, whose leaf blade colours differed from each other. The lowest chroma was observed in PA 11 (16.37), followed by PA 10 (16.96). The results coincide with Alam *et al.* (2014a), who evaluated 45 purslane accessions and reported different shades of leaf colours. Egea-Gilabert *et al.* (2014) reported that among 12 accessions of purslane, the hue angle ranged between 110.0º -115.5º and the chroma value ranged between 17.2 -28.5. Petropoulos *et al.* (2015) also observed the hue angle and chroma values ranged from 162.59-167.52 and 26.55-34.76, respectively, in 6 purslane accessions. The top portion of the stem was observed. The values are shown in Table 2. the hue angle ranged between 116.92º in PA 5 to 36.37º in PA 14. The least chroma was observed in PA 3 (17.07), followed by group PA 8, 14 and 12. Accession PA 3 had beige stems that contributed to the least chroma whereas the grouping PA 8, 12 and 14 had red stems attributed for the least *h*º and C*. The bottom portion of the stem colour values are shown in Table 6. hue angle ranged from 105.61º (PA 2) to 22.08 (PA 12), where the PA 2 had green shaded stems and PA 12 had red shaded stems might be the reason for the differences. The least chroma was observed in PA 13 (16.38) and the highest was in PA 14 (40.15). The difference in saturation was attributed to differences in accessions used. Similar work was reported by Alam *et al.* (2014b), who accessed 25 purslane samples and morphological differences in stem colour were observed as follows: 17 accessions with red stem, 1 accession with pink stem, 1 accession with green stem, 4 accessions with green-red stems and 2 accessions with a red-green stem.

Phytochemical properties

Total chlorophyll content, carotenoids and anthocyanin content were estimated on leaves and stem for bridging the appearance of the samples to the pigments present for each sample values are shown in Table 3. They were affected by genotypes and the crop nature, the highest total chlorophyll content for leaf (1.43mg g^{-1} FW) and stem (0.49mg g^{-1} FW), total carotenoid content for leaf (0.24mg g^{-1} FW) and stem (0.12mg g^{-1} FW) were recorded for wild type accession PA 3. In all the samples, the total chlorophyll content was observed to be higher in leaves compared to stems, indicating that the common purslanes are efficient photosynthetic plants (Dabbou *et al.*, 2020). Total chlorophyll content data are similar to the previously reported work on FW basis (Kopsell *et al.*, 2016). A similar trend was followed for total carotenoid content, where the higher accumulation of carotenoids was found in leaves than in stems. Alam *et al.* (2014c) detected carotenoids in 13 purslane accessions and the value ranged between 0.52 ± 0.06 to 5.64 ± 0.09 mg g^{-1}. Dabbou *et al.* (2020) showed that both the plant's stems and leaves contain trace amounts of carotenoids. Carotenoids oversee giving meals their various hues. They are acknowl-

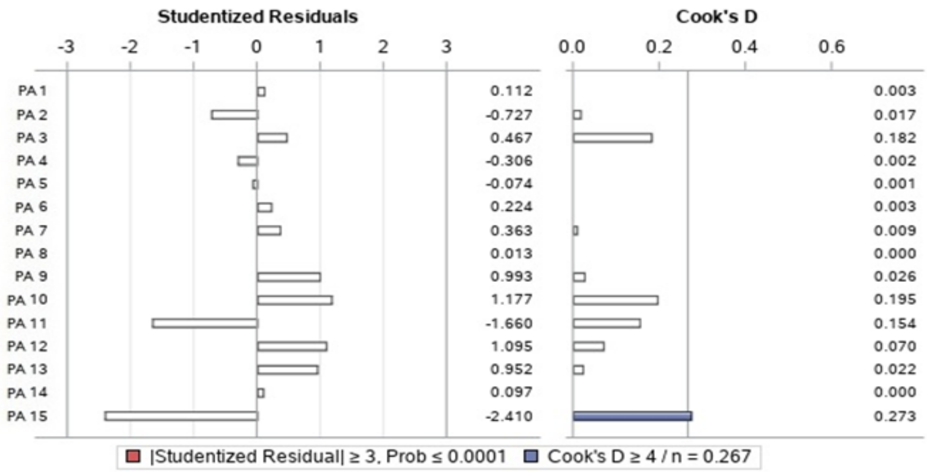

Fig. 1. *Studentized residuals and Cook's distance for leaf total chlorophyll content*

edged for being crucial in preventing human diseases and preserving excellent health (Rao & Rao, 2007). The total anthocyanin content was estimated for all the purslane accessions on a dry basis for both stem and leaves and expressed as equivalent to cyanidin-3-glucoside (CGE). The highest CGE was calculated for PA 3 (0.80µg g^{-1}), and the observed anthocyanin content was comparatively lower than in the previous studies. Dabbou *et al.* (2020) observed 1.08 ± 0.49µg g^{-1} on leaves and 4.61 ± 0.05µg g^{-1} on stems of total anthocyanin content in *Portulaca oleracea*. These can be attributable to the many accessions examined as well as the environmental circumstances.

Correlation of phytochemical properties

The phytochemical parameter values were correlated, data showed various degrees of correlation between them (Table 4.). Among the phytochemical traits, all the parameters *viz.,* leaf chlorophyll content, stem chlorophyll content, leaf carotenoid content, stem carotenoid content and total anthocyanin content showed highly significant and positive relationship within one another ranged between r = 0.88 to 0.99.

Regression for leaf total chlorophyll and total carotenoids content

The intercepts and regression coefficient's value for regression for leaf total chlorophyll (LTCHL) and total carotenoids content (LTCC) are shown in Table 5. The linear terms had a great significant effect for LTCHL. The regression results presented as ANOVA in Table 6 demonstrated that the overall model and leaf chroma showed a significant relationship for the leaf chlorophyll pigment. The highest LTCHL observed for PA 3 (1.43 mg g^{-1}) was in agreement with predicted value (1.38 mg g^{-1}) with positive studentized residual (0.467). The predicted values for LTCHL are given in Table 11. The studentized residuals for other accessions in (Fig. 1) showed negative residuals for PA 2, 4, 5, 11 and 15, indicating observed values are lower than predicted data, whereas PA 1, 3, 6, 7, 8, 9, 10, 12, 13 and14 showed positive residuals. The large studentized residuals observed (Fig. 1) for PA 15 (-2.410) indicated that the overall model was inadequate to predict the leaf total chlorophyll content in PA 15. The Cook's distance was calculated (Fig.1) as described by Cook (1977). The highest distance was calculated for PA 15 (0.273), the influential outliner negatively influencing LTCHL regression. The intercepts and regression coefficient's value for LTCC are shown in Table 7. The linear terms had a great significant effect on LTCC. The regression results presented as ANOVA in Table 8 demonstrated that the overall model and leaf chroma showed a significant relationship for leaf carotenoid pigment. The highest LTCC observed for PA 3 (0.24 mg g^{-1}) is in agreement with the predicted value (0.24 mg g^{-1}) with negative studentized residual (-0.154). The predicted values for LTCC are given in Table 11. The studentized residuals for other accessions (Fig. 2) showed negative residuals for PA 2, 3, 4, 6, 7, 11 and 15, indicating observed values are lower than predicted data, whereas PA 1, 5, 8, 9, 10, 12, 13 & 14 showed positive residuals. The large studentized residuals observed (Fig. 2) for PA 15 (-2.073) indicated that PA 15 was inadequate to predict the LTCC due to large residuals. The Cook's distance were calculated (Fig. 2), where all the accessions' distance was below 0.267, indicating no influential outliner present among the accessions, indicating that all the accessions were positive influencers to the LTCC regression.

Regression for stem total chlorophyll and carotenoids content

The ANOVA result for stem total chlorophyll (STCHL) and carotenoids content (STCC) with F value 1.90 Pr > F 0.1878 and 2.97 Pr> F 0.0740 (*p*>0.05), respectively, which are statistically not significant indicates that stem hue and stem chroma could not predict response for

Table 2. Mean performance of physical traits of purslane

Accessions	Hue angle of leaf *h* (º)	Chroma of leaf C*	Hue angle of stem top portion *h* (º)	Chroma of top portion of stem C*	Hue angle of stem base portion *h* (º)	Chroma of stem base portion C*
PA 1	134.62 ± 0.43 a	32.98 ± 1.69 g	109.62 ±1.08 c	46.51 ±1.80 cd	82.51 ± 1.33 e	27.71 ± 1.30 de
PA 2	125.36 ± 0.50 c	41.46 ± 2.25 de	107.82 ±1.21 c	49.31 ±1.49 bc	105.61 ± 1.71 a	30.23 ± 1.76 cd
PA 3	129.71 ± 1.29 b	13.49 ± 1.25 h	91.32 ±0.57 e	17.01 ±1.35 i	42.34 ± 1.09 f	19.03 ± 1.92 ij
PA 4	122.75 ± 0.11 d	41.53 ± 1.30 de	112.22 ±1.76 b	27.93 ±2.20 g	100.75 ± 2.74 bc	22.56 ± 1.52 gh
PA 5	130.65 ± 0.77 b	38.11 ± 1.56 f	116.92 ±0.58 a	45.51 ±2.08 d	103.20 ± 3.23 ab	30.75 ± 1.83 c
PA 6	123.11 ± 0.45 d	48.87 ± 1.75 b	107.84 ±0.32 c	61.68 ±1.74 a	38.73 ± 1.02 g	22.03 ± 2.32 hi
PA 7	120.80 ± 0.30 e	52.00 ± 1.18 a	108.39 ±0.84 c	50.67 ±1.79 b	41.79 ± 0.37 fg	22.40 ± 2.23 gh
PA 8	117.52 ± 0.57 h	45.86 ± 1.84 c	37.03 ±1.08 f	21.05 ±2.37 h	23.04 ± 1.39 i	34.99 ± 1.72 b
PA 9	124.91 ± 0.53 c	39.60 ± 1.09 ef	115.67 ±0.81 a	41.29 ±1.68 e	83.00 ± 2.51 de	25.12 ± 1.50 efg
PA 10	116.29 ± 0.41 i	40.71 ± 0.95 de	97.40 ±1.63 d	36.82 ±1.48 f	86.18 ± 1.82 d	34.79 ± 1.66 b
PA 11	122.53 ± 0.83 d	34.45 ± 1.24 g	113.18 ±1.46 b	30.51 ±1.72 g	101.73 ± 2.72 bc	23.38 ± 1.90 fgh
PA 12	118.56 ± 1.33 gh	50.80 ± 1.31 ab	36.62 ±1.21 f	23.27 ±1.85 h	22.08 ± 1.35 i	29.11 ± 1.91 cd
PA 13	123.32 ± 0.28 d	42.41 ± 1.12 d	112.62 ±0.87 b	41.43 ±1.77 e	102.12 ± 3.27 bc	16.38 ± 1.74 j
PA 14	120.04 ± 0.85 ef	45.60 ± 1.28 c	36.37 ±0.77 f	21.58 ±2.06 h	26.82 ± 0.72 h	40.15 ± 2.02 a
PA 15	119.13 ± 1.06 fg	48.79 ± 1.86 b	107.97 ±1.55 c	41.58 ±1.51 e	99.20 ± 2.69 c	25.99 ± 1.61 ef

Data are mean values with standard deviations (n = 3). Different letters in the same column indicate significant differences (p<0.05) by Duncan's Multiple Range Test.

Table 3. Mean performance of phytochemical traits of purslane

Accessions	Leaf Total Chlorophyll content (mg g^{-1})	Leaf Total Carotenoid content (mg g^{-1})	Stem Total Chlorophyll content (mg g^{-1})	Stem Total Carotenoid content (mg g^{-1})	Total Anthocyanin content (µg g^{-1})
PA 1	0.83 ±0.10 cd	0.14 ±0.02 cde	0.27 ±0.03 cd	0.08 ± 0.01 bcde	6.33 ±0.51 d
PA 2	0.76 ±0.10 d	0.13 ±0.02 def	0.25 ±0.03 d	0.06 ± 0.01 def	5.83 ±0.47 d
PA 3	1.43 ±0.16 a	0.24 ±0.03 a	0.49 ±0.05 a	0.12 ± 0.01 a	19.25 ±1.54 a
PA 4	0.91 ±0.11 bcd	0.14 ±0.02 cde	0.28 ±0.03 cd	0.07 ± 0.01 cdef	6.93 ±0.55 d
PA 5	0.81 ±0.10 cd	0.13 ±0.02 def	0.26 ±0.03 d	0.06 ± 0.01 def	6.13 ±0.49 d
PA 6	0.84 ±0.09 cd	0.10 ±0.01 fg	0.18 ±0.02 e	0.04 ± 0.01 f	3.48 ±0.28 e
PA 7	0.86 ±0.10 cd	0.11 ±0.01 efg	0.17 ±0.02 e	0.05 ± 0.01 ef	3.31 ±0.26 e
PA 8	1.03 ±0.13 bc	0.17 ±0.02 bc	0.34 ±0.04 bc	0.09 ± 0.01 abc	13.82 ±1.11 b
PA 9	1.13 ±0.14 b	0.19 ±0.02 b	0.37 ±0.04 b	0.10 ± 0.01 abc	11.30 ±0.90 c
PA 10	1.36 ±0.16 a	0.22 ±0.03 a	0.46 ±0.06 a	0.11 ± 0.01 ab	18.33 ±1.47 a
PA 11	0.84 ±0.11 cd	0.14 ±0.02 cde	0.28 ±0.04 cd	0.09 ± 0.01 bcd	6.39 ±0.51 d
PA 12	1.08 ±0.12 b	0.18 ±0.02 b	0.35 ±0.04 b	0.10 ± 0.01 ab	14.51 ±1.16 b
PA 13	1.11 ±0.13 b	0.18 ±0.02 b	0.36 ±0.04 b	0.10 ± 0.01 abc	11.08 ±0.89 c
PA 14	0.98 ±0.10 bcd	0.16 ±0.02 bcd	0.32 ±0.03 bcd	0.08 ± 0.01 bcd	13.13 ±1.05 b
PA 15	0.49 ±0.06 e	0.08 ±0.01 g	0.17 ±0.02 e	0.04 ± 0.01 f	3.73 ±0.17 e

Data are mean values with standard deviations (n = 3). Different letters in the same column indicate significant differences (p<0.05) by Duncan's Multiple Range Test.

Table 4. Pearson's correlation coefficient between the phytochemical traits of common purslane

	LTCHL	STCHL	LTCC	STCC	TAC
LTCHL	1.00000	0.92709 <.0001	0.96257 <.0001	0.88068 <.0001	0.89358 <.0001
STCHL		1.00000	0.99160 <.0001	0.95414 <.0001	0.95193 <.0001
LTCC			1.00000	0.95335 <.0001	0.94701 <.0001
STCC				1.00000	0.91890 <.0001
TAC					1.00000

p<0.05 indicates significance; LTCHL- Leaf total chlorophyll; STCHL- Stem total chlorophyll; LTCC- Leaf total carotenoids; STCC- Stem total carotenoids; TAC- Total anthocyanins

Table 5. Parameter estimates of leaf total chlorophyll content

Variable	DF	Parameter estimate	t Value	*p* Value
Intercept	1	5.40147 ± 1.765	3.06	0.0099
Leaf hue angle	1	-0.02873 ± 0.013	-2.26	0.0436
Leaf chroma	1	-0.02180 ± 0.007	-3.16	0.0083

p<0.05 indicates significance; Parameter estimates are regression coefficients ± SE

Table 6. Analysis of variance of leaf total chlorophyll content of portulaca accessions

Source	DF	Sum of Squares	MeanSquare	F Value	*p* Value
Model	2	0.36140	0.18070	5.04	0.0258
Leaf hue angle	1	0.00377	0.00377	0.11	0.7514
Leaf chroma	1	0.35763	0.35763	9.97	0.0083
Error	12	0.43055			
Total	14	0.79195			

DF: Degree of freedom; R-Squared – 0.4563;Adjusted R-Squared – 0.3657 ;*p*<0.05 indicates significance

STCHL and STCC.

Regression for total anthocyanin content

The intercepts and regression coefficient's value for total anthocyanin content (TAC) are shown in Table 9 The intercept, leaf chroma and leaf hue angle had a great significant effect on TAC. The results of the regression are presented as ANOVA in Table 10. It demonstrated that the overall model, leaf chroma and stem top portion hue angle showed a significant relationship for the total anthocyanin pigment. The highest TAC observed for PA 3 (19.25 μg g^{-1}) is in agreement with the predicted value (19.45 μg g^{-1}) with negative studentized residual (-0.168). The predicted values for TAC are given in Table 11. The studentized residuals for other accessions in (Fig. 3) showed negative residuals for PA 2, 3, 4, 6, 7, 8, 11, 14 and 15, indicating observed values are lower than predicted data, whereas PA 1, 5, 9, 10, 12 & 13 showed positive residuals. The large studentized residuals observed (Fig. 3) for PA 10 (2.089) indicated that the overall model was inadequate to predict the total anthocyanin pigment in PA 10. The calculated Cook's distance (Fig. 2) for PA 10 (1.227) was the influential outliner, which negatively influenced the TAC regression.

There are very few studies available for a regression model. Similar regression studies were conducted for M3 mutant line of purslane by Feizi and Fotokian (2019) and found that stem fresh weight, stem dry weight, leaf fresh weight and leaf dry weight had significant regression with plant fresh weight and were helpful in line selection stages. Stroescu *et al.* (2013) developed a regression model to predict the oil extraction on purslane and found that oil yields agree with predicted values. Similar phytochemical work was previously reported by Ignat *et al.* (2013), who developed a regression model to predict the total chlorophyll content and total carotenoid content in bell pepper.

Conclusion

In the present study, PA 3 wild type common purslane (*Portulaca oleracea* L.) had the highest phytochemical qualities among the accessions studied across all variables. Hue angle and chroma values among the accessions showed variations among themselves in the leaves and stems of the plant. As far as a multiple regression model is concerned, the hue angle and chroma value of leaves and stems could predict the leaf chlorophyll, leaf carotenoid and total anthocyanin pig-

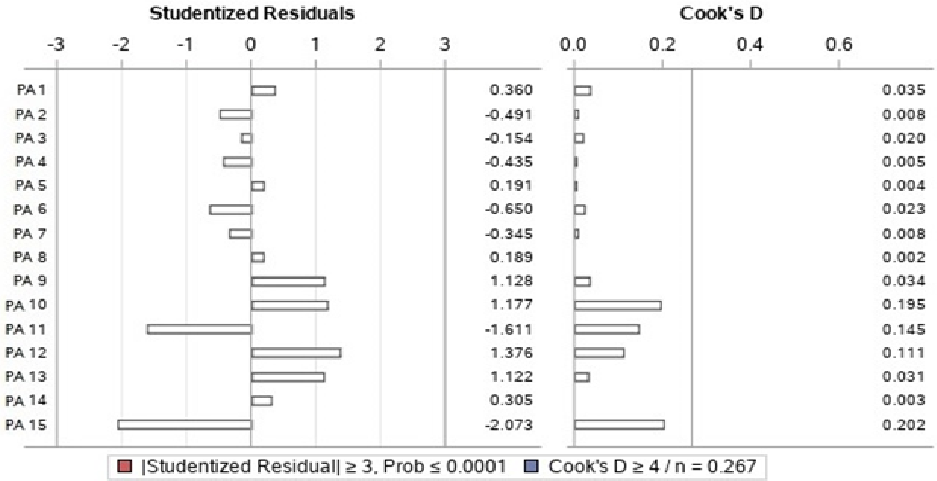

Fig. 2. *Studentized residuals and Cook's distance for leaf total carotenoid content*

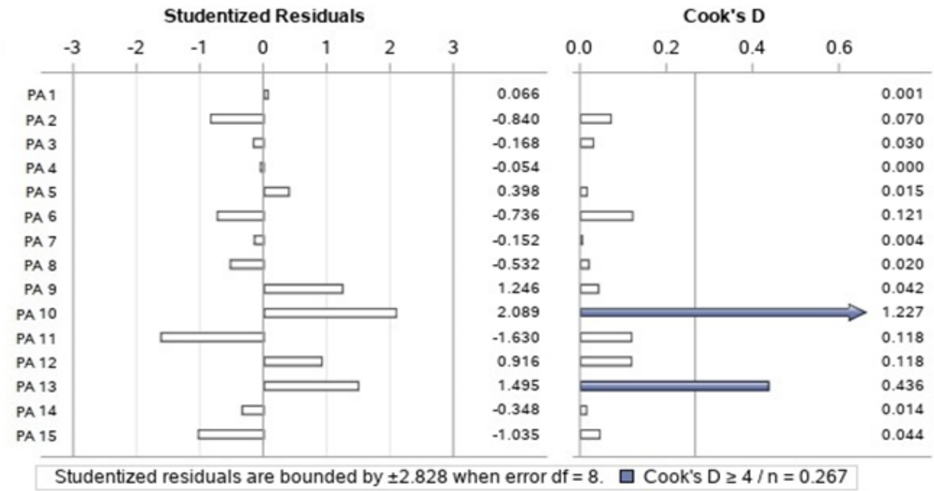

Fig. 3. *Studentized residuals and Cook's distance for leaf total anthocyanin content*

Table 7. Parameter estimates of leaf total carotenoid content

Variable	DF	Parameter estimate	t Value	*p* Value
Intercept	1	0.98496 ± 0.29931	3.29	0.0064
Leaf hue angle	1	-0.00531 ± 0.00216	-2.46	0.0301
Leaf chroma	1	-0.00429 ± 0.00117	-3.67	0.0032

DF: Degree of freedom; p<0.05 indicates significance; Parameter estimate are regression coefficients ± SE

Table 8. Analysis of variance of leaf total carotenoid content of portulaca accessions

Source	DF	Sum of Squares	MeanSquare	F Value	*p* Value
Model	2	0.01390	0.00695	6.74	0.0109
Leaf hue angle	1	0.00002	0.00002	0.03	0.8689
Leaf chroma	1	0.01387	0.01387	13.45	0.0032
Error	12	0.01238	0.00103		
Total	14	0.02627			

R-Squared – 0.5290; Adjusted R-Squared – 0.4505;p<0.05 indicates significance

Table 9. Parameter estimates of leaf total anthocyanin content

Variable	DF	Parameter estimate	t Value	*p* Value
Intercept	1	120.19834 ± 48.17	2.50	0.0372
Leaf hue angle	1	-0.63884 ± 0.33	-1.95	0.0864
Leaf chroma	1	-0.58274 ± 0.23	-2.49	0.0375
Stem top portion hue angle	1	-0.13472 ± 0.13	-1.06	0.3192
Stem top portion chroma	1	0.09906 ± 0.20	0.49	0.6372
Stem base portion hue angle	1	0.02227 ± 0.06	0.35	0.7378
Stem base portion chroma	1	-0.01797 ± 0.24	-0.08	0.9414

DF: Degree of freedom ; p<0.05 indicates significance; Parameter estimate are regression coefficients ± SE

Table 10. Analysis of variance of total anthocyanin content of portulaca accessions

Source	DF	Sum of Squares	MeanSquare	F Value	*p* Value
Model	6	292.992	48.832	3.85	0.0417
Leaf hue angle	1	17.635	17.635	1.39	0.2725
Leaf chroma	1	198.844	198.844	15.66	0.0042
Stem top portion hue angle	1	72.822	72.822	5.74	0.0435
Stem top portion chroma	1	1.841	1.841	0.14	0.7133
Stem base portion hue angle	1	1.776	1.776	0.14	0.7181
Stem base portion chroma	1	0.073	0.073	0.01	0.9414
Error	8	101.580	12.697		
Total	14	394.573			

DF: Degree of freedom; R-Squared – 0.7426; Adjusted R-Squared – 0.5495; p<0.05 indicates significance

Table 11. Predicted values for leaf total chlorophyll, leaf total carotenoid and total anthocyanin content

Accessions	Predicted Value for LTCHL	Predicted Value for LTCC	Predicted Value for TAC
PA 1	0.82 ± 0.13	0.13 ± 0.02	6.16± 2.52
PA 2	0.90 ± 0.06	0.14 ±0.01	8.12± 2.28
PA 3	1.38 ± 0.16	0.24 ±0.03	19.45± 3.34
PA 4	0.97 ± 0.05	0.15 ±0.01	7.07± 2.56
PA 5	0.82 ± 0.10	0.13 ±0.02	5.03± 2.24
PA 6	0.80 ± 0.07	0.12 ±0.01	5.12± 2.78
PA 7	0.80 ± 0.08	0.12 ±0.01	3.67± 2.68
PA 8	1.03 ± 0.08	0.16 ±0.01	15.38± 2.04
PA 9	0.95 ± 0.05	0.15 ±0.01	7.23± 1.42
PA 10	1.17 ± 0.10	0.19 ±0.02	14.01± 2.91
PA 11	1.13 ± 0.07	0.19 ±0.01	11.47± 1.74
PA 12	0.89 ± 0.07	0.14 ±0.01	12.19± 2.51
PA 13	0.93 ± 0.05	0.15 ±0.01	7.61± 2.71
PA 14	0.96 ± 0.06	0.15 ±0.01	14.06± 2.37
PA 15	0.92 ± 0.07	0.14 ±0.01	6.98± 1.69

Dependent variable predicted data mean values ± SE; Define above abbreviations below the table ments. Stem hue and chroma could not predict the stem chlorophyll and carotenoid pigments. The addition or deletion of independent variables in stem properties would help to fit the model. Thus, *P. oleracea* could be viewed as an inexpensive source of carotenoids and anthocyanins. This is the first study in India which demonstrated higher plant physicochemical diversity in a wild plant that could become a raw material to obtain several nutraceuticals.

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Conflict of interest

The authors declare that they have no conflict of interest.

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