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Evaluation of *Coleus forskohlii* Genotypes for Bio Chemical Characters

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Abstract: *Coleus forskohlii* Briq., belonging to the mint family Lamiaceae, is an important ancient root drug credited with various medicinal properties. The root extracts of *C. forskohlii* were found to contain forskolin and its therapeutic properties contributed to the emergence of *C. forskohlii* as a taxon of importance in modern medicine. Traditionally it is used for pickle making and as a condiment in India. Thirty seven *C. forskohlii* genotypes collected from various places of the important *Coleus* growing states viz., Tamil Nadu and Karnataka were evaluated for total sugars, starch and crude protein at Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore to assess its suitability for edible purpose. The genotypes exhibited remarkable variations for all the characters studied. The total sugar, starch and crude protein content in the fresh tubers varied from 5.90 to 10.03 g, 6.97 to 20.94 g and 6.14 to 9.05 g per 100 g, respectively. The genotype CF 37 excelled in the accumulation of total sugars, starch and crude protein in tuber and thus can be utilized for medicinal as well as edible purposes.

Key words: *C. forskohlii*, total sugar, starch, crude protein

INTRODUCTION

Coleus forskohlii Briq. syn. *C. barbatus* Benth, is an indigenous medicinal plant and this ancient root drug is recorded in Ayurvedic *Materia medica* under the Sanskrit name Makandi and Mayani (Shah, 1996). It is used widely against various disorders viz., antiaging, antioxidant and a remedy for heart, abdominal and respiratory disorders (Ammon and Muller, 1985; De Souza and Shah, 1988). It is common on dry, barren hills and it is cultivated in India for its roots which contains the active principle, forskolin (7 β-acetoxy-8, 13-epoxy-1α, 6 β, 9 α-trihydroxylabd-14-en-11-one) and the presence of which is exclusive to this particular species (Shah *et al*., 1980; Abraham *et al*., 1988).

De Souza and Shah (1988) indicated that *C. forskohlii* is the only known natural source of the diterpenoid forskolin. *Coleus forskohlii* is used for pickle making and it is also used as a condiment. Since, forskolin is highly used for curing diseases like glaucoma, intake of *C. forskohlii* tuber through food will be highly beneficial. Hence, the present study was postulated to access the total sugar, starch and crude protein content in the fresh tubers/roots of the *C. forskohlii* genotypes collected and thereby to ascertain their edible quality.

MATERIALS AND METHODS

A total of 37 genotypes collected from different places of Tamil Nadu and Karnataka (Table 1) were grown in the field in a randomized block design with two replications at the Botanical Garden,

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Table 1: *Coleus forskohlii* genotypes subjected to evaluation

Place of collection	Name of the genotype
Bangalore-IIHR	CF 1
Bangalore-IIHR	CF 2
Bangalore-IIHR	CF 3
Bangalore-IIHR	CF 4
Bangalore-IIHR	CF 5
Bangalore-IIHR	CF 6
Bangalore-IIHR	CF 7
Bangalore-IIHR	CF 8
Bangalore-IIHR	CF 9
Bangalore-IIHR	CF 10
Bangalore-IIHR	CF 11
Bangalore-IIHR	CF 12
Bangalore-IIHR	CF 13
Bangalore-IIHR	CF 14
Bangalore-IIHR	CF 15
Bangalore-IIHR	CF 16
Bangalore-IIHR	CF 17
Bangalore-IIHR	CF 18
Bangalore-GKVK	CF 19
Bangalore-GKVK	CF 20
Thondamuthur	CF 21
Thondamutuhr	CF 22
Yercaud	CF 23
Yercaud	CF 24
Singanallur	CF 25
Kallakuruchi	CF 26
Kallakuruchi	CF 27
Sathyamangalam	CF 28
Sathyamangalam	CF 29
Aththani	CF 30
Makkinangkombai	CF 31
Modarpalayam	CF 32
T.N.Palayam	CF 33
KN palayam	CF 34
Vellalapalayam	CF 35
Kallakuruchi	CF 36
Periyakulam	CF 37

Tamil Nadu Agricultural University, Coimbatore during 2005-06. The terminal cuttings of 15 cm length were planted at a spacing of 60×45 cm. As a prophylactic measure against root rot, the cuttings were dipped in 0.1% *Pseudomonas fluorescens* for 15 min just before planting. The recommended cultural practices along organic fertilization (vermicompost 2.5 t ha^{-1} and neemcake 1 t ha^{-1}) and plant protection measures were followed to raise an ideal crop. The roots were harvested at 180 days after planting and fresh tubers/roots were used for the sugars, starch and crude protein estimation. The amount of total soluble sugars and starch present in the tubers/roots were estimated as per the anthrone method suggested by Sadasivam and Manickam (1996). The nitrogen content in tubers/roots of genotypes was estimated by Microkjeldhal's method as recommended by Humphries (1956). From the nitrogen content, the crude protein was estimated by employing the standard multiplication factor of 6.25. The statistical scrutiny of data was done by adopting the standard procedures of Sukhatme and Amble (1985).

RESULTS

The total sugars, starch and crude protein content in the tubers/roots of all the thirty seven *C. forskohlii* genotypes were determined and the results are presented in the Table 2. Significant difference was noticed between tuberous and non tuberous genotypes for all the parameters estimated.

Table 2: Total sugar, starch and crude protein content (g per 100 g) of *C. forskohlii* genotypes

Genotypes	Total sugars in roots/tubers	Starch content in roots/tubers	Crude protein content in root/tuber
	(g/100 g)		
Non-tuberous			
CF 1	6.35	7.13	6.14
CF 2	6.52	6.97	6.37
CF 3	6.77	7.59	6.90
CF 4	6.69	7.45	6.45
CF 5	6.97	7.56	6.87
CF 6	6.78	7.36	6.80
CF 7	6.95	7.64	6.83
CF 8	6.41	7.25	6.45
CF 9	6.32	7.32	6.32
CF 10	5.90	7.57	6.75
CF 11	6.27	7.31	6.35
CF 12	7.03	7.83	6.20
CF 13	7.37	7.17	6.61
CF 14	7.42	7.72	6.95
CF 16	7.37	7.50	6.65
CF 17	7.48	7.89	6.93
CF 18	6.57	7.15	6.69
CF 23	7.49	7.35	6.91
Tuberous			
CF 15	8.42	18.25	8.14
CF 19	8.45	18.70	7.97
CF 20	9.03	19.80	8.38
CF 21	9.17	20.02	8.57
CF 22	8.53	18.92	7.85
CF 24	9.67	20.65	8.83
CF 25	8.75	19.05	8.17
CF 26	9.03	19.82	8.28
CF 27	8.72	19.47	8.11
CF 28	8.98	19.49	8.19
CF 29	9.75	20.62	8.97
CF 30	9.41	20.24	8.15
CF 31	7.87	19.38	8.07
CF 32	9.47	20.49	8.92
CF 33	9.04	19.65	8.15
CF 34	9.27	20.15	8.69
CF 35	8.81	19.52	8.11
CF 36	9.70	20.74	9.03
CF 37	10.03	20.94	9.05
Statistical analysis			
Mean	7.97	13.78	7.54
SED	0.34	0.86	0.32
CD (0.05)	0.69	1.75	0.65

Tuberous genotypes registered higher values for total sugar content in tubers and among them, genotype CF 37 registered the highest total sugar content in tubers followed by the genotype CF 36 whereas the least total sugar content in tubers of 7.87 g/100 g was registered by CF 31. Genotypes CF 23 and 10 exhibited the highest and least values of 7.49 g/100 g and 5.90 g/100 g for total sugar content in roots among non tuberous genotypes.

The starch content of roots/tubers differed significantly among tuberous and non tuberous genotypes. The starch content of tubers was the highest in the genotype CF 37 which exhibited 20.94 g/100 g of fresh tuber followed by CF 36 (20.74 g/100 g). The least starch content of 18.25 g/100 g of fresh tuber was observed in the genotype CF 15. The least starch content of 6.97 g/100 g of fresh root was noticed in CF 2 among non tuberous genotypes. Maximum starch content of 7.72 g/100 g in the roots of genotype CF 14 was observed.

Similar to starch content, the tuberous genotypes recorded higher content of crude protein in tubers than the non tuberous genotypes. The genotype, CF 37 registered an increased crude protein

content of 9.05 g/100 g followed by CF 36 which recorded 9.03 g/100 g (Table 2). The least crude protein content (7.85 g/100 g) was recorded by the genotype CF 22 among tuberous genotypes. The highest and least values of 6.95 and 6.14 g/100 g were recorded by genotypes CF 14 and 1, respectively among non tuberous genotypes.

DISCUSSION

According to Datta (1994), the first formed assimilate in the plant will be the simple sugars which will be used for the plant metabolic activities and the excess be stored in their reserve organs. In the present study, tuberous genotypes accumulated more sugars in tubers than non tuberous genotypes. Increased total sugars in tubers may be attributed to the high partitioning efficiency and increased efficiency of the sink to accumulate assimilates in the tuberous genotypes. Srivastava *et al*. (2002) also reported similar finding in *C. forskohlii* ecotypes.

Datta (1994) reported that, if the simple sugars are not used immediately, they are converted into polysaccharides, such as, starch and cellulose. The bulk of polysaccharides will be stored in the reserve organs in the solid state where they often show a high level of crystallinity, such as, starch granules. In the present study, it was observed that non tuberous genotypes had lower amount of starch in roots, whereas, in the tuberous genotypes, accumulation of starch was more. Patil (2000) reported that there are variations in the presence of starch granules in the mesophyll tissues of *C. forskohlii* genotypes. If the relative low abundance of starch grains in the leaf tissues is an indication of the efficient translocation to the sink, the tuberous genotypes should be credited with high translocation efficiency of the photosynthates to the sink (Patil, 2000). Nanaiah (1993) observed genotypic differences with reference to starch grain abundance in the mesophyll tissue and suggested that it was genetically inherited. Kavitha *et al*. (2007) concluded that tuberous genotypes accumulate more starch than non tuberous genotypes by conducting microtome section analysis of leaf mesophyll tissues. The tuberous genotypes varied among themselves for the starch content in tubers, which is in consonance with in the findings of Srivastava *et al*. (2002) in *C. forskohlii* ecotypes.

Protein is the immediate product of gene expression following transcription and translation and in the present study, significant differences were observed among genotypes for crude protein content in tubers. The variability in crude protein among different clones in cassava had been well documented. In the present study, the crude protein contents varied among the genotypes from 6.14 to 9.05 g/100 g. Similar genotypic variation for crude protein content in tubers was also recorded in several other tuber crops viz., yam (Splittstoesser *et al*., 1973), sweet potato (Purcell *et al*., 1978), *Coleus parviflorus* (Lila and Bala, 1987) and *C. forskohlii* (Srivastava *et al*., 2002).

CONCLUSION

The results obtained from the present study revealed that the genotype CF 37 excelled in the accumulation total sugar, starch and crude protein. Earlier it had been reported that the genotype 37 excelled in forskolin and essential oil content accumulation (Kavitha *et al*., 2006). Hence, it is concluded that the particular genotype may be exploited for medicinal and edible purposes. The culture requires to be tested for tuber yield for commercial exploitation.

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