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Nutritional and Neutraceutical Components of Minor Tubers

Sonal S. Aigal*, Pushpa Bharati and Divya P. Mesta

Department of Food Science and Nutrition, College of Community Science, University of Agricultural Sciences, Dharwad, Karnataka, India
**Corresponding author*

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A B S T R A C T

Roots and tubers provide a substantial part of the world's food supply and are also an important source of animal feed. They are rich in energy, dietary fibre, minerals and antioxidants. A study was conducted to evaluate the neutraceutical components present in 5 types of minor tubers. Significant difference was observed among minor tubers for proximate, carbohydrate, and neutraceutical components. The protein, fat, carbohydrate, starch and energy content of the tubers ranged from 4.14 to 8.73 g, 0.07 to 0.67 g, 76.92 to 85.56 g, 33.97 to 69.18 g and 349 to 368 kcal per 100 g of sample respectively on dry weight basis. Estimated glycemic index of the tubers varied from 53.33 to 73.74. *In vitro* protein digestibility of the tubers ranged from 87.47 to 95.13, while polyphenols, tannins and antioxidant activity ranged from 87.04 to 245.5, 2.29 to 6.54 and 6.18 to 15.17%, respectively.

Introduction

Tuber crops are the third important food crops after cereals and legumes and are either a staple or subsidiary food for about one-fifth of the world population. The tubers are consumed by only a segment of the population hence can be called underutilized crops. Cassava, sweet potato, yams, taro, aroids and tannia are the important root and tuber crops produced globally. India holds a rich genetic diversity of tropical root and tuber crops *viz.* cassava, sweet potato, aroids, yams and several minor tuber crops. The Indo-Burma region is the centre of origin of taro and Asiatic edible yams. Most of the root and tuber crops are rich in energy, minerals, vitamins, antioxidants and dietary fibre. They may play an important role in mitigating hidden hunger through diet diversification and have proved to be life sustaining crops in times of natural calamities and famine.

Taro (*arvi*), elephant foot yam (*jimikand*), and yams are grown as vegetable crops in homestead or in semi-commercial scale throughout India. Most of them are reservoirs of resistant starch, minerals, vitamins, antioxidants, and dietary fibers. Tuber crops not only enrich the diet of the people but also possess medicinal properties to cure many ailments or check their incidence. Many tropical tuber crops are used in the preparation of stimulants, tonics, carminatives

and expectorants. These crops possess medicinal properties to treat many ailments *viz.*, piles, diarrhea, vomiting, rheumatism, headache, epilepsy, leprosy, ulcers, jaundice and dysentery. Mucilage extracted from various tubers and roots has been reported to possess angiotensin converting enzyme inhibitory (Lee *et al.*, 2003) and antioxidative activities (Nagai *et al.*, 2006).

Hence the present study was undertaken with objective to estimate the nutrient composition and antioxidant properties of the selected minor tubers.

Materials and Methods

The minor tubers procured from the farmers of Joida taluk, Uttar Kannada district were washed and cleaned. The fresh sample was peeled and sliced into 1.2 mm thickness and dried in hot air oven at 40±2 °C till constant weight was attained. The dried slices were powdered and stored under refrigerated condition for chemical analysis. Chemical analysis for the nutrients namely moisture, fat and ash was carried out following the procedures of AOAC (Anon, 2005), protein by micro-Kjeldahl method using Kel Plus (Pelican model).

Carbohydrate was computed by difference method. The total and reducing sugars were determined as per Nelson-Somogyi's procedure. Glucose value was multiplied by 0.9 to convert into starch value (McCready *et al.*, 1950). All analyses were carried out in triplicates. *In vitro* starch and protein digestibilities (Moulishwar *et al.*, 1993), estimated glycemic index (Goni *et al.*, 1997), tannins (Schander, 1970), polyphenols (Anon, 2000) and antioxidant activity (DPPH method) of the selected tubers were analyzed. The results were subjected to statistical analysis (one-way analysis of variance and F-test) using SPSS software (version 16.0).

Results and Discussion

Table 1 presents the proximate composition of minor tubers. All the proximate principles differed significantly among the tubers. The moisture content was significantly higher in tannia bulbs (85.52 %), Protein content ranged from lowest of 4.14 percent in Colocasia banda type to highest content in lesser yam (7.06 %). Significant difference was seen in the carbohydrate and energy values of the tubers. Total carbohydrate content of Colocasia banda type (83.53 %), and Greater yam- lion foot type (83.44 %) did not differ significantly as indicated by F-value and was higher. The Greater yam- lion foot type (365 kcal) possessed significantly higher energy. The results of the present study are in agreement with those of Wills *et al.,* (1983) on taro of Papua New Guinea highlands, Wanasundera and Ravindran (1994) on aerial bulbs of tropics, Seralathan and Thirumaran (1999) on Colocasia tubers, Bhandari *et al.*, (2003) on wild yam tubers of Nepal, Dedeh and Sackey (2004) on Colocasia, Mcanuff *et al.,* (2005) on Jamaican yams of Jamaica, Mbofung *et al.,* (2006) on taro, Ogbuagu, (2008) on yam of Nigeria, Shanthakumari *et al.*, (2008) on wild yam of Tamil Nadu, Akin-Idowu *et al.,* (2009) on yellow yams of Nigeria, Udensi *et al.*, (2010) on water yam of Nigeria, Alinnor and Akalezi (2010) on white yam of Nigeria, Abara (2011) on aerial yam of Nigeria, Ezeocha and Ojimelukwe (2012) on water yam of Nigeria, Ezeocha *et al.*, (2012) on trifoliate yam of Nigeria, Sanful *et al.*, (2013) on aerial yam of Ghana, and Owuamanam (2013).

Carbohydrate profile including reducing sugar, non-reducing sugar, total sugar and starch, varied significantly and is narrated in Table 2. Total sugar was significantly higher in banda type of Colocasia (11.16 %), Significantly lower total sugars was recorded in Greater yam- lion foot type (1.31 %) and

was on par Greater yam- lion foot type, Greater yam- bunch type, Lesser yam. Reducing sugar was significantly higher in Colocasia banda type (3.27 %).

Non reducing sugar was significantly higher in banda type of Colocasia (7.50 %). *In vitro* starch digestibility and estimated glycemic index of the tubers were indicated in figure 1 and 3. The starch digestibility of the tubers was found to be high at 30 min and decreased sharply at 90 min. significant difference was found among the tubers. It was found that the estimated glycemic index was lowest in Colocasia banda type tuber (53.33) followed by greater yam-wild edible type (57.51).

Table.1 Proximate composition of minor tubers

Sl. No.	Tubers	Proximate principles (g/100 g)						
		Moisture	Protein	Fat	Ash	CHO		Energy (Kcal)
						Total	Available	
1.	G.Y. (lion foot type/white yam)	65.58 ± 1.24	7.03 ± 0.96	0.32 ± 0.03	3.36 ± 0.01	83.44 ± 1.04	75.64 ± 1.20	365 ± 0.35
2.	G.Y.(wild edible type)	70.50 ± 1.18	6.96 ± 0.16	0.25 ± 0.00	3.55 ± 0.04	82.93 ± 0.10	73.53 ± 0.92	362 ± 0.28
3.	Lesser yam	68.42 ± 0.94	7.06 ± 0.19	0.22 ± 0.03	3.53 ± 0.06	83.06 ± 0.33	72.86 ± 0.36	362 ± 0.57
4.	Colocasia (banda type)	68.29 ± 1.05	4.14 ± 0.22	0.40 ± 0.10	6.10 ± 0.13	83.53 ± 0.06	71.93 ± 0.87	354 ± 0.87
5.	Tannia bulbs	85.52 ± 1.20	4.43 ± 1.35	0.32 ± 0.13	5.95 ± 0.08	82.06 ± 1.28	70.66 ± 1.22	349 ± 0.58
Mean ± SD		70.45 ± 5.93	6.58 ± 1.60	0.42 ± 0.26	4.34 ± 1.27	82.16 ± 2.32	72.52 ± 2.82	359 ± 6.18
F-value		90.93	7.21	32.23	945.92	16.20	17.27	250.39
S. Em. ±		0.63	0.54	0.04	0.04	0.56	0.65	0.40
C. D. @ 1 %		2.46**	2.09**	0.18**	0.16**	2.17**	2.56**	1.56**

Note: G.Y. - Greater yam; **Significant @ 0.01 level, NS-Non-significant

Table.2 Carbohydrate profile of minor tubers

Sl. No.	Tuber	Carbohydrate profile (g/100 g)			
		Reducing sugar	Non reducing sugar	Total sugar	Starch
1.	G.Y. (lion foot type/ white yam)	0.48 ± 0.20	0.79 ± 0.28	1.31 ± 0.10	62.73 ± 3.16
2.	G.Y.(wild edible type)	1.95 ± 0.04	0.92 ± 0.20	2.92 ± 0.17	60.38 ± 1.31
3.	Lesser yam	0.51 ± 0.07	1.07 ± 0.04	1.64 ± 0.11	60.36 ± 4.80
4.	Colocasia (banda type)	3.27 ± 0.04	7.50 ± 0.55	11.16 ± 0.62	52.55 ± 0.05
5.	Tannia bulbs	0.63 ± 0.07	1.62 ± 0.36	2.34 ± 0.31	51.65 ± 6.33
Mean ± SD		1.63 ± 1.18	2.18 ± 2.11	10.28 ± 3.15	51.16 ± 11.32
F-value		152.53	60.15	162.59	19.15
S. Em. ±		0.10	0.27	0.25	2.52
C. D. @ 1 %		0.41**	1.16**	1.06**	9.83**

Note: G.Y. - Greater yam
**Significant @ 0.01 level, NS-Non-significant

Table.3 Neutraceutical properties of the tubers

Sl. No.	Tubers	Polyphenols (mg GAE/g)	Tannins (mg/g)	% DPPH
1	G. yam (wild edible type)	87.04 ± 1.87	2.29 ±0.057	11.68 ±0.26
2	Tannia bulbs	104.03 ±11.02	2.37 ± 0.024	15.97 ± 0.30
3	Lesser yam	96.23 ±4.46	3.05 ± 0.004	6.18 ± 0.48
4	G. yam (lion foot type)	245.5 ± 5.23	6.54 ± 0.077	6.33 ± 0.21
5	Colocassia banda type	207.84 ± 1.11	4.27 ± 0.011	7.59 ± 0.03
	Mean±SD	**148.1 ± 67.9**	**3.71 ± 1.68**	**9.55 ± 3.98**
	F-value	**462.3**	**3162**	**832.3**
	S. Em. ±	**3.402**	**0.031**	**0.146**
	CD @ 1%	**10.72****	**0.11****	**0.53****

** - Significant at 0.01 level

Fig.1 *In vitro* starch digestibility of the minor tubers

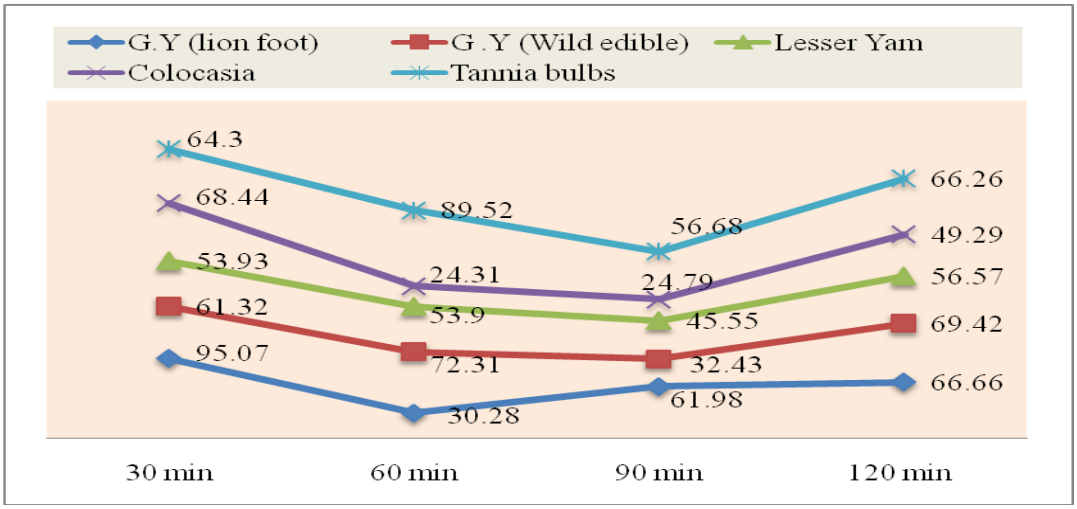


Fig.2 *In vitro* protein digestibility of minor tubers

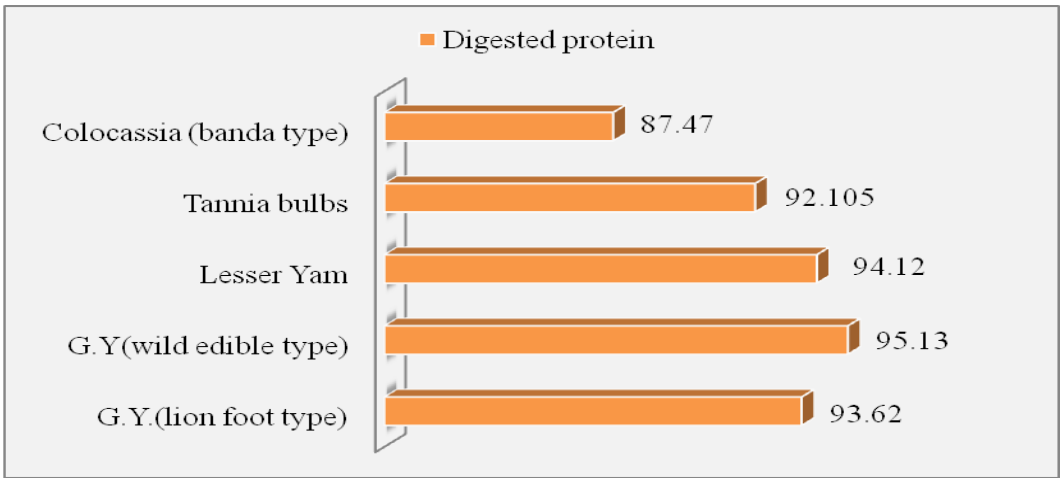
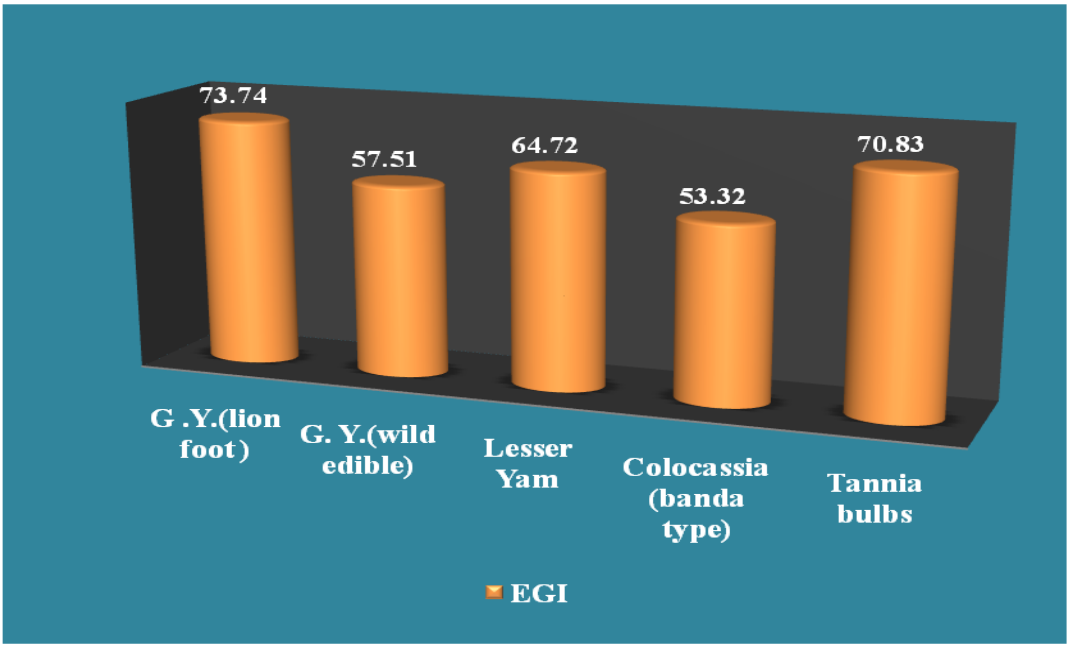


Fig.3 Estimated Glycemic Index (EGI) of minor tubers



The *in vitro* protein digestibility of tubers presented in figure 2 indicated that the protein digestibility was significantly higher among all the tubers. Greater yam (wild edible type) had the highest digestibility (95.13%) followed by lesser yam (94.12), greater yam (lion foot type- 93.62), while lower digestibility was exhibited in Colocasia banda type (87.47).

Neutraceutical properties in terms of polyphenols, tannins and DPPH antioxidant activity is given in Table 3. Results indicated that the greater yam (lion foot type) exhibited highest polyphenols and tannin content of 245.5 mg GAE/g and 6.54 mg/g respectively. Highest antioxidant activity was exhibited in tannia bulbs (15.97%) followed by wild edible type of greater yam (11.68%). The results are in agreement with study of Chandrasekara and Kumar, (2016)

Tubers are reported to possess a good source of starch, high protein digestibility, medium glycemic index, phyto-chemicals and other nutrients. Processing helps to enhance the acceptance of the tubers. Converting these tubers into other value added products may add to the best utilization of tubers as functional and health foods. Thus improves the income of farmers by lowering the post-harvest losses.

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