

Proximate Composition, Available Carbohydrates, Dietary Fibre and Anti Nutritional Factors of Selected Traditional Medicinal Plants

Anita Kochhar*, Malkit Nagi and Rajbir Sachdeva

*Department of Food and Nutrition, College of Home Science,
Punjab Agricultural University, Ludhiana, Punjab, India*

KEYWORDS Traditional Medicinal Plants. Dietary Fibre. Available Carbohydrate. Antinutritional Factors

ABSTRACT Three traditional medicinal plants known for their hypoglycemic action namely bittergourd, fenugreek seeds and jambu seeds were analysed for proximate composition, available carbohydrates, dietary fibres and antinutritional factors. Protein, fat, ash, crude fibre, carbohydrate and energy content of these medicinal plants ranged from 4.16 to 25.80, 0.49 to 6.53, 2.16 to 9.89, 1.28 to 10.92, 58.13 to 90.85 percent and 319.11 to 394.46 kcal respectively. Total soluble sugars, reducing sugars, non-reducing sugars and starch content varied from 2.03 to 11.76, 0.78 to 4.43, 1.03 to 8.0 and 29.20 percent respectively. Dietary fibre constituents like NDF, ADF, hemicellulose, cellulose, lignin, pectin, total dietary fibre varied from 21.90 to 39.66, 2.35 to 13.46, 8.44 to 34.75, 1.46 to 8.23, 0.38 to 5.18, 0.36 to 2.95, 22.4 to 40.38 percent respectively. Phytic acid, phytin phosphorus, polyphenol and saponin content of these three medicinal plants varied from 12.90 to 549, 3.63 to 154.7, 103.8 to 361.40, 214.53 to 1646.58 percent respectively. It was found that these plants are good source of protein, fat, minerals, crude fibre and energy. They are rich source of available carbohydrates and dietary fibre. They also contain anti-nutrient content which help in controlling blood sugar. Thus, it was concluded that these hypoglycemic traditional medicinal plants provide various nutrients which are not provided by allopathic medicine and these plants have no side effects. So, the diabetic patients should be encouraged to include these medicinal plants in their daily diet to control blood sugar level.

INTRODUCTION

The incidence of diabetes mellitus is increasing all over the world and is becoming a problem of significant importance in the affluent societies. Oral hypoglycemic drugs have been frequently used for controlling non-insulin dependent diabetes mellitus but allopathic medicines have side effects.

Medicinal plants and herbs are of great importance to the health of individuals and communities. Despite the existence of herbal medicines over many centuries, only relatively small number of plant species have been studied for their application. However, in the recent past, an increasing research evidence is getting accumulated, which clearly indicate the positive role of traditional medicinal plant in the prevention or control of some metabolic disorders like diabetes, heart diseases and certain types of cancers (Zhang, 1996). One of the great

advantage of these medicinal plant is that these are easily available and have no side effects (Mehta, 1982).

A scientific investigation of traditional herbal remedies for metabolic disorders may provide valuable lead for the development of alternative drug and therapeutic strategies. Various workers have reported the hypoglycemic and hypolipidemic effect of various traditional medicinal plants like fenugreek, jambu and bittergourd. But there is limited information on the nutritional and anti-nutritional factors of these three medicinal plants which lowers the blood glucose and lipid profile. The work is thus, aimed at determining the chemical composition, available carbohydrates, dietary fibre and anti-nutritional factor of traditional medicinal plants.

MATERIAL AND METHODS

Procurement and Processing of the Material: The raw materials, bittergourd fruit (*Momordica Charantia*), fenugreek seeds (*Trigonella foenum, graceum*) and jambu seeds (*Euglnia jambolana*) were procured from local market of Ludhiana city in one lot.
Bittergourd: Fresh immature bittergourd fruit

*Address all correspondence to: Dr. (Mrs.) Anita Kochhar Associate Professor, Department of Food and Nutrition College of Home Science, Punjab Agricultural University, Ludhiana, Punjab
Telephone: 091-0161-2401960/328 Extn. (O)
091-0161-5025890 (R), 9872453467 (M)

were washed in clean water and water was wiped out with clean muslin cloth and were cut into small pieces by stainless steel knife and then dried in oven at 60 to 65°C till complete drying and then converted to the fine powder of 60 mesh sieve size in cyclotec mill. The fine powder of bittergourd was stored in airtight plastic container.

Fenugreek Seeds: Foreign materials were removed from fenugreek seeds and these seeds were washed in clean water to remove the dust. The seeds were soaked in equal volume of water for overnight and excess water was drained off. The soaked seeds were dried in oven at 60-65°C till complete drying and ground to fine powder. The fine powder of fenugreek seeds was stored in air tight plastic container.

Jambu Seeds: The pulp of jambu fruit was removed with stainless steel knife and seed coat was removed. The seed kernels were dried in an oven at 60-65°C till complete drying and ground to fine powder of 60 mesh sieve size in a cyclotec mill and stored in air tight plastic container.

Chemical Composition: The contents of moisture, crude protein (N x 6.25) extractable fat, crude fibre and total ash were determined as described in the AOAC (1990). Total carbohydrate and energy content was calculated by the method of AOAC (1990).

Available Carbohydrates: Extraction of water soluble sugar other than starch was carried out by the method of Corning and Guilhot (1973). Total soluble sugar in the above solution was estimated by method of Yemen and Willis

(1987). Reducing sugars were estimated by the method of Nelson (1944). The content of non-reducing sugar was calculated from the difference between soluble sugar and reducing sugar. Starch was estimated by the method of Clegg (1956).

Dietary Fibre Constituents: Neutral detergent fibre, Acid detergent fibre, Hemicellulose, Cellulose, Lignin were determined by method described by Van Soest and Wine (1967), modified by Arora (1981). Total pectin was determined by the method Ranganna (1977).

Anti-nutritional Factors: Phytic acid content was determined by the method of Hang and Lantzh (1983). Polyphenolic compounds were extracted from the sample by the method of Singh and Jambunathan (1981). The amount of phenolic compounds were estimated as tannic acid equivalent according to Folin Denis procedure given by Swain and Hills (1959). Sapanin was estimated by the method given by Gestetner et al. (1966).

RESULTS AND DISCUSSION

Proximate Composition: The proximate composition of different traditional medicinal plants are given in Table 1. Moisture content of medicinal plants ranged from 11.76 percent in fenugreek seeds to 93.43 percent in bittergourd (Table 1). Moisture content of these medicinal plants differed significantly ($P \leq 0.01$) from each other. Gopalan et al. (1992) reported almost similar moisture content of bittergourd and

Table 1: Proximate composition and energy content of medicinal plants.

Medicinal plants	g/100g on dry weight basis						Energy (kcal/100g)
	Moisture	Crude protein	Extractable fat	Ash	Crude fibre	Total CGO	
1. Bittergourd fruit	93.43±0.86 ^a	20.53±0.46 ^b	0.49±0.02 ^c	9.89±0.9 ^a	10.92±0.08 ^a	58.17±0.65 ^b	319.11±0.62 ^b
2. Fenugreek seeds	11.76±0.26 ^c	25.8±0.16 ^a	6.53±0.17 ^a	3.26±0.20 ^b	6.28±0.85 ^b	58.13±0.21 ^b	394.46±1.3 ^a
3. Jambu seeds	40.86±0.25 ^b	4.16±0.13 ^c	1.55±0.25 ^b	2.16±0.12 ^c	1.28±0.62 ^c	90.85±0.18 ^a	393.96±0.34 ^a
t-value							
Bittergourd vs fenugreek seeds	128.70***	15.13***	49.86***	41.78**	55.39***	0.12 ^{NS}	72.04***
Bittergourd vs jambu seeds	83.18***	47.92***	46.23***	71.07**	132.38***	68.71***	149.82***
Fenugreek seeds vs jambu seeds	113.65***	145.06***	40.99***	6.47**	67.06***	168.16***	0.51 ^{NS}

Values are mean±S.D. of three replicates

*** Significant at 1% level

** Significant at 5% level

NS Non significant

a>b>c

fenugreek seeds. Jambu seeds contained minimum crude protein (4.16%) while fenugreek seeds were richest source of it (25.8%) followed by bittergourd (20.53%). There was significant differences ($P \leq 0.01$) in protein content of these medicinal plants. Ether extractable fat content of medicinal plants ranged from 0.49 to 6.53 percent in bittergourd and fenugreek seeds, respectively. Significant differences ($P \leq 0.01$) were found in fat content of these medicinal plants. Ash content of bittergourd fruit was maximum (9.89%) while it was lowest in jambu seeds (21.6%). Significant differences ($P \leq 0.05$) were found in ash contents of these medicinal plants. Crude fibre content of medicinal plants ranged from 1.28 (jambu seeds) to 10.92 percent (bittergourd fruit). Crude fibre content of medicinal plants was significantly ($P \leq 0.01$) different from each other. Total carbohydrate content ranged from 58.13 in fenugreek seeds to 90.85 percent in jambu seeds. Non-significant differences were found in carbohydrate content of bittergourd and fenugreek seeds while significant ($P \leq 0.01$) difference was found when carbohydrate content of jambu seeds was compared with bittergourd and fenugreek seeds. The energy value of bittergourd was significantly different from fenugreek and jambu seeds while non-significant differences in energy intake of jambu seeds and fenugreek seeds. Gopalan et al. (1992) reported slightly higher amount of moisture and fibre and slightly less protein, fat, minerals, carbohydrate and energy content in fenugreek seeds. Similar amount of carbohydrates and protein in fenugreek seeds was also reported by Saibaba and Raghuram (1997).

Available Carbohydrates: Table 2 presents the available carbohydrate contents of these medicinal plants. Total soluble sugar content of medicinal plants ranged from 2.03 (bittergourd fruit) to 11.76g/100g (jambu seeds) on dry weight basis. Significant ($P \leq 0.01$) differences were found between total soluble sugar content of different medicinal plants. Reducing, non-reducing and starch content of medicinal plants varied from 0.78 to 4.43, 1.03 to 8.0 and 4.33 to 29.20g/100g dry weight basis respectively. Significant differences ($P \leq 0.01$) were found in content of reducing, non-reducing sugar and starch content of different medicinal plants except non-significant difference was found in content of reducing sugar of bittergourd and fenugreek seeds. Lower total, reducing and non-

Table 2: Available carbohydrate content of medicinal plants.

Medi- cinal plants	g/100g on dry weight basis			
	Total soluble sugars	Reducing Sugars	Non reducing sugars	Starch
1. Bitter- gourd fruit	2.03±0.12 ^c	1.0±0.81 ^b	1.03±0.12 ^c	4.33±0.19 ^c
2. Fenugreek seeds	8.78±0.90 ^b	0.78±0.98 ^b	8.00±0.82 ^a	20.83±0.40 ^b
3. Jambu seeds	11.76±0.20 ^a	4.43±0.12 ^a	7.73±0.12 ^b	29.20±0.75 ^a
t-value				
Bitter- gourd vs fenugreek seeds	62.12***	2.36 ^{NS}	66.09***	52.47***
Bitter- gourd vs jambu seeds	57.26***	32.57***	50.51***	45.57***
Fenugreek seeds vs jambu seeds	18.79***	32.46***	6.32**	13.92***

Values are mean ±S.D. of three replicates

*** Significant of 1% level

** Significant of 5% level

NS Non significant

a>b>c

reducing sugar and almost similar starch content of fenugreek seed has been reported early by El-mandy and Sebaiy (1983). While higher total sugar content of fenugreek seeds has also been reported earlier by Singh et al. (1994) and lower starch content (0.32%) has been reported earlier by Nahar et al. (1993).

Dietary Fibre Constituents: Table 3 presents the dietary fibre constituents of these medicinal plants. Neutral detergent fibre (NDF), acid detergent fibre (ADF) content of medicinal plants ranged from 21.90 to 39.66 and 2.35 to 13.46g/100g on dry weight basis respectively. Hemicellulose, cellulose, lignin, pectin content of these medicinal plants varied from 8.44 to 34.75, 1.46 to 8.23, 0.38 to 5.18 and 0.36 to 2.95g/100g respectively. Total dietary fibre content of jambu seeds was maximum (40.38g/100g) while it was minimum in bittergourd (22.4g/100g). NDF content of these medicinal plants was significantly different ($P \leq 0.01$). Similarly ADF and hemicellulose content of these medicinal plants were also significantly ($P \leq 0.01$) different. Significant differences were found in cellulose content of bittergourd-gourd fruit, fenugreek seeds and jambu seeds. Lignin

content of bittergourd fruit was maximum 5.18 and minimum in fenugreek seeds 0.38 followed by jambu seeds 1.33g/100g and lignin content of these medicinal plants were significantly ($P \leq 0.01$) different. Pectin content was higher 2.95g/100g in fenugreek seeds and minimum in bittergourd 0.36g/100g followed by jambu seeds 1.76g/100g.

Gopalan et al. (1992) reported 41g total dietary fibre for fenugreek seeds. Studies conducted at NIN reported that fenugreek seeds contained very high amount of total dietary fibre content (48g/100g). Udayasekhra Rao and Ramulu (1998) reported that fenugreek seeds were the only among the food analysed that contained 20 percent soluble fibre. Dietary fibre content 5%, NDF 2.27%, ADF 1.47% and lignin 0.44% of bittergourd on fresh weight basis has been reported earlier by Sreedevi and Chaturvedi, (1993). Osman, (1990) reported that bittergourd contained 4.21 lignin/100g. Higher total dietary fibre content 68.59% of bittergourd has been

reported earlier by Nahar et al. (1993).

Antinutritional Factors: Table 4 presents the data about antinutritional factors present in the medicinal plants. Phytic acid and phytin phosphorus contents ranged from 12.90 (bittergourd) to 549mg/100g (fenugreek) and 3.63(bittergourd) to 154.70 (fenugreek) mg/100g respectively. Significant ($P \leq 0.01$) differences were obtained in phytic acid content of these medicinal plants. Similarly phytin phosphorus was also found significantly different. Gopalan et al. (1992) reported almost similar phytin phosphorus content in fenugreek seeds and Singh et al. (1994) observed the lower phytic acid in fenugreek seeds. Polyphenol content varied from 103.81 (bittergourd) to 361.60 (jambun seeds) mg/100g dry weight basis. Non-significant differences were found in polyphenol content of bittergourd fruit and fenugreek seeds.

Highly significant ($P \leq 0.01$) differences were found when polyphenol content of jambu seeds was compared with bittergourd and fenugreek

Table 3: Dietary fibre constituents of medicinal plants.

Medicinal plants	g/100g on dry weight basis						Total dietary fibre
	NDF	ADF	Hemicellulose	Cellulose	Lignin	Pectin	
1. Bittergourd fruit	21.90±0.22 ^c	13.46±0.12 ^a	8.44±0.33 ^c	8.23±0.17 ^a	5.18±0.62 ^a	0.36±0.48 ^c	22.4±0.15 ^c
2. Fenugreek seeds	35.15±0.40 ^b	2.35±0.41 ^c	32.80±0.39 ^b	1.46±0.94 ^c	0.38±0.21 ^c	2.95±0.01 ^a	35.29±0.36 ^b
3. Jambu seeds	39.66±0.94 ^a	4.91±0.62 ^b	34.75±0.70 ^a	3.71±0.62 ^b	1.33±0.17 ^b	1.76±0.34 ^b	40.38±0.28 ^a
<i>t-value</i>							
Bittergourd vs fenugreek seeds	85.22***	119.80***	103.71***	49.24***	102.92***	17.40***	46.90***
Bittergourd vs jambu seeds	105.94***	86.72***	110.30***	35.28***	30.07***	5.35***	81.08***
Fenugreek seeds vs jambu seeds	60.78***	48.70***	34.25***	28.15***	7.87***	14.76***	15.63***

Values are mean±S.D. of three replicates

*** Significant at 1% level

Table 4: Antinutritional content of medicinal plants.

Medicinal plants	mg/100g on dry weight basis			
	Phytic acid	Phytin phosphorus	Polyphenol	Saponin
1. Bitter gourd fruit	12.90±0.29 ^c	3.63±0.08 ^c	103.81±0.10 ^b	214.53±0.78 ^c
2. Fenugreek seeds	549.0±0.37 ^a	154.7±1.05 ^a	105.35±0.47 ^b	1646.58±0.81 ^a
3. Jambu seeds	215.35±0.25 ^b	60.68±0.69 ^b	361.40±0.50 ^a	607.66±0.17 ^b
<i>t-value</i>				
Bittergourd vs fenugreek seeds	202.62***	226.74***	1.94 ^{NS}	1794.58***
Bittergourd vs jambu seeds	115.97***	313.19***	322.10***	297.07***
Fenugreek seeds vs jambu seeds	105.26***	140.17***	527.48***	779.95***

Values are mean ±S.D. of three replicates

*** Significant of 1% level

NS Non significant

seeds. Singh et al. (1994) reported lower polyphenol content in fenugreek seeds. Saponin content of the medicinal plants varied from 214.53 (bittergourd fruit) to 1646.58 (fenugreek seeds) mg/100g on dry weight basis. Saponin content was significantly different in all medicinal plants. Higher saponin content has been reported earlier by Udayasekhara Rao and Sharma (1987) while Singh et al. (1994) reported lower saponin content in fenugreek seeds.

CONCLUSION

In addition to their hypoglycemic action, bittergourd, fenugreek seeds and jamun seeds are good source of protein, fat, minerals, crude fibre and energy. They are rich source of available carbohydrates and dietary fibre. They also contain antinutrient content which helps in controlling blood sugar. Thus, it was concluded that these hypoglycemic traditional medicinal plants provide various nutrients which are not provided by allopathic medicine and these plants have no side effects. So, the diabetic patients should be encouraged to include these medicinal plants in their daily diet to control blood sugar.

REFERENCES

- AOAC: *Official Methods of Analysis*. 15th Edn. Association of Official Analytical Chemists Washington, DC, USA (1990).
- Arora, S.K.: Analytical techniques for quality evaluation. *Forage Research*, **7A**: 197-213 (1981).
- Clegg, K.M.: The application of anthrone reagent to the estimation of starch in cereals. *J. Sci. Food Agric.*, **7**: 40 (1956).
- Corning, J. and. Guillhot, J.: Changes in carbohydrate composition during maturation of wheat and barley Kernel. *Cereal Chem.*, **50**: 220 (1973).
- EL-Mandy, A.R. and E L Sebaiy, A.: Changes in carbohydrates of germinating fenugreek seed (*Trigonella foenum graecum*). *J. Sci. Food Agri.*, **34**: 951-56 (1983).
- Gestetner, B., Birk, Y., Bondi, A. and Tencer, Y.: Soyabean saponin VIII. A method for the determination of sapoglenin and saponin contents of soyabean. *Phytochem*, **5**: 803 (1966).
- Gopalan, C., Rama Sastri, B.V. and Balasubramanian, S.C.: Revised and updated by Narasingha Rao B.S., Deosthale, J.G. and Pant, K.C.: *Nutritive value of Indian Foods*. NIN, ICMR, Hyderabad, India (1992).
- Hang, W and Lantzch, H.J.: Sensitive method for rapid determination of phytate in cereals and cereal products. *J. Sci. Food. Agric.*, **34**: 1423-26 (1983).
- Mehta, K.C.: Indian herbal drugs in the treatment of diabetes. *Current Medical Practice*, **26**: 305-309 (1982).
- Nahar, N., Mosihuzzaman, M. and Dey, S.K.: Anaylsis of free and sugar dietary fibre of some vegetables of Bangladesh. *Food Chem.*, **46**: 397-400 (1993).
- Nelson, N.: A photometric adaptation of the somogyi method for determination of glucose. *J. Biol. Che.* **153**: 375-380 (1944).
- Osman, H.: Dietary fibre composition of common vegetables and fruits in Malaysia. *Food Chem.*, **37**: 21-26 (1990).
- Ranganna, S.: *Manuals of Analysis of Fruits and Vegetable Products*. Tata McGraw Hill Publishing Co., New Delhi (1997).
- Saibaba, A. and Raghuram, T.C.: Fenugreek the wonder seed. *Nutrition*, (NIN, ICMR, Hyderabad), **31**: 21-25 (1997).
- Singh, J., Gupta, K. and Arora, S.K.: Changes in antinutritional factors of developing seeds and pod wall of fenugreek (*Trigonella foenum graecum* L). *Plant Food for Human Nutrition*, **46**: 77-84 (1994).
- Singh, V. and Jambunathan, R.: Studies on desi and kabuli chickpea cultivars. The level of protease inhibitors, level of phenolic compounds and invitro digestibility. *J. Food Sci.*, **46**: 1364 (1981).
- Sreedevi and Chaturvedi, A.: Effect of vegetable fibre on post prandial glycemia. *Plant Food for Human Nutr.*, **44**: 71-78 (1993).
- Swain, J. and Hills, W.E.: The phenolic constituents of prumas domestical. The qualitative analysis of phenolic constituents. *J. Sci. Food Agric.*, **10**: 63 (1959).
- Udaya Sekhara Rao, P. and Ramulu, P.: Dietary Fibre. *Nutrition News*, (NIN, Hyderabad) **19**: 2 (1998).
- Udaya Sekhara Rao, P. and Sharma, R.D.: An evaluation of protein quality of fenugreek seeds (*Trigonella foenum graecum*) and their supplementary effects. *Food Chem.*, **24**: 1-9 (1987).
- Van Soest, P.J. and Wine, R.H.: Use of detergents in the analysis of fibre foods. Determination of plant cell wall constituents. *AOAC*, **50**: 1107 (1967).
- Yemen, E.W. and Willis, A.J.: The estimation of carbohydrates in plant extracts by anthrone. *Bio. Chem. J.*, **57**: 508 (1954).
- Zhang, X.: Traditional medicine and WHO World Health. *The Magazine of World Health Organization*. 49th year **No.2**: 4-5 (1996).