

NUTRITIONAL COMPOSITION OF WINGED BEAN, *PSOPHOCARPUS TETRAGONOLOBUS* (L) DeCANDOLE

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ABSTRACT

Eighteen varieties of Winged bean, *Psophocarpus tetragonolobus* (L) DeCandole seeds were evaluated for proximate composition. The range of proximate principles of these test varieties were as follows : moisture, 8.5 to 10.1 per cent; ash, 3.4 to 4.8 per cent; fibre, 10.8 to 12.9 per cent; protein, 33.4 to 39.7 per cent; fat, 16.5 to 20.6 per cent; carbohydrates, 25.1 to 33.1 per cent and energy value, 417.5 to 440.7 Kcal on dry weight basis. It was possible to group these varieties into eight clusters, based on nutritional characteristic of seeds, by using Mahalanobis D² statistics and canonical variate analysis. It was also observed that protein and fat contributed maximum in creating diversity among these varieties.

INTRODUCTION

Winged bean, *Psophocarpus tetragonolobus* (L) DeCandole is an important underutilized plant. (NAS, 1975). This crop originated in South East Asia with maximum diversity in Papua New Guinea. This is also a backyard crop in the southern part of India and is sown in the beginning of the rainy season, commonly called *Chaukoni sem* in Hindi. The seeds of this crop contain about 34 per cent protein and 17 per cent fat. They are also rich in lysine and tocopherol. The nutritive quality of cooked bean as estimated by protein efficiency ratio and net protein utilisation values compares well with soybean (Cerny *et al.*, 1971). As in other pulses and legumes antinutritional factors such as trypsin inhibitor, amylase inhibitor and haemagglutinins are present in winged bean. Literature indicates that these can be eliminated by cooking procedures (Sathe and Salunkhe, 1981). Therefore, investigations were carried out on the proximate composition of seeds of various varieties of winged bean to understand the variations in the nutritional composition of seeds.

MATERIAL AND METHODS

Eighteen varieties of winged bean seed were selected for investigating their proximate composition (Table 1). The whole grain

samples were cleaned free of dust and grit. They were ground in a hand grinder to a coarse powder to pass through 40-mesh sieve. The samples were stored in airtight container for further use. In order to avoid seasonal and climatic effects during determination of moisture content, the seed samples were allowed to imbibe maximum amount of moisture. For this, 10 gm ground samples of each variety were tied in a muslin cloth. These bags were kept in an atmosphere maintaining 75 per cent r.h. using saturated sodium chloride (Winston and Bates, 1960). After 12 days moisture content in the samples were determined by the method described in AACC (1962). A 2 gm sample of each variety was weighed in a dry aluminum dish. All the dishes were oven dried at 105°C to a constant weight. From the difference from the pre weighed sample, moisture content was calculated and the data was presented as percent. The protein was estimated in 1 gm flour of the seeds of each variety by Macro - Kjeldahl method and actual amount was estimated by a conversion factor of 6.25. Soxhlet extraction procedure was used for estimating fat content of seeds (AACC, 1962). For this 0.5 gm sample of seed of each variety was extracted for 16 hr using petroleum ether (40-60°C) and data was calculated in per cent

Table 1. Proximate composition of seeds of winged bean varieties on dry weight basis
(Data expressed in percentage)

Variety	Moisture	Ash	Fibre	Protein	Fat	Carbohydrate	Energy (Kcal)
IHR 3	10.1	4.1	12.0	35.5	19.6	28.8	434.5
IHR 6	9.3	3.4	10.9	36.7	18.0	31.2	434.3
IHR 12	9.4	4.2	12.4	36.2	18.8	28.4	427.4
IHR 13	9.4	4.2	12.9	39.2	17.9	25.6	420.1
IHR 23	9.5	4.1	12.4	37.3	20.4	25.6	435.3
IHR 25	9.1	4.1	10.8	39.7	17.9	27.2	430.1
IHR 60	10.0	4.3	11.2	36.0	20.6	27.8	440.7
IHR 74	8.5	3.9	12.2	39.0	19.1	25.9	431.4
PT15	9.5	4.7	12.7	37.0	17.4	28.2	417.5
PT18	9.9	4.4	11.4	33.6	19.6	31.0	434.8
SLS 1	9.4	4.2	11.5	36.9	18.4	29.2	429.5
SLS 1A	8.7	4.8	12.5	38.4	19.2	25.1	426.8
SLS 1 B	9.2	4.2	11.5	36.8	16.5	31.0	419.0
SLS 7	9.8	4.7	12.3	35.1	18.5	29.5	424.6
Thailand 3	9.5	4.5	11.9	38.4	19.4	25.7	430.7
TPT 2	9.6	4.4	12.9	36.3	18.0	28.3	420.0
Trivandrum	9.3	4.7	11.2	33.7	19.8	30.6	435.4
UPS 66	10.1	4.0	11.6	33.4	17.9	33.1	427.8
P = 0.05	0.4	0.1	0.4	0.6	0.4	0.9	2.3

(AACC, 1962). The carbohydrate content was calculated by subtracting the sum of percentage values of moisture, ash, fibre, protein and fat from 100 and reported as carbohydrate by difference. Total ash content was estimated by ashing 2 gm sample of each variety of seeds in pre-dried porcelain crucibles in the muffle furnace at 550°C for 16 hr. The crucible was cooled and weighed to a constant weight. The difference from the pre-weighed crucible was expressed as per cent ash. Energy content of each variety was also calculated on the basis of physiological fuel values of protein (1 gm = 4 Kcal), carbohydrate (1 gm = 4 Kcal) and fat (1 gm = 9 Kcal). Completely randomized design was used to analyse the data of proximate composition.

Concept of group constellation was employed to understand the overall grouping of the test varieties. For this Mahalanobis D² statistics and Canonical variate analysis was employed by using various characters recorded in the proximate composition. Clustering was carried out by Tocher's method (Rao, 1970;

Singh and Chaudhary, 1977). Per cent contribution of each character in creating diversity among varieties was calculated by using the formula:

$$\text{Per cent contribution} = \frac{N \times 100}{N(n-1)/2}$$

Where,

N = number of times a particular character has been ranked 1;

n = number of treatments.

RESULTS AND DISCUSSION

I. Proximate composition

Moisture content of 18 varieties of winged bean seeds ranged from 8.5 to 10.1 per cent. Lowest moisture was present in variety IHR 74 while the highest moisture was recorded in IHR 3 and UPS 66. The National Academy of Sciences (NAS) (1975) has reported 6.7 to 24.6 per cent of moisture content in the winged bean seeds. Majority of workers have also reported it in the range of 8.54 to 12.58 per cent (Watson, 1971; Claydon, 1974; Gandjar, 1978; Rockland

et al., 1979; Umadevi and Wankhede, 1981). Gracia and Palmer (1980) worked on five varieties of winged bean and reported moisture content in the range of 8.2 to 11.6 per cent. Values of moisture content recorded in this study fall within this range. The difference in values could be attributed to the method of sampling and method followed in estimating the moisture content of the seeds. In this study, seeds were allowed to imbibe maximum moisture content as per their physico-chemical characteristics. Therefore, it is free from the environmental variations caused by relative humidity of surrounding atmosphere (Winston and Bates, 1960).

Total ash content in the test varieties ranged from 3.4 to 4.8 per cent (Table 1). The ash content of this seed ranged from 3.3 per cent (Watson, 1971) to 4.7 per cent (Gracia and Palmer, 1980; Umadevi and Wankhede, 1981). The values obtained in the present investigation fall within this range. The differences in ash content reported in some studies could be attributed to the difference in the mineral content of the soil (Kadwe *et al.*, 1974). The fibre in 18 varieties ranged from 10.8 to 12.9 per cent. The lowest fibre was present in IHR 25 while the highest was present in IHR 13 and TPT 2 (Table 1). NAS (1975) reported it in the range of 5.0 to 12.5 per cent on fresh weight basis. Therefore, in this study fibre content in the test seeds are within the above range except in PT 15, IHR 13 and TPT 2, which showed slightly higher values. The variations recorded by various workers may be due to procedures followed by them in estimating fibre content in winged bean seeds. For example finer grinding of sample results in lower value. Similarly, vigorous boiling gives lower values as compared to less violent boiling. Delay in filtering, in both acid and alkali digests, generally results in low values (Joslyn, 1970). It has been observed that fibre determined by acid - alkali digestion

method shows lower value as compared to neutral detergent method of Van Soest (1966).

Cerny *et al.* (1971) observed the presence of protein content of 37.3 per cent in winged bean seeds while Hilderbrand *et al.* (1981) and Gracia and Palmer (1980) reported it in the range of 33.2 to 38.1 and 33.7 to 37.6 per cent, respectively. These values correspond with the values of protein recorded in this study (Table 1). The variation recorded in this study and literature may be due to genetic character difference in environmental conditions and agronomic practices followed during the growth of the crop. (Tandon *et al.*, 1957; Esh *et al.*, 1959).

Fat content of test varieties ranged from 16.5 to 20.6 per cent. Variety SLS 1B showed lowest value. These values were comparable with values reported by other workers. However, Hettiarachchy *et al.* (1979) reported 11 to 23 per cent fat in the seeds of winged bean.

The lower level of 25.1 per cent carbohydrate was recorded in SLS 1A while highest amount of 33.1 per cent was observed in UPS 66 (Table 1). Other workers recorded a range of 24 per cent (Ekpenyong, 1980) to 42.2 per cent (Bailey, 1968; Umadevi and Wankhede, 1981). NAS (1975) indicated, presence of 28.0 to 31.6 per cent carbohydrate, which is comparable to the values of carbohydrate for PT 15, TPT 2, IHR 12, IHR 3, IHR 6, SLS 1, SLS 7, SLS 1B and PT 18. The overall carbohydrate content changed with alterations in other proximate components of the seed.

Calculated energy value for the winged bean seeds ranged from 417.5 Kcal to 440.7 Kcal. The energy values reported by Platt (1955), Claydon (1974), and Watson (1977) were 404 Kcal, 385 Kcal and 402 Kcal, respectively.

Table 2. Intra and Inter-cluster distance (D^2 values) observed for eighteen varieties of winged bean seeds based on primary nutrient analysis

Clusters	Number of clusters							
	A	B	C	D	E	F	G	H
A	7.87	17.9	17.2	11.2	10.7	14.5	21.2	23.4
B		8.2	14.5	17.5	11.7	12.4	10.6	16.9
C			7.3	13.1	15.8	11.5	10.2	10.9
D				7.2	19.1	13.6	18.3	18.8
E					7.2	16.4	16.2	20.9
F						0.3	12.5	13.0
G							0.0	11.3
H								

Cluster A : IHR 3, PT 18, Trivandrum; Cluster B : PT 15, SLS 1B, TPT 2;
 Cluster C : IHR 74, SLS 1A, Thailand 3; Cluster D : IHR 23, IHR 60;
 Cluster E : IHR 12, SLS 7, UPS 66; Cluster F : IHR 6, SLS 1;
 Cluster G : IHR 13; Cluster H : IHR 25.

Table 3. Percentage contribution of the characters of proximate composition in creating divergence among eighteen varieties of winged bean seed based on Mahalanobis D^2 statistics

Proximate character	D^2 contribution percentage
Moisture	0.7
Total ash	9.2
Crude fibre	7.8
Crude protein	39.2
Crude fat	39.8
Carbohydrate	0.0
Energy	3.3

Variations in the chemical composition of winged bean seed result from agronomic factors such as soil, climate, moisture and varietal differences (Gracia and Palmer 1980). Cartier and Hopper (1942) also reported that chemical composition of soybean, protein content in particular was affected by both agronomic factors and variety under test.

ii. Classification of winged bean varieties by group constellation technique

A wide variation has been observed in the chemical composition of 18 test varieties. Therefore, to understand a comprehensive and biologically meaningful grouping, concept of distant function was used (Rao, 1970). Use of Mahalanobis D^2 statistics revealed that 18 winged bean varieties' could be grouped into eight clusters. Cluster A included PT 18,

Trivandrum and IHR 3 while Cluster B comprised of SLS 1B, PT 15 and TPT 2. Cluster C included IHR 74, SLS 1A and Thailand 3; Cluster D included IHR 23 and IHR 60; Cluster E included SLS 7, UPS 66 and IHR 12, Cluster F included IHR 6 and SLS 1, Cluster G included IHR 13 while cluster H comprised of IHR 25 (Table 2). The intra and inter cluster distance among test varieties are presented in Table 2. Per cent contribution of various nutritional characters in creating diversity among the test varieties based on Mahalanobis D^2 statistics are presented in Table 3. Fat and protein contents with maximum 39.8 and 39.2 per cent contribution had maximum effect in creating diversity among the test varieties. This is followed by ash, fibre, energy and moisture with contribution of 9.2, 7.8, 3.3 and 0.7 per cent, respectively.

However, carbohydrate failed to influence its effect in creating diversity among test varieties.

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