THE WINGED BEAN - ITS NUTRITIONAL POTENTIAL (1976)

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ABSTRACT

The winged bean (Psophocarpus tetragonolobus) has been grown successfully in Ghana. Preliminary work on the raw bean showed that the seed contained an active factor which inhibited the activity of pancreatic trypsin. This factor, however, could be successfully destroyed by applying moist heat for 10 minutes at 130°C. The bean contained no urease enzyme activity as known to exist in soybeans and other legumes. Unlike soybeans, it has a sweet, nutty taste even in the raw state, and does not exhibit any of the bitter, beany flavour detectable in soybeans. The protein content of the dried seed was found to be 37.3% and its nutritional quality compared favourably with that of soybean in digestibility and composition, with methionine as the limiting amino acid. It contained 18.1% fat with a favourable proportion of polyunsaturated essential fatty acids and a high content of tocopherol (125.9 mg ∝+ B per 100g) which can be considered favourable as an antioxidant. Biological assessment gave PER and NPU values comparable to those of soybean. The nutritional potential of the winged bean lies in the fact that it can be processed into various products which can safely be incorporated into weaning foods, high protein food products and animal feed. Edible oil can also be obtained from the seed.

INTRODUCTION

Oil seeds and their industrial by-products, cakes and meals, left after removal of oil, constitute a large and important group of vegetable protein sources for livestock and human feeding. They contain large amounts of protein which could be efficiently used for human consumption. Once the oil and crude fibre have been removed by adequate processing operations, their protein content is increased by approximately 50% or more (Caldwell 1958). The winged bean is such an oil seed.

THE PLANT

The winged bean (Psophocarpus tetragonolobus) also known by various other names such as Goa bean, asparagus pea, etc. has received little attention as a possible source of vegetable protein. Supposed to have originated

from Asia, it has been successfully grown for several seasons in Ghana at the University of Ghana Agricultural Research Station, Kade, and also at the Crops Research Institute's Station (CSIR), Bunso. It is a tropical, perennial, climbing plant, requiring a good supply of nutrients, water and firm support. The plant produces four-sided pods with characteristic wings. The pods vary in length from 6 to 36 cm (2 - 14 inches) and contain from 5 to 20 seeds each. When the seeds are mature, the pod turns woody, shrivels and dries out. The winged bean develops an unusually large amount of nodules on its roots. Certain varieties also form underground tubers (National Academy of Science, 1975).

Composition and nutritive values of various parts of the plant are given in the Table 1 below:-

Table 1 *Composition of Various Parts of the Winged Bean (g/100g Fresh Weight

	Imature Pods	Seeds	Tubers	Leaves	Flowers
Water	76.0-92.0	6.7-24.6	54.9-65.2	64.2-77.7	84.2
Protein	1.9-2.9	29.8-37.4	12.2-15.0	5.7-15.0	5.6
Fat	0.2-0.3	15.0-20.4	0.5-1.1	0.7-1.1	0.9
Carbohydrate	3.1-3.8	31.6-28.0	27.2	Not done	
Fiber	1.2-2.6	5.0-12.5	17.0	"	
Ash	0.4-1.9	3.6-4.0	0.9		

* Source: National Academy of Sciences (USA) 1975.

Immature Pods

The green pods containing the young seeds are tender, snap readily and are generally said to be very palatable when sliced and boiled. Their use as a vegetable may have some nutritional value as shown by their protein content of 1.9 to 2.9 g per cent. However, compared with the potentialities of other parts of the plant, the use of the immature pods as a vegetable appears to be only of minor interest.

Tubers

Not all winged bean varieties produce tubers, but when produced, this part of the plant may also hold some interest for the future as a tuberous root with a protein content reported to vary from 12 to 15 per cent (Table 1). The availability of a tropical root with a protein content 4 to 7 times that obtained from other tubers such as cassava, yam and cocoyam, would be quite unique. The dried root has also been reported to have a protein content as high as 24.6% when the moisture level is reduced to about 9.0 per cent. Further work is needed to confirm these values for Ghanaian conditions before the nutritional potential of the tubers can be emphasized.

Forage

The only available recorded analysis (Masefield 1961), gives a mean crude protein percentage in the dry matter for the above-ground part of the plant 120 days from sowing, as 25.6 g. If this figure is confirmed, it would place the winged bean as a very important tropical forage legume. It has been reported that the leaves can be eaten as vegetable. It is, however, as a forage crop that the most interesting nutritional possibilities exist. Pospisil et al. (1971) reported that they found the haulm remaining after harvesting the seeds palatable to stock.

Seed

The significance and importance of the winged bean come into focus in the nutritional potential of its dry mature seeds. The raw beans, like most legume and oil seeds such as the soybean were found to contain compounds that interfere with protein digestion - trypsin inhibitors and haemagglutinins, (Cerny et al. 1971). Destruction of the trypsin inhibitor was, however, achieved by application of moist heat (direct steam in an autoclave) for 10 minutes at 130°C. The same effect was also obtained by simply boiling for 30 minutes, beans that had previously been soaked in water for 10 hours. Application of dry heat for 10 minutes did not destroy the trypsin inhibitor satisfactorily, not even at 175°C. The seeds were found to contain no urease enzyme activity. Samples of dried, skinned seeds gave the following nutrient composition:-

Protein - 37.3%; Fat - 18.1%; Moisture - 9.7%; Fibre - 5.4%; Ash - 4.3%; Thiamine - 1.39 mg/100g; Riboflavin - 0.18 mg/100g; Calcium - 204-370 mg/100g; Iron - 9.6-11.8 mg/100g; Oil - 125.9 mg; tocopherol (α+ B) /100g and calculated energy value - 410K cals (1717 Kilojoules). (National Academy of Science 1975).

THE WINGED BEAN COMPARED WITH SOYBEAN

The nutritional quality of the proteins of the winged bean appears comparable to that of soybean in its digestibility and composition, with methionine as the limiting amino acid (Cerny et al. 1971). The oil has a favourable proportion of polyunsaturated essential fatty acids, the degree of unsaturation being about 71% of the fatty acid component. The high tocopherol content (2 to 3 times that in soybean oil) can also act favourably as an antioxidant.

The very high protein content of the seeds, pods, leaves and roots, all of which can be utilized by man for himself or for his animals, indicates that the winged bean has the potential for producing more usable protein per unit land area than any other legume grown by man. When knowledge about its growing requirements becomes available and the crop is grown commercially, the winged bean could become a strong rival of soybean.

Direct utilization of the dried seeds as human food would be problematic, since they can only be cooked with great difficulty. Because of its nutritional potentialities industrial processing of the seed would seem even more interesting than utilization directly for domestic consumption.

Nutritionally, it has several advantages over soybean since most parts of the plant can be eaten whereas only the seeds of the soybeans are used. The bitter, beany flavour of many soybean products appears to be absent in the winged bean and this should encourage its introduction into human diets. Like soybeans, the dried seeds can be processed and the residual cake after oil extraction can be utilized in much the same way as soybean cake. With its high content of lysine, it can be used to supplement cereal diets that are lysine deficient.

BIOLOGICAL UTILIZATION OF THE WINGED BEAN

Biological testing of the dried beans gave Protein Efficiency Ration (PER) and Net Protein Utilization (NPU) values comparable with values obtained for soybeans (Cerny et al. 1971). In an experiment reported by Cerny and Addy (1973) in which a mixture of two parts of beans and three parts of maize flour enriched with a small amount of skimmed milk was fed to second and third degree Kwashiorkor patients in Accra, Ghana, the mixture containing winged beans gave results similar to those achieved with a control diet in which 90% of the protein content was supplied by dried skimmed milk.

The experimental diet was readily accepted and well tolerated by the children. They apparently liked the sweet, nutty taste of the winged beans. There were no gastro-intestinal upsets such as abdominal distention, or excess flatus. Relapses of diarrhoea, which sometimes occur during treatment, were observed in some of the children from the milk control group, but were not seen in any of the experimental groups on the winged bean diet.

Recently, from the laboratories of the Food Research Institute, small scale techniques have been employed to produce winged bean flour with protein, moisture, and fat contents of 58.6-60.0%, 7.7% and 1.1% respectively. The protein and critical amino acid contents of winged bean flour as compared with those of skimmed milk powder and soybean flour are given below (Table 2).

Table 2* Protein and Some Critical Amino Acid Contents of Skimmed Milk Powder, Winged Bean Flour and Soybean Flour

Source	Protein g/100 gm	Lysine	Tryptophan	Methionine
		g/16g Nitrogen		
Skimmed Milk	35.5-40.0	7.3-8.3	1.4-1.7	2.0-3.4
Winged Bean Flour	58.6-60.0	7.4-9.0	1.0	1.2
Soybean Flour	40.0-70.0	6.0-6.6	1.2-1.7	1.1

* Data from Harvey, D. (1970) Tables of amino acids in foods and feeding-stuffs, Commonwealth Agricultural Bureaux, Farmham Royal Bucks, England and National Academy of Sciences(1975). Protein value for winged bean flour was obtained from the laboratories of the Food Research Institute, Council for Scientific and Industrial Research, Accra, Ghana.

Winged bean flour has been utilized as milk substitute in the preparation of weaning formulas with other cereals. The coarse grits obtained after sifting the ground, dried extracted meal has been found to contain as much as 42.4 per cent protein. This can either be utilized to supplement cereal or processed starchy root products such as cassava flour or gari, or can be incorporated into animal feed together with the dried brown seed coat which was also found to contain 5.9 per cent protein.

In conclusion, it can be said that, the winged bean is a crop with a great nutritional potential. If properly exploited, it could contribute a great deal to the solution of the protein malnutrition problem in Ghana.

SUMMARY

The nutritional potential of the winged bean has been discussed. The unusually high protein content of the seeds, pods, leaves and roots, all of which can be utilized by man for himself or for his animals has been pointed out. Nutritional advantages of the dried winged bean seeds over the soybeans have also been discussed, and the point made that the winged bean can be processed and utilized in much the same way as the soybean, and that when investigated and commercially grown, the winged bean could become a rival of soybean, and would also contribute a great deal to the solution of the food problem in Ghana.

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