ROLE OF LEGUMES IN TROPICAL NUTRITION

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There is a need to know more about how grain legumes are used and what is their importance in the nutritional status of people living in the humid tropics. This is a very large task but is basic to defining the goals of quality improvement in the grain legumes.

Generally one would attack the problem of determining the nutritional role of any food by conducting a nutritional survey or by examining the results of available surveys. Such surveys should indicate what foods are eaten, the level of average daily consumption for each food, seasonal variation in eating pattern and, from chemical analysis, the average daily (or seasonal) intake of protein, calories, vitamins and minerals. Comparing such data with recognized nutritional needs (and with clinical evidence for malnutrition) gives indication of the nutritional deficiencies of the diet and thus how the diet may be improved.

A continuing effort in the GLIP Biochemistry sub-program is to study nutritional data from surveys made in the humid tropics and to estimate from these the importance of grain legumes in the diet and how improving grain legumes in terms of yield, protein content and protein quality will raise the nutritional status. Reliable data on dietary consumption in West Africa are rather limited. To date there have been collected surveys from Western Nigeria done by the Food Science and Applied Nutrition Unit of the University of Ibadan and reports from surveys done in Ghana, the Ivory Coast and East Africa. All these suffer from lack of quantitative information on consumption and on chemical analysis of the foods actually eaten. This collection of information will continue and should be abetted by the IDRC Network to study cowpea utilization in West Africa, of which IITA is a part.

On the basis of available information, it may be estimated that legumes (especially cowpeas) account for up to 80% of total dietary protein intake for adults and are virtually the only source of protein for many children in West Africa. Yet they are usually grown only as subsidiary crops to be relied on during the "hungry seasons" of the year when the staple foods such as cassava and maize are unavailable or very expensive. Cowpeas form less than 5% of total daily food intake and are consumed in combination with other foodstuffs as maize, rice or plantain. They are also roasted and eaten as snacks and are made into a paste and used as sauce. As a flour, cowpeas are used for making fried balls (akara) or steamed bean paste (moin-moin). In addition, locust beans form important flavorings for soups. Pigeon peas, broad beans and lima beans are consumed to a much lesser extent.

The most significant role legumes can play in tropical nutrition would be to supply high quality protein to children. The predominant infant food to to which children are weaned is usually a starchy gruel of the main staple, nearly devoid of protein. Solid foods, usually mashed forms of the adult diet,

gradually displace the starchy gruels. The excessive bulk characteristic of adult diets in this region is a problem for growing children since they cannot consume enough of the food to meet their nutritional requirements. The problem has been intensified by the practice that children are not given meat at an early age because it was thought that this would predispose them to stealing when they grow up or that meat caused worms in children. Although this notion is fast disappearing as education and economic levels rise, cowpeas could still be the least expensive way to provide essential nutrients to the growing child. Even in combination with the traditional weaning starchy gruels, cowpeas could be a very good starter diet for the child.

Amino acids likely to be limiting in Nigerian meals are tryptophan and threonine in garri; isoleucine in yam, rice and cassava meals; and methionine and cystine in all the foods (Cf. Table 1).

Table 1. Comparison of typical Nigerian diet with the FAO recommended intake of essential amino acids.

	Recommended amino acid balance, mg/100g protein	Ratio of amino acids in Nigerian diet to recommended balance*
Isoleucine	270	1.12
Leucine	506	1.59
Lysine	270	1.49
Meth. & Cyst.	360	0.49
Phe. & Tyt.	270	1.46
Threonine	180	1.34
Tryptophan	90	0.90
Valine	270	1.16

*Typical diet based on 8 foodstuffs.

Although it is desirable that at least one-third of total dietary protein should be of animal origin, a composite of soybean and ogi (the traditional weaning diet) would be a low-cost source of essential amino acids. This combination results in higher concentration of total protein, amino acids, energy and other essential nutrients in the diet. "Soy ogi", a commercial product formulated for infants and now marketed in Nigeria, has been analysed in our laboratory and found to contain three times the protein of normal ogi, 16 times the lysine and about three times the sulfur amino acids. It would have great supplementary effect for lysine, threonine and isoleucine. Although data for the energy, vitamins and mineral content of the product are not available, it is most likely that their concentration in 'soy-ogi' would to a certain extent follow the trend of the amino acids. It will be important to follow the acceptance and use of such blended food products

by the people in Nigeria.

In addition to simple processed foods which may be developed and distributed in urban areas, there is a need to look at other legumes that are grown in rural areas in the household garden or near the community compound. It is known that there is a considerable number of these and, as a group, they may play a significant role in providing protein in the diet. As with all the other foods, there is a need to analyze these legumes in the form they are eaten, so as to obtain a better estimate of the limiting essential amino acids and other limiting nutritional factors.

Legumes are clearly superior to root crops and cereals as producers of protein. Table 2 summarizes the best current estimates of crop yield obtainable with improved varieties and good (but not necessarily optimal) management. Crop duration is taken as those days during the growing season; if seed mature during the dry season when nothing else can be planted, these days are not counted. Values of average protein content are those determined for these materials grown at IITA. Amino acid scores, an estimate of protein quality, are based on FAO data and recent FAO/WHO recommendations for reference protein. Protein productivity is then calculated as:

$$\frac{\text{yield} \times \text{protein content} \times \text{AA score}}{\text{crop duration}}$$

Soybean has by far the highest potential for protein production, but lima beans are above average. By considering the factors which limit protein production (e.g. crop yield, protein quality), priorities may be set for the improvement of these and other grain legumes of importance as protein sources in the tropics.

Table 2. Protein productivity potential of certain tropical food crops

Crop	Programmable yield, kg/ha	Protein content, %	Amino acid score, %	Crop duration days	Protein productivity kg/day-ha
Legumes					
(1) Soybean	2,800	38	81	95	9.1
(2) Lima bean	3,200	25	64	115	4.5
(3) Cowpea	1,800	25	65	80	3.3
(4) Pigeon pea	2,000	22	60	80	3.3
(5) Groundnut	1,600	26	79	120	2.7
(6) Winged bean	1,400	31	78	112	3.0
(7) Chick pea	2,500	20	68	125	2.7
(8) Velvet bean	2,500	21	60	160	2.0
(9) Mung bean	900	24	65	75	1.9
Root crops					
(1) Yam	25,000	2.0	74	185	2.0
(2) Sweet potato	20,000	1.3	63	120	1.4
(3) Potato	15,000	2.0	54	125	1.3
(4) Cassava	20,000	1.2	57	220	0.6
Cereals					
(1) Millet	3,000	12.0	62	85	2.6
(2) Rice	5,000	7.5	72	140	1.9
(3) Maize	4,000	9.5	49	120	1.6
(4) Sorghum	3,500	10.1	47	110	1.5