SOYA PROTEIN—PRODUCTS—
Round table discussions

Composition and Nutritive Value of Green Soybeans of the BM_2 Variety

H. BOURGES and J.L. CAMACHO, National Institute of Nutrition, Mexico, and
N. BANAFUNZI, Instituto Superior Autonomo Agropecuario del Estado de Guerrero

INTRODUCTION

Previous participants in this round table have outlined the characteristics, objectives and mode of operation of the program "Utilization and Consumption of Soybeans in Rural Communities," conducted by the government of the state of Guerrero.

The program is based on the development of a new soybean variety, called BM_2, by Banafunzi and others at the Instituto Superior Autonomo Agropecuario del Estado de Guerrero (ISAAEG). It results from the adaptation of the Mokopu-BM variety (obtained in Hawaii) to the soil, climate and sunlight patterns found in the Iguala region. Under these conditions, BM_2 soybeans reach maturity 95 days after being planted, therefore allowing more than one crop per year.

The program was designed to promote direct consumption of green pods of BM_2 soybeans among the rural population in the state. This decision was made based on the following considerations.

(a) Under the prevailing socioeconomic conditions of rural populations in Mexico, direct consumption of soybeans is far more preferable than the use of industrialized soybean-based products (1,2).

(b) Among the possible ways for direct consumption, ISAAEG had several preparations involving the use of green pods. These preparations are relatively simple, take cultural restraints and habits into consideration and are sensorially attractive. On the other hand, preparations of full-term soybeans were either too complicated, alien to local habits, or sensorially dull.

(c) If green pods prove to be the preferred stage for consumption, harvesting could be earlier and the number of crops per year could increase. If the pods are cut at around 75 days, the foliage, which is most abundant at that time can be used to feed animals (Banufunzi, personal communication, 1979).

The underlying assumption is that the nutritive value of green pods is similar to that of mature beans or at least good enough, considering the other advantages of early harvest. To test this assumption and to provide information on the nutritive characteristics of the BM_2 green pods at different stages of maturation, which was essential to back the program, Camacho and others from our group at the National Institute of Nutrition conducted the study which is the subject of this report.

EXPERIMENTAL PROCEDURES

The objective of the study was to determine the nutritive value of BM_2 green soya pods 65 to 85 days old. Nutritive value, considering the role of legumes in the diet, was defined by the protein content and quality and by the lipid content of the pods. To measure protein quality, biological methods were used and the antitryptic factor (ATF) was measured. Other determinations were also made to complete the picture.

Seeds of the BM_2 variety were planted in August 1979 at the experimental station of ISAAEG in Iguala. Samples of green pods were obtained 65,70,75, 80 and 85 days later, and were taken immediately to the laboratory, where they were analyzed in triplicate for moisture (3), total nitrogen (4), ether extract (5), crude fiber (6), ash (7), direct and total sugars (8), thiamine (9), riboflavin (10), ascorbic acid (11) and antitryptic activity (12). Special care was taken to use fresh samples for the vitamin and ATF determinations. Crude protein was obtained using the 6.25 factor.

The protein efficiency ratio (PER) and net protein utilization (NPU) were determined by the usual techniques (13,14), employing 10 rats per group, on pods 65, 75 and 85 days old. Before the tests, the samples were soaked for 8 hr and boiled for 20 min to inactivate the ATF and other antiphysiological substances known to be present in soybeans and to be thermolabile. Inactivation was essential since these substances would otherwise interfere with protein digestibility, giving artificially low values.

RESULTS AND DISCUSSION

Table I shows the wet composition of the pods at different ages. Apparently, moisture steadily decreased as the pods increased in age. There was a parallel rise in all the measured constituents: 150% in total sugars, 89% in crude fiber, 81% in crude protein, 79% in ether extract and 74% in ash; this rise was, in all cases, above that explained by the

TABLE I

Composition of Green Pods of the BM_2 Soy Variety at Different Stages of Maturation (per 100 g pods)

	Maturation (days)				
Determination	65	70	75	80	85
Moisture (g)	75.0	68.0	63.0	60.0	58.0
Crude protein (g)	9.7	12.7	14.8	16.7	17.6
Ether extract (g)	5.3	6.8	8.2	9.0	9.4
Crude fiber (g)	1.7	2.2	2.6	2.2	2.3
Ash (g)	1.3	1.7	2.0	2.2	2.3
Reducing sugars (g)	0.5	0.0	0.0	0.0	0.0
Total sugars (g)	1.1	1.4	2.0	2.6	2.9
Vitamin					
Thiamine	1.4	1.4	1.1	1.2	1.8
Riboflavin	2.8	2.9	2.9	2.6	3.1
Ascorbic acid	0.24	0.23	0.25	0.24	0.24
Antitryptic factor (UTI/g pods x 10^4)	22.8	32.7	42.8	42.6	59.3

68% increase in solids. Reducing sugars were immeasurable by the technique after 65 days.

The concentration of all components showed a slight increase with the age of the pods. Clearly, already by the 65th day, the composition of the dry pods resembles that of mature beans of other soya varieties (16). Table I also shows the vitamin contents of the pods on wet bases.

The pods are good sources of thiamine and riboflavin, but surprisingly poor sources of ascorbic acid. Only thiamine showed some increase with maturation. Since total solids increased by 68% during the period of study, there was a net dilution of these vitamins.

The results of ATF determinations also are presented in Table I. ATF activity rapidly increased during the study, to more than double. The levels reached by ATF activity are in the range where it interferes with protein digestibility, therefore requiring thermal inactivation before consumption.

Results of the PER and NPU tests, done with ATF inactivated samples, are presented in Table II. The PER of the pods was 69% in the 65- and 75-day samples, in comparison with that of casein, but jumped to 94% in the 85-day samples; this last value is statistically not different from the PER of casein. NPU values, however, were quite similar for the 3 samples and a difference with the NPU of casein could not be statistically shown at the 0.05 confidence level.

The difference found between PER and NPU values for the 65- and 75-day samples is intriguing. Since NPU is a more direct and usually a more precise technique than PER, its results should receive more credit. Furthermore, as seen in Table I, the protein found at 85 days was basically already there at 65 days, so that there is no reason to believe that any major change in protein composition occurred between the two points. Unfortunately, no amino acid analysis could be done at the time of the study because of problems with the analyzer.

The data indicate that green pods of the BM_2 soy variety are good sources of high-quality protein, oil, thiamine and riboflavin. Consumption, however, must be preceded by cooking in order to lower ATF activity to less than 20,000 UTI/g, which has been considered a safe level for this compound (16). Composition of the solids was already established at 65 days so that the same nutrient supply may be obtained by consumption of 1.7 times more of the 65-day pods in comparison to the 85-day pods. Clearly, the older the pods, the more concentrated sources of protein and fat they become; a sharp increase in concentration of protein and oil occurred between 65 and 75 days with a less marked change thereafter. Since at 75 days foliage is optimal, comparatively little is gained in the following 10 days, and these 10 days represent a saving in time from the agricultural point of view. Seventy-five days could be proposed as the best harvesting age for the BM_2 variety grown in Iguala; at least, there would be no strong nutritional basis, considering the present data, to oppose 75- and favor 85-day harvest.

TABLE II

PER and NPU of Green Pods of the BM_2 Soya Variety at Different Stages of Maturation (mean ± S.D.)

Source of protein	PER	PER as % of casein's	NPU	NPU as % of casein's
Casein	2.5 ± 0.43	–	60.0 ± 8.6	–
65-day pods	1.73 ± 0.21	69.2	56.83 ± 7.5	94.7
75-day pods	1.73 ± 0.21	69.2	57.31 ± 8.2	95.5
85-day pods	2.35 ± 0.48	94.0	56.9 ± 7.7	94.8

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