VEGETABLE-TYPE SOYBEANS AS DRY BEAN PRODUCTS[1]

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Abstract. **Vegetable - type soybeans incorporated into canned dry pack and pork and bean style products were judged by sensory panel as equal to similar products made from great northern beans, although less acceptable than corresponding navy bean products. Incorporation of soybeans into these relatively cheap popular products seems to have considerable potential for improving the dietary protein level of low income families.**

Soybeans, containing 40% protein on a dry weight basis, are an excellent source of relatively inexpensive protein throughout large areas of the world. Although the use of soy protein in American diets has increased considerably in recent years, very few whole soybeans are consumed in this country (7). During the past 5 years, total soybean production in Florida has greatly increased, and still further increases are projected (3).

Earlier work (1, 4) has indicated that vegetable-like soybeans are readily accepted by the American public. Unfortunately there is considerable difficulty in removing the immature beans from the pods, preventing the economical production of green soybean products. In view of this problem, feasibility of utilizing vegetable-type soybeans in dry bean products was investigated. If these products - canned dry pack soybeans and pork and bean style soybeans—were found acceptable they might become a source of improved dietary protein for low-income populations. It was also of interest to determine whether there were in fact organoleptic differences between agronomic and vegetable-type soybean cultivars.

Materials and Methods

Two vegetable-type soybean cultivars, 'Disoy' and 'Bansei,' were grown at the Vegetable Crops Research Farm at Gainesville. The beans were allowed to mature to dryness on the plants before harvesting. They were then shelled by passing through a stationary viner, and extraneous material was separated by hand. 'Bragg' soybeans, one of the four leading cultivars of agronomic soybeans grown in Florida, were purchased locally. Dried navy beans, great northern beans, lima beans, and southern peas ('Blackeye No. 5') were purchased at a local supermarket. All dried beans were stored under ambient conditions until utilized.

Chemical Analyses. Beans were dried under vacuum at 70°C for 24 hr. and ground with a Wiley mill to pass a 20 mesh screen after which crude fat determinations were made by extracting with petroleum ether (BP 30°-60°C) for 4 hr., utilizing a Goldfisch apparatus. The defatted material was redried and ground with a Wiley mill to pass through a 80 mesh screen. The finely ground bean powders were used for protein analyses by the micro-Kjeldahl method.

Water Uptake. Triplicate bean samples of 150g each were either soaked in 1 liter of distilled water for 24 hr. or boiled in water for 1 hr. After draining for 1 hr., triplicate 5-g aliquots of each of the above samples and of untreated (control) samples were subjected to moisture determination by drying under vacuum at 70°C for 15 hr.

Product Preparation. Dry beans were soaked overnight in distilled water at ambient temperature, then drained, washed, blanched for 5 min. at 100°C and cooled. Cans (303 x 406 enameled) were filled with 300g blanched beans, and sufficient 94°C brine (5) was added to cover all beans. Cans were then sealed and processed at 122°C for 20 min. (5) followed by cooling in cold tap water.

Pork and beans were prepared in much the same manner as canned dry beans except the covering brine was tomato sauce (5), and a small piece of pork fat was added to each can. Processing was carried out at 122°C for 65 min. (5). All canned beans were stored for 4-6 weeks at 22-25°C until opened for visual observation and organoleptic evaluation.

Organoleptic Evaluation. Samples of the canned dry pack beans and pork and beans were presented to sensory panels composed of 9-11 judges who had expressed a liking for this type of product but who, otherwise, were chosen randomly from available personnel of the Food Science Department. Panelists were asked to rate the products for flavor, texture and general appear-

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ance, according to their individual preferences. At each sitting the panelists compared the flavor, texture and general appearance of each of 4 samples to a reference sample of commercially prepared great northern beans, using a 9 point scale (2). Prior to serving, the samples were heated to make them more palatable. The bean products evaluated are shown in Tables 3 and 4, where each datum represents 3 judgments by each of at least 9 panelists. All organoleptic data were analyzed statistically by methods described by Larmond (5).

Results and Discussion

When mature vegetable-type soybeans were harvested and shelled as described, over 95% of the seeds were recovered. Early maturing beans would be favored under Florida conditions due to molding of the pods during wet weather. Both varieties grown for this study appear to satisfy this requirement.

Although the actual percentages of protein and fat found in a given soybean cultivar vary with maturity and environment (4), on the average, soybeans contain about 60% more protein and 10 times more fat, on a dry weight basis, than do legumes typically used in dry bean products (Table 1). However, the increase in caloric value is much less than one might expect when calculated on a per 100g serving basis. As protein (4 cal. per g) and oil (9 cal. per g) increase, carbohydrate content (4 cal. per g) decreases. Calculated from the values given in Table 1, and on the basis of equal portions of protein (e.g., 24.8g), 100 g of navy beans would furnish 382 calories while 24.8g of protein in 65g of soybeans would be accompanied by less than 300 calories, a decrease of over 20%. A serving of soybeans equal in size to the customary bean serving would furnish both 50% more protein and 17% more energy than the great northern beans. Calculating another way, on the basis of isocaloric servings, soybeans would furnish over 30% more protein than would accompany the same number of calories derived from navy beans. The greater amount of protein in soybeans compared to other dry beans would appear to be a tremendous factor in favor of their utilization in dry bean products.

Table 1. Chemical analyses of selected raw dry legumes (dry weight basis).

	% Crude Protein	Crude Fat (%)	Cal/g[z]	Cal/g Protein
Southern Pea	23.7	1.5	3.81	16.1
Lima Bean	21.5	1.4	3.83	17.8
Great Northern Bean	24.2	1.8	3.82	15.8
Navy Bean	24.8	1.9	3.82	15.4
Soybean	38.0[z]	19.7[z]	4.48	11.8
Soybean (Bansei)	41.5	19.1	----	

[z] from reference 8

Table 2. Water uptake for various types of dry beans after soaking and after boiling.

	Percent Water Content		
	Control	24 hr Soak	1 hr Boil
Navy Beans	6.6	55.8	53.7
Great Northern Beans	6.8	54.6	54.4
Soybean (Bansei)	4.6	64.7	66.6
Soybean (Bragg)	4.2	63.8	62.9

Although the data in Table 2 indicate that soybeans absorb 20% more water than other types upon soaking or hour-long boiling, this may merely indicate that soybean proteins absorb water faster than the carbohydrates of the other beans. Canned dry mature soybeans have been reported (8) as containing 71% water and canned dry mature common beans (including navy and great northern) 69%, possibly indicating final equilibration to very similar moisture levels. An analysis of drained canned beans would be necessary for complete clarification of this point. In either case, considerably more protein can still be expected per serving of soybeans than from navy or great northern beans.

When pork and beans and dry packed beans prepared from navy, great northern, and 'Disoy' soybeans were evaluated organoleptically (Table 3), there was little or no difference in general appearances. 'Bragg' soybeans were sometimes poorer in appearance. Flavor of the two types of 'Disoy' soybean products was not different from the flavor of corresponding products from great northern beans. In each product, however, the flavor of navy beans was preferred over that of the 'Disoy' soybeans. Texture of the soybeans seemed to be less desirable and was indicated by panelists to be too firm. The use of sodium bicarbonate in the soak water to decrease firmness of soybeans has been suggested (7).

It may be inferred by a comparison of Tables 3 and 4 that 'Bansei' soybeans were not as readily accepted by the panelists as were the 'Disoy.' Flavor and texture of 'Bansei' in both type products were inferior to both navy and great northern beans. 'Disoy' was judged equal to great northern in flavor but inferior in texture. In every study the 'Bragg' soybeans were rejected, thus eliminating them from consideration for use in these products.

The soybeans retained their characteristic shape much better than did the other beans, but

Table 3. Sensory evaluation of quality of canned beans prepared from several types of dry beans.[z]

	Dry Pack Beans			Pork & Beans		
	General Appearance	Texture	Flavor	General Appearance	Texture	Flavor
Navy	4.4a	5.1bc	5.2e	6.1h	6.0j	6.1m
Great Northern	4.6a	5.3b	5.1ef	5.7h	5.5j	4.7n
Soybean (Disoy)	5.0a	4.7cd	4.0f	5.0hi	3.9k	4.5n
Soybean (Bragg)	4.0a	4.0d	3.2g	4.0i	3.6k	3.3p

[z] Values followed by the same letter are not significantly different at the 5% level.

Table 4. Sensory evaluation of quality of canned beans prepared from several types of dry beans.[z]

	Dry Pack Beans			Pork & Beans		
	General Appearance	Texture	Flavor	General Appearance	Texture	Flavor
Navy	5.1a	5.2c	5.1e	5.9g	5.5j	5.4m
Great Northern	5.2a	5.5c	5.1e	5.8g	5.4j	5.2m
Soybean (Bansei)	4.7ab	4.3d	3.8f	4.6h	3.7k	3.5n
Soybean (Bragg)	3.9b	3.9d	3.2f	4.1h	2.9k	3.3n

[z] Values followed by the same letter are not significantly different at the 5% level.

the tomato sauce within the cans appeared much thinner than that with the navy and great northern beans. In view of the possibly greater water up-take by the soybeans (Table 1), their firmer texture and lower carbohydrate content, it seems probable that less starch escaped from them to thicken the sauce than occurred with the other dry beans. In that case, use of a thicker sauce would seem to be indicated for pork and bean style soybeans.

The results of this study imply that selected soybean cultivars of vegetable-type could be utilized in acceptable dry bean products. This would have the advantage of increasing the protein content of existing inexpensive popular products without changing food habits and without the need of charging elevated prices.

Fortification of the products with sulfur containing amino acids to improve the nutritional quality of the protein, might also be desirable.

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