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EDIBLE SOYBEANS

By

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The Seminole variety is recommended as an edible soybean because of its ability to yield well and its excellent qualities as a green and dry bean.

The Seminole produces green beans for table use during the month of September. The beans are large and shell easily.

The matured beans of this variety are large, yellow in color, and all beans soften upon soaking. The variety is highly resistant to shattering and as many as 19 bushels of seed per acre have been harvested in tests conducted by the Alabama Agricultural Experiment Station. Like all late-maturing soybean varieties, however, insects can interfere with seed production of Seminole soybeans.

The strain No. 93057 is now known as the "Cherokee".

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Edible Soybeans

INTRODUCTION

ALTHOUGH soybeans have been an important constituent of the diet of Oriental peoples since ancient times, interest in soybeans for human food has developed in this country mainly during the last decade. Most soybeans grown in the United States until recent years were hay varieties, the seed of which retained a strong bean flavor and a tough, hard texture when cooked. In recent years, however, edible varieties with improved flavor and texture have been introduced and developed in this country.

Soybeans have been recommended by food specialists in all sections of the country, but it appears that a special need for them exists in Southern diets. It is unquestionable that the diet of many of the rural and city people of the South is inadequate in protein, minerals, and vitamins. This condition is brought about mainly by the high consumption of foods such as fat meats, corn meal and flour, and the low consumption of lean meats, milk, and other products of animal origin. The lack of animal products in many Southern diets is largely attributable to insufficient production and inadequate purchasing power. The nutritional research which has been conducted in many laboratories indicates that soybeans offer definite possibilities for improving Southern diets without appreciably increasing the cost.

Edible soybeans are easy to grow and success is usually assured because of their high drought and insect resistance. These characteristics of edible soybeans are of particular value during the hot, dry periods in August and September when other vegetable crops are likely to fail.

Experiments were conducted, therefore, at the Alabama Agricultural Experiment Station to determine what varieties of edible soybeans could be recommended for use in Alabama. Data are reported herein regarding yields, date of maturity, nutritive value, palatability and adaptation of these varieties to Alabama conditions. Both green and mature beans were studied in the tests. Since cowpeas are widely used in Southern diets, some information concerning the nutritional value of cowpeas has been obtained and is included for the purpose of comparison. Comparative figures giving the composition of certain other beans and peas have been taken from the literature and are included in the tables. Recommendations for growing edible soybeans and methods of preparing them for table use are also given.

NUTRITIONAL VALUE

Protein.—Soybeans are a very rich source of protein, both as fresh green vegetables and as mature seed. As may be seen in Table I, soybeans contain about twice as much protein as do other legume seeds such as cowpeas or lima beans. It is because of their high protein content that soybeans have frequently been described as “poor man’s meat” and “boneless steak”. Soybeans contain not only a large quantity of protein, but the protein is of unusually high quality.

Several investigators (2, 3, and 8) have demonstrated that the nutritive value of soybean protein is markedly improved by cooking. It is believed that this increase in biological value produced by heat is a result of an increase in the availability of certain amino acids, mainly the sulfur-containing amino acids, cystine, and methionine. In most of the experimental work previously reported the heat treatment to which the soybeans were subjected was considerably more drastic than that which would be used in cooking soybeans for human food. Furthermore, only mature soybeans have been studied. Biological assays were therefore made to determine if a milder heat treatment comparable to that used in the preparation of food would be sufficient to produce a high-quality protein in both fresh green, and mature soybeans. Since very little information is available concerning the biological value of cowpea protein, several varieties of cowpeas were also studied.

The results of this investigation, details of which will be published later, show that the protein of soybeans is definitely superior to that of cowpeas and that the heat treatment to which soybeans are ordinarily subjected in preparing them for human food is sufficient to give the soybean protein its full biological value. The protein of several of the cooked edible varieties very nearly equalled casein, the chief protein of milk, and should contribute generously toward meeting the average daily requirement of the adult human for 100 grams of protein. None of the varieties of cowpeas gave satisfactory growth when fed to rats as a sole source of protein. The protein of two popular varieties of cowpeas was inadequate to support life unless it was supplemented with the amino acid cystine. It should be pointed out, however, that the methods ordinarily employed in measuring the biological value of proteins involve the feeding of single foods as a source of protein, and do not give an accurate measure of the value of that food in a mixed diet. Cowpeas, as well as most beans, are deficient in sulfur-containing amino acids (cystine and methionine), but when they are eaten with other foods which furnish these amino acids, they have considerable nutritional value.

Fat.—Soybeans are rich in fat in both the green and mature stages as may be seen in Table 1. It is well known that large quantities of soybeans are produced in this country and are

TABLE 1.—Composition of Soybeans and Some Competing Foods

	Moisture	Protein	Fat	Carbohydrate	Ash
	per cent	per cent	per cent	per cent	per cent
Green, shelled					
Soybeans ¹	70.0	12.2	5.2	11.1	1.52
Cowpeas ²	65.7	9.4	0.5	23.0	1.40
Lima Beans ¹	66.5	7.5	0.8	23.5	1.71
Mature, dry					
Soybeans ¹	7.0	40.6	16.5	30.9	5.0
Cowpeas ²	13.0	21.4	1.4	60.8	3.4
Lima Beans ¹	10.4	18.1	1.5	65.9	4.1

¹Analyses are from Ill. Agr. Exp. Sta. Bul. 443. 1933.

²Analyses are from U.S.D.A. Farmers Bul. 559. 1913.

extracted commercially for their oil. The oil possesses qualities which make it desirable for food and over 80 per cent of the expressed soybean oil is used in the food industry. Most of this is used in the shortening and margarine industries. The oil contains large amounts of unsaturated fatty acids, and is classified as a semi-drying oil, making it readily adaptable to the paint industry.

Minerals.—The mineral composition of soybeans as well as of other beans and peas is given in Table 2. There is evidence in the literature that the calcium content of soybeans is affected by such factors as soil type, stage of maturity, and especially by variety. The figures for the calcium and iron content of green and mature soybeans are averages for 12 varieties reported by Woodruff and Klass (1). Soybeans do not compare with milk

TABLE 2.—Mineral Constitutents in Beans and Peas

Food	Total Ash	Ca	P	Fe	K	Mg
	per cent	per cent	per cent	per cent	per cent	per cent
Green, shelled						
Soybeans ¹	1.52	.072	—	.0029	—	—
Lima Beans ²	1.71	.028	.133	.0024	.613	.070
English Peas ²	.92	.028	.127	.0021	.285	.038
Mature, dry						
Soybeans	5.0 ¹	.212 ¹	.600 ³	.0103 ¹	1.910 ³	.230 ³
Lima Beans ²	4.1	.071	.338	.0086	1.741	.188
Navy Beans ²	3.5	.160	.471	.0079	1.229	.156
English Peas ²	2.9	.084	.400	.0057	.903	.149
Cowpeas ³	3.4	.100	.470	.0059 ⁴	1.450	.210
Daily requirements ⁵ (grams)		.800	.880	.0120	Not estab- lished	Not estab- lished

¹Analyses are from Woodruff and Klaas, Ill. Agr. Exp. Sta. Bul. 443. 1933.

²Analyses are from Sherman, Chemistry of Food & Nutrition, 4th Ed. 1935.

³Analyses are from Morrison, Feeds and Feeding, 20th Ed. 1936.

⁴Analysis is from Sheets, O., Frazier, E. and Dickens, D. Miss. Agr. Exp. Sta. Bul. 291. 1931.

⁵Human requirements for the minerals are the recommended allowances for a 70 kg. (154 lb.) man.

as a source of calcium, but they contain 2 to 3 times as much of this bone-building element as other beans and peas. An average serving (100 gm.) of soybeans would supply over one-fourth of the day's requirement of calcium for an adult. It should be pointed out that the high calcium content of the soybean gives a calcium-phosphorus ratio more nearly optimum for adults than is obtained with other beans and peas. Soybeans are also appreciably richer in iron, potassium and magnesium than are other beans and peas. A considerably larger percentage of the iron in soybeans is available for hemoglobin formation than in cereals and green leafy vegetables (6). The results of Sheets and Ward (5) indicate that most of the iron of all legume seeds, including cowpeas, is in a readily available form.

Vitamins.—Soybeans are a very good source of some of the vitamins. The amounts of vitamins A and B in soybeans and other beans and peas are given in Table 3. Over 40 varieties of

TABLE 3.—Vitamin Content of Soybeans and Competing Foods

	Vitamin A		Vitamins B		
	I.U./100 gm.	Vitamin B ₁ I.U./100 gm.	Nicotinic acid mg./100 gm.	Riboflavin mg./100 gm.	Pantothenic acid mcgm./gm.
Green, shelled					
Soybeans	360-1200 ¹	159 ⁵			
Cowpeas	233-385 ¹				
Eng. peas	280-530 ²	130 ⁵		.08 ⁵	
Mature, dry					
Soybeans	30-400 ¹	380 ⁴	4.85 ⁷	.323 ¹⁰	14 ¹²
Cowpeas	30-70 ¹	320 ⁴		.30-.32 ¹¹	18 ¹²
Eng. peas			1.8 ⁸	.28 ¹⁰	21 ¹²
Peanuts	0 ³	350 ⁶	13.0 ⁹ 17.2 ¹³	.17-.46 ¹¹	53 ¹²
Daily Requirements ¹⁴	5,000	600	18	2.7	Not established

¹Sherman, W. C. and Salmon, W. D. Food Research 4:371. 1939.

²Rice, P. B. and Munsell, H. E. N.Y. Assoc. for Improving the Condition of the Poor. 1931.

³Makhijani, J. K. and Banerjee, B. N. Ind. J. Vet. Sci. 8:13. 1938.

⁴Halverson, J. O. and Sherwood, F. W. J. Agr. Res. 60:141. 1940.

⁵Fixsen, M. A. B. and Roscoe, M. H. Nutr. Abstr. and Rev. 7:823. 1937-38.

⁶Booher, L. E. U.S.D.A. Tech. Bul. 707. 1939.

⁷Swaminathan, M. Ind. J. Med. Res. 26:427. 1938.

⁸Kodicek, E. Biochem. J. 34:724. 1940.

⁹Waisman, H. A., Mickelsen, O., McKibbin, J. M. and Elvehjem, C. A. J. Nutrition 19:483. 1940.

¹⁰Murthy, G. N. Ind. J. Med. Res. 24:1083. 1937.

¹¹Baars, J. K., Geneesk. Tijdschr. Nederland Indie 78:3145. 1938.

¹²Jukes, T. H. J. Nutrition 21:193. 1941.

¹³Higgins, B. B., Holley, T. A., Prickett, T. A. and Wheeler, C. D. Ga. Agr. Exp. Sta. Bul. 213. 1941.

¹⁴The daily requirements for the vitamins are the recommended allowances for a moderately active man (wt. 70 kg. or 154 lbs.).

soybeans and 8 varieties of cowpeas in the green and mature conditions were analyzed (7) for vitamin A (carotene). Fresh green soybeans are a very good source of vitamin A and are definitely superior to other beans and peas. Unfortunately most of the edible varieties when mature do not contain sufficient vitamin A to have much nutritional significance although they are superior to other beans and peas in this respect. Most of the varieties high in vitamin A were late, small-seeded hay varieties with seed coats which were either green, black, or olive-brown in color, and were unsuitable for human food because of their poor cooking quality. The one exception to this generalization was No. 93057, a bright green bean, with the highest vitamin A content of all soybeans analyzed. It was also a fair bean in all other respects including eating quality, and when seed of this variety become generally available it will deserve a trial.

In the light of the recent advances in knowledge concerning the vitamin B-complex it is apparent that most of the old information on the vitamins B content of foods is of no use in evaluating human diets, and data on the amounts of the various individual components of the B-complex present in the foods are very scattered and limited in extent. The results which are available indicate that soybeans, like other beans and peas, are a very good source of vitamin B₁. An average serving (100 gm.) of mature soybeans would supply over half of the daily requirement of an adult human for this vitamin. From results published by the North Carolina Station (8) it appears that varietal differences in the vitamin B₁ content of soybeans and cowpeas are not great. Nine varieties of mature soybeans and cowpeas ranged in their content of vitamin B₁ from 320 to 480 and from 230 to 370 International Units per 100 gm., respectively.

There is no information available concerning the nicotinic acid, riboflavin and pantothenic acid contents of fresh beans and peas, but published values for the amounts of these factors present in mature beans and peas indicate that soybeans, like other beans and peas, cannot be considered a good source of riboflavin and pantothenic acid. Mature soybeans are, however, a fair source of nicotinic acid; apparently, they are superior to English peas, cowpeas, and most other vegetable products, although inferior to lean meats and most other animal products. A 100 gm. serving would supply about one-fourth the daily requirement for nicotinic acid. The large amount of nicotinic acid in peanuts, most of which is retained in the roasted product, is noteworthy.

Although vitamin C is present in green soybeans, values for vitamin C are not given because nearly all of it would be destroyed in cooking. Soybean sprouts are, however, an excellent source of vitamin C. Soybeans are a very good source of vitamin E and are reported to contain vitamin K; but the human requirements for these vitamins have not been established.

VARIETIES OF EDIBLE SOYBEANS

The different varieties of edible soybeans tested at Auburn can be grouped according to date of maturity: early, intermediate or mid-season, and late. Although the varieties in each group vary in such characteristics as seed size and color, flavor and texture of dried beans, and yielding ability, they are distinctly similar in a number of characteristics. The early varieties, for instance, do not grow tall, are mostly large-seeded, and produce low yields of dried beans, many of which are shrunken and discolored. The late-maturing varieties, on the other hand, are directly opposite to the early varieties as far as these characteristics are concerned; in the mid-season varieties the expression of these characters is more or less intermediate to the two extremes. Most varieties of edible soybeans tested at Auburn, regardless of their date of maturity, are acceptable for use as green beans. In general, the larger-seeded varieties are preferred to the smaller-seeded ones because they are easier to shell as green beans, but this objection is largely overcome when the pods are boiled before shelling.

Although the early maturing varieties produce green beans of good quality and in satisfactory quantity, they are not particularly recommended for use in Alabama because they bear green beans when there is an abundance of other summer vegetable crops. At this time they only add variety to vegetable servings from the home garden. The Willomi, Imperial, and Emperor varieties may be used for this purpose since they are of good texture and quality, yield relatively well, and shell readily. In general, the early maturing varieties bear green beans for only a relatively short period of time.

The early maturing varieties seldom produce high yields of dried beans. For the most part, the early varieties shatter severely and the seed harvested in Alabama have seldom been of high quality. Many of the seed are shrunken and discolored; in some varieties in certain years half the seed harvested have been affected in this manner. This does not appear to be a problem when these varieties are grown in the midwest (4). Shrunken soybeans may become acceptable for table use upon soaking, but they are frequently strong in flavor. It is recommended that seed of early varieties be purchased before each planting season. Seed of such varieties when harvested in Alabama are characteristically very low in germinability.

Edible soybeans of intermediate maturity (Table 4), in general, are more prolific than the early maturing varieties. The plants grow to a greater height, but the period during which suitable green beans are borne is not necessarily longer. The varieties Hokkaido, Funk Delicious and No. 85560 are considered the most desirable of the mid-season varieties tested at Auburn. All three varieties produce green beans of high quality which are ready to use when other vegetable crops begin to fail in Alabama gardens.

TABLE 4.—Yields of Dried Beans and Certain Characteristics of Edible Soybean Varieties Tested at Auburn, 1937-1940.

Variety	Number Years in Test	Yield, Dried Beans Bu. per acre Average	Color of Dried Beans	Size of Green Beans	Period Edible Green Beans Borne	Quality of Cooked Dried Beans	Per cent Beans Soft After Soaking
Early							
Toku	1	7.3	Yellow	Large	Mid. & late July	Poor	100
Green Giant	1	4.8	Green	Large	Mid. & late July	Poor	100
Bansei	1	7.3	Yellow	Medium	Mid. & late July	Fair	100
Jogun	1	2.4	Yellow	Large	Late July	Poor	100
Willomi	2	3.5	Yellow	Large	Late July & early August	Poor	99
Imperial	2	3.6	Yellow	Large	Late July & early August	Fair	98
Emperor	2	3.8	Yellow	Large	Late July & early August	Good	100
Midseason							
Higan	2	5.2	Yellow	Medium	Early & mid. August	Poor	99
Funk Delicious	1	2.4	Yellow	Large	Early & mid. August	Fair	95
Hokkaido	1	1.7	Yellow	Large	Early & mid. August	Fair	98
85560	4	8.3	Yellow	Medium	Mid. & late August	Good	100
83868	3	5.7	Yellow	Medium	Mid. & late August	Fair	86
Late							
Easy Cook	4	8.1	Yellow	Small	Early & mid. September	Poor	75
84785	4	13.7	Black-yellow	Large	Early & mid. September	Poor	99
Rokusun	4	6.7	Yellow	Medium	Early & late September	Very good	98
85883	4	6.6	Yellow	Small	Mid. September	Fair	82
84642	3	10.5	Yellow	Small	Mid. September	Fair	76
Mammoth Yellow	4	7.1	Yellow	Small	Late Sept. & early Oct.	Poor	93
Tokio	3	6.2	Yellow-green	Medium	Mid. and late Sept.	Very good	98
Mamloxi	3	6.2	Yellow	Medium	Late Sept. & early Oct.	Fair	91
Delsta	4	8.0	Yellow	Medium	Late Sept. & early Oct.	Very good	84
Biloxi	4	9.2	Red	Medium	Late Sept. & early Oct.	Fair	66
Kura	1	4.8	Black & lt. green	Large	Late Sept. & early Oct.	Fair	
93057	3	4.6	Green	Small	Late September	Fair	96
Delnoshat	4	7.0	Yellow	Medium	Late Sept. & early Oct.	Good	89
91425	3	3.6	Yellow	Small	Late Sept. & early Oct.	Fair	93
85384	2	3.8	Yellow	Medium	Late Sept. & early Oct.	Fair	
Chame	4	4.3	Brown	Large	Late Sept. & early Oct.	Fair	66
Mamotan	4	8.5	Yellow	Small	Late Sept. & early Oct.	Fair	87

Mid-season varieties of edible soybeans, when grown at Auburn, mature sometime in September. The dried beans of these varieties are usually superior to those harvested from the earlier-maturing varieties since the proportion of shrunken and off-colored beans is decidedly smaller. No. 85560, however, is the only variety of the intermediate group recommended for use as a dried bean since it is superior to the others in quality and all seeds swell and soften upon soaking. The yields of mature beans have been relatively heavy and few shrunken or discolored seed have been harvested in this variety. Seed of this variety are difficult to obtain at this time so it is recommended that one of the late-maturing varieties, such as the Rokusun, Tokio, or Delsta, be planted when dried beans are to be harvested for table use.

The late-maturing varieties, which bear green beans for table use in September, have proved to be the most productive edible soybeans tested at Auburn. They produce high yields of green beans when few other vegetable crops in the garden are available for table use. The plants grow tall, branch freely, and bear acceptable green beans over longer periods than do the early or the mid-season varieties. The Rokusun variety, particularly, yields green beans for table use over a long period when subjected to heavy picking. On several occasions, green beans have been picked from certain plantings of Rokusun soybeans for a full month.

Matured beans of the late-maturing varieties of vegetable soybeans are harvested at Auburn late in October or early in November. The seed are seldom shrunken or discolored unless drought or insect damage to foliage and pods has been very severe. Yields of late-maturing varieties were highest of all edible soybeans tested at Auburn, and the quality of the dried beans for food purposes was generally good (Table 4). The Rokusun, Tokio, and No. 93057 varieties are recommended particularly because they yield well and are considered of excellent quality. The Delsta and Delnoshat varieties are also considered of very good quality, but they do not swell and soften as uniformly as do the Rokusun or Tokio. The ability of dried beans to swell uniformly is considered as important in the selection of a variety as yield and flavor.

The quality of dried beans for table use was judged by a number of people who sampled cooked beans of all varieties listed in Table 4. Their rating of all varieties as regards flavor, texture, and appearance determined in large measure the selection of the varieties recommended for use in Alabama.

The seed harvested in Alabama from late-maturing varieties of edible soybeans are high in germinability and can be used safely for planting.

CULTURAL METHODS

Soybeans grown as vegetables can be planted, generally, in the same manner as those planted for hay. Certain modifications of the method are necessary, of course, to suit particular circumstances.

Land on which edible soybeans are to be grown should be well prepared prior to planting. If possible, it should be plowed, and discing or harrowing may be necessary on the heavier soils.

Maximum seed yields of soybeans can be expected only if the land has been properly fertilized before planting. Tests conducted at Auburn show that application of phosphorus, potash, and lime increased seed production of soybeans. As a result of the tests, the following fertilizer recommendations for edible soybeans grown for green or dried beans are given: 300 pounds of superphosphate, 50 pounds of muriate of potash, and, if the land has never been limed previously, 1 ton of lime per acre may be applied. These recommendations do not differ materially from those advanced by Sturkie (9) for soybeans grown for hay. Sturkie has recommended the use of 300 to 600 pounds of basic slag or 200 to 400 pounds of superphosphate per acre. He also points out that soybeans respond favorably to applications of lime. For general gardening purposes, about 5 pounds of a basic slag — muriate of potash mixture can be applied for each 100 feet of row. If the above fertilizers are not available some good garden fertilizer, such as a 4-10-7, can be applied at the same rate.

It can be stated that on most Alabama soils inoculation of soybeans does not seem to be necessary. However, it is safe practice to inoculate soybeans if they are planted on land which has not grown this crop before. Commercial inoculation, used according to the directions on the package can be applied, or soil from a field which has grown satisfactory crops of soybeans can be drilled in with the seed.

Most edible soybeans are large-seeded; consequently, it is necessary to plant rather high rates of seed for maximum yields of green or dried beans. It is recommended that soybeans be planted so that the seeds are spaced about 2 inches apart in the row. This requires that around 60 pounds of seed of the smaller-seeded edible varieties, such as the Tokio, be planted per acre or about 90 pounds of seed of the larger varieties, such as the Willomi, be planted per acre when the rows are spaced 2½ feet apart.

The home gardener may find that plants spaced 2 inches apart in the row are too close for proper weeding. For convenience in hoeing, plants may be spaced from 4 to 6 inches apart in the row or they may be planted like bunch beans, in hills spaced about 8 inches apart. Some growers of edible soybeans in Alabama are using the latter method. Thinner spacings may also be necessary if seed supplies are limited. It has been generally observed that soybeans planted thinly produce high

yields of seed per plant but lower yields of seed per acre. To assure the grower of green shelled beans throughout the summer, early, mid-season, and late-maturing varieties should be planted at the same time, in April or early in May. Satisfactory yields of soybeans cannot be expected in Alabama if plantings are made after mid-May.

Soybeans are not often attacked by diseases and only the late-maturing varieties are subject to severe insect damage in certain years. Insect injury to the late-maturing soybeans is largely restricted to foliage and green pods, causing, in some years, substantial reductions in seed yields. Insects which may cause defoliation and pod injury in soybeans are the corn earworm, velvet bean caterpillar, and the Mexican bean beetle.

Growers of edible soybeans should be cautioned that rabbits feed heavily upon this crop, often in preference to other vegetables growing in the garden. Small plantings should be protected if rabbit damage to young plants threatens stands.

Green shelled beans for table use from mid-July to late in September or early in October will be assured by the selection of one or more varieties* in each of the following groups:

Early — Willomi, Imperial, or Emperor.

Mid-season — Funk Delicious, Hokkaido, or No. 85560.

Late — Rokusun, Tokio, No. 93057, Delsta, or Delnoshat.

Most edible soybeans shatter their seed severely upon maturity. This is particularly true of the earlier-maturing varieties. Because of this, soybeans should be harvested when the pods are turning brown, rather than after they have completely ripened. Complete maturity is of course necessary if harvests are to be made by combine.

When soybeans are not harvested by combines, the vines can be cut and raked into windrows or placed on hay racks until they are dry enough to thresh. If a grain thresher is used for threshing, the speed of the cylinder should be reduced and the concaves removed to minimize cracking of the seed.

This precaution should also be taken if a combine is used to harvest the seed. If threshing machinery is not available or small amounts of seed are to be threshed, the seed may be beaten out with sticks.

Threshed seed should be dried thoroughly before storage or the seed will heat and spoil. Little or no damage to dried soybeans by stored grain pests occurs.

SHELLING, CANNING, AND COOKING RECOMMENDATIONS

In shelling green soybeans, it is highly important that they be subjected to a preliminary heat treatment, for the seed pods are very tough, and in the raw condition are difficult to open.

*The Alabama Agricultural Experiment Station has no seed of edible soybeans available for distribution, but some varieties are listed in the catalogues of certain seed companies and are also available at certain seed stores in the State.

To facilitate shelling, the green pods should be plunged into boiling water for about two minutes after which the beans can be squeezed from the pods with no difficulty.

The shelled green beans should be boiled until done (usually thirty minutes to an hour). They can then be seasoned and served like green lima beans, English peas or cowpeas.

For canning green shelled soybeans, the methods used for other beans and peas may be used. The green shelled soybeans should be pre-cooked for 3 to 5 minutes in boiling water to cover, after which they are packed in jars, and covered with the boiling water in which they were pre-cooked. One teaspoon of salt per quart is added. In a pressure canner at 10 lbs. pressure the cans should be processed as follows: No. 2 cans for 30 minutes, No. 3 cans and pint jars for 35 minutes, quart jars for 40 minutes.

When mature soybeans are to be eaten, they must be soaked in water for several hours or over-night before cooking. Mature soybeans can be cooked either by boiling for one to two hours or in a pressure cooker for one-half hour at 10 lbs. steam pressure. If soybeans are to be baked, their texture is improved by a preliminary boiling for about an hour. A number of recipes for dishes using mature soybeans are available. In general, most recipes for serving dishes of other types of dry beans give pleasing results with mature soybeans, and may be used without modification, provided the soybeans are soaked and given sufficient cooking. Several soybean recipes taken from Experiment Station and U.S.D.A. publications are given in succeeding pages.

SOYBEAN RECIPES

Recipes Using Green Soybeans.

Scalloped Green Soybeans

3 cups green soybeans	6 tablespoons flour
Water	1 teaspoon salt
3 cups milk	Pepper to taste
6 tablespoons fat	1 cup buttered bread crumbs

Steam or boil the beans until tender. Heat the milk and thicken with the combined fat and flour. Add this to the beans with the seasonings. Place in a greased baking dish, cover with the bread crumbs, and bake until the mixture is heated through and the crumbs are brown.

Green Soybeans in Tomato Sauce

3 cups green soybeans	1 teaspoon onion juice
2 tablespoons butter	1 tablespoon minced parsley
2 cups canned tomatoes or tomato puree	1 tablespoon minced green pepper
½ teaspoon cinnamon	2 tablespoons honey
½ teaspoon cloves	Salt to taste

Steam or boil the beans until tender. Put the mixed ingredients in a greased baking dish and bake about half an hour. Strips of bacon across the top improve the dish.

Recipes Using Cooked Mature Soybeans.

The directions for boiling the mature soybeans are as follows: First, soak the dry beans overnight or for several hours in water, then drain, add fresh water and boil slowly for one or two hours until tender, or, if pressure cooker is available, cooking for one half hour with 10 lbs. steam pressure gives good results.

Baked Soybeans

8 cups boiled soybeans	2 tablespoons molasses
$\frac{1}{4}$ lb. salt pork	1 teaspoon prepared mustard

One pound of dry beans are soaked as above, and drained, giving about 8 cups of soaked beans. These should be boiled in water for about one-half hour (thorough cooking is not necessary). The mixture of molasses and mustard in enough water to cover the soybeans is added, and the pork is placed on the beans. They are covered and baked slowly for four or five hours. More water is added if needed, and the last hour they should be uncovered. The dish may be served with tomato sauce or chili sauce.

Soybean Casserole

2 cups cooked soybeans, chopped	6 tablespoons flour
$\frac{1}{4}$ cup diced salt pork	2 cups milk
2 cups chopped celery	1 tablespoon salt
2 tablespoons chopped onions	1 cup butter and bread crumbs
2 tablespoons chopped green pepper	

The salt pork is browned in a frying pan. The celery, onion and green pepper are added and sautéed for about 5 minutes. Thickening made from flour, milk and salt is added, and stirred until the boiling point is reached. The soybeans, cooked as above, are stirred in, and the mixture transferred to a greased baking dish, covered with the buttered bread crumbs, and baked in a moderate oven for about 30 minutes.

Soybean Loaf

2 cups cold cooked soybeans	1 tablespoon chopped onion
1 cup bread crumbs	Salt and pepper
1 egg	$\frac{1}{3}$ cup cooked tomato

The soybeans, which have been soaked and cooked as above, are run through a food chopper or colander. They are combined with the other ingredients, formed into a loaf and baked for one hour.

Salted Soybeans

Dry soybeans are soaked overnight, drained, and spread out at room temperature until the surface is dry. They are then fried a few at a time in deep fat at 350° F. for 8 to 10 minutes, drained on absorbent paper, and while still warm sprinkled with salt.

Recipes Using Soybean Flour.

Soybean flour can be made by grinding the whole soybean. A home mill can be used for this purpose. The flour can be used in the making of bread, muffins, biscuit, pastry and plain cakes. A proportion of one-fourth soybean flour to three-fourths wheat flour may be used in ordinary recipes for these products without other change. The muffin recipe below uses equal parts of soybean and wheat flour.

Soybean Muffins

1 cup soybean flour	2 teaspoons baking powder
1 cup white or whole wheat flour	$\frac{3}{4}$ cup milk
1 teaspoon salt	1 egg
2 tablespoons sugar	1 tablespoon melted fat

The dry ingredients are sifted together. The milk and beaten egg are mixed with the melted fat, poured into the dry ingredients, and stirred until they are just moistened. The mixture is poured into greased muffin pans and baked in a hot oven (425° F.) for 20 to 25 minutes.

Soybean Sprouts.

Soybeans, like mung beans, can be sprouted in a flower pot, a sink strainer, or any container that has holes in the bottom for drainage and can be covered. In preparing the sprouts, the soybeans are soaked overnight and then placed in a container (usually an earthen jar) which is large enough for the beans to swell at least six times their original bulk as they sprout. A cloth should be placed in the bottom of the container to prevent the beans from running out through the holes. The container is covered to keep out the light. The beans must be moistened at least three times a day in the summer and twice in the winter. In the winter it is advisable to add warm water and keep the beans in a warm place. The time allowed for sprouting is from 3 to 5 days in the summer and from 10 to 15 days in the winter. The sprouts when fully grown (2 to 3 inches long) are ready to be used, and like any fresh vegetable should be kept in a cool place.

The sprouts furnish a fresh vegetable at any time of the year and can be used in salads without cooking or after cooking for only five minutes. Creamed sprouts can be prepared by adding white sauce to washed sprouts which have been simmered for about 5 minutes. The sprouts can be fried for about 5 minutes and served with fried meats. Soybean sprouts are also a good addition to omelets, soufflé, meat stew or fricasse. The addition of the sprouts should be made just a few minutes before serving in order to retain as much of the crispness as possible.

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