FOOD USES OF NORTH DAKOTA DRY EDIBLE BEANS

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North Dakota's Role in Dry Edible Bean Production

During the summers of 1980 and 1981, North Dakota was the nation's leading producer of pinto beans. At the time the original pilot project proposal on "Food Uses of North Dakota Dry Edible Beans" was written in January-February, 1981, statistics compiled by the North Dakota Crop and Livestock Reporting Service indicated that North Dakota ranked sixth among the 10 leading states in dry edible bean production in 1979 with Michigan, California, Idaho, Nebraska and Colorado (listed in rank order) exceeding North Dakota's production. North Dakota as the sixth in rank produced 5 percent of the total production for the U.S. amounting to 141,800,000 lbs. with a total value of $33,607,000 in 1979.

The Cooperative Extension Service "Dry Bean Production Handbook" (1981) stated that North Dakota led the nation in total acreage of pinto beans planted during 1980 and that North Dakota then ranked fourth in total dry edible bean production in the nation. In 1981 North Dakota's dry edible bean production increased by 70 percent over 1980 to reach 4,565,000 cwt.

While the United States produces more than 14 different types of dry edible beans, nearly 60 percent of the production is pinto beans and navy beans (United States Department of Agriculture, 1978). In 1981 it was reported that pinto bean production made up 44 percent of the total dry bean production.

North Dakota's dry edible bean production in 1979 and 1981 was chiefly pinto beans (about 86 percent in 1979 and 81 percent in 1981) and navy beans (about 13 percent in 1979 and 16 percent in 1981) with 3 percent of other bean classes in 1981 (Johnson and Takele, 1980; North Dakota Crop and Livestock Reporting Service, 1981). The Red River Valley (RRV) is the major dry edible bean producing area in North Dakota, accounting for about 80 percent of the State's production.

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Johnson and Takele (1980) state that the dry edible bean crop of the United States is partly exported, but is mainly consumed by low income rural nonfarm households in the South. Those of the Southwest should also be added. This regionality of bean consumption is in large part due to the food habits of various ethnic groups, whose food patterns incorporate relatively large amounts of legumes in the diet; those of Mexican heritage for example. Mexican restaurants serving many legume foods are increasingly popular across the United States. Here in Fargo the current telephone directory lists six restaurants and taco shops featuring Mexican foods. Not only are the spicy flavors and combinations of these foods liked by many, but the comparatively low price of the foods has a distinct advantage. Vegetarianism, which must rely to a considerable degree on legumes as a source of nutrients and which has been practiced for centuries in many countries of the world, is growing in Europe and the United States. It is estimated that 1 percent of the U.S. population is now vegetarian.

Whether vegetarian or not, legumes are valuable sources of nutrients, especially protein, minerals, and B vitamins. There is, however,a general lack of knowledge of how to prepare and utilize legumes by the majority of the U.S. population, other than to open a can of commercially baked beans. One obvious limitation in the use of raw beans in the household is the soaking time and relatively long cooking times required for most legumes.

Nutritional Importance and Value of Legumes

The majority of the earth's population is vegetarian. Vegetarians must depend largely upon legumes and cereal grains for their protein and energy supply in addition to other nutrients. The soybean as a legume is one of the oldest crops known to man and has been used for thousands of years, especially by Asiatic peoples.

In contrast to soybeans, an important oilseed legume which contains about 34 percent protein, 17.7 percent fat, and 33.5 percent carbohydrate in the raw mature beans, pinto beans in the raw state contain 22.9 percent protein, 1.2 percent fat, and 63.7 percent carbohydrate while raw navy beans contain 22.3 percent protein, 1.6 percent fat, and 61.3 percent carbohydrate. Pinto and navy beans contain about 12 percent less protein, about

28-30 percent more carbohydrate (or almost twice as much) and very little fat or about 16 percent less than soybeans. Legumes are excellent or valuable sources of the minerals potassium, phosphorus, iron, magnesium, and calcium; of B vitamins including thiamine, niacin, pyridoxine, and folic acid; and of fiber. In addition, it should be noted that they are low in sodium (U.S. Department of Agriculture, 1975; Pennington and Church, 1980; California Dry Bean Advisory Board, n.d.). Table 1 records nutrient data for navy and pinto beans as compared with several other foods.

In terms of amino acid profiles, legumes are generally considered to be limiting in sulfur-containing amino acids and some in tryptophan. On the other hand, they are excellent sources of lysine, which is known to be limiting in cereal grains. Legumes also tend to complement the lower isoleucine values of cereal grains, so legume protein and the protein in grains and certain seeds and nuts complement each other. Table 2 records amino acid values for navy and pinto beans as compared with several other foods.

The Western Regional Research Center (in Berkeley, California), ARS, U.S. Department of Agriculture, has been involved in dry bean utilization research for over 20 years. Projects have included determination of the chemical constituents of dry beans, projects to reduce soaking and cooking time and to isolate, assay, and moderate factors that cause flatulence when dry beans are ingested (California Dry Bean Advisory Board, n.d.).

Objectives of Pilot Project

During June of 1981 a pilot project was undertaken to determine possible food uses of North Dakota dry edible beans, particularly navy and pinto beans. The plan was to prepare and test various forms of these beans in different food preparations, including whole and mashed beans; bean grits, bean flours, bean nuts, and bean sprouts, for which methods of preparation were developed; and incorporate beans into traditional foods of India and Nigeria, countries which use a considerable amount of legumes in their diet. Recipes were developed and preparations evaluated.

Table 1. Nutrient Values of Navy and Pinto Beans as Compared with Several Other Foods

FOOD	MEAS.	WT g	WATER %	CAL	PRO g	CHO g	FIB g	FAT g	PUFA g	Na mg	K mg	Ca mg	Mg mg	P mg	Fe mg	THI mg	RIB mg	NIA mg	ASC mg	A Iu	D Iu
hamburger, med., fat	1 patty, ca 3" diam. 5/8" thick	85	54.2	224	21.8	0.0	0.0	14.5	0.7	40	382	6	18	187	3.3	0.13	0.15	4.8	0	0	0
Milk, whole (3.5% fat)	1 c.	244	87.4	159	8.5	12.0	0.0	8.6	0.2	122	352	288	37	227	0.1	0.07	.42	0.2	2	340	100
Soybeans, mature seeds, ckd.	½ c.	100	71.0	130	11.0	10.8	1.6	5.7	---	2[a]	540	73		179	2.7	.21	.09	5.6	0	30	
Navy (pea) beans, ckd, no residual cooking liquid	½ c.	100	69.0	118	7.8	21.2	1.5	0.6		7[a]	416	50		148	2.7	.14	.07	0.7	0	0	
Navy (pea) beans, raw	½ c.	100	10.9	340	22.3	61.3	4.3	1.6		19	1196	144	170	425	7.8	.65	.22	2.4		0	
Pinto beans, raw[b]	½ c.	100	8.3	349	22.9	63.7	4.3	1.2		10	984	135		457	6.4	.84	.21	2.2			

Source of values: Pennington and Church (1980) and U.S. Department of Agriculture, 1975.
[a]No salt added.
[b]Cooked values unavailable.

Table 2. Essential Amino Acid Composition of Navy and Pinto Beans as Compared with Several Other Foods.

FOOD	TRY	PHE	LEU	ISO	LYS	VAL	MET	THR
	mg							
Hamburger, med. fat 1 patty (85 g)	255	897	1786	1141	1906	1211	541	963
Milk, whole (3.5% fat) 1 c. (244 g)	119	408	842	544	663	586	204	391
Soybeans, mature seeds, cooked, ½ c. (100 g)	165	594	935	649	759	638	165	423
Navy (pea) beans, ckd., no residual cooking liquid, ½ c. (100 g)	70	429	671	445	577	476	78	335
Navy (pea) beans, raw ½ c. (100 g)	201	1227	1918	1271	1650	1360	223	959
Pinto beans, raw ½ c. (100 g)	206	1260	1969	1305	1695	1397	229	985

Source of values: Pennington and Church (1980).

Results of Study

During this study it was found that navy (or pea) beans and pinto beans are indeed very versatile in food uses. The following indicates the many different forms, uses and products of the beans that were studied and developed. Approximately 75 recipes were developed for the use of these different forms and products of the beans.

Whole beans were used in soups, stews and salads; **whole or mashed beans** were used in vegetarian beanburgers and patties and as an extender in meat loaves and with ground meat in the form of patties; **whole beans** were used in chili and other hot dishes and casseroles and in pilaf; **mashed beans** were also used in deep-fried pastries and in pancakes.

Methods were developed for preparing bean grits and flours from both pinto and navy beans. **Bean grits** were used in soups, stews, meat loaves, patties, scrapple and muffins. **Bean flours** were used in soups, gingerbread and sugar cookies, donuts, fritters, crackers, crepes, tortillas, chips, and pie crust.

Recipes were also developed for using pinto beans and navy beans successfully in **traditional foods of India** including chapati, pooris, and parathas **(unleavened breads)**; **dosai** (a slightly fermented dough of beans and rice fried as a pancake), and **idli** (a steamed rice and bean preparation); and in **traditional bean preparations of Nigeria** such as **akara**, a fried bean fritter (usually made from black-eyed peas), and **moin-moin** (a steamed dehulled ground bean preparation).

Successful methods were also developed for preparing **sprouts** from both pinto and navy beans. These sprouts were used in stir-fry preparations and soups.

Pinto and navy beans **nuts** were also prepared.

Initial studies were done on **navy bean milk**, **navy bean** tofu (bean curd or cheese), navy bean **okara** (a by-product from the preparation of tofu), and on the use of the beans as extenders in sausages, which indicate additional potential uses for dry edible beans.

Within the limits of available data on the newly released Agnet Dietcheck computer program on nutritional analysis, using the U.S. Department of Agriculture Handbook No. 456, the recipes developed were analysed for nutrient values. While data for many ingredients in the recipes could be determined by the computer program, data were not available for nutritional value of the many bean products developed, such as the bean grits and flours, sprouts, dehulled beans, etc., which emphasizes the need for future studies on the nutrient analysis of these products. Laboratory nutrient analysis of the bean products could not be undertaken in this study due to funding limitations.

Through this project the researchers have shown that there is a very great potential for using pinto beans and navy beans in numerous ways in many food products that would be very acceptable to the general public. Due to their very bland and nonfatty nature, they were found to have great versatility and potential for food product development and use both in the home, in commercial establishments, and in the food industry.

A publication on the food uses of pinto and navy beans is in process. It is also hoped that opportunities will become available to demonstrate the many food uses and products that can be prepared from these beans in the average home. This study also provides opportunity for bean growers' associations to become interested in supporting the development and promotion of the food uses and food products of these beans, as well as other beans currently grown on a smaller scale in North Dakota.

Further Research Needed

It is felt that only the "tip of the iceberg" has been experienced in understanding the great versatility of these dry edible beans for food uses in the home and food industry (witness the development of food uses of soybeans and peanuts).

There is need for more recipe development; sensory evaluation of food preparations and products needs to be conducted; nutrient analyses need to be accomplished on the bean products; processing and preparation methods need to be studied relating to cooking, soaking, and drying times and temperatures in relation to nutrient values, and further studies need to be conducted on the best methods for producing dry edible bean flours and grits both at home and commercially along with studies to determine the optimum moisture levels for extended shelf-life and studies of nutrient values.

Above all, it should be stressed that these legumes have a very promising future. This project has shown their great versatility and the potential for acceptance and greater use by people of these nutritious foods.

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There were no significant differences between planting dates for common smut and common rust infection levels, so these ratings were averaged over dates. Resistance to common smut is always a selection criterion in the North Dakota corn improvement project, while resistance to rust is a criterion only when natural infection levels are moderately severe. Yield losses from rust are much less than those from the other two diseases, so selection against susceptibility to this disease has been less rigorous. Probably due to the relative emphasis in previous selection, all lines showed some level of rust infection, but 17 lines were not infected with common smut and most others were infected at quite low levels. Only two lines, ND407 and W64A, had infection levels above 5 percent.

Six lines (ND300, ND376, ND408, ND468, CM105, and CM174) were resistant to both smuts, but resistance to one of these diseases does not necessarily imply resistance to both. Genes for resistance to these diseases are different. The resistance is expected to be quite stable, once seed companies identify lines possessing this resistance and use them to produce resistant hybrids.

Head smut can cause severe yield reductions, but it is not expected to become a major problem for corn producers of this area. Seed companies producing hybrids for this region are capable of rapidly shifting to resistant hybrids since most inbreds appear to be resistant to this disease. Future inbreds undoubtedly will be screened for resistance to head smut if the disease appears to be a serious hazard.

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their family responsibilities seriously. However, unlike their ancestors, these women do not expect their children to help with household work. Also unlike their ancestors, these women are dedicated to employment outside the home and work for career advancement.

They feel a commitment to both their career and family. They are employed because of financial reasons, but mainly because of dedication to their jobs. Generally, they do not expect their children or husband to help them with home related work, but they do try to get their husbands to see the problems faced in combining employment and caring for a family. Their worries are mostly related to their family's well being, but they also worry about themselves and financial matters.

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