

# PROCESSING AND UTILIZATION OF SOYBEAN IN NORTH EAST INDIA

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## INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is being used extensively for protien food in the third world since centuries. It contains nearly 40% protein and 20% oil apart from 23% carbohydrates and 5% minerals (Fig.1). Besides large amount of unsaturated fatty acid and high food value, soybean provide quality protein for man and livestock. The high quality of soy protein is illustrated by its content of all the essential amino acids with exception of the sulpher containing (methionine) amoni acid (Table 1.) This imbalance is adequately offset in the traditional cereal based mixed diet. Supplementation of the cereal based diet with soy protein gives an amino acid complementation, which results in increased protein quality and quantity approaching that of animal protein. Soybean has twice as much protein as pulses, groudnut, meat and fish; three times as much as egg and more than ten times that of milk (Fig 2.) Morever the protein yield per unit of cropped area is also highest in case of soybean (Fig3.)

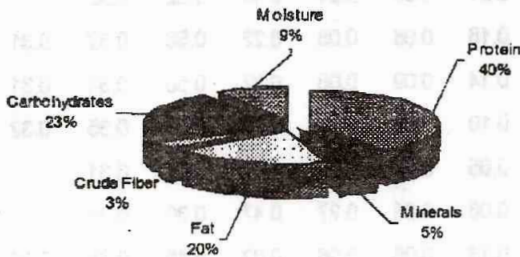


Fig .1 : Nutritional Composition of soybean

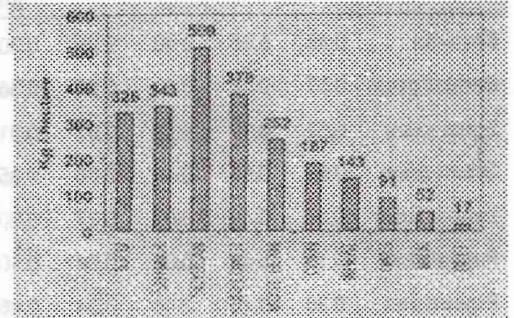


Fig. 2 : Protein Yield in Cultivation

According to the report of American Journal of Clinical Nutrition, soy protein can serve as a sole protein source of all human beings except premature infants. Moerever, it is low in fat and contains no cholesterol. It is an excellent food for babbies, children, elderly people and pergnant and lactaning women. US Department of Food & Drug Administration of (USFDA) has recommended, 25 grams of soy protein a day as part of a diet low in saturated fat and cholesterol, to reduce the risk of heart disease.

Besides being a healthy nutrition for general mass, soy protein is a proven cholesterol lowering agent. It is kedney friendly and causes calcium to be better

utilized to avoid the condition of osteoporosis. Recent studies have shown that some of the nutrients of soybean are also the potential cancer fighters.

### SOYBEAN CULTIVATION IN NORTH EAST INDIA

The total area under soybean cultivation in India during 1970-71 was about 32,000 ha, which has been steadily rising year after year. At present total area under soybean in the country is about 6.00 million-ha. Similarly the production and productivity have increased from merely 14,000 tones and 438 kg/ha (1970-71) to about 6.0 million tones and 1000 kg/ha, respectively. But nearly 72 to 80% of the soybean in India is produced in Madhya Pradesh. Other states, which grow significant amount of soybean are Maharashtra, Rajasthan and Uttar Pradesh. Though productivity of soybean is higher in north eastern region, total area under cultivation is very low. Despite the limited area, soybean has good prospects for cultivation due to higher productivity in this region. Average productivity of the crop is quite high in Arunachal Pradesh, Mizoram and Sikkim and hence intensification of soybean cultivation can be undertaken in these states.

Table 1. Essential amino acid content (g/16g N) in different pulses

Pulse	Essential amino-acids											
	Arginine	Histidine	Lysine	Tryptophan	Phenylalanine	Tyrosine	Methionine	Cystine	Threonine	Leucine	Isoleucine	Valine
Soybean	0.45	0.15	0.40	0.08	0.30	0.21	0.08	0.24	0.48	0.52	0.32	
Bengal gram	0.57	0.16	0.44	0.05	0.36	0.18	0.08	0.08	0.22	0.58	0.32	0.31
Black gram	0.52	0.17	0.40	0.07	0.31	0.14	0.09	0.08	0.22	0.50	0.34	0.31
Green gram	0.50	0.17	0.46	0.06	0.35	0.10	0.08	0.06	0.20	0.51	0.35	0.32
Lentil	0.54	0.16	0.44	0.06	0.27	0.20	0.05	0.07	0.22	0.47	0.27	0.31
Rajmah	0.37	0.18	0.46	0.06	0.34	0.10	0.06	0.06	0.27	0.47	0.30	0.33
Pigeon pea	0.36	0.25	0.48	0.04	0.46	0.13	0.06	0.06	0.02	0.45	0.25	0.36
Milk	0.20	0.13	0.49	0.09	0.27	--	0.17	0.09	0.30	0.64	0.33	0.38

Source: Gopalan C. *et al* (1984) Nutritive values of Indian Foods, NIN, Hyderabad.

In north east, soybean is cultivated in kharif season only. It is difficult to grow the crop in rabi season due to non availability of irrigation facilities, poor water retention capacity of the soil, prolonged low temperature, frosting, free grazing of stray cattle, synchronization of harvesting time with pre monsoon showers etc. Moreover, high rainfall, low sunshine hours and high humidity are major constraints in various stages of cultivation including harvesting, drying and storage. The yield reduction is attributed

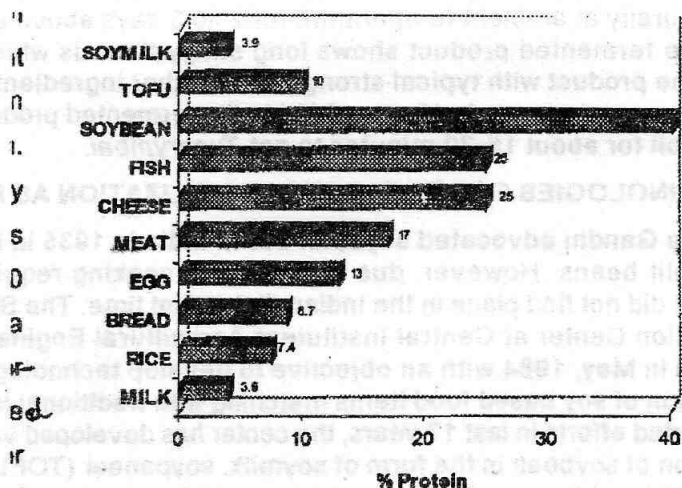


Fig. 3 : Protein in Common Foods

to prolific growth of weeds due to high rainfall and, therefore, considerable proportion of labour is directed for weeding. Conditions like abundant water, humid weather and wind velocity promote lodging of matured crop and in-situ germination of seeds resulting in loss of seed viability and reduction of yield as well as quality of the grain.

### PRESENT STATUS OF SOYBEAN UTILIZATION IN NORTH EAST

Although increasing attention is currently being paid to the potential that soybean offers as a major protein source, the primary interest in soybean in India has been for oil. About 50% of the total soybean produced in the country goes for direct food and feed uses, 10% for seed and 85% is processed for oil protein. Crop residues like leaves and fine straw are used as fodder and the hard and woody stem is utilized as fuel in rural areas.

Soybean was introduced in India primarily as a protein food source, but this main objective was not being met. It was probably due to lack of research in the area of hardware development for soybean processing and its utilization as a food source and, therefore, major emphasis was given to augment edible oil production. In north east, soybean is mainly utilized as pulse crop and as fermented products. *Tungrymbai* (Meghalaya) and *Kinema* (Sikkim) are indigenous fermented soybean food, which serve as a sustainable supply of low cost source of high protein food in the local diet. *Kinema* curry is delicious local cuisine eaten along with boiled rice in main meals. *Tungrymbai* is mainly consumed in the form of chutny along with rice and vegetable curry in Meghalaya. Other products made from soybean in north east are *Hawaijar* (Manipur), *Bekang-um* (Mizoram), *Akhoni* (Nagaland) etc.

Preparations of above items are more or less similar. The soybean seeds are soaked in water over night, cooked in open vessel unit it can be pressed easily, then cooked soybean are wrapped in lamet leaf and kept in bamboo basket and left to

ferment naturally at ambient temperature for 2 to 3 days above earthen oven in the kitchen. The fermented product shows long stinky threads which gives the sticky texture to the product with typical strong flavor. Other ingredients like green chilly, garlic, sesamum, ginger and salt are added to the fermented product and it is cooked in mustard oil for about 15-20 minutes to get *Tungrymbai*.

## **TECHNOLOGIES FOR THE SOYBEAN UTILIZATION AS FOOD USES**

Mahatma Gandhi advocated soybean use in India in 1935 in the form of cooked whole or split beans. However, due to extensive cooking requirement to make it digestible, it did not find place in the Indian diet at that time. The Soybean Processing and Utilization Center at Central Institute of Agricultural Engineering, Bhopal was established in May, 1984 with an objective to develop technologies for processing and utilization of soy based food items matching with traditional Indian food recipes. After concerted efforts in last 17 years, the center has developed various technologies for utilization of soybean in the form of soymilk, soypaneer (TOFU), full fat soy flour, soy fortified biscuit, soy dal etc., which could be used at house hold level for preparation of various soy based recipes. These technologies can also be adopted by small scale entrepreneurs for establishment of cottage level industries and income generation. Processes for preparation of some soy products are discussed below :

### **Soy milk**

For most of the people in India, soymilk is not palatable as such, in spite of the fact that nutritionally it is almost as good as cow's milk and mother's milk. Soymilk has been known in mainland China for centuries. Hot soymilk is used as a breakfast beverage in mainland China, Japan, Taiwan and Thailand. Soymilk is a creamy, milk-like product made by soaking and grinding soybeans in water. The process of making soy milk consists of cleaning, grading, dehulling, soaking of soy splits in water, with beans to water at 1:3 ratio at room temperature for 4-6 hours or for 1 hour at 60°C. The soaked splits are then ground in cooker-cum-grinder using hot water for 15-20 minutes (using beans to water ratio of 1:6 to 1:8). The slurry thus obtained is filtered through muslin cloth in a stainless steel filter to remove residue (okara) and get soymilk. From one kg soybean 7-9 liters of soy milk are obtained.

About 50 per cent of the Indian adult population is lactose intolerant. Soymilk is the only alternative for the children and adults having lactose intolerance or allergy to bovine milk. Soymilk has 3.5-4.0% protein and 7-8% total solids. Besides being rich in protein, vitamin and minerals, soymilk is a very economical, lactose free, highly digestible and nutritious alternative of dairy and meat centered diet. It is cholesterol free product, has a very low fat content and is rich in polyunsaturated fatty acids of phospholipids especially lecithin and also linolenic acid. Adding 3-4% sugar and about 0.05% salt brings it to a sugar, salt and total solid level approximately identical to toned (2% fat) cow's milk, i.e. about 12-13% total solids. This can be consumed as such or after sweetening and diluting. Alternatively, it can be made into yogurt (curd) or tofu. In addition to that, blends of the soymilk with cow/buffalo milk have been successfully tried for the preparation of '*Rasogolla*'. Flavoured soymilk is available in bottles and also in loose packing at some places in the country.

### **Soy paneer (TOFU)**

Soypaneer, popularly known as TOFU in the oriental countries, is a coagulated and pressed soy protein used as a vegetarian food ingredient. Milk paneer is very popular among high income group urban people in India for making vegetarian curry and paneer pakoda. Since, the cost of milk paneer is above Rs. 80/kg, it is out of economic reach of majority of Indian people. Thus soypaneer is an appropriate alternative to milk paneer, as the cost of soy paneer is less than half (Rs. 25-30/kg), and it gives all nutritional advantages and psychological satisfaction of eating paneer dish. From one kilogram of soybean costing Rs. 8-10/kg about 1.5 kg of soy paneer could be obtained. However yield of soypaneer depends on the variety and quality of soybean-seed. Higher, the moisture, more is the yield. Varietal effect has also been observed on paneer yield. Soy paneer at about 72% moisture level, contains approximately 14% protein, 8% oil, 3% carbohydrates and 2% ash. It is very suitable to be used in making paneer curry, paneer pakoda and soy paneer stuffed paratha.

The soymilk when sufficiently hot (about 70°C), then  $\text{CaSO}_4/\text{MgCl}_2$  or citric acid is added at 1.2-1.5g/liter for coagulation. Mixture is thoroughly stirred and then curdled material is poured on the muslin cloth, kept in paneer-forming box to remove excess water called whey, by pressing for about 30 minutes. The paneer thus obtained is further cooled by keeping it in chilled water (6-8°C), stored in refrigerator till further use. The water should be changed daily.

At domestic level soypaneer can be made with the help of domestic mixer grinder and for small scale level soyplant available in the market can be used. The cottage-level soypaneer plant consists of a steam generator, a grinder-cum-cooker, a milk filter/extractor, soypaneer press and other accessories; all made up of food-grade stainless steel. The paneer plant is capable of producing 45-50 kg of paneer in 8 hours. The special feature of the unit is that it grinds and cooks soaked soybean simultaneously under oxygen free environment, and therefore, minimizes beany flavour and results in excellent quality product. It is a compact unit and requires only 5m x 4m space. Establishment of 50 Kg/day capacity soypanner plant would cost about Rs. 2,15,000/- including plant and other machineries.

### **Full fat soy flour**

One of the simplest ways of using soybean in human diet is in the form of full fat soy flour in combination with wheat, sorghum, maize, gram, or rice flour. About 10% blending of soy flour with other flours is recommended in the beginning. Preparation and use of recipes from soy and cereal blended flour does not involve any change in the traditional food habits of the people. Nutritional composition of full fat soy flour is almost similar to that of whole soybean and it contains 40% protein, 22% carbohydrates, 20% oil, 5% fiber and nearly 3% minerals.

Method of preparation of full fat soy flour is very simple. Soybean should be properly cleaned and graded before storage and processing for any consumable products. Yellow coloured, bold and sound grains should be preferred. It is advisable to dehull soybean shortly before processing to avoid any off flavor development. For conditioning/treatment of soybean, to produce full fat soy flour, equipments such as cleaner, grader, destoner, dehuller and autoclave are required for cleaning, grading

destoning, dehulling and blanching respectively. Dryer is required to dry the blanched soybean splits to safe moisture level. Different type of dryer & such as natural convection tray dryer, solar dryer and electric dryer has been developed at various places under different schemes, which can be used effectively according to the availability of fuel sources and climatic condition of the region. Burr type grain mill/hammer mill/pin disc mill is required for grinding of soy split to make soy flour. Process involved in making of full fat soy flour includes cleaning, grading destoning and dehulling to get clean and uniform size soybean splits. Splits are blanched in boiling water with little quantity of sodium bicarbonate for 25-30 minutes. After blanching, wet splits are dried to 6 to 8% moisture level. The dried splits are then ground in a burr mill/hammer mill/pin disc mill to get full fat soy flour. The milling in a pin disc mill is preferred. Soy flour is then packed in suitable packing material like LDPE bags of 400 gauge or airtight container. Well-packed soy flour can be stored for 3 months without any deterioration in quality. Freshly prepared or stored soy flour after opening of package should be utilized preferably within 30 days, which also holds good for soy and wheat flour blends. About 10-15% soy flour could be blended with other flours like wheat flour, maize flour, gram flour etc for better nutritional and economic advantages.

#### **Soy splits (dal)**

Majority of the Indian population are vegetarian and consumes cereals along with cooked pulse in soup/broth form. Pulses are generally consumed to supplement protein requirement. Cooking and eating qualities of soybean differ than other pulses because; it contains less than one per cent starch as compared to 20-25% in other pulses, resulting into poor dispersibility. However, addition of 10% soy dal into other pulses enhances protein level without affecting the eating quality. Process of preparing soy dal is same as getting blanched and dried soy splits for making soy flour as discussed above. In open vessel cooking, which is most common in rural areas, soybean takes about 2 to 3 hours of cooking to get tenderized to a desired degree. However, pressure cooking reduces the time to 25 min and 12 min at 1.05 Kg/cm<sup>2</sup> and 1.4 kg/cm<sup>2</sup> pressure, respectively. Addition of alkaline salt and chelating agents also reduce, the cooking time. For example cooking in 1% solution of NaHCO<sub>3</sub> or sodium citrate reduces the cooking time to 75 min and 60 min respectively at atmosphere pressure. Thus, pressure-cooking is the most economical and better option to tenderize whole soybean and soybean splits. Addition of 5% of rice flour to soy dal gives a well cooked and tasty dal with over 38% protein content and desired consistency. Blending of soy dal with other pulses namely pigeon pea, green gram, black gram and lentil up to 50% and pressure cooking provides a well cooked, dispersed and organoleptically acceptable dal containing about 32% protein. Storage of soy dal in metallic contains or in 400 gauge polyethylene bags up to six months poses no problem except a slight increase in overall cooking time.

#### **Soy fortified biscuits**

The effect of incorporation of full fat soy flour for making various bakery products have been investigated and studies have shown that 5-25% soy flour can be used in preparation of bread, cakes and cookies, doughnuts and other snack foods, without

any loss of physical characteristics but substantial improvement in the nutritional value of the products. The process of making soy fortified biscuits has been standardized for adoption at the home and at industrial level. Blending of 30% soy flour i.e. 300 g soy flour in 1000 g *maida* gives highly acceptable good quality biscuits containing 12% protein and 24% fat. About 1.8 kg biscuits can be made from 1000 g *maida* and other ingredients in suitable proportion. The process for production of soy fortified biscuits at home and cottage/small scale level consists of mixing of all ingredients, sheeting of mixed dough, cutting of sheeted dough using a die mould and baking at 200°C for 15 min. Equipments and machineries required for preparation of soy biscuits include dough mixer, baking oven, baking pans, moulds, dies, heat sealing machine etc.

Addition of soy protein with cereal protein in any form improves the quality of the protein in the resulted product by increasing its biological value. The same thing happens when soy protein is admixed with cow/buffalo milk. In north eastern states there is indeed a great potential for soy products because it is grown in almost ever states since centuries. However, it requires extensive promotional activities by the government and non-governmental organizations to make it popular among common people. Since in this region, soybean is consumed only in the form of fermented products, it needs demonstration and awareness activities to make people aware about the other food products of soybean. Increased use of soy products among tribal and poor people will not only help to overcome the wide spread malnutrition in the region but establishment of soy processing center will also help to generate employment and income among unemployed youths.

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