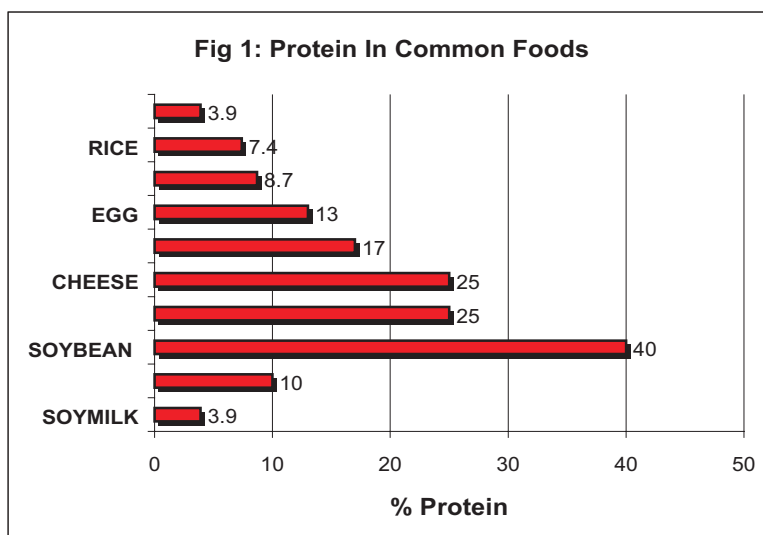


# A PROJECT REPORT ON Soy Milk & Tofu

It is well known that protein yield per hectare by growing soybeans is the highest among all sources of protein - plant or animal (Fig. 1). The protein content of soybean is about 40%. No other natural source has as much protein. Nutritionally, soy protein is the most balanced plant protein for human consumption. These facts were recognized in the orient over two thousand years ago.

Mahatma Gandhi introduced soya bean use in India in 1935 in the form of cooked whole or split beans. However, because of the extensive cooking required to make them digestible by humans, soya beans did not significantly enter the Indian diet at that time



## FUTURE OF SOY PRODUCTS IN INDIA

With the increasing health consciousness among the general people soybean use is getting acceptance in the form of textured vegetable protein (popularly known in India as soy badi or soy nuggets, soy fortified wheat flour for making nutritious chapatis and also for other uses. Soy biscuits made from blends of soybean and wheat flour are also available in the market. These products are penetrating in the diet of the Indians. Here it is important to mention that adding 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 .

Because of the non-availability of soymilk and tofu everywhere in the country, this product is confined only to its local area of production. It requires extensive promotional activities on the national level to make it popular.

Being mainly the country of vegetarian people, India has indeed a very great potential for soy products. Its higher nutritional as well as medicinal value within an affordable price has increased the demand of this product.

Besides extracting oil, soybean is converted into a variety of other nutritious products but this article is intended to focus exclusively on soymilk and its derivatives.

## SOYMILK

It is a creamy, milk-like product made by soaking and grinding soybeans in water. Soymilk has been known in mainland China for centuries. Hot soymilk is used as a breakfast

beverage in mainland China, Japan, Taiwan and Thailand. The product is generally popular with the local Chinese population. During the last few decades soymilk has been introduced in other parts of the world also.

Besides being rich in protein, vitamins and minerals, soymilk is a very economical, lactose free, highly digestible and nutritious alternative of dairy and meat centered diet. It can do almost everything that bovine milk could do. 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 [3]. Generally soymilk contains around 7-8% total solids in it. 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 (paneer) or used directly in cooking. Soy food chart, gives an idea about various products made from soymilk, tofu and okara. In addition to that blends of the soymilk with cow/buffalo milk have been successfully tried for the preparation of "Rasogolla", a chana (coagulated product similar to the silken tofu in texture) based very popular Indian sweet. Flavoured soymilk is available in bottles and also in loose packing at some places in the market.



Soybean contains some anti-nutritional constituents also in it but its careful processing in proper scientific ways during soymilk and other product manufacturing makes it suitable for human consumption.

## TOFU

Tofu is the most popular among all soy products. Also called soy paneer (in India) and bean curd it is a tasty and very nutritious product made by coagulating hot soymilk with some food grade chemicals such as calcium chloride, magnesium chloride, calcium sulphate, acetic acid and citric acid etc. It is a versatile food that can be converted into a variety of value-added products. Tofu is the perfect and least expensive substitute of milk cheese or paneer. Nutritionally its protein is as good as protein derived from animal sources.



Tofu is a very porous product and absorbs the flavour of the food with which it is cooked. Generally three types of tofu viz. firm, soft and silken tofu are available in the market. The basic method of making tofu of the above three varieties is the same. Different types of tofu are suited for different kinds of dishes. Tofu is an extremely perishable food. It should be kept in water under proper refrigeration. The water should be changed daily. It keeps tofu fresh for a week or more, depending on the refrigeration condition. Preferably tofu should be used as fresh as possible. Vacuum packed tofu is also available in the market.

## OKARA

This is the undissolved residual portion left after extracting soymilk from soybeans during the process of making soymilk. Okara is rich in protein and fiber and is mainly used in the preparation of biscuits and other bakery items and for the thickening of soup and gravy



Okara Cookies

etc. Its sun drying after mixing it with some spices and other ingredients makes traditional

type of Indian badi (not nugget) which is used as a protein source to prepare curry. Some traditional Indian dishes like Halwa and Laddu are also prepared from it. Okara is also used as a main protein source in cattle feed. It is a highly perishable product with a very limited shelf life in normal conditions. Proper refrigeration can preserve it for a week or more.



## SOYMILK POWDER

This is concentrated and dried form of soymilk that is prepared after its evaporation and spray drying. This powdered soymilk is used to prepare baby food and nutritious bakery and confectionery items. It retains its nutritional properties after reconstitution and soymilk thus obtained could be converted into instant beverages, tofu and yogurt (curd) etc.

## NUTRITIONALVALUE

As per the American Journal of Clinical Nutrition "It can be concluded that soy protein can serve as a sole protein source in all human beings except premature infants" [5]. It is low in fat and contains no cholesterol. It is an excellent food for babies, children, elderly people and pregnant and lactating women. In a recent development US Department of Food and Drug Administration (USFDA) has authorised a health claim saying that "25 grams of soy protein a day, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease".

For most people in India and in the West soymilk is not palatable as such in spite of the fact that nutritionally it is almost as good as cow's milk, Soymilk typically has 3.5-4% protein and 7-8% total solids. Fig. 5 compares the nutrients in mother's milk, cow's milk and soymilk. It shows that nutritional value of soymilk is almost at par or better than human and cow milk.

About 50% of the Indian adult population is lactose intolerant [6]. Drinking milk causes illness, bloating, abdominal pain and gas to them. In human beings this lactose intolerance is because of the loss of the ability to digest lactose, the carbohydrate portion of cow/buffalo milk. Most of the people suffering from this problem cannot recognize symptoms upon eating dairy products. They simply reject consuming milk.. Soymilk is the only alternative for the children and adults having lactose intolerance or allergy to bovine milk. Besides being a healthy nutrition for the general mass, soy protein is a proven cholesterol lowering agent. This protein is kidney friendly and causes calcium to be better utilized to avoid the conditions of osteoporosis.

Recent studies have shown that some of the nutrients of soymilk are potential cancer fighters. A good protein is relatively free from fat so that the protein intake does not ruin one's overall health. Protein should be inexpensive, appetizing, available in natural form, bulk or fiber, and should contain as many other nutrients as possible. Soybean absolutely fits in this category. Soy is one of the few plant foods that contain the proper balance of nine essential amino acids. Particularly soy is abundant in lysine, an amino acid that is usually scarce in plant food.

## SOYACOW PROJECT

This project is concerned with the production of soymilk - a high nutritious alternative to dairy milk. It is based on a new patented process technology implemented in the so called SoyaCow System.

This project was started in India in 1991 jointly by Child Haven International, CHI a Canada based international NGO (follower of the Gandhian philosophy) working in India and Nepal, and Prosoya Inc. of Canada, a leading name in soymilk technology. Initially the project was granted substantial funding from CIDA (Canadian International Development Agency). Its main objective is to provide low cost nutrition to the general Indian population in the form of soymilk and its derivatives. SoyaCow Centre was established in India jointly by Child Haven

International and Prosoya in the year 1993, and this patented technology of manufacturing table top soymilk machines suitable for the cottage industry in India was transferred to SSP Ltd., a Faridabad (Haryana) based well known dairy, food processing and pharmaceutical equipment manufacturing company. Now these machines are being manufactured at SSP under the guidance of the SoyaCow Centre. This centre is providing all kinds of assistance from making business plan to installation of the machine, operator's training, developing recipes suitable to the



local taste, helping the users of this machine in marketing of soy products, providing all the know-how on soymilk to the general people. In association with the American Soybean Association this center has developed the technology to give 4-6 Months shelf life to soymilk in bottles without any refrigeration. Also, vacuum packaging technology is provided to pack tofu for a longer shelf life. This technology is given free to the SoyaCow users. Sites using this technology are doing very well.

## SOYACOW

SoyaCow is a table-top, batch processing machine that yields high quality soymilk at the cottage industry level. This machine produces 15 liters of soymilk every half an hour (using 2 kg. of soybean in one batch costing about \*Rs. 15 L/kg). These 15 liters of milk could then be converted into 30 liters of flavoured drink, 15 kg of yogurt (curd) or approx. 3 kg of tofu. The production cost of soymilk and tofu comes to around Rs. 5.84 L/per liter and Rs. 33.70/- per kg respectively. Table 1 gives an idea of the economic viability of this project on a

commercial scale.

The machine includes accessories for making tofu (soy paneer) also. It requires only 5-10 m<sup>2</sup> area with domestic power supply for its installation (1 HP. single phase, 220 V) A skilled operator and one helper are enough for operating the machine.

The soymilk produced with Prosoya's advance technology has a mild cereal like flavour and a smooth mouth feel with excellent soluble protein without any "beany-off flavour". This is achieved in the processor by cold grinding of properly soaked soybeans in water without air, pressure cooking the resulting slurry with culinary steam and separating the soymilk from



the undissolved solids (okara) in a filter press (Fig.6). The basic soymilk thus obtained is absolutely free from any chemical impurity and can be easily formulated into tasty cold or hot drinks, or further processed to produce tofu, yogurt, frozen desserts and a variety of other products (Fig. 6).

Many companies, have tried introducing soymilk and other derivatives in India, but have failed primarily due to the presence of a "beany-off flavour" in the milk, high price of the products due to high cost of the equipment, and poor quality of the resultant products.

Keeping in view the aspects of the above failure the "SoyaCow" machine has been developed by Prosoya to produce a "non-beany" (without off-flavour) soymilk at the cottage industry level in India and other developing countries. Based on its patented technology Prosoya also offers larger size plants to produce soymilk and its powder.

### Soy Yogurt

- Good quality acceptable yogurt can be made with soymilk
- Salt, sugar
- Can be made the same way as dairy yogurt
- Soy-based yogurt and cultured milks are growing world over
- Now commercially available in India
- R&D is going on to suit Indian palate



### Ice Cream & Frozen Dessert

- Very popular in west
- Low fat and cholesterol free
- Healthy alternate to ice cream
- Very economical
- Excellent acceptability
- Commercially started in India
- Can be made at home

Table 1: Cost Benefit Analysis of Cottage Industry Soymilk/Tofu Plant

A.	Equipment**	SoyaCow VS-20 System
B.	Capacity	30 liters/hr
C.	Capital Investment	
C.1	Cost of Machine including taxes & duties	130,152.00
C.2	Freezer @ Rs. 20,000/- each	20,000.00
C.3	Pre-Operational Expenses	5,000.00
C.4	Total Capital Investment (C.1+C.2+C.3)	155,152.00
D.	Monthly Expenses @ 16 batches/day/shift	
D.1	Interest on Loan @ 18% pa	2,177.28
D.2	Other Expenses	1,000.00
D.3	Sub-Total (D.1+D.2)	3,177.28
D.4	Manpower Cost 2 Workers @ Rs. 2000/month	4,000.00
D.5	Soy Beans @ Rs. 15/kg	12,000.00
D.6	Cost of Electricity @ Rs. 3.5/KW	1,680.00
D.7	Water, Sewer & Maintenance	2,000.00
D.8	Fuel - LPG @ Rs. 12.50 /batch	5,000.00
D.9	Rent	1,000.00
D.10	Contingency	5,000.00
D.11	Depreciation @ 10% pa	1,209.60
D.12	Sub-Total (D.4 to D.11)	31,889.60
D.13	Total Expenses (D.3 + D.12)	35,066.88
E.	Additional Production Expenses (/month)	
E.1	Flavored & Sweetened Milk @ Rs. 1.5/litre	9,000.00
E.2	Tofu @ Rs. 65/batch	2,000.00
F.	Net Cost of Production	
F.1	Soy Milk (Plain) (Rs./litre)	5.84
F.2	Flavored Soy Milk (Rs./litre)	7.34
F.3	Curd (Rs./kg)	7.31
F.4	Tofu (Rs./kg)	33.70
G.	Monthly Income	
G.1	Soy Milk (Plain) 6000 litre/month @ Rs. 8/litre	48,000.00
G.2	Soy Milk (flavored & sweetened) 6000 liter/month @ Rs. 12/litre	72,000.00
G.3	Curd 4800 kg/month @ Rs. 12/kg	57,600.00
G.4	Soy Paneer (Tofu) 1200 kg/month @ Rs. 45/kg	54,000.00
G.5	Okara (by-product) 1000 kg/month @ Rs 3/kg	3,000.00
H.	Net Profit/Month	
H.1	Soy Milk (Plain)	12,933.12
H.2	Flavored Soy Milk	27,933.12
H.3	Curd	22,533.12
H.4	Tofu	16,933.12
I.	Payback Period (Month)	
I.1	Soy Milk (Plain)	11.61
I.2	Flavored Soy Milk	5.38
I.3	Curd	6.66
I.4	Tofu	8.87

\* All values in Indian Rupees

\*\* Additional Equipment required for Bottling and Sterilization of Flavored Soymilk and Vacuum Packaging of Tofu is not included in the Project cost.

Monthly expenses 16 batches/day (80,000)

Interest on Loan @ 12% pa (85% of CI)	3500
Other Expenses	5000
Sub-Total (D.1+D.2)	8500
Manpower	
Administration manager	15000
Marketing manager	15000
Four marketing executives @ 5000	20000
Three Production in-charges @ 4000	12000
One quality control in-charges	5000
Soy Beans @ Rs. 15/kg	150000
Cost of Electricity @ Rs. 3.5/KW	20000
Water, Sewer & Maintenance	10000
Contingency	10000
Depreciation @ 10% pa	64735
Publicity	50000
Sub-Total (D.4 to D.11)	371735
<b>Total Expenses (D.3 + D.12)</b>	<b>380235</b>
Plain soymilk production cost	4.75
Additional Production Expenses (/month)	
Flavored & Sweetened Milk @ Rs. 1.5/litre	120000
Tofu @ Rs. 100/batch	40000
Curd @ 2/kg	160000
Ice Cream @ 10/kg	800000

\* inclusive of packaging, excise and sales tax



### SoyaCow™ Machine for Soymilk/Tofu (soy Paneer) Production

- SoyaCow is a small and economical batch processor for producing highly nutritious non-beany soymilk without chalkiness and with excellent soluble protein yield.
- Produces 15 L of soymilk in one batch by using two kilograms of soybeans.
- Uses Prosoya's patented 'air less cold grinding' technology.
- Made of stainless steel, which meets sanitary standards.
- Available with manual and electric boiler option.
- Uses any quality of soybeans without de-hulling and still make an excellent soymilk base.
- No chemical treatment or additive is required.
- The machine included tofu making system also.

### Cost Benefit Analysis of Medium-Scale Soymilk / Tofu Plant\*

Capital Investment*	(In Rupees)	Capacity 200 lit/hr
Cost of Equipment	3253800	
Cost of Cld storage facility	250000	
Homogenizer	200000	
water softening plant	800000	
Effluent treatment plant	300000	
Freezers	50000	
Retort & bottling equipment	200000	
Vacume packing machine	75000	
Packaging equipment for curd and ice cream	50000	
Cost of Land & Building	800000	
Working capital	100000	
Pre operational expenses	50000	
<b>Total</b>	<b>6128800</b>	<b>5209480</b>