Production Economics Study of Soy Cow Machine SC 20

THESIS

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In

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(POST HARVEST PROCESS & FOOD ENGINEERING)

By

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CERTIFICATE - I

This is to certify that the thesis entitled Production Economics Study of SOYCOW Machine SC-20 submitted in partial fulfillment of the requirements for the degree of **MASTER OF TECHNOLOGY** *in Agricultural Engineering in* ***POST HARVEST PROCESS AND FOOD ENGINEERING*** *of Jawaharlal Nehru Krishi Vishwavidyalaya Jabalpur is a record of the bonafide research work carried out by* ***Ms. SHALINI MISHRA*** *under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instruction.*

All the assistance and help received during the course of the investigation has been acknowledged by him.

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Declaration and Undertaking by the Candidate

I **Shalini Mishra**. D/o Shri. Pradeep Kumar Mishra. certify that the work embodied in thesis entitled. Production economics study of SOYCOW machine SC 20.Work carried out by me under the guidance of Dr. Mohan Singh. Professor and Head Department of Post Harvest Processing and Food Engineering. College of Agricultural Engineering JNKVV. Jabalpur during 2019 - 2020.

The matter embodied in the thesis has not been submitted for the award of any other degree / diploma. Due credit has been made to all the assistance and help.

I undertake the complete responsibility that any act of misinterpretation. mistakes and errors of fact are entirely of my own.

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Date: **(Shalini Mishra)**

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LIST OF ABBREVIATIONS AND SYMBOLS

%	:	Percent
^{o}C	:	Degree Celcius
cm	:	Centimeter
Fig.	:	Figure
g	:	Gram
hr	:	Hour
i.e.	:	that is
kg	:	Kilogram
No.	:	Number
MT	:	Metric tone
SFP	:	soy fortified paneer
CPCC	:	critical point of coagulant concentration
BEP	:	Break even point
DV	:	Daily value

Chapter-I
INTRODUCTION

INTRODUCTION

1.1 Soybean:

"Soya" (Glycine max (L) Merrill or "Soy" in the United States), is one of the important oil crop grown in Asia and other parts of the world. Top producers of soy are the United States,Brazil,Argentina,China and India. The market size of the popularity known "miracle bean" in India is over Rs 5,000 crore.Production of soybean in the country has been growing at the rate of 5.57% (over the last 10 years).With an annual production of 5.0-5.4 million tons. Madhya Pradesh is the Soybean bowl of India, contributing 80% of the country's soybean production.

Soybean is an excellent source of dietary protein for human food providing almost all the amino acids. It is also an excellent source of minerals and vitamins and consists of 40% protein and about 18-20% oil.Soy protein qualitatively closely to animal protein and higher than that of other common pulses. Thus, properly processed soy protein superior and good source of protein for human diet. Considering the enormousadvantage of soybean it is high time to promote the use of soybean as afood component. Utilization of soya for the soya Milk and development of different process products like tofu/ soy paneer will enhance its acceptability. Milk production from soybean is an avenue, whereby the milk deficit in India can be supplemented.

1.2 Soy cow product (soymilk,tofu,yogurt)

Soymilk is a creamy, milk-like product made by soaking and grinding soybeans in water. It is rich in protein, vitamins, and minerals and has been known in mainland China for centuries. Soymilk is a very economical, lactose-free, highly digestible and nutritious alternative to dairy and meat-centered diet and similar to bovine milk. It is a cholesterol-free product, has very low-fat content and is rich in poly unsaturated fatty acids of phospholipids. In generally, it contains around 7-8% total solids and adding 3-4% sugar and about 0.05% salt brings it to sugar-salt and total solid level approximately identical to toned(2% fat) cow's milk, i.e., about 12 -13 % of

total solids. This can be consumed as such or after sweetening and diluting, and it can be made into yogurt and tofu.

Soymilk is the only alternative for children and adults having lactose intolerance or allergy to bovine milk (carrol 1991)- Additionally, it lowers cholesterol and also become healthy nutrition for the general mass.

1.3 Nutritional values of soy milk

Plain soy milk is very nutritive: it's an excellent source of high-quality proteins, isoflavones, and B-vitamins (soyfood.com-36k). Soymilk is free of milk sugar (lactose) and is a good choice for lactose-intolerant people. It is .Also a good alternative for those who are allergic to the protein of cow's milk.

Soy milk contains about the same proportion of protein as cow's milk~ around 3.5%; also 2% fat, 2.9% carbohydrate and 0.5% ash. Soy milk commercially available today is enriched with added vitamins such as vitamin B12 (en.wikipedia-87k).

Soy milk is promoted as a healthy alternative to cow's milk due to the following reasons:

- Source of lecithin and vitamin E
- Lacks casein
- It is safe for people with lactose intolerance or milk allergy
- Polyunsaturated and monounsaturated fats are good for the heart
- Contains isoflavones, organic chemicals that may be beneficial to health

1.4 Advantages of soybean

Soybean is used to make innumerable products like soy milk, soy paneer, soy nuggets etc. soy product have many advantages, which may be listed as follow:

1.Rich source of protein – The protein in tofu is high quality and approaches to meat and milk quality. A 100 g of tofu contains around 6 to 10 g of protein depending on the type of tofu.

2.Aids against heart diseases – Several studies in recent years have shown that regular intake of soy protein can help lower LDL (bad) cholesterol without lowering HDL (good) cholesterol, which leads to reduced risk of heart diseases. Researchers believe that the protein and isoflavones present in tofu work in combination to produce this effect.

3.Rich source of calcium – tofu can also be a rich source of calcium depending upon the coagulant used in manufacturing. This helps tofu protect against diseases like bone loss, bone weakness, etc.

4.Aids in weight loss – Being high in protein,it satisfies the body's hunger for a longer time. Its low-calorie nature (around 80 calories in 100 g) doesn't add any calories to our diet.

5. Promotes energy production – Tofu is a very good source of iron, providing 30% of the daily recommended value (DV) for iron in just 100 grams.

6. Good source of Selenium – tofu is an excellent source of trace mineral selenium with 100 gram of tofu providing around 14 % of daily value.

1.5 SOYCOW MACHINE SC 20:

The soy cow is an electric food processing system designed for the efficient production of soymilk and its derivatives,including beverages, tofu, yogurt and products using the 'okara' fiber residue.The soy cow is made from durable stainless steel and other sanitary materials and can last at least ten years if maintained properly.Installation typically takes 1 day and training another day or two.The area required for the system is modest, with a total of $10m^2$ for system operation and another 5-$10m^2$ for storage of foods and ingredients, etc. Workers do not require special skills to operate and maintaining the equipment,although it is good to have access to a person familiar with basic electricity and mechanical skills.

There are four main elements to each grinder, a cooker (pressure vessel), a manual filter press, and a steam generator (boiler).With the soy cow ,the boiler can be either automatic electric, or a multi-fuel boiler. The system has many safety features related to steam and pressure-cooking.They are also relatively easy and expensive to clean and maintain. For sanitary food

processing, they require a rudimentary kitchen-like environment with good ventilation, cement or tiled floor etc.

Soy cow SC 20 COMM produces 30L/hour of soymilk base at about 7% solids. It is attached with an optional vacuum deodorizer set to take out the beany flavor/off smell associated with soy milk. It comprises a mini tubular steam generator (Box and press) MOC: food-grade SS 304L and supplied with Baldorwash-down motor/Economic Indian motor

Features:

1. Non corrosive body
2. High productivity
3. Less maintenance
4. Fast sterilization

By consideration of the above facts, this study will be undertaken the following objective:-

1.To study the economic production for SOYCOW machine SC 20.

2. Evaluation performance of Cost-Benefit Analysis of soy cow machine.

Chapter-II
REVIEW OF LITERATURE

REVIEW OF LITERATURE

This chapter deals with the relevant review of the work done to the work from the background for the proposed study.

Denial et al.(1917) reported that soybean contained a sufficient amount of fat-soluble vitamins A and D and water-soluble vitamin B which are essential for promoting growth and reproduction. When soybean seeds are soaked in water and sprouted, they contain vitamin C, which is found in fresh fruits and green vegetables.

Vijaylakshmi et al. (1982) stated that ground one kg of dehulled bean for 8 to 10 minutes using 8 kg of water. The quantity of soymilk extracted using a muslin cloth was 8.2 kg.

Abou and Ella (1983) found that soymilk blending in different proportions in buffalo milk, blending ratio 0.0, 20, 30, 40, and 50 percent.An increase in levels of soymilk decreased sensory qualities.

Wang et al. (1983) stated that soy paneer, tofu (soy curd) has potential in the country as it is liked by many people and has several nutritional advantages. Tofu is a curd made from soymilk that closely resembles dairy paneer (Indian cheese) in appearance, texture and nutrition.

Kulkarni et al. (1985) stated that the firmness of pressed curd increased with the increase in the concentration of the coagulant.The chew count at 2.0% level of coagulant was comparable to that of tender meat. The total solid yield also increased with the increase in the concentration of coagulant. Fried curd dipped in sugar syrup containing cardamom essence was acceptable as a sweet dish.

Nasim et al. (1985) developed a process for the preparation of soy paneer. They studied process parameters for preparing soy paneer such as the level of soydal to water for extraction; total solids content in soymilk, coagulation temperature, an coagulant concentration were standardized. Soymilk on coagulation at 75^0C gave more yield of soy paneer.

William shurtleff et al (1985) reported that the soy foods industry is comprised of those companies that make foods from soybeans. The industry is generally considered to have two segments ,one that manufactures traditional, low-technology soy foods (such as tofu,tempeh,soymilk,soysauce,soynuts,miso etc.) and one that manufactures modern,high-technology soy foods (such as soy protein products,soy oil,etc).The modern sector is sometimes divided further into three segments: the soybean crushing industry,which crushes soybeans to yield defatted soybean meal and crude soy oil; the soy protein industry ,which further processes the meal to make modern soy protein products; and the soy oil refining and processing industry,which transforms crude soy oil into cooking and salad oil, margarine and shortenings, and related products.

Gandhi et al. (1986) reported that varietal variability on soya paneer preparation. Among nine soybean varieties used for making soya paneer, JS-7244 yielded the maximum 2 kg of soypaneer per kg of soybean used. There was no correlation between protein, oil and hydration capacity of the seed with the soya paneer formation.

Vaidehi et al. (1986) conducted a study on the evaluation of tofu and its products prepared from soymilk in combination with sunflower seed milk and skimmed milk.The panel of sensory evaluation adjudged it that tofu of soy 100% and soy plus skimmed milk (60+40%) were acceptable whereas tofu of soy plus sunflower seed plus skimmed milk (60+20+20%) was not texturally accepted. Two snack items namely burfi and pakoda prepared from the accepted tofu were acceptable with no significant differences apart from the tofu curry. It was desirable to popularize soy 100% and soy plus skimmed milk(60+40%) tofu as they are nutritious food products at a low cost.

Ali et al. (1988) reported that certain anti-nutritional factors responsible for interfering with the utilization of essential nutrients or causing adverse reactions have been reported in soybean as under:-

1. Certain enzymes like amylases lipases,ureases.
2. Allergenic factor
3. Flatus factor
4. Saponins
5. off-flavour
6. Phenolic compounds

They can be easily eliminated by heat treatments.To minimize the effects of ant nutritional factors soybean blanching/enzyme inactivation is essential.

Arora et al. (1991) reported that a grinding time of 3 to 5 minutes using a bean to water ratio of 1:9(w/v). The resulting soymilk contained 6.0 percent total solids.

Grover et al.(1989) developed a process for the manufacture of soya paneer from defatted soy flour using organic acids. Total solids content 7.58% (defatted soy flour to water ratio of 1:12.5) and temperature of 95^{o}C was found to be the optimum for coagulation of soy slurry using citric, tartaric, lactic acid as coagulants. Addition of cow's milk (from 10-30%) to soy slurry increased the yield of paneer with higher total solids and less protein content. Recovery of protein in soy paneer was highest with acetic acid as coagulant followed by citric, tartaric and lactic acids. The overall acceptability of fried paneer increased as the concentration of cow's milk in soy slurry increased. The product coagulated with tartaric acid had the highest acceptability amongst all other coagulants.

Aroraet al.(1991) stated that a grinding time of 3 to 5 minutes using bean to water ratio of 1:9 (w/v). The resulting soymilk contained 6.0 percent total solid.

Babje et al. (1992) reported that the possibility of blending soymilk with buffalo milk for obtaining good quality paneer had been examined. Soaking soy dhal in sodium bicarbonate was preferred by consumer penal

over other treatment. The addition of soymilk to buffalo milk up to 20% had no adverse effect on the quality of paneer and resembled that of milk paneer in taste, color and springiness. However, the paneer prepared by blending soymilk showed higher protein content.

Chakrabarti et al.(1992) stated that soypaneer using different coagulant tartaric acid, lactic acid, acetic acid and calcium chloride and different temperature of coagulation; it was found the best quality of soypaneer was obtained by coagulating with calcium chloride at 85^{o}C, which produced soft body, smooth texture and desirable elasticity.Soypaneer prepared using lactic acid and as coagulants produced soypaneer,which possessed fragile texture.

Jain et al.(1992) reported that the quality characteristics of soy paneer used eight soybean varieties. The Protein content of the variety was significantly correlated with protein content of soy milk (r =+0.76). However, no significant correlation between (i) protein content of the bean and paneer yield, and (ii) protein content of the bean and % recovery of paneer were observed.The moisture content of the product significantly influenced its porosity (r = +0.96) and shear strength (r = -0.99). Deep fat frying (180^{o}C for 8 min) substantially reduced the products moisture content and enhanced its fat content. Paneer prepared from ‘pb-1’ variety was superior to paneer prepared from other varieties on sensory qualities.

Nsofor et al. (1992) stated that soy yoghurt with improved sensory characteristics from a base that consisted of 22% soybean citrate, water and fermented with 5% active mixed starter culture (Lactobacillus bulgaricus and streptococcus thermophilus). Comparative sensory evaluation of cow milk yoghurt and improved soy yoghurt 9-point mean hedonic scores of 6.2 and 5.9 for overall acceptability, which were insignificantly different. Seventy-three percent of the respondents rejected soy yoghurt as an alternative to cow milk based yoghurt.

Reddy et al. (1992) determined the physical and chemical characteristics of soymilk prepared from different soybean varieties. The color of milk prepared from different varieties ranged from whitish to grayish-white.

The ranges of different characteristics for various soymilk samples were: total solids 5.16-5.96%, protein 2.38-2.95, pH 6.3-6.7, titratable acidity 0.13-0.17%, specific gravity 1.01-1.03, viscosity 4.5-5.0 cp, surface tension 102.10-111.79 dynes/cm and freezing point -0.7 to 0.8^{o}C.

Pant et al.(1993) stated that a comparative study was carried out on tofu and milk paneer by employing instran-6021. Tofu exhibited significantly higher springiness than milk paneer. However, fried tofu exhibited significantly higher hardness, springiness and chewiness but significantly lower cohesiveness than fried milk paneer. The springiness of tofu and milk paneerremained more or less unaffected by frying, while the other characteristics increased significantly upon frying.

Chopra et al. (1994) found that higher water uptake in whole soybean seed due to the presence of seed coat, which also absorbed additional amount of water. They also showed that soaking of whole soybean seed was markedly affected by temperature and time interval and maximum time required for complete hydration of whole seed was 8 hrs at 35^{o}C.

Rani et al.(1994) reported except for proteins, the cow milk contained higher total solids, fat, acidity and ash as compared to soymilk. The coagulation time of cow milk with calf or microbial rennet was similar. The addition of soymilk to cow milk increased the coagulation time of the blend. Yield and titratable acidity of whey decreased with the increase in proportion of soy solids in the blend, whereas reverse was true for the total solids, protein and ash. The yield of cheese increased with an increase in the proportion of soy solids in the blend. The moisture content of cheese made from cow milk using both the enzymes was similar, but it increased with the increase in the soy solids in the blends. A slight decrease in protein and fat of cheese made with higher soy solids in the blend. An increase in titratable acidity, soluble protein and free fatty acid values of cheese were observed with increases in proportions of soy solids in the cow: soymilk blends.

Prasad et al. (1994) reported that the actual time necessary for complete soaking of soybean seeds. Soybean seeds were soaked in 0.25% solution of bicarbonate at different temperatures. The minimum time required

for complete soaking of seed was 8, 10, 12, & 14 hours at 35^{o}C, 30^{o}C, 25^{o}C and 20^{o}C respectively. The maximum water uptake of seed was 129 %.

Tanteerataran et al. (1994) has developed and evaluated an innovative processing technology for the preparation of soymilk free from beany and other off flavor at the university of Illinois. Soybeans were blanched in sodium bicarbonate water to inactive lipoxygenase enzyme and other components responsible for the development of off flavor. The blanched soybeans were then ground into slurry, filtered, pasteurized, homogenized, cooled and packaged.The major chemical composition of this soymilk was evaluated. Solid and protein recoveries were essentially high and could be controlled to contain 9.2% & 4.5% respectively. According to the sensory evaluation, this soymilk was very bland and was considered as much superior to traditional soymilks.

Wei et al. (1995) reported the antioxidant effect of genistein, the major isoflavone component in soy, on the reduction of damage to cells that can make them potentially cancerous. They concluded that the antioxidant properties exhibited by genistein might be responsible for epidemiological observations that consumptions of soy-based diets has been associated with lower incidence of cancer in Asian populations. Research studies suggest that genistein may potentially inhibit angiogenesis and the multiplication of cells lining the blood vessels.

Fuchigami et al. (1997) to determine the effect of high-pressure-freezing on quality, kinu-tofu (soybean curd) was frozen at 100 Mpa (ice 1), 200 Mpa (liquid phase), 340 Mpa (ice III), 400, 500, 600 Mpa (ice V) or 700 Mpa (ice VI) at ca. 220^{o}C for 90 min. After reduction to atmospheric pressure, tofu was stored 2 days at 230^{o}C then thawed at 20^{o}C. Texture and structure were compared with kinu-tofu frozen (220,230 or 280^{o}C) at atmospheric pressure (0.1 Mpa). The rupture stress and strain of tofu frozen at 0.1 Mpa and 100 Mpa increased, but that of tofu frozen at 200 Mpa and 340 Mpa was similar to untreated tofu. As pressure rose above 500 Mpa, rupture stress increased. The ice crystals in tofu frozen at 200 Mpa~400 Mpa were smaller than in tofu frozen at 100 Mpa or 700 MPa thus, high-pressure-freezing at 200 MPa~ 400 MPa was effective in improving the texture of frozen tofu.

Gupta (1997) studied on a new-patented process that has been used to produce good tasting dairy-like soy foods and beverages at home, commercially, and industrially in varying capacities while household soy milk machine(currently being evaluated for the NASA's manned mission to Mars), produces about 2 liters of soy milk at a time. There are machines that can produces 10,000 liter/hour of finished soymilk beverages. A 30 liter/hours batch machine has been found to be ideally suited for cottage industry in India and elsewhere. Several hundred such machines are in use worldwide which are now manufactured in India and Russia.

Hou et al.(1997) to determine the soft tofu was made using two coagulants (calcium sulfate and modified nigari), three stirring speeds (137, 207, and 285 rpm), and six stirring times (5, 10. 15, 20, 25, and 30 sec.). The lowest stirring speed, 137 rpm, did not coagulate the soymilk. Tofu was made by the highest stirring speed (285 rpm) had a lower yield , but higher brittleness force, hardness and elasticity than tofu made at 207 rpm. Tofu made from modified nigari had lower textural parameter values than those made from calcium sulfate. Yield of tofu made from either coagulants stirred at 207 or 285 rpm decreased as stirring time increased to 30 sec. Textural properties were related to stirring time. Stirring time < 25 sec was appropriate for soft tofu making.

Zhang et al. (1997) research has shown that diadzein, the second major isoflavon component in soy protein, enhance the several functions of the immune system. One of the functions of the immune system is to neutralize or destroy damaged cells, such as those abnormal cells that are potentially cancerous. A number of in vitroo studies have reported that genistein inhibits the multiplication of both estrogen dependent and estrogen independent human breast cancer cells.

Chauhan et al. (1998) reported that the effect of physical and chemical treatment on nutritional changes in soymilk. Soymilk was prepared by atmospheric pressure and pressurized blanching with different level of sodium bicarbonates treatments at different periods of time. Soymilk was subjected to different heat treatments and compared the results in terms of the loss of the nutrients viz. B vitamin, minerals and amino acids. The losses

of vitamins B1, B2 and amino acids methionine were further increased by the use of sodium bicarbonates during blanching in atmospheric blanching.

Chauhan et al.(1998) tofu prepared from soybean was stored for 14 days in various preservative solutions viz., salt, citric acid, potassium sorbate and potassium meta-bi-sulphite at 37^{o}C to assess the quality changes at an interval of 2 days. The floating of tofu in preservative solutions was related to the extent of spoilage. The self-life of tofu under the experimental conditions ranged from 2 to 12 days. The pH of preservative solutions accepts for control (water) increase with the storage period and were inversely related to the self-life of tofu. Acidity of tofu increased with the storage period. Tofu stored in 0.2% potassium meta-bi-sulphite in combination with 2 % citric acid had the highest mean overall organoleptic score. Tofu fried after 8 days of storages was found to be devoid of beany flavor, when compared with fresh fried tofu.

Jinendra et al. (1998) reported that soy milk is actually a very good and equally nutritious alternative for milk. In fact, there are fat free cheddar, jack, and mozzarella cheeses made out of soy milk that make good alternatives for dairy-based cheeses.

Khetan et al. (1998) revealed that citric acid as coagulant gave more yield with high content of total solid and protein in the product compared to tartaric, lactic and gluconic acid and the product possessed fragile texture.

Mohamed et al. (1998) prior studies indicated that soybean varieties and method of processing influence the texture, colour, flavor, and yield of tofu. To identify soybean genotypes most suitable for high quality tofu, 12 soybean genotypes were selected and planted at four locations (AL, GA, MD, and VA). Seed were analyzed for protein, oil, phylate, and sugars. Tofu was prepared from these genotypes using a published procedure. Concentration of CaSO4 (coagulant) was added based on protein concentration in soymilk. After adding coagulant samples were centrifuged at 1,000 to 6,000 rpm for 10 min. and the volume of the curd was determined. Significant ($p<0.05$) variations in protein, oil, phytate contents, and protein patterns were documented. There was a strong correlation between total

protein, protein patterns, and the quality of tofu. A correlation between volume of precipitated curd and its measured texture was found and an equation was formulated. In conclusion, pattern and concentration of protein can be used to determine the quality of tofu in a short period of time using very small quantity of seeds.

Vitasory et al. (1998) soy milk is most commonly found in aseptic (non-refrigerated) quart and 8-ounce containers, but is also sold refrigerated in plastic quart and half-gallon containers. Unopened aseptically packaged soy milk can be stored at room temperature for several months. Once it is opened, the soy milk must be refrigerated. It will stay fresh for about 5 days.

Devdas. (1999) tested on a large group of children in the age of 1 to 2 years in their urban slums of the south Indian city of coimbator and demonstrated improved congnitive function in children fed on soy protein based food supplement. The soy-based formulae are safe and acceptable for infant feeding. In fact, the prevalence of Alzheimer's disease is lower in tofu (soy paneer) consuming populations than in populations eating western diets.

Nsofor et al. (1999) extrusion cooking was simulated by a low-cost process that comprised boiling of whole soybean in 0.5% NaHCO3 solution for one hour, fine milling of the tenderized dehulled cotyledons, slow heating/stirring and coagulation of the slurry with $CaSO_4$ to form curd, with added meat seasonings/spices yielded a fried tofu like product. 26 and 35% fat, 21 and 13% carbohydrate, 14 and 16% moisture, 6 and 5% minerals, 3 and 3.5% crude fiber for tofu analogue and control, respectively. The analogue showed a 5/1/2- fold yield increase (wet weight) relative to the control. Soybean residue (okara) was not generated during analogue preparation. Total solids yield estimates of 0.84 and 0.19 kg per kg raw soybeans utilized were deduced for the analogue and control.

Young et al. (1999) says that in addition to oil and soy foods.soybeans may be produced as a vegetable. The importance of consumption of vegetables including soybeans for the prevention of chronic diseases, i.e. heart diseases and cancer has motivated generic breeders to investigate the nutritional attributes of vegetable soybeans. The purpose of

this research is to investigate the nutritional attributes of vegetable soybeans. Thiry-one vegetable soybean genotypes from MG-III to VI harvested between R6 and R7 were analyzed for their protein, polmitic acid, oleic acid, linoleic acid, total lipids, crude fibre, ash and moisture content. Significant differences for all the nutrients among the genotypes. These variabilities could be exploited for further selection and improvement. The results from this study suggest that when selecting genotypes for production, careful attention should be given to the nutritional attributes of the genotypes.

Emma et al. (2000) To investigate the effect of replacing lean meat with a soy product, on coronary heart disease risk factors including serum lipoproteins, lipoprotein (a), factor VII, fibringon and in vitro susceptibility of LDL to oxidation. Analysis of the seven-day diet record showed that diets were similar in energy, protein, carbohydrate, total fat, saturated and unsaturated fat, polyunsaturated to saturated fat ratio, alcohol and fiber. Total cholesterol and triglycerides were significantly longer on the tofu diet compared to the meat diet. The hemostatic factors, factor VII and fibringogen, and lipoprotein (a) were not significantly affected by the tofu diet.

Erdman et al. (2000) compared the allergenic of soy milk and cow milk during consumption. There is increasing evidence that consuming soy protein may help lower blood cholesterol levels in some people with elevated cholesterol levels and may provide other cardiovascular benefits. Today's soy formulae are equivalent to cow's milk formulae in digestibility, nutrition profile, and acceptability. Soy formulae promote normal growth, nutritional status, and bone mineralization; soy-based formulae are less allergenic than cow's milk formulas. It is important to note that among infants, the incidents of cow's milk allergy ranges from 0.3% to 7.5%. While allergy to soy is seen in approximately 0.5%.

Krishan (2000) standardized the method of preparation of soy paneer. He first get the soy milk (1litre), heated it till hot (not boiling), add either half tea spoon of vinegar or lemon juice. Stir thoroughly so the milk curdles. After 5 minutes add another half teaspoon so that the entire milk curdles. Stain the whey through a thin cotton cloth. Once the curds have been collected, cover them with cloth and put a heavy weight on it and leave aside

for about 8 hours. Then you have a well set tofu. Clean it with cold water to remove stains of the juice/vinegar.Do it at least twice. Dice the tofu and use it as paneer.its blend was very healthy.

Krishnan (2000) given a mode of preparation of soypaneer first gets the soy milk (1 liter). Heat it till it hot (not boiling). Add either ½ tsp of vinegar or lemon juice. Stir thoroughly and you will see that the milk curdles. After 5 minutes add another ½ tsp so that the entire milk curdles. Stain the whey (you can use it for buttermilk if you like it) through a thin cotton cloth. Once the curds have been collected, cover them with cloth put heavy weight on it and leave aside for about 8 hours. Then you have a well-set tofu. Clean it in cold water to remove stains of the juice/vinegar. Do it at least twice. Dice the tofu and use it as paneer. It's bland…but very healthy.

Harue (2001) conducted a survey on nutritional and functional properties of soybean food in the Japanese diet. According to the results obtained from the 1998 National Nutrition Survey. Each person takes approximately 70g of soybeans and soybean products and approximately 47g of tofu and processed tofu products daily. The percentages of nutrients intake from thee soybeans products, compared to the daily intake nutrients were analyzed. And found that protein, calcium and iron accounted for 8.6%, 13.8% and 14.6% respectively. The survey shows that calcium is the only nutrient whose requirement has not been satisfactorily met for several years.

Kenneth et al.(2001) says that pyto-estrogens have become one of the more topical areas of interest in clinical nutrition. These non-nutrient bioactive compounds are ubiquitous to the plant kingdom and possess a wide range of biological properties that contribute to the many different health-related benefits reported for soy foods and flaxseeds-two of the most abundant dietary sources of phytoestrogens. Reviewed is the recent knowledge related to their pharmacokinetics and clinical effects, focusing mainly on isoflavone that are found in high concentrations in soy foods. Arguments are made for considering soy isoflavone as natural selective estrogen receptor modulators (SERMs) based upon recent data of their conformational binding to estrogen receptors. Rebuttal is made to several key and important issues related to the recent concerns about the safety of soy

and its constituent isoflavone. This article is not intended to be a comprehensive review of the literature but merely highlight recent research with key historical perspectives.

Khatib et al. (2001) currently, hundreds of soybean varieties with a wide range of quality attributes are available. The majority of these soybean varieties have not been evaluated for their quality in soymilk and tofu. Soymilk with higher pH, viscosity, and protein produced tofu with higher protein, water held and yield. Varietal differences should be considered in selecting soybeans for tofu production. Macon soybean produced the best tofu with regards to quality attributes.

Manchanda et al. (2001) studied the comparison between cow milk, soy milk, rice milk and found that soy milk is superior than cow and rice milk through soy milk process is lengthy. But it is unbelievably economical and found that the soy cow products, including soy milk soypaneer(tofu). Soy shakes will be given to heart patients and other who are undergoing training and therapy and the yoga institute. As well as to patients and staff of AIIMS and Indian's premiere medical hospital. Both institutions believe that soy milk promotes good health, while dairy products are linked to deadly diseases, including heart disease and cancer.

Shinde et al. (2001) prepared tofu by subjecting soybean to pretreatment such as soaking in solution each of 1% $NaHCO_3$ and NAOH, cooking under pressure and boiling in distilled water for 30 minutes. The soaking pretreatment in 1% solution of $NaHCO_3$ was found better in the contents of protein ,fat, total solids and yield of paneer. The organoleptic qualities of this paneer were also observed to be superior over the paneer prepared by other pre-treatments, but inferior to buffalo milk paneer.

Kim et al. (2002) chitinous polymers have been experimented with for the purpose of shelf-life extension of foods due to their antimicrobial activity. Food additives, however, may impair the taste, colour or texture of foods. Therefore, it is necessary to evaluate the effect of a food additive on foods before it is used. In this study, we investigated how the physiochemical properties, microstructure, textural properties and sensory characteristics of

tofu are affected by the addition of chitooligosaccharide during its preparation. The addition of chitooligosaccharide to tofu did not significantly affect its physiochemical properties including moisture content, yield, turbidity and color. The chitooligosaccharide tofu, however, had lower hardness and smaller protein aggregates than the control tofu. The chitooligosaccharide did not influence most sensory attributes of tofu except for imparting a bitter taste.

Kim et al. (2002) tofu, containing high viscositychitosen dissolved in a-gluconolactone solution, was prepared and physico-chemical properties; microstructure, textural properties and sensory characteristics were investigated. Moisture content and pH of the chitosan tofu were slightly lower than those of the control tofu. The textural properties of tofu such as hardness, cohesiveness, gumminess and chewiness measured by an instrumental method were not significantly changed by the addition of chitosan to tofu. Springiness of chitosan tofu, however, was significantly higher than that of the control tofu. All characteristic except the roasted nutty aroma and yellowness in the sensory evaluation, did not exhibit significant differences between the chitosan tofu and control tofu. Therefore, the quality of tofu was little affected by the addition of the chitosan content employed in this experiment.

Hirekhan et al. (2002) conducted the performance evaluation of cottage level soypaneer plant. The results indicate that coagulant concentration of 2 g/100 g of bean; coagulation temperature of 85^{o}C, soaking time of 3 hr at 60^{o}C soaking time gave the maximum soypaneer recovery.

Balpai et al.(2003) conducted microwave dehydration of soypaneer and its storage studies. The shelf life of soy paneer was 36 days by giving microwave heating and it was further increased to 48 days by using 0.5% sorbic acid plus 0.1% potassium meta-bi-sulphite plus 0.2% acetic acid. Physicochemical change during storage showed very little change in moisture content from the day zero to the end of storage. Non-protien nitrogen and pH of all the soypaneer samples dipped in different preservatives decreased continuously from day zero to the end of storage. Free fatty acid content of soypaneer increased continuously from 0.004% at day zero to 0.22% on day sixty of storage. Microbial population increased with the increase in storage

period irrespective of different treatments but the increase in microbial count was very little. It was maximum for the control and minimum for the sample dipped in 0.5% sorbic acid plus 0.1% KMS plus 0.2% acetic acid. Overall acceptability score was higher for control in comparison to treated samples from day zero to 48 days; preservatives treated samples were also acceptable.

Padmanabhan. (2003) studied that soy milk or soy paneer from soybeans can be stored packed especially at room temperature for several months but when stored in plastic sachets,it lasts for five days. Soy milk contains 20% carbohydrates, which helps in better blood glucose control, reduces triglycerides increase HDL (good cholesterol) and bring down the weight.

Susanto (2003) carried out a study on the influence of soybean storage conditions on the quality and yield of soymilk and tofu. Soybeans were stored for 8 months at: dry at -20^{o}C, 4^{o}C, 25^{o}C, and wet at -20^{o}C analyzed at 0, 2, 6 and 8 months, and processed into soymilk and tofu (steam-jacketed kettle and tofu press). Water absorption of soybean, yield, moisture, protein, color, obrix and viscosity of soymilk, and texture of tofu were determined. Soymilk soluble solids, viscosity, yield, and % protein; tofu yield and % protein; and soybean water absorption did not change during storage. The moisture percentage of soymilk and tofu for all treatments increased and stayed constant after 2 months of soybean storage. Increases in greenness and redness were observed in the soymilk and tofu respectively. The tofu firmness decreased slightly at 2 months, and increased up to 6 month. To maintain tofu firmness, extra coagulant and coagulation time were necessary.

Uprit et al. (2003) prepared soy fortified paneer (SFP) samples prepared from blends containing different proportions of buffalo milk of varying fat content and soy milk (7.5 EB) were evaluated organoleptically for assessing the quality attributes like body and texture, flavor and taste, color and appearance and the overall acceptability. Sensory data were analyzed using fuzzy logic approach, which addresses the problem of data classification in a unified qualitative and quantitative manner. Results of the

study indicated that the fuzzy multiattribute decision making approach provide an adequate and reliable system for product formulation and comparison, based on sensory data. The developed fuzzy mathematical model performed remarkably well in the evaluation and ranking of various SFP samples. The SFP sample made from blend of buffalo milk (4.5% fat) and soy milk (7.5 EB) in the proportion of 90:10 was found to be the most acceptable one for different classes of consumers irrespective of their preferences for a particular sensory quality attribute.

Yadav et al.(2003) quality evaluation of curd prepared from soy milk blends curd was prepared from blends of milk and soy milk in the ratio of 100:0, 90:10, 80:20, 70:30, 60:40, 0:100 and heated for 0, 5 and 10 minute. By increasing the level of soy milk, the contents of protein, fat, ash, carbohydrate, calcium and phosphorous decreased, whereas the content of iron increased significantly. No significant difference was observed in acidity of blend having 30% of soy milk. However, milk curd and soy curd differed significantly from each other with respect to pH and acidity. The results of sensory evaluation indicate that blending of soy milk up to 20% did not have significant differences in sensory characteristics. However, curd prepared from blend having 30% of soy milk and boiled for 5 minute did not differ significantly with respect to flavor and overall acceptability but differ significantly in remaining sensory parameters, which proved that soy milk up to 20% can be blended with milk for the preparation of curd without affecting sensory characteristics significantly.

Anonymous (2004) carried out the study on the effect of soy milk characteristics and cooking condition on coagulant requirement for making filled tofu. Earliar research indicated that the critical point of coagulant be used as an effective indicator of optimal coagulant concentration (OCC) for making filled tofu. The objective of this study was to investigate the possible correlations between CPCC and the characteristic of soy milk made from various soybean samples and the effect of soy milk cooking and dilution conditions on CPCC. CPCC was determined by a titration method. Calcium chloride and magnesium chloride were used as coagulants. Soy milk characteristics including solid, protein, and these characteristics as affected

by heating rate, heating time, and sequence of dilution and heating were studied. The results showed that the CPCC was significantly ($p < 0.05$) positively correlated with phytate content (grams per gram of protein), pH, and 7S protein content but negatively correlated with protein content, 11S protein content, 11S/7S ratio, titratable acidity, and original calcium content. Within the same soybean material, more proteins required more coagulant, but higher protein concentration during cooking resulted in less coagulant required by each gram of protein during coagulation. The CPCC decreased with increasing soy milk heating time or decreasing heating rate. The sequence of heating and diluting for preparing soy milk also had an effect on CPCC.

Anonymous (2004) prepared the soy milk from dried soybeans that are soaked in water, pureed, diluted with water, boiled and stained. Soy milk may be consumed as is, or used to prepare other soybean products. Fresh soy curd (tofu) is prepared from dried soybeans that are soaked in water, pureed, diluted and strained to produce soy milk, which is then made into a curd with a coagulant, separated from the whey, placed in a mold, and lightly pressed. When the tofu is set, it is immersed in water and cut. Tofu may be of a variety of textures and soy milk film formed on the surface of boiling soy milk that is dried. It may be deep-fried or softened in water prior to use in soups or poached food. Also known as fuzhu or yuba. Dehydrated bean curd (kori tofu) from which all moisture has been removed. It may be reconstituted with water or sauce for consumption, or is used directly in prepared dishes. It may also be deep-fried or simmered in sauce.

Anonymous says that soypaneer, popularly known as TOFU in the orient, is a coagulant and pressed soy-protien at 72% moisture, It contains about 14% protein and 9% fat. The production cost of soypaneer is Rs. 15-20/kg.

Kim et al. (2004) reported on the effects of operating conditions on separation of isoflavone from tofu whey. The objective of this study is to investigate the operating conditions of ultra filtration (UF) and nanofiltration (NF) to separate and concentrate isoflavone from tofu whey. Additionally, the effects of filtration on food waste control were studied by measuring SS,

BOD, COD, and SS were measured by the official methods. Average flux (ml permeate/unit area*time) and fouling index were whey and trans-membrane pressure (TMP) resulted an increase in flux and found the condition of 40^{o}C and 2.4 bar TMP to be optimum for maximum flux. Minimal fouling was obtained at 32^{o}C. The recovery of isoflavon in edentate was 15.0% from UF and 73.3% FROM NF. The SS, COD, and BOD in NF permeate were significantly reduced by 100%, 90.0%, and 98.0%, respectively.

Kong et al. (2004) this report was to investigate the influence of total 18 conditions on proto and Vinton soybeans as related to milk and tofu making. Storage conditions covered relative humidity (RH) from 55 % to 80 % and temperature from 4^{o}C (at cooler) to 50^{o}C. The duration time varied from several weeks to 15 months. After storage and processing into soymilk and tofu, various physical and chemical properties were determined. Soybean color became darker with time. Color changes were mainly caused by temperature, although high RH also made contribution for 1 year duration, 30^{o}C and 75% were crucial points to influence tofu making. Beyond these points, a rapid deterioration in the soybean quality was observed, which was characterized by substantial decreases in water absorption rate, solid content in soymilk, protein extraction rate, soymilk pH and tofu yield. Although the protein content decreased in soymilk, it increased in tofu due to a reduction in water binding capacity and product yield. Tofu hardness, brittleness and elasticity increased with storage time. Which could be explained by the increase in the tofu solid content. When soybean was stored at low temperature (< 20^{o}C) and high RH's (>80%), RH played a predominant factor to influence tofu quality. However, in high temperature (> 30^{o}C) and low RH's (<70 %), temperature was more important. Storage time inversely influenced optimum stirring time (the time required to mix coagulant with cooked soy milk to achieve a maximum tofu yield). Prolonged storage in adverse conditions (e.g. RH 70%, 40^{o}C, 10 months), the soy milk could not form gel matrix after the addition of the coagulant, although large aggregates were formed. The results suggest that tofu making process needs to be adjusted to respond to the changes of soybean quality during storage.

Meyers et al. (2004) the potential of chitosan as a coagulant in commercial tofu preparation was investigated with six chitosan of different molecular weights using various treatments. The following optimum processing conditions for tofu preparation were proposed: chitosan with a molecular weight og 28 kDa, chitosan solution type, 1% chitosan and 1% acetic acid; and 1% lactic acid instead of 1% acetic acid alone as a chitosan solvent. Tofu prepared with chitosan had lower ash and higher protein content than those of commercial products tested. In storage tests, the chitosan-tofu had a longer shelf-life, about 3 days, than tofu made with calcium chloride.

Uprit et al. (2004) studied that drying of acid-coagulation protein-rich food products by conventional methods produced insurmountable problems like formation of a moisture-retaining crust, longer drying time, poor rehydration characteristics and oiling off during drying. These problems can be minimized by the use of electromagnetic energy for drying because of its rapid and uniform dissipation. The use of microwaves for drying of soy-fortified paneer has been explored in the present study. The effect of microwave convective drying variables such as hot air temperature and microwave power levels on drying rate and diffusivity were analyzed. Both the drying rate and diffusivity increased with increase in hot air temperature and microwave power level. A hot air temperature of 53.5^{o}C and microwave power of 111.5 watt gave good –quality dried soy-fortified paneer cubes of uniform texture and surface, unblemished and with clear color. The dried soy- paneer cubes rehydrated well had a self-life of 118 days under accelerated storage conditions (38+ 2^{o}C, 90 % relative humidity).

Tripathi et al. (2004) observed that soybean is a very good source of plant protein with other meditional benefits, however due to its beany flavor besides restless efforts made by various organizations and institute ,it has not been possible till date for the common people to accept this as meal directly. Also ,due to other factors like very high protein and oil content it is not possible to directly consume soy based food products. A large number of soy based dairy products have been formulated and launched in the market.

Meredith et al. (2010) explained introduction of soycow systems into the developing world is not a new strategy in the fight against

malnutrition. Soycow have been placed in diverse locations including VietNam,India, South Africa. One of the main issues impending long-term success of the soycow projects is that recipients may possess technical knowledge enabling them to operate the soycow, but generally lack the intangible, human resources that could provide the requisite marketing know-how needed for these projects to survive long-term.

Adelodun (2011) studied Soybean is an important oriental crop whose agronomic characteristic were apparently well known in china before 2200 BC. It is a legume that grows in tropical, sub-tropical and temperate climates. Originally domesticated in china around 1700-1000 BC, soybean is now cultivated throughout East and South East Asia where people depend on it for food,animal feed and medicine.

Chapter-III
MATERIALS AND METHOD

MATERIALS AND METHOD

This Chapter deals with brief description of the experimental site, materials required and method employed to achieve the objectives.

3.1Material

The raw material will be whole soybean seed. The seed is dehulled prior to be used as a raw material for soymilk. Variety and other agronomical details were not considered.

3.2Equipments:

All the equipments are described below with their brief operational details and technical specifications:

3.2.1 Soymilk plant

It is shown in plate 3.1 which consist of various equipments as described below:

3.2.1.1 Grinder/cooker

This is the heart of the soycow machine. It produces 14 liters of soymilk in 20-25 minutes.It is provided with a one HP motor, which works on the single-phase electric power hopper and butterfly wall are affixed on the lid of the grinder/cooker and are used to charge the soybeans' and water. A thermometer and pressure gauge is provided to accurately monitor the cooking condition of soy slurry. This vessel is protected by a safety pressure relief valve that opens automatically at 1.4kgf/cm^2 pressure for safety reasons. The slurry is removed from the grinder/cooker by opening the butterfly wall affixed in the bottom of the level. Place the cylindrical lower screen around the screen locator and over the screen studs (with thread ends) such that the studs go through the holes in the screen holding ears. Position the conical hopper such that the grooves made in the plate are aligned with the ears of the lower screen plate. Move the conical feeding hopper counter-clockwise to fix it on the lower screen plate. Bolt the studs and tighten the nuts well by hand.

3.2.1.2 Boiler

A baby boiler of 12-liter capacity was used as a steam generator for cooking the slurry of the grinder/cooker. This pressure vessel is equipped with a 2.1-kgf/cm^2-safety relief valve a pressure gauge and a water level gauge. A regulator is provided to control the steam flow of the boiler. A blow tube is used to get hot water out, when required. The steam is passed in the grinder/cooker from the boiler through the steam embedded hose tube.

The boiler is fitted with the following accessories:

1. Boiler vessel
2. Ball valve ¼
3. Gauge glass fitting ½
4. Pressure relief valve 30 psi
5. Pressure gauge 2.5 bar
6. Gauge glass

3.2.1.3 Deodorizer

The deodorizer unit consists of a vacuum pump, a capacitor start single-phase induction motor and a deodorization chamber. A vacuum pump is used to create a vaccum pressure of 400mm of Hg in the deodorizing chamber attached to the vaccum chamber. The vacuum gauge is attached on the deodorizer to measure and maintain vaccum during operation .A deodorizer unit is used to remove the undesirable beany flavor from soymilk.

3.2.1.4 Filter press

it has been specially developed to extract soymilk from the soy slurry produced by the grinder/cooker.The soy slurry is collected in a filter bag situated inside the perforated cylinder. A perforated base plate is provided at the bottom of the cylinder. The assembly site inside of a vessel is fitted with a double start screw attached to a perforated pressure plate. Attach the lid to the vessel and tighten the screw gradually to press in the okara in the filter bag in two or three steps. In this way, the soymilk comes out through the drain pipe under sanitary conditions by separating from the Okara. Make sure that a large filter bag is sitting inside the press with mouth open and the folded over the top of the cylindrical screen (perforated cylinder). The bottom of the filter bag should be loose but without any folds for efficient filtering. Ensure that a vessel is attached to the outlet drain elbow and the outlet drain valve is open. Open the outlet drain on the grinder/cooker rapidly and close it again. The slurry is under pressure and is extremely hot. avoid splashing as it may cause scalding if the hot slurry touches the skin. Now open the valve gradually to the extent that the slurry pours into the filter bag without splashing. Once the grinder/cooker is almost empty, switch of the motor, open the hopper valve, and close the outlet valve's slurry outlet valve. start the next batch in the grinder/cooker.

Press filter is provided with the following accessories:

1. Pressing screw with nut
2. Top and bottom pressing plate
3. Press handle bar
4. ¾ ball valve

3.2.1.5 Tofu press

A screw jack type press is provided to press the coagulum obtained after coagulation of soy milk, to prepare tofu. It consists of a screw attached with a handle at the top and a vortex cross at the bottom for pressure distribution. The tofu boxes are perforated with 10mm diameter holes; for firm tofu, they are spaced at 25 mm intervals .materials of construction is stainless steel. The bottom box is lined with two layers of muslin cloth and coagulum is placed in it. The top is also covered with the same muslin cloth over which a pressure plate is positioned to generate the pressure and distribute the pressure. A large but shallow container was used to collect the milk from the drain pipe of the mechanical filter press. A measuring pot with graduations upto 1 mm resolution was used to measure the quality of milk in the container. The pressure is increased gradually by rotating the handle. The whey starts oozing out through the perforations. After the pressing is completed,the pressure is released by moving the screw upwards. The boxes are \removed and the tofu formed is taken out carefully. Tofu press is shown in plate 3.2.

3.2.1.6 LPG Gas: pressure: Atmospheric pressure, capacity: 15.2 kg

3.2.1.7 Electronic balance

An electronic balance having a least count of 10^{-2}g and a range of 6 kg was to weigh the sample soybean and citric acid (for coagulation).

3.2.1.8 Celsius thermometer Range: 0-100^{o}C

Calibration:+ 0.1^{o}C

3.2.1.9 Texture analyzer

The texture analyzer measures Force, distance and time.The texture analyzer is a microprocessor control texture analysis system,which can be interfaced to a wide range of peripherals,including PC-type computers.one main strength of texture analyzer is its versatility. Another is the ease of use.The system design presents the basic functions as clearly as possible.This means we can start the instrument quickly. This is because the texture analyzer has many specialized uses incorporated. Some of which really become lively when used with the stable Micro system texture expert software.

3.2.1.10 Soybean dehuller

This is a cylinder and concave type machine developed by CIAE Bhopal. In this machine the soybean is dehulled due to pressure and abrasion inside the cylinder and concave. The capacity of the machine is 96 kg per hour for soybean having 7.5 m.c. and efficiency 95%.

3.3 SOYCOW FOOD PROCESSING SYSTEM

The soycow is a food processing system for social projects or micro-enterprise development. It is designed to provide daily output of soymilk in the range of 200-300 liters for one typical work shift. This provides a critical daily serving of protein and other nutrition for up to 1,000 beneficiaries, or enough bulk milk to support a micro-enterprise with several workers. In addition is the complementary output of ‘okara’, a nutritious fiber by-product of the soy milk process, which can be used to supplement various foods.

There are two main configurations of Soycow:

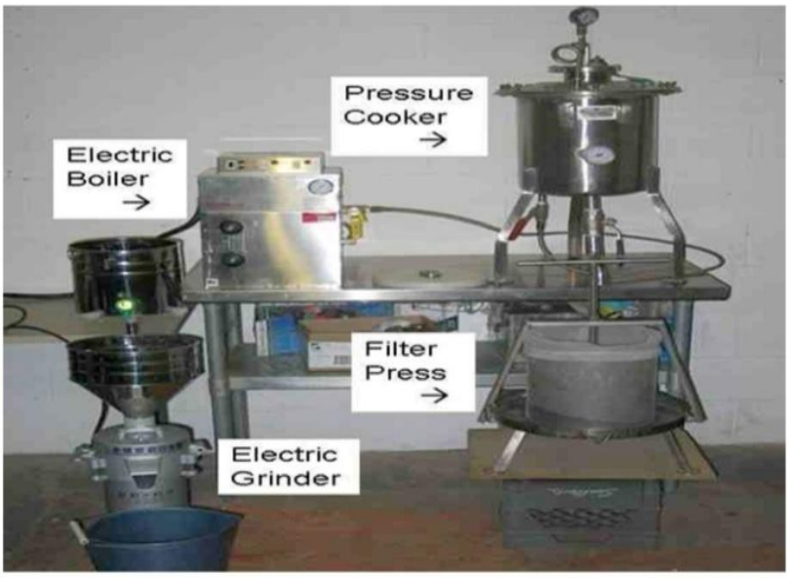
Soycow ‘M’

Soycow ‘E’

The difference is in the kind of boiler used. The Soycow ‘E’ uses an automatic electric boiler with built –in water feed pump. The soycow ‘m’ uses a “multi-fuel” boiler which burns wood, coal,gasor other biomass such as corncobs, coconut shells etc.

3.3.1 Soycow “E” food processing system

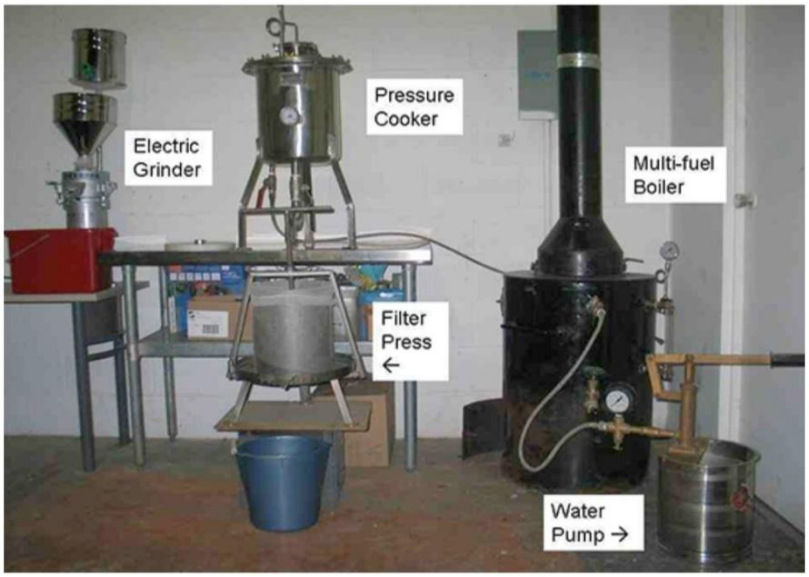
This configuration is intended for applications with adequate and reliable electrical power for the 8kw electric boiler and the electric grinder. It also allows for somewhat faster output with less worker intervention. It is also suitable for urban environments such as commercial and institutional kitchens, and without the need for a chimney and other fuels. Soycow “E” is shown in figure3.3.1



SOYCOW É FOOD PROCESSING SYSTEM

3.3.2 Soycow “M” food processing system

This configuration uses a multi-fuel boiler with manual water- feed pump. it is connected to the chimney pipes included. The boiler is built with a stainless steel core, easy to clean and includes a safety relief valve and pressure gauge.This version is intended for semi-urban or rural installations where electricity supply is not available,and where various are available. Soycow “M” is shown in figure 3.3.2

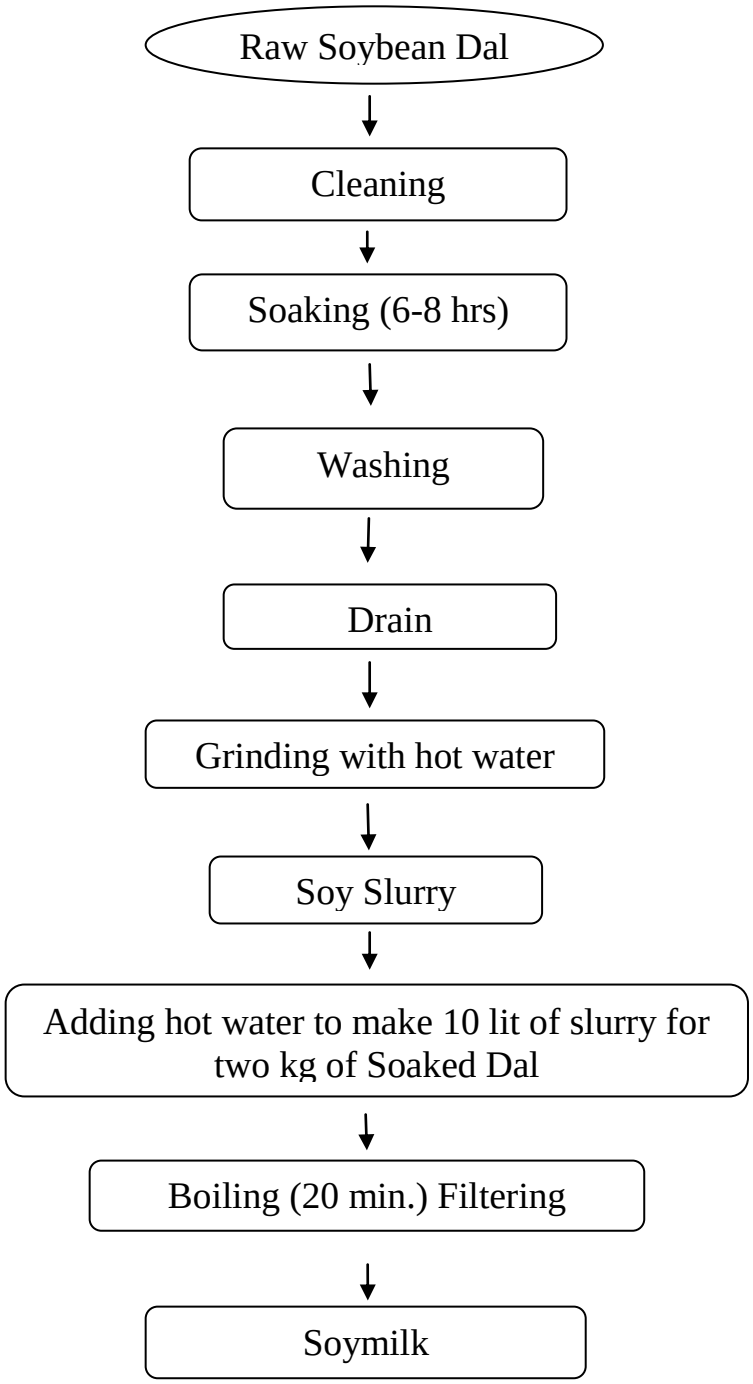


SOYCOW M` FOOD PROCESSING SYSTEM

Production capacity for the soycow M and E is 35-40 liters per hour.

3.4 Soymilk production process/technology

The process involves collection of soybean seed, dehulling and cleaning. All the two operation are performed by a single machine. Thedehulled soybean so obtained is soaked in water for 6-8 hr before making soymilk. The complete procedure of soymilk preparation is as follows(soyfood.com/-36k). Process flow chart is shown in figure 3.4.1.



PROCESS FLOW CHART FOR SOYMILK PRODUCTION

3.5 Preparation of soy milk:

3.5.1 Soaking the soybeans:

2 kg Soydhal obtained by dehulling of soybean was soaked for 6 to 8 hours. After rigorously washing it for 6 to 8 times followed by soaking for 6 hours, it was rinsed 3 to 4 times, before grinding.

3.5.2 Grinding and cooking the soybeans:

The soydhal was now fed into the grinder cooker for boiling at 105^0-110^0 and anaerobic grinding in two stages initially for 3 minutes and then for 2 minutes, after a high temperature boiling for 5 minutes.

3.5.3 Straining the soymilk:

After grinding soybeans, soymilk is separated by using a filter press. After grinding soydhal in two stages, the outlet valve of the grinder cooker is obtained and the soy slurry inside the grinder cooker is allowed to drain into the filter bag kept inside the filter press.

3.5 Methodology

The standard methodology was adopted for economic production analysis of soy milk; the method can be described under following subheadings.

3.5.1 Experimental design:

There are two methods:

- Cost-Benefit Ratio analysis
- Break-Even analysis

Cost-Benefit ratio analysis:

Cost-Benefit Analysis (CBA) is an economic evaluation technique that measures all the positive (beneficial) and negative (costly) consequences of an intervention or program in monetary terms.

The valuation of all program outcomes in monetary units allows decision-makers to compare the outcomes of different types of interventions directly.

Principles of Cost-Benefit Analysis:

1. There must be a common unit of measurement.
2. CBA valuations should represents producers or consumers.
3. Benefits are usually measured by market choice.
4. CBA involves a particular study area.
5. Gross benefits of an increase in consumption is an area under the demand curve.

Cost benefits analysis formula:

Net present value(NPV)=present value of future benefits-present value of future costs.

Benefit-cost Ratio =present value of future benefits /present value of future costs.

Break-Even analysis:

I. A break-even analysis is used to determine how much sales volume your business needs to start making a point.

II. In economics and business, specially cost accounting, the break-even point(BEP) is the point at which cost or expenses and revenue are equal; there is no net loss or gain, and one has "broken even".

III. Total cost =Total revenue =B.E.P.

To calculate how profitable a product will be, we must first look at the cost price and Revenue involved.

There are two basic types of costs a company incurs.

- Variable Costs
- Fixed costs

Variable costs are costs that change in production levels or sales. Examples include: Costs of materials used in the production of the goods.

Fixed costs remain roughly the same regardless of sales/otput levels. Examples include: Rent, Insurance and wages.

Unit price: The amount of money charged to the customer for each unit of a product or service.

Total cost.

The sum of the fixed cost and the total variable cost for any given level of production.

(fixed cost + total variable cost)

Total variable cost:

The product of expected unit sales and variable unit cost.

(Expected unit sales * variable unit cost)

Total revenue:

The product of expected units sales and unit price.

(Expected unit sales * unit price)

Profit/loss

The monetary gain or loss resulting from revenues after subtracting all associated costs.

(Total revenue –Total costs)

Chapter - IV
RESULT AND DISCUSSION

RESULT AND DISCUSSION

This chapter deals with the results on the process of soy cow machine for production and development of soymilk products like tofu (soy paneer), soy yoghurt, soy curd etc. The process involves collection of soybean seed, dehulling and cleaning. All the two operation are performed by a single machine. The dehulled soybean so obtained is soaked in water for 6-8 hr prior to make soymilk.

4.1 Technical program of work

(Including the location of work, facilities available,etc.)the entire experimental work will be carried out at the department of post harvest process and food engineering, CAE, JNKVV,Jabalpur. The work plan for the proposed study is given below:

4.1.1 Location of the unit

The unit is to be located in rural areas where transportation facility is good and at least 15 hr. electricity supply is provided. The site should be very well connected by road or rail. The raw materials is available in plenty and according to estimate soymilk of worth Rs. 6.50/200ml should be sold from here.

4.1.2 Capacity proposed

The plant shall have the capacity of producing 225 litre of soymilk/day. The plant will run for 300 days. Thus the until will produce 67500 litre of soymilk per annum.

4.1 Financial Aspect of the scheme

4.1.1 Land and Building

The unit shall be located in the vicinity of Jabalpur city where the transport facilities already exist and there is a continuous supply of electricity. As the plot area of about 30x20 sq.ft.is required for the project it can be purchased on the appropriate site.

The investment on land ©100/-sq.ft. : Rs. 60,000

The whole area will be required for housing as well as facilities:

Hence investment on building @Rs. 500/sq.ft.Rs. 3,00,000

Total investment on land &building:**Rs. 3,60,000**

4.1.2 Raw Material

The raw material will be whole soybean seed. The seed is dehulled before using as a raw material for soymilk. In one kg soybean, about 800 g of dehulled dal is obtained. The total quantity of dehulled dal/ day is about 30 kg. Hence 37.5 kg of soybean will be required per day, which costs about Rs. 750/- and for 256 days the cost is about Rs. 1,92,000.

4.1.3 Miscellaneous Expenses

a) Assests such as office furniture.

S. No.	Item	No. of unit	Rate (Rs.)	Amount (Rs.)
1.	Tables	02	2,000	4,000
2.	Chair	06	6,00	3,600
3.	Almirah	01	3,000	3,000
4.	Fan	01	1,500	1,500
			Total	**12,100**

b)	**Pre operative Expenses**	**(Rs.)**
	Registration, documentation, legal expenses etc	10,000
	Deposits such as for electricity, water etc	10,000
	Traveling	25,000
	Consultancy etc.	10,000
	Total	**55,000**

c) Administrative Expenses

S. No.	Item	Rs./month	Rs./ Year
1.	Stationary	200	2,400
2.	Traveling	600	7,200
3.	Miscellaneous	2000	24,000
		Total	**33,600**

4.1.4 Utilities

a) Electricity

S. No.	Item	No. of unit 300 day (Rs.)	Total (Kw) 300 day (Rs.)	Total cost/ Total cost/ day	
1.	Soybean dehulled	01	2.0	12.0	3600
2.	Blender	01	2.0	12.0	3600
3.	Light & fan	-	0.5	3.0	900
4.	Submersible Pump	01	1.0	6.0	1800
5.	Hot water tank	01	5.0	30.0	900
			Total		**18,900**

b) Water

Bore well fitted with submersible pump will sufficient for supplying water to the plant.

4.1.5 Equipment and Machinery for 225 liters of soy milk/ day.

S. No.	Item	Specification	No. of unit	Unit price (Rs.)	Total costs. (Rs.)
1.	Soybean dehuller	60 kg/ hr capacity	01	50,000	50,000
2.	Soymilk Plant	30 lit / hr	01	6,00,000	6,00,000
3.	Weighting Machine	1) 1.0 quintal, (cap)	01	25,000	25,000
	L.C. = 10 g				
	2) 10.0 kg (cap)		01	30,000	30,000
	L.C. = 0.01g				
4.	Bottle corking Machine	2000 bottle capacity/day	01	25,000	25,000
5.	Hot water tank	1000 bottle of 200 ml Capacity per batch	01	1,00,000	1,00,000
	Boring+ Submersible	150 ft. 1 HP pump	01	1,00,000	1,00,000
				Total	**9,30,000**

4.1.6 Staff and Labour required

S. No.	Staff	No. ofposition	Salary/ month(Rs.)	Salary/ annum(Rs.)
1.	Manager-cum-productsupervisor	01	30000	3,60,000
2.	Skilled labour	01	20000	2,40,000
3.	Unskilled labour	01	6000	72,000
			Total	**6,72,000**

4.1.7 Working Capital

S. No.	Item	Total quantity/ 90 days	Rate per Unit (Rs.)	Amount (Rs.)	Amount of Loan (Rs.)	Margin money (Rs.)
1.	Soy bean (dehulled) 30 kg/ day	2700 Kg.	22	59,400	35,640	23,760
2.	Bottles 1125/ day	101250 No.	1.5	1,51,875	91,125	60,750
3.	Water and Electricity 11 unit for 6 hr/ day	990	6.60/unit	5,940	-	5,940
4.	Cork for bottle 1200/ day @ Rs. 25/ 100 i.e. for 300/ day	1,08,000	0.25	27,000	16,200	10,800
		Total		**2,44,215**	**1,42,965**	**1,01,250**

4.1.8 Capital Investment (Rs.)

a. Land 600 Sq. ft. (30 x 20 m) @ 100 / Sq. ft.

(Note: Farmers already has land therefore this expenditure of 60,000 can be escaped)

b. Building 600 Sq. ft. @ 500 / Sq. ft. 3,00,000

c. Machinery and Equipment 4,05,000

d. Miscellaneous assets

(i) Office furniture 12,100

(ii) Preliminary expenditure (Registration, documentation, 55,000 stamps duties, traveling expenses)

e. Margin money for working capital 1,01,250

Total	**9,33,350**

4.1.9 Source of Finance

The fixed investment is of the order of Rs. 933350.00. The amount shall be raised as given below.

(i)	The entrepreneur	(1/3rd)	Rs. 280005
(ii)	Loan from bank	(2/3rd)	Rs. 653345
		Total	**Rs. 9,33,350**

4.2 Profitability of the unit

The profitability of soymilk unit is based on its second year of operation at 100% capacity 2,70,000 bottles of soy milk of 200 ml capacity, each having sale cost of Rs. 7.0/- bottle. It was calculated as per the procedure of Paneersalvam (2001).

1.	Sales Revenue (Rs.)	=	18,90,000
2.	Cost of production (Rs.)	=	4.77/ 200 ml. i.e. 23.85/litre

4.3 Variable Cost (Rs.)

(i)	Cost of raw material (30 x 22 x 300)		1,98,000
(ii)	Labour charge		6,72,000
(iii)	Other variables like		
•	Electricity		19,800
•	L.P.G		10,500
•	Protection Cost		1,000
•	Losses during storage processing & transportation @ 5%		9,900
•	Repair and maintenance (@ 5% of machinery & equipment)		20,250
•	Bottle @ 1.5 of 337500 No. of 200 ml capacity		5,06,250
•	Contingent requirement		1,00,000
•	Miscellaneous charge		50,000
		Total	**15,87,700**

4.4 Fixed Cost (Rs./Year)

I. Depreciation on plant, machinery and equipment @ 10/-	93,000
II. Depreciation on building @ 5%	15,000
III. Interest on term loan @ 12.5%	81,668
IV. Interest on working capital @ 11%	26,863
V. Maintenance cost	20,250
VI. Salary	6,72,000
VII. Administrative expenses	33,600
VIII. Insurance	5,000
IX. Sales promotion and expenses @ 2%	10,000
X. Amortization of preliminary expenses @ 10% / annum	5,500
Total	**9,62,881**

4.5 Total cost (4.3 + 4.4) = Rs. 25,50,581

- Profit before taxes Rs. 1,44,919
- Profit before taxes to sales rate:

Break Even Point =Fixed Cost / [S.C. — (V.C./ No. of units)]

= 962881 / 7.0 — (1587700/ 270000)

= 962881 / (7.0 — 5.88)

= 962881 / 1.2

= 8,02,400 bottles of soymilk

Break Even Sales **=**8,02,400 x 7.0

=Rs. 56,16,800

Break Even Period = 8,02,400 / 1125

= 713 days

4.6 Benefit Cost Analysis

Benefit-cost analysis is done by considering a factor called the benefit-cost ratio. It should be greater than 1 to ensure the profitability of the unit.The benefit-cost ratio is expressed as follows:

Benefit Cost Ratio = Present worth of Benefits / Present worth of costs.

Where;

$$\text{Present worth of benefits } B = \sum_{1}^{n} \frac{B_n}{(1+i)^n} \text{ , and;}$$

$$\text{Present worth of costs } C = \sum_{1}^{n} \frac{C_n}{(1+i)^n}$$

Therefore:

$$\text{Benefit Cost Ratio} = B / c = \frac{\sum_{1}^{n} \frac{B_n}{(1+i)^n}}{\sum_{1}^{n} \frac{C_n}{(1+i)^n}}$$

$$\text{Discounting factor} = \frac{1}{(1+i)^n}$$

n = time period, and; i = rate of interest.

To calculate the present worth of benefits and present worth of cost following table is prepared:

Year (n)	Fixed cost (Rs.)	Variable cost (Rs.)	Total cost	Annual Benefits	Discount factor	Discounted cost	Discounted Benefits
0	9,33,350				1		
1	962881	1587700	1890000	189000	0.9090	2318478	171801
2	962881	1587700	1890000	189000	0.8264	2107800	156189.6
3	962881	1587700	1890000	189000	0.7513	1916251	141995.7
4	962881	1587700	1890000	189000	0.6849	1746892	129446.1
5	962881	1587700	1890000	189000	0.6211	1584165	117387.9
	9673586	7168214					

Therefore;Benefit Cost Ratio = 9673586 / 7168214 = 1.34. and

Rate of return = $\frac{B}{C}$ X 100

= $\frac{9673586}{7168214}$ X 100 = 134%

Therefore, every one rupee invested is expected to earn Rupees 1.34.

Chapter-V
SUMMARY, CONCLUSION, AND SUGGESTIONS FOR FURTHER WORK

SUMMARY, CONCLUSION, AND SUGGESTIONS FOR FURTHER WORK

5.1 Summary:

There exists nutritional inadequacy in India and the world. There is an urgent need for some rich source of nutrition, which should be economical to millions of poor people worldwide. In this contest, soybean can come to our rescue. Active research and development efforts continue to expand the already extensive list of soybean products.

This study with the title "**production economics study of soycow machine SC 20"** was conducted with the objectives of Study of economic production for soycow machine SC 20 and also evaluation performance of Cost-Benefit Analysis of soycow machine.

There are four main elements to each system: a grinder, a cooker (pressure vessel), a manual filter press and a steam generator (boiler). The system has several safety features related to steam and pressure- cooking. They are also relatively easy and inexpensive to clean and maintain for sanitary food processing. They require a rudimentary kitchen-like environment with good ventilation, cement or tiled floors etc.

Soy paneer made from soy milk blended with buffalo milk is one promising item as its cost is much lesser than that of the popular milk paneer in India. The presence of characteristics beany flavor of soybeans in all the soy products, which is priced in china and other oriental countries but disliked in India, is mainly responsible for this. Thus; efforts were made to find a suitable technology for promoting an improved quality of soy paneer in the Indian market.

However, looking to the very strong cultural heritage of cow/buffalo milk-based dietary system is our country it is almost impractical to replace milk paneer all together at once by soy paneer therefore it was thought of to identify a blend of soymilk (as continuous phase) and buffalo milk (as dispersed phase) which will suppress the beany flavor and taste of soymilk to a limit such that to make it acceptable to the consumer.

5.2 Conclusion

1. Benefit-cost analysis plays an important role in the establishment of any processing industry. For establishing soy milk production until BEP (period) is 713 days which means that we start getting benefit after 713 days of establishment of production plant.
2. It is concluded that after producing 8,02,400 Bottles of soymilk the no profit no loss point will occur which will correspond to a sales volume of Rs. 56,16,800 and this stage will arrive after 713 days of functioning the unit.

Therefore the small soymilk manufacturing unit will start earning profit from two years after installation.

5.3Suggestions for further work:

While doing this research work some other related points to experiment were needed to be considered but due to time limitations it was not easy to solve all the problems. So here are some suggestions that may be considered for further research work related to soycow machine and soy milk products:

1. Mechanically operated pressing device may be designed for applying pressure on soy products.
2. A uniform pressure and time combination should be applied as per the requirement of the soymilk product.
3. The effect of different varieties should be tested.
4. A component should be designed in soycow machine for evaluating stirring time and speed.
5. Effect of different stirred times and stirring speed should be tried for preparation.
6. Effect of different soaking time and temperature should be tried for preparation for soymilk product.

Chapter-VI

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APPENDICES

APPENDIX

Cost-Benefit analysis for Soycow machine (SC 20) Rev April 2013)

A	Equipment** Soya Cow	
B.	Capacity 28 liters/h	
C.	Capital Investment	(In Rupees)
C.1	Basic Price for Plant and Machinery	210,000
C.2	Packaging @ 3%	6300
C.3	Sales Tax @ 2%	4,326
C.4	Sub-Total-SC-20	220,626
C.5	Basic Price for Deodorizer	100000
C.6	Packaging @ 3%	3,000
C.7	Sales Tax @ 2%	2060
C.8	Sub-Total-Deodorizer unit	105,060
	OPTIONAL UNITS	
C.9	Corking (Sealing) Machine	6,600
C.10	Canning Retort (Sterilizing Machine)	90,000
C.11	Freezer	15,000
C.12	Sub-Total-extras	111,600
C.13	Pre-Operational Expenses 20L/HR	
C.14	Total Capital Investment without Deodorizer	
C.14.1	For SoyMilk (Plain)	250,626
C.14.2	For Soymilk (Flavored)	347,226
C.14.3	For Tofu	250,626
C.15	Total Capital Investment with Deodorizer	
C.15.1	For SoyMilk (Plain)	355,686
C.15.2	For Soymilk (Flavored)	452,286

C.15.3	For Curd	355,686
C15.4	For Tofu	355,686
CA	Input Cost Assumptions	
CA.1	Monthly Interest on LoanPercent per anum 12	
CA.2	Depreciation Rate (percentage)	10
CA.3	Cost of Manpower per month	5000
CA.4	Cost of Soy beans /Rs/ KG	35
CA.5	Cost of Electricity (Rs /KW)	5
D	Monthly Expenses @ 20 batches/day/shift	
D.1	Monthly Interest on LoanPercent per anum 12	
D.1.1	For Soymilk (Plain) without Deodorizer	2,506
D.1.2	For Soymilk (Flavored) without Deodorizer	3,472
D.1.3	For Tofu without Deodorizer	2,506
D.1.4	For Soymilk (Plain) with Deodorizer	3,557
D.1.5	For Soymilk (Flavored) with Deodorizer	4,523
D.1.6	For Curd with Deodorizer	3,557
D.1.7	For Tofu with Deodorizer	3,557
D.2	Other Expenses	2000
D.3	Manpower Cost 2 workers @ Rs. 5000/month	10000
D.4	Soy Beans @ Rs. 35/kg (2 kg/batch)	42000
D.5	Cost of Power	
D.5.1	System without Deodorizer (0.2kW/batch)	600
D.5.2	System with Deodorizer (0.35kW/batch)	1050
D.6	Water, Sewer & Maintenance	2,000
D.7	Fuel – LPG @ Rs. 12/batch	7200
D.8	Rent	5000

D.9	Contingency expenses	5000
D.10	Depreciation Rate (percentage)	10
D.10.1	For Soymilk (Plain) without Deodorizer	2,089
D.10.2	For Soymilk (Flavored) without Deodorizer	2,894
D.10.3	For Tofu without Deodorizer	2,089
D.10.4	For Soymilk (Plain) with Deodorizer	2,964
D.10.5	For Soymilk (Flavored) with Deodorizer	3,769
D.10.6	For Curd with Deodorizer	2,964
D.10.7	For Tofu with Deodorizer	2,964
D.11	Total Expenses	
D.11.1	For Soymilk (Plain) without Deodorizer	78,395
D.11.2	For Soymilk (Flavored) without Deodorizer	80,166
D.11.3	For Tofu without Deodorizer	78,395
D.11.4	For Soymilk (Plain) with Deodorizer	80,771
D.11.5	For Soymilk (Flavored) with Deodorizer	82,542
D.11.6	For Curd with Deodorizer	80,771
D.11.7	For Tofu with Deodorizer	80,771
E	Additional Production Expenses (per Month)	
E.1	Flavoured& Sweetened Milk @ Rs. 3.5/liter	31,500
E.2	Tofu @ Rs. 4/batch	2,400
E.3	Mktg, Packing, Storage and Delivery cost as %age of Total cost	10
F	Net Cost of Production	
F.1	Soy Milk (Plain) without Deodorizer (Rs./liter)	9.33
F.2	Soy Milk (Flavored) without Deodorizer (Rs./liter)	13.29
F.3	Tofu without Deodorizer (Rs/kg)	49.87
F.4	Soy Milk (Plain) with Deodorizer (Rs./liter)	9.62

F.5	Soy Milk (Flavored) with Deodorizer (Rs./liter)	13.58
F.6	Curd with Deodorizer (Rs./liter)	9.62
F.7	Tofu with Deodorizer (Rs./kg)	51.34
G	Selling Price (RS)	
G.1	Soy Milk (Plain) without Deodorizer /liter	14.00
G.2	Soy Milk (Flavored) without Deodorizer /liter	20.00
G.3	Tofu without Deodorizer /kg	80.00
G.4	Soy Milk (Plain) with Deodorizer /liter	16.00
G.5	Soy Milk (Flavored) with Deodorizer /liter	25.00
E.3	MT, Packing, Storage and Delivery cost as %age of Total cost 10	
G.6	Curd with Deodorizer /liter15.00	
H	Monthly Income	
H.1	Soy Milk (Plain) without Deodorizer 8400 liter/month @ Rs.14/liter 117,600.00	
H.2	Soy Milk (Flavored) without Deodorizer 8400 liter/month @ Rs. 20/liter168,000.00	
H.3	Tofu without Deodorizer 1620 kg/month@ Rs. 80/kg	129,600.00
H.4	Soy Milk (Plain) with Deodorizer 8400 liter/month @ Rs. 16/liter 134,400.00	
H.5	Soy Milk (Flavored) with Deodorizer 8400 liter/month @ Rs. 25/litre 210,000.00	
H.6	Curd with Deodorizer 8400 litre/month @ Rs. 15/litre	126,000.00
H.7	Tofu with Deodorizer 1620 kg/month @ Rs. 90/kg	145,800.00
Z	Mktg, Packing, Storage and Delivery as % of Cost of Production 10.00	
I	Net Profit/Month (After reduction by 10%)	
I.1	Soy Milk (Plain) without Deodorizer	31,365.71
I.2	Soy Milk (Flavored) without Deodorizer	45,167.61

I.3	Tofu without Deodorizer	40,725.71
I.4	Soy Milk (Plain) with Deodorizer	45,552.00
I.5	Soy Milk (Flavored) with Deodorizer	84,553.90
I.5	Soy Milk (Flavored) with Deodorizer	84,553.90
I.6	Curd with Deodorizer	37,152.00
I.7	Tofu with Deodorizer	54,312.00
J	Payback Period (Months)	
J.1	Soy Milk (Plain) without Deodorizer	7.99
J.2	Soy Milk (Flavored) without Deodorizer	7.69
J.3	Tofu without Deodorizer	6.15
J.3	Tofu without Deodorizer	6.15
J.4	Soy Milk (Plain) with Deodorizer	7.81
J.5	Soy Milk (Flavored) with Deodorizer	5.35
J.6	Curd with Deodorizer	9.57
J.7	Tofu with Deodorizer	6.55

CURRICULUM VITAE

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The author of this thesis **Ms. Shalini Mishra** D/o Shri Pradeep kumar Mishra was born on 25thJune, 1994 at Rewa (M.P). She passed the High School Examination in the year 2010 with 91.02 percent marks from Saraswati shishu mandir mangawan, Rewa (M.P.) and Higher Secondary Examination in the year 2012 acquiring 81.00 percent marks from Saraswati shishu mandir mangawan, Rewa (M.P.). She joined the College Mahatma Gandhi Chitrakoot Gramodaya Vishwa Vidyalaya Chitrakoot- Satna (M.P) in the year 2013 and successfully completed the degree of B. Tech (Ag. Engg) on 15thJune 2017 with (7.52 OGPA out of 10.00 point scale).After completing graduation, she was selected for M. tech (Agri.Engg) degree programme in Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur through JNKVV and RVSKVV Joint Entrance Examination, in 2017 for specialization in Post harvest process and food engineering. She has successfully completed all the course requirements for Master's degree with First Division securing an OGPA of 7.52 out of 10 point scale.

For the fulfillment of the Master's degree programme, she was allotted research problem entitled " Production economics study of soycow machine SC 20".This is duly completed by her and presented in the form of this thesis.