ISSN No. 0976-8602 RNI No. UPENG/2012/42622 VOL.-III, ISSUE-III, JULY-2014

Asian Resonance

Soymilk Products Development from Sprouted Soybeans: A Healthy Harvest of Germination Biotechnology

Nitu Singh
Associate Professor
Dept of Home Science
Dr. B.R.A. Govt.Girls P.G. College,Fatehpur

Abstract

Viewed against the backdrop of high incidence of PEM in developing countries and increasing cost of protein rich foods, soymilk was hailed as a promising means of alleviating the shortage of good quality proteins. However, the characteristic beany flavor of soybean based products became the main stumbling blocks in its wide utilization. Therefore, in this soyproducts development endeavor, germination biotechnology has been combined with an assortment of simple techniques ranging from blanching treatment, rapid hydration and hot water grinding, in a bid to produce soymilk and its products sans their peculiar beany flavor. Satisfyingly, studies on the effect of above treatments on acceptability and shelf life of soymilk products revealed that soymilk and its products prepared from sprouted, blanched soybeans stood higher in acceptability and stability indices ranking than those made from traditional soymilk with practically no net erosion in its nutritional quality. Further, sensory evaluation studies indicated that milk and its products formed from this milk and buffalo's milk blends were preferred over those prepared from nonblended soymilk. The study also implies that in socio-economic milieu prevailing in developing countries the utilization of soyfoods can be promoted by preparing soymilk using germination biotechnology and developing products made from this soymilk and buffalo's/cow's milk blends. This can go a long way in alleviating malnutrition and improving the nutritional status of teeming millions of the impoverished, undernourished kind.

Keywords: Malnutrition, soyfoods, germination biotechnology blanching.

Introduction

Malnutrition is a health problem prevalent in all developing countries, India being no exception. Under nutrition or lack of adequate diet is a form of malnutrition which is most widespread. The causes of malnutrition are many, and often, interrelated.

Though malnutrition affects individuals of all age, the children below five years are mostly affected as they have relatively high requirements for protein and energy. Deficiency of either of these two nutrients can lead to devastating consequences. Besides in recent years there is an increasing realization of the hazards of protein malnutrition vis-a-vis intellectual dwarfing of children particularly in the preschool age group.

An improvement in the intake of macronutrients i.e. calories and proteins, may help us overcome the problem of malnutrition. However, proteins being the most important yet scare foods, are available from costly foodstuffs like fish, meat, eggs and milk, hence are out of the reach of the common rural Indian. Combined to this is the fact that majority of the people in India are vegetarians and high quality proteins being available in foods of animal origin, are not consumed by them.

Soybean: The miracle gold bean with high nourishing potential

1. Soybeans being low in cost and unique in chemical composition (about40% protein combined with 20% oil) appear to be the appropriate choice for fulfilling the protein energy requirements of the teeming millions.
2. Besides soybeans also contain 35% carbohydrates and minerals.
3. Oil present in soybeans becomes a source of concentrated energyand essential fatty acids, with no high cholesterol fall out. (Nutrition, 1997)
4. Soybeans can grow in a variety of soils and under a wide range of climatic conditions; the yield of edible protein per hectare is on of the highest of all vegetable protein sources.

5. Soybean proteins are of high biological value.

Traditional soymilk

The challenge to develop low cost, highly nutritious and acceptable products from soybeans by techniques that can easily be adopted at the rural house hold level, especially to cater the needs of the developing countries, led to the development of soy products such as soymilk, tofu, soy curd etc.

Statement of the problem

The purpose of the study was to develop soymilk and its products using germination biotechnology and blanching treatment to destroy the beany flavor of soymilk, the raison'd' etre of low acceptability of soymilk made from unsprouted soybeans. It also seemed to improve the nutrient bio availability.

Objectives of the study

A. To study the chemical properties of soymilk concentrates from sprouted soybeans with different treatments.
B. To examine the stability index of soymilk prepared from sprouted, blanched soybeans.
C. To devise various soymilk based recipes.
D. To evaluate the acceptability of soymilk prepared from sprouted, blanched soybeans.
E. To compare the acceptability of blended and unblended soymilk and its products from sprouted, blanched soybeans.

Review of Literature

Malnutrition and under nutrition of protein energy is widespread in developing countries. It is regarded as a spectrum of disease arising from an inadequate diet, especially in childhood. The results of community surveys have shown that 70 to 80 percent of children suffer from various forms of growth retardation due to protein-energy malnutrition in India (Anne et al, 1985).

Besides the young children, expectant and nursing mothers, elderly (aged 60 years and above) also constitute the vulnerable segment of population. The elderly on the whole need better quality of food, though less in quantity. (Pathak, J.D.1997) They require better quality of food rich in calories and proteins that are easy to digest.

Studies conducted by the ICMR indicate that PEM, a debilitating nutritional problem among children can be cured by a daily protein intake of 10 gm (joshi-1993). Hence soybean with its 40% absorbable protein content seems to be the right choice for school-going children.

Of utmost importance is the hypocholesterolemic effect of soy proteins. As little as 25g of soy protein is all that is needed to lower cholesterol in hypercholesterolemic subjects. (Bakhit et al 1994).Hence it is considered as "GOLD" obtained from soil and is thus rightly called today the "**GOLD NUGGET OF NUTRITION".**

Soybean varieties and growing location greatly affect the protein content and color of soymilk and the protein content and yield of tofu. Protein content of soybeans was the most important affecting factor for the qualities of soymilk and tofu. (Min, Martin et al. 2005).

However the main objection to the utilization of soybeans among Indians is its characteristic beany flavor. This beany flavor is not accustomed to us who are habituated to thurdhal and field beans flavors. Besides trypsin inhibitors, certain unavailable carbohydrates and high protein content present cause certain digestibility problems and deleterious effects on health when unsoaked and uncooked soybeans are eaten (Vaidehi 1981).

As a result processing of soybean become necessary. Health activist Vijaya Venkat has rightly remarked,

"soya is a product that's alien to our system and one that cannot be used directly, without the intervention of technology" (Vijaya Venkat 1993)

MATERIALS AND METHODS

The study was conducted in the following three parts:

1. Preparation of soymilk and its nutritive analysis.
a) Soymilk preparation from sprouted soybeans.
b) Chemical analysis of soymilk.
✓ Determination of PH.
✓ Estimation of moisture content.
✓ Protein estimation.
✓ Fat estimation.
✓ Mineral content estimation.
c) Stability indies determination.
2. Preparation of suitable recipes involving soymilk.
✓ Tofu
✓ Soy curd
✓ Soykhoa
3. Testing organoleptic qualities of these recipes.
✓ Triangle difference test for panel member selection.
✓ Sensory evaluation by hedonic scale.

Results and Discussion

The present study was undertaken to prepare and nutritionally analyse soymilk form sprouted soybeans with different treatments as well as to find the acceptance of various soymilk based preparations by organoleptic evaluation.

Storage stability of soymilk concentrates

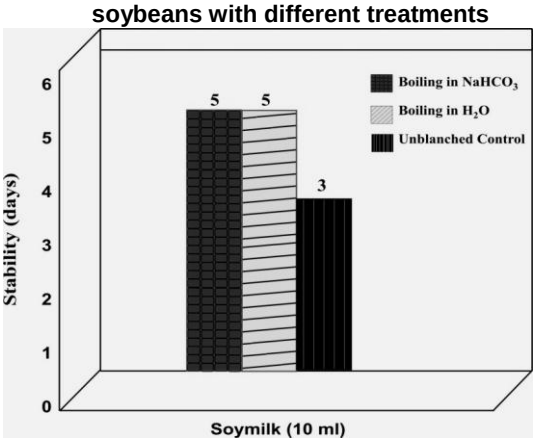
Our results are at variance with those reported by Nsofor Osuji (1997), in regard to the storage stability of the soymilk (sterilized at 121^0c for 10 minutes), at tropical room conditions. This was found to be much lower in the present study (as in Table No. 1; Figure - 1) whereas it was stated to be rather high by these workers. Heating conditions are the most important variables in the processing of soymilk. The heat treatments given to soymilk during extraction and cooking principally influence the yields and nutritive quality of solids and proteins of the soymilk as reported by Kin and Niranjan (2007).

Table No. 1
Yield, Stability And Nutrient Level of Soymilk Concentrates From Sprouted Soybeans With Different Treatments

Type of treatment	Yield of milk (ml/100 gm)	Stability (days)	pH	Moisture (gm/100 ml)	Soluble Proteins (gm/100 ml)	Calcium (mg/100 ml)	Iron (mg/100 ml)	Phosphorus (mg/100 ml)	Fat(gm/100 ml)
Boiling in $NaHCO_3$	666.60	5	6.83	96.3	3.75	60	0.87	19.16	1.49
Boiling in H_2O	666.60	5	6.70	95.8	3.90	62	1.00	21.66	1.51
Unblanched Control	666.60	3	6.25	96.7	4.90	68	1.50	35.0	1.53

However the sprouted; blanched soybeans yielded soy concentrate with greater storage stability than that of the unblanched (control) samples.

Figure- 1
Stability of soymilk concentrates from sprouted soybeans with different treatments



Chemical properties of soymilk concentrates from sprouted soybeans with Different treatments:

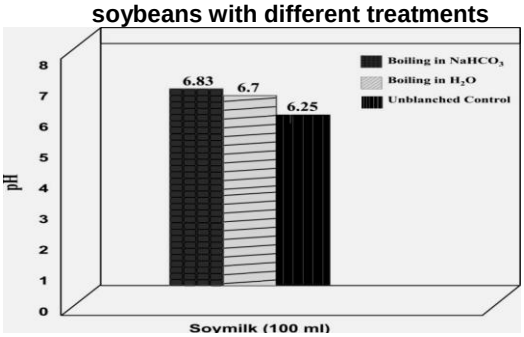
a) Effect on pH of the soy concentrates:

The $NaHCO_3$ blanched and the control samples showed the highest and the lowest pH respectively. The pH in terms of decreasing order is.

$NaHCO_3$ treated >boiling water treated> control

The early coagulation of controls (unbalanced) may be partly related to their low pH. The high pH of soy milk concentrates from $NaHCO_3$ blanched soybeans is attributed to the utilization of $NaHCO_3$ as blanching additive. (Table- 1; Figure- 2)

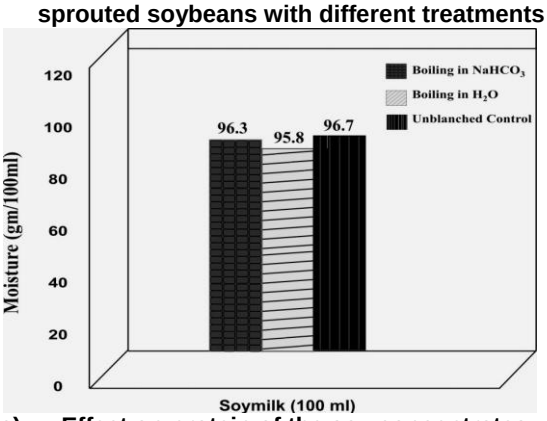
Figure- 2
pH of soymilk concentrates from sprouted soybeans with different treatments



b) Effect on moisture content of the soy concentrates

Slight variations were observed in the moisture content. Of the three samples. Thus indicating that blanching had no effect on the moisture content. (Table- 1; Figure- 3)

Figure- 3
Moisture content of soymilk concentrates from sprouted soybeans with different treatments



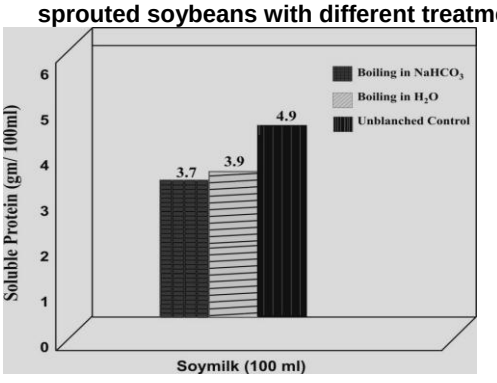
c) Effect on protein of the soy concentrates:

The protein yield estimate of the extracted sample in present study was decreased on blanching in the following order: (Table- 1; Figure- 4)

Control > boiling water treated> $NaHCO_3$ treated

As blanching denatured and in solubilized soybean protein, thereby limiting protein extractability from the blanched samples However extract ablity of protein in soymilk in the present study was higher then the values reported by Leslie and Osuji (1997). This may be attributed to variations in processing methods. Besides soybean varieties and growing location greatly affect the protein content and color of soymilk as stated by Min, Martin et al. (2005).

Figure- 4
Protein content of soymilk concentrates from sprouted soybeans with different treatments



d) Effect on mineral contents of soy concentrates

The mineral content especially the phosphorus, calcium and iron decreased in the order. (Table- 1; Figure- 5, 6,7 respectively)

Control > boiling water treated> $NaHCO_3$ blanched.

Figure- 5
Phosphorus Level of soymilk concentrates from sprouted soybeans with different treatments

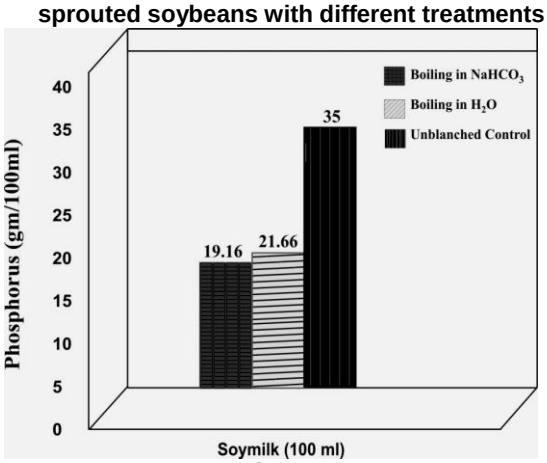


Figure- 6
Calcium Level of soymilk concentrates from sprouted soybeans with different treatments

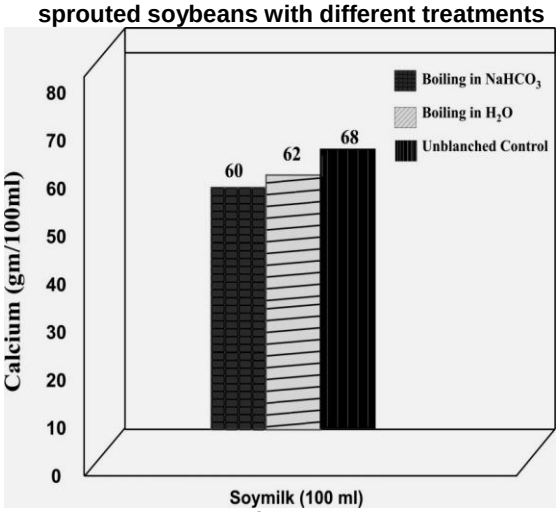
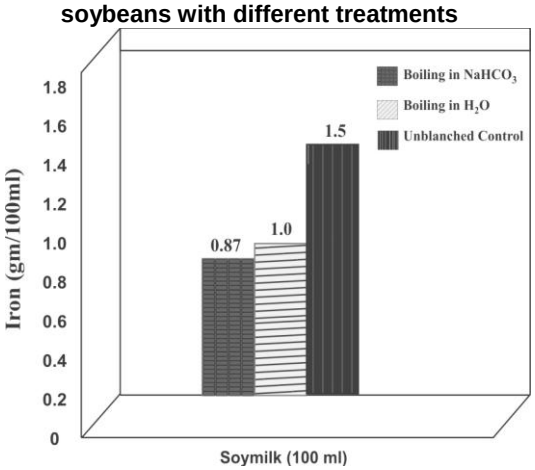


Figure- 7
Iron Level of soymilk concentrates from sprouted soybeans with different treatments



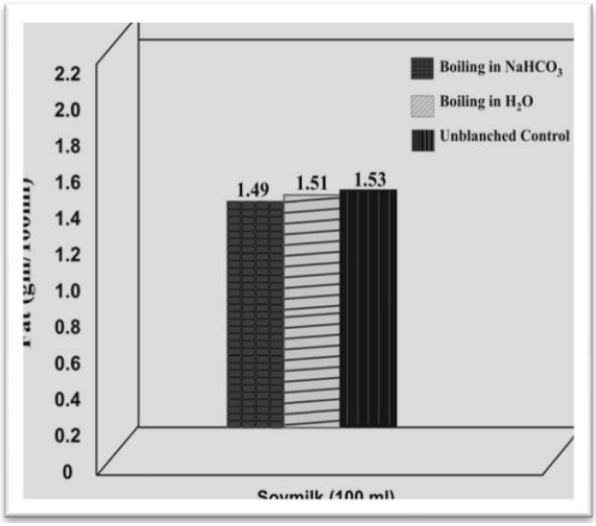
Blanching treatment had adverse effect on the mineral content of soymilk. This may be partly attributed to the leaching of minerals in blanching water, which was then discarded during further processing and partly due to the change in the solubility during heat treatment.

However studies relating the effect of heat on the mineral content of soybeans are fewer and thus the cause either for the increase or decrease in the mineral content after heat treatment is not clear.

e) Effect on the fat content of soy concentrates

Little variation was observed in the fat content of soymilk concentrates from sprouted soybeans with different treatment (Table No. 1; Figure- 8) Thus indicating that blanching had no effect on the fat content of soymilk

Figure- 8
Fat content of soymilk concentrates from sprouted soybeans with different treatments



However, soymilk is not a standardized product, varietal differences and processing conditions such as methods of hydrating beans, bean to water ratio, extraction temperature influence the composition and quality characteristics of soymilk, and there is very little information on quality parameters of soymilk (Reddy and Mittal; 1992)

II- Sensory Evaluation of Soymilk and soymilk Based products:

The acceptability of soymilk and its products was evaluated on a 9 point Hedonic scale by twenty five judges. Responses and comments from evaluation was recorded and quantified in terms of percentage. In the present study acceptability of blended and non-blended soymilk and its products were evaluated. A comparative study of different products form soymilk and buffalo's milk blends in ratio 70:30 was done using soymilk from sprouted, blanched soybeans as well as unsprouted, unblanched soybeans. Evaluation was done for appearance, flavours, taste and overall acceptability.

Table No. 2
Acceptability (As Positive Attributes) Of Blended And Nonblended Soymilk And Its Products From Sprouted, Blanched And Unsprouted, Unblanched Soybeans

Attributes	SM (100%)		SM (SM+BM; 70:30)		Khoa (SM 100%)		Khoa (SM+BM; 70:30)		Tofu (SM 100%)		Tofu (SM+BM; 70:30)		Curd (SM 100%)		Curd (SM+BM; 70:30)	
	SP	UN	SP	UN	SP	UN	SP	UN	SP	UN	SP	UN	SP	UN	SP	UN
Appearance	77%	75%	88%	88%	54%	52%	66%	64%	88%	88%	92%	90%	47%	43%	65%	60%
Flavour	48%	32%	60%	40%	55%	32%	65%	56%	70%	53%	91%	72%	46%	25%	52%	31%
Taste	42%	30%	58%	42%	57%	32%	68%	52%	72%	60%	92%	80%	38%	25%	42%	32%
Overall acceptability	40%	28%	50%	35%	55%	42%	68%	54%	72%	64%	90%	78%	25%	20%	30%	25%

It is evident from Table No. 2 that while comparing the appearance, flavor, taste and overall acceptability of soymilk, tofu, curd and Khoa, the acceptability was greater for products made of soymilk form sprouted, blanched soybeans. The overall acceptability was highest for tofu and lowest for curd. The responses are in accordance with those reported by Murugkar (2014) which stated that the improvement in composition and quality parameters was seen in all the varieties of soymilk tested showing that sprouting could be beneficial for product development across varieties. In the present study the palatability was further improved on blending with buffalo's milk at 70:30 proportion.

The acceptability of non blended as well as blended soymilk form unsprouted unblanched soybeans was comparatively much lower than those of soymilk from sprouted blanched soybeans due to the beany flavour and chalky after taste. As stated by Kin and Niranjan (2007) heating conditions are the most important variables in the processing of soymilk which principally influence the colour and the flavor of the milk and the qualities of other soyproducts derived from soymilk.

Summary

Nutrient requirements of growing children, expectant and lactating mothers and of elderly (aged above 60 years), make them prime targets of the scourge malnutrition.

Against such nutritional scenario, the study was undertaken with the avowed aim of making easily consumable and affordable high energy and nutrient dense soymilk food products prepared from sprouted, blanched soybeans that can not only be used as weaning diet but also be of value in adult malnutrition, and above all, have therapeutic significance too.

In fact, soymilk prepared earlier was also nutrient dense and held out a considerable promise as an effective substitute for cow's milk. It promoted growth in infants allergic to cow milk and posed lesser problems of availability to the rural population.

However, the typical beany flavor which developed due to volatile compounds following activation of lipoxidase enzyme constituted the most serious impediment against its popular acceptability.

However, this problem was overcome almost completely by using sprouted and blanched soybeans for soymilk production. Preparation of this improved version of soymilk was an intricate multistep process. It involved germination of soybeans as a major innovation, blanching, dehulling and grinding of cotyledons, and finally adjusting the ratio of milled cotyledons and water to yield 30% soy solids in the final soy extract. The high temperature rapid hydration-cum-grinding process seemed to have ensured optimal protein extraction from the seeds and also minimized the chances of development of off flavor.

The effect of various treatments on nutritive quality of soymilk was studied and the stability index evaluated vis-à-vis soymilk from sprouted, unblanched samples. Thus nature's most bountiful germination biotechnology was used to affect acceptability and nutritive value enhancing modifications.

In the second part of the study various soymilk based products were prepared from 100% soymilk. Alternatively to increase nutritive quality and acceptability; products were also made using blends in the ratio 70:30 of soymilk and buffalo's milk.

Acceptability evaluation studies constituted the third part. They were made by conducting intake trails using a 9- point hedonic scale with the help of twenty five semi trained panel members having good discrimination and communication power, selected using triangle difference test. Percentage was applied for the evaluation of the scores of acceptability trails of soymilk and its products.

Conclusions

Within the limitations of the study the following conclusions were drawn:-

1. The sprouted, blanched soybeans yielded soymilk concentrate with greater storage stability. Though the protein yield estimate of the extracted sample decreseased somewhat on blanching. However the protein content remained almost equal to cow or buffalo's milk.
2. The mineral content especially phosphorus and calcium decreased on blanching while not much variation was observed in the iron content of soymilk from blanched and control samples.
3. Fat content of the milk samples remained unaffected by the blanching treatment.

4. Sensory evaluation of soymilk from sprouted soybeans and its products also revealed that though soymilk as such was quite acceptable but products, mainly tofu and khoa prepared with the same soymilk blends were comparatively higher in acceptability.
5. The results of the study showed that though blanching caused a little loss of nutrients yet, soymilk and its products prepared from sprouted, blanched soybeans had better acceptability than soymilk and its products from unsprouted, unblanched, soybeans.

Thus from the present study it can be concluded that soymilk and its products prepared using germination biotechnology and blanching when blended with buffalo's milk could become a source of popular and nourishing food products. An added feature of this food product development is that the cost of such blends is less than one-half of cow's milk with nourishing ability the same or even more.

Soymilk from sprouted soybeans and its products appear to have the potential to become a nutritious and cost effective answer in alleviating malnutrition in the developing countries like India, where the majority of the people are vegetarians and the staple food continues to be based primarily on cereals and millets.

References

1. Anne,U. and Begum,J.M.(1985) Nutritional status of children attending the UAS school. The Ind.J.Nutr. Dietet, vol. 22 pp 221.
2. Gopalan, C and srikantia, S.G.(1973) Nutrition and disease. World Rew.Nutr. Dietet, vol. 16 pp 97.
3. Joshi, C.L. (1993) Making sense of soybean, Lifeline, Dec11.
4. Kin and Niranjan, K. (July 2007) Review: Effect of thermal processing on soymilk. Article first published online : 9 jul. 2007. Dol: 10.1111/J.1365-2621.1995. tb.0 1377 x
5. Lefshity, F. (1985) Nutrition and growth. Clinical Nut, vol. 4 pp 40-47.
6. Min, S., Yu, Y. and Martin, S (Jan. 2005) Effect of soybean varieties and growing locations on the physical and chemical properties of soymilk and tofu. Journal of food science volume 70, issue 1, pp C8-C21.
7. Messina M, Messina V (April 2000) Soy foods, soybean isoflavones and bone health: a brief overview. J Ren. Nutr. Vol. 10, No. 2 pp 63-8.
8. Murugkar A.D. (May. 2014) Effect of sprouting soybeans on the chemical composition and quality of soymilk and Tofu. J.Fd. Sci. Technol. Vol. 51, issue 5. pp 915-921.
9. Nsofor, L. M. and Osuji, C.M. (1997). Stability, Pheology and chemical properties of soymilk concentrates developed from sprouted soybeans. J.Fd. Sci. Technol. Vol. 34, pp 33-40.
10. Pathak, J.D. (1997) Our elderly, some effects of ageing in Indian subjects. Medical research centre Publication, Bombay.
11. Tezuka M, Taira H, Lgarashi Y (2000) Properties of tofus and soymilks preapared from soybeans having different subunits of glycinin- J. Agric food chem.. vol. 48, No. 4, pp 1111- 1117.
12. Vaidehi, M.P. (1981) Guideline for the course soya use in daily diet. University of Agri.Sciences.Banglore.
13. Vijaya Venkat (1993). Making sense of soya bean. Lifeline, Dec.11