

ALTERNATIVE PROTEIN SOURCE FOR RESOURCE SUSTAINABILITY

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Abstract: *The demand for alternatives to cow's milk is growing due to problems with lactose intolerance and desire for more 'vegetarian' alternatives. Soy milk-based products have emerged as a popular alternative to traditional dairy-based one due to strong antioxidant properties which have capability of lowering cholesterol and saturated fat and thus have gained significant consideration for their nutritional health benefits and are expected to drive the growth market in the near future. Continuous efforts are being made to develop products from certain non-conventional food sources such as soybeans to convert them to more acceptable and palatable forms thus producing low-cost nutritious foods. But studies are still scanty in this area and therefore interest in soy-based product has been identified as the prime objective of the present study. Through this project we offer absolute dairy-free soy based products. The survey of sensory evaluation was undertaken to measure consumer's attitudes and expectations toward the products. The research work is being pursued to explore the inherent technological opportunities for better utilization of these resources in designing value added foods which have the high potentials for commercialisation.*

Index Terms: *anti-oxidant; dairy-free; lactose intolerance; sensory evaluation; soybeans*

I. INTRODUCTION

The soy products have immense health benefits. Soy milk-based products have emerged as a popular alternative to traditional dairy-based one because soy has good amino acid profile contains higher levels of essential fatty acids, soluble fiber, vitamins, and minerals, easy to digest, low in carbohydrates and calories, lacking cholesterol and lactose. Soy also contains phytochemicals which include isoflavones, phytic acid and saponins which have strong antioxidant properties and have capability of lowering the cholesterol level. Soybean is widely accepted in world because of its high nutritional quality, abundance, availability, and low cost. Soymilk based products have gained significant consideration for their many nutritional health benefits for reducing cardiovascular disease, weight loss, arthritis and brain function (Singh et al., 2008).

Soymilk as a base for production of beverages remained deprived of commercial exploitation because of its low acceptability associated with unpleasant beany flavor, astringent and bitter taste. The main aim of the project is to prepare different soybean products with improved acceptability by adding natural food colours and flavours and making the product more nutritious and consumable (Tiwari, 2017). The project addresses the production of value added products from the less explored soybeans and their fortification thereof for better health benefits to mankind.

II. METHODOLOGY

2.1. Preparation of Soy milk

Good quality soy beans were carefully selected and soaked for overnight in water. Hulls were removed manually by rubbing and beans were blended with water in blender. The resultant slurry was filtered through muslin cloth. The milk thus extracted was boiled and cooled down to prepare various soya milk products. The residue called Okara was dried and used for making baked products.

2.2. Preparation of value added products from Soy milk

Flavoured soy milk was prepared by the addition of kesar, cinnamon powder, dates puree, raspberry syrup and cardamom to the milk thus extracted. Dairy free ice cream was prepared by conventional method by using soy milk fortified with Fig pulp/ Chickoo pulp/ Custard apple pulp/ date pulp/ spinach extract/ beetroot extract/ seed powder of pumpkin chia and sunflower which not only served as flavouring agents but also as nutritional enhancers.

Fermented products were prepared by inoculating soy milk with starter cultures of *Lactobacillus* (0.2%) and incubating at 37°C for approx. 6-8 h. Value added products like sweetened yoghurt, butter and ghee were prepared in conventional way. Tofu was prepared by curdling of soy milk using lemon juice, allowed to stand for few minutes to settle down solids, strained through muslin cloth to remove the whey water and the solid remaining – Tofu, pressed between muslin cloths to remove the moisture, shaped, packed tightly in a container and refrigerated.

Baked products like biscuits and cake were prepared by using Okara by conventional method where the refined flour is replaced by okara

2.3. Sensory evaluation of the products

The product development will be successful only when it is accepted by the consumer. Sensory evaluation of the products prepared in the current study was carried out with fifty members of age group 20-60 years. Sensory attributes (organoleptic study) like colour, texture, firmness, taste, sweetness, sourness, flavour and overall acceptance of all fruit products were assessed using five point score for the sensory evaluation. The product that ranked the highest was further analysed for its proximate nutritional value and its comparison with the similar commercial biscuit was studied.

2.4 Cost analysis of the nutraceutical products

The cost of raw materials during seasonal and off-seasonal period was noted. The cost of each value added product calculated accordingly and comparison was made so as to understand the need for preserving the surplus fruits available during seasons at reasonable price.

III. Results and discussion

In general, the soy products such as soymilk yogurt have low acceptability ratings due to unappealing flavour, odour and little known about their health benefits. On the other hand, resolving these concerns with improved consumer education and knowledge of soy health benefits, increases acceptability scores. One of the purposes of this study was to develop value added soy products to increase its acceptability.

In the present study, fortification of soy milk with the fruit pulp/ vegetable extracts in ice cream production was done not only to impart appealing colour but also provide additional minerals and vitamins and improves its organoleptic quality (Fig 1). According to Bueno et al (2018), the soy-based ice cream had a good acceptance based on the sensory parameters evaluated, demonstrating the great potential of acceptance in the market for people intolerant to lactose or who want to consume food health claim purpose. Bisla et al (2012) also developed soy base ice cream and evaluated their acceptability and nourishing potential.

The products prepared from the fermentation of soy milk (sweetened yoghurt, butter, ghee and Tofu) have scored good acceptability (Fig 1). The reduction of the beany flavour of soymilk, which improved the sensory quality of the final product, could be connected with fermentation of n-hexanal and pentanal in soymilk – the former is responsible for the undesirable flavour. Furthermore, fermentation also reduces the content of soy galactoligosaccharides: indigestible carbohydrates, which can in higher amounts cause undesirable flatulence (Horackova et al, 2015). Soy butter and ghee offer a significant nutritive value. Soybean butter has the highest protein (25.8–30 g/100 g) when compared to the commercial peanut butter that had the highest amount of fats (58.7 g/100 g) (Hayat and Amal, 2016). Tofu is the most popular among all soy products also called soy paneer and bean curd. It is a tasty and very nutritional product made by coagulating hot soymilk. Nutritionally its protein is as good as the protein derived from the animal sources. It is a component in many East Asian and Southeast Asian cuisines. The primary health benefit of tofu is to lower risk of atherosclerosis, hypertension and cardiovascular diseases. Being mainly the country of vegetarians, India has indeed a very great potential for Soya products. Experts predict that the Soya food industry will grow 20% annually over the next few years. Studies have shown that the Tofu has been successfully prepared from soy milk with good consumer acceptability (Raja *et al.*, 2014)

This study also aimed at producing quality baked products from cheap and underutilized soybeans by demonstrating production of biscuits and cake with Okara substitution. All the products were highly rated for all the selected sensory attributes and were nutritionally superior to that of the commercially available biscuits made with refined flour (Fig 1). The findings of the present work may help in developing commercial processing technology for effective utilization of soy flour in the manufacturing of biscuits. Various researchers also demonstrated that biscuits with soy flour substitution enhance nutritional quality (Farzana and Mohajan, 2015; Banureka and Mahendran, 2009; Ndife et al, 2014). Okara is the fiber rich by-product of the soymilk process. It is an ideal ingredient in baking and cooking, and value-added food processing. It is essentially available at no extra cost to the processor, and is otherwise a waste product or animal feed (Katayama and Wilson, 2015, Li et al, 2012; García et al, 1997). Through this project, soy-based Okra, has been prepared and incorporated in making soy based baked products thus enhancing the health benefits with an enjoyable flavor and texture.

Analysis of foods is an important part of the quality assurance program in food processing from ingredients and raw materials to finished products. It is also important in formulating and developing new products and evaluating new processes for making food products, and in identifying the source of the problem for unacceptable products (Nielsen, 2003).

Many traditional foods can be supplemented with various soy foods to produce new consumer products. The proven health benefits, and growing consumer awareness of soya, support the production and marketing of many existing and new products. The production of non-dairy food products has been pointed out as a novel trend in the production of functional foods (Atallah and Barakat, 2017).

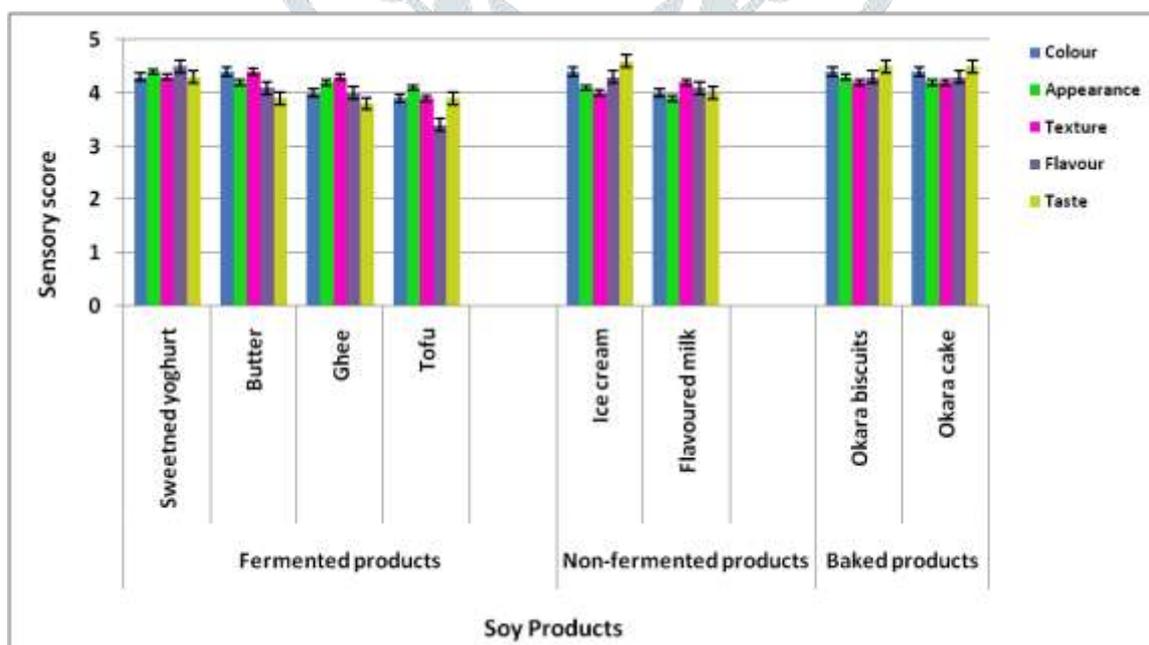


Fig. 1 Sensory evaluation of soy products

(n=50; error bar indicates mean \pm SE)

Table 1: Cost analysis of soy based products

| PRESENT STUDY | | COMMERCIAL | |
|-------------------|---------------|-------------------|-----------------|
| SOY PRODUCT | PRICE | PRODUCT | PRICE |
| Ice cream | Rs.50(1litre) | Ice Cream | Rs.150(1litre) |
| Okara biscuit | Rs.78(500g) | Biscuit | Rs.550(500g) |
| Okara cake | Rs.102(300g) | Cake | Rs.328(300g) |
| Butter | Rs. 80 (500g) | Butter | Rs.212 (500g) |
| Ghee | Rs.80 (500ml) | Ghee | Rs. 225 (500ml) |
| Sweetened yoghurt | Rs.25(500ml) | Sweetened yoghurt | Rs.37(500ml) |

Table 1 reveals that the soy based products prepared in the present study are relatively cost effective and has good market potential. From a nutritional point of view, the ethnic and novel products of soy bean were found to be comparatively richer in protein than those made out of conventional elements. Indeed, since substitution of refined flour to standard recipes, has improved the nutritional quality of the products by increasing macro as well as micronutrients. Recipes based with soy bean need to be widely popularized for combating hidden nutritional deficiencies, particularly high among school going children. Value addition also showed to be a highly strategic intervention in the popularization of nutritionally and technologically rich local crops which are currently largely neglected and underutilized.

IV. Conclusion

Soymilk can be a good source for the development of soymilk based fermented product like yoghurt and further its nutritional value and palatability can be enhanced by fortification. With the increased rise of "Veganism" in India, these products can be a good alternative for daily consumption since it contains all the required nutritional benefits. Processing and utilization of millets in value added product development have promising prospects with regard to nutrition, quality and health benefits and can be an alternative to cereals but its full scope and utilization is yet to be established. Popularization in the broader range is essential and specific design of foods acceptable to the population can help in promoting the consumption of these millets. Value addition also showed to be a highly strategic intervention in the popularization of nutritionally and technologically rich local crops which are currently largely neglected and underutilized.

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