DISCUSSION

VI. DISCUSSION

Literature is replete with varieties of products developed from soybean. In the advanced countries as in USA a large number of products appears in scientific and patent literature and their numbers continue to rise. However a large number of these works are based on the utilisation of soybean derivatives such as isolates, concentrates, grits, flours, etc.(Circle and Smith 1972; Hoover, 1979), the technology of which has been fairly well developed. In a country like India such soybean derivatives are not available in a form and at a price to be cost effective under our present economy. Attempt of this work therfore has been to use whole soybean as the starting material, due to its inherent simplicity and processing cost saving potential. This study has established that starting with whole soyabean, a soft cheese type product, namely soybean "muska" can be obtained by simple procedures adopted from the preparation of "muska" from dairy milk during shrikand making. By incorporating sugar,thickening agents such as egg, rice, wheat and potato, coluring and flavouring agents and heat setting the product by baking, a cheese cake like product can be made with excellent organoleptic and shelf life properties.

As "muska" making involves lactic fermentation, using lactic cultures to obtain a desired degree of acid level was considered

in this study for the production of curd, and its subsequent conversion to muska by draining off whey. Although, acidification in several dairy products has been possible without the use of lactic fermentation, (e.g. by gradual hydrolysis of compounds such as Delta dodeca lactone), fermentation was considered preferable in the light of its ability to destroy several antinutritional factors of soybean system and to improve the flavour profile of the fermented product.

Only five commercial "dahi" cultures were obtained for setting soycurd, and these cultures were essentially similar in their acid producing ability, which was much lower in the soymilk system, in comparison to their performance in dairy milk systems. Although, using a proper combination of fermentable sugars by choosing Reconstituted Skimmed Milk (RSM), whey and lactose did improve the extent of acid production, there appears to be a need for undertaking further work in this area to search for acid producing cultures, which would be particularly suitable for soymilk systems, resulting in about 1 % lactic acidity and a pH around 5. In this regard, Mital *et al.*, (1974) have shown that *L. acidophilus* is more effective in the utilisation of sucrose in soymilk. However, the use of pure cultures in the preparation of soybean based cheese cakes remains to be studied.

Soybean system is known to have calcium sensitive proteins. Soy curd strength is therefore expected to be influenced by calcium ion content of the system (Saio *et al.*, 1974). However the addition of calcium hydroxide to soymilk in our experiments caused some protein precipitation resulting in weaker curds. Different ways require to be explored for adding ionic calcium without causing the precipitation of calcium sensitive soy protein. In turn, the curd forming properties of soymilk system, containing higher level of calcium , remains to be studied particularly in terms of curd tension.

Curd strength properties could also be influenced due to the changes in total solid concentration in milk. However, studies carried out in our department showed that the extraction efficiency was lower when the proportion of bean to water ratio was increased from 100 to 200 g/L (Naik , 1995). Others have also observed similar trends (Beddows and Wong, 1987 ; Chang and Stone, 1990). In any case, for our cheese cake preparations, the curd strength obtained from the fermentation of soymilk systems, without added calcium and containing 8-9 % total solids, gave a curd tension of about 30g. This could be handled without any difficulty for subsequent conversion of soy-curd to soymuska, causing a loss of 1.5 % solids in whey during the draining of the curd.

At the initial stages of preparing soybean cheese cake, egg was used as a setting/thickening agent. Although in the egg containing products no beany flavour could be detected, the presence of egg flavour was disliked by many panel members, especially by those who were vegetarians. Attempts to find a suitable substitute for egg as a texture modifier resulted in the successful application of commonly available food ingredients such as rice, wheat and potato, without resorting to the use of chemical additives such as carboxymethyl cellulose, pectin, modified starch, etc., which are the common adjuncts to many of the modern day processed foods. The incorporation of rice, wheat and potato paste as thickening agents into the cheese cake involved no elaborate processes, requiring essentially the preparation of pastes that could be smoothly worked into muska before the final heat setting step. These additives within the limits of incorporation did not seriously affect the flavour profile.

The lactic fermented muska with added sugar and thickeners resulted in soybean cheese cakes that appeared to be essentially a bland, slightly off-white product, requiring further enhancement of flavour and appearance. Suitable combinations of flavouring essence and permissible colour were chosen with the aim of keeping the overall cost of the finished product to a minimum. Alternate to this would have been the

incorporation of the natural fruits, which would require additional studies in terms of their optimum levels of addition, effect of such levels on body & texture and shelf-life properties of the finished products, and finally, their impact on the overall cost. These have to be weighed against possible dividents to be earned from real fruit added products with a premium price. These aspects can be taken up when such products are considered for commercial exploitation.

In the tropical country as in India, many of our dairy milk based desserts involve considerable heat treatment such as the frying of "Gulabjamun" (in hot oil), or boiling of "Rasgulla" in syrup. Cheese cake also belongs to this category. Since such products undergo a final in-container heat treatment for setting (i.e. heat setting of the product after filling and sealing the container), post-processing contamination is eliminated and the product can be exposed to the atmosphere just before consumption. Such product is likely to ensure prolonged shelf-life and public health safety as indicated in our study.

In the final stage of heat setting in our study, the filled aluminium/stainless steel containers were not actually "sealed" by the stainless steel or aluminium foil, but the top of the containers were merely covered as tightly as possible. Even under such conditions of packaging , soybean cheese cakes could

be kept at the refrigeration temperature (4-10^{o}C) for more than three months. This seems to be an added advantage for soybean cheese cake, as prolonged shelf-life and public health safety is built into the manufacturing process through low pH (below 5), high sugar concentration (50 %), and terminal heat setting in a sealed container.

Another attractive feature of this product appears to be its easy adaptability both at the household level of preparation as well as commercial scale of manufacturing. The steps required for household preparation of cheese cake has already been outlined (Fig 4.2).

In the commercial scale, such product manufacturing could incorporate mechanisation to varying degrees on the basis of process steps outlined in Fig 6.1. Scope of such a mechanisation need not be fulfilled by designing production lines specifically for this, but by adapting various segments of manufacturing set ups that are already existing for several other products. In the industrial scale preparation of soymilk, conventional steps such as soaking, grinding, and filtering are already mechanised to varying degrees, by the commercial manufacturer of soybean products such as Tofu (Shurtleff and Aoyagi, 1979). The conversion of soymilk to lactic curd and the draining of the curd

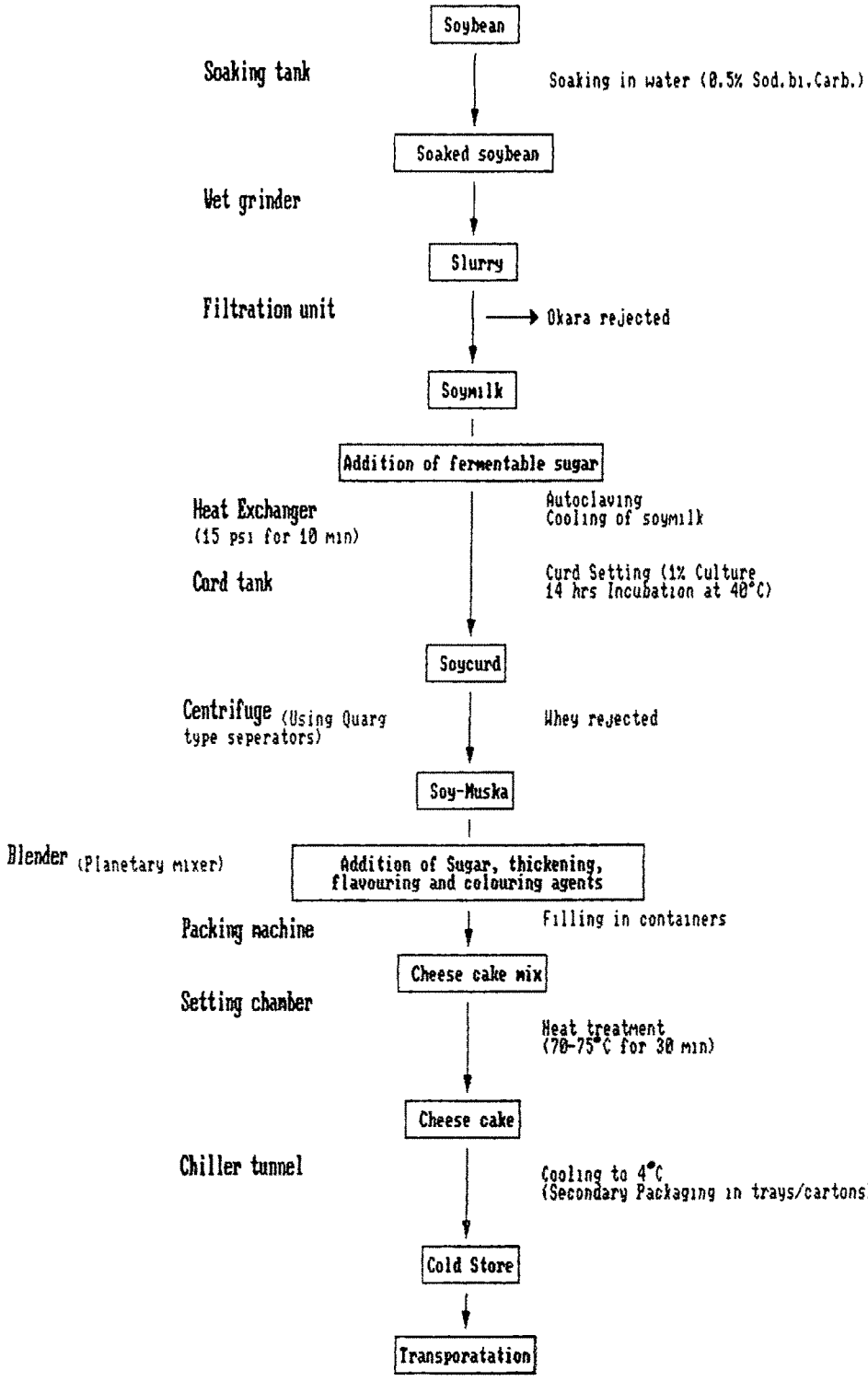

Fig. 6.1 Suggested setup for soybean cheese cake manufacture on an industrial scale

to obtain soy-muska are essentially similar to the muska preparation steps for shrikhand from dairy milk, which has also been mechanised in India (Aneja *et al.*, 1977). Prior to the heat setting treatment, mixing of additives with muska can be accomplished with the use of planetary mixers, blenders, homogenisers for semisolid or viscous products, in set ups typically used for mechanised shrikhand manufacture.

Mechanical filling devices already available for filling jams, jellies, mayonaise, yoghurt, processed cheese etc., could be used for packing the finished product in containers.Since the product requires to undergo the heat treatment, thicker guage aluminium foil or heat tolerant plastic containers made of polypropylene or other heat tolerant composite materials would be suitable for mechanised packaging of this product. Even in small scale establishments manual filling can be followed by weighing and sealing of individual cups. The sealed cups, coming out of mechanised filling lines or manual set up can be arranged for suitable tempering either in sets of trays placed in waterbaths in batches, or by running them through endless conveyers.

Exact choice of a set-up for the industrial scale preparation will ofcourse depend on commercial considerations of the size of operation, manufacturing cost and returns. Although

it is not possible to establish any realistic manufacturing cost at this stage ,it is possible to compare the relative cost of raw materials using dairy milk or soybean, on the basis of the ingredient cost, as summarised in Table 6. 1.

Table 6.1 Raw material cost of soy-based cheese cake

Ingredients	Quantity (g/kg)	Unit cost	Cost of cheese cake(Rs./kg)			
			Egg-based		Vegetarian	
		Rs/Kg.	Milk	Soy	Milk	Soy
Milk	1 ltr	14.00	14.00	-	14.00	-
Soybean	115	20.00	-	2.30	-	2.30
Sugar	400	14.00	4.20	4.20	4.20	4.20
Egg	200	1.50	5.00	5.00	-	-
Rice/Wheat/ Potato	25	10.00 3.50	-	-	0.50	0.50
Flavour	20 ml	11.00	11.00	11.00	11.00	11.00
Colour	2 ml	10.00	0.25	0.25	0.25	0.25
	Total	..	34.45	22.75	29.95	18.25

The soy based cheese cake per kg of final product works out to be Rs.22.75 with egg, Rs.18.25 with rice, wheat and potato compared to the cost of Rs 34.45 and 29.95 per kg for egg based and vegetarian cheese cake respectively, prepared using -

dairy milk. Eventhough, on equivalent total solids basis soybean total solids would cost about 1/5th the cost of dairy milk, relatively higher cost of other ingredients, particularly, added flavouring essences, sugar, and egg narrows down the cost difference of the total ingredients mix. However, the prices of various materials have been collected on an adhoc basis from the retail markets. Wholesale prices of the essences, colours etc., are expected to be lower than this as offered to the commercial establishments, on wholesale basis. Thus, the costing of the final product is tentative,and there is scope for further reduction in the cost of final product, when the manufacturing of cheese cake is considered at the industrial level. To the cost of raw materials, processing, marketing and investment costs are to be added depending on the scale of operation. As a consequence the final consumer price of soy-based products may not appear to be much different from that for the traditional dairy-based products. However such products may have particularly nutritional appeal on the basis of its low fat content (0.7 - 1.5 % as against 20 % for milk based cheese cakes), higher Poly Unsaturated Fatty Acid (PUFA) containing vegetable fats, and low lactose content (important in case of lactose intolerance). Therefore this type of soy products can be considered as a nutritional alternative to dairy milk products which are often in short supply.