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Estimating the consumer preference and cost of production of whey protein enriched milk chocolate for assessing the technological viability

Sandeep Singh and Sunil Kumar Khatkar

Abstract
The consumer preference and the cost of production were accessed by considering several technological factors and assumptions in mind to access the technological viability of developed whey protein enriched milk chocolate. A total number of 110 prospective consumers, representing either sex and of varying age groups, education level and income group from the faculty members, campus of GADVASU and PAU and common people of proximate areas were selected). In order to arrive at a realistic cost of processing and that of the end product, certain basic assumptions were assumed. It was observed that 26.36 per cent consumers rated the optimized product 'Liked Extremely' and the production cost was found much lower than currently available milk chocolate in the market (Rs. 65-80 per kg pack).

Keywords: Whey protein, chocolate, consumer response, COS estimation, overall acceptability

1. Introduction
The consumer awareness for healthy and functional foods increasing day-by-day therefore, the functional foods have taken a significant position in the global food market. Now a days, academia as well as industry are paying attention for the development of functional foods either by alteration of processes or by the addition of additional functional components. No doubt, the claims or quote of health benefits of any food are the key determinant factor for acceptance. Still, there are other factors which have significant positive and negative impact on the overall acceptability of the developed functional foods and the market viability of developed technology like the consumer response to the developed products and the production cost of the developed technology. Therefore, in the present study the developed whey protein enriched milk chocolate was accessed for its consumer preference and cost of production to find out technological viability and marketability of the developed product. The milk chocolate is a complex multiphase of particulate (sugar, cocoa, certain milk components) and continuous phases (cocoa butter, milk fat and emulsifiers) which is prepared with the process of refining, mixing, conching, tempering, moulding and packaging (Beckett 2009, Schantz and Rohm 2005) [3, 5]. In general, milk powder contributes 20% in the formulation of milk chocolate (Afoakwa *et al* 2008a, Lucisano *et al* 2006) [1, 6] and significantly responsible for organoleptic attributes, it's processing, melting behaviour, and rheological attributes (Taylor and Oliver 2009) [10]. Therefore, the addition of whey protein concentrate will also affect the same attributes being a milk component. Therefore, the impact analysis of addition of whey protein concentrate on the overall acceptability of the developed products w.r.t. Consumers point of view and its burden on the cost of the production need to evaluate to find out the technological feasibility of the developed product.

2. Materials & Methods
2.1 Materials
The skim milk powder, cocoa powder, cocoa butter, WPC (80%) and sugar were procured from local market of Ludhiana.

2.2 Milk Chocolate Preparation
The whey protein enriched milk chocolate was prepared as per the method described by Wan *et al.* (2014) with slight modification for standardization of levels of whey protein. The ingredients were homogenously mixed, conched and tempered with the standardized conditions after that the prepared chocolate mass were poured in 10 g chocolate mould and

kept for 30 min for shape stabilization. After that the chocolate samples were packed in aluminum foil (as resemblance to market replica) and stored at refrigeration temperature (7°C±1°C) till further consumer survey.

2.3 Consumer Survey

Consumer survey of whey protein enriched milk chocolate was done by offering optimized milk chocolate to total number of 110 prospective consumers, representing either sex and of varying age groups, education level and income group. Each and every consumer's response was recorded and analysed for the acceptability of the final product (Fig I).

2.4 Cost Analysis

The cost of production of whey protein enriched milk chocolate was estimated as per the guidelines of Peter and Timmerhang (1968) [7], Aneja *et al* (2012) [7], Gupta (2007) [4], Singh and Kalra (1975) [9] and Khatkar and Gupta (2011) [5]. In order to arrive at a realistic cost of processing and that of the end product, certain basic assumptions were assumed. Cost of the developed product was calculated for one batch (100 kg chocolate production), by taking into considerations all fixed and variable cost.

2.5 Statistical Analysis

The data obtained from the various experiments during experimental work were analyzed for overall mean and standard deviation, wherever required, using Microsoft Excel (Microsoft office 2010).

Name of the Product: Whey Protein Enriched Milk Chocolate

Name : _____ Educational status : _____

Occupation : _____ Age : _____

Sex: ☐ Male ☐ Female

Family Income: ☐ < 1.5 lakh ☐ 1.5-5.0 lakh ☐ >5.0 lakh

1. When you buy some eatables(chocolate), then you give more importance to
   - ▫ Health/ Taste/ Price
2. Did you like this milk chocolate (serving approx 10-11% protein /10g or a cube)
   - ▫ Yes/ No
3. If yes, degree of liking
   - ▫ Like extremely
   - ▫ Like very much
   - ▫ Like moderately
   - ▫ Like slightly
4. If available in market then would you like to buy this product
   - ▫ Yes/ No
5. If yes, then at what price would you like to buy this product (Rs./30gm)
   - ▫ 30
   - ▫ 40
   - ▫ 50
6. Any Suggestion/ remarks for this product

_____

Signature (With time)

Fig 1: Performa for consumer survey

3. Results and Discussion

3.1 Consumer acceptability studies of whey protein enriched milk chocolate

Consumer acceptability of any newly developed food product is one of the key parameter to be taken under consideration for exploring the potential marketability of the product. Consumer acceptance studies thus play important role in decision making for the launch of a newly developed product in the market. In present study to evaluate the potential of the developed protein enriched milk chocolate for marketability a pilot consumer study was conducted. For consumer study optimised milk chocolate was prepared as per the procedure standardised in laboratory. A total number of 110 prospective consumers, representing either sex and of varying age groups, education level and income group from the faculty members, campus of GADVASU and PAU and common people of proximate areas were selected. The consumer's response/ comments were recorded on a predefined Performa supplied along with the sample (Fig. 1). The results are presented in Table 1.

Table 1: Frequency distribution of consumer acceptance (preference) of the milk protein enriched milk chocolate

	Number of consumer	Degree of Liking			
		Like extremely	Like very much	Like moderately	Didn't like
Protein enriched milk chocolate	110	29	61	15	5
Percent of total respondents	100	26.36	55.45	13.63	4.54

It is evident from the Fig. 2 that out of total people who participated in the consumer study, 26.36 per cent of them rated the product 'Liked extremely' while 55.45 per cent rated it as 'Liked very much' and 13.63 per cent rated as 'Liked moderately'. Out of 110 consumers, only 5 consumers disliked the product and provided the fact that they don't like

eating high sugar products. So it was the mind-set of the consumers which didn't allow them to provide good sensory scores. However, consumers from all age groups liked the product very much (Fig. 3) which means that a satisfactory performance for the product was obtained and therefore, it is safe to conclude that the developed protein enriched chocolate has potential for wider marketability.

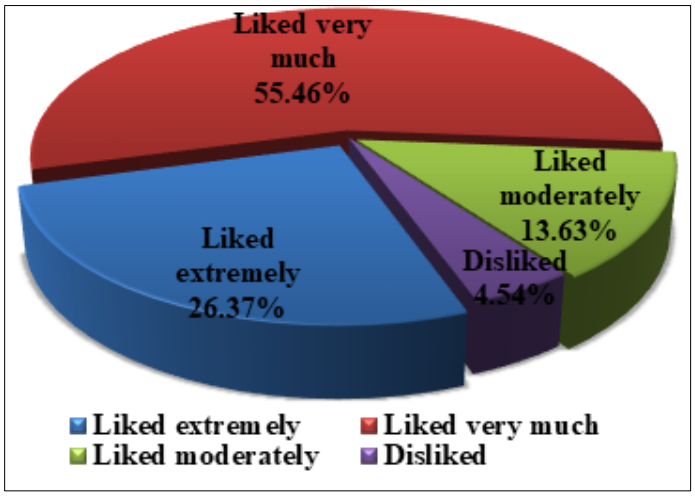

Fig 2: Consumer response for optimized milk protein enriched chocolate

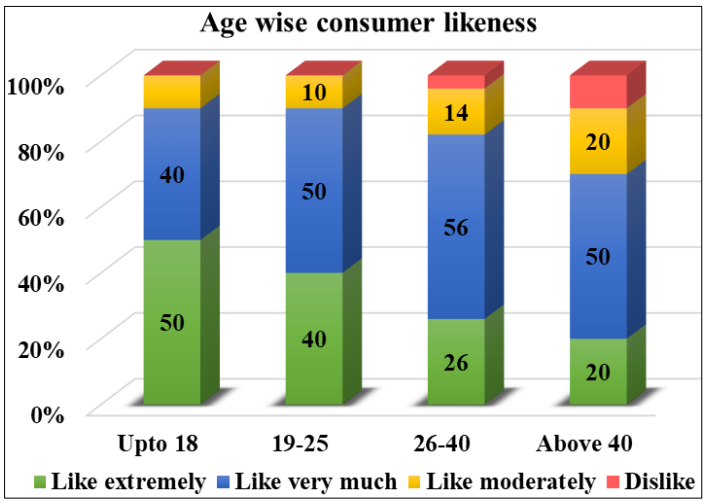

Fig 3: Degree of liking based on different age groups for milk protein enriched chocolate

3.2 Total cost estimation of the developed product

The success of a new product exists on the economic feasibility of manufacturing process. Having established the technology for preparing whey protein enriched milk chocolate, the next logical step would be to estimate its total cost. For this purpose, earlier cost and operational data of cottage dairy plant have been utilized with some modification (Khatkar and Gupta, 2011) [5].

3.2.1 Basic Assumption for Total Cost of Optimized Product

Following assumptions were made for estimating the total cost of estimation of total cost of whey protein enriched milk chocolate:

- Milk chocolate would be manufactured under semi urban area based cottage plant with chocolate handling capacity: 100 Kg/day.
- Schedule for milk chocolate production plant: 300 days/year.
- Skim milk powder, whey protein concentrate, cocoa powder, cocoa butter and sugar were procured @ Rs. 250/ Kg, Rs. 1000/Kg, Rs. 1000/Kg, Rs. 900/Kg and Rs. 35/ Kg, respectively.
- Formulation and production of standardized product would be done as per the final optimized process.
- Handling losses of 0.5% and 1% of optimized whey protein enriched milk chocolate and packaging materials, respectively, were assumed.

The detailed costing is mentioned in 3.2.2 and supported by table 2 - 7.

3.2.2 Detailed breakup of total cost for preparation of optimized Milk chocolate

The requirement in terms of building and equipments and their approximate costs at current rates, along with the annual depreciation, are presented underneath in tabular form. The detailed break-up cost of optimized product has been calculated as in Tables 2 and 3. The estimated total cost per 60 g pack of optimized product was estimated to be about Rs. 48.36 and by including 15% profit margin the optimized product market selling price was estimated Rs. 55.614. As such, the cost of these products is much lower than currently available milk chocolate samples in the market (Rs. 65 per 60g pack).

Table 2: Manufacturing cost of the product

S. No		Cost Component	Rates	Rs. per annum
		Manufacturing Cost		
	a	**Direct Product Cost**		
	i	Raw materials	Table 4	15851265.00
	ii	Packaging material Annual requirement for 497500 units of 60 g with 1% extra as losses	Table 4	209409.00
	iii	Manpower Cost	Table 5	912000.00
A	iv	Power and utilities	Table 5	72120.00
	v	Maintenance and repairs	5% of the fixed capital	79800.00
	vi	Laboratory Charges	0.2% of cost of raw material	31702.53
	vii	Contingencies and Consultancy Charges	1% of cost of raw material	158512.65
	viii	Cleaning and sanitizing material	0.1% of cost of raw material	15851.27
		Sub-total		17330660.45
	b	**Fixed charges**		
	i	Interest on total fix capital and working capital	12% of Total Fixed Capital	2271199.00
	ii	Depreciation on capital investment	Table 7	83771.00
	iii	Insurance and taxes	2% of the capital investment	191520.00
	iv	Plant overheads	1% of Direct Product Cost	173306.60
Sub-total (b)				2719796.60
Manufacturing Cost (A = a + b)				20050457.05

Table 3: Marketing and distribution cost

C	Marketing And Distribution			
	I	Marketing and distribution	20% of Manufacturing Cost	4010091.41
	Total			473922.38
	Total Cost (Rs.) per annum (A + B)			2369611.88
Cost (Rs.) of Whey Protein Enriched Milk Chocolate (per Kg: 29850) Rs.				806.05
Total cost (Rs.) per 60 g (497500 packet)				48.36
Sale Price		With @15% Profit		55.614

Table 4: Requirement and cost of raw materials

		Requirement (Kg)		Rate	Annual Cost
S. No.	**Item**	**Daily**	**Annual**	**(Rs/Kg)**	**(Rs)**
1	Skim Milk Powder	9.12	2736	250	684000
2	Whey Protein Concentrate	8.85	2655	1000	2655000
3	Sugar	38.33	11499	35	402465
4	Cocoa Butter	33.34	10002	900	9001800
5	Cocoa Powder	10.36	3108	1000	3108000
6	Packaging Material				209409
Total					15851265
	Total Product	100	30000		
	Losses (@0.5%)	99.5	29850	29850000	In grams
	Bricks (60 g)		In Number	497500	

Table 5: Details of manpower cost

S. No	Staff	Nos.	Monthly Salary	Monthly Cost (total Rs.)	Annual Cost (Rs)
Operating Labourers					
1	Labourers	3	9000	27000	324000
2	Skilled worker	1	12000	12000	144000
3	Plant Manager	1	20000	20000	240000
4	Store Keeper-Cum-Accountant	1	12000	12000	144000
5	Security staff	1	5000	5000	60000
	Sub Total (A)			76000	912000

Table 6: Details of charges on power and utilities

		Requirement		Rate	Annual Cost
S. No.	**Item**	**Daily**	**Annual**	**(Rs)**	**(Rs)**
1	Electricity (kWh)	30	9000	8 / Unit	72000
2	Water	200	60000	3 / 1000 L	120
Total					72120

Table 7: Initial costs and depreciation on plant, equipment and machinery

S. No.	Item	NOS	Rate (Rs)	Initial Value (Rs)	Scrap Value (Rs)	Life (Yrs)	Annual Depreciation	Capacity
1	Roller Mill	1	150000	150000	15000	17	7941	Medium
2	Concher	1	500000	500000	50000	15	30000	25 L/hr
3	Multipurpose holding vat with agitator	1	50000	50000	5000	15	3000	100 L
4	Tempering Unit	1	100000	100000	10000	30	3000	50 Kg/hr
5	Cold Store (1) & Refrigeration (2) system	1	500000	500000	50000	17	26471	Medium
6	Molding Unit	2	50000	100000	10000	12	7500	50 Kg/hr
7	Weighing balance	1	20000	20000	2000	17	1059	100 Kg
8	Packaging Unit (Batch Type)	1	50000	50000	5000	15	3000	
9	Miscellaneous	-	30000	30000	3000	15	1800	
Total				1500000			83771	
10	Rent Charges	12	8000	96000				
Total Fixed Investment				1596000				

4. Summary and Conclusion

The present study was undertaken to evaluate the response of consumers on the overall acceptability of the whey protein enriched milk chocolate. It was observed that out of 110 consumers, 26.36 per cent rated the product 'Liked extremely' while 55.45 per cent rated it as 'Liked very much' and 13.63 per cent rated as 'Liked moderately' and only 5 consumers disliked the product. Thus, it can be concluded that product has good market viability and scope. The estimated total costs and selling price per 60g pack of optimized product were estimated to be about Rs. 48.36 and Rs. 55.61, respectively. As such, the cost of these products is much lower than currently available milk chocolate in the market (Rs. 65-80 per kg pack).

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