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ORIGINAL ARTICLE

A study on techno-economic feasibility for production of parboiled rice based extrudates through single screw extruder

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ABSTRACT
The techno- economic feasibility of preparation of ready to eat extrudates from the best blend raw materials (parboiled rice, bitter-gourd, water chestnut and skim milk powder) with the blend ratio of 80:12:6:2 was estimated in this study. To estimate the techno- economic feasibility, three economic parameters (break even volume/ quantity, break even sale and break even period) were analysed. From this break even analysis it was found that in order to produce 15, 00,000 units of 20 gram packets of ready to eat extruded snacks prepared from the parboiled rice, bitter-gourd, water chestnut and skim milk powder in the blend ratio of 80: 12:6:2, the break even quantity was 12, 16, 229 units and break even sales was 12, 16, 2290 /- and break even period was 328 days (10.8 months).This study helps in commercial production of extruded snacks.
Keywords: *Extrusion cooking, Techno-economic feasibility, Break even analysis, Parboiled rice, Bitter-gourd*

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INTRODUCTION

Extrusion cooking technology is very much popular among snack food processing industries. Different types of highly expanded, low density, attractive and marketable ready to eat extruded snacks can be formulated by this technology. It is versatile, handy, low cost technology by which high productivity achieves [4]. It is high temperature short time (HTST) cooking process. There are various types of extruded snacks available in the market. According to food extrusion market, the proposed value of worth 68.38 billion USD reached by the extruded food products and equipment by 2022 [5]. The material, energy and money are quite essential component for the production of any finished product. Therefore, it is necessary to optimize the technical and economic viability of extrusion cooking [3]. It can be evaluated by break even analysis. The main purpose of break-even analysis is to determine the minimum output that must be exceeded for a business to profit. It is one of the simplest analytical tools. It is very useful for marketing department which help to increase the sales and achieve financial goals to marketers by providing useful data [1]. Therefore, the main aim of this study is to analyze the techno-economic feasibility of the commercial production of extrudates prepared from parboiled rice, bitter-gourd, water chestnut and skim milk powder by break even analysis.

MATERIAL AND METHODS

The extrudates were produced by using the raw materials such as parboiled rice, bitter-gourd, water chestnut and skim milk powder with the best blend ratio of 80:12:6:2 in Brabender single screw extruder (laboratory model). Numbers of unit operations were performed during preparation of extruded snacks such as grinding of raw materials, drying, conditioning, extrusion-cooking, spicing and packaging. Techno-economic feasibility of production of ready to eat extrudates from this blend of raw materials, three economic parameters (break even volume/ quantity, break even sale and break even period) were analysed by the following formulae [2]:

$$\text{Break Even Quantity} = \frac{\text{Fixed Costs}}{(\text{Selling price per unit} - \text{Variable cost per unit})} \quad \text{.....Eq. (1)}$$

$$\text{Break Even Sale} = \frac{\text{Fixed Costs X Selling price per unit}}{(\text{Selling price per unit} - \text{Variable cost per unit})} \quad \text{.....Eq. (2)}$$

$$\text{Break Even Period} = \frac{\text{Break even Sale}}{\text{Total number of units produced per month}} \quad \text{.....Eq. (3)}$$

RESULTS AND DISCUSSION

Break Even Analysis

The economics of preparation of ready to eat extrudates from the best blend flour of parboiled rice, bitter-gourd, water chestnut and skim milk powder with the blend ratio of 80:12:6:2 was analysed. The selling cost of one unit of 20 gram was fixed as Rs. 10/-.

Following assumptions for calculating break even analysis were taken as given below:

A. Fixed Capital

Table1: Cost of machines and equipments:

S. No.	Machine/Equipment	Cost (Rs.)
1.	Food extruder with accessories	22,00,000
2.	Hammer Mill	25,000
3.	Automatic Pouch Packaging Machine (total quantity3, @ Rs. 12,00,000 each) Cost inclusive of freight, Installation & Commissioning, taxes, duty and insurance charges.	38,00,000
4.	Moisture Tester	50,000
5.	Weighing Balance	30,000
6.	Furniture	30,000
7.	Containers for raw materials and finished product	35,000
8.	Crates	25,000
9.	Slicers and Blender	7,000
10.	Sieve Set	12,000
11.	Miscellaneous	15,000
Total		62,29,000

Table 2: Cost of land and buildings:

S. No.	Item	Cost (Rs.)
1.	Land area 600 sq. ft. @ Rs. 550 per sq. ft.	3,30,000
2.	Construction cost @ Rs. 1600 per sq. ft.	9,60,000
Total		9,93,000
Total fixed cost (per month)	= 62, 29,000 + 9, 93,000	
	= 72, 22,000	

Assumptions

- Useful life of machine: 10 years
- Useful life of building: 20 years
- Salvage values (depreciation) on per annum: 10% of initial cost
- Rate of interest per annum: 12%

$$\text{Depreciation of machines per year} = \frac{\text{Fixed cost of machine (C)} - \text{Salvage Value(S)}}{\text{Useful life of machine (L)}}$$

$$= \frac{62,29,000 - 6,22,900}{10}$$

= 5, 60,610 /-

1. Depreciation of land and building per year $= \frac{9,93,000}{20}$

   = 49,650 /-

2. Total depreciation per year = 5, 60,610 + 49,650

   = 6, 10,260

3. Interest @12 % per year $= \frac{(6,10,260\ X\ 12)}{100}$

   = 73,231.20 /-

4. Total Fixed Cost = 72, 22,000 + 6, 10,260 + 73,231.2

   = 79, 054, 91.20 /-

B. Variable Cost:

S. No.	Items	Cost (Rs.) per month
1.	Labour Charges	
a.	Manager/Supervisor (01)	25000 /-
b.	Operator (01)	12,000 /-
c.	Helper (01)	8,000 /-
d.	Security guard (01)	5,000 /-
	Total	50,000 /-
2.	Raw Materials required per month	
a.	Parboiled rice (30,000 kg x 0.80 part x @ Rs. 40 per kg)	960000
b.	Bitter-gourd (30,000 kg x 0.12 part x @ Rs. 80 per kg)	288000
c.	Water chestnut (30,000 kg x 0.06 part x @ Rs. 50 per kg)	90000
d.	Skim milk powder (30,000 kg x 0.02 part x @ Rs. 250 per kg)	150000
	Total	1488000
3.	Spices @2% @ Rs. 400 per kg	2,40,000
4.	Electricity charges (1500 kWh@Rs.10/kWh)	15,000
5.	Packaging material @ 1Rs./packet (15,00,000 x 1)	15,00,000
6.	Repair and maintenance @ 10% of machine cost	62,29,00
7.	Transport charges (To and fro)	5000
8.	Miscellaneous expenses	2000
9.	Insurance charges @ 10% of total fixed cost	68,349.12
	Total	3,991,249.12

The cost of production, break even quantity, break even sales and break even period:

Assumption for cost of production, break even analysis

- Capacity: 100 kg raw materials per hour
- Working hours in one shift :10
- Number of shifts: One
- Number of working days in a month: 26
- Selling price per unit (20 gm of one unit): Rs.10/-

Total installed capacity of unit in terms of kg of materials: 30,000 kg

Size of one unit: 20 g

Therefore,

Total no. of units per month $= \frac{30,000 \text{ x } 1000}{20}$

= 15, 00,000

Assuming the unit to operate at 75% of installed capacity:

Total number of units produced per month

= 0.75 x 15, 00,000

= 11, 25,000

Variable cost per unit $= \frac{3991249.12}{1125000}$

= 3.5 /-

$$Break\ Even\ Quantity = \frac{Fixed\ Costs}{(Selling\ price\ per\ unit - Variable\ cost\ per\ unit)}$$

$$Break\ Even\ Quantity = \frac{79,054,91.20}{(10 - 3.5)}$$

= 12, 16,229.42 units of 20 g each

(Approx. 12, 16,229 units)

$$Break\ Even\ Sale = \frac{Fixed\ Costs\ X\ Selling\ price\ per\ unit}{(Selling\ price\ per\ unit - Variable\ cost\ per\ unit)}$$

$$Break\ Even\ Sale = \frac{79,054,91.20\ X\ 10}{(10 - 3.5)}$$

= 12, 16, 2290 /-

$$Break\ Even\ Period = \frac{Break\ even\ sale}{Total\ number\ of\ units\ produced\ per\ month}$$

$$= \frac{12,16,2290}{11,25,000} =$$

328 days (10.8 months)

CONCLUSION

The techno- economic feasibility of preparation of ready to eat extrudates from the best blend flour of parboiled rice, bitter-gourd, water chestnut and skim milk powder with the blend ratio of 80:12:6:2 was analysed by break even analysis and the break even quantity: 12, 16,229 units of 20 g each, break even sales: 12, 16, 2290 /- and break even period: 10.8 months were observed from this study.

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Conflict of Interest: None declared

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