Appendices

APPENDIX A

Appendix 1. Analysis of Variance (ANOVA) for Capacity

Source	Sum of Squares	Df	Mean Square	F-value	p-value	
Model	1508.24	9	167.58	14.66	0.0009	significant
A- Flow rate of chocolate	50.00	1	50.00	4.38	0.0748	
B-Belt speed	1250.00	1	1250.00	109.38	< 0.0001	
C- Flow rate of hot air	50.00	1	50.00	4.38	0.0748	
AB	25.00	1	25.00	2.19	0.1827	
AC	25.00	1	25.00	2.19	0.1827	
BC	25.00	1	25.00	2.19	0.1827	
A^2	31.84	1	31.84	2.79	0.1390	
B^2	21.32	1	21.32	1.87	0.2143	
C^2	31.84	1	31.84	2.79	0.1390	
Residual	80.00	7	11.43			
Lack of Fit	0.0000	3	0.0000	0.0000	1.0000	not significant
Pure Error	80.00	4	20.00			
Cor Total	1588.24	16				

Std. Dev.	3.38	**R^2**	0.9496
Mean	176.47	**Adjusted R^2**	0.8849
C.V. %	1.92	**Predicted R^2**	0.9213
		Adequate Precision	11.5704

Appendix 2. Analysis of Variance (ANOVA) for Enrobing efficiency

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	443.71	9	49.30	7.83	0.0064	Significant
A- Flow rate of chocolate	153.13	1	153.13	24.33	0.0017	
B- Belt speed	128.00	1	128.00	20.34	0.0028	
C- Flow rate of hot air	0.1250	1	0.1250	0.0199	0.8919	
AB	9.00	1	9.00	1.43	0.2707	
AC	6.25	1	6.25	0.9932	0.3522	
BC	9.00	1	9.00	1.43	0.2707	
A^2	138.00	1	138.00	21.93	0.0023	
B^2	1.16	1	1.16	0.1844	0.6805	
C^2	0.3184	1	0.3184	0.0506	0.8284	
Residual	44.05	7	6.29			
Lack of Fit	15.25	3	5.08	0.7060	0.5965	not significant
Pure Error	28.80	4	7.20			
Cor Total	487.76	16				
Std. Dev.	2.51				**R^2**	0.9097
Mean	92.88				**Adjusted R^2**	0.7936
C.V. %	2.70				**Predicted R^2**	0.4075
					Adequate Precision	9.4856

Appendix 3. Analysis of Variance (ANOVA) for Energy requirement

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	0.0841	9	0.0093	11.74	0.0019	Significant
A- Flow rate of chocolate	0.0001	1	0.0001	0.1413	0.7182	
B- Belt speed	0.0010	1	0.0010	1.27	0.2967	
C- Flow rate of hot air	0.0012	1	0.0012	1.57	0.2505	
AB	0.0002	1	0.0002	0.2825	0.6115	
AC	0.0361	1	0.0361	45.33	0.0003	
BC	0.0049	1	0.0049	6.15	0.0422	
A^2	0.0003	1	0.0003	0.4048	0.5449	
B^2	0.0390	1	0.0390	48.98	0.0002	
C^2	0.0008	1	0.0008	0.9995	0.3507	
Residual	0.0056	7	0.0008			
Lack of Fit	0.0044	3	0.0015	4.86	0.0804	not significant
Pure Error	0.0012	4	0.0003			
Cor Total	0.0897	16				
Std. Dev.	0.0282			**R^2**		0.9379
Mean	5.48			**Adjusted R^2**		0.8579
C.V. %	0.5148			**Predicted R^2**		0.1988
				Adequate Precision		12.7053

Appendix 4. Analysis of Variance (ANOVA) for Coating thickness

Source	**Sum of Squares**	**df**	**Mean Square**	**F-value**	**p-value**	
Model	2.05	9	0.2281	7.01	0.0089	Significant
A- Flow rate of chocolate	1.37	1	1.37	42.06	0.0003	
B- Belt speed	0.0050	1	0.0050	0.1536	0.7068	
C- Flow rate of hot air	0.1485	1	0.1485	4.56	0.0701	
AB	0.0225	1	0.0225	0.6911	0.4332	
AC	0.0702	1	0.0702	2.16	0.1854	
BC	0.0009	1	0.0009	0.0276	0.8727	
A^2	0.2951	1	0.2951	9.06	0.0196	
B^2	0.0489	1	0.0489	1.50	0.2601	
C^2	0.1150	1	0.1150	3.53	0.1023	
Residual	0.2279	7	0.0326			
Lack of Fit	0.0364	3	0.0121	0.2536	0.8556	not significant
Pure Error	0.1915	4	0.0479			
Cor Total	2.28	16				

Std. Dev.	0.1804	**R^2**	0.9001
Mean	2.48	**Adjusted R^2**	0.7716
C.V. %	7.29	**Predicted R^2**	0.6133
		Adequate Precision	8.8970

APPENDIX B

Score card for sensory evaluation

SENSORY SCORE CARD

Department of Processing and Food Engineering,

KCAEFT, Tavanur

Name of the judge: **Date:**

You are requested to assess the product in terms of general acceptability on a 9-point hedonic scale.

Characteristics	Sample A	Sample B	Sample C	Sample D
Appearance				
Colour				
Taste				
Flavour				
Crispiness				
Overall acceptability				

Nine point Hedonic Scale

Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

Comments if any :

Signature :

APPENDIX C

Cost Economic of chocolate enrobing machine

Capacity of chocolate enrobing machine = 190 cookies/hour

Life span of chocolate enrobing machine = 10 years

Annual usage = 200 days

Daily usage = 8 hours (3 h for melting and 5 h for enrobing)

Interest rate = 12 % per annum

Total cost of equipment = Rs. 3,35,000

A) Fixed cost

i) Fixed cost of equipment $= \frac{i(i+1)^n}{(i+1)^n+1} \times 3{,}35{,}000$

$= \frac{(0.12)(0.12+1)^{10}}{(0.12+1)^{10}+1} \times 3{,}35{,}000$

$= \frac{0.3727}{4.1058} \times 3{,}35{,}000$

= Rs. 30,410

ii) Housing charge = Rs. 150/month

Housing charges/year = Rs.1,800/year

Total fixed cost/year = Rs. 30,410+ 1,800

= Rs. 32210/ year

B) Variable cost

i) Repair and maintenance, 2 % = Rs. 3,35,000× 2/100

= Rs.6700 /year

ii) Labour cost

Labour cost per day = Rs.800

Number of labours = 3

Total labour cost = Rs. 800×3 x 200

= Rs. 4,80,000 / year

iii) Power consumption

Power consumption/day = 15.33 KWh

Power consumption/year = 15.33 × 200

= 3,066 KWh

Cost of 1 KWh = Rs.8.00

= 3,066 × 8

= Rs. 24,528 / year

Total variable cost = Rs. 6,700 + Rs. 4,80,000 + Rs.24,528

= Rs. 5,11,228 / year

Operating cost of chocolate enrobing machine = Fixed cost + variable cost

= 32,210 + 5,11,228

= Rs. 5,43,438/ year

= Rs. 2,717/ day

= Rs. 340 / hour

1.1. Benefit – cost ratio

1.1.1. Assumptions

Cost of chocolate per kilogram = Rs. 690

Cost of cookies = Rs. 2.5/ cookie

Machine working hours per day = 8 h (3 h for melting and 5 h for enrobing)

Machine working days per year = 200 days

Selling price of chocolate enrobed cookies = Rs. 15/cookie

1.1.2. Actual performance of the machine

Operating cost of machine per hour = Rs. 340

Actual capacity of machine = 190 cookies/hour

1.1.3 Calculation

Cost of chocolate per hour = Rs. 690 × 2.5 kg/hour

= Rs. 1,725

Cost of chocolate per year = Rs. 1,725 × 5 hours × 200 days

= Rs. 17,25,000

Cost of cookies per hour = Rs. 2.5 × 190 cookies/hour

= Rs. 475/-

Cost of cookies per year = Rs. 475 ×5 hours × 200 days

= Rs. 4,75,000

Cost of raw material per year = Rs. 17,25,000 + Rs. 4,75,000

= Rs. 22,00,000

Actual operating cost of machine per year = 340 ×8×200

= Rs. 5,44,000

Number of chocolate enrobed cookies produced per year = 190 × 5 ×200

= 1,90,000 cookies

Total cost of obtained chocolate enrobed cookies per year (gross income) = Rs.15× 1,90,000

= Rs. 28,50,000

Net income = (Total gross income – Actual processing cost)

= 28,50,000 – 5,44,000

= Rs. 23,06,000

Benefit – cost ratio $= \frac{\text{Net income}}{\text{Actual cost of raw material per year}}$

$= \frac{23,06,000}{22,00,000}$

= 1.05:1

2. Payback period

Cost of equipment = Rs. 3,35,000

Cost of raw material for chocolate enrobed cookies production = Rs. 22,00,000

Labor charge per year = Rs. 4,80,000

Interest rate = 12 % per annum

Net income = (Total gross income – Actual processing cost)

= 28,50,000 – 5,44,000

= Rs. 23,06,000

Investment required for a project Payback period = (3,35,000+22,00,000+4,80,000)+12% (3,35,000+22,00,000+4,80,000)

= 30,15,000 + 3,61,800

= Rs. 33,76,800

Net annual cash inflow = Investment required for a project – Net income

= 33,76,800 - 23,06,000

= Rs. 10,70,800

Payback period = $\frac{\text{Investment required for a project}}{\text{Net annual cash inflow}}$

= $\frac{33,76,800}{10,70,800}$

= 3.15 years