APPENDICES

APPENDIX - A

Appendix A.1 Analysis of variance (ANOVA) for moisture content

(Ultrasound pretreatment :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	141.90	5	28.38	20.38	0.005	significant
A - Sonication time	34.08	1	34.08	24.47	0.0017	
B - Temperature	66.15	1	66.15	47.49	0.0002	
AB	11.39	1	11.39	8.18	0.0243	
A^2	0.0910	1	0.0910	0.0653	0.8056	
B^2	29.25	1	29.25	21.00	0.0025	
Residual	9.75	7	1.39			
Lack of fit	9.75	3	3.25	8122.99	<0.0001	significant
Pure Error	0.0016	4	0.0004			
Cor total	151.65	12				
Std Dev.	1.18	**R^2**	0.9357			
Mean	79.47	**Adj R^2**	0.8898			
C.V%	1.49	**Pred R^2**	0.5429			
		Adequate precision	14.6063			

Appendix A.2 Analysis of variance (ANOVA) for water activity

(Ultrasound pretreatment :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	0.0002	5	0.0000	23.95	0.0003	Significant
A - Sonication time	4.500E-06	1	4.500E-06	3.48	0.1045	
B - Temperature	0.0001	1	0.0001	52.50	0.0002	
AB	1.00E-06	1	1.00E-06	0.7727	0.4085	
A^2	1.087E-07	1	1.087E-07	0.0840	0.7804	
B^2	0.0001	1	0.0001	61.23	0.0001	
Residual	9.059E-06	7	3.020E-06			
Lack of fit	9.059E-06	3	0.0000			
Pure Error	0.0000	4				
Cor total	0.0002	12				
Std Dev.	0.0011	**R^2**	0.9448			
Mean	0.9840	**Adj R^2**	0.9053			
C.V%	0.1156	**Pred R^2**	0.6072			
		Adequate precision	15.7625			

Appendix A.3 Analysis of variance (ANOVA) for antioxidant activity

(Ultrasound pretreatment :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	38.90	5	7.78	9.53	0.005	significant
A - Sonication time	27.33	1	27.33	33.49	0.0007	
B - Temperature	2.18	1	2.18	2.67	0.1462	
AB	0.0064	1	0.0064	0.0078	0.9319	
A^2	3.64	1	3.64	4.46	0.0727	
B^2	4.53	1	4.53	5.55	0.0506	
Residual	5.71	7	0.8519			
Lack of fit	5.71	3	1.90	8275.98	<0.0001	significant
Pure Error	0.0009	4	0.0002			
Cor total	44.61	12				
Std Dev.	0.9033	**R^2**	0.8720			
Mean	71.28	**Adj R^2**	0.7805			
C.V%	1.27	**Pred R^2**	0.0897			
		Adequate precision	10.5497			

Appendix A.4 Analysis of variance (ANOVA) for vitamin C

(Ultrasound pretreatment :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	11319.3	5	2263.86	13.40	0.0018	significant
A - Sonication time	7598.64	1	7598.64	44.98	0.0003	
B - Temperature	546.54	1	546.54	3.23	0.1151	
AB	26.01	1	26.01	0.1540	0.7065	
A^2	88.91	1	88.91	0.5262	0.4917	
B^2	2873.78	1	2873.78	17.01	0.0044	
Residual	1182.65	7	168.95			
Lack of fit	1182.65	3	393.88	1575.53	<0.0001	significant
Pure Error	1.0000	4	0.2500			
Cor total	12501.95	12				
Std Dev.	13.00	**R^2**	0.9054			
Mean	242.69	**Adj R^2**	0.8378			
C.V%	5.36	**Pred R^2**	0.3278			
		Adequate precision	12.3572			

Appendix A.5 Analysis of variance (ANOVA) for L*value

(Ultrasound pretreatment :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	29.46	5	5.89	7.94	0.0084	significant
A - Sonication time	1.26	1	1.26	1.70	0.2336	
B - Temperature	6.08	1	6.08	8.19	0.0242	
AB	6.00	1	6.00	8.09	0.0249	
A^2	2.08	1	2.08	2.81	0.1377	
B^2	15.23	1	15.23	20.53	0.0027	
Residual	5.19	7	0.7418			
Lack of fit	5.14	3	1.71	142.07	0.0002	significant
Pure Error	0.0483	4	0.0121			
Cor total	34.65	12				
Std Dev.	0.8613	**R^2**	0.8501			
Mean	36.86	**Adj R^2**	0.7431			
C.V%	2.34	**Pred R^2**	-0.0579			
		Adequate precision	79622			

Appendix A.6 Analysis of variance (ANOVA) for a* value

(Ultrasound pretreatment :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	4.97	5	0.9939	13.40	0.3058	Not significant
A - Sonication time	0.5348	1	0.5348	44.98	0.4012	
B - Temperature	1.97	1	1.97	3.23	0.1301	
AB	0.8836	1	0.8836	0.1540	0.2884	
A^2	0.7118	1	0.7118	0.5262	0.3368	
B^2	1.07	1	1.07	17.01	0.2464	
Residual	4.69	7	0.6696			
Lack of fit	4.60	3	1.53	71.74	0.0006	significant
Pure Error	0.0855	4	0.0214			
Cor total	9.66	12				
Std Dev.	0.8183	**R^2**	0.5146			
Mean	-11.91	**Adj R^2**	0.1679			
C.V%	6.87	**Pred R^2**	-2.4023			
		Adequate precision	3.5957			

Appendix A.7 Analysis of variance (ANOVA) for b* value

(Ultrasound pretreatment :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	43.92	5	8.78	3.50	0.0666	Not significant
A - Sonication time	7.55	1	7.55	3.01	0.1266	
B - Temperature	16.14	1	16.14	6.42	0.0390	
AB	13.91	1	13.91	5.54	0.508	
A^2	2.65	1	2.65	1.06	0.3382	
B^2	4.45	1	4.45	1.77	0.2247	
Residual	17.58	7	2.51			
Lack of fit	0.0411	3	5.85	568.81	<0.0001	significant
Pure Error	61.50	4	0.103			
Cor total		12				
Std Dev.	1.58	**R^2**	0.7141			
Mean	22.54	**Adj R^2**	0.5099			
C.V%	7.03	**Pred R^2**	-1.0294			
		Adequate precision	6.1022			

Appendix A.8 Analysis of variance (ANOVA) for moisture content

(Ultrasound pretreatment :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	14.74	5	2.95	13.45	0.0018	significant
A - Sonication time	5.93	1	5.93	27.05	0.0013	
B - Temperature	5.50	1	5.50	25.12	0.0015	
AB	2.03	1	2.03	9.27	0.0187	
A^2	0.8364	1	0.8364	3.82	0.0916	
B^2	0.6023	1	0.6023	2.75	0.1413	
Residual	1.53	7	0.2191			
Lack of fit	1.53	3	0.5093	356.18	<0.0001	significant
Pure Error	0.0057	4	0.0014			
Cor total	16.27	12				
Std Dev.	0.4681	**R^2**	0.9057			
Mean	89.86	**Adj R^2**	0.8384			
C.V%	0.5209	**Pred R^2**	0.3316			
		Adequate precision	11.4090			

Appendix A.9 Analysis of variance (ANOVA) for water activity

(Ultrasound pretreatment :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	9.440E-06	5	1.888E-06	2.71	0.1127	Not significant
A - Sonication time	5.000E-07	1	5.000E-07	0.7190	0.4245	
B - Temperature	1.457E-06	1	1.457E-06	2.10	0.1910	
AB	1.000E-06	1	1.000E-06	1.44	0.2695	
A^2	1.653E-06	1	1.653E-06	2.38	0.1670	
B^2	4.045E-06	1	4.045E-06	5.82	0.0467	
Residual	4.868E-06	7	6.954E-07			
Lack of fit	1.668E-06	3	5.560E-07	0.6950	0.6017	Not significant
Pure Error	3.200E-06	4	8.000E-07			
Cor total	0.0000	12				
Std Dev.	0.0008	**R^2**	0.6598			
Mean	0.9918	**Adj R^2**	0.4168			
C.V%	0.0841	**Pred R^2**	-0.1784			
		Adequate precision	6.1022			

Appendix A.10 Analysis of variance (ANOVA) for antioxidant activity

(Ultrasound pretreatment :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	733.17	5	146.63	7.79	0.0089	significant
A - Sonication time	49.28	1	49.28	2.62	0.1497	
B - Temperature	121.52	1	121.52	6.46	0.0386	
AB	92.64	1	92.64	4.92	0.0620	
A^2	17.75	1	17.75	0.9433	0.3638	
B^2	467.76	1	467.76	24.85	0.0016	
Residual	131.74	7	18.82			
Lack of fit	131.74	3	43.91	2.928E+05	<0.0001	significant
Pure Error	0.0006	4	0.0002			
Cor total	864.91	12				
Std Dev.	4.34	**R^2**	0.8477			
Mean	75.78	**Adj R^2**	0.73889			
C.V%	5.72	**Pred R^2**	0.0831			
		Adequate precision	7.9079			

Appendix A.11 Analysis of variance (ANOVA) for betalain content

(Ultrasound pretreatment :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	124.89	5	24.98	30.19	0.0001	significant
A - Sonication time	1.18	1	1.18	1.43	0.2704	
B - Temperature	4.47	1	4.47	5.40	0.0530	
AB	23.23	1	23.23	28.08	0.0011	
A^2	90.29	1	90.29	109.14	<0.0001	
B^2	13.01	1	13.01	15.73	0.0054	
Residual	5.79	7	0.8273			
Lack of fit	5.79	3	1.93	2879.89	<0.0001	significant
Pure Error	0.0027	4	0.0007			
Cor total	130.68	12				
Std Dev.	0.9096	**R^2**	0.9557			
Mean	36.44	**Adj R^2**	0.9240			
C.V%	2.50	**Pred R^2**	0.6850			
		Adequate precision	12.5413			

Appendix A.12 Analysis of variance (ANOVA) for L* value

(Ultrasound pretreatment :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	44.56	5	8.91	3.64	0.0611	Not significant
A - Sonication time	7.53	1	7.53	3.07	0.1231	
B - Temperature	0.0937	1	0.0937	0.0382	0.8506	
AB	16.40	1	16.40	6.69	0.0361	
A^2	15.70	1	15.70	6.41	0.0392	
B^2	7.27	1	7.27	2.97	0.1286	
Residual	17.16	7	2.45			
Lack of fit	17.13	3	5.71	815.63	<0.0001	significant
Pure Error	0.0280	4	0.0070			
Cor total	61.72	12				
Std Dev.	1.57	**R^2**	0.7220			
Mean	25.27	**Adj R^2**	0.5235			
C.V%	6.19	**Pred R^2**	-0.9742			
		Adequate precision	5.6320			

Appendix A.13 Analysis of variance (ANOVA) for a* value

(Ultrasound pretreatment :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	43.02	5	8.60	0.5169	0.7574	Not significant
A - Sonication time	0.1431	1	0.1431	0.0086	0.9287	
B - Temperature	1.75	1	1.75	0.1050	0.7553	
AB	10.66	1	10.66	0.6404	0.4499	
A^2	30.34	1	30.34	1.82	0.2190	
B^2	1.15	1	1.15	0.0689	0.8005	
Residual	116.52	7	16.65			
Lack of fit	90.22	3	30.07	4.57	0.0880	Not significant
Pure Error	26.30	4	6.57			
Cor total	159.54	12				
Std Dev.	4.08	**R^2**	0.2697			
Mean	31.22	**Adj R^2**	-0.2520			
C.V%	13.07	**Pred R^2**	-3.2789			
		Adequate precision	1.6094			

Appendix A.14 Analysis of variance (ANOVA) for b* value

(Ultrasound pretreatment :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	1.99	5	0.3980	1.14	0.4216	Not significant
A - Sonication time	0.0800	1	0.0800	0.2289	0.6470	
B - Temperature	0.4447	1	0.4447	1.27	0.2965	
AB	0.5776	1	0.5776	1.65	0.2395	
A^2	0.1313	1	0.1313	0.3756	0.5594	
B^2	0.8274	1	0.8274	2.37	0.1678	
Residual	2.45	7	0.3496			
Lack of fit	2.32	3	0.7745	25.08	0.0047	significant
Pure Error	0.1235	4	0.0309			
Cor total	4.44	12				
Std Dev.	0.5912	**R^2**	0.4485			
Mean	8.71	**Adj R^2**	0.0546			
C.V%	6.79	**Pred R^2**	-2.7672			
		Adequate precision	3.0661			

APPENDIX - B

Appendix B.1 Analysis of variance (ANOVA) for drying time

(Infrared drying :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	443.93	9	49.33	21.65	0.0003	significant
A - Temperature	378.13	1	378.13	165.95	<0.0001	
B - Airflow rate	0.1250	1	0.1250	0.0549	0.8215	
C - Heater speed	32.00		32.00	14.04	0.0072	
AB	1.0000	1	1.000	0.4389	0.5289	
AC	6.25	1	6.25	2.74	0.1417	
BC	20.25	1	20.25	8.89	0.0205	
A^2	0.0105	1	0.0105	0.0046	0.9477	
B^2	3.80	1	3.80	1.67	0.2376	
C^2	2.06	1	2.06	0.9055	0.3730	
Residual	15.95	7	2.28			
Lack of fit	14.75	3	4.92	16.39	0.0103	significant
Pure Error	1.20	4	0.3000			
Cor total	459.88	16				
Std Dev.	1.51	**R^2**	0.9653			
Mean	21.35	**Adj R^2**	0.9207			
C.V%	7.07	**Pred R^2**	0.4827			
		Adequate precision	15.3317			

Appendix B.2 Analysis of variance (ANOVA) for water activity

(Infrared drying :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	0.0839	9	0.0093	4.95	0.0233	significant
A - Temperature	0.0395	1	0.0395	20.97	0.0025	
B - Airflow rate	0.0020	1	0.0020	1.05	0.3387	
C - Heater speed	0.0073		0.0073	3.89	0.0892	
AB	0.0007	1	0.007	0.3730	0.5607	
AC	2.500E-07	1	2.500E-07	0.0001	0.9911	
BC	0.0042	1	0.0042	2.21	0.1807	
A^2	0.0140	1	0.0140	7.41	0.0296	
B^2	0.0021	1	0.0021	1.14	0.3211	
C^2	0.0114	1	0.0114	6.06	0.0433	
Residual	0.0132	7	0.0019			
Lack of fit	0.0132	3	0.0044	14642.22	<0.0001	significant
Pure Error	1.200E-06	4	3.000E-07			
Cor total	0.0971	16				
Std Dev.	0.0434	**R^2**	0.8643			
Mean	0.5202	**Adj R^2**	0.6897			
C.V%	8.34	**Pred R^2**	-1.1718			
		Adequate precision	6.8962			

Appendix B.3 Analysis of variance (ANOVA) for rehydration ratio

(Infrared drying :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	0.4290	9	0.0477	6.13	0.0129	significant
A - Temperature	0.0338	1	0.0338	4.35	0.0755	
B - Airflow rate	0.0800	1	0.0800	10.29	0.0149	
C - Heater speed	0.0072		0.0072	0.9265	0.3678	
AB	0.0400	1	0.0400	5.15	0.0576	
AC	0.0004	1	0.0004	0.0515	0.8270	
BC	0.1156	1	0.1156	14.87	0.0062	
A^2	0.0038	1	0.0038	0.4876	0.5075	
B^2	0.0825	1	0.0825	10.62	0.0139	
C^2	0.0606	1	0.0606	7.80	0.0268	
Residual	0.0544	7	0.0078			
Lack of fit	0.0538	3	0.0179	119.56	0.0002	significant
Pure Error	0.0006	4	0.0002			
Cor total	0.4834	16				
Std Dev.	0.0882	**R^2**	0.8875			
Mean	5.54	**Adj R^2**	0.7428			
C.V%	1.59	**Pred R^2**	-0.7825			
		Adequate precision	8.6523			

Appendix B.4 Analysis of variance (ANOVA) for shrinkage

(Infrared drying :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	137.36	9	15.26	5.97	0.0140	significant
A - Temperature	94.81	1	94.81	37.07	0.0005	
B - Airflow rate	16.53	1	16.53	6.46	0.0385	
C - Heater speed	0.2112		0.2112	0.0826	0.7821	
AB	12.04	1	12.04	4.71	0.0666	
AC	5.86	1	5.86	2.29	0.1740	
BC	0.9025	1	0.9025	0.3529	0.5712	
A^2	1.67	1	1.67	0.6544	0.4452	
B^2	4.78	1	4.78	1.87	0.2139	
C^2	0.4711	1	0.4711	0.1842	0.6807	
Residual	17.90	7	2.56			
Lack of fit	17.88	3	5.96	1234.24	<0.0001	significant
Pure Error	0.0193	4	0.0048			
Cor total	155.27	16				
Std Dev.	1.60	**R^2**	0.8847			
Mean	14.08	**Adj R^2**	0.7364			
C.V%	11.35	**Pred R^2**	-0.8431			
		Adequate precision	10.1950			

Appendix B.5 Analysis of variance (ANOVA) for L* value

(Infrared drying :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	19.53	9	2.17	21.50	0.0003	significant
A - Temperature	0.0684	1	0.0684	0.6779	0.4374	
B - Airflow rate	3.18	1	3.18	31.45	0.0008	
C - Heater speed	0.00392		0.00392	0.3882	0.5530	
AB	7.62	1	7.62	75.45	<0.0001	
AC	0.5476	1	0.5476	5.42	0.0527	
BC	0.9025	1	0.9025	8.94	0.0202	
A^2	0.3714	1	0.3714	3.68	0.9066	
B^2	5.49	1	5.49	54.39	0.0002	
C^2	0.8226	1	0.8226	8.15	0.0245	
Residual	0.7068	7	0.1010			
Lack of fit	0.7043	3	0.2348	372.62	<0.0001	significant
Pure Error	0.0025	4	0.0006			
Cor total	20.24	16				
Std Dev.	0.3178	**R^2**	0.9651			
Mean	32.24	**Adj R^2**	0.9202			
C.V%	0.9856	**Pred R^2**	0.4431			
		Adequate precision	16.4953			

Appendix B.6 Analysis of variance (ANOVA) for a* value

(Infrared drying :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	7.95	9	0.8830	5.74	0.0156	significant
A - Temperature	3.62	1	3.62	23.51	0.0019	
B - Airflow rate	8.882E-16	1	8.882E-16	5.77E-15	1.0000	
C - Heater speed	0.2520		0.2520	1.64	0.2414	
AB	0.0002	1	0.0002	0.0015	0.9706	
AC	0.3306	1	0.3306	2.15	0.1862	
BC	0.6642	1	0.6642	4.32	0.0764	
A^2	2.17	1	2.17	14.09	0.0071	
B^2	0.2370	1	0.2370	1.54	0.2546	
C^2	0.6495	1	0.6495	4.22	0.0790	
Residual	1.08	7	0.1539			
Lack of fit	1.08	3	0.3590	5128.81	<0.0001	significant
Pure Error	0.0003	4	0.0001			
Cor total	9.02	16				
Std Dev.	0.3923	**R^2**	0.8806			
Mean	-5.16	**Adj R^2**	0.7271			
C.V%	7.60	**Pred R^2**	-0.9096			
		Adequate precision	7.7189			

Appendix B.7 Analysis of variance (ANOVA) for b* value

(Infrared drying :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	9.04	9	1.00	5.87	0.0147	significant
A - Temperature	6.66	1	6.66	38.92	0.0004	
B - Airflow rate	0.0190	1	0.0190	0.1111	0.7487	
C - Heater speed	0.0231		0.0231	0.1351	0.7241	
AB	0.1089	1	0.1089	0.6363	0.4513	
AC	1.35	1	1.35	7.86	0.0264	
BC	0.5852	1	0.5852	3.42	0.1069	
A^2	0.0041	1	0.0041	0.0240	0.8812	
B^2	0.0698	1	0.0698	0.4078	0.5434	
C^2	0.2015	1	0.2015	1.18	0.3139	
Residual	1.20	7	0.1711			
Lack of fit	1.19	3	0.3982	468.46	<0.0001	significant
Pure Error	0.0034	4	0.0009			
Cor total	10.24	16				
Std Dev.	0.4137	**R^2**	0.8830			
Mean	14.75	**Adj R^2**	0.7325			
C.V%	2.81	**Pred R^2**	-0.8677			
		Adequate precision	9.4079			

Appendix B.8 Analysis of variance (ANOVA) for energy consumption

(Infrared drying :Moringa leaves)

Source	Sum of squares	df	Mean square	F value	p value	
Model	0.4606	9	0.0512	35.82	<0.0001	significant
A - Temperature	0.3200	1	0.3200	224.00	<0.0001	
B - Airflow rate	0.0050	1	0.0050	3.50	0.1036	
C - Heater speed	0.0000		0.0000	0.0000	1.0000	
AB	0.0025	1	0.0025	1.75	0.2275	
AC	0.0225	1	0.0225	15.75	0.0054	
BC	0.0625	1	0.0625	43.75	0.0003	
A^2	0.0059	1	0.0059	4.14	0.0812	
B^2	0.0059	1	0.0059	4.14	0.0812	
C^2	0.0322	1	0.0322	22.57	0.0021	
Residual	0.0100	7	0.0014			
Lack of fit	0.0100	3	0.0033			
Pure Error	0.0000	4	0.0000			
Cor total	0.4706	16				
Std Dev.	0.0378	**R^2**	0.9787			
Mean	0.9765	**Adj R^2**	0.9514			
C.V%	3.87	**Pred R^2**	0.6600			
		Adequate precision	19.8354			

Appendix B.9 Analysis of variance (ANOVA) for drying time

(Infrared drying :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	1.55	9	0.1722	7.80	0.0065	significant
A - Temperature	1.16	1	1.16	52.64	0.0002	
B - Airflow rate	0.800	1	0.800	3.62	0.0988	
C - Heater speed	0.0036		0.0036	0.1635	0.6980	
AB	0.0009	1	0.0009	0.0407	0.8458	
AC	0.0006	1	0.0006	0.0283	0.8712	
BC	0.1225	1	0.1225	5.55	0.0507	
A^2	0.1461	1	0.1461	6.61	0.0369	
B^2	0.0171	1	0.0171	0.7747	0.4080	
C^2	0.0055	1	0.0055	0.2505	0.6321	
Residual	0.1546	7	0.0221			
Lack of fit	0.1544	3	0.0515	1029.50	<0.0001	significant
Pure Error	0.0002	4	0.0000			
Cor total	1.70	16				
Std Dev.	0.1486	**R^2**	0.9093			
Mean	1.38	**Adj R^2**	0.7927			
C.V%	10.73	**Pred R^2**	-0.4497			
		Adequate precision	8.4437			

Appendix B.10 Analysis of variance (ANOVA) for water activity

(Infrared drying :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	0.0220	9	0.0024	20.12	0.0003	significant
A - Temperature	0.0126	1	0.0126	103.97	<0.0001	
B - Airflow rate	0.0002	1	0.0002	1.73	0.2301	
C - Heater speed	0.0013		0.0013	10.49	0.0143	
AB	0.0013	1	0.0013	10.37	0.0147	
AC	0.0039	1	0.0039	32.13	0.0008	
BC	0.0015	1	0.0015	12.51	0.0095	
A^2	0.0003	1	0.0003	2.41	0.1642	
B^2	0.0008	1	0.0008	6.41	0.0392	
C^2	0.0001	1	0.0001	1.01	0.3484	
Residual	0.0009	7	0.0001			
Lack of fit	0.0008	3	0.0003	403.93	<0.0001	significant
Pure Error	2.800E-06	4	7.000E-07			
Cor total	0.0229	16				
Std Dev.	0.0110	**R^2**	0.9628			
Mean	0.3516	**Adj R^2**	0.9149			
C.V%	3.14	**Pred R^2**	0.4062			
		Adequate precision	16.7913			

Appendix B.11 Analysis of variance (ANOVA) for rehydration ratio

(Infrared drying :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	6.44	9	0.7158	9.15	0.0040	significant
A - Temperature	1.08	1	1.08	13.82	0.0075	
B - Airflow rate	0.1513	1	0.1513	1.93	0.2069	
C - Heater speed	1.01		1.01	12.89	0.0088	
AB	0.1444	1	0.1444	1.85	0.2163	
AC	0.1849	1	0.1849	2.36	0.1680	
BC	1.51	1	1.51	19.35	0.0032	
A^2	0.4475	1	0.4475	5.72	0.0480	
B^2	1.20	1	1.20	15.35	0.0058	
C^2	0.7392	1	0.7392	9.45	0.0180	
Residual	0.5474	7	0.0782			
Lack of fit	0.5453	3	0.1818	349.55	<0.0001	significant
Pure Error	0.0021	4	0.0005			
Cor total	6.99	16				
Std Dev.	0.2796	**R^2**	0.9217			
Mean	6.88	**Adj R^2**	0.8210			
C.V%	4.07	**Pred R^2**	-0.2487			
		Adequate precision	12.2627			

Appendix B.12 Analysis of variance (ANOVA) for shrinkage

(Infrared drying :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	89.74	9	9.97	4.80	0.0253	significant
A - Temperature	32.04	1	32.04	15.42	0.0057	
B - Airflow rate	42.32	1	42.32	20.37	0.0028	
C - Heater speed	0.7875		0.7875	0.3791	0.5576	
AB	0.0462	1	0.0462	0.0223	0.8856	
AC	0.0100	1	0.0100	0.0048	0.9466	
BC	0.2256	1	0.2256	0.1086	0.7514	
A^2	3.80	1	3.80	1.83	0.2185	
B^2	0.3115	1	0.3115	0.1500	0.7101	
C^2	9.15	1	9.15	4.41	0.0740	
Residual	14.54	7	2.08			
Lack of fit	13.53	3	4.51	17.86	0.0088	significant
Pure Error	1.01	4	0.2526			
Cor total	104.28	16				
Std Dev.	1.44	**R^2**	0.8606			
Mean	45.63	**Adj R^2**	0.6813			
C.V%	3.16	**Pred R^2**	-1.0912			
		Adequate precision	7.7823			

Appendix B.13 Analysis of variance (ANOVA) for L* value

(Infrared drying :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	83.16	9	9.24	2.0	0.1867	Not significant
A - Temperature	12.75	1	12.75	2.76	0.1407	
B - Airflow rate	7.41	1	7.41	1.60	0.2460	
C - Heater speed	11.52		11.52	2.49	0.1584	
AB	20.25	1	20.25	4.38	0.0746	
AC	13.32	1	13.32	2.88	0.1334	
BC	0.2025	1	0.2025	0.0438	0.8402	
A^2	14.49	1	14.49	3.13	0.1200	
B^2	1.25	1	1.25	0.2705	0.6190	
C^2	2.83	1	2.83	0.6124	0.4595	
Residual	32.36	7	4.62			
Lack of fit	31.37	3	10.46	42.16	0.0017	significant
Pure Error	0.9920	4	0.2480			
Cor total	115.52	16				
Std Dev.	2.15	**R^2**	0.7199			
Mean	32.17	**Adj R^2**	0.3597			
C.V%	6.68	**Pred R^2**	-3.3581			
		Adequate precision	5.7837			

Appendix B.14 Analysis of variance (ANOVA) for a* value

(Infrared drying :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	90.40	9	10.04	17.01	0.0006	significant
A - Temperature	5.95	1	5.95	10.08	0.0156	
B - Airflow rate	0.0113	1	0.0113	0.0190	0.8941	
C - Heater speed	0.4050		0.4050	0.6857	0.4350	
AB	0.0100	1	0.0100	0.0169	0.9001	
AC	1.10	1	1.10	1.87	0.2141	
BC	0.7225	1	0.7225	1.22	0.3053	
A^2	81.33	1	81.33	137.70	<0.0001	
B^2	0.3917	1	0.3917	0.6631	0.4423	
C^2	0.2038	1	0.2038	0.3450	0.5754	
Residual	4.13	7	0.5906			
Lack of fit	2.48	3	0.8275	2.00	0.2559	Not significant
Pure Error	1.65	4	0.4130			
Cor total	94.54	16				
Std Dev.	0.7685	**R^2**	0.9563			
Mean	16.71	**Adj R^2**	0.9000			
C.V%	4.60	**Pred R^2**	0.5525			
		Adequate precision	11.8757			

Appendix B.15 Analysis of variance (ANOVA) for b* value

(Infrared drying :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	31.01	9	3.45	5.67	0.0162	significant
A - Temperature	3.51	1	3.51	5.77	0.0473	
B - Airflow rate	5.61	1	5.61	9.23	0.0189	
C - Heater speed	3.92		3.92	6.45	0.0387	
AB	0.2500	1	0.2500	0.4110	0.5419	
AC	1.82	1	1.82	3.00	0.1271	
BC	0.1225	1	0.1225	0.2014	0.6671	
A^2	10.78	1	10.78	17.72	0.0040	
B^2	2.06	1	2.06	3.39	0.1081	
C^2	1.64	1	1.64	2.70	0.1441	
Residual	4.26	7	0.6082			
Lack of fit	3.20	3	1.07	4.02	0.1061	Not significant
Pure Error	1.06	4	0.2650			
Cor total	35.27	16				
Std Dev.	0.7799	**R^2**	0.8793			
Mean	7.62	**Adj R^2**	0.7241			
C.V%	10.23	**Pred R^2**	-0.4975			
		Adequate precision	5.9977			

Appendix B.16 Analysis of variance (ANOVA) for energy consumption

(Infrared drying :Beetroot)

Source	Sum of squares	df	Mean square	F value	p value	
Model	13.92	9	1.55	12.88	0.0014	significant
A - Temperature	12.25	1	12.25	102.03	<0.0001	
B - Airflow rate	0.0000	1	0.0000	0.0000	1.0000	
C - Heater speed	0.0112		0.0112	0.0937	0.7684	
AB	0.4900	1	0.4900	4.08	0.0831	
AC	0.0225	1	0.0225	0.1874	0.6781	
BC	0.6400	1	0.6400	5.33	0.0543	
A^2	0.3127	1	0.3127	2.60	0.1506	
B^2	0.1642	1	0.1642	1.37	0.2805	
C^2	0.0032	1	0.0032	0.0265	0.8752	
Residual	0.8405	7	0.1201			
Lack of fit	0.8125	3	0.2708	38.69	0.0021	significant
Pure Error	0.0280	4	0.0070			
Cor total	14.76	16				
Std Dev.	0.3465	**R^2**	0.9430			
Mean	4.59	**Adj R^2**	0.8698			
C.V%	7.55	**Pred R^2**	0.1161			
		Adequate precision	11.9467			

APPENDIX - C

Scorecard for sensory evaluation

SENSORY SCORECARD

Department of Processing and Food Engineering, KCAEFT Tavanur

Name of 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				
Texture				
Overall acceptability				

Nine point hedonic scale

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

Comment if any:

Signature:

Appendix C-1 Mean sensory scores of ultrasound assisted dried moringa leaves

Sample	Appearance	Colour	Texture	Overall acceptability
Fresh moringa leaves	9	9	9	9
Cabinet dried moringa leaves	8	7.5	7	7.5
Heat pump dried moringa leaves	8	8.5	7.5	8
Infrared dried moringa leaves	9	9	9	9

Appendix C-2 Mean sensory scores of ultrasound assisted dried beetroot

Sample	Appearance	Colour	Texture	Overall acceptability
Fresh beetroot	9	9	9	9
Cabinet dried beetroot	7.5	7.5	7	7.5
Heat pump dried beetroot	8	8	7.5	8
Infrared dried beetroot	8.5	9	9	9

APPENDIX D

ECONOMIC ANALYSIS

Appendix D.1 Cost economics of semi continuous infrared dryer

- Capacity of infrared dryer : 12 kg/batch
- Lifespan of heaters (n) : 10 years
- Annual usage : 200 days
- Daily usage : 8 hours
- Interest rate :12%
- Total cost of equipment (c) :Rs 2,00,000/-

a. Fixed cost

I. Fixed cost of the equipment = i(i+1)n(i+1)n+1c

= 0.12(0.12+1)10(0.12+1)10+1200000

= 18,154.68/-

II. Housing charge = Rs 150/month

Housing charge per year = Rs 1800/year

Total fixed cost per year = Rs 18154.68 + 1800

= Rs 19,954.68/-

b. Variable cost

I. Repair and maintenance = 5% of initial cost

= Rs 4,000/year

II. Labour charge = Rs 800

Total labour charge = 800 200

= 1,60,000/year

c. Cost of energy

I. Energy requirement = 8 kWh

II. Energy charges = Rs 5.85/kWh

III. Energy consumption = No. of days Energy Rate Batch

= 200 8 5.85 4

= Rs 37,440/year

Total variable cost = 4000 +160000 +37,440

= Rs 2,01,440/-

Total cost of drying = Total fixed cost +Total variable cost

= 19,954.68 + 2,01,440

= Rs 2,21,394.68 / year

= Rs 1,106.97/ day

= Rs 138.37/h

d. Revenue generated

I. Cost of dried beetroot per kg = Rs 800/kg

Quantity of dried beetroot obtained per day = 6 kg

Quantity of dried beetroot obtained per year = 6× 200 = 1200 kg

Total revenue of beetroot = 1200× 800 = Rs 9,60,000/-

II. Cost of dried moringa leaves = Rs 792/kg

Quantity of dried moringa leaves per day = 4 kg

Quantity of dried moringa leaves obtained per year = 4 × 200 = 800 kg

Total revenue of moringa leaves = 800 × 792 = Rs 6,33,600/-

e. Raw material cost

I. Raw material cost of beetroot = Rs 60/kg

Total cost of beetroot per year = 60 × 40 × 200 = 4,80,000/-

II. Raw material cost of moringa leaves = Rs 50/kg

Total cost of moringa leaves per year = 50 × 40 × 200 = 4,00,000/-

f. Benefit cost ratio

I. Beetroot

Total raw material cost = 4,80,000/-

Operational cost of equipment per year = 2,21,394.68/-

Gross income = 9,60,000/-

Net income = gross income- actual processing cost

= 9,60,000 - 2,21,394.68

= Rs 7,38,605.32/-

Benefit cost ratio = Net income/Raw material cost

= 7,38,605.32/4,80,000

= 1.53 : 1

II. Moringa leaves

Total raw material cost = 6,00,000/-

Operational cost of equipment per year =2,21,394.68/-

Gross income = 6,33,600/-

Net income = gross income- actual processing cost

= 6,33,600 - 2,21,394.68

= Rs 4,12,205.32/-

Benefit cost ratio = Net income/Raw material cost

= 4,12,205.3/24,00,000

= 1.03 : 1

g. Payback period calculation

I. Beetroot

Cost of equipment = 2,00,000

Cost of raw material = 4,80,000/-

Labour charge per year = 1,60,000/-

Interest rate = 12%

Net income = gross income- actual processing cost

= 9,60,000 - 2,21,394.68

= Rs 7,38,605.32/-

Expenses = working capital + interest (15% cost of equipment) +depreciation of the equipment (10% total cost)

= 2,21,394.68 + 30000+ 20,000

= 2,71,394.68/-

Total investment = expenses + cost of raw material

= 2,71,394.68 + 4,80,000

= 7,51,394.68/-

Payback period= total investment / annual cash inflow = 1.27 years

II. Moringa leaves

Cost of equipment = 2,00,000

Cost of raw material = 6,00,000/-

Labour charge per year = 1,60,000/-

Interest rate = 12%

Net income = gross income- actual processing cost

= 6,33,600 - 2,21,394.68

= Rs 4,12,205.32/-

Expenses = working capital + interest (15% cost of equipment) +depreciation of the equipment (10% total cost)

= 2,21,394.68 + 30000+ 20,000

= 2,71,394.68/-

Total investment = expenses + cost of raw material

= 2,71,394.68 + 6,00,000

= 8,71,394.68/-

Payback period= total investment / annual cash inflow = 1.38 years