KERONE

A CRISIL-NSIC RATED COMPANY
ISO-9001-2008 COMPANY

Member Of

AIMCAL (USA) (EUROPE)

A.M.P.E.R.E

In Association With

EMitech

ELECTRO MAGNETIC Innovative Technologies

Kerone Research & Development Centre (KRDC)
B/47, Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Vacuum Microwave + Convection Heat Treatment for Drying of Cottage Cheese

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Customer :	**M/s. Dollon's Food Product Ltd.**
Process :	**Vacuum Microwave + Convection Heat Treatment for Drying of Cottage Cheese**

Test Report No*: *188/KRDC/LAB/17 Mum 05/03/2023

Date Sample reception : 21/02/2023
ID : 188/LAB/05

***Sample Description*:**

Sampling : As Requested
Sample Condition : Acceptable
Sampling date : 28/02/2023
Product : Cottage Cheese
Start Date test : 28/02/2023
End Date test : 04/02/2023

Laboratory Experimental System –

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

System Specifications –

Magnetron Power Generator Rating	Air Cooled 1.45KW/2450+50 MHZ x 1 No.
Convection Power	1.5 KW
Total Heater Power	3 KW (MW 1.45KW + Convection 1.5KW)
Supply Voltage required	230V- 2Ph supply
MW Overall (LxWxH) in mm	620X670X640
Cavity Chamber (INNER) in mm	L-300 & Φ220
Vacuum Pump	1/2 hP; 1440rpm

Laboratory's Environmental Conditions –

Temperature (degree C)	29.4ºC (±5ºC)
Humidity (%)	≤50% RH
Pressure (kN/m2 or kPa)	Not recorded

Note for recommendation: Environmental conditions have a direct impact on test results. Accuracy and consistency of test data are affected by the laboratory conditions

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Equipment Used -

Name of Equipment	Picture of Equipment	Specifications
Compact Thermal Imaging Camera		**Model: FLIR E-30** **Resolution: 160x 120IR Thermal sensitivity of 0.10°C**
Thermo Hygrometer		**Model No: HTC-2** **Temperature accuracy: ±°C (1.8°F)** **Temperature resolution: 0.1°C (0.2°F)** **Humidity range: 10%~99% RH** **Humidity accuracy: ±5% RH** **Humidity resolution: 1% RH**
Moisture Analyzer		**Make: Axis Balance** **Description:** **Moisture range: 1%(sample 0.02/0.05g), 0.1% (Sample 0.5/5g), 0.01%(Sample>5g)**

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Procedure of the Experiment -

- The experiment was performed on Cottage Cheese to speed up the heating rate.
- For this experimental run, the sample was prepared using cow milk with Calcium lactate chemical in a ratio of 4:1
- The prepared same was taken and then passed in the Vacuum Microwave + Convection heating system with suitable parameters.
- After the heating treatment, the sample was analyzed.

Analytical Results:

VACUUM MICROWAVE HEATING SYSTEM

Trials 1 – TM1

Initial Weight – 100g

Initial Moisture – 64.8%

Cycle	Cycle time	System Specification	On Product temp	Remark
C1	After 5 min	Vacuum pressure: 300mmHg; MW Power: 1.45Kw; Heater: 0.5Kw	(70-71) ˚C	Drying started
C2	After 10 min	Vacuum pressure: 300mmHg; MW Power: 1.45Kw; Heater: 0.5Kw	(75-80) ˚C	Drying continuous
C3	After 20 min	Vacuum pressure: 300mmHg; MW Power: 1.45Kw; Heater: 0.5Kw	(90-100) ˚C	Some Charring
C4	After 25 min	Vacuum pressure: 300mmHg; MW Power: 1.45Kw; Heater: 0.5Kw	(75-80) ˚C	Drying continuous
C5	After 30 min	Vacuum pressure: 300mmHg; MW Power: 1.45Kw; Heater: 0.5Kw	(80-82) ˚C	Drying continuous
C6	After 35 min	Vacuum pressure: 300mmHg; MW Power: 1.45Kw; Heater: 0.5Kw	(82-85) ˚C	Dried below 5% moisture content

Final Weight – 28g

Final Moisture – 3.7%

Total cycle time - 35 mins.

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Trials 2 – TM2

Initial Weight – 100g
Initial Moisture – 64.8%

Cycle	Cycle time	System Specification	On Product temp	Remark
C1	After 5 min	Vacuum pressure: 100mmHg; MW Power: 1.45Kw; Heater: 0.5Kw	(70-71) ˚C	Drying started
C2	After 15 min	Vacuum pressure: 100mmHg; MW Power: 1.45Kw; Heater: 0.5Kw	(70-72) ˚C	Drying continuous
C3	After 25 min	Vacuum pressure: 100mmHg; MW Power: 1.45Kw; Heater: 0.5Kw	(70-74) ˚C	Drying continuous
C4	After 35 min	Vacuum pressure: 300mmHg; MW Power: 1.45Kw; Heater: 0.5Kw	(70-75) ˚C	Drying continuous
C5	After 45 min	Vacuum pressure: 300mmHg; MW Power: 1.45Kw; Heater: 0.5Kw	(70-80) ˚C	Dried below 4% moisture content

Final Weight – 32g
Final Moisture – 3.3%
Total Cycle time – 45 mins.

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Trials 3 – TM3
Initial Weight – 100g
Initial Moisture – 64.8%

Cycle	Cycle time	System Specification	On Product temp	Remark
C1	After 30 min	Vacuum pressure: 100mmHg; MW Power: 0.3Kw; Heater: 0	(45-50) ˚C	Drying started
C2	After 60 min	Vacuum pressure: 100mmHg; MW Power: 0.3Kw; Heater: 0	(45-50) ˚C	Drying continuous
C3	After 90 min	Vacuum pressure: 100mmHg; MW Power: 0.3Kw; Heater: 0	(45-50) ˚C	Drying continuous
C4	After 120 min	Vacuum pressure: 300mmHg; MW Power: 0.3Kw; Heater: 0	(45-50) ˚C	Drying continuous
C5	After 150 min	Vacuum pressure: 300mmHg; MW Power: 0.3Kw; Heater: 0	(45-50) ˚C	Drying continuous
C6	After 180 min	Vacuum pressure: 300mmHg; MW Power: 0.3Kw; Heater: 0	(45-50) ˚C	Drying continuous
C7	After 210 min	Vacuum pressure: 300mmHg; MW Power: 0.3Kw; Heater: 0	(45-50) ˚C	Drying continuous
C8	After 240 min	Vacuum pressure: 300mmHg; MW Power: 0.3Kw; Heater: 0	(45-50) ˚C	Dried up to 3% moisture content

Final Weight – 27g
Final Moisture – 2%
Total Cycle time – 4 hours.

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

VACUUM CONVECTION HEATING SYSTEM

Trials 1 – TC1

Initial Weight – 100g

Initial Moisture – 63.4%

Cycle	Cycle time	System Specification	On Product temp	Remark
C1	After 30 min	Vacuum pressure: 300mmHg; Set temp: 45˚C; Heater: 1.5Kw	(70-71) ˚C	Drying started
C2	After 60 min	Vacuum pressure: 300mmHg; Set temp: 45˚C; Heater: 1.5Kw	(71-73) ˚C	Drying continuous
C3	After 90 min	Vacuum pressure: 300mmHg; Set temp: 45˚C; Heater: 1.5Kw	(70-75) ˚C	Some Charring
C4	After 120 min	Vacuum pressure: 300mmHg; Set temp: 45˚C; Heater: 1.5Kw	(75-80) ˚C	Dried below 4% moisture content

Final Weight – 37g

Final Moisture – 3.5%

Total cycle time – 2 hours.

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Trials 2 – TC2

Initial Weight – 100g

Initial Moisture – 63.4%

Cycle	Cycle time	System Specification	On Product temp	Remark
C1	After 60 min	Vacuum pressure: 100mmHg; Set temp: 35˚C; Heater: 0.5Kw	(50-55) ˚C	Drying started
C2	After 120 min	Vacuum pressure: 100mmHg; Set temp: 35˚C; Heater: 0.5Kw	(50-55) ˚C	Drying continuous
C3	After 180 min	Vacuum pressure: 100mmHg; Set temp: 35˚C; Heater: 0.5Kw	(50-55) ˚C	Some Charring
C4	After 240 min	Vacuum pressure: 100mmHg; Set temp: 35˚C; Heater: 0.5Kw	(50-55) ˚C	Dried below 4% moisture content

Final Weight – 40g

Final Moisture – 3.9%

Total cycle time – 4 hours.

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Trials 3 – TC3

Initial Weight – 100g

Initial Moisture – 63.4%

Cycle	Cycle time	System Specification	On Product temp	Remark
C1	After 60 min	Vacuum pressure: 100mmHg; Set temp: 30˚C; Heater: 0.5Kw	(50-55) ˚C	Drying started
C2	After 120 min	Vacuum pressure: 100mmHg; Set temp: 30˚C; Heater: 0.5Kw	(50-55) ˚C	Drying continuous
C3	After 180 min	Vacuum pressure: 100mmHg; Set temp: 30˚C; Heater: 0.5Kw	(50-55) ˚C	Drying continuous
C4	After 240 min	Vacuum pressure: 100mmHg; Set temp: 30˚C; Heater: 0.5Kw	(50-55) ˚C	Drying continuous
C5	After 300 min	Vacuum pressure: 100mmHg; Set temp: 30˚C; Heater: 0.5Kw	(50-55) ˚C	Drying continuous
C6	After 360 min	Vacuum pressure: 100mmHg; Set temp: 30˚C; Heater: 0.5Kw	(50-55) ˚C	Dried below 2% moisture content

Final Weight – 28g

Final Moisture – 1.6%

Total cycle time – 6 hours.

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Trials Images:

Untreated Sample

Treated Sample (Tm1, Tm2, Tm3)

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

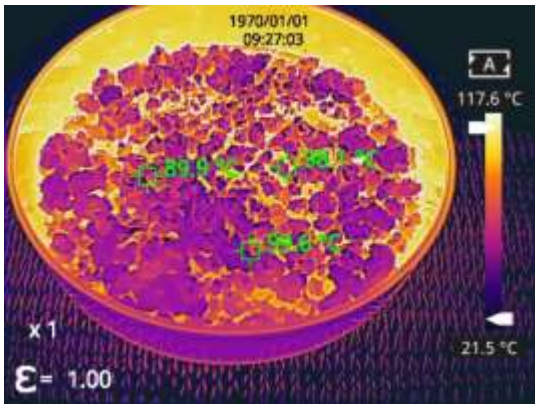
Treated Sample (Tc1, Tc2, Tc3)

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Thermal Images:

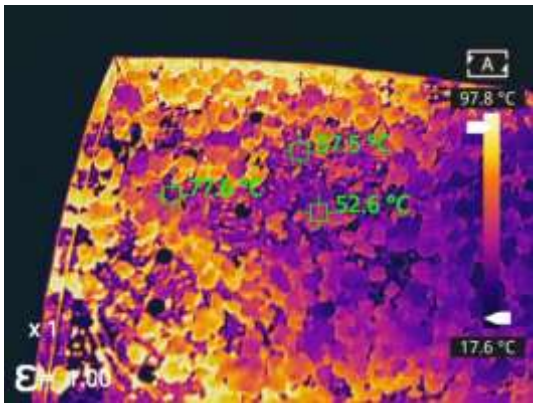
Measurements	
Sp1	98.2°C
Sp2	99.6°C
Sp3	89.9°C

Parameters	
Emissivity	1.00
Temp.	117.6°C



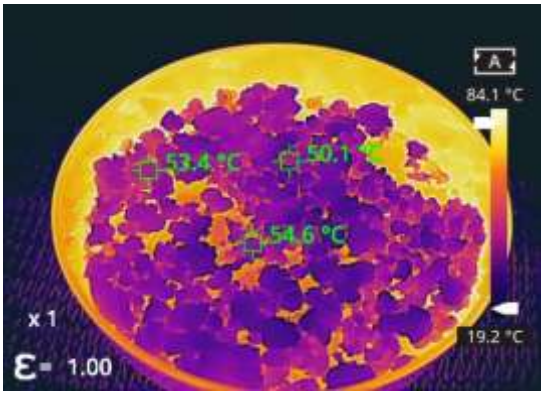
Measurements	
Sp1	77.6°C
Sp2	57.5°C
Sp3	52.6°C

Parameters	
Emissivity	1.00
Temp.	97.8°C



Measurements	
Sp1	53.4°C
Sp2	50.1°C
Sp3	54.6°C

Parameters	
Emissivity	1.00
Temp.	84.1°C



Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Moisture Analysis Report:

Tm1

Drying started

Date : 2-03-2023
Time :10:19:27
Model:AQC200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 105.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 0.797 g
Final weight : 0.715 g
Drying time : 00:04:00s
Sampling interval : 20 sec
Moisture : 3.7 %

NOTE Final moisture

The analysis performed by:

Signature

Tm2

Drying started

Date : 2-03-2023
Time :10:01:58
Model:AQC200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 105.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 0.764 g
Final weight : 0.739 g
Drying time : 00:06:00s
Sampling interval : 20 sec
Moisture : 3.3 %

NOTE Final moisture

The analysis performed by:

Signature

Tm3

Drying started

Date : 3-03-2023
Time :11:01:37
Model:AQC200
Serial number : 138

Drying parameters

Product : 0
Drying temperature : 105.0 °C
Drying profile : standard
Mode : Short mode
Calculation : ((m0-m)/m0)*100%
Finished : 3 samples
Initial weight : 1.015 g
Final weight : 1.004 g
Drying time : 00:03:20s
Sampling interval : 20 sec
Moisture : 2.0 %

NOTE Final moisture

The analysis performed by:

Signature

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Kerone Research & Development Centre (KRDC)
B/47,Addl. MIDC. Anand Nagar, Ambernath (East), Thane- 421 506, India
Tel- +91-251-2620542/13/44/45/46, Email-info@kerone.com, www.kerone.com

Observations:

The heating behavior of Cottage Cheese was investigated under the Convection heating system. The heating rate was found to be increasing with respect to increasing in time. As per the physical investigation, it was observed that the product was dried as desired without any charring effect at low temperature with prolonged time and was seal packed after treatment. Also, the desired moisture content was obtained.

Ms. Sayali Asole
(Tested By)