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ISO-9001-2008 COMPANY



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In Association With



ELECTRO MAGNETIC innovative technologies

Kerone Research & Development Centre (KRDC),
B/47, Addl. MIDC, Anand Nagar, Ambarnath (East), Thane- 421 506, India
Tel- +91-251-2620542/43/44/45/46, Email-info@kerone.com, www.kerone.com



**Continuous Microwave+IR Heat
Treatment for Drying & Roasting of Pistachios**

ISO 9001-2008 | ISO 9001-2015 | EMS 14001 | OHSAS 18001
In Association with SVCH-Technologii, Moscow (Russia)



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Customer :	M/s. Food Studio
Process :	Continuous Microwave+IR Heat Treatment for Drying & Roasting of Pistachios

TEST REPORT No: 47/KRDC/LAB/17 Mum 20/06/2021

Date Sample reception : 19/06/2021
ID : 47/LAB/165

SAMPLE DESCRIPTION:

Sampling : As Requested
Sample Condition : Acceptable
Quantity : 30 kg
Sampling date : 20/06/2021
Product : Pistachios
Requirement : Drying & Roasting
Start Date test : 20/06/2021
End Date test : 20/06/2021

LABORATORY EXPERIMENTAL SET UP:



Format: F/R&D/01



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LAB BATCH MICROWAVE+CONVECTION HEATING SYSTEM SPECIFICATIONS:

Microwave Power	1.45 kW(CW)
Frequency	2450 MHz \pm 50
Infra-red Power	2 kW
Microwave Exposure Zone (Cavity)	1000 mm length wise
IR Exposure length	210 mm
Web width	380mm
Entry Vestibule length	1200mm
Exit Vestibule Length	1200 mm
Exhaust Power	0.5 HP

ENVIRONMENT-LABORATORY AMBIENT CONDITIONS:

Temperature (degree C)	29°C (\pm 5°C)
Humidity (%)	\leq 65% RH
Pressure (kN/m ² 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.



EUROPE ASSOCIATION of Manufacturers and Suppliers



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EQUIPMENTS 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: $\pm^{\circ}\text{C}$ (1.8°F) Temperature resolution: 0.1°C (0.2°F) Humidity range: 10%~99% RH Humidity accuracy: $\pm 5\%$ 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)

SAMPLE PREPARATION AND METHOD/PROCEDURE:

The experiment has been performed on given sample of pistachios to speed up the heating rate for drying & roasting treatment. For this experimental run, given product has been placed in Continuous Microwave Hybrid Heating System and microwave+IR exposure has been given with suitable parameters. The observations are made on the basis of temperature on product, final moisture content and any damage to product samples.

Also, the observations are made after every 1 pass of 13 minutes on the basis of method by checking moisture content.

Format: F/R&D/01



ANALYTICAL RESULTS:

1) Trial 1

Pistachio Grade: Y-OK

Pass 1: Microwave Intensity- 80% & IR Temperature- 120°C

Pass 2: Microwave Intensity-90% & IR Temperature- 120°C

Initial Moisture Content: 9.4%

Initial Weight: 1 kg

Sr. No.	Time (minutes)	Final Moisture	Surface Temp. (°C)	Remarks
1.	13	-	65	Drying rate started
2.	26	1.5%	80	Drying & Roasting Completed

Total Exposure Time: 11x2mins (MW) + 2x2mins (IR) = 26Mins

Final Moisture Content: 1.5%

BEFORE AND AFTER PICTURES OF TREATED SPECIMEN SAMPLE:

1. Before Heat Treatment:



2. After Heat Treatment:



Format: F/R&D/01



2) Pistachio Grade: Y-OK

Pass 1: Microwave Intensity- 90% & IR Temperature- 110°C

Initial Moisture Content: 9.4%

Initial Weight: 1 kg

Sr. No.	Time (minutes)	Final Moisture	Surface Temp. (°C)	Remarks
1.	13	1.1	70-75	Drying & Roasting completed.

Total Exposure Time: 11mins (MW) + 2mins (IR) = 13Mins

Final Moisture Content: 1.1%

BEFORE AND AFTER PICTURES OF TREATED SPECIMEN SAMPLE:

1. Before Heat Treatment:



2. After Heat Treatment:





3) Pistachio Grade: Y-OK

Pass 1: Microwave Intensity- 90% & IR Temperature- Above 120°C

Initial Moisture Content: 9.4%

Initial Weight: 1 kg

Sr. No.	Time (minutes)	Final Moisture	Surface Temp. (°C)	Remarks
1.	13	0.7	100	1. Drying & Roasting Completed 2. Colour change observed on shells due to high IR temperature but not on kernel

Total Exposure Time: 11mins (MW) + 2mins (IR) = 13Mins

Final Moisture Content: 0.7%

BEFORE AND AFTER PICTURES OF TREATED SPECIMEN SAMPLE:

1. Before Heat Treatment:



2. After Heat Treatment:





4) Pistachio Grade: B

Pass 1: Microwave Intensity- 90% & IR Temperature- 110°C

Initial Moisture Content: 6.3%

Initial Weight: 1 kg

Sr. No.	Time (minutes)	Final Moisture	Surface Temp. (°C)	Remarks
1.	13	1.6	70-75	Drying & Roasting Completed

Total Exposure Time: 11mins (MW) + 2mins (IR) = 13Mins

Final Moisture Content: 1.6%

BEFORE AND AFTER PICTURES OF TREATED SPECIMEN SAMPLE:

1. Before Heat Treatment:



2. After Heat Treatment:





5) Pistachio Grade: ABK

Pass 1: Microwave Intensity- 90% & IR Temperature- 110°C

Initial Moisture Content: 7.5%

Initial Weight: 1 kg

Sr. No.	Time (minutes)	Final Moisture	Surface Temp. (°C)	Remarks
1.	13	1.3	75-80	Drying & Roasting Completed

Total Exposure Time: 11mins (MW) + 2mins (IR) = 13Mins

Final Moisture Content: 1.3%

BEFORE AND AFTER PICTURES OF TREATED SPECIMEN SAMPLE:

1. Before Heat Treatment:



2. After Heat Treatment:





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OBSRVATIONS:

The drying & roasting behavior of pistachios has been investigated under the Microwave+IR Heating System. The drying rate is found to be increasing with respect to increasing drying time. It has been found that the moisture content on the dry basis (%) decreases with respect to increase drying time. In the processed sample, as per physical investigation, it has been observed that there is no change in colour on sample except sample in trial 3 which was exposed in IR at above 120°C temperature.

Miss. Komal Ingale
Tested By