DECLARATION

I hereby declare that this thesis entitled "**DEVELOPMENT OF SEMI-CONTINUOUS ULTRASOUND ASSISTED INFRARED DRYER FOR FOOD PRODUCTS"** is a bonafide record of research work done by me during the course of research and thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Place: Tavanur
Date: 13/02/2025

Er. JAHANA THASNEEM P
(2021-18-001)

CERTIFICATE

Certified that this thesis entitled "**DEVELOPMENT OF SEMI-CONTINUOUS ULTRASOUND ASSISTED INFRARED DRYER FOR FOOD PRODUCTS"** is a bonafide record of research work done by **Er. JAHANA THASNEEM P (2021-18-001)** under my guidance and supervision and that has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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SYMBOLS AND ABBREVIATIONS

θ	:	Angle of repose
/	:	Per
&	:	And
%	:	Percentage
±	:	Plus or minus
<	:	Less than
>	:	Greater than
”	:	Inch
≤	:	Less than or equal to
℃	:	Degree celsius
β	:	Beta
μm	:	Micrometer
3D	:	Three dimensional
ΣC	:	Sum of colonies counted on all retained dishes
ΔE	:	Total colour change
$\boldsymbol{\alpha}$	:	Absorptivity
$\boldsymbol{\varrho}$	:	Reflectivity
T	:	Transmissivity
η	:	Energetic efficiency
μ	:	Coefficient of friction
$\chi 2$	:	Chi square
A	:	Absorbance at 538 nm
A	:	Ampere
A	:	Area of cross section
a*	:	Greenness or redness
AC	:	Antioxidant activity

ACT	:	Actual
AMP	:	Antimicrobial peptide
ANOVA	:	Analysis of variance
aw	:	Water activity
b	:	Intermediate axial length
B. bruxellensis	:	*Brettanomyces bruxellensis*
B. subtils	:	*Bacillus subtils*
b*	:	Blueness or yellowness
BDA	:	British Dietetic Association
C	:	Specific heat
$Ca(OH)_2$	:	Calcium hydroxide
Ca^{2+}	:	Calcium ion
CCD	:	Central Composite Design
C_d	:	Specific heat of bone dry matter
cfu	:	Colony forming unit
cm^2	:	Square centimetre
C_p	:	Specific heat capacity of air at constant pressure
C_{Pp}	:	Specific heat of sample
C_{pw}	:	Specific heat of water
CV	:	Coefficient of variance
C_w	:	Specific heat of water
d	:	Base diameter of pile
D	:	Dilution factor corresponding to first dilution
D_c	:	Diameter of smallest circumscribing circle
DC	:	Direct current

D_e	:	Diameter of sphere having the same volume as that of particle
D_{eff}	:	Effective moisture diffusivity
DF	:	Dilution factor
D_{final}	:	Geometric mean diameter of particle after drying
D_g	:	Geometric mean diameter
$D_{initial}$	:	Geometric mean diameter of particle before drying
DR	:	Drying rate
dt	:	Duration of drying
D value	:	Decimal reduction time
E	:	Molar extinction coefficient of betacyanin
E162	:	Betanin food additive
E_C	:	Energy used to drive the conveyor belt
E coli	:	Escherichia coli
E_F	:	Energy used to drive the fan/blower
E_H	:	Energy used to heat the air
E_{IR}	:	Energy used by the infrared heater
EMR	:	Electromagnetic radiation
$E_{supplied}$	:	Energy supplied
E_T	:	Total energy
et al	:	And others
Etc	:	Et cetera
F	:	Frictional force
Fig	:	Figure
FIR	:	Far infrared

FSSAI	:	Food Safety and Standard Authority of India
G	:	Geometry
g	:	Gram
G-glutamyl	:	Gamma glutamyl transpeptidase
GHz	:	Gigahertz
GI	:	Galvanized iron
h	:	Height of the pile
h	:	Hour
h°	:	Hueness
H_2O	:	Water
H_2SO_4	:	Sulphuric acid
ha	:	Hectare
HAD	:	Hot air drying
HA -IR	:	Hot air assisted infrared
HAMW	:	Hot air assisted microwave
hp	:	Horse power
HPD	:	Heat pump drying
IR	:	Infrared
IRD	:	Infrared drying
IRHAD	:	Infrared assisted hot air drying
K	:	Kelvin
k	:	Number of different factors
K	:	Thermal conductivity
KCAEFT	:	Kelappaji College of Agricultural Engineering and Food Technology
kcal	:	Kilocalorie
kg	:	Kilogram
kHz	:	KiloHertz

kJ	:	Kilojoule
kPa	:	KiloPascal
kW	:	Kilowatt
kWh	:	Kilowatt hour
L	:	Latent heat
L	:	Litre
l	:	Major axial length
L	:	Path length
L*	:	Lightness or darkness
LDPE	:	Low density polyethylene
LPU	:	Low power ultrasonography
m	:	Metre
m^3	:	Cubic metre
mbar	:	Millibar
MC	:	Moisture content
M_d	:	Moisture content dry basis
M_e	:	Equilibrium moisture content
MER	:	Moisture Extraction Rate
min	:	Minute
MIR	:	Mid infrared
ml	:	Millilitre
mm	:	Millimetre
M_o	:	Initial moisture content
MOSFET	:	Metal Oxide Semiconductor Field Effect Transistor
MR	:	Moisture ratio
MS	:	Mild steel
MSE	:	Mean Square Error

M_t	:	Moisture content at time t
M_{t+dt}	:	Moisture content at time t+dt
m_w	:	Mass of water evaporated from the product
M_W	:	Moisture content wet basis
MW	:	Molecular weight of betacyanin
N	:	Normal force
N	:	Number of experiments
n	:	Number of repetition
N_1	:	Number of dishes retained in the first dilution
N_2	:	Number of dishes retained in the second dilution
NIR	:	Near infrared
nm	:	Nanometre
NO - NC	:	Normally Open - Normally Close
p_B	:	Bulk density
PC	:	Phenolic content
pH	:	Potential of hydrogen
PRESS	:	Prediction Error Sum of Squares
PT	:	Platinum resistant Temperature sensor
p_T	:	True density
PTFE	:	Poly Tetra Fluoro Ethylene
p value	:	Probability value
PZT	:	Piezoelectric transducer
Q	:	Sensible heat
R	:	Rotational speed of heater
R^2	:	Coefficient of correlation
RH	:	Relative humidity

RMSE	:	Root mean square error
RPM	:	Revolutions Per Minute
RSM	:	Response Surface Methodology
s	:	Second
S	:	Sonication time
S	:	Surface area
S. enteritidis	:	*Salmonella enteritidis*
SEC	:	Specific Energy Consumption
SMER	:	Specific Moisture Extraction Rate
SMPS	:	Switched Mode Power Supply
SS	:	Stainless Steel
SSE	:	Sum of Square Error
T	:	Temperature
$\Delta T/\Delta x$	:	Temperature gradient
T_f	:	Final drying temperature
T_i	:	Inlet air temperature
TPC	:	Total Plate Count
TSS	:	Total Soluble Solids
US	:	Ultrasound
US-C	:	Ultrasound assisted Cabinet
US-HP	:	Ultrasound assisted Heat Pump
US-IR	:	Ultrasound assisted Infrared
V	:	Air flow rate
V	:	Velocity
V	:	Volt
V	:	Volume
V_a	:	Volumetric air flow rate
VFD	:	Variable frequency drive

w	:	Weight
W	:	Watt
wb	:	Wet basis
w_f	:	Weight of sample after drying
w_i	:	Weight of sample before drying