

DECLARATION BY THE CANDIDATE

The candidate certifies that the thesis entitled “**Development of an Integrated Solar Greenhouse Dryer and Performance Evaluation for Ginger Drying in Northeastern Region of India**” is being submitted to **School of Engineering, Tezpur University** in part fulfilment for the award of the degree of **Doctor of Philosophy** in the **Department of Food Engineering and Technology** is a record of research work accomplished by me under the supervision of Dr Manuj Kumar Hazarika, Professor, Department of Food Engineering and Technology.

All assistance received from various sources have been appropriately acknowledged.

No part of the thesis has been submitted elsewhere for the award of any other degree.

Date: 30/11/2024

Place: Tezpur, Assam



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Certificate of the Supervisor

This is to certify that the thesis entitled “**Development of an Integrated Solar Greenhouse Dryer and Performance Evaluation for Ginger Drying in Northeastern Region of India**” submitted to the **School of Engineering, Tezpur University** in part fulfilment for the award of the degree of **Doctor of Philosophy** in the **Department of Food Engineering and Technology** is a record of research work carried out by **Mr. Arun Kumar Choudhary** under my supervision and guidance.

All helps received by **her** from various sources have been duly acknowledged.

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List of Tables

Table 3.1.1 Detail List of the major instruments used	22
Table 3.2.1 Dimension and properties of corrugated SAH with PCM	27
Table 3.2.2 Component and specification of developed integrated solar greenhouse drying system	32
Table 3.2.3 TES material and their properties used in ISGHD for agriculture product drying	34
Table 3.2.4 Outlines the drying models used for studying the drying kinetics of ginger slices ...	42
Table 4.3.1 Shows the performance of SAH and ISGHD system for ginger drying	98
Table 4.3.2 Uncertainty of the parameters during the experiment of ginger drying.....	103
Table 4.4.1 Embodied energy under integrated solar greenhouse drying (ISGHD)	105
Table 4.4.2 Carbon dioxide emission, mitigation, and carbon credits	106
Table 4.4.3 Cost analysis for the developed ISGHD	106
Table 4.4.4 Economic evaluations of the developed ISGHD	107

List of Figures

Fig. 2.1.1 Experimental set-up during solar drying	8
Fig. 2.1.2 Schematic diagram of mixed mode tent solar dryer	10
Fig. 3.1.1 Fresh slices of ginger samples for the experiment	22
Fig. 3.2.1 Illustrates the development process of an integrated solar greenhouse drying system.....	25
Fig. 3.2.2 Flat-type solar air heater	26
Fig. 3.2.3 Corrugated type solar air heater with PCM	27
Fig. 3.2.4 3D Schematic diagram of solar greenhouse dryer	29
Fig. 3.2.5 (a) even span SGHD and (b) parabolic SGHD	29
Fig. 3.2.6 Developed ISGHD system with flat plate type SAH.....	30
Fig. 3.2.7 Developed ISGHD system with corrugated type SAH.....	31
Fig. 3.2.8 The circuit diagram for the flow of DC current in the ISGHD drying system by PV module ...	33
Fig. 3.2.9 Speed controller to control speed of exhaust and blower	33
Fig. 3.2.10 SHS system inside the drying chamber	35
Fig. 3.2.11 PCM system inside the corrugated type SAH.....	36
Fig. 3.2.12 Flow chart of ginger drying by using different drying methods	37
Fig. 3.2.13 Experimental methods for drying ginger and quality characteristics	39
Fig. 3.2.14 Flow chart of energy and exergy analysis for the ISGHD.....	46
Fig. 3.2.15 flow chart for simulation of the dryer using COMSOL Multiphysics	48
Fig. 3.2.16 Flow chart of Environmental and Economic evaluation for ISGHD system.....	50
Fig. 4.1.1 Average of 20 days readings of ambient parameter during (a) Summer and (b) Winter seasons in the northeastern region	55
Fig. 4.1.2 Solar radiation variation in parabolic and even span solar greenhouse dryers	56
Fig. 4.1.3 Variation of outlet temperature on corrugate and flat type solar air heater.....	57
Fig. 4.1.4 Variation of temperature in corrugated type (SAH with PCM) and ISGHD with respect to solar radiation	59
Fig. 4.1.5 Variation of temperature in OSD (Natural convection), SGHD (Passive Mode) and ISGHD (Active Mode) drying method	59
Fig. 4.1.6 Variation of relative humidity in OSD, SGHD and ISGHD drying method.....	60
Fig. 4.1.7 Variation of temperature under ISGHD with and without sensible heat storage (SHS)	61
Fig. 4.1.8 Variation of temperature under OSD and inside drying chamber, ISGHD at SAH with and without PCM.....	61

Fig. 4.1.9 Variation of relative humidity under OSD and inside drying chamber, ISGHD at SAH with and without PCM.....	62
Fig. 4.1.10 Temperature profile of SAH at different (a)MFR 0.0067 kg/s, (b) 0.012 kg/s, (c) 0.018 kg/s and (d) 0.024 kg/s	64
Fig. 4.1.11 SAH output temperature at different MFR at 0.0067 kg/s, 0.012 kg/s ,0.018 kg/s and 0.024 kg/s.....	65
Fig. 4.1.12 Temperature of ISGHD in drying chamber at different MFR	66
Fig. 4.1.13 Relative humidity of ISGHD in drying chamber at different MFR.....	66
Fig. 4.2.1 Flowchart for drying of ginger slices at different drying methods	67
Fig. 4.2.2 Moisture content vs drying time curve for 3.0 mm thickness of ginger slices	68
Fig. 4.2.3 Moisture ratio vs drying time curve for 3.0 mm thickness of ginger slices.....	69
Fig. 4.2.4 Drying rate vs drying time curve for 3.0 mm thickness of ginger slices	70
Fig. 4.2.5 Moisture content vs drying time curve for 5.0 mm thickness of ginger slices	70
Fig. 4.2. 6 Moisture ratio vs drying time curve for 5.0 mm thickness of ginger slices.....	71
Fig. 4.2.7 Drying rate vs drying time curve for 5.0 mm thickness of ginger slices	71
Fig. 4.2.8 Moisture content vs drying time curve for 7.0 mm thickness of ginger slices	72
Fig. 4.2.9 Moisture ratio vs drying time curve for 7.0 mm thickness of ginger slices.....	72
Fig. 4.2.10 Drying rate vs drying time curve for 7.0 mm thickness of ginger slices	73
Fig. 4.2.11 Effect of SAH (with or without PCM) in drying of ginger slices.....	74
Fig. 4.2.12 Moisture diffusivity of ginger slices by using different drying methods.....	75
Fig. 4.2.13 Moisture ratio of predicted and experimental by using different drying models for (a) OSD, (b) ISGHD, (c) TD, and (d) RWD.....	77
Fig. 4.2.14 Experimental and predicted moisture ratio values for ginger drying using the Page model	78
Fig. 4.2. 15 Experimental and predicted moisture ratio value of ginger drying for logarithmic model	79
Fig. 4.2.16 Experimental and predicted moisture ratio value of ginger drying for Newton model	80
Fig. 4.2.17 ANN structure.....	81
Fig. 4.2.18 ANN regression graph of MC, MR, and DR for ISGHD method.....	81
Fig. 4.2.19 Rehydration ratio of ginger slices by using different drying methods, with different letters (a–e) indicating significant differences ($p < 0.05$).....	82
Fig. 4.2.20 Shrinkage ratio of ginger slices for different drying methods, with different letters (a–e) indicating significant differences ($p < 0.05$).....	83
Fig. 4.2.21 Hardness of ginger slices for different drying methods, with different letters (a–e) indicating significant differences ($p < 0.05$).....	84

Fig. 4.2.22 Essential oil of ginger slices for different drying methods, with different letters (a–e) indicating significant differences ($p < 0.05$).....	84
Fig. 4.2.23 Colour properties of ginger slices for different drying methods, with different letters (a–f) indicating significant differences ($p < 0.05$).....	85
Fig. 4.2.24 Antioxidant properties of ginger powder under different drying methods, with different letters (a–e) indicating significant differences ($p < 0.05$).....	87
Fig. 4.2.25 X-ray diffraction pattern of ginger powder for different drying methods	88
Fig. 4.2.26 Fourier transform infrared spectra of ginger powder for different drying methods	89
Fig. 4.2.27 Scanning electron micrographs of (a) OSD, (b) SGHD, (c) ISGHD, (d) TD, and (e) RWD....	90
Fig. 4.3. 1 Thermal energy rate of corrugated type SAH at various mass flow rates	91
Fig. 4.3.2 Thermal efficiency of corrugated type SAH at various mass flow rates	92
Fig. 4.3.3 Thermal energy rate of ISGHD system at various air flow rates.....	93
Fig. 4.3.4 Thermal efficiency of ISGHD at various flow rates.....	94
Fig. 4.3.5 Exergy input, exergy output and exergy loss of ISGHD at various flow rates.....	95
Fig. 4.3.6 Exergy efficiency of ISGHD at various mass flow rates.....	96
Fig. 4.3.7 Energy and exergy efficiency of ISGHD over three consecutive days with respect to solar radiation.....	97
Fig. 4.3.8 Generated mesh for the computational domain for ISGHD	99
Fig. 4.3. 9 Thermocouple placed inside the drying chamber during the experiment.....	99
Fig. 4.3.10 Air turbulence flow inside the drying chamber of ISGHD.....	100
Fig. 4.3.11 Air profiling inside the drying chamber of ISGHD	100
Fig. 4.3.12 Temperature distribution vs time in solar greenhouse dryer at 0.018 kg/s air flow rate.....	102
Fig. 4.3.13 Simulated and experimental temperature value inside the drying chamber at 0.018 kg/s air flow rate.....	103
Fig. 4.4.1 Embodied energy percent distribution chart of ISGHD	104
Fig. 5. 1 Scheme of solar greenhouse drying system assisted with biomass-fired air heater.....	115

Nomenclature

List of abbreviations

A	Area (m ²)
ANFIS	Adaptive Neuro Fuzzy Inference system
ANN	Artificial Neural Network
a, b, c	Model constant
C _a	Specific Heat in (J/kg)
CFD	Computational Fluid Dynamics
DR	Drying rate (kg water/kg dry matter*h)
E	Energy rate (W)
Ex	Exergy rate (W)
EPBT	Energy Payback Period (year)
I	Solar radiation (Wm ⁻²)
ISGHD	Integrated Solar Greenhouse Drying system
L, a, b	Colorimetric parameters
L	Latent heat of fusion (J/kg)
MC	Moisture content (%)
MR	Moisture ratio dimensionless
M ₀	Initial moisture content (kg water/kg dry matter)
M _t	Final moisture content (kg water/kg dry matter)
M _e	Equilibrium moisture content (kg water/kg dry matter)
m _a	Mass flow rate of air (kg/s)
m _w	Mass of moisture (kg)
n	Model constants
N	Observations number
PCM	Phase Change Material
Q	Heat transfer rate (J/kg)
R ²	Coefficient of determination
R	Uncertainty function
RMSE	Root Mean Square Error
SAH	Solar Air Heating

SGHD	Solar Greenhouse Drying system
SEC	specific energy consumption (kWh/kg)
T	Temperature (°C)
t	Drying time (h)
ΔR	Total uncertainty

Greek symbols

η	Efficiency (%)
λ	Water latent heat of evaporation (J/kg)
χ^2	Chi-squared
τ	Transmissivity
α	Absorptivity

Subscripts

<i>a</i>	Air
<i>amb</i>	Ambient
<i>ev</i>	<i>Evaporation</i>
<i>exp</i>	experimental
<i>ex</i>	Exergy (W)
<i>i</i>	Inlet
<i>o</i>	Outlet
<i>in</i>	Inflow
<i>out</i>	Outflow
<i>pre</i>	Predicted