Effect of Humidity And Temperature on Mango Leather

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Abstract- *Mangoes are native to south Asia from where the mangoes are distributed to the worldwide to become one of the most cultivated fruit in tropical region. Konkan area is most popular for production of mango. The Alphanso mangoes which are worldwide popular is the main crop product in konkan area. In this project we have considered usefulness of automatic mango pulp dryer and their acceptability in food industry. Traditional method of mango pulp drying is time consuming and unhygienic. It is also depend on environmental condition. The motive behind project used is to design automatic mango pulp dryer and to investigate effect of humidity and temperature on mango leather by using temperature and humidity sensor.*

Keywords- Automaticdryer, mango leather, relative humidity, temperature, drying time.

I. INTRODUCTION

Automatic dryer is a setup which is most commonly used in various food industry for making various mango products such of *amba-barfi, Ambapoli, Muramba, Ambawadi, Amba-modak* . Traditionally it is prepared by mixing sugar in mango pulp and kept it in sunlight for drying. It takes around 7 to 8 days to dry it. The main limitation is that in this traditional method of drying we cannot dry the product in cloudy day; it needs very bright sunlight to dry this. Traditional method of drying is possible only in summer season. In other seasons, conditions are not favorable for drying hence, production of *Ambapoli* in other season is not possible. Alternate way of drying *Ambapoli* is heating it in electc drier. But direct heating of pulp in electric drier causes the burning of sugar content present inside the mango pulp in absence of relative humidity. This causes the blackening of *Ambapoli*. Hence, providing humidity by supplying steam blackening of Mango leather can be avoided.

II. LITERATURE REVIEW

S. Jaya and H. Das [1] studied a vacuum drying model for mango pulp. Vacuum drying of mango pulp at varying conditions of pulp thickness (2,3 and 4mm) and vacuum chamber plate temperature (65,70 and 75°C) was carried out under 30-50mm of mercury absolute pressure. Colour change of mango pulp was found to depend on pulp thickness and pate temperature. To get low colour change vacuum drying should be carried at maximum pulp thickness of 2.6mm and vacuum chamber plate temperature of 72.3°C. The heating plate at 75°C temperature or lower and vacuum in order of 50mm of mercury absolute and less is normally used for drying. Since, increase in thickness of material increases drying time. Hence, relationship between change in moisture content and time of drying with respect to thickness of material and drying temperature need to be studied. This paper aims at finding out the relationships for moisture content variation and colour of dried product during vacuum drying of mango pulp.

P. Rajkumar, R. Kailappan *et al*[2] studied the drying characteristics of foamed alphanso mango pulp in a continuous type foam mat dryer. Trials were conducted for foam mat drying of mango pulp using batch type cabinet dryer. From the trial it was observed that foamed mango pulp dried at 60°C with 1mm foam thickness was found to be the best result. Parameters such as viscosity, stickiness and specific heat values were determined. The drying study showed that time required to dry fresh(non-foamed) and foamed mango pulps were 75 and 35min, respectively. Quality of foamed dried pulp is lower than the non-foamed dried pulp. Moisture diffusion and drying rate were higher in foamed mango pulp. The dryer has a scope to increase the capacity for industrial applications.

Kalra and Bharadwaj[3] conducted an experiment on solar drying of fruits and vegetable products by using simple solar dehydrators. It took about 7hours to reduce moisture content from 83% to 6% compare to about 9hours needed in open atmosphere for getting 8% moisture. The quality of product is more superior than the quality produced in open sun dried product.

Sagar and Khurdiya[4] work on simple method of preparing dehydrated ripe mango by using standardized cabinet drying techniques has been standardized.

The mango slices were heated for 2minutes in equal amount of 70°C Bricks sugar syrup in the presence of 0.1%KMS at 90°C and after drying in cabinet dryer at 58°C gave the best dehydrated products. The addition of sugar to the slices improved the solid contents and chewing characteristics of dehydrated mango slices. For storage of dehydrated mango slices, 260 gauge aluminium laminated poly ethylene pouches were found to be better as compared to 400 and 200 gauge pouches with respect to its colour, flavour, texture and overall quality.

III. METHODOLOGY

3.1 Description of unit:

It contains all the detailed design and calculation of the heating chamber. These calculations are carried out according to the various factors that are necessary to maintain the required conditions for drying inside the chamber. According to the required relative velocity and ideal temperature for heating, various components required for fabrication are decided.

IV. DESIGN OF DRYER

4.1 Tray size:
A_t =300×200 mm^2

4.2 Design of Cabinet:
A_c = 350×250 mm^2

4.3 Selection of Fan:
CFM = A_t × 10.76 × 400
CFM = 258.24
Hence, select fan with 400 CFM.
Q_1 = Quantity of air
Q_2 = Quantity of steam
Q_3 = Mixture of quantity of air and steam
1CFM = 0.0004719 m^3/s
Q_3 = 0.1889 m^3/s
We have,
Q_2 = 0.0188 m^3/s
Therefore, Q_1 = 0.17 m^3/s
m1 = ρ × Q_1
m1 = 0.2 kg/s
Heater Capacity = m1×Cp×Δt
=0.02 × 1.005 × (55 – 30)

Heater Capacity = 0.5 KW

Design of steam inlet diameter:

V = natural velocity of air = 3 m/sec

Area of tray = $\frac{12" * 8"}{144}$ = 0.667 sqft.

$(\rho)_{air} = \frac{P}{RT} = \frac{1.013*10^5}{287*35} =$ 1.1465 kg/m^3 -

$m_1 = (\rho)_{air} * V$
=1.1465*0.18878
m_1= 0.2164 kg/s

Mixing of two mixtures:

$$\frac{m1}{m2} = \frac{T3-T2}{T1-T3}$$

m_2=0.08323 kg/sec.
$m_2 = \rho_2 * Q_2$

$(\rho)_{steam} = \frac{P}{RT}$

$(\rho)_{steam}$ = 1.1039 Kg/m^3

Q_2= 0.075396 $\frac{m^3}{sec}$

Applying Bernoulli's Theorem

$$\frac{P1}{\rho g} + \frac{V1^2}{2g} + Z1 = \frac{P2}{\rho g} + \frac{V2^2}{2g} + Z2$$

V_2 = 473.27 m/sec

$A_2 = 1.5930 * 10^{-4}\ m^2$

$A_2 = \frac{\pi}{4} * D_2^2$
D_2 = 0.014242 m
D_2 = 1.4242 cm

V. FABRICATION OF DRIER

Based on design calculations drier is fabricated. Metal sheet is the material used and asbestos for insulation.

5.1 Heater

A heating element converts electricity into heat through the process of resistive or Joule heating. Electric current passing through the element encounters resistance, resulting in heating of the element.

5.2 Blower

Primary function of the blower is to provide and accommodate a large flow of air to various parts of cabinet. This is achieved by rotating a number of blade, connected to hub and shaft and driven by motor. A blower of 2100rpm is used.

5.3 Sensors

DHT(Digital Humidity and Temperature) sensors consists of capacitive humidity sensor and thermistor. Analog to digital converter to split out digital signals to display temperature and humidity.

5.4 Arduino

Arduino uses single board microcontroller and microcontroller kit for creating digital devices and interactive objects. The board are equipped with the sets of digital and analog input or output pins that may be interfaced to various expansion boards or breadboards and other circuits. The Arduino provides an integrated development environment based on the Processing Language project.

VI. EXERIMENTATION

Experimentation is carried at various temperatures. And reading of dry bulb temperature and wet bulb temperature are recorded. From dry bulb and wet bulb temperature, relative humidity is calculated and recorded in table.

First, sensible heating is carried out at various temperatures. Then for the same temperature, steam is added in cabinet for humidification, keeping the solenoid valve fully open. Steam flow is kept for each experimentation. The readings for corresponding temperature are recorded.

6.1 Experimentation Result:

Sample is heated in the mango pulp drier for 6 hours at 55^0C and observation s are recorded.

Without humidification

With humidification

Sample is heated in the mango pulp drier for 5 hours at 65^0C and observation s are recorded.

Without Humidification

With Humidification

Sample is heated in the mango pulp drier for 4 hours at 75^0C and observation s are recorded.

Without Humidification

With Humidification

VII. RESULTS AND DISCUSSION

According to the observation tables for each temperature, the result table is drawn. The result table of products is as follows:

Table No. 7.1 Heating at 55°C heater temperature

Description	Average Temperature		RH
	DBT	WBT	
Sensible Heating	52	37	35%
Heating with Humidification	52	40	50%

Table No. 7.2 Heating at 65°C heater temperature

Description	Average Temperature		RH
	DBT	WBT	
Sensible Heating	59.4	41	32%
Heating with Humidification	59.5	48.12	52%

Table No. 7.3 Heating at 75°C heater temperature

Description	Average Temperature		RH
	DBT	WBT	
Sensible Heating	67.125	42.8	25.3%
Heating with Humidification	69	50	51%

From above table it is observed that for 55°C, 65°C and 75°Ctemperature ranges relative humidity decreases with increase in temperature and also drying time decreases. Hence, to maintain required relative humidity, humidification process is implemented. Blower is mounted to maintain air velocity inside the chamber equal to natural velocity of air under normal conditions.

VIII. RESULT ANALYSIS

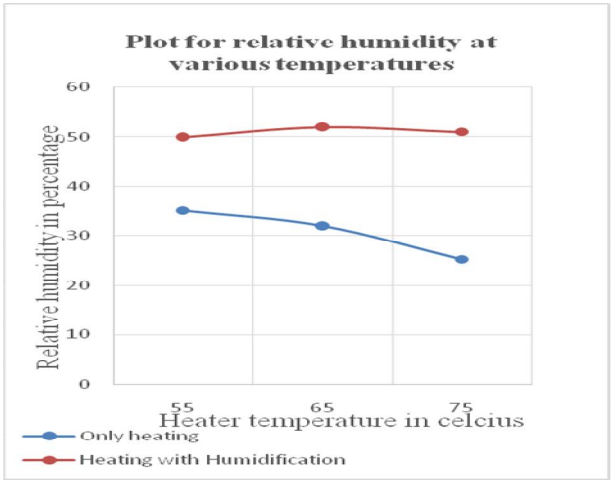

Fig. 8.1 Plot for effect of heating and humidification on relative humidity at various temperatures

IX. CONCLUSION

Based on result obtained on batch type drying, a mango pulp having weight 40grams is dried in dryer. It can be seen that as temperature of heater increases effect of humidity decreases. Required relative humidity is maintained at 65^0C.power saved is 4%. Carbon decomposition on mango leather can be prevented and color is improved by providing steam for humidification.

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