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Optimization Process Parameters of Foam Mat Drying in Totapuri Mango Pulp with Foaming Agent GMS

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A B S T R A C T

Mango is widely preferred because of its excellent flavour and nutritional quality. Mango pulp from *Totapuri* was extracted and then was subjected to foam mat drying along with 5, 7, and 9% GMS and later with egg white as foaming agents and then dried at temperatures of 60, 70 and 80°C. Weight loss was used to estimate change in moisture ratio with respect to time and effective diffusivity. Three thin layer drying models were fitted to get the best fit model, which was selected on the basis of various statistical parameters. Wang and Singh model was found to be best in almost all cases. Nutritional status in terms of ash content was estimated and it was observed that there was significant effect of drying temperatures, GMS and egg white concentration. Based on above parameters it was resolved that foam mat drying using 5% GMS and egg white at 60°C air- drying temperature was the best combination.

Introduction

Mango *(Mangifera indica L)* is a highly seasonal tropical fruit, very popular among millions of people in the tropics. It also occupies a prominent place among the best fruits of the world. However, it is in constant demand, there is a pre-harvest scarcity and at times a post-harvest glut for this fruit. Mango is currently ranked 5th in total world production among the major fruit crops (FAO, 2004). Global production of mangos is concentrated mainly in Asia and more precisely in India being the leading producer in the world. Mango commonly known as king of fruits is a major fruit in Asia and around the world. India being the largest producer of mango contributes 37% of 30.5 million tons of global production (Hymavathi and khader, 2005). The *Lalpatta* variety is mainly cultivated in India and Pakistan (Rathore *et al.,* 2007). In India, the name *Lalpatta* is believed to be derived from that of a village between Hyderabad and Tamil Nadu.

The genesis of this variety was as a result of a superior chance-seedling in the *southern* garden. It is well distributed all over the Indo-Gangetic plain and Bengal in the North, and as far as Hyderabad (Deccan) in the South. Thus, *Lalpatta* is one of the most popular mango varieties in Southern India (Gupta and Jain, 2014).

The fruit has excellent flavor, attractive colour, and delicious taste with high nutritional value. Due to higher moisture content (85%), it has very poor keeping quality and cannot withstand any adverse climatic conditions during results in loss of 30 per cent of fruits every year (Thind, 2002). India dominates the world trade of processed mango, though hardly 1-2% of the total mango produced in India is processed. However, only 20% of the processed mango products is being exported, out of which mango pulp accounts for 80% of the exported products. The post-harvest losses of mango were estimated at around 25 - 40% (Vijayanand *et al.*, 2015). To increase the availability of this fruit throughout the year, the surplus production must be processed into a variety of value-added products (Saxena and Arora, 1997; Srinivasan *et al.*, 2000; Singh *et. al.*, 2005).

Mangos can be processed into a number of unique products such as dried mango pieces, chutney and mango leathers (Azeredo, *et al.*, 2006). Dried mango products could successfully serve this purpose. Processing of mangos enables exporters to serve their markets even during 'off season' periods for fresh fruits. In addition, the mango varieties have a length and width of 9.87 and 4.80 cm respectively.

Fruit weight of 175.62 g, seed weight of 22.99 g, peel weight of 33.47 and pulp weight of 115 The fruit size ranges from small to medium having average dimension of 13^8 cm and weighs between 130 and 260 g; it's shape ranges from oblong to oblong-oblique; and has a rounded to obliquely rounded base. It has sweet taste, pleasant flavor, firm flesh, attractive cadmium yellow pulp and has no fiber. It may have scanty or moderately abundant juice. It also has good keeping and peeling quality (Gangolly *et al.*, 1957).

In terms of physicochemical properties, the *Lalpatta* mango matures in 116 days and produces about 34 fruits per panicle with each fruit producing 141 mg (per 100 g) of vitamin C (Jilani *et al.*, 2010). Among which 69 species are mostly confined in the tropical region (Medina and Garria, 2002).

Materials and Methods

The experimental studies were carried out in the Department of Food Process Engineering, Vaugh Institute of Agricultural Engineering and Technology, SHUATS Allahabad. The methodology adopted has been described under the following headings.

Plan of work

Every research study is based on an experimental plan shows the basic experimental structure which was followed to conduct this study. Fresh mango *(Magnifera indica* L.) *Totapuri and Dushehri* was purchased from local fruit sellers in Allahabad, India, Saharanpur Up India, Rohtak Haryana India. As soon the mangoes were purchased they were subjected to the processing for the development of the product.

GMS (Glycerol mono stearate) was purchased to be used as one foaming agent. Egg white was purchased from the local vendors and was separated for whites to be used as the foaming agent for the process.

Extraction of mango pulp

Fresh fully ripe sound *Totapuri* mangoes will be used for extraction of pulp. Firstly ripe mangoes were washed within clean water then fruits were peeled by knife. Pulp will be collected by squeezing the flesh of mangos. The pulp was blended in an electric blender. The mango pulp contains 15.1% total solid. It will be stored in a deep freeze at a temperature of -18°C for future use.

***Totapuri* mango**

Processing of mango pulp

The mango was kept at refrigeration temperature until the time of the experiment. The mango was removed from the refrigerator before conducting an experiment and kept at ambient temperature for 2 hours to achieve equilibrium. The mango was peeled and then sliced into rectangular slabs of an average thickness of 5 mm each. Fresh mango pulp contains 15.1% of total solid. So pulp TSS %age should be increase for quality mango pulp processing. First all fresh mango pulp poured into a bowl. Then the bowl will be heated at 80-90^C until Total Soluble Solid (TSS) %age become 30.

Preparation of mango pulp

At first processed mango, pulp will be taken and weighted by a balance. Then total mango pulps will be separated into three parts in order to processing of three kinds of sample. After that mango pulps will be mixed with weighted according to the described formulation. Mixed pulp will be heated at 60-80 C for 30 minutes and cooled. Then mixture will be placed on a steel tray and smeared with very thin layer of polyethylene to preserve sticking of mango pulp after drying. The mixture will be dried by using tray dryer with constant temperature 70°C a maximum period of 6.5 hours. After drying sheet will be cut into (4"x1"xvarious thickness) bar form. The mango pulp were packed with high density polyethylene bag and low density polyethylene bag and stored at room temperature.

Sensory analysis of finished product

Sensory attributes including color, aroma, taste and overall acceptability is determined by hedonic rating tastes as recommended by Ranganna (2007). Hedonic rating taste is used for evaluation of sensory characteristics. This test is used for acceptability by consumer for the product. The detail methodology is presented below. A panel of 5 expert judges of different age group having different habit will be selected and sample will be serving to them.

Results and Discussion

This chapter deals with the results of all testing performed on the final samples of "Optimization process parameters of foam mat drying in mango pulp" to show that which sample or samples are the best and appropriate for the foam mat drying purpose. This chapter has been completed by considering all the parameters and results for each sample.

Drying characteristic of mango pulp

The chemical, physical, and organoleptic evaluation of mango leather had been carried out. Studies on quality were based on physicochemical analysis (i.e., moisture, ash content, foaming density, foaming stability and texture analysis) and characteristics, which were determined for fresh and stored samples.

The moisture content of mango leather increased linearly with increase in concentration of mango pulp. The results for moisture content of mango leather was similar with the results obtained by the researchers who in-corporated papaya in preparation of the papaya leather and found that moisture content was found to increase with coarse of time. Moisture reduction was higher at initial stages and then started to decrease with the increasing of drying time. Concentrations of foaming agent and drying temperatures have significant effect on drying process. *Totapuri* mango foamed with 9% GMS & Egg white concentration took less than time with 7% and 5% GMS & egg white. Drying time was lower at 80°C as compare to 70°C & 60°C. For all experiments moisture content was higher at initial stage of drying and after then decreased with coarse of time. Graphically representation was shown in fig.

In *dussehri* mango pulp, % moisture score for control sample was found to be 9.2% at temperature 60°C for 420 min, GMS 5% sample moisture was 8.8 % at 60°C for 420min,, GMS 7% 8.2 % was 60°C in 420min,, GMS 9% sample have moisture content % at 60°C for 420 min shown in figure 4.2

In *Totapuri* mango pulp, % moisture score for control sample was 9.3 % at temperature 60°C at 420 min, Egg white 5% sample have moisture content of 8.1 % at 60°C for 420min Egg white 7% sample have 8.0 % at 60°C for 420min, Egg white 9% sample have 7.3 % moisture at 60°C for 420min Similarly for sample at 70 and 80°C respectively shown in figure. The mango blend contains mango pulp and foaming agents to retain the moisture.

In *totapuri* ash content in the food stuff represents inorganic matters remaining after the organic matters have been burnt. The % ash score for sample A(control)was 1.81%, 1.77 % GMS 5%, 1.53 % GMS 7%,1.47 % GMS 9%,1.75 % Egg white5%,1.54 % Egg white 7%,1.49 % Egg white 9%. Similarly sampleat70 and 80°C show decrease in ash level which shows the effect of different treatment and storage periods on % ash content.

Table.1 Effect of Egg white concentration and whipping time on foam stability of mango pulp (Totapuri)

S. No.	Variables/Parameter	Levels	Description
1	Product	2	Mango Pulp(totapuriMango)
			Foaming agent (Glycerol mono stearate &
2	Ingredients	6	Egg white) with varying concentration of 5, 7, and 9%.
3	Processing	3	Tray Dryer (60°C, 70°C, 80°C)
4	Physico-chemical Analysis	6	Moisture Content, Total ash, Ph, Foaming density, Foaming stability, Foaming Expansion
			[Control sample 2 + sample with foaming
5	Total Sample	216	agent (2 mango variant x 4 ratio of foaming agents)] x thee different temperatures (60°C, 70°C, 80°C) x 3 replication = 90

Fig.1 Effect of GMS Foaming Agents Concentration on Moisture Content During Drying at 60°C Temperature

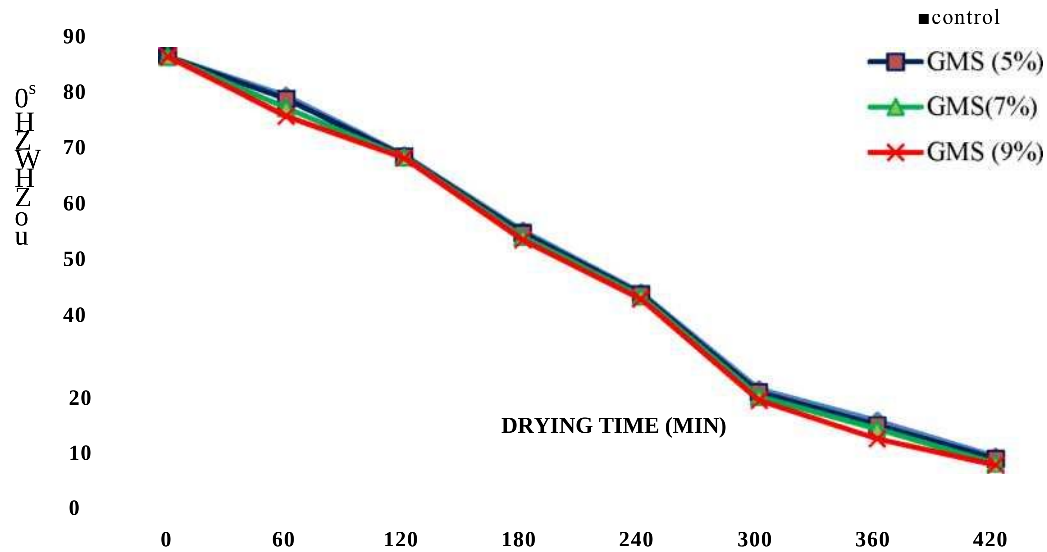

Fig.2

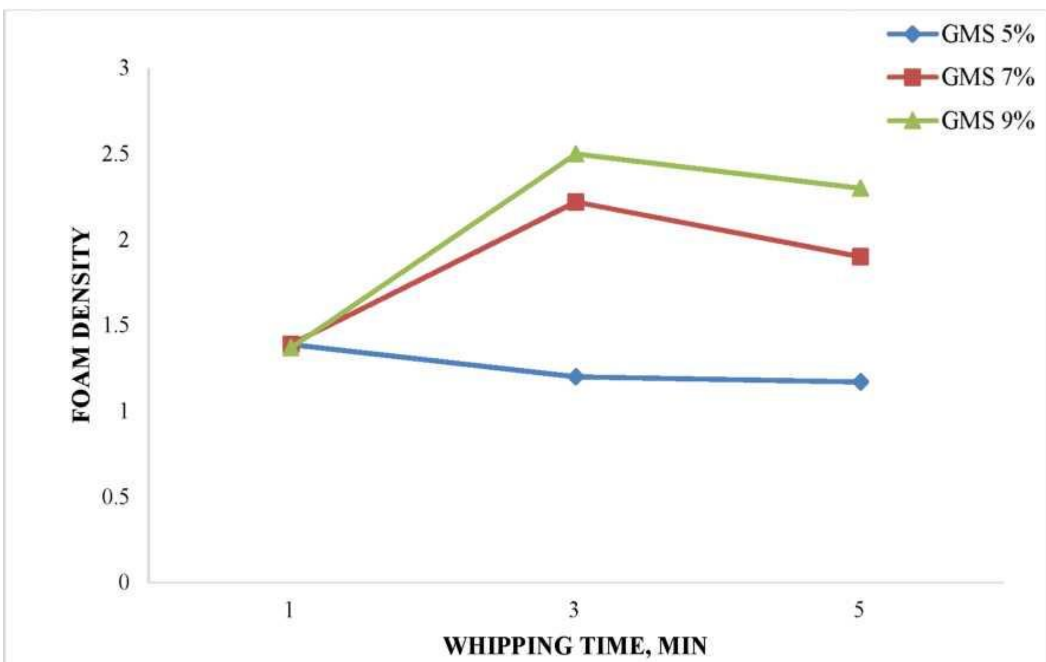

Fig.1 Effect of different treatments on Ash content of *Dussehri* mango pulp

In ***totapuri*** mango pulp, ***%*** moisture score for sample control 9.3 ***%*** at temperature 60°C in 420 min, GMS 5% 8.9 % was 60°C in 420min,, GMS 7% 8.1 % was 60°C in 420min,

It is evident that the calculated value of F due to treatment is greater than the tabulated value at 5 % probability level From the ANOVA. Therefore it can be concluded that significant effect of ash content of sample A, B, C and D.

Mango pulp having GMS 5%,7% and 9%, the increase in volume of foam was 20%,21.66% and 25% for totapuri and 25%,28.33% &31.66% respectively when whipped for 1 min.

While the mango pulp foam was whipped for 3 min having GMS concentration 5% &7% is expended upto 95% whereas for 9%GMS concentration, Mango pulp foam is expended upto 66.66%. Increase in whipping time from 3 and 5 min the volume of mango pulp foam expended to 63.33%, 71.66% & 81.66% for Totapuri and 76.66%, 93.33% & 101% for dussehri for GMS concentration 5%, 7% & 9% respectively. The effect of duration of whipping on foam expansion in mango pulp at different concentration of GMS and egg white.

Mango pulp having egg white 5%,7% and 9%, the increase in volume of foam was 23.33%,25% and 30% for totapuri and 25%,28.33% &31.67% respectively when whipped for 1 min. While the mango pulp foam was whipped for 3 min having egg white concentration 5% &7% is expended upto 95%, whereas for 9% egg white concentration, Mango pulp foam is expended upto 66.66%.

Increase in whipping time from 3 and 5 min the volume of mango pulp foam expended to 63.33%, 71.66% & 81.66% for Totapuri and 70%, 91.66% & 101.66% for dussehri for egg white concentration 5%, 7% & 9% respectively.

Foam stability reflects the water holding capacity of the foam and one way to determine the rate at which the liquid drains from it (Kampet*al.* 2003).The stable foam structure is desirable for rapid drying and ease of removing the dried material from the tray. If foams break or drain excessively, drying time is increased, reducing product quality. The stability/drainage volume of foam is influenced by the thickness of the interface, foam size distribution, interface permeability, and surface tension. The concentration of foaming agent is one of the major factors in foam stability. It is seen that the foam with higher concentration of GMS exhibited more stability as compared to lower concentration of GMS. However, crease in pulp concentration caused decrease in stability of foam and increase in drainage volume. Increase in GMS concentration caused stability of foam or decrease of drainage volume.

Foam stability reflects the water holding capacity of the foam and one way to determine the rate at which the liquid drains from it. The drainage is accompanied by a progressive thinning in the lamella and can increase the probability of the film of the foam volume over the course of time. The stable foam structure is desirable for rapid drying and ease of removing the dried material from the tray. If foam break or drains excessively, drying time is increased, reducing product quality. The concentration of foaming agents is one of the major factor in stability.

Effect of GMS and whipping time on foam density of tomato pulp. The foam density measured after incorporating the air into the tomato pulp by whipping. During whipping process, air is brought in to liquid puree and entrapped in the liquid as bubble. Density of tomato puree decreased from 0.93 g/ml to 0.54/ml for concentration 0.50-1.00% when whipped for both concentrations 0.50% and 0.75% and foaming density increase to 0.71 g.ml for 1.00% when whipped for 3 min. Decrease in the foam density indicate that more volume of air trapped in the foam during whipping process. Requirement to produce easily detrayable foams after drying is dependent on the ability to produce foams with low densities between 0.4 to 0.6 g/ml (Ratti and kudra, 2006).

The present investigation on “Optimization process parameters of foam mat drying in mango pulp” prepared from mango pulp and foaming agents was undertaken in the Department of Food Process Engineering, Vaugh School of Agriculture Engineering and Technology, Sam Higginbottom University of Agriculture, Technology and Sciences Allahabad. In the present investigation efforts were made to enhance the nutritional quality of mango pulp by incorporating mango, foaming agents (Glycerol mono stearate & Egg white).

*Totapuri*mango samples using different concentration of GMS (5, 7 & 9%) of which 5% was found to be most effective with respect to foam mat drying.

*Totapuri*mango samples using different concentration of Egg white (5, 7 & 9%) of which 5% was found to be most effective with respect to foam mat drying.

No significant changes were observed in ash content on *dussehri*samples with foaming agents.

Foam expansion was highest for *totapuri*for GMS concentration 9% 25.Foam expansion was highest for *totapuri*for Egg white concentration 9% 28.33.Foam stability was highest for *totapuri*for GMS concentration 9% 60.Foam stability was highest for *totapuri*for Egg white concentration 7% 56.25.Foam density was highest for *totapuri*for GMS concentration 5% 1.38.Foam density was highest for *totapuri*for Egg white concentration 5% 1.35.The above research works showed that the Mango pulp treated with foaming agent shows reduce in moisture content and increase in drying rate as compare to normal mango pulp without foaming agent. Foaming volume was also found to increase in treated mango samples. Ash content remains the same in all treated samples. Weight loss was used to estimate change in moisture ratio with respect to time. From all treated samples foam mat drying using 5% egg white and 5% GMS at 60°C air drying temperature shows best results. Further increase in egg white and GMS concentration either had similar or negative impact on drying.

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