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Foam-mat Drying of Papaya (Carica Papaya L.) using Glycerol monostearate as Foaming Agent

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Abstract

The study was carried out to production of papaya powder using glycerol mono-stearate as foaming agent under foam-mat drying technique. Foaming, drying, reconstitution, quality and sensory attributes of dried papaya powder were investigated. Foams were prepared from papaya pulp by adding different concentration of glycerol monostearate (1, 2, 3 and 4% w/w) at whipping time of 5, 10 and 15 min. The foam expansion was significantly influenced by pulp concentration and levels of the foaming agent at 1% level. The maximum stable foam formation was 90% at 3% glycerol monostearate with 9°Brix pulp concentration and whipping time of 10 min. The resulting foams were dried at air temperatures of 60, 65 and 70°C with foam thickness of 2, 4, 6 and 8 mm in a batch type cabinet dryer under air flow rate of 2.25 m^3/min. Lower drying temperature and higher foam thickness resulted in longer drying time. Biochemical and sensory properties of fresh papaya fruit and reconstituted juice from foam-mat dried papaya powder were determined. Biochemical analysis results showed a significant ($P \leq 0.05$) reduction in ascorbic acid, β-carotene and total sugars in the foamed papaya dried product at higher foam thickness (6 and 8 mm) and temperature (65 and 70°C due to destruction at higher drying temperature and increasing time. There was no significant change in other biochemical constituents such as pH and acidity. The sensory attributes of papaya powder juice were significantly ($P \leq 0.01$) influenced by drying temperature and was compared with fresh papaya juice. The papaya powder obtained from the foam thickness of 4 mm and dried at 60°C was found to be optimum to produce the foam-mat dried papaya powder.

Keywords: papaya pulp, glycerol monostearate, whipping, foam expansion, foam thickness, drying, moisture content

1. Introduction

Papaya (*Carica papaya L.*) is one of the important fruits of tropical and subtropical regions in the world. The fruit is rich in β-carotene, vitamin-A and C, iron, calcium, protein, carbohydrates, phosphorous and good source of energy. Papaya can be made into jam, jelly, nectar, dried into slabs, canned in the form of slice and the fruit powder can be used for preparation of nectar, ice cream flavour, ready to eat fruited cereals. India is the leading producer of papaya and its share in the world production about 37% (NHB 2009). Most fruits including papaya have high moisture content and are highly perishable, can not be preserved for longer period of time results massive losses. The total postharvest losses of papaya worked out to 25.49% (Gajanana *et al.* 2010). The climacteric nature, high tendency to deteriorate in ambient storage conditions and inadequate preservation techniques are some of the reasons for losses associated with the commodity. When the moisture is removed, it can be preserved over a longer period of time with minimal deterioration. Among the several methods of preservation, air drying is one of the common methods for preservation of foodstuffs, offering dehydrated products that have extended shelf life. However, the quality of conventionally air dried products is often lower compared to the original material, particularly the color, rehydration ratio, texture, and other characteristics (Ratti 2001). This could be due to the long exposure of food to heat during drying. Thus, the dehydration time needs to be minimized to avoid loss of nutritional and sensory qualities.

Developed by Morgan *et al.* (1961), foam-mat drying is a process by which a liquid concentrate along with a suitable foaming agent is used to whip to form stable foam and is subjected to dehydration in the form of a thin mat of foam at relatively low temperature. Rate of drying in this process is comparatively very high because of an enormous increase in the liquid-gas interface, in spite of the fact that the heat transfer is impeded by a large volume of gas present in the foamed mass (Martin *et al.* 1992). Drying occurs in multiple constant rate periods due to periodic bursting of successive layers of foam bubbles, thus exposing new surfaces for heat and mass transfer as the drying progresses (Chandak & Chivate 1972). This method is suitable for any heat sensitive, sticky and viscous materials which cannot be dried by spray drying (Hart *et al.* 1963; Berry *et al.* 1965). The foam-mat

dried products has better reconstitution properties and are superior to drum and spray dried products (Morgan *et al.* 1961; Chandak & Chivate 1974). Foaming of liquid and semisolid materials has long been recognized as one of the efficient methods to shorten drying time. In the recent years, foam mat drying technology has revamped and renewed attention for its added ability to process hard-to-dry materials to produce products of desired properties, retaining its volatiles that otherwise would be lost during the drying of non foamed materials (Kudra & Ratti 2006).

Over the years, the foam-mat drying have been applied to many fruits including coffee extract (Chandak & Chivate 1974), mango, banana, guava, apple (Jayaraman *et al.* 1974), mango (Baldry *et al.* 1976), egg (Rao *et al.* 1987), soymilk (Akintoye & Oguntunde 1991), tomato and pine apple (Jayaraman 1993), pine apple (Hassan & Ahmed 1998), star fruit (Karim & Wai 1999a), cowpea (Falade *et al.* 2003), bananas (Sankat & Castaigne 2004), mango pulp (Rajkumar *et al.* 2007a), banana (Thuwapanichayanan *et al*. 2008), mango (Alakali *et al*. 2009), plantain and cooking banana (Falade & Okocha 2010), mango (Kadam *et al*. 2010), tomato juice (Kadam & Balasubramanian 2011), Mandarin powder (Kadam *et al*. 2011a) and bael fruit pulp (Bag *et al*. 2011). Since there is no report showing its application to papaya, the investigation has been carried out with the specific objectives (a) to optimize the concentration of papaya pulp and foaming agent (b) to study the drying characteristics of foamed papaya concentrate (c) to analyses the nutritional qualities of foam mat dried papaya powder**.**

2. Materials and Methods

2.1 Selection of fruits and foaming agent

The papaya fruits used for this study were obtained from local orchard at Coimbatore, Tamil Nadu. The fruits were washed in running water and kept at room temperature till the desired peel colour is attained. Fully ripened fruits were peeled manually using a stainless steel knife and the flesh portions were pulped using a mixer grinder (Sumeet, India) and the pulp was passed through a sieve of IS 50. Biochemical analyses of fresh papaya pulp namely acidity, pH, TSS, total sugars, ascorbic acid and β-carotene contents were carried out to evaluate their relative loss during foam mat drying as per the method described by Ranganna (2000). The pulp was placed in sterilized stainless steel container and sealed. The pulp in the sealed container was heated in boiling water for 15 min to inhibit microbial and enzyme activity. During foaming trials, the desired pulp concentration (°Brix) was prepared by mixing calculated amount of distilled water. Glycerol monostearate (GMS) was selected as foaming agent cum stabilizer and was used within the limits stipulated in the Prevention of Food Adulteration Act (1955) of the Government of India. A suspension of GMS was prepared by a known weight of GMS powder was added into a measured amount of hot distilled water (100°C) to get 20% (w/w) GMS suspension. The suspension was blended in a Kenwood mixer for 1-2 min, at maximum speed, until a smooth suspension was formed and then kept at room temperature until ready for use (Oguntunde & Adeojo, 1992). The suspension was added to papaya pulp at 1, 2, 3 and 4% (w/w).

2.2 Foaming experiments

The laboratory scale foaming device consisting of 153 mm diameter and 280 mm height cylindrical stainless steel container with graduated scale at inside was connected to a nozzle at bottom. A rubber tube of one end was connected to the nozzle and other end with an air compressor. A regulating valve was installed for monitoring compressed airflow rate. The whipping mechanism of 17 mm diameter shaft was fixed with 8 stainless steel propeller blades having height and diameter of 150 and 100 mm respectively and was used to agitate the material in the foaming container. The shaft of the mechanism was fitted to the shaft of electric motor having 0.25 horse power mounted on the top lid (Figure 1). The speed of the rotation of the propeller was 1440 rpm. About 200 ml of papaya pulp was taken in the foaming container along with selected levels of GMS (1, 2, 3 and 4%, w/w). The whipper was allowed to rotate and air was introduced to the chamber slowly at the rate 0.03 cu.m min^{-1} but there was no foam formation in the pulp. This may be due to its high consistency and viscosity. When the pulp was adjusted to lower concentration, the foam was developed rapidly. Hence, it was adjusted to different concentrations (12, 11, 10, 9, 8 and 7°Brix) from its initial concentration (13°Brix) by using pearson square method (Siddappa *et al.* 1998). The desired pulp concentration (°Brix) was prepared by mixing calculated amount of distilled water. The TSS was checked with hand refractometer (ERMA, Tokyo, Japan). The pre-determined papaya pulp concentrate and required quantity of GMS was taken in the foaming chamber on w/w basis. The foaming device was operated at 1440 rpm at room temperature until maximum foam formation. Compressed airflow at the rate 0.03 cu.m min^{-1} was maintained. The foamed slurry was directly discharged from the foaming device by removing top lid along with electric motor. During the foaming study, all the experiments were replicated thrice and the mean values were recorded. The influence of pulp concentration and levels of GMS on foam expansion was statistically analyzed ($P \leq 0.01$) by factorial completely randomized design.

2.3 Determination of foaming properties

The foaming process was optimized in terms of maximum foam expansion (i.e., minimum foam density) and maximum foam stability (i.e., minimum drainage volume). Based on these foaming properties, the optimum levels were identified. The foam expansion (Eqn.1) was measured as described by Durian (1995):

$$\text{Foaming expansion (FE)} = \left[\frac{V_1 - V_0}{V_0}\right] \times 100 \quad (1)$$

Where, V_1 is the final volume of foamed papaya pulp, cm^3 and V_0 is the initial volume of papaya pulp, cm^3

The foam obtained from 9°Brix pulp concentration was filled into a transparent graduated cylinder and kept at room temperature for 3 h. The amount of liquid juice which separated from the foam as a result of drainage and the reduction in foam volume were measured as an index for the foam stability for every 30 min by using the following relationship (Akiokato *et al.* (1983).

$$\text{Foam stability} = V_0 \frac{\Delta t}{\Delta V} \quad (2)$$

Where, V_0 is the volume of foam at zero time and ΔV is the change in foam volume during the time interval Δt

2.4 Drying experiments

A batch type cabinet drier (Kilburn, India) having heating unit, blower, drying chamber, air outlet openings and thermostat was used for drying studies. The drier was run some times in order to stabilize the desired temperature inside the chamber. The homogeneous foamed papaya pulp was evenly spread on the food grade non-sticky stainless steel round plates of 16.5 cm diameter at a thickness of 2, 4, 6 and 8 mm. These plates were kept in the aluminium tray size of 90 x 40 x 2.5 cm having 5 mm diameter holes. The foam thickness was arrived by multiplying the foam of known density (mass/volume) with drying area to get in terms of 'g/min'. Similarly non-foamed papaya pulp thickness was also arrived. The trays were then placed on the tray stand in position for drying. The temperature inside the drying chamber was measured by using thermometer. The foamed and non-foamed papaya pulps were dried at different temperatures viz., 60, 65 and 70°C with an air flow rate of 2.25 cu.m min^{-1}. The drying temperatures were selected as research reports presented in the previous literatures for fruits. The round plates were taken out of the drying chamber at every one hour interval for determination of weight loss. Moisture content was recorded using a digital electronic balance having least count of 0.01 mg (Citizen Instruments, Pune, India) on initial and final weight basis. The drying was ceased when the weight of the samples recorded constant values. The moisture content (%) on dry basis and rate of drying were calculated as described by Chakravarty (1997):

$$MC\ ,\%(\ db\ ) = \frac{W_m}{W_d} \times 100 \quad (3)$$

Where, MC is the moisture content on dry basis, %, W_m is the weight of moisture in the sample, g and W_d is the weight of dry matter of the sample, g

2.5 Quality evaluation

The dried foam was scraped and the flakes were milled and sieved to obtain a fineness of 250 micron. The powder was packed immediately in high density polyethylene (300 µm) and sealed to prevent diffusion of moist air and caking. The samples were stored at ambient conditions for periodical evaluations. To distinguish the relative changes in nutrients, papaya powder samples were analyzed for different biochemical properties viz., total soluble solids, pH, acidity, ascorbic acid, total sugars and β-carotene after reconstituting the powder to its original moisture content by following standard procedures (Ranganna 2000). The biochemical contents of the reconstituted foam mat dried papaya powder with three replications were statistically analysed as completely randomized block design. Organoleptic evaluation of papaya powder samples were evaluated by 9-point Hedonic scale with a panel of 10 untrained judges for colour, flavour, taste and overall acceptability by using unknown codes (Ranganna 2000) and the results obtained were analysed statistically by completely randomized block design (CRBD) using AGRES statistical package ($P \leq 0.05$).

3. Results and Discussion

Various biochemical contents of fresh non-foamed papaya pulps were determined as total soluble solids (13°Brix), acidity (1.4%), pH (5.2), ascorbic acid (145 mg/100g), total sugar (36.8 g/100g) and β–carotene (4.056 mg/100g). The results obtained on biochemical properties are in comparison with the results reported by Aruna *et al.* (1998), Pandey (1997).

3.1 Effect of papaya pulp and GMS concentration on foam expansion

Effect of concentration of papaya pulp and GMS on foam expansion is shown in Figure 2. From the figure, it is seen that all the levels of GMS have got no influence over the foam formation at higher concentration of the pulp (13 and 12°Brix). This may be due to its high viscosity and consistency. As the concentration of pulp decreased, the foam volume increased with amount of foaming agent increased and whipping time. Foam expansion increased with a decrease in total soluble solids content of pulp from 11to 9°Brix. The lowering of the concentration of papaya pulp below 9°Brix did not yield much change in the foam expansion. Similar trend was reported by Bag *et al*. (2011) for bael fruit pulp. As the concentration of GMS in the pulp increased, the foam expansion increased significantly ($P \leq 0.01$). Higher foam expansion indicates that more air was trapped in the foam and GMS reduces the surface tension and interfacial tension to a level sufficiently low to form the interfacial film that exceeds the critical thickness. Apparently, at lower concentration of GMS, the air bubbles were not stable because the critical thickness required for interfacial film could not be formed (Karim & Wai 1999b). As the concentration of GMS was increased, the foam expansion increased until maximum value was obtained at a GMS concentration of around 3% (w/w). At this concentration, the foam expansion was as high as 90%. However, increasing the GMS concentration beyond this level did not produce appreciable changes in the foam expansion. Similar observations were reported on the foam expansion of star fruit (Karim & Wai 1999(a), (b) and bael fruit pulp (Bag *et al*. 2011). The whipping time also influenced the foam expansion. It is observed from the Fig. 3 that the foam expansion increased with increase in whipping time. The GMS stabilized foams exhibited maximum upto 10 min of whipping and thereafter a considerable decrease in foam expansion was noticed. Raharitsifa *et al*. (2006) also reported that expansion of foams increased with whipping time up to a maximum and decreased thereafter probably because excessive whipping (overbeating) could cause foam to collapse. The GMS stabilized foams exhibited maximum at 10 min of whipping thereafter no appreciable increase in foam expansion occurred. Similar trend was reported by Sankat & Castaigne (2004) for bananas and Bag *et al*. (2011) for bael fruit pulp.

3.2 Effect of concentration of GMS on foam stability

Foam stability reflects the water holding capacity of the foam and one way to determine the rate at which the liquid drains from it (Kampf *et al*. 2003). The liquid in foams is distributed between thin films and plateau borders. Because of the radius of curvature of a plateau border, the pressure inside is less than that in thin films by capillary pressure. This difference, known as plateau border suction, leads to drainage of liquid from thin films to the neighboring plateau border. Finally, all liquid in the plateau border of foams are subject to drain of the liquid from between the bubbles caused by the action of gravity (Narsimhan 1991). 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. Figure 3 shows the effect of GMS concentration on foam stability. From the figure, it is seen that the foam with higher concentration of GMS exhibited more stability as compared to lower concentration of GMS. However, decrease 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. The foam stability value was 95.4% and 97.2% at the concentration of 3% and 4% GMS respectively at 180th min and it was less in lower concentration of GMS (1 and 2%). Similar result was reported by Pernell *et al*. (2002) for egg white and Falade *et al*. (2003) for cowpea.

3.3 Effect of foam thickness on drying characteristics papaya pulp

Foam mat drying of foamed papaya pulp was carried out foam obtained using foaming developing unit at optimized levels with four foam thicknesses viz., 2, 4, 6 and 8 mm and three drying temperatures of 60, 65 and 70°C in a batch type cabinet tray dryer. The effect of foam thickness on the moisture content of foamed papaya pulp during drying at 60°C is shown in Figure 4(a). From the figure, it is observed that the time taken for drying of foamed papaya pulp from 843.57 to 4.5 ± 0.3% moisture content on dry basis was 3, 4, 7 and 9 h for 2, 4, 6 and 8 mm thick foam. While time taken for drying of non-foamed papaya pulp was 6, 8, 10 and 12 h for 2, 4, 6 and 8 mm thick respectively to reach the moisture content 18 ± 3% on dry basis (Figure 4d). The effect foam thickness on drying characteristics of foamed papaya pulp at 65°C is shown in Figure 4(b). At 65°C, the drying time of 1, 3,

5 and 6 h for 2, 4, 6 and 8 mm foam thickness respectively to bring the final moisture content 4.5 ± 0.3% on dry basis whereas it took 4, 5, 7 and 9 h for 2, 4, 6 and 8 mm pulp thickness of non-foamed papaya pulp to bring the moisture content 18 ± 3% on dry basis. The Figure 4(c) shows the drying behavior of foamed papaya pulp at 75°C. The drying time for 2, 4, 6 and 8 mm foam thickness were 1, 2, 4 and 5 h respectively to bring the final moisture content 4.5 ± 0.3% on dry basis. The equilibrium weight could be obtained in 4, 5, 6 and 8 h for 2, 4, 6 and 8 mm pulp thickness of non-foamed papaya pulp respectively with moisture content of 18 ± 3% on dry basis. The drying of foamed and non-foamed papaya pulp occurred in the falling rate period. The drying time increased as the foam thickness increased and decreased with temperature. This may be due to the fact that moisture migration is higher in less foam thickness than high foam thickness. The rate of moisture removal in the non-foamed papaya pulp was less than the foamed papaya pulp due to the fact that the water in the foamed pulp was present in thin films making it easily vaporizable. Akintoye & Oguntunde (1991) for soymilk foam, Rajkumar *et al*. (2007a) for alphonso mango pulp and Thuwapanichayanan *et al*. (2008) for banana have also reported similar trend.

3.4. Effect of drying temperature on quality of foam-mat dried papaya powder

The nutritional qualities of dried product play an important role in selecting the drying parameters and were compared with fresh pulp. The dried foam was scraped after cooling the trays to room temperature and the product was ground to a fineness of 250 micron and packed immediately in high density polythene bags. But non-foamed dried samples of thickness 2 and 4 mm was not able to scrap from the plates because it was fully adhered with the plate whereas 6 and 8 mm thick dried products were turned like leather and can not grind them. The biochemical results of the foamed papaya pulp dried at 60, 65 and 70°C are shown in Table 1. The biochemical changes were comparatively higher in 6 and 8 mm thick foam dried at 65 and 70°C than in 2 and 4 mm thick foam dried at 60°C. It was found that there was a significant reduction in ascorbic acid (120 to 83mg/100g). This may be due to the destructive effect of the prolonged thermal treatment, which caused oxidation of the ascorbic acid (Levi et al. 1983). It was also found that there was a significant reduction in β-carotene (4.95 to 3.87 mg/100g). Total sugars (36.4 to 34.5 g/100g) also changed significantly. Other biochemical contents such as pH (5 to 4.8) and acidity (0.77 to 0.75%) were not significant. Similar biochemical changes were reported by Srivastava (1998) for mango, Aruna *et al*. (1998) for papaya, Hassan & Ahmed (1998) for pineapple, Mishra *et al*. (2002) for apple, Thuwapanichayanan *et al.* (2008) for bananas, Falade & Okocha (2010) for banana and Kadam *et al.* (2011b) for mandarin powder. Based on the biochemical analysis, it was found that the papaya powder obtained from foam thickness of 2 and 4 mm and dried at 60°C retained significantly higher amount of nutritional qualities than other treatments such 6 and 8 mm foam thickness and dried at 65 and 70°C. For selecting the foam thickness, yield of the powder was considered as nutritional values are same in 2 and 4 mm thick foamed powder. The yield obtained from 2 and 4 mm thick foamed papaya powder is presented in Table 2. It is clear from the Table 2 that 4 mm thick dried foamed pulp yielded nearly 100% more than that of 2 mm thickness for all the temperatures studied.

3.5. Sensory evaluation of foam-mat dried papaya powder

The juice was prepared from the papaya powder obtained from 4 mm thick foam and was compared with fresh papaya fruit juice. The effect of drying temperature on sensory attributes of reconstituted papaya powder for different characteristics such as colour, flavour, taste and overall acceptability were used to test the significance of different treatments and are presented in Table 3. From the Table, it is clearly seen that the sample dried at 60°C recorded higher ratings on colour, flavour, taste and overall acceptability as compared to the samples dried at 65 and 70°C. The various treatments adopted had not significantly effect on flavour, taste and overall acceptability but significant effect on the colour. However, the fresh sample also received the higher rating in all the attributes. However, the flavor and taste of the reconstituted sample at 65 and 70°C received a lower rating. This could be due to the loss of volatiles during the drying process. Similar trend was reported by Hassan & Ahmed (1998) for foam-mat dried pineapple powder juice and Falade & Okocha (2010) for foam-mat dried reconstituted banana paste.

4. Conclusion

The optimum level of GMS was found to be 3% with papaya pulp concentration of 9°Brix and foaming time of 10 min for foam-mat drying of papaya pulp. The stability of foam (95.4%) also was found to be long at higher concentration of GMS (3%) compared to lower concentration of GMS. Based on the nutritional qualities, it was concluded that 2 and 4 mm thick foamed papaya powder at 60°C retained significantly higher amount of nutritional qualities than the other treatments. Yield of the papaya powder was considered for selecting the foam thickness as nutritional values are same in 2 and 4 mm thick foamed powder. Therefore, 4 mm foam thickness was optimum for foam-mat drying of papaya pulp. It was concluded that the time taken for drying of 4 mm thick foamed papaya pulp was 4, 3 and 2 h at 60, 65 and 70°C respectively to obtain dried papaya powder of 4.5 ± 0.3%

moisture content on dry basis. Based on the overall study, it was concluded that the papaya pulp of 9°Brix added with 3% GMS whipped for 10 min and dried with a foam thickness of 4 mm at a temperature of 60°C was found to be optimum condition for production of foam-mat dried papaya powder.

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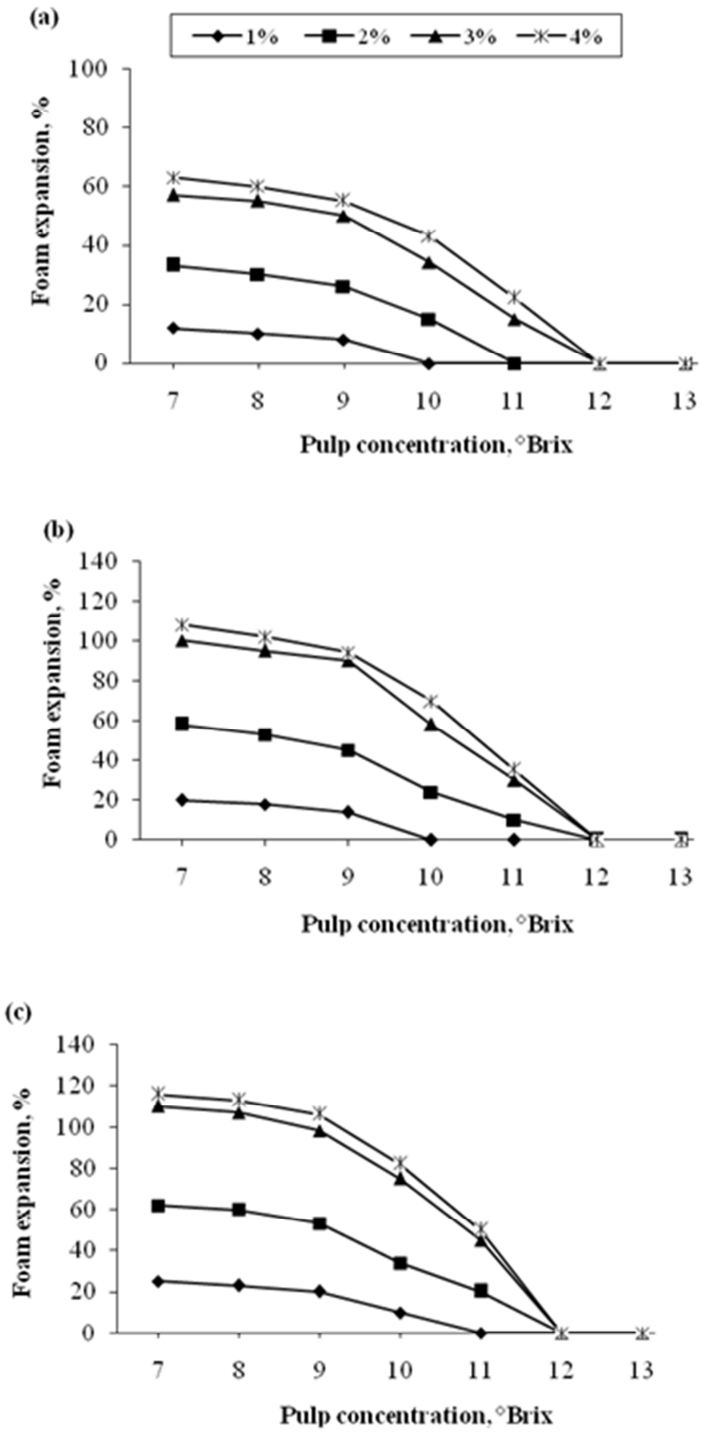

Figure 2. Effect of concentration of papaya pulp and levels of GMS on foam expansion

(a), (b) and (c) are 5, 10 and 15 min whipping time respectively

Each observation is the mean of three replicates, significant at 1% level, CV=3.47%

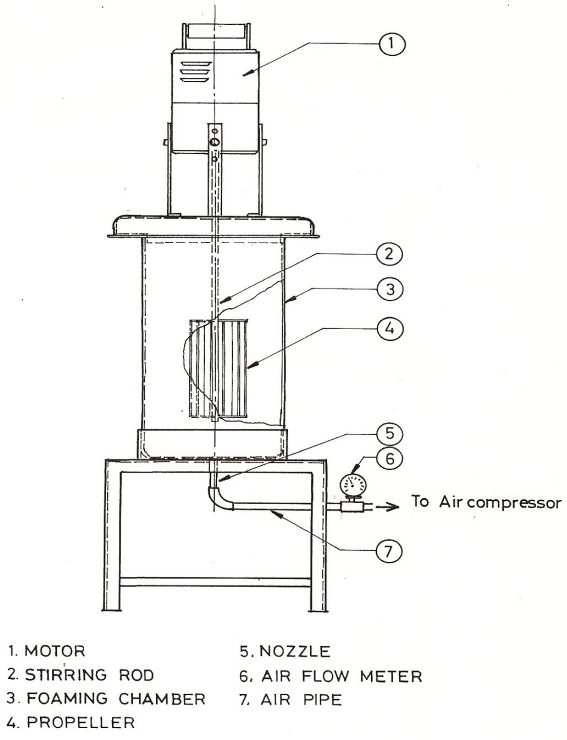

Figure 1. Foam developing unit

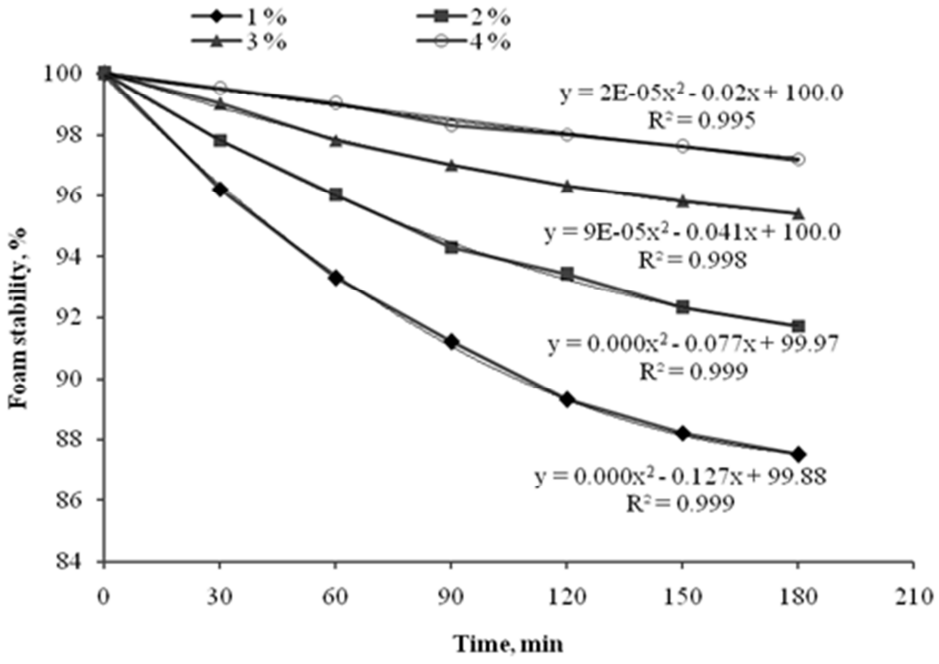

Figure 3. Effect of concentration of glycerol mono-stearate on foam stability

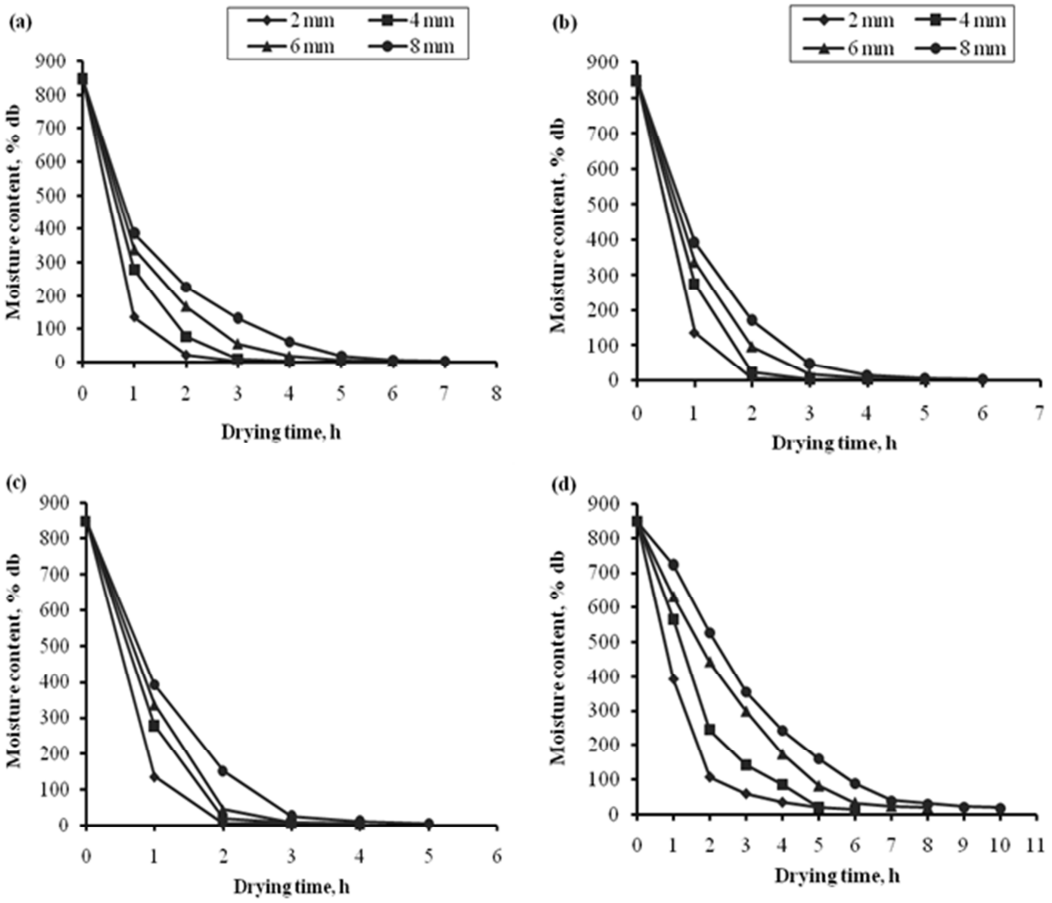

Figure 4. Effect of foam thickness on drying characteristics of foamed papaya pulp at (a) 60°C (b) 65°C (c) 70°C and (d) non-foam (60°C)

Table 1. Biochemical composition of foam-mat dried papaya powder

Drying temperature	Foam thickness (mm)	Biochemical compositions				
		Acidity %	pH	Ascorbic acid (mg/100g)	β – Carotene (mg/100g)	Total sugar (g/100g)
60°C	2	0.76	4.80	120.00	4.95	36.70
	4	0.75	4.80	120.00	4.95	36.67
	6	0.75	4.80	110.00	4.80	36.00
	8	0.76	4.80	107.00	4.75	35.95
65°C	2	0.76	4.80	115.00	4.50	36.00
	4	0.76	4.80	114.00	4.20	36.00
	6	0.77	5.00	103.00	4.12	35.65
	8	0.76	4.90	98.00	4.00	35.60
70°C	2	0.76	4.90	97.00	4.25	36.20
	4	0.77	4.90	95.00	3.95	35.97
	6	0.77	4.90	86.00	3.90	34.50
	8	0.76	4.80	83.00	3.87	34.52
	CD (5%)	0.06	0.17	1.65	0.13	1.64
		NS	NS	**	**	**

Each observation is the mean of three replicates, NS = Not-significant ** Significantly difference

Table 2. Yield of foam-mat dried papaya powder

Foam thickness (mm)	Yield (kg/m^2)		
	60°C	65°C	70°C
2	0.0787	0.0786	0.0789
4	0.1540	0.1542	0.1541
6	0.2376	0.2374	0.2375
8	0.3172	0.3174	0.3173

Each value is the mean of three replicates

Table 3. Effect of drying temperature on sensory attributes of reconstituted papaya powder

Characteristics	Fresh sample	Dried sample			CD (1%)	
		60°C	65°C	70°C		
Colour	7.7	7.7	7.2	6.2	1.278	**
Flavor	7.0	6.6	6.2	6.0	1.460	NS
Taste	7.2	6.7	6.0	5.8	1.438	NS
Overall acceptability	6.9	6.8	6.4	6.0	1.350	NS

(n =10), ** significantly difference at ($P \leq 0.01$), NS = Not significant