

Physico-Chemical and Antioxidant Properties of Foam Mat Dried Muskmelon (*Cucumis Melo*) and Application in Dairy Products

K Balaswamy, P G P Rao, G N Rao and A Satyanarayana*

Council of Scientific and Industrial Research-Central Food Technological Research Institute (CSIR-CFTRI),
Resource Centre, Habshiguda, Uppal Road, Hyderabad-500 007, Telangana, India.

Received 11 June 2014; revised 19 July 2015; accepted 22 November 2015

Foam mat dried muskmelon (FMDM) powder was prepared from a seasonal elongated variety and analysed for its physico-chemical composition and antioxidant activity. Application of FMDM in dairy products was evaluated. FMDM was found to be a rich source of total polyphenol content, vitamin C content and exhibited good antioxidant properties. Microstructure analysis of FMDM by scanning electron microscope showed the presence of numerous void spaces indicating its highly porous structure with lower density. FMDM possessed a characteristic aroma of muskmelon during sensory analysis and its application at 3 and 2% was found to be optimum during the preparation of flavoured flan and ice cream respectively.

Keywords: *Cucumis melo*, foam mat drying, antioxidant activity, scanning electron microscopy, dairy products

Introduction

Muskmelon (*Cucumis melo*) is a unique fruit belonging to Cucurbitaceae family which possesses a characteristic flavour. It is reported to possess medicinal properties such as analgesic, anti-inflammatory, antioxidant, anti-platelet, anti-ulcer, anti-cancer, anti-microbiol, hepato-protective, diuretic, anti-diabetic, anthelmintic and antifertility activity¹. Generally muskmelons are available throughout the year, but a few of them are seasonal fruits. Muskmelon with a smooth surface and elongated variety is much sought after by consumers. The honey dew melon (orange-flesh variety) is relatively superior and reported to be a rich source of natural antioxidants, vitamin A and C and bioactive enzymes². The shelf life of muskmelon has been recorded as 7-10 days. Muskmelon (cantaloupe) products such as juice concentrate and osmo-air dried products were prepared earlier³⁻⁵. Drying is the one of the unit operation for food preservation. Drying of fruit pulps and juices has been carried out employing solar drying, freeze drying, foam mat drying and spray drying techniques⁶⁻⁹. Foam mat drying is one of the novel drying methods. During foam mat drying the air incorporated into food matrix facilitates more surface area for escape of moisture at faster rates at low temperature resulting in high quality end

products. Foam mat dried mango pulp prepared by using 10% egg albumin and 0.5% methyl cellulose at 60 °C resulted in better retention of flavor, taste and improved reconstitution properties¹⁰. Fruits and vegetables are excellent sources of phenolic compounds¹¹. Ismail *et al.* (2010)¹² studied phenolics, flavonoid content and antioxidant activity of methanolic extracts from different parts of cantaloupe. In the present study, foam mat dried muskmelon (FMDM) was prepared and its antioxidant activity of methanolic extract was evaluated. Foam mat dried muskmelon was assessed in dairy products for its applicability.

Materials and Methods

Raw materials and chemicals

Fresh muskmelons (smooth skinned and elongated variety) were collected from Kurnool, Andhra Pradesh, India. The average weight of muskmelon was noted about 2-2.5 kg. Agar agar (Amar Industries, Mumbai, India), milk cream with 25% fat (Mother Dairy, Gandhinagar, India) and toned milk with 3% fat and 8.5% SNF (Vijaya Dairy, Hyderabad, India) were purchased from a departmental store. DPPH (2,2-diphenyl-1-picrylhydrazyl), 2,6-Dichlorophenol-indophenol dye and ABTS (2,2-Azinobis-3-ethyl Benzothiazoline-6-Sulfonic acid) diammonium salt were purchased from Sigma-Aldrich Ltd., USA.

*Author for correspondence
E-mail: kbswamy66@gmail.com

Butylated hydroxy toluene (BHT), and carboxymethyl cellulose (CMC) and Tween 80 and solvents of analytical grade used in the study were procured from Sd Fine-Chem Ltd., Mumbai, India. Natural emulsifier, egg albumin was isolated from fresh chicken egg using a nylon mesh.

Foam mat drying

Muskmelons (5.4 kg) were cleaned under running water just before cutting. Fruits were cut into longitudinal pieces, removed the skin and seed and ground to yield pulp (3.17- 3.30 kg). Foam mat drying of muskmelon pulp was carried out using different foaming agents namely, 5% egg albumin, 0.25-1% CMC, and combination of CMC (0.25%) and Tween 80 (0.2%). The pulp was homogenized using a high speed mixer (Sumeet, Nasik, India) by the addition of foaming agent along with compressed air for 20 min using an air compressor at a flow rate of 50 L/min (Hitachi, Japan). The foam was distributed uniformly in aluminum trays (size: 80 × 40 × 3 cm) up to a thickness of 4-8 mm (1-1.1kg/tray) and dried at 50 ± 2 °C for 8 h in a cabinet tray dryer (Chemida, Mumbai, India) at air flow velocity of 1.5 m/s. The foam mat dried product was scraped from trays and ground immediately to obtain powder. The product was packed in metallized polyester polyethylene (MPE) laminate pouches and stored at room temperature (RT) in the dark for further experiments.

Physico-chemical composition and colour readings

Physico-chemical analysis of the fruit pulp and the FMDM powder was carried using standard methods (Ranganna 1986)¹³. Total carotenoids as β-carotene was estimated employing a spectrophotometric method using UV-1601 spectrophotometer (Shimadzu, Japan) at 452 nm after total extraction of colour pigments into hexane. Vitamin C was analyzed by a titrimetric method employing standardized 2, 6-dichlorophenolindophenol dye. HunterLab *L**, *a** and *b** values of FMDM were measured using HunterLab Ultrascan XE (HunterLab, Reston, VA).

Determination of total phenolic content (TPC)

The total phenolic content in FMDM was measured by employing a method described in literature¹⁴ using Folin Ciocalteu reagent. The TPC was calculated from a standard gallic acid (0-76 µg/ml) calibration curve and expressed as gallic acid equivalent (GAE) g/100 g FMDM as follows:

$$\text{TPC (GAE g/100g)} = \frac{\text{TPC in the aliquot (}\mu\text{g)} \times \text{Total Volume of solution}}{\text{Volume of aliquot taken} \times \text{Weight of the sample} \times 1000000}$$

Determination of antioxidant activity (AA)

DPPH radical scavenging activity

The methanolic extract of FMDM was determined for AA by the stable DPPH radical scavenging activity¹⁵ with a minor modification. The methanolic extract (1-20 mg FMDM) dispersed in 1 ml methanol was mixed with 4 ml of DPPH (0.004% solution) and measuring the absorbance at 517 nm. The DPPH radical scavenging activity was compared with that of BHT (1-50 µg/ml). The percent Inhibition (IC) was calculated using the following equation:

$$\text{IC, \%} = \frac{\text{Absorbance of control} - \text{Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

FRP assay

The FRP of the FMDM was assessed by a reported method¹⁵. FMDM (1-5 mg/ml) dispersed in 1 ml methanol was added with 2.5 ml of phosphate buffer (pH 6.6) and 2.5 ml 1% potassium ferricyanide solution in different test tubes. The contents were incubated for 20 min at 50 °C. Later 2.5 ml of 10% trichloroacetic acid was added and centrifuged at 8000 rpm for 10 min. An aliquot 2.5 ml was mixed with 2.5 ml of distilled water and 0.5 ml of 0.1% ferric chloride. The colour developed was read at 700 nm and expressed as absorbance per mg/ml. The reducing power of BHT (1-200 µg) was also measured for comparison.

ABTS assay

ABTS inhibition assay of FMDM was conducted according to a reported method¹⁶ with a minor modification. The ABTS solution was diluted to obtain an absorbance of 0.700 (control). ABTS solution (3 ml) was mixed with 1-500 µg FMDM/ml in water, and absorbance was recorded at 734 nm after 10 min. The inhibition of ABTS was compared with BHT taken in the concentration range of 1-5 µg/ml. The percent inhibition, IC of the samples was calculated using the following expression.

$$\text{IC, \%} = \frac{\text{Absorbance of control} - \text{Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

Scanning electron microscopy (SEM) of FMDM

The microstructure of FMDM was analyzed using SEM (Model LEO435 VP, Leo Electron Microscopy Limited, Cambridge, UK). The sample was vacuum

dried and loaded on aluminum stub using special double adhesive carbon tape and coated with gold using E5100 Polaron SEM coating system. The images were recorded at 15kv using differential magnification.

Application of FMDM in dairy products and sensory analysis

FMDM powder was reconstituted using potable water at 1:10, 1:20, 1:30, 1:40 and 1:50 ratios and observed for retention of characters like colour, flavour, taste and texture. FMDM powder was used in dairy products like flan and ice cream prepared by following standard procedures. The flan was prepared by adding optimized quantities of sugar powder (150 g, 15%), FMDM (1-4% on product basis) and agar agar (8 g, 0.8% pre-soaked and dispersed in water 100 ml) to boiled toned milk (750 ml) under hot conditions. Further the resultant mixture was homogenized by stirring and allowed to cool at RT for setting. Similarly, the preparation of ice cream involves thorough mixing of different quantities of FMDM in sugar powder (300 g), milk (400 ml), milk cream (400 g), 0.1% CMC, allowed to set at 0 to -4 °C under refrigerated conditions. The resultant mixture was blended every two hours during freezing to obtain ice cream with uniform texture. Similarly, ice cream with vanillin essence was prepared to serve as a control. The products were evaluated for sensory attributes like appearance, colour, flavor, taste, texture and overall acceptability for optimization of FMDM quantity using a 9 point Hedonic scale and used scores of 9 to 1 for like extremely, like very much, like moderately, like slightly, neither like nor dislike, dislike slightly, dislike moderately, dislike very much, and dislike extremely, respectively (Amerine *et al.* 1965)¹⁷.

Statistical analysis

The proximate composition, colour measurement and antioxidant activity of FMDM were conducted in triplicate and mean values with standard deviation (SD) computed using MS Excel, 2007 were reported. Standard error bars were shown in the bar graphs for antioxidant activity. Sensory data for the dairy products were analysed by paired T test and statistically considered by $P < 0.05$ using IBM-SPSS 19.0 version.

Results and discussion

Yield, physico-chemical composition and colour

Preliminary analysis of fresh muskmelon fruit pulp showed °brix 6, acidity 0.08%, pH 6.3 and bulk

density 1 g/ml. β -carotene and vitamin C (ascorbic acid) were 1.86 and 193 mg/100 g respectively, in fresh pulp which are comparable to the findings of Menon and Ramana Rao (2012)¹⁸. Foam mat drying of muskmelon fruit pulp yielded $8.0 \pm 0.5\%$ FMDM after a drying time of 6 h. A typical drying curve for foam mat drying of muskmelon was presented in Fig. 1. Maximum loss of moisture was observed during initial hours followed by a gradual decrease and stagnant curve at later stages. Earlier foam mat drying technique employing egg albumin as a foaming agent was used for drying of mango pulp¹⁹, papaya pulp using CMC²⁰; aloe vera using maltodextrin and Tween 80²¹. The foam mat dried muskmelon powder prepared with 0.25% CMC was found to be attractive with good appearance, colour and flavor, and hence chosen for further studies. The results showed that FMDM contained moisture 5.7%,

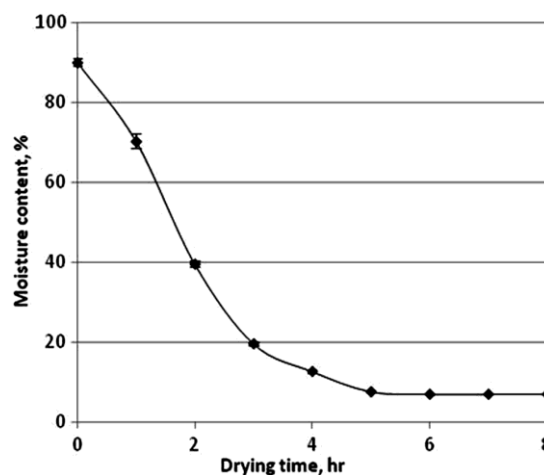


Fig. 1—Typical foam mat drying curve of muskmelon pulp

Table 1—Physico-chemical characteristics of foam mat dried muskmelon*

Parameter	Value
Bulk density (g/ml)	0.44 ± 0.03
Moisture (%)	5.73 ± 0.57
Acidity as citric acid (%)	3.37 ± 0.12
Protein as N x 6.25 (%)	10.22 ± 0.28
Crude fibre (%)	5.54 ± 0.38
Total ash (%)	7.33 ± 0.20
Total sugars (%)	40.01 ± 0.97
Total carotenoids as β -carotenes (mg/100 g)	15.37 ± 0.51
Vitamin C (mg/100 g)	288.66 ± 1.63
Phenolic compounds (GAE g/100 g)	1.03 ± 0.0002

*Values expressed on samples basis and are mean of triplicate analyses with $\pm$ SD;

GAE = gallic acid equivalent

Table 2—HunterLab L^* , a^* and b^* colour values of foam mat dried muskmelon powders prepared by using different foaming agents^a

Foaming agents used	Brightness, L^*	Redness, a^*	Yellowness, b^*
Egg albumin, 5%	46.29 ± 0.54	7.55 ± 0.28	8.28 ± 0.07
CMC, 0.25%	57.66 ± 0.46	14.0 ± 0.44	20.78 ± 0.38
CMC, 0.5%	49.64 ± 0.52	10.84 ± 0.05	12.38 ± 0.09
CMC, 0.25%+tween 80, 0.2%	46.57 ± 0.22	7.04 ± 0.07	9.01 ± 0.02

^aValues expressed on samples basis and are mean of triplicate analyses with ± SD

acidity 3.3%, protein 10.09%, crude fibre 5.53%, total ash 7.3% and total sugars 40% (Table 1). The results are comparable with Turkey's traditionally dried muskmelon product called 'kavun kaki' prepared from different cultivars²². Total carotenoids as β -carotenes were found to an extent of 15.36 mg/100 g and vitamin C 288.6 mg/100 g in FMDM. The higher retention of vitamin C may be attributed due to lower drying temperature. Kadam *et al.* (2010)²³ revealed the presence of ascorbic acid content of 24 mg/100g fresh mangoes and 32.03 mg/100 g in foam mat dried mango powder. However, the oxidative loss of ascorbic acid was considerably lower in freeze drying (18.8%) compared to tunnel drying (32.2%) during preparation of guava juice powder²⁴. FMDM samples produced during the study were assessed for colour using HunterLab colorimeter, and the data is presented in Table 2. The product was bright orange in colour due to higher value of b^* (20.76) than a^* (14.0). Similar values were observed in osmo air dried cantaloupe by Phisut *et al.* (2013)⁵. In contrast, Solval *et al.* (2012)⁹ revealed that the cantaloupe powder prepared by spray drying was white in colour ($L^* = 94.5$) with a lower vitamin C (136.36 mg/100 g) and similar β -carotene (16.4 mg/100g) contents.

Total phenolic content

A good quantity of TPC was observed (1.03 GAE g/100g) in FMDM and presented in Table 1. Earlier reports also showed phenolic content to an extent of 0.102 GAE g /100 g (Phisut *et al.*⁵) and 0.168% (Ismail *et al.*¹²) in fresh cantaloupe pulp.

Antioxidant activity of FMDM

The concentration required for 50% DPPH radical scavenging activity is expressed as IC_{50} value. Higher IC_{50} value for the methanolic extract of FMDM

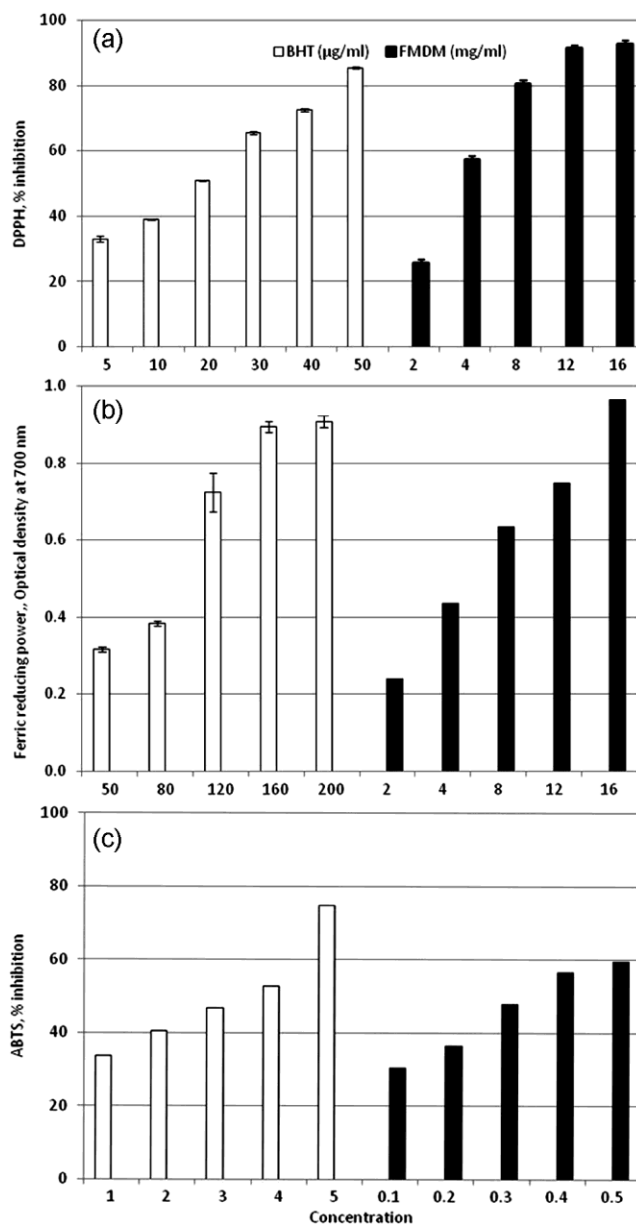


Fig. 2—Antioxidant activity of BHT and foam mat dried muskmelon (FMDM) (a) DPPH radical scavenging activity (b) Ferric reducing power (c) ABTS assay

(3.8 mg/ml) was observed, when compared to value of 20 μ g/ml for BHT (Fig. 2). Studies conducted by Shofian *et al.*⁷ on antioxidant activity of methanolic extract showed the radical scavenging activities of 25, 48 and 87% inhibition for muskmelon, papaya and mango freeze dried powders respectively at 5 mg/ml concentration. ABTS assay was determined by recording percent inhibition of absorbance of ABTS solution as a function of concentration. In this method, IC_{50} was found to be 340 μ g/ml for FMDM, when compared to 3.4 μ g/ml of BHT. Turkey is the

second largest producer of muskmelon after China. A study of polyphenolic content and water soluble antioxidant activity in 42 melon varieties indicated the presence of phenolic compounds in the range of 0.12-0.36 g GAE/kg and antioxidant capacity in the range between 1.18-4.64 mmol trolox equivalents (TE)/kg fresh weight measured by ABTS method²⁵. Earlier, Pellegrini *et al.*²⁶ noticed antioxidant capacity measured by ABTS method showed 1.20 mmol TE/kg for cantaloupe and 0.65 mmol TE/kg for honeydew melon. Ferric reducing power (FRP) in terms of optical density (OD of 0.5) was observed at concentrations of 5 µg/ml and 105 µg/ml for FMDM and BHT respectively. Maximum OD was observed to be 0.96 for 16 mg and 0.91 for 200 µg for FMDM and BHT respectively. The methanolic extract of guava (*Psidium guajava*) possessed highest total phenolic content of 374 mg/100 g and exhibited antioxidant activity of 496 and 891 mg/100 g (trolox equivalent) with ABTS and DPPH assays respectively²⁷.

SEM of FMDM

Microstructure of FMDM as seen from scanning electron microscope (SEM) studies at 1500 and 7500X resolutions indicated a plenty of eruptions due rupture of air bubbles on the surface. Narsih *et al.*²¹ observed similar air bubbles on foam mat dried Aloe vera samples and concluded that the air bubbles are responsible for low density of the products. The micro structure of the foam mat dried muskmelon powder appeared as thin flakes with a uniform thickness. Void spaces are seen in the product, which might be due to the air incorporated during homogenisation. The uniformly spread foam remained a thin layer in aluminum trays during drying which resulted in a wafer like structure. On grinding the film the foam mat dried muskmelon formed uneven shaped particles which are hygroscopic in nature. The hygroscopic nature of the product can be explained based on the presence of reducing sugars.

Application of FMDM in dairy products and their sensory evaluation

Flan and ice cream were prepared with FMDM at 1-4% and along with controls. Lower concentration (1%) yielded products with very lower flavor and colour and conversely, higher concentrations at 4% level were harsh in taste with dark colour. Hence, the products prepared with 2 and 3% FMDM were selected for organoleptic evaluation and compared

Table 3—Sensory evaluation of flan and ice cream prepared with 2-3% FMDM powder

Parameter	Flan		Ice cream	
	2%	3%	2%	3%
Appearance	7.6 ± 0.5 ^a	8.1 ± 0.6 ^a	8.0 ± 0.4 ^a	7.2 ± 0.3 ^a
Colour	7.2 ± 0.4 ^a	8.5 ± 0.3 ^b	8.2 ± 0.4 ^a	7.6 ± 0.4 ^b
Flavour	7.5 ± 0.5 ^a	8.3 ± 0.4 ^b	8.3 ± 0.5 ^a	7.8 ± 0.6 ^b
Taste	8.1 ± 0.5 ^a	8.0 ± 0.9 ^a	8.1 ± 0.5 ^a	7.6 ± 0.4 ^b
Texture	8.0 ± 0.4 ^a	8.1 ± 0.2 ^a	8.0 ± 0.9 ^a	7.5 ± 0.4 ^a
Overall acceptability	7.5 ± 0.5 ^a	8.1 ± 0.4 ^a	8.2 ± 0.3 ^a	7.5 ± 0.5 ^a

Different superscript letters in a row for each product indicate significant difference (P<0.05)

with control (without addition of FMDM) for optimizing the FMDM quantity. The results of organoleptic evaluation of flan and ice cream prepared with 2-3% FMDM are presented in Table 3. The flan containing 3% FMDM possessed significantly high sensory scores for flavour and colour, whereas appearance, taste, texture and overall acceptability were not significant. Ice cream containing 2% FMDM was found to be optimum to obtain characteristic muskmelon flavor, taste and creamy colour. Addition of 3% FMDM to ice cream significantly decreased the sensory parameters such as colour, flavor and taste. Earlier, a palatable functional health drink was formulated by dry blending of foam-mat dried papaya, skimmed milk, CMC, sugar and diluting with water at the ratio of 1:5 (v/v)²⁸.

Conclusion

The higher polyphenol content can be inferred with the antioxidant activity of foam mat dried muskmelon. FMDM powder containing vitamin C and carotenoids can be successfully utilized in preparation of flavoured flan and ice-creams to relish the characteristic flavour, taste and colour.

References

- 1 Milind P & Kulwant S, Muskmelon is eat-must melon, *Int Res J Pharma*, **2** (2011) 52-57.
- 2 Lester G E & Hodges D M, Antioxidants associated with fruit senescence and human health: Novel orange fleshed non-netted honey dew melon genotype comparisons following different seasonal productions and cold storage durations, *Postharvest Biol Technol*, **48** (2008) 347-354.
- 3 Galeb A D S, Wrolstad R E & McDaniel M R, Composition and quality of clarified cantaloupe juice concentrate, *J Food Proc Preserv*, **26** (2002) 39-56.
- 4 Fernandez R M, Norena C P Z, Silveira S T & Brandelli A, Osmotic dehydration of muskmelon (*Cucumis melo*): influence of blanching and syrup concentration, *J Food Proc Preserv*, **31** (2007) 392-405.

- 5 Phisut N, Rattanawadee M & Aekkasak K, Effect of osmotic dehydration process on the physical, chemical and sensory properties of osmo-dried cantaloupe, *Int Food Res J*, **20** (2013) 189-196.
- 6 Hassanain A A, Simple solar drying system for banana fruit, *World J Agric Sci*, **5** (2000) 446-455.
- 7 Shofian N M, Hamid A A, Osman A, Saari N, Anwar F, Dek M S & Hairuddin M R, Effect of freeze-drying on the antioxidant compounds and antioxidant activity of selected tropical fruits, *Int J Mol Sci*, **12** (2011) 4678-4692.
- 8 Beristain C I, Cortes R, Casillas M A & Diaz R, Obtainment of pineapple juice powder by foam-mat drying, *Archiv Latinoamericanos Nutricion*, **41** (1991) 238-245.
- 9 Solval K M, Sundararajan S, Alfaro L & Sathivel S, Development of cantaloupe (*Cucumis melo*) juice powders using spray drying technology, *LWT Food Sci Technol*, **46** (2012) 287-293.
- 10 Kadam D M, Patil R T & Kaushik P, Foam mat drying of fruit and vegetable products. In *Drying of foods, vegetables and fruits*, vol. 1, edited by S V Jangam, C I Law & K S Mujumdar (NUS, Singapore), (2011) 111-124.
- 11 Ames B N, Shigenaga M K & Hagen T M, Oxidants, antioxidants, and the degenerative diseases of aging, *Proc of the National Academy of Sci USA*, **90** (1993) 7915-7922.
- 12 Ismail H I, Chan K W, Mariod A A & Ismail M, Phenolic content and antioxidant activity of cantaloupe (*Cucumis melo*) methanolic extracts, *Food Chem*, **119** (2010) 643-647.
- 13 Ranganna S, *Hand Book of Analysis and Quality Control for Fruits and Vegetable Products*, 2nd edn., (Tata McGraw-Hill Publishing Company Limited, New Delhi, India) 1986.
- 14 Sadasivam S & Manickam A, *Biochemical Methods*, 2nd edition. (New Age International Publishers, New Delhi) 1997.
- 15 Yen G C & Chen H Y, Antioxidant activity of various tea extracts in relation to their antimutagenicity, *J Agric Food Chem*, **43** (1995) 27-32.
- 16 Re R, Pellegrini N, Proteggente A, Pannala A, Yang M & Rice-Evans C, Antioxidant activity applying an improved ABTS radical cation decolorization assay, *Free Radical Biol Med*, **26** (1999) 1231-1237.
- 17 Amerine M A, Pangborn R M & Roessler E B, *Principles of sensory evaluation of food* (Academic Press, New York) 1965.
- 18 Menon S V & Ramana Rao T V, Nutritional quality of muskmelon fruit as revealed by its biochemical properties during different rates of ripening, *Int Food Res J*, **19** (2012) 1621-1628.
- 19 Wilson R A, Kadam D M, Chadha S & Sharma M, Foam mat drying characteristics of mango pulp, *Int J Food Sci Nutri Eng*, **2** (2012) 63-69.
- 20 Kandasamy P, Varadharaju N, Kalemullah S & Moitra R, Production of papaya powder under foam-mat drying using methyl cellulose as foaming agent, *Asian J Food Agro Ind*, **5** (2012) 374-387.
- 21 Narsih Kumalaingsih S S, Usinggih W & Wignyanto, Microencapsulation of natural antioxidant powder from *Aloe vera* (L.) skin using foam mat drying method, *Int Food Res J*, **20**, (2013) 681-685.
- 22 Berdiyev M, Arslan D & Ozcan M M Nutritional composition, microbiological and sensory properties of dried melon: A traditional Turkmen product, *Int J Food Sci Nutri*, **60** (2009) 60-68.
- 23 Kadam D M, Wilson R A & Kaur S, Determination of biochemical properties of foam-mat dried mango powder, *Int J Food Sci Technol*, **45** (2010) 1626-1632.
- 24 Mahendran T, Physico-chemical properties and sensory characteristics of dehydrated guava concentrate: effect of drying method and maltodextrin concentration, *Trop Agric Res Extension*, **13** (2010) 48-54.
- 25 Selale H, Sigva H O, Celik I, Doganlar S, Frary A, Water soluble antioxidant potential of melon lines grown in Turkey, *Int J Food Prop*, **15** (2012) 145-156.
- 26 Pellegrini N, Serafini M, Colombi B, Rio D D, Salvatore S, Bianchi M & Brighenti F, Total antioxidant capacity of plant foods, beverages and oils consumed in Italy assessed by three different in vitro assays, *J Nutri*, **133** (2003) 2812-2819.
- 27 Vijaya Kumar Reddy C, Sreeramulu D & Raghunath M, Antioxidant activity of fresh and dry fruits commonly consumed in India, *Food Res Int*, **43** (2010) 285-288.
- 28 Widyastuti T E W & Srinta I, Development of functional drink based on foam-mat dried papaya (*Carica papaya* L.): optimisation of foam-mat drying process and its formulation, *Int J Food Nutri Public Health*, **4** (2011) 167-176.