

Original Research Article

<https://doi.org/10.20546/ijcmas.2018.705.368>

Effect of Maltodextrin Concentration on Spray Dried Bitter Gourd Powder

D. Srinivas*, N. Vinoda and L. Edukondalu

College of Agricultural Engineering, Bapatla, India

*Corresponding author

ABSTRACT

An experiment was conducted to study the effect of different concentrations of maltodextrin on spray drying of bittergourd powder. The results showed that after spray drying, initially the water activity, water absorption index (WAI), and bulk density were decreased with increase in maltodextrin concentration and water soluble index, pH, ascorbic acid, reducing sugars and whiteness index were increased with increase in maltodextrin concentration. During the storage period, the water activity, bulk density and reducing sugars were increased and pH, ascorbic acid and whiteness index were decreased gradually. On 45th day of storage, the water activity was high in sample T₉ (0.564), the bulk density was high in samples T₁T₈ and T₉ (0.57 g/cm³), the WSI was lower in sample T₉ (15%), WAI was high in T₇, T₈ and T₉, whiteness index was lowest in T₃ and T₆ samples (2.6 and 2.2, respectively), the ascorbic acid content was more in T₁, T₂ and T₃ samples i.e., 37.14 mg/100 g and less in T₄ (31.43 mg/100 g) sample and reducing sugars was less in T₃ (15.42%). Finally it was concluded that at the end of the storage period of 45 days, the quality of product was good at 8% maltodextrin concentration and 15 ml/min feed flow rate.

Keywords

Bitter gourd powder, Maltodextrin concentrations, Spray drying, Feed flow rate, Storage period

Article Info

Accepted:

22 April 2018

Available Online:

10 May 2018

Introduction

Bitter melon (*Momordica charantia* L.) is a medicinal fruit often used for the treatment of diabetes, due to its content of saponins, phenolics and flavonoids and its antioxidant capacity. The total area of this crop during 2012-13 was 83 thousand hectares and the production was about 940 thousand metric tonnes (Hand book of horticulture, 2014).

It is very effective in inhibiting the growth of HL60 human leukaemia cells and this effect probably contribute in cancer prevention. Rich in nutrients such as glycosides, niacin, riboflavin, sodium, thiamine, ascorbic acid

and iron that can be found in the fruit. Antimicrobial are made from seeds, leaves, fruit and bitter oil melon.

It is one of the strongest hypoglycemic available which helps in regulating blood sugar levels. Indians consume bitter melon juice for treating their gastrointestinal problems like stomachache, hemorrhoids and dermatological problems like skin infections. Bitter melon is a natural blood purifier and helps in getting rid of acne naturally. Bitter melon juice also helps in natural weight loss (Nadine *et al.*, 2005). It is rich in iron, β -carotene and potassium, Vitamins A, B1, B2, B3 and C, phosphorous and fiber.

Bittergourd is a seasonal vegetable and need to preserve them to make them available for consumption in off season by extending the shelf life in fresh form or in the processed form. Generally, preservation of bitter gourd was done by different methods such as steeping preservation, processing of bitter gourd into rings, sun drying and dehydration of bitter gourd, hot air drying of bitter gourd slices, etc. Spray drying is widely used in the industry for conversion of a suspension or solution into a dry powder product.

Spray dryers can dry a product very quickly compared to other methods of drying. Spray drying is a process of suspending sprayed liquid particles and moisture removal by hot air to produce high quality products. The dried product from spray dryers can be in the form of powders, granules or agglomerates depending on the physical and chemical properties of the feed, the dryer design and final powder properties desired (Michael, 1993). The high quality of the spray-dried products is due to the protection of the suspended particles by evaporative cooling during the process. The physicochemical properties of the final product mainly depend on inlet temperature, air flow rate, feed flow rate, atomizer speed, types of carrier agent and their concentration. Hence, the present study was taken up to study the effect of concentrations of maltodextrine on quality and shelf life of bitter gourd powder.

Materials and Methods

Freshly harvested, healthy and unripe (green color) bitter gourd were procured from local vegetable market, bapatla and used for this study. The fruits were cleaned with water to remove all dirt adhering and the pesticide residues. The selected fruits were cut into small pieces and seeds and pith were removed. The sliced samples were pretreated with salt of 8% w/w for 30 min for removing bitterness.

After pretreating with salt, the samples were washed with water and subjected to blanching with hot water at 60°C for 15 min. Juice was extracted from blanched bittergourd slices using juice extractor and concentrated juice by using rotary vacuum evaporator. The carrier agent maltodextrin of 8, 10, 12% w/v was added to the concentrated bitter gourd juice to increase concentration and to reduce hygroscopicity of the dried powder. Then the concentrated bitter gourd juice was spray dried by using spray dryer (SMST-15, Kolkata) to obtain bitter gourd powder. The concentrated bitter gourd juice was fed in to the drying chamber with feed flow rates of 15, 20 and 25 ml/min and inlet air temperature was maintained at 140 °C. The obtained powder samples were stored in LDPE covers under ambient conditions and the shelf life of powder samples were determined by analyzing quality characteristics for every 15 days interval. The sample were named as T₁ (8 % maltodextrine and 15 ml/min feed flow rate), T₂ (8 % maltodextrine and 20 ml/min feed flow rate), T₃ (8 % maltodextrine and 25 ml/min feed flow rate), T₄ (10 % maltodextrine and 15 ml/min feed flow rate), T₅ (10 % maltodextrine and 20 ml/min feed flow rate), T₆ (10 % maltodextrine and 25 ml/min feed flow rate), T₇ (12 % maltodextrine and 15 ml/min feed flow rate), T₈ (12 % maltodextrine and 20 ml/min feed flow rate) and T₉ (12 % maltodextrine and 25 ml/min feed flow rate).

Water activity

The water activity of samples was determined with Hygro Lab C1 bench-top meter.

Bulk density

The bulk density of bitter gourd powder was determined by taking 2 g of powder in an empty 10 ml graduated cylinder. The ratio of mass of powder (g) and the volume occupied

(cm³) in the cylinder gives the bulk density (Goula *et al.*, 2004) of powder. The measurements were done in three replications for each sample and mean values were taken.

$$\rho_b = \frac{W_s}{V_s}$$

Where,

ρ_b = bulk density, g/cm³

W_s = weight of sample, g

V_s = volume of the sample, cm³

WSI and WAI

Water solubility index (WSI) was measured according to the method of Ahmed *et al.*, 2010. Half gram of bitter gourd powder and 50 ml water were mixed under agitation using magnetic stirrer (CBM5-1042, Rami instruments Div. Vasai, India) at 700 rpm for 5 min. The dispersion was centrifuged at 3000 rpm for 5 min.

The supernatant was collected in a pre-weighed Petri dish and the residue was weighed after oven drying overnight at 105°C. The amount of solids in the dried supernatant as a percent of the total dry solids in the original 0.5 g sample was used as indicator of WSI and WAI was expressed as ratio of sediment sample to the original sample.

$$WSI (\%) = \frac{\text{Dry weight of supernatant}}{\text{Dry weight of sample}} \times 100$$

$$WAI = \frac{\text{Sediment sample}}{\text{Dry weight of sample}}$$

pH

pH of the bitter gourd powder samples was determined using a Digital pH meter (HI-98107, Hanna).

Titration acidity

Titration acidity was determined by titrating bitter gourd powder in water against 0.1N sodium hydroxide (Ranganna, 2010). About 5-10 g of bitter gourd powder sample was taken and added with little amount of water and mixed thoroughly. Now the sample solution was titrated against 0.1N NaOH using phenolphthalein as indicator. Appearance of light pink color denotes the end point. The acidity was calculated by using following equation and expressed in percent.

$$\text{Titration acidity (\%)} = \frac{\text{Equivalent weight of acid} \times \text{Normality of NaOH} \times \text{Titer} \times 100}{\text{Weight of sample} \times 1000}$$

Ascorbic acid content

The ascorbic acid content of the powder was determined using 2, 6- dichloroindophenol indophenols (Ranganna, 2010).

Results and Discussion

Variation in water activity

Initially water activity of bittergourd powder samples was less in T₇ (0.311) and more water activity was observed in T₃ (0.343) sample. The water activity increases with decrease in concentration of maltodextrin due to the addition of maltodextrin could increase the total solid content in the feed and thus reduce the water activity of the product (Quek *et al.*, 2007). But during storage period, the water activity in all samples gradually increased due to absorption of moisture. On 45th day of storage, the water activity was high in sample T₉ (0.564). Similarly water activity increased with increase in feed flow rate. Higher flow rates imply shorter contact time between the feed and drying air, making the heat transfer less efficient and thus causing lower water evaporation. Due to this reason the water activity was higher at feed flow rate of 25 ml/min in sample T₉ (0.564) as compared to feed flow rates 15 and 20 ml/min (Fig. 1).

Variation in bulk density

The variation is in bulk density of different samples as shown in Figure 2. The bulk density decreased when the maltodextrine concentration increased. After spray drying of bittergourd juice, initially the bulk density of bitter gourd powder was observed less in 12 % concentrations as compared with 10 and 8% maltodextrine concentrations. During the 45 days storage period of bitter gourd powder, the bulk density gradually increased. On 45th day of storage, the bulk density was high in samples T₁T₈ and T₉ (0.57 g/cm³).

Variation in water soluble index

From the Figure 3, it was observed that after spray drying at an inlet air temperature of 140°C, initially WSI was more in T₉ (12% maltodextrine and 25 ml/min feed flow rate) i.e. 40.8% and lowest WSI was observed in T₁ (8% maltodextrine and 25 ml/min feed flow rate) i.e. 33.4%. When maltodextrine concentration in bittergourd powder was increased from 8% to 12% the water soluble index was increased. It means water soluble index increases with increase in maltodextrine concentration. This is due to higher maltodextrine concentrations led to a decrease in powder moisture content and an increase in powder solubility. On 45th day of storage, the WSI was lower in sample T₉ (15%). During the storage period, the absorption of moisture powders increased with increase in maltodextrin concentration (Goula and Adamopoulos, 2008). Hence more moisture content was observed in the samples of 12% maltodextrine compared to 10% and 8% maltodextrine.

Variation in water absorption index

From the Figure 4, initially WAI was less in T₉, T₈ (1.814%) and the highest WAI was observed in T₁ (2.464%). The results showed that, water absorption index decreases with

increase in maltodextrine concentration. The carrier agent maltodextrine could form an outer layer of the drops and alter the surface stickiness of particles due to the transformation into a glassy state. The changes in surface stickiness reduce the particle–particle cohesion resulting in less agglomeration, and therefore, lower water holding capacity of the powders. Increased maltodextrine concentration caused a partial reduction in the powder WAI, although it increases powder moisture content. Agglomeration, which usually occurs in powders with higher moisture content, may contribute to their wetting ability because the liquid penetrates into the pores more easily (Buffo *et al.*, 2002). During the storage period of bitter gourd powder, the WAI was increased gradually and this increase was observed more in the samples of higher maltodextrine concentrations i.e., T₇, T₈ and T₉.

Variation in whiteness index

The whiteness index of powder was lowest in T₃ (6.8) and highest in T₆ (10.1) sample as shown in Figure 5. If the white index of the sample is more, the chlorophyll content will be less in the bittergourd powders. The whiteness index was observed highest in 12% maltodextrine concentration. The whiteness index was increased with increase in maltodextrine concentration and inlet air temperature.

During the storage period, the whiteness index was decreased and it was lowest in T₃ and T₆ samples (2.6 and 2.2, respectively) as compared to other samples and more chlorophyll content was observed in T₄ and T₇ samples (4.4). As the storage period increased, the whiteness index of powder decreased due to absorption of moisture content thus causing non-enzymatic browning resulting in color change.

Fig.1 Variation in water activity of spray dried powder during storage

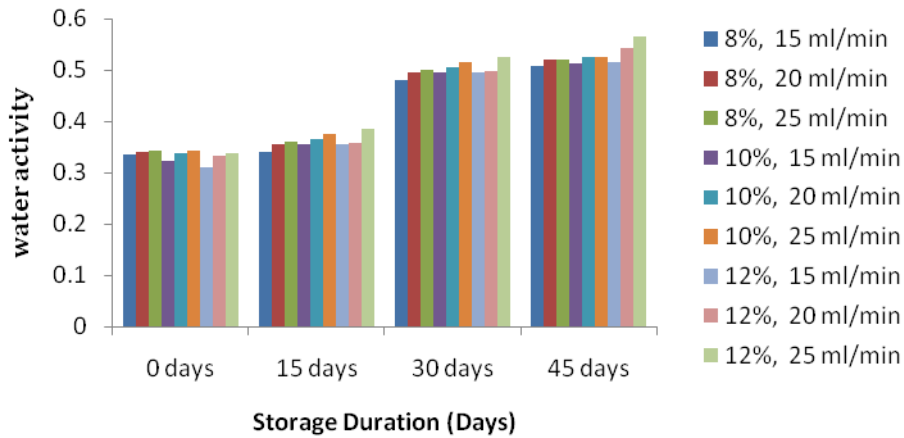


Fig.2 Variation in bulk density of spray dried powder during storage

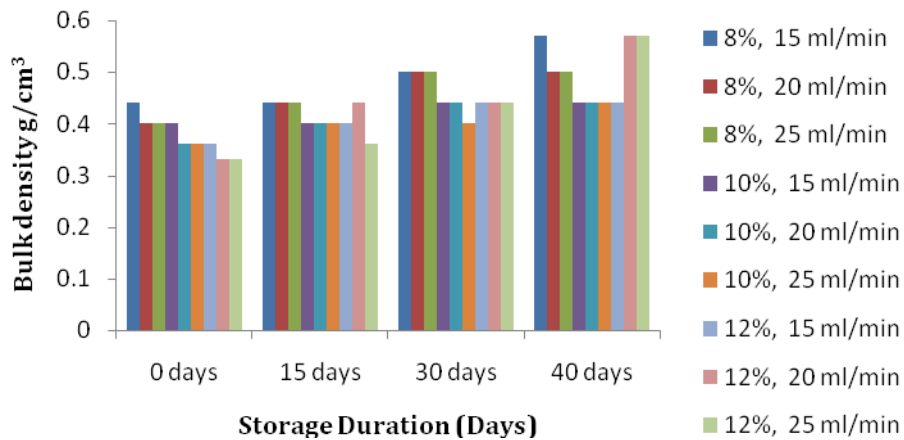


Fig.3 Variation in water soluble index of spray dried powder during storage

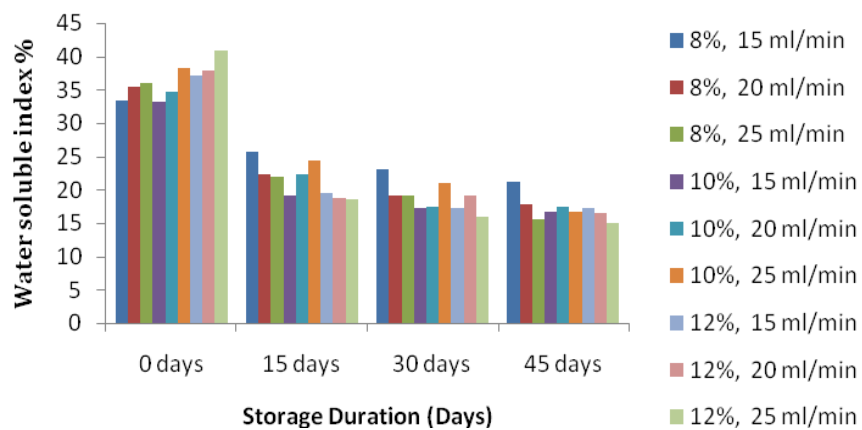


Fig.4 Variation in water absorption index of spray dried powder during storage

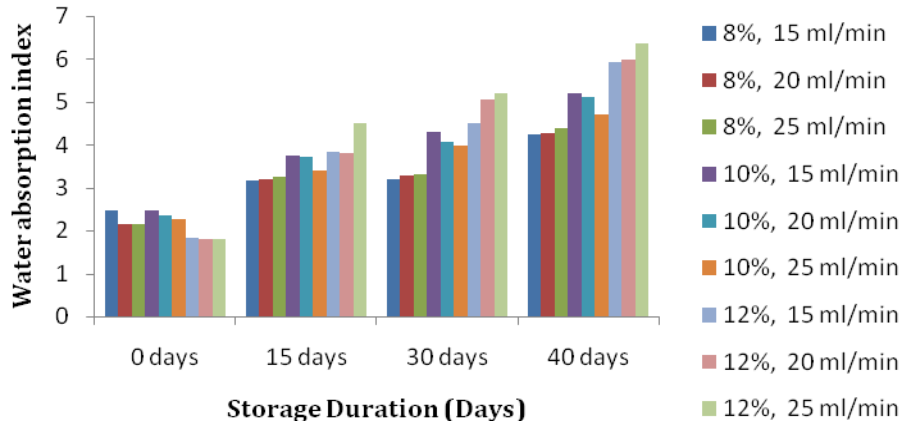


Fig.5 Variation in whiteness index of spray dried powder during storage

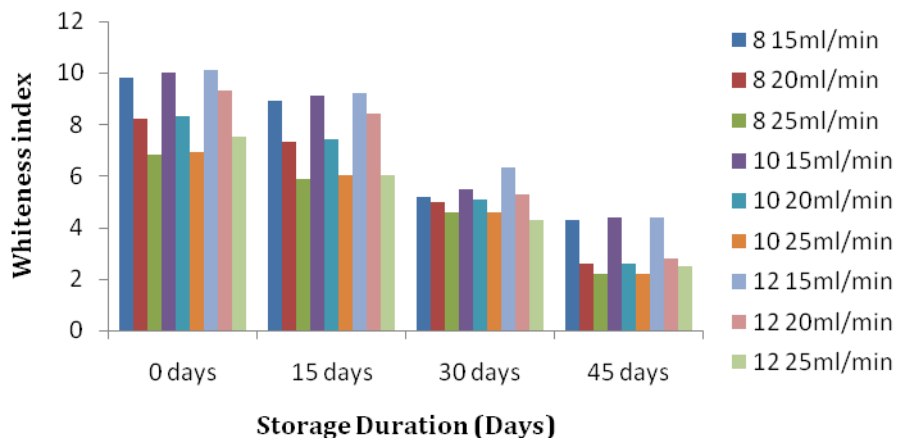


Fig.6 Variation in pH of spray dried powder during storage

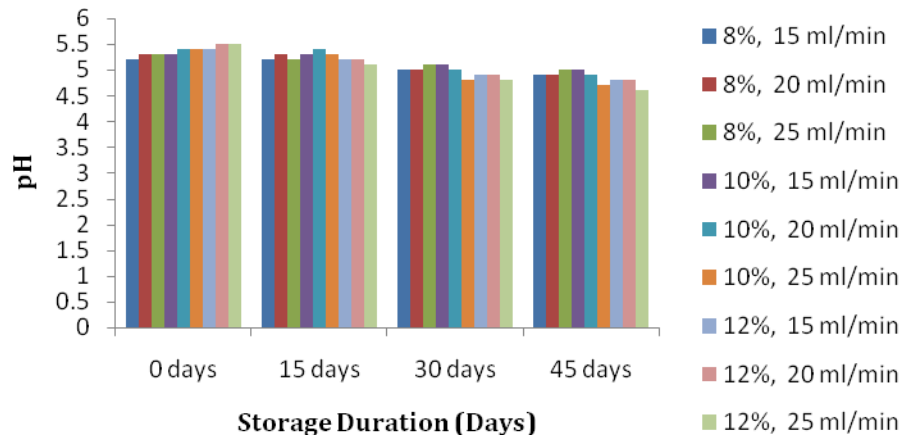


Fig.7 Variation in ascorbic acid of spray dried powder during storage

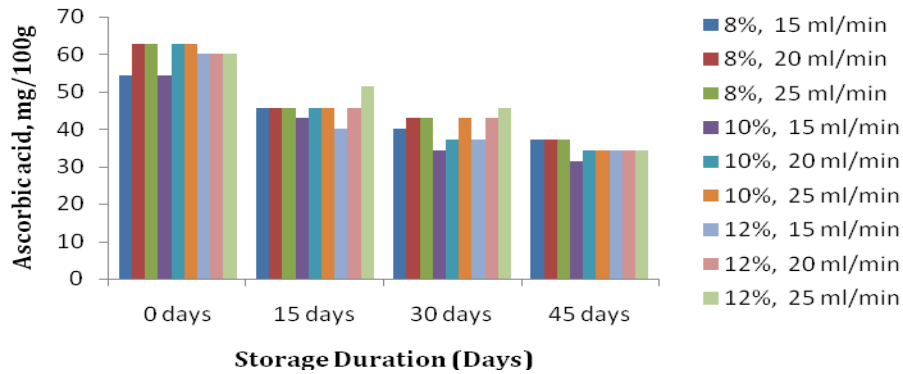
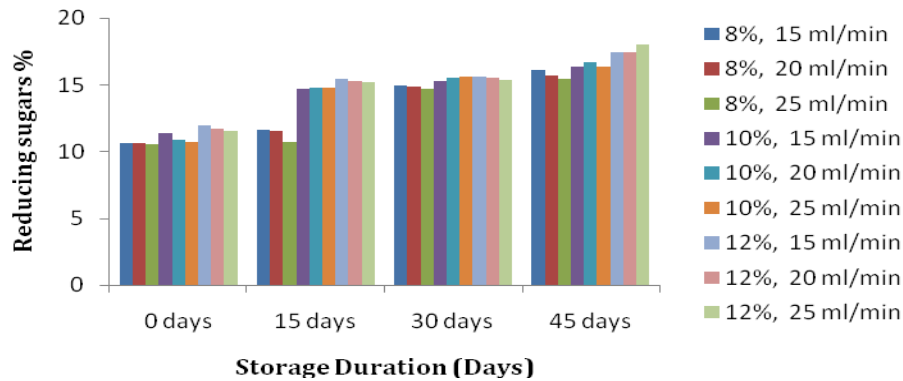


Fig.8 Variation in reducing sugars of spray dried powder during storage



Variation in pH

The pH of spray dried bitter gourd powders was almost same in all treatments. The pH was observed slightly less in 10% maltodextrin concentrations and increased with increase in maltodextrin concentration (Fig. 6).

The pH values obtained ranged from 5.2 to 5.5 at an inlet air temperature 140°C. During storage, the pH decreased due to the production of acetic acid and lactic acid. At 45th day of storage, the pH of powder decreased from 5.5 to 4.6 in T₉ sample.

Variation in ascorbic acid

The ascorbic acid content of bitter gourd powder was highest for T₂, T₃, T₅ and T₆ (62.86

mg/100 g sample) and was lowest for T₁ sample (54.29 mg/100 g) as shown in Figure 7.

On 45th day of storage period, the ascorbic acid content was more in T₁, T₂ and T₃ samples i.e., 37.14 mg/100 g and less in T₄ (31.43 mg/100 g) sample.

This decrease might be due to the factors such as storage temperature, oxidative enzymes, processing techniques, metal contamination and the presence of atmospheric oxygen in the head space.

Variation in reducing sugars

The reducing sugars of bitter gourd powder was observed more in T₇ (11.95%) sample) and less in T₃ (10.53%) sample as shown in Figure 8.

The increase in concentration of maltodextrin in samples would result in increase in reducing sugars. At 8% maltodextrin concentration the reducing sugars was less compared to 10 and 12% maltodextrin concentrations. During the storage period of bitter gourd powder, the reducing sugars increased gradually. On 45th day of storage period, the increase in reducing sugars was less in T₃ (15.42%).

The results showed that after spray drying, initially the water activity, water absorption index (WAI), and bulk density were decreased with increasing maltodextrin concentration and water soluble index, pH, ascorbic acid, reducing sugars and whiteness index were increased with increasing maltodextrin concentration. During the storage period, the water activity, bulk density and reducing sugars were increased and pH, ascorbic acid and whiteness index was decreased gradually. On 45th day of storage, the water activity was high in sample T₉ (0.564), the bulk density was high in samples T₁T₈ and T₉ (0.57 g/cm³), the WSI was lower in sample T₉ (15%), WAI was high in T₇,T₈ and T₉, whiteness index was lowest in T₃ and T₆ samples (2.6 and 2.2, respectively), the ascorbic acid content was more in T₁, T₂ and T₃ samples i.e., 37.14 mg/100 g and less in T₄ (31.43 mg/100 g) sample and reducing sugars was less in T₃ (15.42%). Finally it was concluded that at the end of the storage period of 45 days, the quality of product was good at 8% maltodextrine concentration and 15 ml/min feed flow rate.

References

- Ahmed, M., Akter, M.S. and Eun, J.B. 2010. Peeling, drying temperatures, and sulphite treatment affect physicochemical properties and nutritional quality of sweet potato flour. *Food Chemistry*. 121-128.
- Buffo, R.A., Probst, K., Zehentbauer, G., Luo, Z. and Reineccius, G.A. 2002. Effects of agglomeration on the properties of spray-dried encapsulated flavors. *Flavour and Fragrance Journal*. 17: 292–299
- Goula, A.M. and Adamopoulos, K.G. 2004. Influence of spray drying conditions on residue accumulation Simulation using CFD. *Drying Technology*. 22(5): 1107-1128.
- Goula, A.M. and Adamopoulos, K.G. 2008. Effect of maltodextrin addition during spray drying of tomato pulp in dehumidified air: ii. Powder properties. *Drying Technology*. 26(6): 726–737.
- Hand Book on Horticulture Statistics. 2014. Government of India, Ministry of Agriculture. Department of Agriculture and Cooperation. New Delhi. <http://agricoop.nic.in/imagedefault/whatsnew/handbook2014.pdf>
- Michael, J.K. 1993. Spray drying and spray congealing of pharmaceuticals. *Encyclopedia of Pharmaceutical Technology*. 14: 207-221.
- Nadine, B., Messanvi, G., Akpagana, K., Hudson, J., Komlan, S., Kossi, K. and Arnason, J. 2005. Ethnomedicinal uses of *Momordica charantia* (Cucurbitaceae) in Togo and relation to its phytochemistry and biological activity. *Journal of Ethnopharmacology*. 96(1-2): 49-55.
- Quek, Y.S., Chok, N.K. and Swedlund, P. 2007. The physiochemical properties of spray dried watermelon powder. *Chemical Engineering and Processing*. 46: 386-392.
- Ranganna, S. 2010. Proximate constituents (chapter 1), Vitamins (chapter 5). In: *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. McGraw Hill Education Private Limited, pp: 9-16, 105-106.

How to cite this article:

Srinivas, D., N. Vinoda and Edukondalu, L. 2018. Effect of Maltodextrin Concentration on Spray Dried Bitter Gourd Powder. *Int.J.Curr.Microbiol.App.Sci*. 7(05): 3147-3154.
doi: <https://doi.org/10.20546/ijcmas.2018.705.368>