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RESEARCH ARTICLE

Optimisation of drying process parameters for bitter guard drying

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ABSTRACT

Bitter gourd (*Momordica Chrantia*) fruits were analyzed for its proximate composition. The results showed that it is a good source of vitamin C and proteins. The optimization of dehydration process for bitter gourd was done. Blanching pre-treatment was optimized on the basis of sensory quality. Blanching in plain water and in 5% salt water for 1,3,5 minute was accomplished and the sensory quality of the blanched bitter gourd slices before and after drying were observed. Bitter gourd slices were dried in a cabinet tray dryer at temperatures 50 0C, 60 0C and 70 0C. Temperature for drying was optimized on the basis of parameters such as drying rate, drying time required, moisture in final product, yield of powder and sensory quality. Slices were then grinded to powder. The packaging and shelf life study of bitter gourd powder was carried out. From this research work it was found that the blanching of bitter gourd slices in plain water for 3 minute and drying at 60 °C resulted in the best quality product. The developed bitter guard powder was rich source of protein, vitamin C was safely stored at room temperature for three months.

Keywords: Bitter gourd, blanching, drying temperature, *Momordica Chrantia*

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INTRODUCTION

Bitter gourd (*Momordica chrantia* L.) is a member of the cucurbit family. It is considered to be native to China or India and Pakistan. It is cultivated widely in many tropical and subtropical regions of the world and is frequently used in India and orient as a foodstuff and a medicinal plant (Habicht et al., 2011).

Bitter gourd has important role as a source of proteins, carbohydrates, vitamins, minerals and other nutrients in human diet (Ali et al., 2008). It is a nutrient-dense plant and is composed of a complex array of beneficial bioactive chemicals and antioxidants (Singhet al., 2009). Bitter gourd is traditionally known for its medicinal properties such as antidiabetic, anticancer, anti-inflammation, antivirus, and cholesterol lowering effects (Joseph and Jini, 2013). It has been used for several ailments like jaundice, abdominal pain, kidney stone, piles, pneumonia, fever, hyperlipidaemia, digestive disorders, microbial infections and menstrual problems (Grover et al., 2004; Joseph and Jini, 2013). It has also been reported to be laxative or aphrodisiac (Habicht et al., 2011), antidotal, antilypolytic, lypogenic, antipyretic, tonic, appetizing, stomachic, antiflatulent and antibilious and also shows anti-inflammatory property and has a healing capacity as well (Singh et al., 2009).

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India is the largest producer of bitter gourd in the world and shares 31% of the world's total production (Reyes, 2014). Irrespective having high nutritional and health promoting properties, there is a huge loss of bitter gourd because of lack in post-harvest technology, processing methods and storage facilities. Thus, there is need to develop new technologies for the preservation and reduction in post-harvest losses of the bitter gourd. Dehydration is one of the oldest and important methods of preservation of fruits and vegetables.

The main objective of drying is removal of free water from fruits and vegetables to the extent where microorganisms do not survive and reproduce and remain stable in ordinary storage conditions. Simultaneously, the total solids viz. sugar, organic acids etc. are concentrated. Dried product is preferred because of some advantages like it reduced mass (bulk) and lower the cost of packaging and storage requirement (Singh et al., 2006). Through the introduction of these new technologies such as dehydration, the income of people living in remote areas can be increased by using their produces, paying higher prices and providing them with employment opportunities in food industry. Hence, the study was conducted to optimize the dehydration process of the bitter gourd fruits so as to get the best quality product.

MATERIALS AND METHODS

Bitter gourds of the variety Phule Green Gold were purchased from the local vegetable market of Kolhapur, Maharashtra. The graded fruits were washed thoroughly under running water to make it free from dust, dirt and other external matters. Bitter gourd were then analyzed for the physical properties such as weight, volume, length and diameter.

Chemical analysis of bitter gourd was carried out by using standard procedures of Association of Official Analytical Chemists (AOAC, 2000). Parameters such as crude protein (955.04:2.4.03), crude fibre (962.09:4.6.01), moisture content (934.01:4.1.03), ash (942.05:4.1.10), crude fat (920.39:4.5.01) and carbohydrate bye difference were analyzed. Fruits were then cut into slices of thickness 0.5 cm. Slices were then blanched in boiling water and 5% salt water for 1 minute, 3 minutes and 5 minutes to inactivate enzymes. Then these were soaked in 0.2 % KMS solution for 15 minutes.

Drying of bitter gourd slices was carried out in cabinet tray dryer at temperatures 50^0C, 60^0C and 70^0C. Dried bitter gourd slices were then powdered by using grinder. The proximate analysis of bitter gourd powder was carried out as per standard procedures. The powdered bitter gourd samples were packed in HDPE and LDPE pouches. These were stored at room temperature for the study of moisture content, sensory attributes and microbial growth at regular interval of one month over the period of three months. Sensory evaluation was carried out by a panel of ten semi trained panel members. Hedonic rating test was employed using 9-point hedonic scale. Sensory parameters such as colour, taste, texture and overall acceptability were evaluated (Ranganna, 2000).

RESULTS AND DISCUSSION

Physical analysis of bitter gourd

Bitter gourd fruits were cut and analyzed for the percent share of each part of the fruit such as pericarp, seeds, and arils which were found as 80.80%, 9.30% and 9.89% respectively. Physical properties of bitter gourd fruit were determined. The average weight, length, diameter and volume were determined. Physical properties of the fruit have an effect on the physical properties of dried product. The required fruits were taken randomly for examination of physical parameters. These physical properties are enlisted in Table 1.

Table 1: Physical characteristics of bitter gourd fruits

Characteristic	Average value
Weight	78.22 gm
Length	14.85 cm
Diameter	23.62 cm
Volume	84.4 ml
Colour	Dark green

Proximate analysis of bitter gourd

Bitter gourd fruits were analyzed for the proximate composition and the results are indicated in Table 2. Results of moisture content of whole fruit were well comparable with results of Kocchar et al. (2006) who observed moisture 93.43% in whole fruits. Moisture content of pericarp and seeds determined was well comparable with Horax et al. (2010) who observed it to be 91.2-92.4% and 58.2-72.2 % respectively.

Table 2: Proximate analysis of bitter gourd fruits

Parameter	Amount
Moisture (%)	92.30
Fat (%)	0.93
Protein (%)	13.13
Ash (%)	0.83
Vit. C (mg/100g)	87.82
Crude fiber	1.26
Carbohydrates	3.67
Total energy	27.09Kcal

Results of fat content of whole fruit were well comparable with Yuwai et al. (1991) who observed it 0.76%. Fat content of seeds was less than the results of Horax et al. (2010) which was 28-30.4%. The difference may be due to the varying maturity index of seeds, varietal and geographical differences. Enough literature is not available for the fat content of pericarp of bitter gourd fruits.

The protein content of whole fruit determined was 18.02% which was less than Yuwaiet al. (1991). This difference may be due to the varying maturity index of seeds, varietal and geographical differences. Results of fat content of pericarp are well comparable with Horax et al. (2010) which was 13.14-14.2%.

Percent ash determined was well comparable with data of National Horticulture Board, India which is 0.8%. Enough literature is not available for the values of ash content of pericarp and seed. Crude fiber content found to be slightly higher than the reported to be 1% by Gopalan et al. (2004). Vitamin C content was near to the value of 84mg as reported by USDA. The proximate analysis of bitter gourd fruits has revealed that it is a good source of protein, crude fiber and a rich source of vitamin C.

Optimization of dehydration process

The dehydration process was optimized based on blanching pretreatments, drying parameters.

Optimization of blanching pretreatment

Blanching pretreatment was optimized on the basis of sensory quality. Blanching in plain water for 1 min (B1), 3 min (B 2) and 5 min (B 3) and blanching in 5% salt water for 1 min (B 4), 3 min (B 5) and 5 min (B 6) was accomplished and the sensory quality of the blanched bitter gourd slices before and after drying was observed. The observations were summarized in Figure 1.

Based on sensory attributes, the treatment B_2 in which slices were blanched in plain water for 3 min, was selected for further process as it was having the better quality in terms of sensory attributes than other samples with other treatments. The results were comparable with the results of Mudgal et al. (2009).

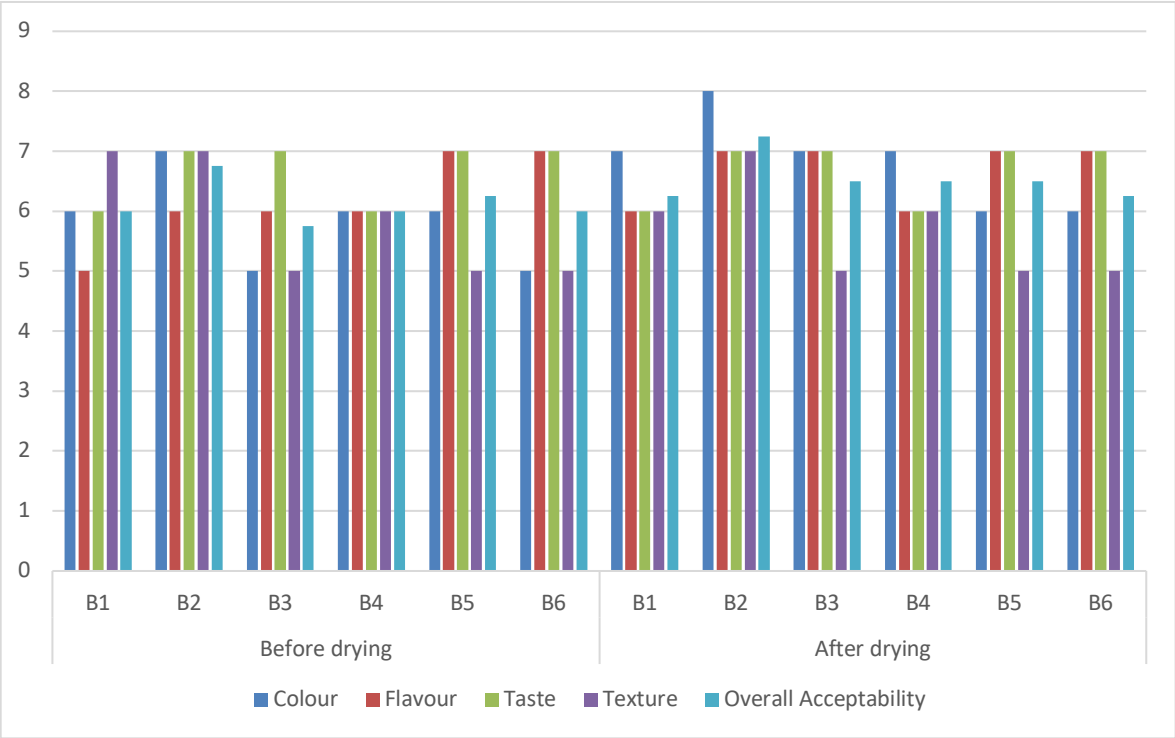

Figure 1: Optimization of blanching pretreatment

Optimization of temperature of dehydration process

Bitter gourd slices were dried at 50^0C (T1), 60^0C (T2) and 70^0C (T3). These were analyzed for moisture content, drying time and sensory attributes. The observations made were summarized in the Table 3.

The slices dried at 60^0 C were of a better quality, the time required was less and the yield of powder was more as well as the moisture removed was optimum. Effect of drying temperature were as shown in Figure 2. Based on these analysis, temperature 60^0 C was selected for the drying. These results were comparable with results of Khodke et al. (2014).

Table 3: Optimization of temperature of dehydration process

Treatment	Required time for drying (Hrs)	Moisture in dried product	Yield of powder	Observation
T1	10	8.50	6.5%	Moisture in dried product was more. Required time was more. Overall quality was not good
T2	8	6.33	6.8%	Optimum moisture was removed. Quality was very good in terms of texture and colour.
T3	7.2	6.36	6.1%	Texture was very hard and rubbery. Vitamin C content was reduced. Yield of powder was less

By considering the observations from tables above, the blanching in plain water for 3 minute, soaking in 0.2% KMS solution and then drying at 60^0c was selected for the final drying process of the bitter gourd.

Figure 2: Effect of drying temperature on sensory attributes of dried slices

T_1: Drying at 50^0 C; T_2: Drying at 60^0C ; T_3 : Drying at 70^0C

Proximate analysis of bitter gourd powder

Proximate analysis of bitter gourd powder was done. The results are summarized in table 4. The proximate analysis of bitter gourd powder it is revealed that bitter gourd powder was a good source of protein, fiber and vitamin C content with content as 12.98%, 11.21% and 518 mg/100g.

Table 4: Proximate analysis of bitter gourd powder

Parameter	Value
Moisture (%)	6.33
Ash (%)	9.89
Fat (%)	0.95
Protein (%)	12.98
Crude fiber (%)	11.21
Carbohydrates (%)	60.75
Total energy (Kcal)	296.67
Vitamin C (mg/100g)	518

Shelf life and Packaging study of bitter gourd powder

The bitter gourd was packed in LDPE and HDPE bags at room temperature for the period of three months (Fig. 3). The sensory and microbial analysis were done at the regular interval of one month. Moisture content was also measured to check the increase in moisture content during the storage period.

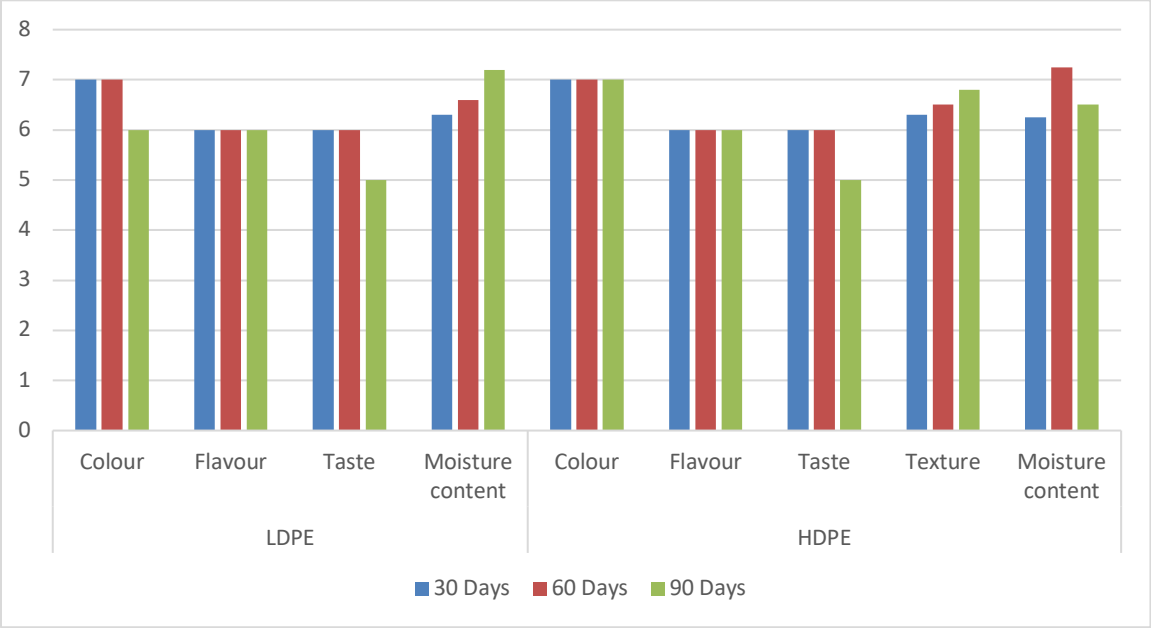

Figure 3: Shelf life and Packaging study of bitter gourd powder

Sensory and microbial evaluation showed that the bitter gourd powder was in a good quality at least for three months. There was gradual increase in the moisture content during the storage period. There was no growth found for TPC throughout the storage period but little growth was there in third month of storage.

CONCLUSION

From this study, it can be concluded that the bitter gourd is nutrient dense vegetable fruit with number of medicinal properties. The blanching in plain water for 3 minutes and drying at 60^0C resulted in best quality product. It can be preserved for a long period by drying it. The bitter gourd powder can be safely stored at least for three months.

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