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PROCESS STANDARDIZATION AND STORAGE EVALUATION OF DEVELOPED WHOLE UNRIPE PUMPKIN (*CUCURBITA MOSCHATA*) POWDER IN MECHANICAL CABINET AIR DRYER

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ABSTRACT

The present investigation, entitled "Process standardization and storage evaluation of developed whole unripe pumpkin (*Cucurbita moschata*) powder in mechanical cabinet air dryer" was conducted in the Department of Food Technology, Parul University. The goal of this study was to develop pumpkin powder from whole unripe pumpkin. The developed product was examined for various physico-chemical attributes, including storage stability and the FT-IR procedure for identification of functional groups. Pumpkins are rich in beta-carotene, carbohydrates, thiamine, riboflavin, and minerals like potassium, phosphorus, magnesium, iron, and selenium increases its use in production of juice, pomade, pickles, and dried products. The standardized blanching time was 2 min at 80ºC temperature. The nutritional analysis of pumpkin powder revealed that protein, fiber, fat, calcium, magnesium, iron and zinc contents of the freshly developed pumpkin powder were 10.54 per cent, 7.63 per cent, 1.80 per cent, 10.54 mg/100g, 294.21 mg/100g, 6.96 mg/100g and 7.02 mg/100g respectively. The results of the FT-IR analysis confirmed the presence of lipids at 1021.05 cm^{-1}, OH from lipids or other compounds such as carboxylic acid and ketone at 3267.27

cm^{-1} and 338.56 cm^{-1} and CH absorption at 2926 cm^{-1} in the developed powder. The developed pumpkin powder was packed in polyethylene and stored for 3 months under refrigeration condition (4ºC) and ambient condition (18-38ºC). The moisture content was increased while ash, protein and fat content were decreased at both ambient and refregiration temperature.Thus refrigeration temperature could be regarded as better storage temperature as it could retain maximum amount of nutrients.

Keywords: Unripe pumpkin, Mechanical cabinet air dryer, FT-IR, Antioxidant

INTRODUCTION

Pumpkin is native to tropical and subtropical regions such as Mexico and South America **[1]**. "Pepon" is Greek word for pumpkin which means "large melon". Pumpkin belongs to the Cucurbitaceae family and genus Cucurbita. Five domesticated species make up the genus Cucurbita: *Cucurbita moschata, Cucurbita pepo, Cucurbita maxima, Cucurbita ficifolia,* and *Telfairia occidentalis* **[2]**. The most widely cultivated and economically beneficial species are *C. moschata, C. maxima, and C. pepo* **[3]**. The notable pumpkin varieties include CM-14, Pusha Vishwas, Arka Chandan, Arka Suryamukhi, CM-350 and NDPK-24 **[4]**.

Pumpkin is creeping plant with monoecious, annual and short-lived perennial root **[5]**. All plant parts, including the pumpkin's edible, protein-rich seed, fruit, and leaves, provide a variety of nutrients when consumed. Presence of beta-carotene, carbohydrates, vitamins like B6, K, thiamine, riboflavin, and minerals like potassium, phosphorus, magnesium, iron, and selenium increases its use in production of juice, pomade, pickles, and dried products **[6]**. Pumpkin contains protein (1.0g), water (91.6g), lipids (0.1g), ash (0.8g), dietary fiber (0.5g), carbohydrates (6.5g), and provides 26 kcal per 100g **[7]**. Pumpkin seeds are a nutritional powerhouse due to the minerals like zinc, phosphorous, magnesium, potassium, and selenium **[8]**. Apart from rich source in pro-vitamin A carotenoids, it includes pigments like lutein and b-carotene. However, small amounts of cis-b-carotene, a-carotene, lutein, lycopene, cryptoxanthin, and lutein are present **[9]**. Plant phytosterols, tannins, alkaloids, flavonoids, phenolics, tocopherol, and cucurbitacin are the most important bioactive constituents. Pumpkin seeds have numerous health benefits, and they contain a variety of biologically active components such as polysaccharides, para-aminobenzoic acid, fixed oils, sterols, and proteins. The pumpkin seed kernel contained

the most phytosterols (265-289 mg/100 g) **[10]**. According to biological investigation carried in 2015, it was noted pumpkin meal decreases cholesterol and LDL levels and boosts HDL in a dose-dependent way **[11]**. Bioactive compounds present in pumpkin peel, pulp and seeds show anti-inflammatory **[12]**, antibacterial **[13]**, anticarcinogenic **[14]** and antidiabetic **[15]**.

Dehydration refers to the elimination of water from the food while maintaining controlled levels of temperature, relative humidity, and airflow. Fruits and vegetables can be dried in a variety of ways, including direct application of energy from a radiant microwave or dielectric source, superheated steam, a vacuum, heated inert gas, or hot air. Air is the most common medium for removing moisture from foods. Hot air dryer can be categorized into natural-draft driers and forced-draft driers. Natural draft dryer includes kiln, cabinet, tower, and Oregon tunnel driers. Forced draft drier includes tunnel driers, conveyer driers, fluidized-bed driers, and spray driers. In mechanical cabinet air dryer, insulated cabinets with air circulating fans and heater are installed. The hot air collides with baffles which direct air between food and tray. Air-powered dehydrators are less expensive to build and easier to set up and use. Overheating, discoloration, and scorching of the product are greatly reduced by using air as a drying medium. Foods can also be slowly dried by air, preventing juice loss through dripping **[16-18]**.

Drying gives a new spectrum in foods variety like dried chips, dried powder etc. Dried powders produced can be stabilized by lowering their moisture content or water activity. Longer shelf life, lesser storage space, lesser net weight, easy availability during off season, storage and transportation are some benefits of drying processes. After harvesting, pumpkin remains stable for one to three months. Pumpkin quality deteriorates due to moisture loss, softening, color changes, and microbial spoilage after being peeled. Because of high moisture content, drying and powdering may be appropriate methods for extending their shelf life **[19]**. The addition of pumpkin powder to cereal flours in bakery goods including bread, cakes, and cookies as well as in soups, seasonings, sauces, and instant noodles as well as its usage as a natural coloring agent in flour and pasta mixtures **[20]**.

MATERIALS AND METHODS

The present study, entitled "Process standardization and storage evaluation of developed whole unripe pumpkin (*Cucurbita moschata*) powder in mechanical cabinet air dryer" was conducted in the product

development laboratory of the Department of Food Technology, PIAS, Parul University, Vadodara, Gujarat, India.

Procurement of raw unripe pumpkin

Unripe pumpkins were procured from local market of Vadodara. The unripe pumpkins were used for development of whole pumpkin powder.

Optimized method for preparation of whole unripe pumpkin powder

The unripe pumpkin was sorted to remove the cuts or bruises if present on pumpkin. The pumpkin was trimmed and washed thoroughly with running water to remove the dirt or dust. Then it was cut into small even thin pieces using a stainless steel knife. The pieces were then water blanched for 2 min at 80ºC to inhibit its enzyme activity. After blanching, they were spread on trays and kept in the mechanical cabinet air dryer at 65 ± 2ºC for 8 h. Dried pumpkins were grounded into fine powder using electrical grinder. The powder was passed through 30 mesh sieves to obtain fine powder.

Chemical analysis

The crude protein and fat were estimated using **[21]**. The moisture, ash, crude fibre and carbohydrates were estimated by **[22]**. The dry ash method was used for mineral estimation given by **[23]**. FT-IR peaks were interpreted as per the guidelines given by **[24]**.

Storage study

The obtained powder was packed in sample bags and stored for 3 months at refrigeration (4ºC) and ambient (18-38ºC) temperatures. The pumpkin powder was analyzed for various physico-chemical and sensory parameters at different intervals of 0, 1, 2 and 3 months of storage.

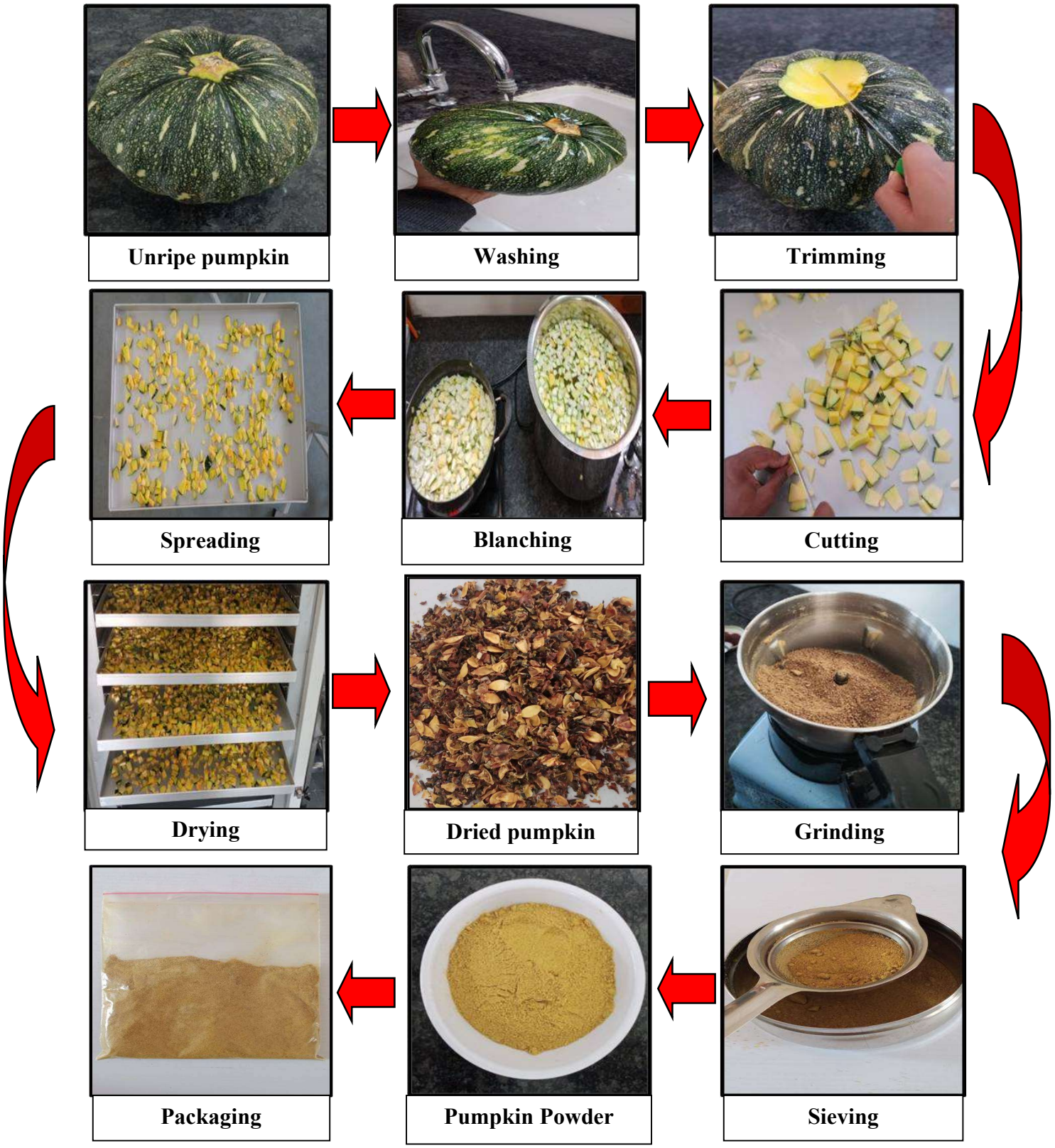

Figure 1: Preparation of pumpkin powder

RESULTS AND DISCUSSION

The present research, entitled "Process standardization and storage evaluation of developed whole unripe pumpkin (*Cucurbita moschata*) powder in mechanical cabinet air dryer" was conducted in the product development laboratory of the Department of Food Technology, PIAS, Parul University, Vadodara, Gujarat, India

Proximate analysis

Various physical parameters like waste index, drying yield and drying time were calculated. The chemical parameters ash, moisture, crude protein, crude fiber, carbohydrates and energy value were determined in order to understand the composition of developed pumpkin powder **(Table 1)**.

The waste index was calculated by dividing waste obtained with total weight of pumpkin and multiplied with 100. The waste index obtained was 1.22 per cent. The drying was carried out in mechanical cabinet air dryer at 80ºC and total drying time obtained was 8h. Drying yield was calculated by dividing weight of dried sample with total weight of sample and multiplied with 100. The drying yield obtained was 5.29 per cent.

The moisture and ash content values obtained were 7.6 per cent and 6 per cent respectively. The obtained values of protein, fat, carbohydrates and fiber were 10.54 per cent, 1.80 per cent, 79.97 per cent and 7.63 per cent respectively. The energy value obtained was 344.88 kcal/100g. These values closely resemble to the findings of **[25] (Table 2)**.

The calcium, magnesium, iron and zinc contents were 10.54, 294.21, 6.96 and 7.02 mg/100g respectively. Similar results were obtained by **[26]**.

The values obtained from developed whole pumpkin powder were compared with values of pumpkin powder (without rind, fibrous matter and seeds). The moisture, protein and fat content of developed whole pumpkin powder were slightly lower than pumpkin powder (without rind, fibrous matter and seeds) whereas fibre, ash and iron were present in higher amount **[27]**.

FT-IR analysis

Fourier Transform - Infrared Spectroscopy (FT-IR) is a spectral measurement technique with long-wave infrared radiation that captures absorbance in a time field and converts it to a frequency field using the Fourier transform algorithm. Because of its ability to identify functional groups of chemical compounds like carbohydrates, esters, and chemical bonds between atoms, FT-IR has been used to examine a wide range of samples.

The data in **Figure 2** shows peak at 2926 cm^{-1}, indicates the presence of CH absorption.

The peaks at 3267.27 cm^{-1} and 338.56 cm^{-1} represent OH from carbohydrates or other compounds like carboxylic acid and ketone. The band 1021.05 cm^{-1} represents the presence of lipids. Similar results were reported by **[28]**. The peak 1642.47 cm^{-1} may represent amide (N-H) bending in primary and secondary amides **[29]**. The band at 2926.78 cm^{-1} represents either symmetric stretching of $–CH_2$ or C-H stretching of aliphatic acid **[30]**.

Storage evaluation

The developed pumpkin powder was packed in polyethylene and stored under refrigeration condition (4ºC) and ambient condition (18-38ºC). The powder was stored for 3 months (90 days) and was evaluated for their nutritional quality during storage **(Table 3)**.

Table 1: Physico-chemical composition of developed pumpkin powder

Parameters	Amount (%)
Physical parameters	
Drying yield	5.29
Drying time	8 (h)
Wastage	1.22
Chemical parameters	
Ash	6
Moisture	7.6
Crude protein	10.54
Crude fat	1.80
Crude fiber	7.63
Carbohydrates	79.97
Energy value	344.88 (Kcal/100g)

Table 2: Minerals content of pumpkin powder

Minerals	Amount (mg/100g)
Calcium	10.54
Magnesium	294.21
Iron	6.96
Zinc	7.02

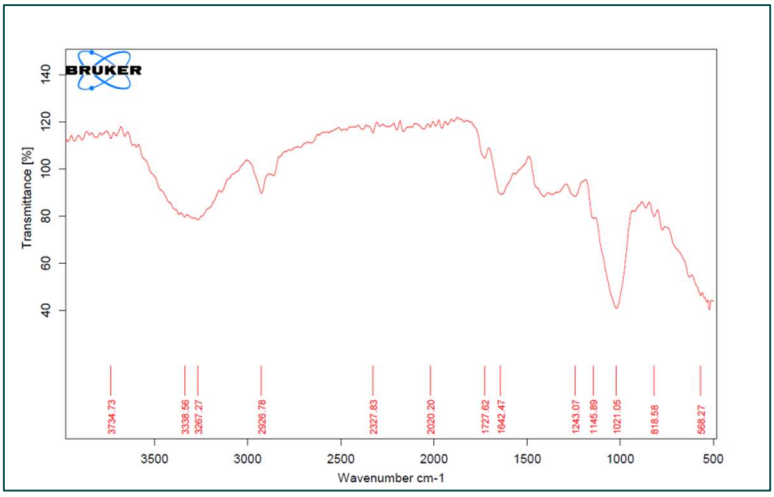

Figure 2: FT-IR analysis of developed pumpkin powder

Table 3: Storage studies of pumpkin powder at ambient temperature (18-38ºC) and refrigeration temperature (4ºC)

	Ambient temperature (18-38ºC)				Refrigeration temperature (4ºC)			
Parameters (%)	**0th day**	**1st month**	**2nd month**	**3rd month**	**0th day**	**1st month**	**2nd month**	**3rd month**
Moisture	**7.6**	**7.67**	**7.72**	**7.75**	**7.6**	**7.62**	**7.64**	**7.65**
Ash	**6**	**5.7**	**5.4**	**5.1**	**6**	**5.89**	**5.84**	**5.80**
Fat	**1.80**	**1.74**	**1.68**	**1.59**	**1.80**	**1.78**	**1.75**	**1.72**
Protein	**10.54**	**10.47**	**10.43**	**10.40**	**10.54**	**10.53**	**10.51**	**10.49**

The pumpkin powder showed a significant rise in its moisture content from 7.6 per cent to 7.75 per cent.. Similar observations were noted during their studies on spray dried papaya powder **[31]**. The ash content, fat content and protein content all decreased from 6 per cent to 5.1 per cent, 1.80 per cent to 1.59 per cent and 10.54 per cent to 10.40 per cent. This could be referred to from findings obtained by **[32]**.

The increase in moisture was less at refrigeration temperature from 7.6 per cent to 7.65 per cent. Also, the fat, protein and ash contents decreased from 1.80 per cent to 1.72 per cent, 10.54 per cent to 10.49 per cent and 6 per cent to 5.80 per cent respectively. The increase in moisture content may be due to the permeability of air. Protein and fat content might be decreased due to denaturation of proteins and oxidation of lipids. The above values suggest that increase in moisture was more for ambient temperature compared to refrigeration temperature. Moreover, decrease in ash, protein and fat content were less at refrigeration temperature when compared with values of ambient temperature. The nutrients were better retained at refrigeration temperature with minimal changes. Thus, refrigeration temperature can be considered better storage temperature.

CONCLUSION

Pumpkin has recently gained recognition among people due to its excellent nutritional and health benefits. Bioactive compounds found in pumpkin peel, pulp and seeds possess anti-inflammatory, antibacterial, anticarcinogenic and antidiabetic properties. The obtained values of protein, fat, carbohydrates and fiber content were 10.54 per cent, 1.80 per cent, 79.97 per cent and 7.63 per cent respectively. It is packed with antioxidants, β-carotene and minerals like calcium, magnesium and potassium. The calcium and magnesium content obtained were 10.54 and 294.21mg/100g, and presence of antioxidants was confirmed by FT-IR analysis. On comparing the changes during storage at ambient and refrigeration temperature, it was found out that minimum changes in the parameters were observed at

refrigeration condition. So, I would highly recommend refrigeration condition as best storage condition. Also, the developed pumpkin powder is nutritionally dense and can be incorporated into variety dishes like soups, bakery products and instant noodles and can be consumed by individuals of all ages.

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