Preservation of cauliflower by dehydration technique for ensuring extended shelf life and higher return to rural women folk of Khagaria District

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### ABSTRACT

A study was made on preservation techniques of cauliflower to get better shelf life, organoleptic qualities and economic return to farmers. Two processes of preservation namely sun drying and oven drying were compared. For the purpose, cauliflower purchased from local market were undergone processes of drying at normal room temperature, weighing and cutting into 3-4 cm long pieces, blanching and removing of excess water. Afterwards, the samples of blanched cauliflower were sun dried at 30-35°C and oven dried at 50-60°C separately. The dehydrated samples were then analyzed for proximate composition such as moisture, ash, fat, crude fiber, crude protein and carbohydrate content. For sensory evaluation cauliflowers recipes from oven dried and sun dried samples were prepared. Unit cost of processed cauliflower in case of dehydration by sun drying was Rs. 68.50 compared to oven dried as Rs.70.70 per kg. Rehydration ratio of sun dried was 5.9:1 where as in oven dried sample was 5.8:1. The moisture content was found to be higher in sun dried sample (5.5%) as compared to oven dried sample (5.0%). Ash content (7.75%) was higher in oven dried sample compared to 7.25% in sun dried sample. As regards proximate composition of dehydrated cauliflower, fat content was observed to be similar in both methods of drying where as crude fiber content were 12.0% and 10.0% in oven dried and sun dried samples respectively. Crude protein contents were found to be 12.75% and 13% in oven dried and sun dried samples respectively where as carbohydrate contents were 60.50% and 62.25% respectively. Organoleptic properties such as colour, flavor, texture and taste of the recipes prepared from the dehydrated cauliflower were found to be in highly preferable range of 30 respondents upto 6 months period of dehydration. As investigated from the above facts, shelf life, organoleptic qualities and nutrient composition of sun dried and oven dried cauliflower samples were observed to be almost similar. Adding to this sun drying can be done easily by rural women folk, hence this method can be advocated as preferred technique for the farmers of Khagaria district. Women folk earned substantial benefit by marketing of sundried cauliflower.

### KEYWORDS

Cauliflower, Dehydration, Nutrient Composition, Economic Return

### HOW TO CITE THIS ARTICLE


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Cauliflower (*Brassica oleracea*) is an important cole crop of Bihar and belongs to Cruciferae family. Bihar accounts for more than 17% of total cauliflower production of India. In Khagaria district this is being cultivated in more than 1300 ha area with the production of approx. 23.5 thousand MT. It is cultivated for its shortened flower part (white tender curd), which is commonly used as vegetable beside its use in curry, salad, soup and pickle making. Cauliflower is rich sources of protein, carbohydrates, Minerals and vitamins (Bose et al., 1993). Due to its high nutritive value it can be used as a cereal supplement (Garcha et al., 1971, Subba Rao and Narendra Singh, 1971). Although the production of fruits and vegetables is high, post harvest losses in the segment are more than 25% (Radhakrishanan, 1999). The Central Institute of Harvest Engineering and Technology (CIPHET), Ludhiana has estimated the annual value of harvest and post-harvest losses of major agricultural produces at national level to be of the order of Rs. 92,651 Crore calculated using production data of 2012-13 at 2014 wholesale prices. The level of fruits and vegetables processing in India is hardly 2% of the total production, whereas countries such as Thailand, Brazil, Philippines and Malaysia process 30%, 70%, 78% and 83% of their produce, respectively. Situation in Khagaria district is not very different as significant proportion of vegetables gets wasted in the peak production time due to poor storage and transportation facilities. Apart from it farmers don’t get proper price of their produce in the peak season due to prevailing low price in markets. In spite of
higher production and productivity of achieved, there is a wide gap between the gross production and net availability of vegetable due to heavy post-harvest losses (Susanta Roy 1996). High postharvest losses and huge availability during glut demands to preserve fruits and vegetables so that their useful characteristics can be reaped during unavailability. Removal of water from foods is the essence to enhance the shelf life of vegetables and dehydration is one of the techniques, widely used to preserve agricultural produce. The fundamental aspect of food dehydration is to reduce the availability of water in food to such an extent, which is not favourable for undesirable microorganism and favourable for minimized rates of chemical reactions. The enzymes get rapidly deactivated above 70°C in case of cauliflower (Garcia-Reverter et al. 1994). A number of studies for drying of fruits and vegetables have been reported by various authors (Maskan et al. 2002; Togrul and Pehlivan 2002; Doymaz 2006; Akpinar 2006; Eren and Kaynak-Ertekin 2007; Mudgal and Pandey 2009; Shalini et al. 2009). Rahman et al. (2005), Kadam et al. (2008), Singh et al. (2008), Lidho (2008). Fresh cauliflower has 92 to 94% water (w.b.) and it can be stored for 2 to 4 weeks at 0 °C (Mudgal and Pandey 2007). Processing of cauliflower can be an alternate for extending the shelf life. Dehydrated Cauliflower can be used to enhance the taste and nutritional value of various products such as rehydrated vegetable mix, soups, canned products, extruded products etc (Gupta et al. 2013). A number of scientists including Shukla and Singh (2006), Jadhav et al. (2005), (Kadam and Samule 2006) have reported drying mechanism of cauliflower, but optimum conditions are required to be accessed as per desired characteristics in the dried product.

MATERIALS AND METHODS

The present study was made to assess preservation techniques of cauliflower to get better shelf life, organoleptic qualities and economic return to farmers.

Sample Preparation

Cauliflower (cv. Pusa Snowball) was purchased from the local wholesale market for study. After sorting and cutting stalk with the help of stainless steel knife the cauliflower heads (white curds) were washed thoroughly in fresh water and dried in air under normal room temperature to remove extra water on the surface. Then they were weighed and cut into 3-4 cm long pieces, each having, stalk up to 2 cm in length. Then the pieces were blanched in open pan containing hot water (98 ± 1°C ) for 5 min as a pretreatment (Thakur and Thakur 2000). The ratio of material to water was 1:10. It was reported (Srivastava and Sulebel 1975) that the hot water blanching resulted in better colour and flavor than steam blanching. During blanching process, 0.05 per cent potassium metabisulphite (KMS) was added to cold water for better quality and better colour. After completion of blanching the material was removed quickly from the cold water and spread over a perforated tray to drain excess water. The tray was kept below ceiling fan for 20 min to get complete removal of adhered water to the surface of blanched cauliflower. An amount of one kilogram blanched cauliflower was taken as one unit. A total at six units were taken for the study. All the six units containing 1 kg blanched cauliflower each were kept in six steel trays separately.

Cauliflower Drying

Sun Drying

The blanched cauliflower of three units was dried by direct exposure to sunlight at temperature 30-35 °C after covering then with muslin cloth in the open yard.

Oven Drying

Rest three units were kept in the oven for drying at 50-60 °C. The dryer was adjusted to the selected temperature and was switched on for at least 30 min. before start of experiment to bring the dryer in a steady state. The dried sample was collected from the tray, cooled to room temperature. Dehydrated samples from both the processes were weighed and sealed in polythin bags and kept in ambient conditions for subsequent evaluation of rehydration and sensory qualities.
Analytical Methods

The dehydrated cauliflower were analyzed for proximate composition such as moisture ash, fat, crude, fiber, crude protein and carbohydrate content by the method of National Institute of Nutrition, Hyderabad. The moisture content was determined by Hot Air Oven methods of AOAC.

Sensory Evaluation

For sensory evaluation cauliflowers recipes such as pakodas and vegetables from oven dried and sundried cauliflower after 90 days and 180 days of storage were prepared separately. The evaluators consisting of 30 respondents from the village Mehsouri were selected randomly. The organoleptic qualities like colour, flavor, texture, taste and over all acceptability were determined by using 9 points hedonic scale.

RESULT AND DISCUSSION

The rehydration ratio of sun dried was found to be 5.9:1 were as of oven dried sample was 5.8:1. The higher is rehydration ratio the better is the quality of produce. Unit cost of processed cauliflower dehydration by sun drying was Rs. 18.70 while by oven drying was Rs. 16.50 per Kilogram.

Proximate Composition of Dehydrated Cauliflower

The moisture, ash, fat, crude, fiber, crude protein and carbohydrate content of fresh, sundried and oven dried cauliflower have been presented in Table No.2. The moisture content was found to be higher in sundried sample (5.5%) as compared to oven dried sample (5.0%) where as ash content was higher in oven dried sample consisting of 7.75% and 7.25 % respectively. Similar fat contents were observed in both methods of dehydration. The crude fiber contents were 10.0% and 12.0% per cent in sundried and oven dried samples respectively. There was slight difference in crude protein content of sundried sample (13.0%) compared to oven dried sample (12.75%) where as in fresh cauliflower it was found to be 2.34%. Carbohydrate content was higher in sun dried sample (62.25%) than in oven dried sample (60.50%). It can be concluded that moisture content of dehydrated cauliflower was below the desired level in both the methods of drying which ensured increased the shelf life of vegetable. As lower moisture content reduces the volume of vegetable bulk of the vegetables can be stored in small space which also makes its transportation easier. The higher fiber content of oven dried samples can be utilized for the development of therapeutic diets requiring high fiber content. The protein content of oven dried cauliflower was lower than the sundried cauliflower. Hence, dehydrated cauliflower can be utilized for year round supplementation of our diet with nutrient rich vegetable.

Table 1. The recovery, rehydration ratio and unit cost of dehydrate cauliflower

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Sundried</th>
<th>Oven dried</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery (%) (Water absorption)</td>
<td>6.36</td>
<td>6.36</td>
</tr>
<tr>
<td>Rehydration ratio</td>
<td>5.9:1</td>
<td>5.8:1</td>
</tr>
<tr>
<td>Unit cost (Rs/kg)</td>
<td>68.50</td>
<td>70.70</td>
</tr>
</tbody>
</table>

Table 2. Proximate composition of fresh and dehydrated Cauliflower

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Fresh (g per 100)</th>
<th>Sundried (%)</th>
<th>Oven dried (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>75</td>
<td>5.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Ash</td>
<td>1.0</td>
<td>7.25</td>
<td>7.75</td>
</tr>
<tr>
<td>Fat</td>
<td>1.53</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>2.34</td>
<td>10.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Crude Protein</td>
<td>6.56</td>
<td>13.0</td>
<td>12.75</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>7.69</td>
<td>62.25</td>
<td>60.50</td>
</tr>
</tbody>
</table>

Sensory Evaluation

Mean score for the acceptability testing of product developed from dehydrated cauliflower has been presented in Table 3 and illustrated in Figure 2. As per the reference to be drawn from the 9 point hedonic scale the scores obtained for all the sensory qualities are between liked much to liked very much range for both the sun dried and oven dried cauliflower samples. But oven dried sample has comparatively higher score than sun dried sample which indicates higher preference by the respondents. But sun drying can be done easily by...
Table 3. Acceptability scores of dehydrated cauliflower stored for varying periods

<table>
<thead>
<tr>
<th>Dehydration Techniques</th>
<th>Period of storage (in months)</th>
<th>Colour</th>
<th>Flavour</th>
<th>Texture</th>
<th>Taste</th>
<th>General Acceptability</th>
<th>Overall average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun drying</td>
<td>0</td>
<td>7.5</td>
<td>7.0</td>
<td>7.2</td>
<td>7.0</td>
<td>7.2</td>
<td>7.18</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>7.6</td>
<td>7.4</td>
<td>7.5</td>
<td>6.7</td>
<td>7.2</td>
<td>7.28</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>7.0</td>
<td>7.2</td>
<td>7.2</td>
<td>7.4</td>
<td>7.3</td>
<td>7.22</td>
</tr>
<tr>
<td>Average Score</td>
<td></td>
<td>7.36</td>
<td>7.2</td>
<td>7.3</td>
<td>7.03</td>
<td>7.23</td>
<td>7.22</td>
</tr>
<tr>
<td>Oven Drying</td>
<td>0</td>
<td>8.1</td>
<td>7.8</td>
<td>7.8</td>
<td>8.3</td>
<td>7.4</td>
<td>7.88</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>7.6</td>
<td>7.5</td>
<td>7.8</td>
<td>7.6</td>
<td>7.3</td>
<td>7.56</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>7.6</td>
<td>7.2</td>
<td>7.3</td>
<td>7.6</td>
<td>7.5</td>
<td>7.4</td>
</tr>
<tr>
<td>Average Score</td>
<td></td>
<td>7.76</td>
<td>7.56</td>
<td>7.63</td>
<td>7.83</td>
<td>7.4</td>
<td>7.63</td>
</tr>
</tbody>
</table>

Fig 1. Acceptability of sun dried cauliflower

Fig 2. Acceptability of oven dried cauliflower
rural women folk, hence this method can be advocated as preferred technique for the farmers of Khagaria district.

**Economics of Dehydrated Cauliflower Marketing**

It was observed that women members of farmer’s families were actively involved in dehydration of cauliflower through sun drying method and marketing of dehydrated cauliflower. As per the estimates 15.25 kg of fresh cauliflower is required to produce 1 kg of sundried product. During glut period farmers have to sell at throw away prices to the vegetable vendors or whole sellers. Considering the throw away price Rs 5 per kg of fresh cauliflower total cost for producing 1 kg of dried cauliflower is Rs 80. women members were able to sell Rs 150 per kg of dried cauliflower with a net profit 70 per kg of the product. Women were able to sell at almost uniform rate during 6 months from the date of processing of cauliflower and in this way availability of cauliflower to the highly extended period was ensured.

**REFERENCES**


