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Rehydration properties of tray dried cauliflower (*Brassica oleracea*)

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Abstract

This study was conducted to determine the rehydration properties of dried Cauliflower (*Brassica oleracea*). The samples were blanched by using 0.25% KMS (Potassium Metabisulphite). After blanching they were dried in tray drier at 50 °C, 60 °C and 70 °C (T₀, T₁, T₂, T₃ respectively). The drying time for Cauliflower required to reduce the moisture content from 92.50% to 5 to 6% was 10 h at 60 °C. Quality of dehydrated sample such as rehydration ratio, coefficient rehydration and percent of water were evaluated. The rehydration ratio and co-efficient rehydration in rehydrated sample ranged from 3.84 to 5.50 and 0.305 to 0.449 respectively. The Rehydration characteristics of Cauliflower dried at 60 °C (T₂) had showed comparatively better reconstitutions than other treatments. The moisture after rehydration was 76.8 to 82.88. Sensory attributes indicated that drying of Cauliflower at 60 °C yield relatively satisfactory dried product. The low temperature (50 °C drying produced good color and appearance with overall good acceptability score.

Keywords: Blanching, cauliflower, quality analysis, rehydration, sensory evaluation and tray dryer

1. Introduction

Cauliflower (*Brassica oleracea*) is one of several vegetables in the family Brassicaceae. It is mainly grown in China, USA, UK, Iran, Japan and India. Cauliflower is a popular vegetable crop grown throughout the country for its white tender curd, which is commonly used as vegetable besides its use in curry, soup and pickles making. India's production of cauliflower data was reported at 9174000 ton in the 2019 (CEIC, 2019) [3].

As a member of the brassica family, cauliflower shares with broccoli and cabbage several phytochemicals which are beneficial to human health. Numerous epidemiological and pharmacological works showed a significant role of a diet abundant in cauliflower, which may protect against many chronic diseases, including type II diabetes, cardiovascular disease, age-related macular degeneration, dementia, immune dysfunction, obesity and some kinds of cancers. Cauliflower is rich in Vitamins B1, B2, B3, B5, B6, folic acid and C, E, K, as well as omega-3 fatty acids, dietary fibre, phosphorus, magnesium, manganese, and iron. Chemical components contents in Brassica vegetables vary among cultivars. This also contains also a lot of valuable and healthy plant's metabolites, including flavonoids, terpenes, S-methyl cysteine sulfoxide, sulphur-containing glycosylates, coumarins, and other minor compounds. These compounds of cauliflower and other Brassica vegetables, were found to be effective in the protection of some kinds of cancer as cancer-fighting components (Kapusta *et al.*, 2019) [6].

About 30% of produce gets spoiled due to inadequate and improper Post harvest handling and also lack of proper processing facilities in spite of higher production and productivity achieved, there is a wide gap between the gross production and net availability of specific vegetable due to heavy post-harvest losses (Singh *et al.*, 2019) [9].

In India, cauliflower is harvested in the January and February month, which creates glut in the market and growers do not get remunerative prices and even if half of the wastage could be prevented, there will be enough calories to feed the poor. These losses can be reduced by Processing. However, Indian consumer has psychological barrier to purchase processed foods and specially processed vegetables. This may be due specific food habits, availability of fresh produce and cheap labor at domestic level. As a result, Indian consumer is expected to accept a product that involves minimal processing of the vegetables rather than processed product.

In use of different method and extend the shelf life and study of rehydrated characteristics or property of cauliflower have been reviewed and presented under the following headlines.

Cauliflower is available only during in the season. In order to use cauliflower during off season usually the dried cauliflower is used. The Nutritional value of cauliflower per 100 g is

given in Table 1. When rehydrated there are some changes in the properties like color, taste, texture etc. Hence, this study on rehydration property would help to understand the rehydration characteristics.

Table 1: Nutrition facts of raw cauliflower per 100 g.

Nutrient	Amount	Daily Value (%)
Carbohydrate	5 g	2
Protein	1.92 g	4
Dietary Fibre	2 g	7
Calcium	22.00 mg	2
Potassium	299 mg	6
Vitamin C	48.2 mg	54
Magnesium	5 mg	4
Iron	0.42 mg	2

Source: (USDA-United States Department of Agriculture, 2019).

2. Materials and Methods

The description of various materials and methods used to accomplish the experimental work to attain the desired

objectives of the study entitled “Rehydration properties of Tray dried cauliflower” in different treatments are explained. The experiment was carried out during Feb to April 2021 in Flex Foods Ltd Dehradun, Uttarakhand.

2.1 Samples preparation

Good quality (fresh, matured, uniform size and white in color) of cauliflower were collected, sorted and used for the study. Cauliflower samples were blanched (90 °C for 60 sec), pre-treated 0.25% KMS for 15 mins. Drying was performed continuously for 12 h at 50 °C, 10 h at 60 °C and 8 h at 70 °C separately. Until the samples were dried to approximately to 5% moisture content. The moisture content reached at the end of drying was taken equilibrium moisture content (EMC). This dehydrated cauliflower was packed in HDPE bag and stored at room temperature (20 to 25 °C). The cauliflower was dipped at different time, temperature combination for rehydration studies. Process flow chart of cauliflower shown in Fig. 1.

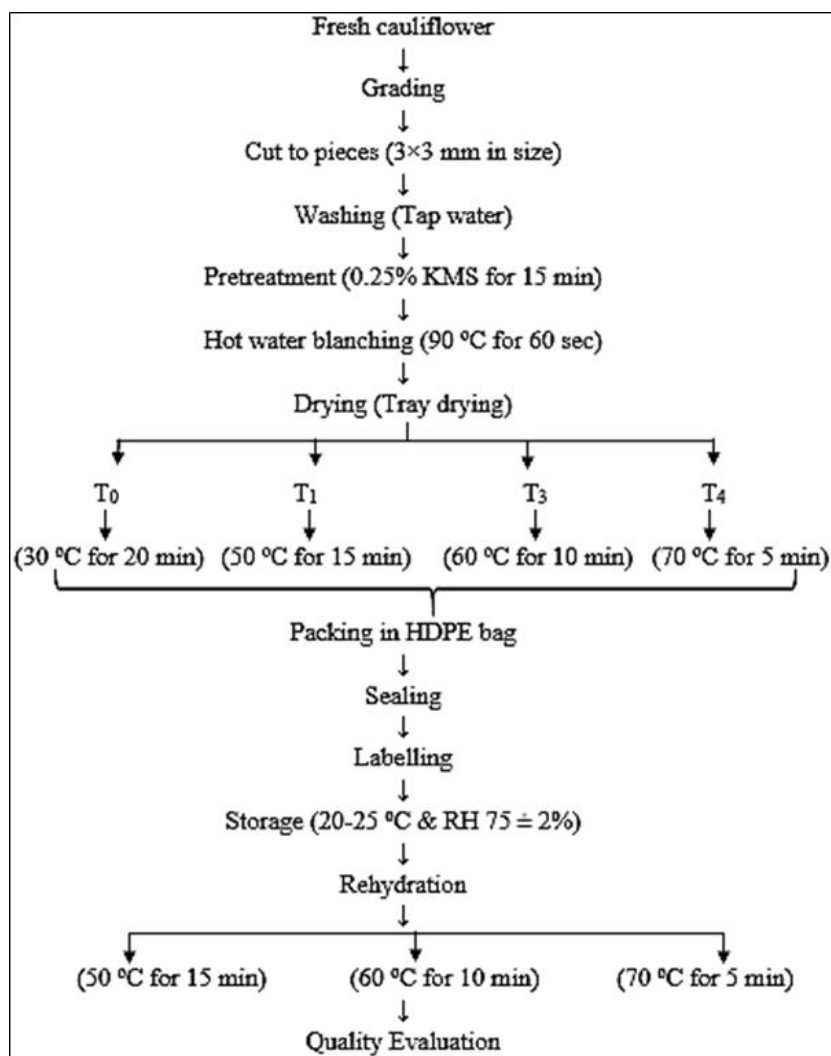


Fig 1: Process flow chart of cauliflower

3. Results and Discussion

3.1 Drying

Drying of Cauliflower at various time and temperature is given in Table 2. A drying period of 12 h was required for sample at 50 °C, 10 h for 60 °C and 8 h for 70 °C respectively for a final moisture content of 5-6%.

Table 2: Drying of Cauliflower at various Time and Temperature

Sr. No.	Drying Time (h)	Drying Temp (°C)
1.	12	50
2.	10	60
3.	8	70

3.2 Re-Constitutional qualities of rehydrated samples

The dehydrated samples were rehydrated to determine the rehydration properties. Re-Constitutional qualities of rehydrated cauliflower like rehydration ratio, co-efficient of reconstitution, percent water in rehydrated materials were determined. Table 3 shows the rehydration properties of cauliflower.

In rehydrated cauliflower, treatment T₀, at 30 °C temperature for 20 min showed 3.85 rehydration ratio, 0.305 coefficient of rehydration and 75.6 percent of water. Whereas for treatment T₁, at 50 °C temperature for 15 min showed 4.06 rehydration ratio, 0.332 coefficient of rehydration and the percent of water was 76.8.

The rehydrated cauliflower for treatment T₂, at 60 °C temperature for 10 min showed 4.56 rehydration ratio, 0.372 coefficient of rehydration and 76.8 percent of water. For treatment T₃ at 70 °C temperature for 5 min showed 5.50 rehydration ratio, 0.449 coefficient of rehydration and 82.88 percent of water.

Table 3: Re-Constitutional Qualities of Rehydration

Treatments	Time (min)	Rehydration Temp. (°C)	Rehydration Ratio	Coefficient Rehydration	Percent of water (%)
T ₀	20	30	3.85	0.305	75.6
T ₁	15	50	4.06	0.332	76.8
T ₂	10	60	4.56	0.372	79.35
T ₃	5	70	5.50	0.449	82.88

3.3 Rehydration Ratio (RR)

The rehydration behavior was analyzed in terms of the ability of the dried cauliflower pieces to regain their original product characteristics. The rehydration ratio of cauliflower with respect to time and temperature is given in Table 3.

Similar observation was made by (Thakur *et al.*, 2008) for mechanically tray dried blanched cauliflower, with rehydration ratio of 4.5 but favourable textural criteria were different for this sample pre-soaking of 60 and 45 mins, was more favourable for blanched sample at 45 mins. Rehydrated test was carried out by using the previously selected pre-soaked samples. which were than boiled individually for up to 30 min in a water bath. It was seen that boiling up to 20 min gave the highest rehydration ratio (disruption of structure).

The rehydration ratio of dehydrated cauliflower at 30 °C, 50 °C, 60 °C and 70 °C temperatures were 3.85, 4.06, 4.56 and 5.50, respectively. The rehydration ratio of cauliflower from range 3.84 to 5.50 range.

Visual observation of all rehydrated samples revealed the best one from T₂. Other samples from to was sticky, T₁ was torn with disrupted structure and T₃ had foul smell.

3.4 Rehydration Coefficient (RC)

The rehydration behavior was analyzed in terms of the ability of the dried cauliflower pieces to regain their same product characteristics. The rehydration ratio of cauliflower with respect to time and temperature is given in Table 3.

Similar observation was made by (Thakur *et al.*, 2008) with a co-efficient of rehydration of 4.9 for mechanically tray dried blanched cauliflower. They observed favourable textural criteria at co-efficient of rehydration of 70 and 50 mins. Rehydrated test was carried out by using the previously selected pre-soaked samples, which were than boiled individually for up to 20 min in a water bath. It was seen that boiling up to 20 min. gave the highest co-efficient rehydration but texture is not set.

The Co-efficient of reconstitution of dehydrated cauliflower at 30 °C, 50 °C, 60 °C and 70 °C temperatures were 0.305, 0.332, 0.372 and 0.449, respectively. In 30°C and 50°C was structure disrupted and irreversible damage to the structure these textural changes cause the tissues to shrink. Better co-efficient rehydration is 60 °C (without disruption of structure) 70 °C is high rehydration of co-efficient but highly stickiness and foul smell.

3.5 Percent water in rehydrated cauliflower

The percent water in rehydrated cauliflower with respect to time and temperature is given in Table 3.

The percent water in rehydrated cauliflower at 30 °C, 50 °C, 60 °C and 70 °C temperatures were 75.6, 76.8, 79.35 and 82.88 respectively. The percent water in rehydrated cauliflower range 75.6 to 82.88%. In 30 °C, the water percentage was very less, 50 °C and the tissue was very hard and textural changes caused the tissues to shrink. The percent water in the rehydrated cauliflower was the indicative of water absorption capacity of dehydrated cauliflower percentage for which at 60 °C (without damage) texture was best and 70 °C is high percentage of water, its highly stickiness and disruption the structure. In these treatments (T₂) 60 °C is better water percentage.

3.6 Sensory evaluation

The variation in overall acceptability with rehydration time of all treatments is show in Table 4. Sensory analysis of cauliflower processed by different treatments was carried out, using the 9point hedonic scale, as described by (Tepe *et al.*, 2020) [12]. The attributes like colour, texture, taste and flavour and overall acceptability were evaluated by panellists. The overall acceptability of cauliflower calculated by composite scoring 4, 5, 6, 7, 8 and 9 scales, the colour and appearance, texture, taste and flavour and overall acceptability, score respectively from all treatments T₁, T₂, and T₃ Treatments T₀ is control sample and it has undesirable colour, flavour and taste. The decrease in appearance score is due to low.

Colour and appearance of rehydrated cauliflower at 30, 50, 60 and 70 °C temperature, were 5, 6, 8 and 7 respectively. Colour and appearance range 4 to 8. Texture of rehydrated cauliflower at 30, 50, 60 and 70 °C temperature, were 4, 5, 7 and 5.6 respectively, texture range 4 to 7. Taste and flavour of rehydrated cauliflower at 30, 50, 60 and 70 °C temperature, were 6, 6, 7 and 7.3 respectively, Taste and flavour range 6 to 7. Overall acceptability of rehydrated cauliflower at 30, 50, 60 and 70 °C temperature, were 5, 5.6, 7.3 and 6.6 respectively, overall acceptability range 5 to 8 in 70 °C temperature. The rehydration method main factor was temperature, temperature at 60 °C would be considered as adequate for getting comparatively good quality of the rehydration.

The sensory evaluation was carried out the all the quality parameter Showed significant differences. The cauliflower dried at 30, 50, 60 and 70 °C except taste and flavour, also reported significant difference in their mean score for all the quality parameters. Cauliflower dried at 60 °C was relatively better than 50 and 70 °C temperatures samples, the lower temperature drying 50 °C maintained good color where taste and flavour scored less. Similarly, higher temperature 70 °C was imparted a little burnt-like smell. After drying and rehydration. Overall, (T₂) 60 °C was best temperature of rehydration. The sensory evaluation of cauliflower with respect to time and temperature is given in Table 4.

Table 4: Sensory Evaluation of Rehydrated Cauliflower

Characteristics	T ₀	T ₁	T ₂	T ₃
Colour and Appearance	5	6	8	7
Texture	4	5	7	6
Taste and Flavour	6	6	7	7
Overall Acceptability	5	5.6	7.3	6.6

4. Conclusion

Blanching improved the retention of color and prevent browning, studies clearly indicated that the sample dried in tray dryer were more acceptable.

Blanched cauliflower with 0.25% KMS was the best to improve the higher reconstitution ratio and have the best. The Treatment T₂ showed 4.56 rehydration ratio, 0.372 coefficient of rehydration and percent of water in rehydrated cauliflower was 76.8.

The sensory (overall acceptability) taste, appearance and texture score of treatment T₂ was best. In off session and higher reconstitution ratio of the cauliflower at 60 °C for 10 min in water bath temperature.

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