QUALITY ASSESSMENT AND NUTRIENT ANALYSIS OF FREEZE-DRIED GRAPE SEED AND PEEL POWDERS

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ABSTRACT

The study conducted in the year 2023 aimed to develop freeze-dried grape seed and peel powder and evaluate its quality parameters and nutrients. Sun-dried grape seed and peel powder were also developed with a significant focus on comparison with freeze-dried samples, taking into account the economic feasibility and popularity of sun drying as compared to freeze-drying. Grape seed and peel were separated manually. The seed and peel were freeze-dried and stored in a freezer and sun-dried samples were kept in airtight containers. The quality parameters, nutrient composition, and sensory characteristics of both the freeze-dried and sun-dried grape peel and seed powder were examined. Quality parameters assessed included colour, solubility, pH and sensory attributes. Nutrients analysed included ascorbic acid by dye method, iron, phosphorus and carbohydrates by colorimetry. It was observed that freeze-dried grape seed and peel powders retained more colour, while freeze-dried grape peel powder had the highest solubility (67.22%). Both freeze-dried and sun-dried grape seed and peel powder exhibited an acidic pH (3.97, 5.25, 4.23 and 5.06). Freeze-dried grape peel powder was found to be rich in ascorbic acid (113.49 mg). Sun-dried grape seed and freeze-dried grape peel powders were found to have high phosphorus content (123.33 mg and 108.33 mg, respectively), whereas, sun-dried grape seed featured the highest iron content (25.83 mg). Freeze-dried grape seed and peel powders were superior to sun-dried powder in quality and nutrients and hence can be used for manufacturing nutraceuticals.

Keywords: Freeze-dried grape peel, Freeze-dried grape seed, Grape, Sun-dried grape peel, Sun-dried grape seed, Vitis vinifera L.

INTRODUCTION

Grape (Vitis vinifera L.) is a fruit considered botanically as a berry and an evergreen, woody vine with a blistering bark and among the most extensively consumed fruits in the world. It is a member of the Vitaceae family and several varieties are known, among which one of the most popular species is the Vitis vinifera L. which outnumbers all the other species by 90 percent (Parihar and Sharma, 2021). They can be consumed raw, in fresh form, and can also be consumed by processing them into products like jam, wine, jelly, extract, raisins, vinegar, etc.
The skin, stem, seeds, and juice of the grape have also been utilized in the manufacturing of nutritional supplements and grape extract. Several pharmacological and therapeutic advantages of grape seed extract have been demonstrated—anti-oxidative, antibacterial activity, anti-inflammatory, neuroprotective hepatoprotective, and cardioprotective effects (Martin et al., 2020). The by-products of grapes have numerous applications in the food industry. Many products obtained from grape seed like nutraceuticals are sold in the market such as grape seed extract capsules and grape seed oil. A wide spectrum of biological activities such as antioxidant, anti-inflammatory and antibacterial characteristics are present in grape-derived nutraceuticals (Georgiev et al., 2016).

Grape is an exceptional source of bioactive compounds, particularly polyphenols which bestow grapes with a variety of biological activities. Anthocyanins, flavanols, flavonols and resveratrol are the most important grape polyphenols (Cosme et al., 2018). According to studies, grape pulp has a total polyphenol content that is 130 times lower on average than the seed (Kupe et al., 2021). They are an excellent source of antioxidants especially red grape varieties which provide more antioxidants than white or bluish grape varieties (Zhou et al., 2022). Grapes have several health benefits and the whole fruit, skin, leaves, and seed of the grape plant are used as medicine. The entire fruit, peel, leaves, and seed of the grape plant are utilized in medicine, and grapes have several health benefits (Sabra et al., 2021).

Foods may be dried in several ways. One of the most effective method for drying is "freeze-drying" and among the most widely used modes is "Sun drying". Freeze-drying is a technique for eliminating water by sublimation of ice crystals from frozen material (Bhambere et al., 2015). Although freeze-drying is seen to be an expensive procedure, it is employed because it makes transporting food, especially to space, simple (Bhatta et al., 2020). Sun has been used for preserving food through the process of drying since time immemorial. Sun drying is one of the most popular ways of preservation that is still widely practiced in several regions of the world. Sun drying essentially entails relying solely on the strength of the sun and natural breeze. It is simple for regular people to use without any special skills or training. Sun drying is sustainable and considered to be cost-efficient (Mohammed et al., 2020).

Although studies on the qualities and nutritional worth of fresh grapes have been conducted, none have yet been done on freeze-dried and sun-dried grape peel and seed powder. The study aimed to prepare freeze-dried grape seed and peel powder, evaluate its quality and determine its nutritive and organoleptic properties. The study also focused on comparison of the freeze-dried grape seed and peel powder with sun-dried grape seed and peel powders.

MATERIALS AND METHODS

Sample collection
The study was conducted at Avinashilingam Institute for Home Science and Higher Education for Women in the year 2023. Grapes (Vitis vinifera L.) were collected by checking the freshness, size, colour and maturity of the fruit from Madampatti Grape Growers’ Association, Coimbatore.

Sample preparation
The grapes were washed thoroughly. The seed, peel and pulp of cleaned grapes were separated. The pulp that was obtained was discarded. Both freeze-drying and sun drying of grape seed and peel were carried
out. Freeze-drying of seed and peel was carried out in a freeze drier at 48 °C in a vacuum pressure of 0.17-0.20 mbar. The powdered seed and peel were dried in the sun for seven days. After drying, the seed and peel were ground to make a powder. 358 g of freeze-dried grape peel powder, 132 g of freeze-dried grape seed powder, 551 g of sun-dried grape peel powder and 252 g of sun-dried grape seed powder were acquired from 10 kg of grapes. Freeze-dried grape seed and peel powder were stored in the freezer and sun-dried grape seed and peel powder were stored in airtight containers during the study period.

Quality assessment

Quality assessment of the freeze-dried and sun-dried grape seed and peel powders were assessed by its colour, solubility, pH, and sensory attributes.

Colour

Colour assessments were carried out using a C-10 portable colour reader. The instrument used to measure the colour was based on the L*a*b* colour system. Initially, the instrument was calibrated using a black and white calibration block and further the colour of grape seed and peel powder was assessed.

Solubility

The solubility of the grape seed and peel powder was tested as per Trimedona et al. (2022) method. The solubility was tested by adding 1 g of a powder sample to a beaker containing 10 ml of distilled water. The mixture was kept at room temperature for 5 min. The supernatant was poured onto a pre-weighed petri dish and dried in an oven at 105 °C for 2 h. The solubility of the powder in percentage was determined by calculating the difference between the weight of an empty petri dish and the weight of a petri dish with obtained solids content and was divided by the initial sample weight and multiplied by 100 to calculate the percentage of solubility.

\[
\text{Solubility} = \frac{\text{Wt. of petri dish with solids (after drying)} - \text{Wt. of the empty petri dish}}{\text{Initial wt. of the sample}} \times 100
\]

pH

The pH was tested using a pH meter. Two g of grape seed and peel powder were dissolved in 10 ml of distilled water which is neutral in pH in a beaker. The measurement electrodes were immersed into the solution in a beaker and the pH was observed.

Sensory evaluation

Sensory evaluation of the freeze-dried and sun-dried grape seed and peel powder was carried out in the Food Sensory Laboratory, Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore. The samples were evaluated for their sensory attributes – Appearance, colour, flavour, taste and overall acceptability using a 9-point hedonic scale. Thirty semi-trained panel members were involved in the organoleptic evaluation and they were asked to assign a score of 1 (minimum) to 9 (maximum) for the sensory characteristics of freeze-dried and sun-dried *Vitis vinifera* L. seed and peel powders.

Nutrient analysis

The phosphorus and iron content was estimated colorimetrically by measuring the intensity of colour developed at 660 millimicrons and 540 millimicrons respectively. Proximate analysis of nutrients such as carbohydrates and Vitamin C was carried out. Approximation of carbohydrates was done by the anthrone method and vitamin C was estimated by titrating against standardized 2,6 dichlorophenol indophenol dye. The analysis
was done for triplicate samples and conducted in the Nutrition Research Laboratory, Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore.

**Statistical analysis**

The statistical data of sensory scores were obtained using Sigma Plot 14.5 version and one-way Analysis of Variance (ANOVA) was applied to obtain the p-value and to test whether any significant difference was present or absent.

**RESULTS AND DISCUSSION**

**Quality assessment**

**Colour**

In this study, it was found that freeze-dried grape seed and peel powder retained more colour compared to sun-dried grape seed and peel powder. The L*a*b values measured using the colour reader were +49.43, -1.96, and -6.86 for freeze-dried grape peel powder, +6.86, -3.95 and -10.04 for freeze-dried grape seed powder, +49.5, -2.89, -7.39 for sun-dried grape peel powder and +48.87, -3.53 and -8.67 for sun-dried grape seed powder. AE value for freeze-dried and sun-dried peel powder was 1.07 and AE value for freeze-dried and sun-dried seed powder was 42.03.

Freeze-dried seed and peel powder were found to be better in quality in terms of colour than sun-dried seed and peel powder. On comparing the freeze-dried and sun-dried peel powder, the colour difference was perceptible through close observation and for freeze-dried and sun-dried seed powder the colours were more or less similar.

**Solubility**

Freeze-dried grape peel powder was assessed to have a solubility of 67.22% followed by sun-dried grape peel powder (61.46%) freeze-dried grape seed powder (30.76%) and sun-dried grape seed powder (29.63%). Freeze-dried grape peel powder readily dissolved in distilled water with only a small amount of deposit compared to freeze-dried grape seed powder, sun-dried grape peel and seed powders. Freeze-dried grape peel powder was assessed to have the highest solubility, followed by sun-dried grape peel powder, freeze-dried grape seed powder, and sun-dried grape seed powder. Freeze-dried grape peel powder readily dissolved in water.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Sample</th>
<th>Appearance</th>
<th>Colour</th>
<th>Flavour</th>
<th>Texture</th>
<th>Taste</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Freeze-dried grape peel powder</td>
<td>7.9 ± 1.29</td>
<td>8.06±1.22</td>
<td>7.7±1.20</td>
<td>8.03±0.99</td>
<td>7.63±1.32</td>
<td>7.9 ± 0.95</td>
</tr>
<tr>
<td>2</td>
<td>Freeze-dried grape seed powder</td>
<td>7.66 ± 0.88</td>
<td>7.7±0.98</td>
<td>6.86±1.79</td>
<td>7.23±1.22</td>
<td>6.43±1.83</td>
<td>6.8 ± 1.52</td>
</tr>
<tr>
<td>3</td>
<td>Sun-dried grape peel powder</td>
<td>8.03 ± 0.80</td>
<td>8.23±0.81</td>
<td>7.73±1.01</td>
<td>7.73±1.28</td>
<td>7.56±1.73</td>
<td>7.8 ± 1.37</td>
</tr>
<tr>
<td>4</td>
<td>Sun-dried grape seed powder</td>
<td>7.66 ± 1.02</td>
<td>7.79±1.37</td>
<td>6.86±1.79</td>
<td>7.1±1.56</td>
<td>6.8 ±1.64</td>
<td>7.2 ± 1.56</td>
</tr>
</tbody>
</table>
The pH was observed as 3.97, 5.25, 4.23, and 5.06 for freeze-dried grape peel and seed and sun-dried grape peel and seed powders, respectively. The pH of freeze-dried grape peel and seed and sun-dried grape peel and the seed powders were determined to be acidic (pH<7).

### Sensory evaluation

The average sensory evaluation scores were obtained from 30 semi-trained panel members and are represented in Table 1.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Sample</th>
<th>Mean Scores</th>
<th>SD</th>
<th>Standard error</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Freeze-dried grape peel powder</td>
<td>7.90</td>
<td>0.960</td>
<td>0.175</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>2</td>
<td>Freeze-dried grape seed powder</td>
<td>6.87</td>
<td>1.525</td>
<td>0.278</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sun-dried grape peel powder</td>
<td>7.80</td>
<td>1.375</td>
<td>0.251</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sun-dried grape seed powder</td>
<td>7.20</td>
<td>1.562</td>
<td>0.285</td>
<td></td>
</tr>
</tbody>
</table>

While freeze-dried grape peel powder was determined to be the best in terms of texture and flavour, sun-dried grape peel powder was shown to be superior in terms of appearance, colour and taste (Table 1). Freeze-dried grape peel powder was concluded as the sample with the highest overall acceptability.

The statistical data obtained using the Sigma plot 14.5 version is presented as mean, standard deviation, standard error and p-value in Table 3 and Figure 1.

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**Fig 1. Overall acceptability of freeze-dried and sun-dried seed and peel powders of grape**
The p-value obtained <0.005, represents a significant difference between the four samples-freeze dried grape peel powder, freeze-dried grape seed powder, sun-dried grape peel powder and sun-dried grape seed powder. From the graph, it can be interpreted that there is a significant difference between column 2 and column 4 (Fig 1) i.e. freeze-dried grape seed powder and sun-dried grape seed powder.

**Nutrient analysis**

The nutrient content of freeze-dried and sun-dried grape peel and seed powders is presented in Table 2.

Freeze-dried grape peel powder consisted of 113.49 mg per 100 g of Vitamin C. Vitamin C estimated in freeze-dried grape seed powder was 63.8 mg/100 g, the sun-dried grape peel powder was 81.57 mg/100 g and the sun-dried grape seed powder was 46.10 mg/100 g. The phosphorus content/100 g was estimated as follows- 85 mg in the freeze-dried grape peel powder, 123.33 mg in grape seed powder, 123.33 mg in sun-dried grape peel powder and 108.33 mg in sun-dried grape seed powder. The iron content/100 g was found to be 14.16 mg in the freeze-dried grape peel powder, 23.33 mg in freeze-dried grape seed powder, 19.16 mg in sun-dried grape peel powder and 25.83 mg in sun-dried grape seed powder. The carbohydrate was determined to be 0.3 g in the freeze-dried grape peel powder, 0.66 g in freeze-dried grape seed powder, 0.66 g in sun-dried grape peel powder and 0.34 g in sun-dried grape seed powder.

According to Sharma et al. (2018), pomegranate peel had the highest levels of vitamin C compared to the seed and whole fruit powder. Freeze-dried grape peel powder was observed to be rich in vitamin C. It was concluded that freeze-dried grapes had a greater amount of ascorbic acid compared to sun-dried grapes. On comparing seed and peels, it was concluded that grape peel powder had greater vitamin C content than freeze-dried grape seed powder. The phosphorus content/100 g was estimated to be similar in freeze-dried grape seed and sun-dried grape peel powders. The study concluded that freeze-dried grape seed and sun-dried grape peel powders had high phosphorus content, the iron content/100 g was found to be 14.16 mg in the freeze-dried grape peel powder, 23.33 mg in freeze-dried grape seed powder, 19.16 mg in sun-dried grape peel powder and 25.83 mg in sun-dried grape seed powder. The findings showed sun-dried grape seed powder was greatest in iron followed by freeze-dried grape seed powder. It was concluded that grape seed powder had higher iron content than grape peel powder. It was found that the freeze-dried and sun-dried grape seed and peel powders had negligible amounts of carbohydrates.

**CONCLUSIONS**

Overall, freeze-dried grape peel and seed powders were found to have better quality and nutrients than sun-dried grape...
seed and peel powders and may therefore the former products can be used to make nutraceuticals.

REFERENCES


