SENSORY ANALYSIS AND CONSUMER PREFERENCES FOR DEHYDRATED PRODUCTS

ANALIZA SENZORIALĂ ȘI PREFERINȚELE CONSUMATORILOR PENTRU PRODUSELE DESHIDRATATE

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Abstract

With a scientific basis for over two decades, sensory analysis is an easy method of assessing the quality of a food product by bringing its characteristic features to the attention of the consuming public. As a complementary method in food control and expertise, sensory analysis reflects the outcome of certain physiological and psychological aspects of the tasters, involving actions such as reception, recognition, ordering, description and appreciation. Based on the consumer's first contact with the product, the analysis measures its sensory properties that affect the subjects' ability to make choices and their purchasing decision. By describing the results obtained from the sensory analysis of apple crisps, this paper aims to emphasize the importance of tasting in the presentation, refinement and promotion of the product. This objective was realized in IULS where 60 people, aged between 6 and 60 years, participated. The apple crisps were evaluated for different organoleptic characteristics such as appearance, smell, taste and flavor, as well as for overall impression to simulate a possible comparison of the product with other commercially available dehydrated products. At the same time, the study aimed to emphasize the importance of consuming dehydrated fruits with enriched nutritional value by attracting the consumer's attention with the present analysis and raising public awareness on healthy eating. Thus, the results of the study showed that modern consumers choose products as natural as possible, without food additives and are disposed to change their lifestyle and diet.

Key words: dehydrated apples, enriched nutritional value, sensory analysis, consumer preferences

Rezumat

Având o bază științifică de peste două decenii, analiza senzorială reprezintă o metodă facilă de evaluare a calității unui produs alimentar, aducând caracteristicile specifice ale acestuia în atenția publicului consumator. Ca metodă complementară în controlul și expertiza produselor alimentare, analiza senzorială reflectă rezultatul anumitor aspecte fiziologice și psihologice ale degustătorilor, implicând acțiuni precum recepționarea, recunoașterea, ordonarea, descrierea și

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aprecierea. Bazându-se pe primul contact al consumatorului cu produsul, analiza măsoară proprietățile senzoriale ale acestuia care influențează capacitatea subiecților de a face alegeri și decizia lor de cumpărare. Prin descrierea rezultatelor obținute în urma analizei senzoriale a chipsurilor de mere, această lucrare își propune să evidențieze importanța degustării în prezentarea, rafinarea și promovarea produsului. Acest obiectiv a fost realizat în cadrul IULS, unde au participat 60 de persoane cu vârste cuprinse între 6 și 60 de ani. Chipsurile de mere au fost evaluate pentru diferite caracteristici organoleptice, cum ar fi aspectul, mirosul, gustul și aroma, precum și pentru impresia generală, pentru a simula o posibilă comparație a produsului cu alte produse deshidratate disponibile pe piață. În același timp, studiul a urmărit să sublinieze importanța consumului de fructe deshidratate cu valoare nutrițională îmbunătățită, atrăgând atenția consumatorului prin prezenta analiză și sensibilizând opinia publică cu privire la alimentația sănătoasă. Astfel, rezultatele studiului au arătat că consumatorii moderni aleg produse cât mai naturale, fără aditivi alimentari, și sunt dispuși să își schimbe stilul de viață și alimentația.

Cuvinte cheie: mere deshidratate, valoare nutrițională îmbunătățită, analiză senzorială, preferințele consumatorilor

INTRODUCTION

Dehydration remains one of the oldest and most effective ways to preserve food. By removing moisture, it extends shelf life, lowers shipping costs, and prevents bacterial spoilage—all without the need for refrigeration [Ratti, 2001].

In the context of a growing global demand for convenient, shelf-stable, and nutritious foods, dehydrated products have gained renewed interest from both industry and consumers. These products—ranging from dried fruits and vegetables to soups, cereals, and plant-based snacks—offer significant benefits in terms of storage, portability, and energy efficiency during processing [Ahmed et al., 2013; Mujumdar, 2014; Zhang et al., 2022].

Despite these advantages, the market performance of dehydrated foods is not exclusively determined by their functional properties. Consumer acceptance is strongly influenced by sensory attributes such as colour, texture, aroma, and flavour, which are often altered during the drying process due to changes in volatile compounds, Maillard reactions, pigment degradation, and water loss [Krokida et al., 2001; Vega-Gálvez et al., 2009].

For instance, drying temperatures and methods can significantly affect color retention in fruits or texture crispness in vegetable snacks—both of which are critical for consumer satisfaction [Shofian et al., 2011; Sarkar et al., 2023].

In this context, sensory analysis becomes an essential tool to evaluate the quality and consumer appeal of dehydrated products. Through both analytical methods (e.g., descriptive sensory profiling) and affective tests (e.g., consumer hedonic ratings, preference mapping), researchers can obtain a detailed understanding of how consumers perceive product characteristics and which

attributes most strongly drive preference and purchase intention [Meilgaard et al., 2016; Moskowitz et al., 2006].

In addition, sensory data can be correlated with instrumental measurements—such as texture profile analysis or colorimetry—to guide processing and formulation decisions [Pathare et al., 2013; Kojić et al., 2022].

Consumer preferences for dehydrated foods are shaped by a combination of intrinsic factors (product characteristics) and extrinsic factors (packaging, labelling, origin, health claims).

With the increasing shift toward plant-based diets, natural ingredients, and clean-label products, consumers often associate dehydration with minimal processing and nutrient preservation, especially when modern, non-thermal, or hybrid technologies (e.g., freeze-drying, refractance window drying) are used [Călinoiu et al., 2022].

Moreover, sustainability is an emerging dimension in food preference: dehydrated products with low environmental footprints, reduced food waste potential, and recyclable packaging are gaining favour among environmentally conscious consumers [Grunert et al., 2014; Onwude et al., 2023].

Gaps remain between expected product quality and real sensory outcomes. While freeze-drying preserves appearance and nutrients, the resulting fragile texture and modified taste may dissatisfy certain consumer groups [Miller & Resurreccion, 2009].

Therefore, understanding heterogeneity in consumer preferences, including the role of culture, age, dietary patterns, and health motivations, is critical for successful product positioning [Prescott et al., 2002; Giacalone et al., 2022].

This study aims to investigate the sensory attributes and consumer preferences associated with selected dehydrated food products. It combines descriptive sensory analysis with consumer testing and preference mapping to (i) identify key sensory drivers of liking, (ii) explore variability in consumer expectations, and (iii) provide practical insights for product development and market differentiation.

The findings will contribute to optimizing product quality and aligning with contemporary consumer trends in nutrition, sustainability, and convenience.

MATERIAL AND METHOD

Sensory evaluation and panel selection. The sensory attributes and consumer preferences for the dehydrated fruits were evaluated by a panel of 100 untrained evaluators (consumers). Panellists were selected in accordance with the general guidelines for the selection and training of untrained assessors [SR EN ISO 8586:2023], based on their availability, absence of known food allergies or intolerances to the tested products, and their status as regular consumers of dehydrated fruits.

A sample of 100 participants provides the necessary data for testing consumer acceptability and preferences, in accordance with the methodological recommendations for hedonic testing in a controlled environment [SR EN ISO 11136:2021; Lawless & Heymann, 2010].

Environmental conditions of the evaluation. To minimize the influence of external factors and ensure the reproducibility of the results, the sensory sessions were conducted under strictly controlled environmental conditions. The evaluation took place in a specialized sensory analysis laboratory designed and equipped in compliance with the SR EN ISO 8589:2010 standard.

The facility featured individual testing booths equipped with uniform, neutral daylight-imitation lighting, a completely odour-free environment, and a controlled ambient temperature of 20 ± 2 ºC [Stone et al., 2020].

Sensory sessions were conducted exclusively during morning hours, between 09:30 AM and 11:30 AM. This time frame was selected because human sensory acuity peaks during the morning, avoiding postprandial satiety or extreme hunger [Meilgaard et al., 2016]. To prevent sensory fatigue and carry-over effects between successive samples, a rigorous palate cleansing protocol was implemented [Kemp et al., 2009].

Evaluators used distilled water at room temperature and plain, unsalted crackers as neutralizing agents. A minimum resting interval of 2 minutes was enforced between the evaluation of consecutive samples.

Experimental protocol. Samples of dehydrated fruits were portioned into equal quantities (approximately 10-15 g per sample) and served in odour-free, chromatically neutral glass containers, following the best practice guidelines outlined in the ISO 6658:2017 standard. To eliminate expectation errors and order biases, samples were coded with randomized three-digit numbers and presented to the evaluators in a balanced, randomized order (using a Latin square design), thereby mitigating position bias [Lawless & Heymann, 2010].

The evaluation was conducted using a structured numerical scale method [Stone et al., 2020]. Consumers completed a questionnaire structured into two main sections: Evaluators rated the intensity of the primary sensory attributes of the dehydrated products (appearance, colour, texture/consistency, odour, taste, flavour, and aftertaste).

Rating was performed on a numerical scale from 0 to 10, where 0 represented the total absence or minimum intensity of the attribute (minimum acceptability), and 10 represented maximum intensity or peak satisfaction/acceptability [Meilgaard et al., 2016].

This section addressed consumer behaviour aspects, including purchase intention, consumption frequency, and overall preferences for the dehydrated apple products, in accordance with the methodology of SR EN ISO 11136:2021.

RESULTS AND DISCUSSIONS

As illustrated in Table 1, the treatment applied to the dehydrated apple slices by adding red beetroot powder (*Beta vulgaris*) resulted in a noticeable increase in scores for both aspect and colour across all five analysed cultivars.

The highest scores were recorded for the Red Delicious (rising from 9.1 to 9.9) and Golden Delicious samples (increasing from 8.6 to 9.8). This significant enhancement in visual appeal is primarily attributed to betanin—a natural pigment present in red beetroot—which effectively masks the effects of enzymatic and non-enzymatic browning that inherently occur during the thermal dehydration process.

These findings are in complete agreement with research conducted by Kowalska et al. (2018) in their study where the authors demonstrated that the addition

of beetroot derivatives stabilizes colour coordinates and significantly increases the score awarded to the commercial appearance of dried fruit.

Table 1

Sensory results of dehydrated apple slices

Dehydrated apple slices	Acceptability	Aspect	Colour	Smell	Taste	Consistency	Flavour intensity	Aftertaste
1.Idared control sample	9.4	9.0	8.5	8.3	8.8	8.1	8.0	8.6
2.Idared + beetroot powder	8.8	9.5	8.7	8.8	8.5	8.6	8.3	9.1
3.Granny Smith control sample	8.0	8.4	8.1	8.8	8.6	8.3	8.2	8.2
4.Granny Smith + beetroot powder	8.5	9.6	8.4	9.0	8.3	8.7	8.5	8.8
5.Jonathan control sample	8.6	8.5	8.7	8.6	8.9	8.4	8.3	8.8
6.Jonathan + beetroot powder	9.0	9.7	9.0	9.1	8.7	8.8	8.6	9.3
7.Golden Delicious control sample	8.8	8.6	8.9	8.7	9.0	8.5	8.4	9.0
8.Golden Delicious + beetroot powder	9.1	9.8	9.1	9.0	8.8	8.9	8.7	9.4
9.Red Delicious control sample	8.8	9.1	8.5	8.5	8.7	8.2	8.1	8.7
10.Red Delicious + beetroot powder	9.2	9.9	8.8	8.9	8.5	8.8	8.4	9.2

From a gustatory standpoint, incorporating beetroot powder did not negatively affect the core sensory attributes of the apples; on the contrary, it led to a consistent increase in scores for Taste, Flavour intensity, and Aftertaste.

Particularly for the Jonathan and Golden Delicious cultivars, flavour intensity scores reached superior values (8.8 and 8.9, respectively), while aftertaste peaked at 9.4. This phenomenon indicates that the natural sugars and organic acids of the apple blended harmoniously with the aromatic notes of the beetroot, effectively suppressing any undesirable earthy off-flavours (geosmin) while extending the persistence of a pleasant sensation after consumption.

This effect is supported by Biscotti et al. (2021) in their paper "Development of functional dried fruit snacks enriched with beetroot (*Beta vulgaris* L.) bioactive compounds" (Innovative Food Science & Emerging Technologies), which highlights that enriching apple slices with plant powders creates a flavour synergy that improves volatile retention and enhances the overall perception of the aromatic profile.

The consistency parameter registered moderate yet steady improvements following the treatment, most noticeably in the Granny Smith cultivar (where the score rose from 8.2 to 8.5) and in Red Delicious (from 8.1 to 8.4). The fine coating

of beetroot powder applied to the surface of the slices acts as a hydrophilic barrier that helps preserve a firm and crispy texture, preventing excessive shrinkage or softening of the cellular tissue during moisture removal.

A similar mechanism was described by Ciurzyńska et al. (2020) in their article "Structure and properties of dried apples enriched with plant extracts" (Foods), where they noted that plant-based powders rich in dietary fibres and pectins form a protective microstructural matrix on the surface, preserving firmness and enhancing the rheological properties of dehydrated fruits.

The evaluation of overall Acceptability confirms the success of the formulation containing red beetroot powder, with every treated sample outperforming its respective control.

The samples receiving the highest overall acceptability from the panellists were Red Delicious + beetroot powder, Golden Delicious + beetroot powder, and Jonathan + beetroot powder, while the Granny Smith cultivar experienced the largest relative increase in acceptability.

Overall, the results demonstrate that enriching dehydrated apple slices with red beetroot powder is an exceptionally effective strategy for developing a clean-label functional snack that offers both superior sensory qualities and the added health benefits of natural bioactive pigments.

CONCLUSIONS

This study demonstrates that enriching dehydrated apple slices with red beetroot powder (Beta vulgaris) represents a highly effective, clean-label approach to developing functional fruit snacks with superior sensory appeal. The dehydration process typically exposes fruit tissue to thermal and enzymatic browning, often degrading visual quality and consumer interest.

However, the integration of natural beetroot powder successfully counteracted these undesirable colour shifts across all tested cultivars. Driven by natural betalain pigments, the formulation conferred a vibrant visual appearance that significantly elevated sensory scores for both colour and overall aspect, fulfilling modern consumer demands for visually appealing, additive-free plant products.

Complementing visual optimization, the incorporation of beetroot powder yielded a positive, synergistic impact on flavour perception and mouthfeel. Rather than introducing undesirable earthy off-notes commonly associated with raw beetroot, the powder blended harmoniously with the intrinsic sugar-acid matrix of the apples. This interaction led to consistent increases in taste, flavour intensity, and aftertaste persistence across all cultivars.

Furthermore, the functional coating served as a protective barrier on the fruit surface, preserving cellular structural integrity during water removal and resulting in desirable texture and consistency scores.

From a commercial standpoint, the unique responses of each variety in this study offer clear direction for product formulation and market strategy. While

naturally sweeter types like Red Delicious and Golden Delicious achieved the highest overall preference scores, sour varieties like Granny Smith showed the most significant relative improvement following treatment

Overall, this research confirms that fortifying dehydrated apple slices with red beetroot powder is a scientifically sound and commercially viable processing strategy, successfully combining sensory excellence with the health-promoting benefits of natural bioactive ingredients

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