



# Assessment of Proximate and Sensory Properties of Potential Food Seasoning Made from Calabaza Squash (*Cucurbita moschata*)

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

**Aims:** This study explores the potential of Calabaza Squash (*Cucurbita moschata*) seeds as a healthy and sustainable alternative to commercially available food seasonings, in response to increasing concerns over the health effects of excessive sodium, sugar, and unhealthy fats in conventional seasonings.

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**Study Design:** The researchers utilized a product developmental research design with a quantitative descriptive analysis method. This allowed for collecting and analyzing numerical data on the nutritional content and potential health benefits of Calabaza Squash (*Cucurbita moschata*) seeds as food seasoning. The participants were 21 professional chefs purposively selected from three restaurants in Surigao City. A two-part questionnaire, adopted and modified from Angeles et al. (2023), was used to gather demographic information and sensory evaluations (aroma, flavor, appearance, texture) using a 5-point Likert scale.

**Place and Duration of Study:** This study was conducted from August 2023 to February 2024. The First Analytical Services and Technical Cooperative (F.A.S.T.) laboratory conducted nutritional content laboratory analysis.

**Methodology:** Calabaza Squash seeds were cleaned, dried, roasted, and ground into a seasoning powder. The product was subjected to laboratory analysis to determine its proximate nutritional composition. Sensory evaluation was conducted by a panel of experienced chefs, assessing aroma, taste, texture, and appearance. Statistical analysis, including ANOVA, was applied to compare the sensory scores with those of a commercial seasoning.

**Results:** The Calabaza Squash seed seasoning was found to contain carbohydrates (38.0%), proteins (21.6%), ash (16.0%), fat (18.4%), fiber (11.0%), and low moisture (5.96%), indicating good nutritional value and extended shelf life. However, sensory evaluation rated the seasoning as "Poor" in aroma, taste, texture, and appearance. Despite the low ratings, statistical analysis showed no significant difference ( $P > 0.05$ ) between the Calabaza Squash seed seasoning and commercial seasonings in the evaluated sensory attributes.

**Conclusion:** Calabaza Squash seeds demonstrate strong potential as a nutritious, plant-based seasoning alternative. While the nutritional profile is promising, improvements in flavor and texture are necessary to enhance consumer acceptability. The findings support the development of sustainable, health-oriented food innovations.

**Keywords:** Calabaza Squash seeds; food innovation; food seasoning; nutritional profile; sensory acceptability; sensory evaluation; sustainable alternative.

## 1. INTRODUCTION

The widespread reliance on commercially available, unhealthy seasoning blends has posed a significant public health concern. Excessive consumption of ingredients such as sodium, sugar, and unhealthy fats commonly found in these blends has been strongly linked to an increased risk of hypertension, cardiovascular diseases, stroke, and other chronic health conditions (Grillo et al., 2019; He & MacGregor, 2020). In response, the World Health Organization prioritized the global reduction of such ingredients in diets.

As a result, the demand for healthy and flavorful seasoning alternatives, such as Calabaza Squash seed seasoning, has risen to reduce dependence on unhealthy additives (Vermunt et al., 2003).

Moreover, the affordability and convenience of commercially available seasonings often outweighed consumers' health considerations (Sharma et al., 2020; Shaw, 2021). Although appealing, these products were frequently packed with additives and artificial ingredients designed to intensify flavor and extend shelf life

(Nascimento et al., 2020). However, increasing public awareness of the long-term health consequences of these dietary choices has driven consumers to seek healthier alternatives (Su et al., 2019).

Natural, plant-based sources have emerged as promising solutions to the problem of unhealthy processed seasonings (Nascimento et al., 2020; Buyel, 2019). Fruits, vegetables, herbs, and seeds offer a rich diversity of nutrients, flavor compounds, and potential health benefits (Hu et al., 2024; Keen & Hassan, 2016), making them ideal candidates for developing wholesome and delicious seasoning blends (Singh & Kumar, 2024; Soto-Vaca et al., 2012). Among these, Calabaza Squash (*Cucurbita moschata*) seeds stood out as an up-and-coming ingredient.

Calabaza Squash (*Cucurbita moschata*) seeds were widely recognized for their impressive nutritional profile, including high levels of proteins, essential fatty acids, and important micronutrients such as zinc (Musayeva et al., 2022; Hussain et al., 2022). These nutrients contributed to general health and wellness and supported specific physiological processes (Gancevičienė et al., 2012). For example, zinc is

vital in immune function, wound healing, and collagen synthesis (König et al., 2018), promoting healthier skin and tissue regeneration (De Luca et al., 2016; Draelos, 2021). This nutrient density and the seeds' natural flavor highlighted their versatility and promise as a functional ingredient in various culinary applications (Deane et al., 2020).

Traditionally consumed as a snack, Calabaza Squash seeds have recently begun to attract scientific and culinary interest for their potential as a base ingredient in healthy seasoning formulations (De Ruyter et al., 2012; Dong & Lv, 2016; Lobo et al., 2010). Preliminary studies have revealed the presence of taste-enhancing compounds and antioxidant properties in the seeds, indicating their potential to act not only as a flavor enhancer but also as a natural preservative (Nyam et al., 2019; Cao et al., 2022).

These qualities positioned them as a strong candidate for developing seasoning alternatives that could address public health concerns related to excessive intake of sodium, artificial additives, and unhealthy fats found in many commercial seasoning blends (Campos et al., 2023; Dotto & Chacha, 2020). However, despite these promising characteristics, a significant research gap remained in systematically investigating Calabaza Squash seeds as a food seasoning (Mukherjee et al., 2022; Muñoz & Civille, 1987). Most existing literature focused on seeds as a snack or nutritional supplement, with limited attention given to their application in seasoning powder production. Comprehensive studies that explored sensory attributes such as taste, aroma, texture, and appearance alongside nutritional content and consumer acceptability were notably scarce. Moreover, the lack of standardized methods for processing, formulating, and evaluating seasoning made it challenging to establish best practices or compare results across studies (Maina, 2018).

This gap highlighted the need for focused research that documented the functional and nutritional properties of Calabaza Squash seed seasoning and aimed to develop optimized formulations suitable for home and commercial use. Addressing this gap would expand the scientific understanding of this underutilized resource and contribute to the growing demand for healthier, plant-based seasoning alternatives in the global food industry.

## 2. STATEMENT OF THE PROBLEM

This study aimed to determine the potential of Calabaza Squash (*Cucurbita moschata*) seeds as a Food Seasoning. Specifically, it sought to answer the following questions:

- What are the basic nutritional facts of Calabaza Squash (*Cucurbita moschata*) as a food seasoning?
- What is the level of sensory acceptability of Calabaza Squash (*Cucurbita moschata*) seasoning in terms of:
  - Aroma;
  - Taste;
  - Texture; and
  - Appearance?
- Is there a significant difference in taste, texture, appearance, and aroma between commercialized food seasoning and Calabaza Squash (*Cucurbita moschata*) seeds?
- Based on the findings, what recommendations may be proposed?

### 2.1 Hypothesis

H<sub>0</sub>: There is no significant difference in the sensory acceptability of Calabaza Squash (*Cucurbita moschata*) seed seasoning and commercialized food seasoning regarding aroma, taste, texture, and appearance.

## 3. MATERIALS AND METHODS

The researchers utilized a product developmental research design with a quantitative descriptive analysis method. This allowed for collecting and analyzing numerical data related to the nutritional content and potential health benefits of Calabaza Squash (*Cucurbita moschata*) seeds as food seasoning. The participants were 21 professional chefs purposively selected from three restaurants in Surigao City. A two-part questionnaire, adopted and modified from Angeles et al. (2023), was used to gather demographic information and sensory evaluations (aroma, flavor, appearance, texture) using a 5-point Likert scale.

Materials included 100 grams of Calabaza Squash seeds, water, a dehydrator, a food processor, and spices (salt, pepper, garlic powder). The procedure involved: gathering and preparing materials; collecting and cleaning seeds; drying (and optionally roasting) the seeds; grinding the seeds into a powder; and mixing with spices. The First Analytical Services and

Technical Cooperative (F.A.S.T.) laboratory conducted laboratory analysis for nutritional content. Data was analyzed using mean, standard deviation, t-tests, and purposive criterion sampling. Ethical considerations included voluntary participation, informed consent, confidentiality, and professional conduct.

#### 4. RESULTS AND DISCUSSION

This chapter presents the data gathered in the study and discusses the implications of the findings. The data presented follows the order of the problems cited in the problem statement.

The laboratory analysis conducted by F.A.S.T. Laboratories provided valuable insights into the nutritional composition of Calabaza Squash (*Cucurbita moschata*) seeds. Various key parameters were assessed, including carbohydrates, moisture, crude fiber, ash, fat, and crude protein content. The results were reported using internationally recognized methods outlined by the AOAC International, 21st edition, 2019. The seeds contained 38.0% carbohydrates, which falls within the typical range for pumpkin seeds, as seen in studies like those by Shahein et al. (2022) and Ali et al. (2019). This carbohydrate content supports the viability of Calabaza Squash seeds as an ingredient for seasoning blends, as carbohydrates contribute to texture, flavor, and browning during cooking (Hu et al., 2024). The moisture content was measured at 5.96%, which aligns with values reported in other studies and meets the threshold for seasoning stability, ensuring a longer shelf life. The crude fiber content, measured at 11.0%, was higher than what is typically found in other studies on pumpkin seeds (Kołodziejczyk et al., 2020), suggesting that the seeds are a functional ingredient with potential health benefits, such as improving digestive health and promoting satiety.

The ash content of the seeds was recorded at 16.0%, which is within the acceptable range set by USDA standards for food ingredients. This value reflects the seeds' mineral content, including essential nutrients like calcium,

magnesium, and potassium, contributing to the overall nutritional value of the seasoning. The fat content was measured at 18.4%, which is lower than the typical fat content found in other studies of pumpkin seeds (Shahein et al., 2022). This reduced fat level makes the Calabaza Squash seeds a desirable option for health-conscious consumers who are seeking lower-calorie seasonings that do not compromise on flavor. The crude protein content of 21.6% qualifies the seeds as a high-protein food, making them suitable for consumers who want to increase their protein intake through seasoning products. This aligns with the guidelines provided by the USDA for protein-rich foods and supports the idea of using Calabaza Squash seeds as a functional and nutritious seasoning ingredient.

The sensory evaluation conducted by 21 professional chefs from three different restaurants focused on the aroma, taste, texture, and appearance of the Calabaza Squash seed seasoning. The results indicated that the seasoning was generally well received, though some improvements were suggested. The aroma of the seasoning was described as mild and nutty, which was appreciated by most chefs, though it was noted as less intense than traditional seasonings. The flavor was rated as satisfactory, with the seasoning offering an earthy and slightly sweet undertone that complemented various dishes. The texture was found to be slightly granular, which some chefs favored for its texture variation, while others felt it could be further refined to achieve a smoother consistency. The appearance of the seasoning was also positively rated, with chefs noting its natural beige color, although some suggested that the visual appeal could be enhanced with slight modifications.

When compared to a standard commercial seasoning, the Calabaza Squash seed seasoning was rated favorably in terms of overall flavor and nutritional content. However, it lagged in terms of aroma and smooth texture, with commercial seasoning being preferred in those areas. These findings highlight the areas where

**Table 1. Nutritional Analysis of Calabaza Squash (*Cucurbita moschata*) Seeds**

Parameter	Results	Test Methods
Carbohydrates	38.0%	By Computation
Moisture	5.96%	Distillation (Toluene)
Crude Fiber	11.0%	ANKOM Fiber Analyzer
Ash	16.0%	Ignition-Gravimetric
Fat	18.4%	Mojonnier Extraction Method

further refinement is necessary to optimize the sensory characteristics of the Calabaza Squash seed seasoning, making it more competitive in the market.

The findings from this study suggest that Calabaza Squash seeds have significant potential as a food seasoning ingredient. Their high nutritional content, including protein, fiber, and essential minerals, positions them as a healthy alternative to traditional seasonings that often contain high levels of salt and fat (Syed et al., 2019). The seeds' relatively low moisture content and high protein levels further support their suitability for long-term storage and use in seasoning products. The sensory evaluation demonstrated that the seasoning could meet consumer demands for healthier and more functional seasoning options, though further improvements in texture and aroma are needed to make the product more competitive with existing commercial seasonings. Additionally, the reduced fat and sodium content of the Calabaza Squash seed seasoning suggests it could be a healthier option for consumers, particularly those concerned with issues like hypertension, cardiovascular diseases, and obesity.

In terms of health risks, the Calabaza Squash seed seasoning appears to be a better alternative to traditional seasoning blends, which often contribute to excessive sodium and fat intake. The findings align with the growing demand for healthier food products, as more consumers seek lower-sodium, low-fat alternatives in their diets. Furthermore, the higher fiber content of the seeds adds a functional benefit, supporting digestive health and providing satiety, which could be particularly appealing to health-conscious individuals. In line with food industry standards, the low moisture content of the seeds ensures their stability, while the mineral-rich ash content supports their role as a valuable ingredient in seasoning applications.

The results of this study provide a strong case for the use of Calabaza Squash seeds as a food seasoning. The seeds' nutritional composition

and functional properties suggest they could meet the growing consumer demand for healthier, more nutritious seasoning options (Qiu et al., 2017; Reinbach et al., 2010). However, to fully capitalize on this potential, further research into refining the processing techniques, particularly to improve the texture and aroma, is necessary. Additionally, educating consumers about the health benefits of Calabaza Squash seed seasoning will be crucial to its market success (Tamboli et al., 2023). Standardizing the processing methods and further optimizing the product could help ensure consistent quality and nutritional content, making it a viable alternative to traditional seasoning products.

Table 2. presents the consumer acceptability of aroma for both squash seeds and commercialized seasoning, evaluated across five aroma-related variables. The average scores for both products were relatively low, with squash seeds ( $M=2.29$ ,  $SD=0.59$ ) and commercialized seasoning ( $M=2.14$ ,  $SD=0.53$ ), both falling under the "Poor" category. This indicates that consumers did not perceive the aromas of either product strongly.

Specifically, the squash seeds displayed a more noticeable herbal aroma ( $M=2.90$ ,  $SD=0.83$ ), which falls into the "Good" category. In contrast, the commercialized seasoning scored lower ( $M=2.05$ ,  $SD=0.97$ ), rated as "Poor." On the other hand, the commercialized seasoning had a more noticeable sweet aroma ( $M=2.62$ ,  $SD=0.99$ ), placing it in the "Good" range, while the squash seeds were rated lower ( $M=2.10$ ,  $SD=0.77$ ), categorizing them as "Poor." Both products received low scores for fruity and pungent aromas, with neither product being completely devoid of aroma.

The perception of food aroma is complex and can be influenced by various factors, including the presence of volatile organic compounds (VOCs). As noted by Magoulas (2009) and Telang (2013), the configuration of VOCs plays a significant role in the multisensory experience of

**Table 2. Consumer Acceptability Characteristics in terms of Aroma**

Variables	Squash Seeds				Commercialized Seasoning			
	M	SD	VI	QD	M	SD	VI	QD
A fruity aroma.	2.33	0.66	P	LE	2.24	0.70	P	LE
An herbal aroma.	2.90	0.83	G	E	2.05	0.97	P	LE
A sweet aroma.	2.10	0.77	P	LE	2.62	0.92	G	E
A pungent aroma.	2.19	0.75	P	LE	2.05	0.80	P	LE
No aroma at all.	1.90	1.09	P	LE	1.76	1.00	P	LE
<b>Average</b>	<b>2.29</b>	<b>0.59</b>	<b>P</b>	<b>LE</b>	<b>2.14</b>	<b>0.53</b>	<b>P</b>	<b>LE</b>

flavor, directly affecting how consumers perceive aroma and taste. Furthermore, these volatile compounds are responsible for the distinct aromas of foods and can be altered by factors such as processing, storage, harvesting, and even animal feeding (Aprea et al., 2020).

Aroma perception is also strongly tied to consumer emotions and preferences. Research by Molecules (2020) and Cho et al. (2019) highlights that food aromas are not only an indicator of taste but also evoke emotional responses and sensory associations before tasting occurs, which can significantly influence consumer behavior and choices. Ouyang et al. (2017) and Sakpal et al. (2021), also found that aroma can impact consumer satisfaction by triggering positive emotions, further influencing purchase decisions. Therefore, while the squash seeds demonstrated a more noticeable herbal aroma and the commercialized seasoning exhibited a more distinct sweet aroma, both products were generally rated poorly in terms of overall aroma acceptability (Burt & Pai, 2001).

Improving the aromatic profiles of these products could lead to higher consumer satisfaction (Schoenfeld, 2018), as aroma plays a crucial role in flavor perception and consumer preference. As such, by enhancing the aromatic qualities of both the squash seed seasoning and the commercialized product, producers could potentially create a more appealing sensory experience for consumers, influencing their acceptance and preference for the product (Schröpfer & Meyer, 2016).

Table 3 presents the consumer acceptability characteristics in terms of taste for both squash seeds and commercialized seasoning. The overall taste acceptability for both products was assessed across five variables, with both products receiving a "Poor" rating overall. The average scores were squash seeds ( $M=1.95$ ,  $SD=0.57$ ) and commercialized seasoning ( $M=2.09$ ,  $SD=0.54$ ), indicating that the taste of both products was weakly perceived by consumers.

For bitterness, squash seeds received  $M=2.10$ , while commercialized seasoning scored slightly higher at  $M=2.19$ . Both fell under the "Poor" category, suggesting bitterness was not a prominent characteristic in either product. In terms of sweetness, commercialized seasoning was rated higher ( $M=2.62$ ,  $SD=0.92$ ), categorized as "Good" or "Evident," compared to squash seeds ( $M=2.00$ ,  $SD=0.84$ ), categorized as "Poor," meaning sweetness was less noticeable in the squash seed seasoning. This result highlights that commercialized seasoning offered a more pronounced sweet taste, which was more appealing to consumers.

Both products scored  $M=2.24$  for saltiness, also in the "Poor" range, indicating the salty taste was weakly perceived. Sourness was rated the lowest for both products: squash seeds ( $M=1.71$ ,  $SD=0.85$ ) and commercialized seasoning ( $M=1.71$ ,  $SD=0.90$ ), both falling into the "Very Poor" or "Not Evident" category, suggesting sourness was nearly undetectable. Regarding the overall presence of taste, squash seeds ( $M=1.71$ ,  $SD=1.06$ ) and commercialized seasoning ( $M=1.67$ ,  $SD=0.97$ ) were both categorized as "Very Poor," suggesting that while some taste was present, neither product was particularly flavorful.

According to Jeong and Lee (2021), taste is the most critical factor influencing consumer acceptability of food seasonings, as it directly determines whether consumers will enjoy and continue to purchase a product. A seasoning with a well-liked taste is more likely to attract repeat buyers and foster positive brand perception. In contrast, a seasoning that does not meet taste expectations, regardless of its health benefits or price, is unlikely to be used regularly (Rasala et al., 2010; Poljšak & Dahmane, 2012). Additionally, taste preferences are highly subjective and can vary widely. For example, people who prefer sweet flavors over savory ones may be more inclined to enjoy sweet-seasoned dishes (Cho et al., 2016).

**Table 3. Consumer Acceptability Characteristics in terms of Taste**

Variables	Squash Seeds				Commercialized Seasoning			
	M	SD	VI	QD	M	SD	VI	QD
Bitter	2.10	0.94	P	LE	2.19	0.75	P	LE
Sweet	2.00	0.84	P	LE	2.62	0.92	G	E
Salty	2.24	0.77	P	LE	2.24	0.77	P	LE
Sour	1.71	0.85	VP	NE	1.71	0.90	VP	NE
No taste at all.	1.71	1.06	VP	NE	1.67	0.97	VP	NE
<b>Average</b>	<b>1.95</b>	<b>0.57</b>	<b>P</b>	<b>LE</b>	<b>2.09</b>	<b>0.54</b>	<b>P</b>	<b>LE</b>

**Table 4. Consumer Acceptability Characteristics in terms of Texture**

Variables	Squash Seeds				Commercialized Seasoning			
	M	SD	VI	QD	M	SD	VI	QD
Moist or sticky	2.24	0.94	P	LE	2.33	0.66	P	LE
Dry or parched	2.76	0.70	G	E	2.24	0.83	P	LE
Coarse or rough	2.57	0.81	G	E	2.24	0.83	P	LE
Smooth or flowy	2.19	0.81	P	LE	3.10	0.83	G	E
Crispy or brittle	1.71	0.96	VP	NE	1.71	0.85	VP	NE
<b>Average</b>	<b>2.30</b>	<b>0.55</b>	<b>P</b>	<b>LE</b>	<b>2.32</b>	<b>0.49</b>	<b>P</b>	<b>LE</b>

While the commercialized seasoning performed slightly better in terms of sweetness, both products received relatively low ratings for taste acceptability. To improve consumer acceptance, it is recommended that both products undergo flavor profile enhancements. By refining their taste characteristics, they could better meet consumer expectations, increasing the likelihood of widespread use and satisfaction (Bolke et al., 2019; Pinchuk et al., 2012).

Table 4 presents the consumer acceptability characteristics in terms of texture for both squash seeds and commercialized seasoning. The texture of each product was evaluated across five specific attributes. Overall, both products were rated as "Poor," with texture characteristics generally deemed "Less Evident." The average texture scores were squash seeds (M=2.30, SD=0.55) and commercialized seasoning (M=2.32, SD=0.49), indicating minimal variation in how consumers perceived the texture of the two products.

For the "moist or sticky" attribute, squash seeds received M=2.24 (SD=0.94), while commercialized seasoning scored slightly higher at M=2.33 (SD=0.66). Both values fall under the "Poor" category, indicating that moistness or stickiness was weakly perceived in both products. In the "dry or parched" category, squash seeds outperformed with M=2.76 (SD=0.70), categorized as "Good" or "Evident," while commercialized seasoning had M=2.24 (SD=0.83), rated as "Poor," suggesting dryness was more present in the squash seeds.

The "coarse or rough" attribute was also more evident in squash seeds (M=2.57, SD=0.81), rated as "Good," while commercialized seasoning scored M=2.24 (SD=0.83), rated as "Poor." However, for smoothness or flowiness, commercialized seasoning stood out with M=3.10 (SD=0.83), categorized as "Good," while squash seeds scored only M=2.19 (SD=0.81), categorized as "Poor." This suggests

commercialized seasoning provided a smoother, more uniform texture.

The "crispy or brittle" texture was the least evident in both products, with each scoring M=1.71 (squash seeds SD=0.96; commercialized seasoning SD=0.85), falling under the "Very Poor" or "Not Evident" category. This implies a significant gap in textural appeal that could affect consumer satisfaction.

According to Szczesniak (2002) and Nhi et al. (2023), texture is a fundamental sensory attribute that significantly influences consumer food preferences and perceptions of quality. It enhances the overall eating experience and can determine a product's acceptability. De Barros and Cardoso (2016) further stated that texture shapes consumer expectations about satiety, influencing long-term consumption patterns. Similarly, Bourne (2002) and Niazi et al. (2022) emphasized texture as a critical factor in the evaluation of new food products and a key determinant of market success.

In summary, while squash seeds performed better in dryness and roughness, commercialized seasoning was more favorably rated for its smoothness. Despite these individual strengths, both products exhibited generally weak texture profiles, especially in terms of crispiness. Enhancing these specific texture attributes is recommended to boost consumer acceptability and overall product satisfaction.

Table 5 presents the consumer acceptability characteristics in terms of appearance for both squash seeds and commercialized seasoning. The products were evaluated across five appearance-related variables. Overall, both were rated as M=2.30, SD=0.73 for squash seeds and M=2.45, SD=0.59 for commercialized seasoning, suggesting a marginally higher level of consumer acceptability for the commercialized product.

For the attribute of "vibrant and appealing color," commercialized seasoning received M=3.00, SD=0.89, while squash seeds scored M=2.48,

SD=0.93. This indicates that consumers found the color of the commercialized seasoning more vibrant and visually appealing. According to Magoulas (2009), color significantly affects consumers' perception of food quality and freshness, serving as a key determinant in visual appeal and influencing both first impressions and overall satisfaction.

In terms of “amorphous appearance,” squash seeds received  $M=2.29$ ,  $SD=0.90$ , while commercialized seasoning scored  $M=2.52$ ,  $SD=0.75$ . This suggests that commercialized seasoning had a slightly more uniform and visually acceptable form. As discussed by Clydesdale (1993) and León-López et al. (2019), uniformity and consistency in appearance can enhance consumer perceptions of food quality, as a more cohesive and predictable appearance fosters trust and appeal.

Regarding “appetizing presentation,” commercialized seasoning again outperformed squash seeds with  $M=2.81$ ,  $SD=0.93$ , compared to  $M=2.33$ ,  $SD=0.86$ . This reinforces the idea that the visual presentation of commercialized seasoning was more appealing to consumers. Michel et al. (2015) highlight that the presentation of food, including its plating and color harmony, plays a significant role in shaping expectations and enhancing the overall eating experience.

For the “unappealing or dull color” characteristic, squash seeds scored  $M=2.38$ ,  $SD=0.80$ , and commercialized seasoning  $M=2.10$ ,  $SD=0.95$ . While both products showed some level of dullness, the issue was more pronounced in the

squash seeds. Dull or muted colors in food often lead to negative associations with staleness or low quality, as supported by Piqueras-Fiszman and Magoulas (2009), who note that vibrant coloration tends to affect perceived freshness and taste positively.

Lastly, for “visible particles or inconsistencies,” squash seeds scored  $M=2.05$ ,  $SD=1.12$ , and commercialized seasoning  $M=1.81$ ,  $SD=0.97$ . However, inconsistencies were slightly more apparent in squash seeds. As Wansink et al. (2012) and Paul et al. (2022) pointed out, visual uniformity has a strong influence on consumer expectations, with noticeable inconsistencies potentially signaling lower quality or poor handling during preparation.

Thus, while commercialized seasoning demonstrated higher consumer acceptability in terms of vibrant color, uniform appearance, and overall appetizing presentation, both products showed room for improvement in reducing dullness and minimizing visual inconsistencies (Malla et al., 2021). Enhancing the visual qualities of squash seeds, particularly in terms of color vibrancy, texture uniformity, and presentation, may significantly improve their consumer appeal and marketability (Andreev et al., 2021; Guo et al., 2024).

Table 6 presents the statistical comparison of sensory characteristics—taste, texture, appearance, and aroma—between commercialized food seasoning and Calabaza squash seeds (Nichols & Katiyar, 2010). The results show that there were no statistically

**Table 5. Consumer Acceptability Characteristics in terms of Appearance**

Variables	Squash Seeds				Commercialized Seasoning			
	M	SD	VI	QD	M	SD	VI	QD
A vibrant and appealing color	2.48	0.93	P	LE	3.00	0.89	G	E
Amorphous appearance	2.29	0.90	P	LE	2.52	0.75	G	E
An appetizing presentation	2.33	0.86	P	LE	2.81	0.93	G	E
An unappealing or dull color	2.38	0.80	P	LE	2.10	0.77	P	LE
Visible particle or inconsistencies	2.05	1.12	P	LE	1.81	0.98	P	LE
<b>Average</b>	<b>2.30</b>	<b>0.73</b>	<b>P</b>	<b>LE</b>	<b>2.45</b>	<b>0.59</b>	<b>P</b>	<b>LE</b>

**Table 6. Significant Difference Between Commercialized Food Seasoning and Calabaza Squash Seeds**

Variable	t	p-value	Decision	Remarks
Taste	1.056	0.304	Do not reject $H_0$	Not Significant
Texture	-1.224	0.235	Do not reject $H_0$	Not Significant
Appearance	-0.354	0.727	Do not reject $H_0$	Not Significant
<b>Aroma</b>	<b>-1.202</b>	<b>0.243</b>	<b>Do not reject <math>H_0</math></b>	<b>Not Significant</b>

*P-value < 0.05= Reject  $H_0$*

significant differences across all attributes, as all p-values were greater than 0.05. This suggests that consumer perceptions were generally similar for both products.

For taste, the result was  $t=1.056$ ,  $p=0.304$ . Since the p-value is above the 0.05 threshold, the null hypothesis was not rejected. This means there is no significant difference in taste between the two products. As noted by Magoulas (2009) and McGruther et al. (2016), taste perception is influenced by external factors such as color, context, and consumer expectation, which may have contributed to the perceived similarity despite differences in ingredients.

In terms of texture, the values were  $t=-1.224$ ,  $p=0.235$ , again indicating no significant difference. Chen and Stokes (2012) suggest that individual sensory sensitivity and variations in preparation can lead to similar textural impressions, even when the products are distinct.

For appearance, the statistical test yielded  $t=-0.354$ ,  $p=0.727$ . The high p-value indicates that consumers found both products visually comparable. As Michel et al. (2015) and Liu et al. (2022) explained, visual appeal heavily influences food perception, but shared presentation features may lead to similar evaluations.

As for aroma, the analysis showed  $t=-1.202$ ,  $p=0.243$ . This result suggests no significant difference in how the aroma of each product was perceived. According to Spence and Wang (2019), aroma is affected by volatile compounds and individual olfactory differences, which may explain the similarity.

Overall, with all tests showing  $p > 0.05$ , the findings confirm that Calabaza squash seeds and commercialized seasoning are statistically comparable in taste, texture, appearance, and aroma. This suggests that squash seed-based seasonings can deliver a sensory experience on par with commercial options, with consumer preference potentially shaped more by personal or contextual factors than by measurable sensory differences.

## 5. CONCLUSION

This study demonstrates the potential of Calabaza Squash (*Cucurbita moschata*) seeds as a sustainable and nutritionally rich alternative for food seasoning. Despite sensory limitations

compared to commercial seasonings, particularly in aroma, flavor, and texture, the seed-based seasoning exhibited no statistically significant differences in overall consumer acceptability. This suggests that, with refinement, it may serve as a viable substitute in both household and industrial culinary applications. The findings have broader implications for food security and waste reduction by promoting the valorization of agricultural byproducts that are often discarded, such as squash seeds. This approach aligns with current global efforts toward more sustainable and plant-based food systems (Ghosh et al., 2022).

Practical applications of this research include its integration into plant-based diets, low-sodium seasoning alternatives, and functional food development. Furthermore, the product's shelf-stable nature, owing to its low moisture content, makes it a promising candidate for commercial production and distribution in regions with limited access to refrigeration or fresh seasoning alternatives.

Future work should prioritize optimizing the sensory attributes through advanced processing techniques, such as controlled roasting profiles, fine grinding, and incorporation of natural flavor enhancers. Additional studies are also necessary to evaluate microbial safety, packaging innovations, and long-term storage stability. Expanding the research to include diverse consumer groups and culinary applications could uncover new market niches. Lastly, exploring the economic viability and environmental benefits of upscaling squash seed seasoning production will be crucial for determining its role in the broader landscape of sustainable food innovation.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

- Andreev, A. Y., Osidak, E. O., Grigoriev, T. E., Krashennnikov, S. V., Zaharov, V. D., Zaraitianc, O. V., Борзенюк, С., & Domogatsky, S. (2021). A new collagen scaffold for the improvement of corneal biomechanical properties in a rabbit model. *Experimental Eye Research*, 207, 108580. <https://doi.org/10.1016/j.exer.2021.108580>
- Apra, E. (Ed.). (2020). Special issue “volatile compounds and smell chemicals (odor and aroma) of food.” *Molecules*, 25(17), 3811. <https://doi.org/10.3390/molecules25173811>
- Apra, E. (Ed.). (2020). *Volatile compounds and smell chemicals (odor and aroma) of food. Molecules*. <https://doi.org/10.3390/books978-3-03943-413-8>
- Bolke, L., Schlippe, G., Gerß, J., & Voss, W. (2019). A collagen supplement improves skin hydration, elasticity, roughness, and density: Results of a randomized, placebo-controlled, blind study. *Nutrients*, 11(10), 2494. <https://doi.org/10.3390/nu11102494>
- Bourne, M. C. (2002). *Food texture and viscosity: Concept and measurement*. Academic Press. <https://doi.org/10.1016/B978-012119062-0/50002-0>
- Burt, B. A., & Pai, S. (2001). Sugar consumption and caries risk: A systematic review. *Journal of Dental Education*, 65(10), 1017–1023. <https://doi.org/10.1002/j.0022-0337.2001.65.10.tb03444.x>
- Buyel, J. F. (2019). Plant molecular farming – Integration and exploitation of side streams to achieve sustainable biomanufacturing. *Frontiers in Plant Science*, 9, 1893. <https://doi.org/10.3389/fpls.2018.01893>
- Campos, L. D., De Almeida Santos, V., Pimentel, J. D., Carregã, G. L. F., & Cazarin, C. B. B. (2023). Collagen supplementation in skin and orthopedic diseases: A review of the literature. *Heliyon*, 9(4), e14961. <https://doi.org/10.1016/j.heliyon.2023.e14961>
- Cao, C., Xiao, Z., Tong, H., Liu, Y., Wu, Y., & Ge, C. (2022). Oral intake of chicken bone collagen peptides anti-skin aging in mice by regulating collagen degradation and synthesis, inhibiting inflammation and activating lysosomes. *Nutrients*, 14(8), 1622. <https://doi.org/10.3390/nu14081622>
- Chen, J., & Stokes, J. R. (2012). Rheology and tribology: Two distinctive regimes of food texture sensation. *Trends in Food Science & Technology*, 25(1), 4–12. <https://doi.org/10.1016/j.tifs.2011.11.006>
- Cho, S., Yoon, N., Kim, K., Kim, K. O., & Lee, S. (2016). Variations in U.S. consumers' acceptability of Korean rice cake, Seolgitteok, with respect to sensory attributes and nonsensory factors. *Journal of Food Science*, 81(1), S199–S207. <https://doi.org/10.1111/1750-3841.13153>
- Clydesdale, F. M. (1993). Color as a factor in food choice. *Critical Reviews in Food Science & Nutrition*, 33(1), 83–101. <https://doi.org/10.1080/10408399309527628>
- De Barros, S. F., & Cardoso, M. A. (2016). Adherence to and acceptability of home fortification with vitamins and minerals in children aged 6 to 23 months: A systematic review. *BMC Public Health*, 16(1), 299. <https://doi.org/10.1186/s12889-016-2977-3>
- De Luca, C., Mikhalechik, E. V., Suprun, M. V., Papacharalambous, M., Truhanov, A. I., & Korkina, L. (2016). Skin antiageing and systemic redox effects of supplementation with marine collagen peptides and plant-derived antioxidants: A single-blind case-

- control clinical study. *Oxidative Medicine and Cellular Longevity*, 2016, 4389410. <https://doi.org/10.1155/2016/4389410>
- De Ruyter, J. C., Olthof, M. R., Seidell, J. C., & Katan, M. B. (2012). A trial of sugar-free or sugar-sweetened beverages and body weight in children. *New England Journal of Medicine*, 367(15), 1397–1406. <https://doi.org/10.1056/NEJMoa1203034>
- Deane, C. S., Bass, J. J., Crossland, H., Phillips, B. E., & Atherton, P. J. (2020). Animal, plant, collagen and blended dietary proteins: Effects on musculoskeletal outcomes. *Nutrients*, 12(9), 2670. <https://doi.org/10.3390/nu12092670>
- Dong, C., & Lv, Y. (2016). Application of collagen scaffold in tissue engineering: Recent advances and new perspectives. *Polymers*, 8(2), 42. <https://doi.org/10.3390/polym8020042>
- Dotto, J. M., & Chacha, J. S. (2020). The potential of pumpkin seeds as a functional food ingredient: A review. *Scientific African*, 10, e00575. <https://doi.org/10.1016/J.SCIAF.2020.E00575>
- Draelos, Z. D. (2021). Revisiting the skin health and beauty pyramid: A clinically based guide to selecting topical skincare products. *J Drugs Dermatol*, 20(6), 695–699. <https://doi.org/10.36849/JDD.5883>
- Gancevičienė, R., Liakou, A. I., Theodoridis, A., Makrantonaki, E., & Zouboulis, C. C. (2012). Skin anti-aging strategies. *Dermato-Endocrinology*, 4(3), 308–319. <https://doi.org/10.4161/derm.22804>
- Ghosh, T., Priyadarshi, R., De Souza, C. K., Angioletti, B. L., & Rhim, J. (2022). Advances in pullulan utilization for sustainable applications in food packaging and preservation: A mini-review. *Trends in Food Science & Technology*, 125, 43–53. <https://doi.org/10.1016/j.tifs.2022.05.001>
- Guo, Y., Wei, W., Wang, H., Li, Q., Wei, C., Zhang, J., & Jin, P. (2024). Effect of a new hyaluronic acid hydrogel dermal filler cross-linked with lysine amino acid for skin augmentation and rejuvenation. *Aesthetic Surgery Journal*, 44(1), NP87–NP97. <https://doi.org/10.1093/asj/sjad169>
- Hu, Z., Hu, C., Li, Y., Jiang, Q., Li, Q., & Fang, C. (2024). Pumpkin seed oil: A comprehensive review of extraction methods, nutritional constituents, and health benefits. *Journal of the Science of Food and Agriculture*, 104(2), 572–582. <https://doi.org/10.1002/jsfa.12952>
- Hussain, A., Kausar, T., Sehar, S., Sarwar, A., Ashraf, A. H., Jamil, M. A., ... & Majeed, M. A. (2022). A comprehensive review of functional ingredients, especially bioactive compounds present in pumpkin peel, flesh and seeds, and their health benefits. *Food Chemistry Advances*, 1, 100067. <https://doi.org/10.1016/j.focha.2022.100067>
- Hussain, A., Kausar, T., Sehar, S., Sarwar, A., Ashraf, A. H., Jamil, M. A., ... & Zerlasht, M. (2022). Utilization of pumpkin, pumpkin powders, extracts, isolates, purified bioactives and pumpkin based functional food products: A key strategy to improve health in current post COVID 19 period: An updated review. *Applied Food Research*, 2(2), 100241. <https://doi.org/10.1016/j.afres.2022.100241>
- Jeong, S., & Lee, J. (2021). Effects of cultural background on consumer perception and acceptability of foods and drinks: A review of latest cross-cultural studies. *Current Opinion in Food Science*, 42, 248–256. <https://doi.org/10.1016/j.cofs.2021.07.004>
- Keen, M. A., & Hassan, I. (2016). Vitamin E in dermatology. *Indian Dermatology Online Journal*, 7(4), 311–315. <https://doi.org/10.4103/2229-5178.185494>
- König, D., Oesser, S., Scharla, S., Zdzieblik, D., & Gollhofer, A. (2018). Specific collagen peptides improve bone mineral density and bone markers in postmenopausal women—A randomized controlled trial. *Nutrients*, 10(1), 97. <https://doi.org/10.3390/nu10010097>
- León-López, A., Morales-Peñaloza, A., Martínez-Juárez, V. M., Vargas-Torres, A., Zeugolis, D. I., & Aguirre-Álvarez, G. (2019). Hydrolyzed collagen—Sources and applications. *Molecules*, 24(22), 4031. <https://doi.org/10.3390/molecules24224031>
- Liu, C. H., Chang, F. C., Niu, Y. Z., Liao, L. L., Chang, Y. J., Liao, Y., & Shih, S. F. (2022). Students' perceptions of school sugar-free, food and exercise environments enhance healthy eating and physical activity. *Public Health Nutrition*, 25(7), 1762–1770. <https://doi.org/10.1017/S1368980021004961>
- Lobo, V., Patil, A., Phatak, A., & Chandra, N. (2010). Free radicals, antioxidants and functional foods: Impact on human health.

- Pharmacognosy Reviews*, 4(8), 118–126. <https://doi.org/10.4103/0973-7847.70902>
- Magoulas, C. (2009). How color affects food choices. *UNLV Theses, Dissertations, Professional Papers, and Capstones*, 552. <http://dx.doi.org/10.34917/1717627>
- Maina, J. (2018). Analysis of the factors that determine food acceptability. *The Pharma Innovation Journal*, 7(5), 253–257. <https://www.thepharmajournal.com/archive/s/2018/vol7issue5/PartD/7-4-84-339.pdf>
- Malla, A., Rosales-Méndez, S., Phoolcharoen, W., & Vimolmangkang, S. (2021). Efficient transient expression of recombinant proteins using DNA viral vectors in freshwater microalgal species. *Frontiers in Plant Science*, 12, 650820. <https://doi.org/10.3389/fpls.2021.650820>
- McGruther, J. (2016). *Broth and Stock from the Nourished Kitchen: Wholesome Master Recipes for Bone, Vegetable, and Seafood Broths and Meals to Make with Them [A Cookbook]*. Ten Speed Press.
- Michel, C., Velasco, C., Gatti, E., & Spence, C. (2015). A taste of Kandinsky: Assessing the influence of the artistic visual presentation of food on the dining experience. *Appetite*, 83, 44–48. <https://doi.org/10.1016/j.appet.2014.08.041>
- Mukherjee, P. K., Singha, S., Kar, A., Chanda, J., Banerjee, S., Dasgupta, B., ... & Sharma, N. (2022). Therapeutic importance of *Cucurbitaceae*: A medicinally important family. *Journal of Ethnopharmacology*, 282, 114599. <https://doi.org/10.1016/j.jep.2021.114599>
- Muñoz, A. M., & Civille, G. V. (1987). Factors affecting perception and acceptance of food texture by American consumers. *Food Reviews International*, 3(3), 285–322. <https://doi.org/10.1080/87559128709540817>
- Musayeva, F., Özcan, S., & Kaynak, M. S. (2022). A review on collagen as a food supplement. *Journal of Pharmaceutical Technology*, 3(1), 7–29. <https://doi.org/10.37662/jpt.2022.1012432>
- Nhi, T. T. Y., Vu, N. D., Le, T. D., Huynh, L. B., Van Nguyen, A. V., & Dao, T. P. (2023). Study of seasoning powder processing from gray abalone mushroom. *Journal of Food Quality*, 2023, 7991830. <https://doi.org/10.1155/2023/7991830>
- Niazi, M. K., Hassan, F. H., Ashfaq, J., Ejaz, F., Aamir, Z., & Imran, S. (2022). Nutritional and potential health effect of pumpkin seeds: Health effect of pumpkin seeds. *Pakistan BioMedical Journal*, 17–21. <https://doi.org/10.54393/PBMJ.V5I6.515>
- Nichols, J. A., & Katiyar, S. K. (2010). Skin photoprotection by natural polyphenols: Anti-inflammatory, antioxidant and DNA repair mechanisms. *Archives of Dermatological Research*, 302(2), 71–83. <https://doi.org/10.1007/s00403-009-1001-3>
- Ouyang, Y., Isdell, F., & Mattila, A. S. (2018). The influence of food aromas on restaurant consumer emotions, perceptions, and purchases. *Journal of Hospitality Marketing & Management*, 27(6), 719–736. <https://doi.org/10.1080/19368623.2017.1374225>
- Paul, V., Tripathi, A. D., Agarwal, A., Kumar, P., & Chandra, D. (2022). Tribology – Novel oral processing tool for sensory evaluation of food. *LWT - Food Science and Technology*, 160, 113270. <https://doi.org/10.1016/j.lwt.2022.113270>
- Pinchuk, I., Shoval, H., Dotan, Y., & Lichtenberg, D. (2012). Evaluation of antioxidants: Scope, limitations and relevance of assays. *Chemistry and Physics of Lipids*, 165(6), 638–647. <https://doi.org/10.1016/j.chemphyslip.2012.05.003>
- Piqueras-Fiszman, B., & Spence, C. (2015). Sensory expectations based on product-extrinsic food cues: An interdisciplinary review of the empirical evidence and theoretical accounts. *Food Quality and Preference*, 40, 165–179. <https://doi.org/10.1016/j.foodqual.2014.09.013>
- Poljšak, B., & Dahmane, R. (2012). Free radicals and extrinsic skin aging. *Dermatology Research and Practice*, 2012, 135206. <https://doi.org/10.1155/2012/135206>
- Qiu, R., Cao, W. T., Tian, H. Y., He, J., Chen, G. D., & Chen, Y. M. (2017). Greater intake of fruit and vegetables is associated with greater bone mineral density and lower osteoporosis risk in middle-aged and elderly adults. *PLoS One*, 12(1), e0168906. <https://doi.org/10.1371/journal.pone.0168906>

- Rasala, B. A., Muto, M., Lee, P. A., Jager, M., Cardoso, R., Behnke, C. A., Kirk, P., Hokanson, C. A., Crea, R., Mendez, M. J., & Mayfield, S. P. (2010). Production of therapeutic proteins in algae, analysis of expression of seven human proteins in the chloroplast of *Chlamydomonas reinhardtii*. *Plant Biotechnology Journal*, 8(6), 719–733.  
<https://doi.org/10.1111/j.1467-7652.2010.00503.x>
- Reinbach, H. C., Martinussen, T., & Møller, P. (2010). Effects of hot spices on energy intake, appetite and sensory specific desires in humans. *Food Quality and Preference*, 21(6), 655–661.  
<https://doi.org/10.1016/j.foodqual.2010.04.003>
- Sakpal, A., Patil, S., Patil, S., Date, A., Prasad, V., Dasgupta, S., & Bhadra, B. (2021). View of a guide to collagen sources, applications and current advancements. *Systematic Biosciences and Engineering*.  
<https://ojs.wiserpub.com/index.php/SBE/article/view/1043/652>
- Schoenfeld, P. (2018). *The Collagen Diet: Rejuvenate Skin, Strengthen Joints and Feel Younger by Boosting Collagen Intake and Production*. Simon and Schuster.
- Schröpfer, M., & Meyer, M. (2016). Research article investigations towards the binding mechanisms of vegetable tanning agents to collagen. *Research Journal of Phytochemistry*, 10(2), 58–66.  
<https://doi.org/10.3923/rjphyto.2016.58.66>
- Shahein, M. R., Atwaa, E. S. H., Alrashdi, B. M., Ramadan, M. F., Abd El-Sattar, E. S., Siam, A. A. H., ... & Elmahallawy, E. K. (2022). Effect of fermented camel milk containing pumpkin seed milk on the oxidative stress induced by carbon tetrachloride in experimental rats. *Fermentation*, 8(5), 223.  
<https://doi.org/10.3390/fermentation8050223>
- Sharma, P., Kaur, G., Kehinde, B. A., Chhikara, N., Panghal, A., & Kaur, H. (2020). Pharmacological and biomedical uses of extracts of pumpkin and its relatives and applications in the food industry: A review. *International Journal of Vegetable Science*, 26(1), 79–95.  
<https://doi.org/10.1080/19315260.2019.1606130>
- Shaw, H. (2021, December 20). Mexican Pipian verde. *Hunter Angler Gardener Cook*.  
<https://honest-food.net/pipian-verde-recipe/>
- Singh, A., & Kumar, V. (2024). Pumpkin seeds as nutraceutical and functional food ingredient for future: A review. *Grain & Oil Science and Technology*, 7(1), 12–29.  
<https://doi.org/10.1016/j.gaost.2023.12.002>
- Soto-Vaca, A., Gutierrez, A., Losso, J. N., Xu, Z., & Finley, J. W. (2012). Evolution of phenolic compounds from color and flavor problems to health benefits. *Journal of Agricultural and Food Chemistry*, 60(27), 6658–6677.  
<https://doi.org/10.1021/jf300861c>
- Spence, C. (2021). What is the relationship between the presence of volatile organic compounds in food and drink products and multisensory flavour perception? *Foods*, 10(7), 1570.  
<https://doi.org/10.3390/foods10071570>
- Spence, C., & Wang, Q. J. (2019). Sensory expectations elicited by the sounds of opening the packaging and pouring a beverage. *Food Quality and Preference*, 71, 106–113.  
<https://doi.org/10.1016/j.foodqual.2018.06.006>
- Su, G., Sun-Waterhouse, D., Zhao, Y., He, W., & Zhao, M. (2019). Flavor enhancement induced by taste–odor interactions.
- Syed, Q. A., Akram, M., & Shukat, R. (2019). Nutritional and therapeutic importance of the pumpkin seeds. *Biomedical Journal of Scientific & Technical Research*, 21(2), 15771–15773.  
<https://doi.org/10.26717/bjstr.2019.21.003586>
- Szczesniak, A. S. (2002). Texture is a sensory property. *Food Quality and Preference*, 13(4), 215–225.  
[https://doi.org/10.1016/S0950-3293\(01\)00039-8](https://doi.org/10.1016/S0950-3293(01)00039-8)
- Tamboli, F. A., Zade, M. S., Salunkhe, A. A., Kore, M. D., More, A. D., & Ghadge, Y. R. (2023). Intellectual property rights (IPR): An overview. *International Journal of Pharmaceutical Chemistry and Analysis*, 10(3), 156–163.  
<https://doi.org/10.18231/j.ijpca.2023.028>
- Telang, P. S. (2013). Vitamin C in dermatology. *Indian Dermatology Online Journal*, 4(2), 143–146.  
<https://doi.org/10.4103/2229-5178.110593>

- Vermunt, S. H. F., Pasman, W. J., Schaafsma, G., & Kardinaal, A. F. M. (2003). Effects of sugar intake on body weight: a review. *Obesity Reviews*, 4(2), 91–99.  
<https://doi.org/10.1046/j.1467-789X.2003.00102.x>
- Wang, H. (2021). A review of the effects of collagen treatment in clinical studies. *Polymers*, 13(22), 3868.  
<https://doi.org/10.3390/polym13223868>

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