

A Comparative Analysis of Nutritional Content in Fresh and Frozen Fruits and Vegetables

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ABSTRACT

This research paper provides a comparative examination of the nutritional composition of fresh and frozen fruits and vegetables, with the objective of clarifying their individual roles in promoting a nutritious diet. The nutritional value and potential health advantages of fresh food have been widely acknowledged, although frozen alternatives have become increasingly popular due to their convenience and prolonged shelf life. The alteration in eating patterns necessitates a thorough investigation of the extent to which frozen fruits and vegetables maintain similar nutritional content as their fresh counterparts. This study conducts a comprehensive analysis of relevant scholarly literature and empirical evidence to investigate and compare essential elements, including vitamins, minerals, fibre, and antioxidants, in fresh and frozen food products. This paper also examines the various factors that impact nutrient retention during the processes of freezing and storage, as well as the potential implications of these factors on health outcomes. The results of this study enhance our comprehension of the nutritional disparities between fresh and frozen produce, thereby enabling customers to make well-informed decisions on their dietary preferences.

Key Words : Nutritional Content, Fresh Fruits and Vegetables, Frozen Fruits and Vegetables, Vitamins, Minerals, Antioxidants, Dietary Choices

INTRODUCTION

Fresh fruits and vegetables are widely acknowledged as essential elements of a nutritious diet because of their abundant nutritional content and potential positive effects on health (Slavin and Lloyd, 2012). On the other hand, frozen produce has experienced a surge in popularity due to its convenience, since it provides an extended shelf life and less time required for preparation. The alteration in eating patterns necessitates a thorough investigation of the extent to which frozen fruits and vegetables maintain similar nutritional content as their fresh counterparts. In order to make well-informed dietary decisions and advance public health, it is imperative to possess a comprehensive comprehension of the nutritional disparities between fresh and frozen produce. Fresh produce is frequently preferred due to its perceived

sense of freshness and flavour. However, frozen alternatives provide ease and year-round accessibility, rendering them an appealing option for individuals with hectic schedules or restricted availability of fresh produce (Rickman *et al.*, 2007). Nevertheless, there have been expressed concerns pertaining to the potential depletion of nutrients that may occur during the refrigeration and preservation procedures. According to García-Alonso *et al.* (2003), empirical evidence indicates that several vitamins, notably vitamin C and certain B vitamins, might experience degradation as a result of various conditions, including exposure to light, heat, and oxygen. Notwithstanding these apprehensions, empirical data indicates that frozen fruits and vegetables have the capacity to preserve a substantial proportion of their initial nutritious content, rendering them a feasible alternative for adhering to dietary guidelines (Willet, 2003).

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The objective of this study is to conduct a thorough examination of the nutritional composition of both fresh and frozen fruits and vegetables. This study will analyse and compare essential elements, including vitamins, minerals, fibre, and antioxidants, in fresh and frozen variants by reviewing current literature and empirical data. Furthermore, this paper will examine the various aspects that impact nutrient retention during the process of freezing, as well as the potential consequences for health outcomes. The outcomes of this research will enhance comprehension of the nutritional disparities of fresh and frozen produce, thereby empowering customers to make well-informed dietary choices.

METHODOLOGY

The methodology involved an extensive review of existing literature related to the nutritional content of fresh and frozen fruits and vegetables. Various databases such as PubMed, Google Scholar, and Web of Science were searched using keywords including “fresh fruits and vegetables,” “frozen fruits and vegetables,” “nutritional content,” and “nutrient retention.” Relevant studies published in peer-reviewed journals, books, and reports were identified and analyzed to gather information on the nutrient composition of fresh and frozen produce, as well as factors influencing nutrient retention during freezing and storage.

RESULTS AND DISCUSSION

Nutritional Composition of Fresh Fruits and Vegetables:

The nutritional density of fresh fruits and vegetables is widely recognised, as they offer vital vitamins, minerals, fibre, and antioxidants that are crucial for maintaining good health (Liu, 2004). Based on data obtained from the United States Department of Agriculture (USDA) National Nutrient Database, the subsequent table illustrates the nutritional composition of specific fresh fruits and vegetables per 100 grammes (Table 1).

Table 1 : Nutritional composition of specific fresh fruits and vegetables per 100 grammes				
Nutrient	Apples	Bananas	Carrots	Spinach
Vitamin C (mg)	4.6	8.7	5.9	28.1
Vitamin A (IU)	54	64	16706	9377
Fiber (g)	2.4	2.6	2.8	2.2
Potassium (mg)	107	358	320	558
Calcium (mg)	6	5	33	99

The aforementioned numbers underscore the wide array of nutrients that are plentiful in fresh fruits and vegetables. As an illustration, carrots exhibit a notable abundance of vitamin A, predominantly in the form of beta-carotene, which assumes a pivotal duty in maintaining optimal visual health and bolstering immune system functionality (Yeum and Russell, 2002). Spinach is notable for its elevated concentration of vitamin C, a crucial antioxidant that facilitates the synthesis of collagen and enhances immune system functionality (Padayatty and Levine, 2016). Moreover, it is worth noting that both bananas and spinach are considered to be highly beneficial sources of potassium, an essential electrolyte that plays a crucial role in the maintenance of fluid equilibrium, muscle performance, and the regulation of blood pressure (Whelton *et al.*, 2017).

Fresh fruits and vegetables provide a high amount of dietary fibre, which not only provides vitamins and minerals but also aids in maintaining digestive health and regulating blood sugar levels (Slavin, 2005). One example of prominent sources of dietary fibre is apples and carrots, which contain roughly 2.4 grammes and 2.8 grammes per 100 grammes, respectively. The inclusion of a varied range of fresh fruits and vegetables in an individual's dietary regimen promotes a comprehensive consumption of vital nutrients, hence bolstering overall physical and mental health.

Nutrient Retention in Frozen Fruits and Vegetables:

The process of freezing is a commonly employed technique for preserving fruits and vegetables, with the objective of maintaining their nutritional content and prolonging their shelf life (Bernaert *et al.*, 2017). Nevertheless, the process of freezing can have an effect on the preservation of some nutrients, specifically vitamins that are susceptible to heat and oxidation. The subsequent table displays the mean nutrient retention rates in several frozen fruits and vegetables in comparison to their fresh counterparts, as determined by a range of research.

The Table 2 demonstrates that although freezing can result in a certain degree of nutritional loss, a significant proportion of vital vitamins and minerals are preserved at comparatively elevated concentrations. According to Rickman *et al.* (2007), frozen fruits and vegetables generally preserve approximately 70-90% of the vitamin C content present in fresh products. In frozen cultivars, vitamin A, which plays a vital role in maintaining visual

Table 2 : Nutrient retention rates in several frozen fruits and vegetables

Nutrient	Fresh (%)	Frozen (%)
Vitamin C	100	70-90
Vitamin A	100	80-95
Fiber	100	90-95
Potassium	100	90-100
Calcium	100	90-95

health and immunological function, is conserved at levels ranging from 80-95% (Bernhardt *et al.*, 2007). Frozen produce retains fibre, a crucial element for maintaining digestive health, with rates ranging from 90% to 95%, in comparison to fresh produce (Rickman *et al.*, 2007). According to Bernhardt *et al.* (2007), frozen fruits and vegetables have been found to possess high retention rates of minerals such as potassium and calcium, which are crucial for a range of physiological activities including nerve transmission and bone health. According to Rickman *et al.* (2007), frozen produce has a higher retention of potassium, with levels ranging from 90% to 100%, in comparison to fresh produce. The results of this study indicate that although freezing may lead to a certain degree of nutrient depletion, the nutritional consequences are negligible. Consequently, frozen fruits and vegetables continue to serve as significant reservoirs of vital vitamins, minerals, and dietary fibre.

Comparative Analysis of Nutritional Content:

Extensive research has been undertaken to examine and contrast the nutritional composition of fresh and frozen fruits and vegetables, with the objective of elucidating potential disparities in their nutrient profiles. A comparative examination of major nutrients in selected fresh and frozen produce is presented in the Table 3.

Table 3 : A comparative examination of major nutrients in selected fresh and frozen produce

Nutrient	Fresh (%)	Frozen (%)	Difference (%)
Vitamin C	100	85-95	5-15
Vitamin A	100	85-95	5-15
Fiber	100	90-95	5-10
Potassium	100	90-100	0-10
Calcium	100	90-95	5

The presented data provides evidence that although there exist slight variations in nutrient retention between fresh and frozen food, the overall nutritional composition stays reasonably comparable. According to Rickman *et*

al. (2007), frozen fruits and vegetables exhibit a higher retention rate of 85-95% for vitamin C and vitamin A, which are crucial antioxidants, in comparison to their fresh counterparts. Frozen food maintains a high level of fibre, which is crucial for maintaining digestive health, with levels ranging from 90-95% (Rickman *et al.*, 2007). According to Bernhardt *et al.* (2007), frozen fruits and vegetables demonstrate a retention rate of approximately 90-100% in potassium, a vital element for maintaining heart health and muscle function, when compared to their fresh counterparts. Calcium, a crucial element for maintaining bone health and neurological function, exhibits little disparities between fresh and frozen types, with frozen food retaining 90-95% of its calcium content (Bernhardt *et al.*, 2007). The comparison investigation indicates that although there may be minor differences in the amount of nutrients retained in fresh and frozen fruits and vegetables, both types still serve as significant sources of vital vitamins, minerals, and fibre.

Factors Influencing Nutrient Retention:

Several factors influence the retention of nutrients in frozen fruits and vegetables, affecting their overall nutritional quality. The Table 4 summarizes key factors and their impact on nutrient retention:

These factors collectively influence the nutritional quality of frozen fruits and vegetables, emphasizing the importance of proper processing, handling, and storage practices to maximize nutrient retention.

Implications for Health and Dietary Choices:

The importance of health and nutritional choices is underscored by the comparative examination of fresh and frozen fruits and vegetables. Although both types of produce provide essential nutrients, each possesses unique benefits that can impact dietary choices. According to Rickman *et al.* (2007), frozen fruits and vegetables offer convenience and an extended shelf life, hence facilitating persons in meeting their recommended fruit and vegetable consumption. This is particularly beneficial during seasons when fresh options may be scarce or costly. Moreover, the technique of freezing can effectively maintain the nutritional composition, enabling consumers to savour a diverse array of vital vitamins, minerals, and fibre throughout the year (Bernaert *et al.*, 2017).

Conversely, fresh fruits and vegetables are frequently favoured due to their apparent youthfulness,

Table 4 : Key factors and their impact on nutrient retention

Factor	Influence on Nutrient Retention
Freezing Method	Different freezing methods, such as flash freezing or IQF (individually quick frozen), can affect the rate of nutrient retention. Flash freezing tends to preserve nutrients more effectively due to its rapid cooling process (Bernaert <i>et al.</i> , 2017).
Blanching	Blanching, a pre-freezing treatment involving brief exposure to hot water or steam, can deactivate enzymes that cause nutrient degradation. While blanching may lead to some nutrient loss, it can help preserve the overall quality of frozen produce (Bernaert <i>et al.</i> , 2017).
Storage Conditions	Storage temperature and packaging materials play a crucial role in maintaining the nutritional integrity of frozen fruits and vegetables. Proper storage at optimal temperatures, typically below 0°C, helps minimize nutrient degradation over time (Bernaert <i>et al.</i> , 2017).
Selection of Produce	The selection of ripe and high-quality produce prior to freezing can impact the initial nutrient content and subsequent retention during freezing and storage. Choosing fresh and ripe fruits and vegetables ensures higher nutrient density in frozen varieties (Rickman <i>et al.</i> , 2007).
Exposure to Light, Air, and Heat	Exposure to light, air, and heat during processing, packaging, and storage can accelerate nutrient degradation in frozen produce. Proper handling and packaging techniques, such as vacuum sealing, can help minimize exposure to these factors and preserve nutrient content (Bernaert <i>et al.</i> , 2017).

flavour, and consistency. According to Slavin (2005), these products may also provide specific benefits in terms of sensory appeal and culinary variety, which can promote increased consumption among those who prioritise these aspects in their dietary decisions. The inclusion of both fresh and frozen food in an individual's dietary regimen can offer a wide range of essential nutrients, while also catering to personal preferences and lifestyle considerations. When choosing between fresh and frozen products, consumers can make well-informed dietary decisions by taking into account aspects such as availability, price, and personal taste preferences. The presence of both fresh and frozen fruits and vegetables affords consumers the opportunity to embrace a versatile approach to their eating habits, so guaranteeing sufficient nutrient consumption and fostering holistic health and wellness.

Conclusion:

The examination of the nutritional composition of fresh and frozen fruits and vegetables provides valuable insights into their individual roles in promoting a nutritious dietary regimen. While both types of produce provide essential nutrients, they also provide distinct benefits and factors to consider for consumers.

According to Rickman *et al.* (2007), frozen fruits and vegetables offer convenience and year-round accessibility, hence facilitating persons in meeting their nutritional needs for vital vitamins, minerals, and fibre. Although frozen produce experiences slight nutrient losses throughout the process of freezing and storage, it nevertheless preserves a substantial amount of its initial

nutritional content. This characteristic makes it a viable option for individuals seeking to maintain a nutritious diet (Bernaert *et al.*, 2017).

In contrast, fresh fruits and vegetables are typically preferred due to their perceived attributes of freshness, taste, and sensory appeal (Slavin, 2005). Additionally, these products may provide specific benefits in terms of their culinary adaptability and pleasurability, hence promoting increased consumption among persons who prioritise these aspects in their dietary decisions. The selection between fresh and frozen fruit is contingent upon a multitude of aspects, encompassing the accessibility, cost-effectiveness, and individual inclinations. Individuals can optimise their nutritional intake and benefit from the convenience and flexibility of both fresh and frozen fruits and vegetables by including a combination of these options in their meals. Additional investigation is necessary to examine the most effective freezing procedures, storage situations, and processing methods in order to improve the nutritional value of frozen food products and advance public health.

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