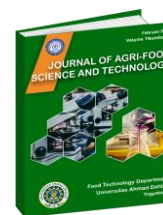


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# Enriched of Orange Jam (Marmalade) with Vitamin C

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### ABSTRACT

*This study explores the enrichment of orange jam, also known as marmalade, with vitamin C. Orange jam is a popular preserve enjoyed worldwide, prized for its tangy flavor and versatility. However, the conventional processing methods involved in its production may lead to a loss of essential nutrients, including vitamin C. To address this issue, the enrichment of orange jam with vitamin C is proposed to enhance its nutritional value. Various techniques can be employed to enrich orange jam with vitamin C, including fortification during the manufacturing process or through the addition of vitamin C-rich ingredients such as citrus fruits or supplements. Additionally, the stability of vitamin C in jam formulations must be considered to ensure its efficacy throughout the product's shelf life. The enrichment of orange jam with vitamin C offers numerous benefits, including enhancing its nutritional profile, boosting consumer health, and potentially extending its market appeal. Furthermore, the addition of vitamin C may contribute to the preservation of the jam by acting as an antioxidant, thereby extending its shelf life. In conclusion, enriching orange jam with vitamin C presents a promising opportunity to enhance its nutritional value and appeal to health-conscious consumers. Further research is warranted to optimize enrichment techniques, ensure stability, and evaluate the sensory attributes of fortified orange jam to meet consumer expectations and preferences. This research is contributing to explore the benefit of vitamin c addition on orange jam.*

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## 1. INTRODUCTION

Orange jam, also known as marmalade, is a beloved spread enjoyed by many around the world. Traditionally made from oranges, sugar, and water, this sweet and tangy preserve is a staple in breakfasts, snacks, and desserts (Afoakwah et al., 2023; Atkinson et al., 2008; Joye, 2019). In recent years, there has been a growing interest in enhancing the nutritional value of foods, including jams and preserves. One such enhancement is the enrichment of orange jam with vitamin C, a vital nutrient known for its numerous health benefits (Molfetta et al., 2022; Ozkan et al., 2021; Son, 2022).

Vitamin C, also known as ascorbic acid, is a water-soluble vitamin found in various fruits and vegetables, particularly citrus fruits like oranges. It plays a crucial role in supporting the immune system, promoting wound healing, and acting as an antioxidant that helps protect cells from damage caused by free radicals. While oranges naturally contain vitamin C, the processing involved in making jam can lead to some loss of this nutrient. By enriching orange jam with additional vitamin C, consumers can enjoy not only the delicious flavor of the fruit but also the added health benefits (Hossain et al., 2015; Nelson et al., 2014; Ozkan et al., 2021).

In this paper, we explore the process of enriching orange jam with vitamin C, including the methods used, the potential health benefits, and considerations for manufacturers and consumers. We will also discuss the importance of preserving the natural taste and texture of orange jam while incorporating this beneficial nutrient. Through this exploration, we aim to highlight the potential of fortified orange jam as a nutritious and flavorful addition to the diet (Kim et al., 2017; Salem et al., 2018; Yun et al., 2023).

Vitamin C, or ascorbic acid, plays a crucial role in maintaining overall health due to its various functions within the body. As a potent antioxidant, it helps combat oxidative stress, thereby reducing the risk of chronic diseases such as heart disease and cancer (Carr & Maggini, 2017). Additionally, vitamin C is essential for collagen synthesis, which is vital for skin health, wound healing, and maintaining the integrity of blood vessels (Ashraf et al., 2012; Nader et al., 2014; Pullar et al., 2017). Furthermore, it supports the immune system by enhancing the function of immune cells and promoting the production of antibodies (Hemilä, 2017). It's important to include adequate sources of vitamin C in your diet to maintain optimal health. Vitamin C values can vary depending on factors such as ripeness, growing conditions, and preparation methods. The Recommended Dietary Allowance (RDA) for vitamin C varies based on age, sex, and life stage. The National Institutes of Health (NIH) recommendations ensure adequate intake of vitamin C to support overall health and well-being. It's important to obtain vitamin C from a balanced diet whenever possible, including fruits and vegetables such as oranges, strawberries, kiwi, bell peppers, and broccoli. If considering supplementation, it's advisable to consult with a healthcare professional, especially when considering doses above the RDA.

## **2. MATERIALS AND METHODS**

This scientific article is a review article compiled based on related scientific articles published in the last 10 years. The data collection technique entailed performing an intensive search in Scopus-indexed journals, employing the keywords "Orange Jam". The search could be confined to the article's abstract, title, and keywords. The articles included in the present study were carried out from 2005 to 2024.

## **3. RESULT AND DISCUSSION**

### **3.1. Benefits of Vitamin C-Enriched Orange Jam**

By adding vitamin C to orange jam, its nutritional profile is significantly enriched. Oranges are already a good source of vitamin C, but during processing into jam, some of the vitamin content may be lost (Carr & Maggini, 2017). Fortifying orange jam with additional vitamin C ensures that consumers receive a substantial amount of this essential nutrient, which plays a pivotal role in maintaining various physiological functions. Vitamin C, or ascorbic acid, is indispensable for collagen synthesis, a process vital for skin health, wound healing, and maintaining the integrity of blood vessels. It also enhances iron absorption from plant-based foods, which can help prevent anemia, especially in populations with limited access to heme iron sources. Furthermore, vitamin C is known for its role in bolstering immune function by supporting the activity of white blood cells and acting as a potent antioxidant, neutralizing harmful free radicals that contribute to cellular damage. Enriching orange jam with vitamin C

not only leverages the natural association of citrus flavors with this nutrient but also offers a convenient, palatable way for individuals to meet their daily nutritional requirements, thereby promoting overall health and well-being. This approach aligns with broader public health strategies aimed at addressing nutrient deficiencies through fortified foods. (Hampl et al., 2004).

Vitamin C is renowned for its role in bolstering the immune system. It stimulates the production and function of white blood cells, which are essential for fighting off infections and diseases (Hemilä, 2017; Hemilä & Chalker, 2023). Incorporating vitamin C-enriched orange jam into one's diet can help maintain optimal immune function, potentially reducing the risk and severity of infections such as the common cold and flu (Carr & Maggini, 2017). This is particularly beneficial during times of increased susceptibility to illness, such as the cold winter months or periods of heightened stress.

Vitamin C also acts as a potent antioxidant, scavenging free radicals and neutralizing oxidative stress within the body (Carr & Maggini, 2017). Free radicals are unstable molecules that can cause cellular damage, leading to various chronic diseases and accelerating the aging process. By incorporating vitamin C-enriched orange jam into their diet, individuals can benefit from its antioxidant properties, helping protect cells and tissues from oxidative damage and promoting overall health and longevity (Carr & Maggini, 2017; Mundi & Aluko, 2014; Yıldız et al., 2015). By fortifying orange jam with vitamin C, not only is its nutritional value enhanced, but it also offers immune-boosting properties and potential antioxidant benefits, making it a healthier and more appealing option for consumers.

### 3.2. Production Process

The production of vitamin C-enriched marmalade involves a series of carefully controlled steps to ensure quality and nutritional content (Anonymous, 2009). The process begins with the selection of ripe, high-quality fruits, such as oranges and lemons, which are chosen for their balance of sweetness and acidity. These fruits are then thoroughly washed to remove any dirt or pesticide residue. Depending on the type of fruit, it may be necessary to peel the fruit and cut it into smaller pieces, although in some cases, the peel is included to take advantage of its natural pectin content. Once the fruit is prepared, it is ground by crushing or mashing it to form a fruit pulp, which is then heated to begin breaking down the fruit structure and releasing the natural pectin. At this stage, sugar is added in a typical 1:1 ratio (fruit to sugar), although this can be adjusted based on the natural sweetness of the fruit. The mixture is then brought to a boil, stirring constantly to prevent it from burning. The boiling continues until the mixture reaches a temperature of 105 °C (220 °F), which is the point at which the fruit and sugar combine to form marmalade. Figure 1 is present the methods of vitamin C-enriched marmalade.

Vitamin C enrichment is done after boiling, just before the marmalade is poured into the jars. Ascorbic acid (vitamin C) is added to the mixture in powdered form, usually around 500 mg per 100 g of marmalade. It is essential to add vitamin C at this stage to reduce its degradation due to heat. The mixture is then stirred well to ensure even distribution of vitamin C. After enrichment, the jam is poured into sterilized jars, leaving a small space at the top. The rims of the jars are carefully wiped before closing them with sterilized lids. For further preservation, the jars can be sterilized by placing them in boiling water for around 10 minutes, which extends the shelf life of the jam. After closing, the jars are left to cool at room temperature. During cooling, a vacuum seal should form, indicated by the lids making a “pop” sound. The marmalade is then ready to be stored in a cool, dark place, where it can be kept for up to a year if properly sealed and pasteurized. To ensure that the product meets quality standards, testing is carried out on pH levels, sugar content (°Brix) and vitamin C. After passing these tests, the jars are labelled with relevant information, including ingredients, production

date and best before use.

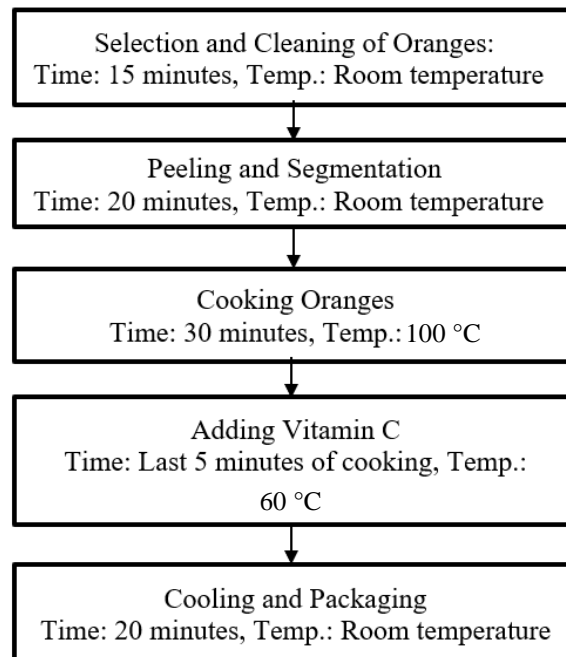


Figure 1. The methods of vitamin C-enriched marmalade (Anonymous, 2009).

### 3.3. Techniques for Incorporating Vitamin C

Incorporating powdered vitamin C (ascorbic acid) into a jam mixture involves several precise steps to preserve its nutritional and functional qualities. The use of high-quality powdered vitamin C is essential, as impurities or variations in quality can impact the final product's effectiveness and safety. The vitamin C powder should be introduced gradually to the cooking mixture, accompanied by continuous stirring to prevent clumping, which could lead to uneven distribution and textural inconsistencies. The timing of the addition is a critical factor; adding the vitamin C towards the end of the cooking process minimizes its exposure to prolonged heat, which is known to degrade its potency and reduce its antioxidant properties. Uniform mixing ensures that the vitamin C is evenly distributed throughout the jam, maintaining a consistent flavor and texture while maximizing its health benefits. Furthermore, monitoring the pH level of the jam is vital to ensure that the addition of vitamin C does not significantly alter the product's acidity. Such changes could affect both the sensory properties of the jam, such as taste, and its preservation, as pH plays a key role in inhibiting microbial growth. Adhering to these steps not only enhances the nutritional value of the jam but also ensures a high-quality, consumer-friendly product that aligns with food safety and industry standards (Hui & Sherkat, 2006).

### 3.4. Market Trends and Consumer Demand

Market analysis for vitamin C-enriched orange jam involves examining factors such as consumer demand, trends, competition, and potential growth opportunities. Here's a breakdown:

1. **Growing Interest in Functional Foods and Fortified Products:** Consumers are increasingly seeking out foods that offer additional health benefits beyond basic nutrition. Functional foods, which provide health benefits beyond basic nutrition, have been gaining popularity. Fortified products, enriched with vitamins, minerals, or other nutrients, are also in demand as consumers become more health-conscious.

2. **Consumer Preferences for Healthier Food Options:** With rising awareness of the importance of a balanced diet and its impact on overall health, consumers are actively seeking healthier food options (Kussmann et al., 2023). This includes products that are low in sugar, fat, and calories, and those that offer added nutritional benefits such as vitamins and antioxidants.
3. **Market Potential for Vitamin C-Enriched Orange Jam:**
  - **Target Audience:** The target market for vitamin C-enriched orange jam would include health-conscious consumers, fitness enthusiasts, parents looking for nutritious options for their children, and individuals with specific dietary needs such as those with vitamin deficiencies (Aboje et al., 2021; Iwatani & Yamamoto, 2019; Niyibituronsa et al., 2019).
  - **Demand:** There is likely to be a significant demand for vitamin C-enriched orange jam, given the popularity of functional foods and the widespread knowledge of the health benefits of vitamin C. Consumers may be drawn to the product for its immune-boosting properties, as well as its potential to support skin health and collagen production.
  - **Competitive Landscape:** While traditional orange jams are widely available, the market for specifically vitamin C-enriched variants may still be relatively niche (Nigam, 2015). However, competition may arise from other functional spreads and jams enriched with various nutrients.
  - **Distribution Channels:** The product could be distributed through various channels such as supermarkets, health food stores, online retailers, and specialty stores catering to health-conscious consumers (Hoang, 2023).
  - **Price Point:** Pricing may be slightly higher compared to regular orange jam due to the added vitamin C content and positioning as a functional food product.
  - **Marketing and Positioning:** Emphasizing the health benefits of vitamin C and the natural goodness of oranges can be key in marketing the product (Knežević et al., 2021). Highlighting its immune-boosting properties, suitability for various dietary needs, and versatility in usage (e.g., on toast, in baking, as a topping) can appeal to different consumer segments.

By analyzing key factors such as consumer preferences, market trends, and nutritional awareness, businesses can gain valuable insights into the market potential for vitamin C-enriched orange jam. The growing demand for functional foods, driven by increasing consumer interest in health and wellness, presents a unique opportunity to position vitamin C-enriched jam as a convenient and appealing product. Understanding demographic trends, such as the rise in health-conscious younger consumers and aging populations seeking immune-boosting foods, can help businesses tailor marketing strategies to meet these specific needs. Additionally, evaluating competitors' offerings and identifying gaps in the market can guide product differentiation and innovation, ensuring that the fortified jam stands out in a crowded marketplace. Furthermore, leveraging the global trend toward natural and clean-label products, businesses can emphasize the use of high-quality, sustainably sourced ingredients in their marketing campaigns. By integrating these insights, companies can not only capitalize on the trend toward healthier food options but also establish a strong foothold in the functional foods segment, driving both consumer trust and brand loyalty.

### 3.5. Health Considerations

Consuming too much vitamin C can have risks and potential side effects, although it is generally considered safe in moderate amounts as shown in Table 1. Common side effects of excessive vitamin C intake include gastrointestinal disturbances such as diarrhea, abdominal cramps, and nausea, which are caused by the osmotic effects of unabsorbed ascorbic acid in the gastrointestinal tract. Over time, consistently high doses may contribute to the formation of kidney stones, particularly in individuals predisposed to hyperoxaluria, as excess vitamin C is

metabolized into oxalate. Furthermore, excessive vitamin C can interfere with certain medical conditions or medications, such as by enhancing iron absorption in individuals with iron overload disorders like hemochromatosis. Despite these risks, moderate consumption of vitamin C, through dietary sources or supplements within recommended daily allowances, remains safe and beneficial for the majority of individuals. Therefore, it is crucial for consumers to balance their intake to maximize the health benefits of vitamin C while avoiding potential adverse effects.

Table 1. Some risks and potential side effects of increasing vitamin C intake.

Risk/Side Effect	Description	References
Digestive Disturbances	Excessive intake of vitamin C can cause gastrointestinal disturbances such as diarrhea, nausea, and abdominal cramps.	(Hemilä & Chalker, 2023)
Kidney Stones	High doses of vitamin C may increase the risk of kidney stone formation, especially in individuals predisposed to kidney stone formation or with pre-existing kidney conditions.	(Fattah et al., 2014)
Iron Overload	Vitamin C enhances iron absorption. Consuming large amounts of vitamin C along with iron supplements or high-iron foods can lead to iron overload, particularly in individuals with hemochromatosis.	(Hunt, 2003)
Risk of Oxalate Formation	Excessive vitamin C intake can increase the production of oxalate, potentially leading to the formation of oxalate kidney stones.	(Agrawal et al., 2016)

#### 4. CONCLUSIONS

The enrichment of orange jam, also known as marmalade, with vitamin C offers numerous benefits both in terms of flavor and nutrition. By fortifying this beloved spread with additional vitamin C, we enhance its nutritional profile, providing consumers with a healthier option. Vitamin C, also known as ascorbic acid, is a vital nutrient that supports immune function, collagen production, and overall health. Oranges are already a rich source of vitamin C, but by enriching orange jam with this essential nutrient, we can further boost its health benefits. Moreover, the addition of vitamin C to orange jam can extend its shelf life by acting as a natural preservative, thereby reducing food waste and ensuring that consumers can enjoy its delicious taste for longer periods.

Furthermore, the enhanced orange jam can cater to a wider demographic, including individuals who may have dietary restrictions or preferences that limit their intake of fresh fruits. With its convenient and accessible form, enriched orange jam provides an easy way for people to incorporate essential nutrients into their daily diet. Enriching orange jam with vitamin C not only enhances its nutritional value but also contributes to its flavor and longevity. It's a win-win situation that offers consumers a delicious and nutritious option for enjoying the goodness of oranges.

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