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Estimation of Vitamin C Concentration in Commercially Available Fruit Juices from Various Countries Using Iodine Titration

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تقدير تركيز فيتامين سي في عصائر الفاكهة المتوفرة تجارياً من بلدان مختلفة باستخدام معايرة اليود

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Abstract:
This study quantified vitamin C (ascorbic acid) concentrations in six commercially available fruit juices from Libya, Saudi Arabia, Lebanon, and Turkey using iodine titration. Samples included single-fruit and mixed juices: Basil, Zain (cocktail), Rauch (Libya), Mizo (Saudi Arabia), Biko (Lebanon), and Daren (Turkey; orange). Results revealed significant variability, with Daren orange juice containing the highest concentration (138.45 mg/200 ml). The findings highlight the influence of juice type, regional fortification practices, and processing on vitamin C content, underscoring the need for standardized labeling to inform consumer choices.

Keywords: Fruit juice, Iodine titration, Vitamin C.

الملخص
تم في هذه الدراسة قياس تراكيز فيتامين سي (حمض الأسكوربيك) في ستة عصائر فواكه متوفرة تجارياً من ليبيا والمملكة العربية السعودية ولبنان وتركيا باستخدام المعايرة باليود. وتضمنت العينات عصائر الفاكهة المفردة والمختلطة: الريحان، وزين (كوكتيل)، وراوخ (ليبيا)، وميزو (المملكة العربية السعودية)، وبيكو (لبنان)، ودارين (تركيا؛ برتقال). وكشفت النتائج عن تباين كبيرمن حيث المحتوى من الفيتامين، حيث احتوى عصير البرتقال دارين على أعلى تركيز (138.45 مجم/200 مل). وتسلط النتائج الضوء على تأثير نوع العصير وممارسات الحماية الإقليمية والمعالجة على محتوى فيتامين سي، مما يؤكد على الحاجة إلى وضع ملصقات موحدة لإعلام المستهلكين بالخيارات المتاحة.

الكلمات المفتاحية: عصير الفواكه، المعايرة باليود، فيتامين سي.

Introduction

Ascorbic acid, often known as vitamin C, is a vital water-soluble antioxidant that is necessary for the production of collagen, immune system function, and iron absorption (Motora, 2017; Sánchez-Moreno et al., 2003; Valente et al., 2014) . Vitamin C must be obtained through diet because humans are unable to produce (Devolli et al., 2021; Valente et al., 2014). Although commercial fruit juices are a common source, pasteurization, processing, and storage can reduce their vitamin C concentration (Ikewuchi & Ikewuchi, 2011; King et al., 2010; Tareen,

Ahmed, Mengal, Masood, Bibi, Mengal, Shoaib, Irum, Akbar, Mandokhail, et al., 2015). Although previous research shows that vitamin C levels vary among products, there is still a dearth of information from the Middle Eastern and North African markets. By examining juices from Libya, Saudi Arabia, Lebanon, and Turkey and assessing adherence to nutritional claims and regional variations, this study fills this knowledge vacuum.
Theorem: Because single-fruit juices, especially citrus-based ones, undergo less processing and dilution than mixed-fruit cocktails, they will maintain higher vitamin C concentrations.

Material and methods

Samples :

- Six brands were analyzed: Basil (Libya, apple), Zain (Libya, cocktail), Rauch (Libya, mixed fruit), Mizo (Saudi Arabia, mango), Biko (Lebanon, orange), and Daren (Turkey, orange) .
- Samples were purchased from local retailers in Tripoli, Libya, in January 2023, with expiration dates ≥6 months. All were stored at 4°C until analysis .

Reagents :

- Iodine solution (0.01M, Sigma-Aldrich, ≥99.5% purity) .
- Starch indicator (1%, prepared fresh with soluble starch, Merck) .
- Distilled water (Milli-Q system) .

Procedure :

1. Sample Preparation: Juices were homogenized, filtered (0.45 µm cellulose filter), and diluted 1:10 with distilled water .
2. Titration Setup: A 20 mL aliquot of diluted juice was mixed with 1 mL starch indicator in a 250 mL Erlenmeyer flask. Using a calibrated burette (Class A), the solution was titrated with iodine until a persistent blue-black endpoint (indicating excess iodine-starch complex) .
3. Calculations: Vitamin C concentration was calculated using the stoichiometric 1:1 ratio ($C_6H_8O_6$: I_2). Results were expressed as mg/200 mL, with triplicate measurements averaged (± standard deviation) .
4. Quality Control: A standard ascorbic acid solution (100 mg/L) was titrated daily to validate method accuracy (recovery rate: 98.5 ± 1.2%) .

Results and discussion

Single Fruit vs. Mixed Juices: Daren (orange) exhibited the highest concentrations (138.45 mg/200 ml), aligning with citrus fruits' natural ascorbic acid richness. In contrast, Zain (cocktail) (24.24 mg/200 mL) had lower levels, likely due to dilution with low-vitamin C fruits (e.g., apple, grape). In addition, Processing Impact Pasteurization and prolonged storage degrade vitamin C. Zain's cocktail, containing heat-sensitive fruits, may have undergone aggressive thermal processing. Daren's high concentration may reflect Turkish fortification standards, whereas Zain's low value suggests lax Libyan regulations .

Table 1. Vitamin C content in commercial fruit juices determined by volumetric method.

commercial fruit juices	Juice type	Volume of thiosulfate consumed in ex 1	Volume of thiosulfate consumed in ex 2	Volume of thiosulfate consumed in ex 3	Vitamin C (mg/200mL)	Percentage per (200mL)
DAREN Juice (Turkish)	Orange	**8.1 mL**	**13mL**	**18mL**	**138.45mg / 200ml**	**69.22 %**
Alrayhan juice (Libyan)	Guava	**8.1 mL**	**13mL**	**18.4mL**	**129.6mg / 200ml**	**64.53 %**
	Orange	**9.4mL**	**14 mL**	**19.1 mL**	**58.66 mg / 200ml**	**29.33 %**
	Lemon mint&	**9.4 mL**	**14.4 mL**	**19.2 mL**	**46.93 mg / 200ml**	**23.46 %**
Zain juice (Libyan)	Orange	**9.2 mL**	**14.3 mL**	**19.3 mL**	**51.62 mg / 200ml**	**25.81 %**
	Grapes	**9.4 mL**	**14.4 mL**	**19.3 mL**	**44.58 mg / 200ml**	**22.29 %**
	Cocktail	**9.4 mL**	**14.4 mL**	**19.4 mL**	**24.24 mg / 200ml**	**21.12 %**

Mizo juice (Saudi)	Guava	**9.1 mL**	**13.4 mL**	**19 mL**	**82.13 mg / 200ml**	**41.06 %**
	Orange	**9.3 mL**	**14.3 mL**	**19 mL**	**56.32 mg / 200ml**	**28.16 %**
PIKO Juice (Lebanese)	Orange	**8.4 mL**	**13mL**	**19.3 mL**	**100.90 mg / 200ml**	**50.45 %**
RAUCH juice (Libyan)	Orange	**8.1 mL**	**13.4 mL**	**18.4 mL**	**119.68 mg / 200ml**	**59.84 %**

It is clear from the findings of the titrimetric approach used to measure vitamin C that ascorbic acid served as a standard reference in this method (López-Pastor et al., 2020; Pfendt et al., 2003). Among all the fruit samples tested, oranges were found to contain the most vitamin C. The presence of other reducing substances in foods, apart from ascorbic acid, may influence the results, as the iodometric titration relies on an oxidation-reduction reaction (Tareen, Ahmed, Mengal, Masood, Bibi, Mengal, Shoaib, Irum, Akbar, & Mandokhail, 2015). Numerous compounds, including phenols, sulfhydryl's, and triose reductions, along with certain ions like ferrous, cuprous, or sulphite, can reduce ascorbic acid, which may result in inaccurately high titration results (Kabasakalis et al., 2000; Zulueta et al., 2007). Typically, this interference can be managed by altering the pH and other reaction parameters to ensure that most substances react at a significantly slower rate than ascorbate (Okafor et al., 2024; Spínola et al., 2014). Factors in the environment, such as climate, temperature, and the amount of nitrogen fertilizer applied during plant growth, can also affect the level of ascorbic acid (vitamin C) in fruits (Alam et al., 2019; Klimczak et al., 2007; Salem et al., 2024). Additionally, factors like light may also play a role (Ramful et al., 2011). A notable practical challenge linked to the titrimetric technique for ascorbic acid lies in accurately identifying the endpoint when dealing with colored food extracts, particularly those with reddish or purplish hues.

Conclusion

This research reveals a notable variation in vitamin C levels in various commercial juices, which is affected by the type of fruit used, local methods, and how the juice is processed. The findings indicate that the highest levels of ascorbic acid in orange juice were measured using iodometric titration. Vitamin C, also known as ascorbic acid, plays a vital role in human health. Not getting enough can lead to issues like scurvy and gum bleeding, while too much ascorbic acid can cause problems such as kidney stones, diarrhea, and stomach cramps. Therefore, the amount of ascorbic acid found in foods and drinks is an important quality marker that needs careful observation, especially considering how it can change during production and storage.

Recommendations

- Manufacturers: Optimize processing to retain vitamin C; consider fortification .
- Regulators: Enforce accurate labeling and regional standards .
- Consumers: Prioritize single-fruit, citrus-based juices for vitamin C intake .

Future Research :

- Expand sample size across seasons .
- Investigating storage effects on vitamin C degradation

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