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Original article

Chemical Characterization of Commercial Fruit Juices: Quantitative Determination of Vitamin C and Major Constituents

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ABSTRACT

This study aimed to evaluate the chemical composition of locally produced canned fruit juices available in Tripoli, Libya, with a focus on vitamin C (ascorbic acid), citric acid, sucrose, sodium chloride, and pH. A total of 15 juice samples representing three local companies were collected and analyzed using standardized titrimetric and density measurement methods. The results indicated considerable variation among samples, which can be attributed to differences in fruit type, processing conditions, and formulation practices. Vitamin C content ranged from 16 to 82 mg/100 mL, with higher levels observed in less processed products. Citric acid concentrations varied between 0.00% and 0.90%, reflecting both natural fruit acidity and possible industrial addition. Sucrose content ranged from 3.21% to 26.78%, highlighting potential nutritional concerns related to high sugar intake. Sodium chloride levels were negligible (≤0.00069%). The pH values ranged from 3.5 to 6.3, indicating acceptable acidity levels for product stability. Overall, the analyzed samples were generally consistent with Codex Alimentarius guidelines; however, the observed variability in sugar content and vitamin C suggests the need for improved quality control and labeling practices. These findings provide useful baseline data on the composition of locally available fruit juices and support the need for continuous monitoring to ensure product quality and consumer awareness.

Introduction

Fruit juices are widely consumed beverages due to their nutritional value and palatability. They are typically produced by extracting liquid from fruits or vegetables and may be processed, preserved, or reconstituted from concentrates [1,2]. Despite their popularity, commercial fruit juices have raised concerns regarding their sugar content and overall nutritional quality [3,4]. Vitamins are essential micronutrients required for normal physiological functions, and their adequate intake is crucial for maintaining human health. Among these, vitamin C (ascorbic acid) is a vital water-soluble vitamin known for its antioxidant properties and its role in various metabolic processes [5,6]. Since the human body cannot synthesize vitamin C, it must be obtained through dietary sources, particularly fruits and vegetables [7,8]. However, the stability of vitamin C in fruit juices can be affected by processing methods and storage conditions, leading to variations in its concentration [4,9]. In addition to vitamin C, organic acids such as citric acid are commonly present in fruit juices. Citric acid is a naturally occurring organic acid found in citrus fruits and plays an important role in determining the acidity, flavor, and stability of juice products [10,11]. It is widely used in the food industry as an acidifying and preservative agent [12,13].

The chemical composition of fruit juices, including vitamin C content, acidity, sugar levels, and salt content, is an important indicator of their nutritional quality and safety. Several studies have reported variations in these components depending on fruit type, processing methods, and storage conditions [14,15,16]. These variations highlight the importance of continuous quality assessment of commercially available juices. However, limited data are available regarding the chemical composition and quality of commercially available fruit juices in local markets, particularly in Libya [16,17]. Therefore, there is a need to evaluate these products to ensure their compliance with international standards such as those established by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) [1].

This study aims to determine the concentration of vitamin C (ascorbic acid) and citric acid, as well as to measure the pH, sugar content, and sodium chloride concentration in locally produced canned fruit juices available in the Libyan market.

Methods

Sample Collection

Fifteen (15) canned juice samples were collected from three local companies in Tripoli from various retail stores (Table 1). All samples were stored at 4°C prior to analysis to preserve their chemical integrity. Each

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measurement was performed in triplicate, and the average values were used for the final calculations to ensure accuracy and statistical reliability [9,13].

Table 1. Samples of locally produced canned juices collected from Tripoli

Samples	Sample Name	Manufacturer	Samples	Sample name	Manufacturer
1	Orange Juice	Rayhan	9	Grape juice	Judi
2	Apple Juice	Rayhan	10	Cocktail juice	Judi
3	Mango Juice	Rayhan	11	Mango juice	Judi
4	Pear Juice	Rayhan	12	Grape juice	Naseem
5	Grape Juice	Rayhan	13	Cocktail juice	Naseem
6	Peach Juice	Rayhan	14	Lemon juice	Naseem
7	Cocktail Juice	Rayhan	15	Pear juice	Naseem
8	Orange Juice	Judi			

Note: Each sample was analyzed in triplicate.

Estimation of Ascorbic Acid (Vitamin C)

The ascorbic acid content in the juice samples was determined using a redox titration with a standard 0.1 N iodine solution and starch as an indicator [8,18]. 10 mL of each juice sample was placed in a conical flask. 3–4 drops of starch indicator were added. The sample was titrated with 0.1 N iodine solution until a permanent blue color appeared, indicating the endpoint. The ascorbic acid content was calculated using:

$$\text{Ascorbic Acid (mg/100mL)} = \frac{\text{V x F x 100}}{\text{Volume of sample}} \quad (1)$$

Where:

- V = Average volume of iodine solution consumed (mL)
- F = Equivalent amount of ascorbic acid per mL of 0.1 N iodine (mg) = 8.807

Acidity Determination

The citric acid content was estimated by acid-base titration using 0.5 M NaOH. The neutralization reaction between citric acid and NaOH was employed [10].

$$\text{Weight of citric acid (g)} = \frac{\text{Molecular Weight of Citric Acid x Volume of NaOH consumed in titration } x \text{ Molarity}}{3} \quad (2)$$

$$\text{Percentage of citric acid} = \frac{\text{Weight of citric acid in the sample}}{\text{Weight of the sample}} \text{x100} \quad (3)$$

Sugar Content Determination

Sugar content was determined using a density-based method. Standard glucose solutions (5–25%) were prepared, and their densities were measured. A calibration curve was plotted, and sample densities were measured to calculate sugar concentration using the standard curve equation [14,15].

Estimation of Sodium Chloride

Sodium chloride content was determined by the Mohr method, which titrates chloride ions with $AgNO_3$ using potassium chromate as an indicator [19].

$$\text{Chloride \%} = \frac{\text{Average volumes of silver nitrate x Normality x 0.0584}}{\text{Sample weight}} \times 100 \quad (4)$$

The endpoint was identified by the formation of a brownish-red silver chromate precipitate.

pH Measurement

pH was measured using a calibrated digital pH meter at room temperature. Measurements were taken directly from the juice samples to assess acidity, which affects product preservation and microbial stability [4].

Results and Discussion

The chemical composition of the 15 locally produced canned fruit juice samples was evaluated in terms of vitamin C, citric acid, sucrose, sodium chloride, and pH. (Table 2) summarizes the quantitative results obtained from the analyses, providing an overview of the variation among samples from different companies.

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Table. 2. Results of Chemical Analyses of Locally Produced Canned Fruit Juice Samples

Samples	Sample type	Company Name	Vitamin C content mg /100 mL	Citric acid ratio %	Sucrose ratio %	sodium chloride ratio %	pH
1	Orange	Rayhan	31.5	0.90	3.21	0	4.4
2	Apple	Rayhan	41	0	18.39	0	4.8
3	Mango	Rayhan	16	0	5.35	0.00020	5.7
4	Pear	Rayhan	37.2	0.29	5.35	0.00041	5.3
5	Grape	Rayhan	77	0.56	15	0	4.4
6	Peach	Rayhan	69	0	8.92	0.00059	6.1
7	Cocktail	Rayhan	19	0	13.92	0.00038	5.5
8	Orange	Judi	39	0	16.07	0.00013	5.1
9	Grape	Judi	18.9	0.70	6.78	0.00069	4.5
10	Cocktail	Judi	38	0.56	10.71	0	5.1
11	Mango	Judi	82	0	13.92	0	5.5
12	Grape	Naseem	72.9	0.22	16.07	0.00020	5.5
13	Cocktail	Naseem	70	0	8.92	0	5.6
14	Lemon	Naseem	34	0.56	26.78	0	3.5
15	Pear	Naseem	51	0.86	11.60	0	6.3

Vitamin C (Ascorbic Acid) Content

The ascorbic acid content in the 15 canned juice samples ranged from 16 to 82 mg/100 mL (Table 2, Figure 1). The highest concentration was observed in sample 11 (Judi Mango Juice) with 82 mg/100 mL, while the lowest was recorded in sample 3 (Rayhan Mango Juice) at 16 mg/100 mL. This variation reflects differences in fruit type, processing methods, and storage conditions. These results are consistent with previous studies on local fruit juices, which reported ascorbic acid concentrations varying widely depending on the fruit source and production techniques [12,16]. Modern processing methods, such as pasteurization, can cause partial degradation of vitamin C, whereas juices processed with minimal heat retain higher levels [4]. Maintaining vitamin C stability is crucial as it acts as an antioxidant and supports immune function [5]. Therefore, juices with higher natural vitamin C content or processed with non-thermal techniques provide greater nutritional value to consumers.

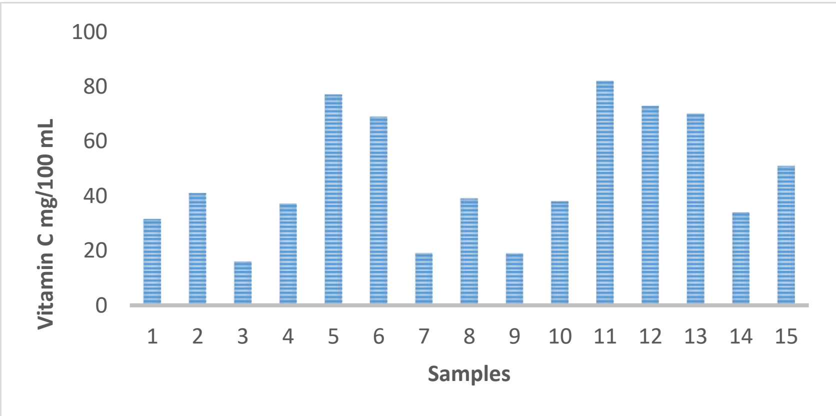

Fig. 1. Vitamin C content (mg/100 ml)

Citric Acid Content

The citric acid content in the analyzed juice samples ranged from 0.00% to 0.90% (Table 2). The highest concentration was observed in sample 1 (Rayhan Orange Juice, 0.90%), whereas some samples, such as sample 2 (Rayhan Apple Juice), contained negligible citric acid. This variation is primarily attributed to differences in fruit types, as citrus fruits naturally contain higher levels of citric acid, and to the possibility of addition during manufacturing to enhance flavor and preserve shelf life [10,16]. Citric acid contributes to the tartness of the juice, supports metabolism, and acts as a natural preservative by lowering pH and inhibiting microbial growth. The measured values were within the permissible limits according to the FAO/WHO Codex standards for fruit juices [1] and are consistent with previous reports on local juices in Libya, which reported citric acid content ranging from 0.16% to 0.47% depending on the producing company [16]. Maintaining appropriate citric acid levels is important not only for taste and quality but also for consumer safety, as it ensures microbial stability without excessive reliance on artificial preservatives.

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Sucrose (Sugar) Content

The sucrose content of the analyzed canned juice samples varied widely, ranging from 3.21% to 26.78% (Table 2, Figure 2). The highest sugar concentration was found in sample 14 (Naseem Lemon Juice, 26.78%), while the lowest was in sample 1 (Rayhan Orange Juice, 3.21%). This variation reflects both the natural sugar content of the fruit and the addition of sweeteners during processing. Higher sucrose levels increase the energy value of the product but may pose nutritional concerns if consumed excessively, particularly for individuals monitoring sugar intake or at risk of obesity and diabetes [16,13]. The measured sugar contents are generally within the acceptable limits for commercial juices, but highlight the need for consumer awareness regarding high-sugar products. Strategies such as reducing added sugar and label transparency can help consumers make healthier choices while still enjoying commercially available juices [4].

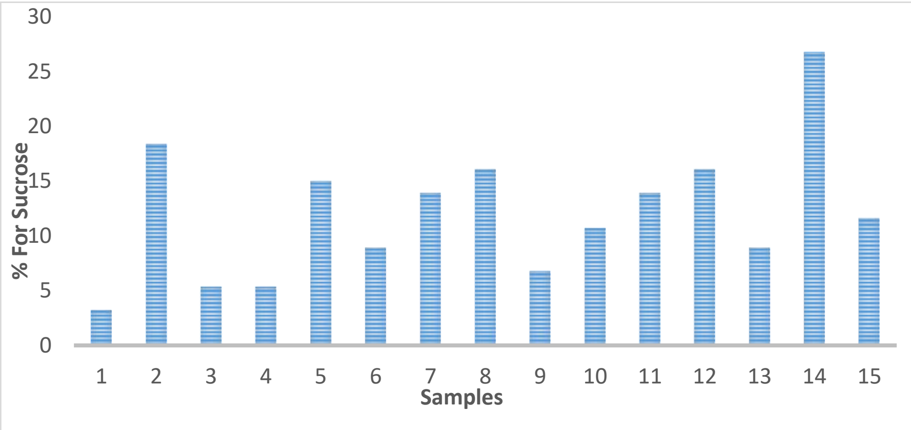

Fig. 2. Sucrose content in the samples

Sodium Chloride (NaCl) Content

The sodium chloride content in the analyzed juice samples was very low, ranging from 0% to 0.00069% (Table 2). Most samples contained negligible amounts, indicating that NaCl is not intentionally added as a preservative in these local canned juices. This minimal sodium content aligns with the modern trend in juice production, where preservation relies primarily on pH control, citric acid, and heat treatment, rather than adding salt. Such practices help maintain the natural taste of the juice while minimizing sodium intake, which is important for public health, particularly in reducing the risk of hypertension [3,16]. The results confirm that all samples meet quality standards regarding sodium content and are consistent with previous findings in local and international studies, which reported low or negligible NaCl levels in fruit juices [11,13].

pH Values

The pH of the analyzed canned juice samples ranged from 3.5 to 6.3 (Table 2, Figure 3), reflecting variations in acidity depending on the fruit type and added components. The lowest pH was observed in sample 14 (Naseem Lemon Juice, 3.5), indicative of its high natural acidity, while the highest pH was recorded in sample 15 (Naseem Pear Juice, 6.3). pH is a critical quality parameter in fruit juices, affecting flavor, chemical stability, and microbial safety. Lower pH values help inhibit microbial growth, contributing to longer shelf life, while higher pH values may require additional preservation measures [3,4]. The observed pH values in this study are within the recommended range for commercially canned juices, confirming that the local products generally meet safety and quality standards. Minor variations between samples may result from differences in fruit composition, processing techniques, or added ingredients, which is consistent with previous studies on local Libyan juices [16,13].

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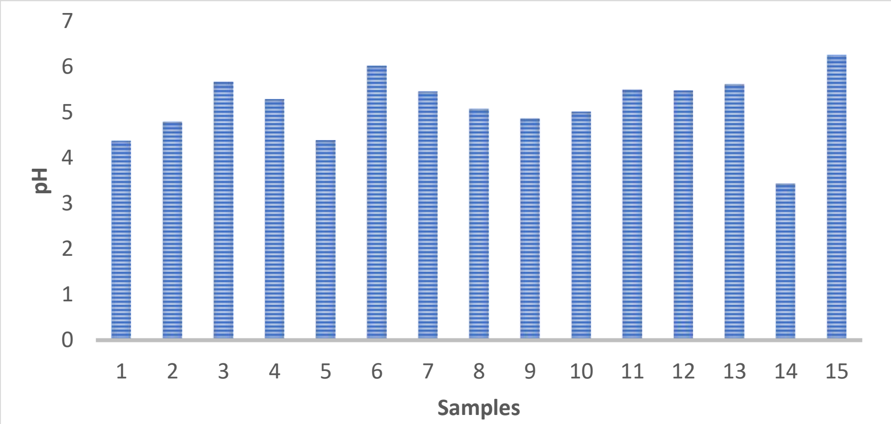

Fig. 3. pH values of the analyzed samples

Conclusion

The study conducted in Tripoli examined fifteen locally produced canned juice samples to assess their nutritional and chemical composition, focusing on vitamin C, citric acid, sucrose, sodium chloride, and pH levels. The findings revealed considerable variation among the samples, largely attributable to differences in fruit type, processing methods, and the use of additives. Vitamin C concentrations varied widely, with higher levels observed in juices that underwent minimal processing, underscoring the impact of manufacturing practices on nutrient retention. Citric acid values fell within expected ranges, playing a dual role in enhancing flavor and contributing to preservation. Sucrose content showed notable variability, with certain samples containing elevated sugar levels, a result that highlights the importance of consumer awareness regarding added sugars in processed beverages. Sodium chloride was present only in negligible amounts, indicating limited relevance to the overall nutritional profile. The pH values of the juices were consistently within safe limits, ensuring both product stability and microbial safety. Collectively, these results emphasize the necessity of stringent quality control measures, transparent nutritional labeling, and careful monitoring of sugar content to enhance the health value of locally produced juices and to support informed consumer choices.

Conflict of interest. Nil

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