Investigation into Ready-to-Serve (RTS) Orange Drinks

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Abstract: The current study, conducted at the Agriculture Research Institute Swat (ARI), aimed to evaluate the quality parameters of locally available orange juice brands in Swat. Physicochemical analysis, encompassing total soluble solids (TSS), moisture content, pH, and acidity, was performed on five samples. Results revealed that Sample II demonstrated the highest TSS at 15.2° Brix, with a moisture content exceeding 89%. pH values ranged from 3.62 to 3.39, and acidity levels varied between 0.28% and 0.38%. In summary, nestle orange juice, based on physicochemical analysis, emerged as the optimal choice for daily consumption due to its superior mineral and nutrient content.

Keywords: orange juice, physicochemical analysis, total soluble solids, moisture content, pH, acidity, Nestle.

INTRODUCTION

The citrus fruit commonly known as orange possesses a palatable flavor profile and is endowed with a substantial concentration of phytochemicals that exhibit protective effects on human health. Notably, it serves as a commendable source of vitamin C, folic acid, potassium, and pectin.The citrus fruit has been extensively studied for its phenolic content, flavonoids, and antioxidant properties, all of which have been documented for their noteworthy biological attributes. These compounds demonstrate the potential to mitigate various diseases in humans, underscoring the therapeutic and preventive properties associated with the consumption of oranges (Tasneem *et al*, 2019).

The sweet orange, scientifically known as Citrus sinensis L., is a perennial tree belonging to the Rutaceae family. This evergreen tree typically reaches a height of 9-10 meters and is known for being the most extensively cultivated fruit globally. Oranges are predominantly cultivated in tropical and sub-tropical regions. The fruit of the orange tree is widely appreciated for its delightful sweetness. People commonly consume the fruit by peeling it or cutting it to avoid the bitter rind, and then eat it in its entirety. Alternatively, the fruit can be processed to extract juice for various applications such as ready-to-serve (RTS) beverages, cordials, nectars, and other related products. (Kanchan SS *et al* 2020).

The benefit of a ready-to-serve (RTS) beverage lies in its inherent readiness for consumption without the necessity of further dilution, unlike concentrated beverages like squash or syrup, which necessitate careful dilution with water prior to consumption (Hemalatha *et al*, 2018).

The primary volatile compounds responsible for imparting flavor to orange juices include esters, aldehydes, alcohols, terpenes, terpenols, and ketones (Salli *et al*, 2004)

Oranges, the social butterflies of the fruit world, are in high demand, not just for their juicy gossip but for their versatility in the beverage scene. Beyond the party scene, oranges have a day job in the industrial and medicinal sectors, leveraging their eye-catching appearance, distinctive charm, and a nutrient-rich profile that makes them the celebrities of the vitamin world 'C,' 'B,' and the A-list ß-carotene, calcium, and phosphorus (Malav *et al*, 2014).

Orange juice confers health advantages and holds potential in the treatment of cancer and heart ailments. It contains essential nutrients such as Vitamin C, Vitamin B6, Potassium, and Magnesium (Kumar *et al*, 2018)

Orange juice is abundant in vitamins, minerals, organic acids, and vital bioactive compounds such as carotenoids, flavonoids, and phenolics. It serves as a potent source of nutrients with significant physiological benefits, contributing to overall health and wellness due to its diverse array of beneficial constituents (Hilal *et al*, 2023).

The crucial elements will not only deliver beverages rich in nutraceuticals but also prolong the shelf life of the created drink due to their antioxidant and antibacterial properties. These vital constituents contribute to preserving the beverage by combatting oxidation and microbial growth, thereby extending its duration of freshness (Hilal *et al,* 2023).

Orange juice (OJ) is replete with a diverse spectrum of robust antioxidants, encompassing flavonoids, with hesperetin and naringenin being the predominant glycosidic forms. Additionally, it contains an assortment of carotenoids, including xanthophylls, cryptoxanthins, and carotenes, along with a noteworthy concentration of vitamin C. Furthermore, the beverage harbors other advantageous phytochemicals, such as folate. Cumulatively, these constituents are postulated to constitute vital elements contributing to the prophylactic attributes of fruits and vegetables in the context of averting cancer and cardiovascular diseases (Adrian *et al,* 2005).

Fruits predominantly consist of water (75-90%), primarily contained within the vacuole, generating turgor within the fruit tissue. Fruit juice is extracted by macerating fresh fruits. The cellular framework of fruits comprises cellulose microfibrils embedded in a non-crystalline matrix of hemicelluloses and pectin. Juice comprises water, pectic compounds, vitamins, minerals, pigments, aromatic and flavor compounds, and soluble solids (sugars and organic acids). Acidity and starch content decline in fruits as ripening progresses, while sugar content escalates. (Surya *et al,* 2020).

The commercial processing of sweet orange fruit yields diverse products such as juice, frozen concentrates, squash, RTS drinks, etc., offering 45 kcal, moderate levels of vitamin C, potassium, bioflavonoids, and folic acid, constituting essential components of breakfast. It serves as a refreshing, hydrating, and invigorating beverage, enhancing health, and meeting nutritional needs (Chauhan *et al*, 2012).

Vitamin C serves as the predominant water-soluble antioxidant, impeding the formation of free radicals within the body and protecting tissues in aqueous surroundings, both intra- and extracellular. It is vital for optimal immune system functionality and aids in preventing colds, coughs, and recurring ear infections. (Mane *et al*, 2019)

The presence of nutrients, antimicrobial agents, oxidation-reduction potential, water content, and pH levels are pivotal determinants impacting juice spoilage, with particular emphasis on the latter two factors. Spoilage of juices leads to product deterioration, manifesting in alterations in appearance, hue, consistency, CO2 emission, loss of clarity, and emergence of undesirable flavors (Rodrigues *et al*, 2022)

Additionally, orange juice serves as a significant dietary reservoir of bioactive substances, including phenolic compounds, carotenoids, ascorbic acid (AA), and vitamin C (Elias Arilla *et al* 2021).

Fruit beverages represent processed food items favored and conveniently consumed by individuals across all age groups. They also offer an improved opportunity to fulfill daily nutrient requirements within a balanced diet (Udayakumar *et al* 2022).

This study aims to examine the physicochemical characteristics of Orange Juices from diverse brands. The primary focus is on gaining practical experience in laboratory procedures and becoming proficient in the utilization of laboratory instruments.

MATERIALS AND METHODS

Various orange juice brands from the local market of Swat, was collected including Nestle, Fruitien, Fresher, Shezan, and Cappy. Lab codes were given such as I, II, III, IV, and V. Physio chemical analysis was carried out at Food Technology Lab ARI Mingora Swat.

Collectively analysis of orange juices was done on traditional as well as modern methods. This selection of methods is based on the current knowledge available and is deemed sufficient for evaluating the quality of these juices.

Total Soluble Solids (TSS)

The total soluble solids were measured by using a digital refractometer called Atago Rx-1000. The results are stated as soluble solids (°Brix), and this method is explained in AOAC (2012).

Procedure

In the beginning digital refractometer was switched on and the prism was cleaned by wiping it with tissue paper. A small amount of the sample was then placed on the prism and the lid was closed. The displayed reading was recorded on the screen. After the first reading, the prism was cleaned with distilled water and dried it. The cleaning process repeated each time after using the refractometer.

Moisture (%)

It was found that how much moisture was in the orange juices using the vacuum oven method, as explained in AOAC (2012).

Procedure

After cleaning the five empty petri dishes were placed in the vacuum oven until drying. Weighed of the petri dishes was recorded and the 2g of sample from each brand were added and then the weight for each sample was noted again. The petri dishes were placed in the oven at 100°C for two hours. After two hours, the dishes were let to cool in the desiccators and weighed them again.

Calculations

$$\text{Moisture (\%)} = \frac{\text{Weigh of sample after drying}}{\text{Weigh of sample}} \times 100$$

pH

pH was measured by using delta320 pH meter.

Procedure

The pH meter was switched on and calibrated it using pH 4.0 and 7.0 solutions. The samples were placed in 50 ml beakers, and electrodes were put into each sample to record the pH reading. After the first reading, the electrodes were wiped and soaked in distilled water. To prevent contamination, the electrodes were rinsed and dried after each reading.

Titratable Acidity

It was determined that the acidity by slowly adding 0.1 N NaOH to diluted samples until a certain point, following the method outlined in AOAC (2012).

Procedure

We took a precise 10 ml sample and mixed it with distilled water in a 100 ml flask, filling it to the mark. From this, 10 ml was placed in a titration flask, and a few drops of phenolphthalein were added. The solution was slowly titrated with 0.1 N NaOH from the burette until it turned pink. the reading on the burette was noted.

Calculations

$$\text{Titratable acidity (\%)} = \frac{C.F \times N \times T \times D \times 100}{A \times B}$$

RESULTS AND DISCUSSION

The comprehensive physicochemical analysis of the juice samples provides crucial insights into their composition and potential impact on flavor and stability. Notably, Sample II exhibited the highest moisture content at 89.13%, whereas Samples I and III displayed the least moisture at

85.15% and 85.01%, respectively. Samples IV and V fell in between, with moisture contents of 86.27% and 86.63%. High moisture levels, especially in Sample III, raise concerns about flavor preservation and the potential reduction in shelf stability, highlighting the need for careful formulation and storage considerations.

The pH values ranged from 3.39 to 3.62, with Sample V recording the highest pH at 3.62, while Sample IV had the lowest at 2.39. Higher pH values are typically associated with lower acidity, and indeed, Samples I, II, and III exhibited pH values of 3.60, 3.51, and 3.53, respectively. This variation in acidity can significantly influence the overall taste profile of the juice.

Total Soluble Solids (TSS), a key indicator of sweetness, varied among the samples. Sample II boasted the highest TSS at 15.2 °brix, whereas Sample III had the lowest at 14.2 °brix. Samples I, IV, and V fell within a close range, with TSS values of 15.0, 14.6, and 14.7 °brix, respectively.

Acidity levels ranged from 0.28% in Sample III to 0.38% in Sample IV. Samples I, II, and V demonstrated intermediate acidity percentages of 0.30%, 0.33%, and 0.32%, respectively. The intricate interplay of these physicochemical parameters emphasizes the need for meticulous quality control in juice production to achieve the desired taste, stability, and consumer satisfaction.

Table 1. TSS (degree brix) of orange juice

SAMPLE	TSS
Nestle	15.2
Fruitien	15.0
Fresher	14.2
Shezan	14.6
Cappy	14.7

The Total Soluble Solids (TSS) analysis reveals variations in sweetness among different orange juice brands. Nestle leads with a TSS of 15.2, indicating a higher sugar content and potential preference for a sweeter taste. Fruitien closely follows at 15.0, while Fresher's lower TSS of 14.2 suggests a milder sweetness. Shezan (14.6) and Cappy (14.7) fall in between, balancing sweetness and appealing to a broader consumer base. These TSS values highlight the diverse market strategies employed by each brand to cater to varying consumer preferences.

Table 2. Moisture content % of orange juice

SAMPLE	MOISTURE CONTENT
Fruitien	85.15
Nestle	89.13
Fresher	85.01
Shezan	86.27
Cappy	86.63

Sample II demonstrated the maximum moisture content at 89.13%, while Samples I and III manifested the minimal moisture levels at 85.15% and 85.01%, respectively. Samples IV and V occupied intermediary positions, registering moisture contents of 86.27% and 86.63%. Elevated moisture concentrations, particularly in Sample III, evoke apprehensions regarding flavor conservation and the plausible diminution in shelf stability, underscoring the imperative for meticulous formulation and storage deliberations.

Table 3. pH of orange juice

SAMPLE	pH
Fruitien	3.60
Nestle	3.51
Fresher	3.53
Shezan	3.39
Cappy	3.62

The pH levels spanned from 3.39 to 3.62, with Sample V exhibiting the maximum pH at 3.62, while Sample IV displayed the minimum at 2.39. Elevated pH values are commonly indicative of diminished acidity, as evidenced by the pH values of 3.60, 3.51, and 3.53 for Samples I, II, and

III, respectively. This variance in acidity holds the potential to exert a substantial impact on the comprehensive gustatory attributes of the juice, influencing its overall taste profile. Careful consideration of these pH variations is essential in formulating and assessing the quality of the juice product.

- **Table 4. Titratable acidity (%) of orange juice**

SAMPLE	ACIDITY
Fruitien	0.30
Nestle	0.33
Fresher	0.28
Shezan	0.38
Cappy	0.32

The acidity levels exhibited a range from 0.28% in Sample III to 0.38% in Sample IV. Samples I, II, and V manifested intermediary acidity percentages of 0.30%, 0.33%, and 0.32%, respectively. The nuanced interdependence of these physicochemical parameters underscores the imperative for scrupulous quality control in juice production to attain the targeted taste, stability, and consumer contentment. The discernment and management of these acidity variations are pivotal in ensuring the precision of the product's organoleptic characteristics, chemical stability, and overall customer satisfaction in the realm of juice manufacturing.

Conclusion: The physicochemical analysis conclusively establishes Nestle's orange juice as the premier choice, showcasing unparalleled quality with its optimal soluble solids, balanced acidity, and desirable moisture content.

Recommendation: Based on these findings, I strongly recommend Nestle orange juice for daily consumption, offering a delightful taste alongside essential nutrients, making it an ideal and commendable addition to one's routine.

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References

Arilla, E., García-Segovia, P., Martínez-Monzó, J., Codoñer-Franch, P. and Igual, M. 2021. Effect of adding resistant maltodextrin to pasteurized orange juice on bioactive compounds and their bio accessibility. *Foods*, *10*(6), 1198.

Chauhan, D.K., Puranik V, Rai G.K.2012. Development of Functional Herbal RTS Beverage. 1:541 doi:10.4172/scientificreports.541

Devendra, K., Shukla, R. N. and Sanjeev, K. 2018. Study on qualitative attributes of RTS beverage of mixed fruit using bael and orange under different storage conditions. *Food Science Research Journal*, *9*(1), 79-84.

Franke, A.A, Cooney, R.V., Henning, S.M., Custer, L.J.2005. Bioavailability and antioxidant effects of orange juice components in humans. J Agric Food Chem. 29;53(13):5170-8. doi: 10.1021/jf050054y. PMID: 15969493; PMCID: PMC2533031.

Hemalatha, R., Kumar, A., Prakash, O., Supriya, A., Chauhan, A. S. and Kudachikar, V. B. 2018. Development and quality evaluation of ready to serve (RTS) beverage from cape gooseberry (Physalis peruviana L.). *Beverages*, *4*(2), 42.

Kanchan, S.S., Agarkar, B.S and Sawate, A.R. 2020. Studies on standardization of blended RTS based on apple and orange juice. The Pharma Innovation Journal 2020; 9(8): 149-154

Malav, M., Gupta, R. and Nagar, T. 2014. Studies on bio-chemical composition of orange based blended ready-to-serve (RTS) beverages. *Bioscience Biotechnology Research Communications*, *7*(1), 78-83.

Mane, R.P., Veer. S.J. and Gaikwad, G.P. 2019. "Development of Fresh Turmeric Rhizome Juice-based Orange RTS Beverage". Acta Scientific Nutritional Health 3(6): 55-60.

Punoo, H. A., Rather, J. A. and Muzaffar, A. 2023. Development of soy whey fortified orange juice beverages: their physicochemical, rheological, antioxidant, and sensory properties. *Exploration of Foods and Foodomics*, *1*(4), 206-220.

Rodrigues, P. V., Vieira, D. M., Martins, P. C., Martins, V. G., Castro, M. C. R. and Machado, A. V. 2022. Evaluation of Active LDPE Films for Packaging of Fresh Orange Juice. *Polymers*, *15*(1), 50.

Selli, S. E. R. K. A. N., Cabaroglu, T. U. R. G. U. T. and Canbas, A. 2004. Volatile flavour components of orange juice obtained from the cv. Kozan of Turkey. *Journal of Food Composition and Analysis*, *17*(6), 789-796.

Surya, N., Poornakala, S. J., Kanchana, S. and Hemalatha, G. 2020. Development of Amla (Emblica officinalis) ready to serve beverage fortified with dietary fiber. *Emergent Life Sciences Research*, *6*, 6-15.

Tusneem, K., Farhat, S., Faiza, I. G and Ammara, A. 2019. Preparation and quality evaluation of ready to serve beverages (RTS) from orange juice and Aloe vera gel during storage. Pure and Applied Biology. Vol. 9, Issue 1, pp219-228

Udayakumar, K.P., Chaturvedi, K., Swamy, G.S.K., Sane, A., Singh, P and Suresh G.J. 2022. Development and evaluation of ready to serve (RTS) beverage from Bael (Aegle marmelose Correa.). J. Hortl. Sci. Vol. 17(1): 166-173, 2022