JGPS, November 2025, Volume 9 Nomor 2
ISSN 2599-0152 eISSN 2599-2465
http://jos.unsoed.ac.id/index.php/jgps

SENSORY CHARACTERISTICS OF A PINEAPPLE AND COCONUT-WATER-BASED SPORT DRINK

Karakteristik Sensoris Minuman Olahraga Berbahan Dasar Nanas dan Air Kelapa

Ruth Surya Wahyu Setyaning[1*], Ariana Endrinikapoulos[1]
[1]Sekolah Tinggi Ilmu Kesehatan Panti Rapih, Yogyakarta, Indonesia
Email:ruthsuryaws@stikespantirapih.ac.id

ABSTRACT

Coconut water is a natural isotonic beverage that can provide effects comparable to commercial sports drinks in supporting physical performance and physiological responses. On the other hand, pineapple is a tropical fruit with natural anti-inflammatory properties, a sweet taste, and a distinctive, refreshing aroma, making it a potential enhancer of the sensory characteristics of sports drinks. This study aimed to develop a sports drink formulation based on coconut water and pineapple juice and to evaluate the sensory characteristics of the formulated beverages. Sensory evaluation was conducted with 38 panellists using a 4-point scale, and the data were analysed using ANOVA followed by Duncan's Multiple Range Test. The difference in the proportion of coconut water and pineapple juice significantly affected the organoleptic parameters of colour ($p<0.001$) and aftertaste ($p=0.011$) but had no significant effect on aroma ($p=0.450$), taste ($p=0.136$), or overall preference ($p=0.743$). An increased proportion of pineapple juice in the formulation resulted in a brighter colour and a more pungent aftertaste in the sports drink. The selected formulation in terms of colour was Formula 3; meanwhile, Formula 1 was preferred for aftertaste.

Keyword : *coconut water; pineapple juice; sensory evaluation; sports drink*

ABSTRAK

Air kelapa merupakan isotonik alami yang dapat memberikan efek yang setara dengan minuman olahraga komersial dalam mendukung performa dan respon fisiologis. Di sisi lain, buah nanas merupakan buah tropis yang memiliki efek anti-inflamasi dan rasa manis serta aroma khas yang menyegarkan sehingga berpotensi meningkatkan karakteristik sensorik dari minuman olahraga. Penelitian ini bertujuan untuk mengembangkan formulasi minuman olahraga berbahan dasar air kelapa dan nanas, dan mengevaluasi karakteristik sensorisnya. Uji sensoris melibatkan 38 panelis menggunakan skala 4 poin, dan data dianalisis menggunakan ANOVA yang dilanjutkan dengan uji Duncan. Perbedaan proporsi air kelapa dan sari buah nanas memberikan pengaruh terhadap parameter organoleptik warna ($p<0.001$) dan aftertaste ($p=0.011$), namun tidak memberikan pengaruh terhadap aroma ($p=0.450$), rasa ($p=0.136$), dan tingkat kesukaan ($p=0.743$). Formula terpilih berdasarkan parameter warna adalah Formula 3, sedangkan, Formula 1 terpilih berdasarkan aspek *aftertaste*.

Kata Kunci : air kelapa; organoleptik; minuman olahraga; sari buah nanas

DOI 10.20884/1.jgipas.2025.9.2.17219

INTRODUCTION

A sports drink is a non-carbonated beverage containing sugars, minerals, and electrolytes, formulated to replace fluids and electrolytes lost during exercise. Fluid loss or dehydration can impair physical performance; therefore, it is essential to maintain adequate hydration and energy availability during exercise (Muñoz-Urtubia et al., 2023). The hydrating effect of fluid replacement following the consumption of a sports drink does not occur immediately, as the fluid must first be absorbed in the intestines, where approximately 50-60% of orally consumed fluids are absorbed (Riesenhuber et al., 2006). To achieve optimal hydration and support performance, a sports drink should possess characteristics that promote rapid gastric emptying, help maintain the body's fluid balance, contain sufficient minerals to replace those lost through sweat, and provide an adequate amount of carbohydrate to supply energy during exercise (Maughan et al., 2016).

Sports drinks are classified into three types based on their fluid, electrolyte, and carbohydrate composition: isotonic, hypertonic, and hypotonic. Most sports drinks are isotonic, which enables rapid fluid replacement while providing additional carbohydrate (Colakoglu et al., 2016). Coconut water is a natural isotonic beverage containing electrolytes such as potassium and magnesium, and it is commonly used to manage digestive issues, including diarrhoea, gastroenteritis, and cholera (Segura-Badilla et al., 2020). A study by O'Brien et al. (2023) demonstrated that coconut water can provide effects comparable to those of commercial sports drinks in supporting performance and physiological responses during resistance training. However, it resulted in lower blood glucose levels compared to the group consuming a commercial sports drink.

The sales trend of sports drinks has shown a significant increase and is no longer limited to athletes (Muñoz-Urtubia et al., 2023). Sales rose notably during the COVID-19 pandemic, when many individuals opted to exercise at home. Increased awareness of the importance of physical activity has been influenced by several factors, including the improved availability of sports facilities and open spaces, as well as support from families and communities, such as sports clubs (Kitreerawutiwong et al., 2021). Participation in a sports club enhances both the frequency of physical activity and the amount of

DOI 10.20884/1.jgipas.2025.9.2.17219

informational and emotional support received (Golaszewski et al., 2022). Moreover, the growing demand for sports drinks has been driven by a preference for natural ingredients, particularly as the public becomes increasingly concerned about the potential side effects of synthetic additives (Gretebeck et al., 2002). However, most commercial sports drinks still use artificial sweeteners in place of sugar to produce low-calorie products (Mroczek et al., 2023). Sweetened beverages, especially those containing artificial sweeteners, may pose long-term health risks (Ghusn et al., 2023).

In response to increasing consumer demand for beverages made from natural ingredients, there is growing industrial interest in producing fruit juice-based drinks. This interest is driven by fruit juices' ability to enhance flavour and natural colour, as well as to contribute additional vitamins, minerals, and antioxidants, thereby enriching the product both nutritionally and sensorially (García et al., 2024). Pineapple is a tropical fruit that contains minerals, vitamins, fibre, organic acids, and natural sugars (de Ancos et al., 2017). It also contains the functional enzyme bromelain, which has been widely used and recognised as a natural remedy due to its therapeutic potential, particularly its anti-inflammatory effects, attributed to its biochemical and pharmacological properties. The anti-inflammatory response may be beneficial for recovery processes in athletes following regular intensive physical activity (Wan Nur Zahidah et al., 2023). In addition to its nutritional and therapeutic properties, pineapple has a naturally sweet taste and a distinctive, refreshing aroma (de Ancos et al., 2017), which may enhance the sensory acceptance of sports drinks. Therefore, this study aims to develop a sports drink formulation using locally available, affordable ingredients with nutritional benefits for athletes, with coconut water and pineapple serving as the primary components.

METHOD

Sports Drink Formulation

The sports drink was formulated using young coconut water and pineapple juice in three different volume ratios: 14:6, 10:10, and 6:14 (ml), as described by Aprilia et al. (2023). The preparation process involved several steps. First, fresh coconut water was filtered and pasteurised at 80 ºC for

DOI 10.20884/1.jgipas.2025.9.2.17219

10 minutes. Pineapples were washed, peeled, and cut into small pieces before being steam-blanched at 70 ºC for 7 minutes. The pineapple flesh was then blended and filtered through a muslin cloth to obtain clear juice.

Each formulation consisted of a 20 ml mixture of coconut water and pineapple juice according to the designated ratio. Additional ingredients were added to the mixture, followed by the addition of distilled water to reach a final volume of 100 ml. The resulting solution was reheated at 60-70 ºC for approximately 7 minutes to ensure uniformity and improve microbial stability. The final product was then bottled and stored for further analysis. Details of the ingredients and quantities are presented in Table 1.

Table 1. Sport Drink Composition

Ingredients	Quantities		
	Formula 1	Formula 2	Formula 3
Young coconut water	14 ml	10 ml	6 ml
Pineapple juice	6 ml	10 ml	14 ml
Citric acid	0,1 gram	0,1 gram	0,1 gram
Salt	0,25 gram	0,25 gram	0,25 gram
Sodium benzoate	0,1 gram	0,1 gram	0,1 gram
Water	80 ml	80 ml	80 ml
Sugar	5,5 gram	5,5 gram	5,5 gram

Sensory Evaluation

The sensory evaluation involved 38 untrained panellists, comprising students from the Department of Physical Education and Health, Faculty of Health Sciences, Universitas Jenderal Soedirman. Selecting physically active panellists was considered relevant to the target consumers of sports drinks, as their regular exposure to these beverages may contribute to a more realistic assessment of sensory attributes within the intended user group (Khan et al., 2022). The panellists were asked to assess the following parameters: colour, aroma, taste, aftertaste, using the following scoring criteria:

1. Colour = 1 (pale yellow), 2 (bright yellow), 3 (deep yellow), 4 (brownish yellow)
2. Aroma = 1 (very unpleasant), 2 (unpleasant), 3 (pleasant), 4 (very pleasant)
3. Taste = 1 (very unpleasant), 2 (unpleasant), 3 (pleasant), 4 (very unpleasant)
4. Aftertaste = 1 (very weak), 2 (weak), 3 (strong), 4 (very strong)

DOI 10.20884/1.jgipas.2025.9.2.17219

In addition, the panellists were asked to rate their overall preference using a scale of: 1 (strongly dislike), 2 (dislike), 3 (like), 4 (strongly like).

Statistical Analysis

Data processing was performed using Microsoft Excel, and statistical analysis was conducted using statistical software. The sensory evaluation data were analysed using analysis of variance (ANOVA), followed by Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

The results of the sensory evaluation of the three sports drink formulations, including aspects of colour, aroma, taste, aftertaste, and overall preference, are presented in Table 2. Variations in the proportion of coconut water and pineapple juice significantly affected the colour and aftertaste of the sports drink (Table 2). The higher the proportion of pineapple juice used, the brighter the resulting yellow colour will be. Formula 3 exhibited a brighter yellow hue compared to Formula 1, which contained the lowest amount of pineapple juice ($p < 0.001$). In terms of aftertaste, a significant difference was observed between Formula 1 and Formula 3, with Formula 3 producing a more pungent aftertaste ($p < 0.05$). These findings suggest that the volume of pineapple juice in the formulation contributes to a more pungent aftertaste.

Table 2. Sensory Evaluation Results of Sports Drink

Formula	Colour	Aroma	Taste	Aftertaste	Preference
F1	1,34 ± 0,582	2,76 ± 0,59[a]	2,37 ± 0,541[a]	2,42 ± 0,642[a]	2,47 ± 0,557[a]
F2	2,11 ± 0,798[a]	2,58 ± 0,722[a]	2,61 ± 0,755[a]	2,61 ± 0,638[a, b]	2,42 ± 0,758[a]
F3	2,29 ± 0,802[a]	2,58 ± 0,858[a]	2,68 ± 0,809[a]	2,92 ± 0,850[b]	2,55 ± 0,891[a]
Nilai p	<0,001	0,450	0,136	0,011	0,743

F1 = formula 14:6; F2 = formula 10:10; F3 = formula 6:14. Values in the same column followed by the same letter notation indicate no significant difference (p>0,05).

Formula 3 exhibited a brighter yellow colour compared to Formula 1 ($p<0,05$). This result suggests that a higher volume of pineapple juice yields a more vibrant yellow hue. The bright yellow colour in the sports drink formulation is attributed to carotenoid pigments in pineapples (Pangaribuan et al., 2022). This finding is consistent with the

DOI 10.20884/1.jgipas.2025.9.2.17219

study by Rahayu et al. (2020), which reported that the addition of pineapple juice altered the brown colour of cascara tea to a yellowish-brown shade.

In terms of aroma, no significant differences were observed among the three formulations, with aroma scores ranging from "unpleasant" to "pleasant". The pleasant aroma in sports drink formulations may be influenced by various volatile compounds present in pineapple, two of which, ethyl hexanoate and methyl hexanoate, contribute to the characteristic pineapple scent (Wei et al., 2011). According to the panellists' assessment, the pineapple aroma in the pineapple juice may have reduced the concentration of volatile compounds responsible for it. On the other hand, the Maillard reaction that occurs during heating can produce furan derivatives, which impart a sweet aroma to the sports drink (Zhang et al., 2012).

The variation in the volumes of coconut water and pineapple juice did not significantly influence the taste scores, which ranged from "unpleasant" to "pleasant". However, a higher proportion of pineapple juice tended to produce a more pungent aftertaste. Formula 3, which contained the highest volume of pineapple juice, tended to produce a more pungent aftertaste compared to Formula 1. According to the panellists' assessments, the pineapple flavour in the sports drink was not particularly prominent. It was generally sour, with a relatively strong aftertaste, especially in Formula 3. The pronounced aftertaste in Formula 3 may be attributed to the presence of bromelain enzyme and various organic acids, such as citric, malic, and ascorbic acid, which are naturally found in pineapple (Spence, 2023).

The different proportions of pineapple juice and coconut water did not significantly affect the panellists' overall preference, with preference scores ranging from "strongly dislike" to "like". The relatively low preference ratings may be attributed to the drink's dominant sourness and intense aftertaste. In addition to the organic acids naturally present in pineapple, the sourness was likely enhanced by the addition of citric acid, a common ingredient used to regulate the pH of isotonic beverages. A study by Asnia et al. (2024) demonstrated that higher doses of added citric acid in isotonic drinks were associated with a decline in consumer preference.

Furthermore, based on the overall

DOI 10.20884/1.jgipas.2025.9.2.17219

organoleptic evaluation, the selected formula in terms of colour was Formula 3, which received a score ranging from "bright yellow" to "dark yellow", with a pineapple juice to coconut water ratio of 14:6. For the aftertaste aspect, the selected formula was Formula 1, which received scores ranging from "not strong" to "strong". Nevertheless, no single formulation excelled across all sensory parameters. Each demonstrated strengths in particular attributes, indicating the need for further optimisation to achieve a more balanced product. Future refinements may focus on reducing the acidity to address the strong aftertaste observed in Formula 3, or on adding natural colour enhancers to improve the visual quality of Formula 1 while maintaining its preferred aftertaste.

The relatively small number of panellists represents a limitation of this study. Future research should therefore include a larger sample of physically active consumers, as they represent the primary target users of sports drinks, along with physicochemical and functional property assessments to support broader application of the product in sports nutrition.

CONCLUSION

An increased proportion of pineapple juice in the sports drink formulation significantly affected the sensory attributes of colour and aftertaste. The higher the volume of pineapple juice used, the brighter the colour and the stronger the aftertaste of the sports drink, as observed in Formula 3. In contrast, the attributes of taste and aroma did not differ significantly among the formulations. The overall preference for the sports drink formulations ranged from "dislike" to "like".

BIBLIOGRAPHY

Aprilia, A., Maherawati, M., Dewi, Y.S.K., 2023. Effect of Formulations and Sweetener Type to Characteristic of Coconut-Pineapple Isotonic Drink. Agritekno 12, 40–49. https://doi.org/10.30598/jagritekno.2023.12.1.40

Asnia, K.K.P., Maherawati, M., Hartanti, L., 2024. Karakteristik fisikokimia minuman isotonik air kelapa dengan formulasi penambahan asam sitrat dan NaCl. AGROINTEK: Jurnal Teknologi Industri Pertanian 18, 40–48. https://doi.org/10.21107/agrointek.v18i1.17733

Colakoglu, F.F., Cayci, B., Yaman, M., Karacan, S., Gonulateş, S., Ipekoglu, G., Er, F., 2016. The effects of the intake of an isotonic sports drink before orienteering competitions on

DOI 10.20884/1.jgipas.2025.9.2.17219

skeletal muscle damage. J Phys Ther Sci 28, 3200–3204. https://doi.org/10.1589/jpts.28.3200

de Ancos, B., Sánchez-Moreno, C., González-Aguilar, G.A., 2017. Pineapple composition and nutrition, in: Handbook of Pineapple Technology. John Wiley & Sons, Ltd, pp. 221–239. https://doi.org/10.1002/9781118967355.ch12

García, M.A., Ruiz, Y., Rodríguez, J.E., Cruz-Socorro, A., Casariego, A., 2024. Isotonic sports drink prepared from pineapple juice: Stability during its accelerated storage. Agroind. sci. 13, 135–152. https://doi.org/10.17268/agroind.sci.2023.03.03

Ghusn, W., Naik, R., Yibirin, M., 2023. The Impact of Artificial Sweeteners on Human Health and Cancer Association: A Comprehensive Clinical Review. Cureus 15, e51299. https://doi.org/10.7759/cureus.51299

Golaszewski, N., LaCroix, A., Hooker, S., Bartholomew, J., 2022. Group exercise membership is associated with forms of social support, exercise identity, and amount of physical activity. Int J Sport Exerc Psychol 20, 630–643. https://doi.org/10.1080/1612197x.2021.1891121

Gretebeck, R.J., Gretebeck, K.A., Tittelbach, T.J., 2002. Glycemic Index of Popular Sport Drinks and Energy Foods. Journal of the American Dietetic Association 102, 415–417. https://doi.org/10.1016/S0002-8223(02)90097-0

Khan, K., Qadir, A., Trakman, G., Aziz, T., Khattak, M.I., Nabi, G., Alharbi, M., Alshammari, A., Shahzad, M., 2022. Sports and Energy Drink Consumption, Oral Health Problems and Performance Impact among Elite Athletes. Nutrients 14, 5089. https://doi.org/10.3390/nu14235089

Kitreerawutiwong, N., Keeratisiroj, O., Mekrungrongwong, S., 2021. Factors That Influence Physical Activity Among Older Adults Living in Rural Community in Wangthong District, Phitsanulok, Thailand. SAGE Open 11, 21582440211061368. https://doi.org/10.1177/21582440211061368

Maughan, R.J., Watson, P., Cordery, P.A., Walsh, N.P., Oliver, S.J., Dolci, A., Rodriguez-Sanchez, N., Galloway, S.D., 2016. A randomised trial to assess the potential of different beverages to affect hydration status: development of a beverage hydration index. Am J Clin Nutr 103, 717–723. https://doi.org/10.3945/ajcn.115.114769

Mroczek, K., Saletnik, B., Bajcar, M., Saletnik, A., Puchalski, C., Zaguła, G., 2023. Effect on Ionic Composition and Tonic Parameters of Sweeteners Used in the Production of Functional Beverages. Beverages 9, 98. https://doi.org/10.3390/beverages9040098

Muñoz-Urtubia, N., Vega-Muñoz, A., Estrada-Muñoz, C., Salazar-Sepúlveda, G., Contreras-Barraza, N., Castillo, D., 2023. Healthy Behavior and Sports Drinks: A Systematic Review. Nutrients 15, 2915. https://doi.org/10.3390/nu15132915

DOI 10.20884/1.jgipas.2025.9.2.17219

O'Brien, B.J., Bell, L.R., Hennessy, D., Denham, J., Paton, C.D., 2023. Coconut Water: A Sports Drink Alternative? Sports (Basel) 11, 183. https://doi.org/10.3390/sports11090183

Pangaribuan, J.F., Nocianitri, K.A., Darmayanti, L.P.T., 2022. Pengaruh Lama Fermentasi Terhadap Karakteristik Minuman Probiotik Sari Buah Nanas (Ananas comosus L.) dengan Isolat Lactobacillus rhamnosus SKG34. Jurnal Ilmu dan Teknologi Pangan (ITEPA) 11, 699–711. https://doi.org/10.24843/itepa.2022.v11.i04.p10

Rahayu, W.E., Purwasih, R., Hidayat, D., 2020. Pengaruh penambahan sari nanas terhadap karakteristik kimia dan sensori minuman teh cascara: Teknologi Pangan : Media Informasi dan Komunikasi Ilmiah Teknologi Pertanian 11, 144–151. https://doi.org/10.35891/tp.v11i2.1900

Riesenhuber, A., Boehm, M., Posch, M., Aufricht, C., 2006. Diuretic potential of energy drinks. Amino Acids 31, 81–83. https://doi.org/10.1007/s00726-006-0363-5

Segura-Badilla, O., Lazcano-Hernández, M., Kammar-García, A., Vera-López, O., Aguilar-Alonso, P., Ramírez-Calixto, J., Navarro-Cruz, A.R., 2020. Use of coconut water (Cocus nucifera L) for the development of a symbiotic functional drink. Heliyon 6. https://doi.org/10.1016/j.heliyon.2020.e03653

Spence, C., 2023. Are pineapples really delicious? The history of the pineapple's taste/flavour and the role of varietal and terroir. International Journal of Gastronomy and Food Science 31, 100682. https://doi.org/10.1016/j.ijgfs.2023.100682

Wan Nur Zahidah, W.Z., Mohd Nazrul Hisyam, D., Hadijah, H., Norhida Arnieza, M., 2023. Pineapple juice drink: potential functional drink for reducing inflammation inathletes. Food Res. 6, 263–267. https://doi.org/10.26656/fr.2017.6(s2).039

Wei, C.-B., Liu, S.-H., Liu, Y.-G., Lv, L.-L., Yang, W.-X., Sun, G.-M., 2011. Characteristic Aroma Compounds from Different Pineapple Parts. Molecules 16, 5104–5112. https://doi.org/10.3390/molecules16065104

Zhang, X., Shen, Y., Prinyawiwatkul, W., Xu, Z., 2012. Volatile Compounds in Fresh-Cut Pineapple Heated at Different Temperatures: Volatiles in Heated Pineapples. Journal of Food Processing and Preservation 36, 567–573. https://doi.org/10.1111/jfpp.12009

DOI 10.20884/1.jgipas.2025.9.2.17219