International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Formulation, Sensory and Nutritional Assessment of Sports Drinks

Pushpa Bhoware[1], Dr. Prajakta Nande[2]

[1]M.Sc. (Food Science and Nutrition), Post Graduate Teaching Department of Home Science, Rashtrasant Tukadoji Maharaj Nagpur University, Jyotiba Phule Campus, Amravati Road- 440033, Nagpur (Maharashtra), India

[2]Assistant Professor in Food Science and Nutrition (Sr. Gr.), Post Graduate Teaching Department of Home Science, Rashtrasant Tukadoji Maharaj Nagpur University, Jyotiba Phule Campus, Amravati Road- 440033, Nagpur (Maharashtra), India
Corresponding Author Email: *prajaktanande[at]yahoo.co.in*

Abstract: ***This study focuses on the formulation and sensory assessment of six novel sports drinks developed using combinations of fruit juices, glucose powder, and electrolytes. Designed to optimize hydration and energy replenishment for athletes and active individuals, each beverage underwent comprehensive compositional and nutritional assessment. Six sports drinks namely Minty Lemonade, Tangerine Twist, Jamba Juice, Limey Power, Red Storm & Blue Blend were standardized. Sensory evaluation, conducted using a 9-point hedonic scale, assessed attributes such as appearance, colour, flavour, taste, and overall acceptability. All six drinks achieved high palatability scores (typically 9.88-10), confirming their potential appeal for consumer use. The research demonstrates that natural ingredient-based sports drinks can deliver requisite nutrients, electrolytes, and consumer-acceptable flavours, supporting the dual objectives of nutritional adequacy and market viability.***

Keywords: Sports drink, formulation, sensory assessment, palatability, electrolyte beverages, hedonic scale, nutritional analysis

1. Introduction

Maintaining fluid and electrolyte balance during exercise is fundamental to sustain performance, limit heat-related illness and support recovery. Dehydration of even ~2% body mass loss impairs aerobic capacity, cognitive function and thermoregulation; therefore evidence-based fluid replacement strategies are central to sports nutrition recommendations. Expert position statements emphasize beginning exercise euhydrated, replacing fluid losses during exercise, and restoring fluid and electrolyte balance afterwards[1].

Sports drinks are designed to provide the right balance of carbohydrate and fluid, to ensure that they are emptied quickly from the stomach and are rapidly absorbed from the small intestine. When used according to sports nutrition guidelines, sports drinks can have performance benefits[2]. Carbohydrate-electrolyte solutions (CES, commonly called "sports drinks") serve a dual role during prolonged or high-intensity exercise: (1) deliver rapidly absorbable carbohydrate to delay fatigue and sustain work rate, and (2) replace water and key electrolytes (primarily sodium) lost in sweat to support plasma volume and osmolality. Typical commercially formulated sports drinks are isotonic to mildly hypertonic and most commonly contain carbohydrates in the ≈4-8% range ant this concentration balances energy delivery with gastric emptying and palatability[3].Electrolyte composition especially sodium concentration is a critical compositional variable. Sodium facilitates intestinal co-transport of water and glucose, stimulates thirst, reduces urine output, and therefore improves net fluid retention during rehydration[3].

Hydration and nutrient replenishment are central to sustaining exercise performance, preventing heat-related stress, and promoting post-exercise recovery. Even mild dehydration, amounting to a fluid loss of 2% body weight, has been shown to impair aerobic capacity, endurance, thermoregulation, and cognitive[1]. Consequently, athletes and physically active individuals are encouraged to replace both fluids and electrolytes lost through sweat. Sports drinks—carbohydrate-electrolyte solutions—are widely used for this purpose, as they not only restore hydration but also supply rapidly absorbable energy during prolonged or high-intensity activity[3].

Commercial sports drinks typically contain 4-8% carbohydrate and 10-25 mmol/L sodium, which are concentrations demonstrated to optimize gastric emptying, fluid absorption, and palatability[1]. However, their accessibility and affordability may be limiting factors, especially in low-resource communities, and regular consumption of certain brands has raised concerns over high sugar content, artificial additives, and cost-effectiveness. In contrast, homemade sports drinks, prepared using locally available carbohydrate sources such as fruit juices, glucose, honey, and natural salts, offer a potentially economical, customizable, and health-oriented alternative.

The nutritional quality of a sports drink is defined not only by its energy contribution but also by its electrolyte composition, osmolality, and capacity to support rehydration. Sodium is essential for fluid retention and stimulation of thirst, while potassium supports muscle function and glycogen synthesis. Carbohydrates maintain blood glucose and delay fatigue by sustaining substrate availability for working muscles. Homemade formulations, when designed with these parameters in mind, can provide adequate hydration and energy replacement while minimizing excessive sugars and artificial ingredients. At the same time, beverage palatability and consumer acceptance play a crucial role in determining voluntary fluid intake during exercise[4].

Homemade formulations often rely on natural flavors such as citrus juice or herbal infusions, which may enhance both sensory appeal and antioxidant potential. However, rigorous scientific evaluation of their nutritional adequacy compared to standard guidelines is limited. This underscores the importance of research that systematically analyzes the nutritional composition of homemade sports drinks, evaluates their alignment with physiological requirements, and establishes their potential as affordable, health-conscious alternatives to commercial beverages.

Therefore, the present study aims to formulate and analyze the nutritional quality of homemade sports drinks prepared from natural and locally available ingredients. By examining their nutritional composition, the study will assess the acceptability of these sports drinks. By combining compositional analysis with sensory science and referencing current expert guidance on fluid and electrolyte replacement, the research will produce practical recommendations for formulations that optimize both hydration/fueling outcomes and voluntary intake.

2. Methodology

Total six drinks - Minty Lemonade, Tangerine Twist, Jamba Juice, Red Storm, Blue Blend & Limey Power - were designed, prepared, standardized and evaluated for sensory quality.

(a) Composition and Method of Preparation:

Minty Lemonade:

Table 1: Composition of Ingredients for Minty Lemonade

Sr. No.	Ingredients	Quantity (g)
1.	Lemon Juice	50
2.	Tender Coconut Water	250
3.	Mint Leaves	15
4.	Glucose Powder	35
5.	Pink Salt	10

Method of Preparation:
- In a container, take tender coconut water.
- Mix freshly squeezed lemon juice in it.
- Wash & cut fresh mint leaves. In a mixer grinder, make paste of it by adding little water. Strain & mix this mint juice in coconut juice.
- Add glucose powder & pink salt. Mix vigorously.
- Dissolve well.
- Minty lemonade is ready to serve.

Tangerine Twist:

Table 2: Composition of Ingredients for Tangerine Twist

Sr. No.	Ingredients	Quantity (g)
1.	Orange	200
2.	Pineapple	100
3.	Ginger	5
4.	Black Pepper Powder	2
5.	Glucose Powder	50
6.	Salt	5

Method of Preparation:
- Peel orange and pineapple. Prepare juices separately.
- In a container, mix freshly squeezed orange & pineapple juice.
- Add ginger juice, sugar, glucose powder & salt to it.
- Mix & dissolve well.
- Tangerine twist is ready to serve.

Jamba Juice:

Table 3: Composition of Ingredients for Jamba Juice

Sr. No.	Ingredients	Quantity (g)
1.	Guava	275
2.	Amla	25
3.	Ginger	2
4.	Saffron Strands	6
5.	Cardamom Powder	2
6.	Salt	5

Method of Preparation:
- Wash guava and amla.
- Remove seeds from amla.
- Cut amla and guava into pieces and prepare juice.
- Add sugar, ginger powder, saffron strands, cardamom powder & salt to it.
- Mix & dissolve well.
- Jamba juice is ready to serve.

Red Storm:

Table 4: Composition of Ingredients for Red Storm

Sr. No.	Ingredients	Quantity (g)
1.	Strawberry	100
2.	Watermelon	100
3.	Pomegranate	100
4.	Glucose Powder	50
5.	Ginger	10
6.	Cumin Seeds Powder	5
7.	Black Pepper Powder	2
8.	Salt	5

Method of Preparation:
- Wash the fruits. Remove skin and seeds from water melon.
- Prepare juice of strawberry, water melon pieces & pomegranate.
- Add glucose powder, ginger powder, cumin seeds powder, black pepper powder & salt to it.
- Mix & dissolve well.
- Red storm is ready to serve.

Blue Blend:

Table 5: Composition of Ingredients for Blue Blend

Sr. No.	Ingredients	Quantity (g)
1.	Black Grapes	200
2.	Apple	100
3.	Glucose Powder	50
4.	Cumin Seeds Powder	5
5.	Black Pepper Powder	2
6.	Salt	5

Method of Preparation:
- Wash the fruits.
- Remove the seeds of black grapes.

- Peel the apple & remove the seeds and central part.
- Prepare juice from black grapes & apple.
- Add sugar, glucose powder, cumin seeds powder, black pepper powder & salt to it.
- Mix & dissolve well.
- Blue blend is ready to serve.

Limey Power:

Table 6: Composition of Ingredients for Limey Power

Sr. No.	Ingredients	Quantity (g)
1.	Green Grapes	100
2.	Kiwi	100
3.	Lemon Juice	5
4.	Glucose Powder	50
5.	Saffron Strands	6
6.	Salt	5

Method of Preparation:

- Wash the fruits.
- Remove the seeds of green grapes.
- Remove the skin of kiwi.
- Extract juice of grapes & kiwi.
- Add lemon juice, sugar, glucose powder, saffron strands & salt to it.
- Mix & dissolve well.
- Limey power is ready to serve.

(b) Sensory Evaluation of Drinks:

All sports drinks were standardized till final uniform products were developed. Sensory evaluation of drinks was conducted by six judges in three trials. For sensory evaluation, score cards with keys were prepared. On the day of sensory evaluation, freshly prepared sports drinks were presented with score card & key along with glass of water & tissue paper to the judges.

Table 7: Score Card for Sports Drinks

S.No.	Trials	Appearance	Colour	Flavour	Taste	Acceptability
1.	I					
2.	II					
3.	III					

Table 8: Key for Sports Drinks

Sr. No	Appearance/ Colour/ Flavour/Taste	Acceptability	Scores
1.	Very good	Highly acceptable	10
2.	Good	Acceptable	8
3.	Fair	Slightly acceptable	6
4.	Poor	Unacceptable	4

(c) Calculation of Nutritive Value of Drinks:

Nutritive values (energy, macro and micro nutrients) of all drinks were calculated using standard food composition tables [5].

Photo 1: Minty Lemonade

Photo 2: Tangerine Twist

Photo 3: Jamba Juice

Photo 4: Red Storm

Photo 5: Blue Blend

Photo 6: Limey Power

3. Results and Discussion

Basic Data for Sports Drinks:

Table 9: Basic Data for Sports Drinks

Sr. No.	Parameters	Minty Lemonade	Tangerine Twist	Jamba Juice	Red Storm	Blue Blend	Limey Power
1.	Weight of fruit pulp (g)	69	135	109	60	63	174
2.	Weight of concentrated juice (g)	340	350	300	400	350	300
3.	Weight of prepared drink (g)	360	376	355	450	390	345
4.	Quantity of prepared drink (ml)	360	376	355	450	390	345

The yield of each homemade sports drink varied according to the proportion of fruit pulp and added ingredients, directly influencing both nutrient density and sensory quality. The weight of fruit pulp ranged from 60 g in Red Storm to 174 g in Limey Power. Higher pulp content generally indicates greater fiber, micronutrient, and phytochemical contribution, potentially enhancing nutritional density and viscosity. Drinks like Limey Power (174 g) and Tangerine Twist (135 g) provided a higher proportion of pulp, which may enrich them with vitamins, and minerals but could also impact clarity and mouthfeel. In contrast, Red Storm (60 g) and Minty Lemonade (69 g) relied more on added liquid bases (coconut water, diluted juices), resulting in lighter texture and potentially higher immediate palatability for athletes seeking quick hydration without heaviness.

The weight of concentrated juice varied from 300 g (Jamba Juice, Limey Power) to 400 g (Red Storm). Higher concentrated juice volumes increase fluid yield and carbohydrate availability while diluting pulp density, resulting in smoother textures and more isotonic characteristics. Red Storm, with the largest concentrated juice portion, aligns with the goal of maximizing fluid volume for rehydration. On the other hand, Jamba Juice (300 g) balanced moderate pulp with lower concentrated juice, likely producing a thicker beverage, more nutrient-rich but potentially less rapidly absorbed than isotonic formulations.

Water should be replaced for sports drink during shorter activities[6]. The total prepared drink weight ranged from 345 g (Limey Power) to 450 g (Red Storm), closely corresponding to the fluid quantity (ml). Red Storm (450 ml) provided the highest yield, indicating its practicality as a hydration-focused drink for longer duration activities. Limey Power (345 ml) and Jamba Juice (355 ml), despite lower volumes, may serve better in shorter-duration or post-exercise recovery settings where nutrient density is prioritized over fluid replacement.

Sensory Evaluation of Sports Drinks:

Table 10: Mean Palatability Evaluation Scores for Sports Drinks

Sr. No.	Sensory Characteristics	Minty Lemonade	Tangerine Twist	Jamba Juice	Red Storm	Blue Blend	Limey Power
1	Appearance	9.88	9.88	9.88	10	10	9.88
2	Colour	9.88	9.88	9.88	10	10	9.88
3	Flavour	9.88	9.88	9.88	10	10	9.88
4	Taste	9.88	9.88	9.88	10	10	9.88
5	Acceptability	9.88	9.88	9.88	10	10	9.88

All drinks scored exceptionally high on palatability, with mean hedonic ratings approaching the maximum (9.88–10 across appearance, color, flavor, taste, and acceptability). This suggests that the formulations were universally well-accepted, with Red Storm, Blue Blend, and Limey Power attaining perfect scores (10) in all sensory attributes. These results align with literature emphasizing the role of flavor, sweetness, and color in driving voluntary fluid intake during exercise.

The incorporation of natural flavor enhancers (mint, saffron, cardamom, cumin, ginger) not only diversified the sensory profile but may also have contributed mild functional benefits such as improved digestion or anti-inflammatory properties. The balance of sweetness from fruit and glucose, combined with freshness from herbs and spices, likely enhanced consumer appeal, reinforcing the practicality of homemade formulations for athletes.

The result of mean sensory evaluation scores of data shows that appearance, colour, flavor, taste as well as acceptability of minty lemonade received identical mean score of 9.88. All other characteristics especially, taste and flavor, were very much liked by the judges.

Nutrient Composition of Sports Drinks:

Table 11: Nutritive Value (per 100 g) of Sports Drinks

Sr. No.	Nutrients	Minty Lemonade	Tangerine Twist	Jamba Juice	Red Storm	Blue Blend	Limey Power
1.	Energy (kcal)	68.41	163.78	132.7	68.55	78.68	71.25
2.	Carbohydrates (g)	8.480	11.78	6.012	10.13	15.98	17.02
3.	Protein (g)	0.872	0.624	1.380	0.972	0.756	0.308
4.	Fat (g)	1.101	0.142	0.309	0.618	0.605	0.222
5.	Sodium (mg)	819.6	801.5	803.1	803.5	803.4	801.9
6.	Potassium (mg)	218.9	145.9	279.91	172.9	163.02	187.8
7.	Magnesium (mg)	30.30	11.60	15.99	18.51	13.72	7.371
8	Zinc (mg)	0.447	0.058	0.228	0.185	0.117	0.050
9	Iron (mg)	1.747	0.621	0.44	0.634	0.546	0.019
10	Thiamine (mg)	0.025	0.054	0.044	0.044	0.031	0.011
11	Riboflavin (mg)	0.062	0.020	0.036	0.013	0.021	0.035
12	Niacin (mg)	0.252	0.198	0.554	0.313	0.190	0.140
13	Pyridoxine (mg)	0.079	0.063	0.099	0.140	0.077	0.066
14	Total Folates (µg)	23.78	16.26	26.47	15.33	6.204	3.261
15	Vitamin C (mg)	7.936	34.16	238.09	20.85	11.25	69.96
16	Carotene (µg)	932.46	419.32	888.74	1238.6	203.61	86.71

The energy content of the drinks ranged from 68.41 kcal/100 g (Minty Lemonade) to 163.78 kcal/100 g (Tangerine Twist). This variability reflects differences in fruit bases—citrus fruits contributed moderate energy, while combinations involving higher-sugar fruits such as orange and pineapple elevated the caloric density. For athletes, this diversity allows selection based on exercise intensity and duration: lower-calorie drinks (Minty Lemonade, Red Storm) may be suitable for light to moderate activity, whereas energy-dense options (Tangerine Twist, Jamba Juice) can support prolonged endurance exercise by providing greater carbohydrate availability.

Healthy food and drinks have become a current trend due to the increase in consumers' awareness. Athletes, especially, require healthy food and drinks from natural sources which are expected to meet their carbohydrate, electrolytes and fluid needs[7]. Carbohydrate content was highest in Limey Power (17.02 g/100 g) and Blue Blend (15.98 g/100 g), aligning with the recommended 4-8% carbohydrate concentration in sports drinks for optimal fluid absorption and energy supply. Minty Lemonade (8.48 g/100 g) and Red Storm (10.13 g/100 g) also fell within this range, indicating that most

formulations were nutritionally appropriate for hydration and performance support. The results of Kanchana, N. et al.[8] showed that inclusion of fruits significantly affected the total carbohydrates, fat, protein and energy values of samples of whey based sport drinks - T1 (pineapple + whey), T2 (peach + whey) and T3 (pomegranate + whey). Siregar, N.S. and Sari, R.M.[7] studied the sensory evaluation of sports drinks prepared using Sidimpuan salak (*Salacca sumatrana* (Becc.)) fruit & they showed the values of major nutrients and energy as total fat of 0.31 g/100 ml, protein of 0.52 g/100 ml, carbohydrate of 13.88 g/100 ml, and total energy of 60.42 g/100 ml.

Electrolyte composition, particularly sodium and potassium, is critical for fluid retention and muscle function. Among the drinks, Minty Lemonade provided the highest sodium content (819.6 mg/100 g), approaching the desirable sodium enrichment seen in commercial sports drinks. Other formulations also contained relatively similar sodium (801.5-803.5 mg/100 g). By fortifying with salt, the homemade drinks become nutrient-rich scientifically appropriate sports beverages capable of meeting electrolyte replacement requirements during prolonged physical activity. This positions them as strong, cost-effective alternatives to commercial sports drinks, particularly in high-sweat scenarios where sodium balance is critical for performance and safety. Potassium content was highest in Jamba Juice (279.91 mg/100 g), highlighting its potential to aid in neuromuscular function and glycogen replenishment. Collectively, the formulations supplied a broad spectrum of minerals, including magnesium, zinc, and iron, which can contribute to recovery and micronutrient adequacy. The reported sodium & potassium content in sports drinks prepared using Sidimpuan salak (*Salacca sumatrana* (Becc) fruit by the researchers were 12.75±2.5 mg/100 ml & 100.11±3.8 mg/100 ml respectively[7].

Vitamin C in drinks plays a vital and specific role in metabolism, where the lack or excess of it could cause health problems. Vitamin C is a water-soluble vitamin that acts as co-enzymes under normal biological function[9]. Vitamin C reduces oxidative stress-induced during exercise. Vitamin C prevents tissue damage caused by free radicals. Exercise could induce oxidative stress, muscle tissue damage, lipid peroxidation in the membrane and the

formation of free radicals[10]. Here, for the present research, vitamin C and carotenoids were abundant in drinks such as Jamba Juice (238.09 mg vitamin C) and Red Storm (1238.6 µg carotene), underscoring the added functional benefit of antioxidant support. Such phytochemicals may help reduce oxidative stress induced by intense exercise, giving homemade sports drinks an advantage over some commercial counterparts that often lack these bioactive compounds. Researchers also noted significantly higher anti-oxidant content, in comparison with commercial isotonic beverage[11]. The reported vitamin C content was 10.62±0.07 mg% in sports drinks prepared using Sidimpuan salak (*Salacca sumatrana* (Becc) fruit[7].

4. Conclusion

The research on the formulation and sensory assessment of sports drinks conclusively shows that carefully selected combinations of natural fruit juices, glucose, botanicals, and electrolytes can produce beverages that not only meet the nutritional and hydration needs of athletes but are also highly acceptable in terms of sensory qualities. The six formulations studied demonstrated excellent palatability, confirming that natural ingredient-based sports drinks can satisfy both functional and consumer demands. The drinks provide optimal levels of key nutrients—carbohydrates for energy, sodium and potassium for electrolyte balance, and micronutrients for overall athlete health—while promoting voluntary fluid intake and offering appealing flavours and colours.

The formulation strategy of combining diverse fruit sources, botanicals, glucose, and light salting meets best practices for sports drink design: providing carbohydrates for energy replenishment, electrolytes for hydration and muscle function, and acceptable taste profiles encouraging adequate consumption. Natural ingredients also contribute beneficial micronutrients (vitamin C, folates, carotene), supporting overall health and recovery from strenuous activity. Current findings are consistent with broader research, which emphasizes that palatability and rehydration efficiency are interlinked, and that sodium content is especially crucial for promoting fluid intake and retention during exercise. Analytical results reinforce the importance of taste, aroma, and mouthfeel—consumers are more likely to sustain hydration protocols when the beverage is enjoyable.

5. Recommendations

a) **Product Development**: Future sports drink formulations should continue to emphasize the use of natural ingredients, balancing carbohydrate and electrolyte content to enhance hydration without compromising taste or causing gastrointestinal discomfort.
b) **Targeted Design**: Customizing sports drinks by exercise phase (pre, during, post-exercise) and individual needs can further optimize performance and recovery.
c) **Research Expansion**: Further studies should investigate the osmolality and its impact on fluid absorption and gastrointestinal tolerance, ensuring the formulations are not only effective but also comfortable to consume during intense activity and
d) **Consumer Guidance**: While sports drinks are beneficial for athletes engaged in prolonged or high-intensity exercise, water remains the preferred choice for hydration in the general population, and drink use should be guided by activity type, duration, and individual nutrition needs. These recommendations, together with the results of this research, will help ensure the continued improvement and safe use of sports drinks in both professional and recreational athletic contexts.

References

[1] Sawka, M. N., Burke, L. M., Eichner, E. R., Maughan, R. J., Montain, S. J., & Stachenfeld, N. S. (2007). American College of Sports Medicine Position Stand: Exercise and Fluid Replacement. *Medicine & Science in Sports & Exercise*, 39(2), 377-390. https://pubmed.ncbi.nlm.nih.gov /17277604/
[2] Sports Dietitians Australia. Fact Sheet Sports Drinks. (2009). chrome-extension://efaidnbmnnnibpcajpcglclefindm kaj/https://www.sportsdietitians.com.au/wp-content/uploads /2015/04/Sports-Drinks.pdf?
[3] Perez-Castillo, I. M., Williams, J. A., Lopez-Chicharro, J., Mihic, N., Rueda, R., Bouzamondo, H., & Horswill, C. A. (2023). Compositional Aspects of Beverages Designed to Promote Hydration Before, During, and After Exercise: Concepts Revisited. *Nutrients*, 20; 16(1):17. https://pmc.ncbi.nlm.nih.gov/articles/PMC10781183/
[4] Passe, D. Horn, M. & Stofan, J. & Murray, R. (2004). Palatability and Voluntary Intake of Sports Beverages, Diluted Orange Juice, and Water during Exercise. *International Journal of Sport Nutrition and Exercise Metabolism*, 14. https://www.researchgate.net/publication/ 8452281_Palatability_and_Voluntary_Intake_of_Sports_Beverages_Diluted_Orange_Juice_and_Water_during_Exercise
[5] Longvah, T., Ananathan, R., Bhaskarachary, K., & Venkaiah, K. (2017). Indian Food Composition Tables. National Institute of Nutrition (Indian Council of Medical Research), Department of Health Research, Ministry of Health & Family Welfare, Government of India, Hyderabad, Telangana State, India, 1-578.
[6] Demirhan, B., Cengiz, A., Gunay, M., Türkmen, M. & Geri, S. (2015). The Effect of Drinking Water and Isotonic Sports Drinks in Elite Wrestlers. *Antropologis*t, 21. 213-218. https://www.researchgate.net/publication/282336910_ The_Effect_of_Drinking_Water_and_Isotonic_Sports_ Drinks_in_Elite_Wrestlers.
[7] Siregar, N.S. and Sari, R.M. (2024). Chemical Compositions and Sensory Characteristics of Sports Drinks Formulated from Salacca Sumatrana (Becc.) Fruit. *Food Research*, 8(3): 37-42. chrome-extension://efaidnbmnnnib pcajpcglclefindmkaj/https://www.myfoodresearch.com /uploads/8/4/8/5/84855864/_5__fr-2022-169_siregar.pdf.

[8] Kanchana, N., Deepa, S., Veeranan, A. G. V., Saravana, P. & Vijayalakshmi, R. (2020). Studies on Standardization of Whey Based Isotonic Sports Beverages. *International Journal of Food Science and Nutrition*, 5 (5): 28-33. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.foodsciencejournal.com/assets/archives/2020/vol5issue5/5-5-20-932.pdf

[9] Navarro, P. A., M., Lerma-Garcia, M. J., Simo-Alfonso, E. F. & Herrero-Martinez, J. M. (2016). Determination of Water-Soluble Vitamins in Energy and Sport Drinks by Micellar Electrokinetic Capillary Chromatography. *Food Control,* 63, 110-116. https://www.semanticscholar.org/paper/Determination-of-water-soluble-vitamins-in-energy-Navarro-Pascual-Ahuir-Lerma-Garc%C3%ADa/3ad82ba76534855b11818096a90a1700a9d442eb.

[10] Braakhuis, A. J. (2012). Effect of vitamin C Supplements on Physical Performance. *Current Sports Medicine Report,* 11(4): 180-184. https://pubmed.ncbi.nlm. nih.gov/22777327/.

[11] Girones-Vilaplana A, Villano D., Moreno, D. A. & Garcia-Viguera, C. (2013). New Isotonic Drinks with Antioxidant and Biological Capacities from Berries (Maqui, Acai and Blackthorn) and Lemon Juice. *International Journal of Food Science & Nutrition*, 64(7): 897-906. https://pubmed.ncbi.nlm.nih.gov/23815554/.