



ISSN: 0975-833X

Available online at <http://www.journalera.com>

International Journal of Current Research
Vol. 13, Issue, 02, pp.16342-16344, February, 2021

DOI: <https://doi.org/10.24941/ijcr.40872.02.2021>

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

RESEARCH ARTICLE

BIOLOGICALLY SIGNIFICANT ION CONCENTRATIONS AND PHYSICO-CHEMICAL PARAMETERS OF EIGHT PACKED BEVERAGES AVAILABLE IN INDIA

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ARTICLE INFO

Article History:

Received 25th November, 2020
Received in revised form
20th December, 2020
Accepted 15th January, 2021
Published online 28th February, 2021

Key Words:

Physico-Chemical Parameter,
Sodium, Potassium,
Calcium, Nitrate, Chloride.

ABSTRACT

In this work we had studied Amul Tulsi Doodh, Amul Ginger Doodh, Paper Boat Alphonso Mango, Red Bull Yellow edition, Red Bull Sugar free, B Natural Cloudy Apple, B Natural Orange and B Natural Litchi drinks. We had studied physico-chemical parameters like pH, Salinity, TDS, Conductance and biologically significant ions like sodium, potassium, calcium, nitrate, ammonium and chloride. Milk products are less acidic and have high TDS, salinity and conductance. B Natural products have relatively low conductance, salinity and TDS. Calcium content is much higher in Amul ginger doodh and Amul tulsi doodh. Nitrate concentration is greater than 20000 mg/lit in Paper Boat Alphonso Mango and B Natural Litchi drink. High chloride concentrations (>2000 mg/lit) are found within Amul ginger doodh and B Natural orange.

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Citation: Monojit Ray, Sahali Dey and Gourab Saha. 2021. "Biologically Significant Ion Concentrations and Physico-chemical parameters of Eight packed Beverages Available in India.", *International Journal of Current Research*, 13, (02), 16342-16344

INTRODUCTION

Human blood pH always remain always slightly above 7 and Total Dissolved Solid (TDS) indicates the amount of dissolved substance present. Conductance value denotes the amount of ions present and salinity reflect the amount of salt present. Low pH value denotes, higher acidity of packed drinks. For carbonated soft drinks available in India $[K^+]/[Na^+]$ values are mostly less than unity. For RC Cola, Pepsi, Coca cola and Thums up the values are greater than unity (Ray, 2015). All the Tropicana and Real brand packed juices contain relatively high potassium ion concentration and $[K^+]/[Na^+]$ value lies between 1.07 to 48.57 (Ray, 2015). Sodium ion regulates, blood pressure, blood volume, osmotic pressure and pH of human blood (Das, 2008). Potassium is the most important intracellular ion. Calcium ion is the major component of the structural materials of bone, teeth and shell in living systems (Das, 2008).

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Chloride ions are present in living system as bulk anion. The estimated daily ammonia intake through food and drinking-water is 18 mg, by inhalation less than 1 mg, and through cigarette smoking (20 cigarettes per day) also less than 1 mg. In contrast, 4000 mg of ammonia per day are produced endogenously in the human intestine (Ammonia, 1986). Permissible limits for nitrate in drinking water is 45 mg/L NO_3^- (Bureau of Indian Standards, 2012) and have a guideline value of 50 mg/L (WHO 2011) above which it can pose serious health hazards (Taneja et al., 2015). Refreshing packed drinks which widely consumed specially during summer by the people, provide sodium, potassium, calcium, chloride etc, ions to human body (Das, 2008; Ray, 2019; Ray, 2020; Aurelia, 2011; Carbonated drinks, 2011; Ashurst, 2009; Gibson, 2008; Louis, 1980; Martin Hickman Caution, 2007; Michael Jacobson, 2015). Sodium ion concentration, potassium ion concentration, calcium ion concentration, chloride ion concentration, ammonium ion concentration and nitrate ion concentration within human body fluid and blood are almost constant. The exact concentrations of the ions are different for different type of cells or body fluids.

The extracellular potassium ion concentration is 0.2 g per liter(approx), at the same time, the intracellular potassium ion concentration is 6 g per liter (approx). The extracellular

sodium ion concentration is 3.45 g per liter (approx), whereas, the intracellular sodium ion concentration is 0.23 g per liter (approx)³. The extracellular chloride ion concentration is 100 millimole per liter (approx), whereas, the intracellular chloride ion concentration is 10 millimole per liter (approx). The $[Ca^{2+}]_{outside\ cell}/[Ca^{2+}]_{inside\ cell} = 1000$ (approx). For the present study samples taken are Amul Tulsi Doodh, Amul Ginger Doodh, Paper Boat Alphonso Mango, Red Bull Yellow edition, Red Bull Sugar free, B Natural Cloudy Apple, B Natural Orange and B Natural Litchi drinks.

MATERIALS AND METHODS

All the samples subjected for study were sealed packs or metal cans and manufactured within last three month of study date. The sodium ion concentrations and potassium ion concentrations were measured at the Environmental Chemistry Research Laboratory, Barrackpore Rastraguru Surendranath College, Barrackpore, North 24 Parganas, WB, using Systronics (India) made Flame photometer 128 μ C.

Chloride, nitrate, ammonium and calcium ion concentrations are measured using Systronics (India) made ion meter model number SYS-460 at Environmental Chemistry Research Laboratory, Barrackpore Rastraguru Surendranath College, Barrackpore, North 24 Parganas, WB.

Calcium ion concentration was measured using ISE 40 electrode. Nitrate ion concentration was measured using ISE 62 electrode. Ammonium ion concentration was measured using ISE 17 electrode, Chloride ion concentration was measured using ISE 35 electrode, Total Dissolved Solid (TDS), pH, Temperature, conductance and salinity were measured using EUTECH made Multi-parameter PCSTestr 35 at the Environmental Chemistry Research Laboratory, Barrackpore Rastraguru Surendranath College, Barrackpore, North 24 Parganas, WB. Ion free, redistilled water, prepared at laboratory, were used for all the analysis. All the measurements were carried out between 20°-23°C.

RESULTS

Table 1. Name . Make, Batch number and Energy value of Beverages

Sl No.	Name	Make	Batch Number	Energy Value (Kcal/100 ml)
1.	Amul Tulsi Doodh	Amul Fed Dairy	KEB2381	100
2.	Amul Ginger Doodh	Amul Fed Dairy	KEB2551	105
3.	Paper Boat Alphonso Mango	Hector Beverages Pvt. Ltd.	AA9301	62.4
4.	Red Bull Yellow edition	Rauch Fruchtsafte GmbH & Co	1861551	46
5.	Red Bull Sugar free	Rauch Fruchtsafte GmbH & Co	1871890	03
6.	B Natural Cloudy Apple	ITC Ltd, Kolkata	B2AR22102	54
7.	B Natural Orange	ITC Ltd, Kolkata	B2OR151	52
8.	B Natural Litchi	ITC Ltd, Kolkata	B2LF14122	50

DISCUSSION

The make, batch number and energy value per 100 ml for packed beverages subjected for study are listed in Table-1.

Table 2. Physicochemical Parameter Data of Beverages

Sl No.	Name	pH	Conductance (μ S/cm)	Salinity (ppm)	TDS (ppm)
1.	Amul Tulsi Doodh	6.18	4780	2540	3370
2.	Amul Ginger Doodh	6.30	4340	2330	3110
3.	Paper Boat Alphonso Mango	3.31	1210	597	854
4.	Red Bull Yellow edition	3.20	1647	825	1170
5.	Red Bull Sugar free	3.42	2290	1160	1620
6.	B Natural Cloudy Apple	2.89	663	322	471
7.	B Natural Orange	2.95	1420	710	1010
8.	B Natural Litchi	3.20	667	325	473

Table 3. Ion Concentration Data of Beverages (ppm)

Sl No.	Name	Na ⁺	K ⁺	Ca ⁺⁺	NH ₄ ⁺	Cl ⁻	NO ₃ ⁻
1.	Amul Tulsi Doodh	703.65	1305.6	87	17.6	1667	8.8
2.	Amul Ginger Doodh	734.55	1405.2	87	22.8	2301	20
3.	Paper Boat Alphonso Mango	68.8	919.8	3.2	0.984	1338	>20000
4.	Red Bull Yellow edition	1117.6	12.2	14	52	759	150
5.	Red Bull Sugar free	843.9	39.4	4.9	17.0	1390	0.042
6.	B Natural Cloudy Apple	55.3	353.5	0.463	0.284	1279	2.2
7.	B Natural Orange	393.3	502.4	2.2	66	2572	22
8.	B Natural Litchi	105.0	276.3	0.890	123	1223	>20000

Amul Ginger doodh and Amul tulsi doodh provide 105 kcal and 100 kcal energy respectively per 100 ml. Red Bull Sugar free provide minimum energy (3 kcal/100 ml), while all the B Natural product beverages subjected for study provide around 50 kcal energy. In the common carbonated soft drinks pH value lies between 2.45 to 2.38, and most of them have pH below 3.0 i.e., they are strongly acidic. For packed beverages subjected for this study pH values lies between 2.89 to 6.30. Salinity and conductance are relatively high for Amul ginger doodh, Amul tulsi doodh and Red Bull Sugar free. B Natural Cloudy Apple and B Natural Litchi have lower Salinity and conductance. The studied drinks show TDS value between 471 to 3370 mg/lit. The TDS value of Amul Tulsi Doodh and Amul Ginger Doodh were found 3370 and 3110 ppm respectively. For all the drinks subjected for study. Salinity ranges between 322 to 2540 mg/lit. B Natural Cloudy Apple and B Natural Litchi shows relatively low salinity and relatively low conductance value. Conductance value of studied beverages remain between 663 to 4780 μ S/cm. In the studied items sodium ion concentrations ranges between 55.3 to 1117.6 ppm, that for potassium ion is 12.2 to 1405.2 ppm. The concentration of calcium ion lies within the range 0.463 to 87 ppm. The span of ammonium concentration found within the range 0.284 to 123 ppm. Chloride concentration found between 759 to 2572 ppm. The nitrate concentration for B Natural Litchi and Paper Boat Alphonso Mango were found above 20000 ppm. For the other items the nitrate concentration lies between 0.042 to 150 ppm.

CONCLUSION

Except Amul ginger doodh and Amul tulsi doodh all are strongly acidic. TDS value for Amul ginger doodh, Amul tulsi doodh, B Natural Orange and Red bull products are very high and more than WHO limit. B Natural Cloudy Apple and B Natural Litchi are better than others with respect to TDS. Chloride ion maintain the electroneutrality of intracellular fluids. In plasma chloride concentration is approximately 100 miliequivalent per liter and 125 miliequivalent per liter. These are required for maintaining Donan membrane equilibrium.

Salt content is relatively high for Amul ginger doodh, Amul tulsu doodh and Red Bull Sugar free. B Natural Cloudy Apple and B Natural Litchi are lower salt containing drinks. TDS of milk products are very high and few thousands mg/lit. High conductance value indicates the presence of larger amount of dissolved salts. Potassium ion concentration for Red Bull products are very low. For other products $[K^+]/[Na^+]$ values are greater than unity. Calcium is a bulk and essential metal for human body. Amul Tulsu Doodh and Amul Ginger Doodh provide sufficient calcium ions. B Natural products and Paper Boat Alphonso mango have very low calcium content (less than 5 ppm). Acceptable limit of ammonium ion in drinking water 0.5 ppm and that for nitrate is 45 ppm (Bureau Of Indian Standards, 2012). Maximum acceptable chloride concentration as per BIS is 250 ppm. In all the studied items chloride concentrations are greater than BIS limit. With respect to ammonium ion value Paper Boat Alphonso Mango and B Natural Cloudy Apple are acceptable drinks only. All the other drinks contain high ammonium concentration. Amul Tulsu Doodh, Amul Ginger Doodh, Red Bull Sugar Free, B Natural Cloudy Apple and B Natural Orange have nitrate ion within permissible BIS limit. Paper Boat Alphonso Mango and B Natural Litchi are very poor quality drinks with respect to nitrate content. In general way it can be said that Amul doodh products, Red Bull sugar free and B Natural Cloudy apple are relatively safe drinks. Patients suffering from kidney diseases or problem should not consume drinks containing high potassium concentration hence drinks having very low $[K^+]/[Na^+]$ ratio are preferred for them.

ACKNOWLEDGEMENT

The authors are extremely grateful to Governing Body and the Research monitoring committee of Barrackpore Rastraguru Surendranath College for financial assistance & funding a research project.

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