PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 14 (8): 453-456, 2015
ISSN 1680-5194

Effect of Banana Isotonic Drink to Maintain Hydration Through Urine and Blood Electrolytes

Yuni Afriani[1], Kurniasari Rofianti Putri[2], Mirza Hapsari Sakti Titis Penggalih[2], Istiti Kandarina[3] and Zaenal Muttaqien Sofro[4]
[1]Nutrition Program, Faculty of Health Sciences, Universitas Respati Yogyakarta, Yogyakarta, Indonesia
[2]Department of Nutrition and Health, [3]Department of Public Health, [4]Department of Physiology, Faculty of Medicine, Universitas Gadjah Mada, Yogyakarta, Indonesia

Abstract: Banana isotonic drink is a potential beverage which has positive effect to maintain blood circulation. To make an improvement of product, clinical trials must be done in humans to know the effects of rehydration based on electrolyte analysis. This study used cross-over design with 7 days of washed out periods. Sixteen respondents, aged up to 20 years old and passed the selection of orthostatic test, were involved in this study. Changes in urine and blood electrolyte levels were checked before and after intervention. Electrolyte, include sodium, chloride and potassium, were measured using Easylyte. Data were analyzed with paired t-test and independent sample test. There were significant differences of urine level of chloride and sodium ($p<0.05$) after consumption plain water and banana isotonic drink. However, there was no significant difference ($p>0.05$) in urine level of potassium. Urine electrolyte decreased in all group after intervention. Meanwhile, potassium level increased after consumption banana isotonic drink. There were significant differences of chloride blood level ($p<0.05$) between plain water and banana isotonic drink. There were no significant differences ($p>0.05$) in blood level of potassium and sodium. Blood level of sodium and chloride decreased in all group. Meanwhile, potassium level increased after consumption banana isotonic drink. Banana isotonic drink was effective to maintain level of electrolyte in body by decreasing the level of electrolyte in urine output and improve potassium level.

Key words: Banana isotonic drink, hydration, urine, blood, electrolytes

INTRODUCTION

Many teenagers have mild dehydration higher than adults by 49.5 and 42.5% (Hardinsyah, 2009). Dehydration in women is 3.5% whereas in men is 3% measurement of blood pressure and heart rate using orthostatic test (Schroeder *et al*., 2002). Wotton *et al*. (2008) explained that hidden dehydration will seriously affect health conditions. Dehydration can lead to sustained blood coagulation and impaired circulation which lead the failure of organs function such as kidneys, liver, heart and brain (Ekawati, 2008).

Healthy drink is one of products that is new for consumer of goods industry in Indonesia. A healthy drink consists of three groups of products, namely energy drinks, isotonic drinks and milk (Julianingsih, 2005). The increasing of sweat production can cause dehydration and body electrolyte imbalance and it can be minimized by consuming water containing electrolytes with sufficient amount (Casa *et al*., 2000).

Weasley (2006) revealed that isotonic drink for rehydration should essentially contains a mixture of carbohydrates such as fructose, glucose, flavoring and electrolytes that predominantly are sodium and potassium. Not only isotonic drink contains electrolytes but also has similar osmolarity with body fluid so that it can directly refund the balance of body fluid. Isotonic drink can be made of natural or local product using banana kepok kuning which contains electrolytes and carbohydrate (Soenarto and Suparyati, 1986). In addition, conducted by Penggalih *et al*. (2008), has proven that there are benefits of banana kepok kuning to rise level of blood sugar and performance of athletes (Penggalih *et al*., 2008).

Banana flour, made from banana kepok kuning, is one of Indonesian commodity which could be developed into an isotonic drink. The content of carbohydrates and electrolytes, availability of the fruit, the price of fruit are the consideration to develop banana kepok kuning being banana isotonic drink. The formulation of banana isotonic drink had been developed. Compared to plain water, banana isotonic drink gave the positive effects to maintain blood circulation and body volume and showed a rapid tolerance to blood pressure when the subject provoked to upright position. Banana isotonic drink showed more improvement for the orthostatic tolerance in voluntary dehydration subject (Penggalih *et al*., 2012). This study aims to conduct clinical testing of banana isotonic drink on human body rehydration through urine

Corresponding Author: Yuni Afriani, Nutrition Program, Faculty of Health Sciences, Universitas Respati Yogyakarta, Yogyakarta, Indonesia

and blood electrolyte in male subjects with voluntary dehydration by orthostatic measurements.

MATERIALS AND METHODS

This study used an experimental study with cross-over design. The study population was 16 men aged up to 20 years old who lives in Yogyakarta (Gonzales *et al*., 1992). Research instruments used in this study were informed consent form, weight scales, microtoise, Easylite, digital blood pressure and heart rate. The study was begun with the screening process of dehydration with orthostatic measurements. The subject carried out the measurements of blood pressure and heart rate in a state of lying down for 5 min and standing for 7 min without break in between. Dehydrated subject was marked by increasing heart rate more than 30/min or more than 120/min in 7 min of standing with or without decreasing blood pressure by 20 mmHg. Subjects who were not dehydrated were not involved in this study.

One day before the data collection, each subject was given standard diet and fulfills the programs for controlling fluid consumption. The whole treatment of experiments were conducted in the morning at 06.00 to 9.00 am. Over the last 48 h subjects were asked to avoid excessive activity, caffeinated beverages, alcohol and vitamin or mineral supplements. Subjects were asked fasting overnight to control the intake of food and drink (Cheuvront and Sawka, 2005).

After sleeping and fasting overnight, subjects were asked to collect the morning urine. Furthermore, the subjects were asked to sit in a comfortable room for 15 min to take venous blood at the arm. Then, the orthostatic measurement was taken for 15 min. The subjects were asked to consume as much as 500 ml of fluids with cold temperature to reach the optimal rehydration process. Orthostatic measurements were taken again for 15 min. After that, the blood sampling was taken after 2 h of rehydration period followed by urine collection. Two experimental treatments are done separately with a range of 7 days. The purpose of washed out period is to eliminate the effects of early intervention before the second intervention was begun.

Statistical data analysis used in this study are paired t-test and independent sample test. The data are tested using statistics software with a significance difference $p<0.05$ and are presented as mean±SD. Ethical clearance from Medical and Health Research Ethics Committee (MHREC) has been obtained before the study was conducted. All data in this study will be kept confidentially.

RESULTS

Subject characteristics: Subject characteristics which is measured include age, weight, height, body mass index (BMI) describing nutritional status (Table 1).

Table 1: Subject characteristics

		----- Group ------			
Variable	Category	PW	BID	Sum	p-value
Age (year)	18-19	6	7	13	0.522
	>19-20	2	1	3	
		8	8	16	
Body weight (kg)	45-59	5	5	10	1.000
	60-90	3	3	6	
		8	8	16	
Height (cm)	160-169	3	4	7	0.614
	170-200	5	4	9	
		8	8	16	
BMI (kg/m^2)	<18.49	2	2	4	0.774
	18.5-22.9	5	4	9	
	23-24.9	1	1	2	
	25-27	0	0	0	
	>27	0	1	1	
Sum		8	8	16	

Descriptions, PW: Plain water, BID: Banana Isotonic drink

Table 2: Results of urine and blood electrolytes in plain water (n = 16)

		---------- Mean±SD ----------		
Variable	Sample	Before	After	p-value
Na^+ (mEq/L)	Urine	117.938±49.052	66.9375±36.477	0.001*
	Blood	143.000±2.338	143.250±1.949	0.687
K^+ (mEq/L)	Urine	23.425±14.190	20.544±15.281	0.362
	Blood	4.175±0.338	4.106±0.289	0.201
Cl^- (mEq/L)	Urine	109.312±43.330	77.750±38.651	0.010*
	Blood	102.250±2.380	101.875±2.094	0.130

*: Significant ($p<0.05$)

Table 3: Results of urine and blood electrolytes in banana isotonic (n = 16)

		---------- Mean±SD ----------		
Variable	Sample	Before	After	p-value
Na^+ (mEq/L)	Urine	136.375±56.420	81.438±48.807	0.001*
	Blood	144.562±1.590	143.875±1.310	0.119
K^+ (mEq/L)	Urine	23.038±11.426	23.888±16.188	0.861
	Blood	4.131±0.233	4.188±0.236	0.398
Cl^- (mEq/L)	Urine	125.068±42.300	94.438±54.241	0.042*
	Blood	102.750±1.438	101.688±1.448	0.000*

*: Significant ($p<0.05$)

Effect of plain water on urine and blood electrolyte: The statistical tests between pre, post and 2 h rehydration showed that there were significant differences of Urine Na^+ and Cl^- level ($p<0.05$) in the plain water group. There were no significant differences of Urine K^+, Blood Na^+, K^+ and Cl^- level however ($p>0.05$) (Table 2).

Effectiveness of banana isotonic drink on urine and blood electrolyte: The statistical tests between pre, post and 2 h rehydration showed that there were significant differences of Urine Na^+ and Cl^- level also Blood Cl^- ($p<0.05$) in the Banana Isotonic Drink group. There were no significant differences of Urine K^+ and Blood Na^+ and K^+, however ($p>0.05$) (Table 3).

Differences of urine and blood electrolyte between plain water and banana isotonic drink: Independent t-test analysis showed that there was a significant difference of Blood Cl^- level between plain water and

Table 4: Differences of urine and blood electrolyte level between plain water and banana isotonic drink (n = 16)

		------ Mean±SD (Δ) ------		
Variable	Sample	PW	BID	p-value
Na^+ (mEq/L)	Urine	-51.000±52.058	-54.938±55.261	0.837
	Blood	0.25±2.436	-0.69±1.662	0.215
K^+ (mEq/L)	Urine	-2.881±12.250	0.850±19.114	0.516
	Blood	-0.069±0.2056	0.056±0,2607	0.143
Cl^- (mEq/L)	Urine	-31.563±42.510	-13.756±63.193	0.357
	Blood	-0.38±0.957	-1.06±0.680	0.029*

Descriptions, PW: Plain water, BID: Banana isotonic drink
*: Significant (p<0.05)

banana isotonic drink (p<0.05). However, there were no significant differences Urine and Blood Na^+ and K^+ level also Urine Cl^- level between groups (p>0.05) (Table 4).

DISCUSSION

This research provided that consumption of plain water give decreased Na^+ level in urine (p<0.05), increased Na^+ in the blood, reduced levels of K^+ in urine and Cl^- in urine (p<0.05) and blood (p>0.05). On the other hand, consumption of banana isotonic drinks decreased Na^+ urine and Cl^- urine and blood (p<0.05) and increased K^+ in urine and blood (p>0.05).

There were no significant differences of electrolytes-Na^+, K^+, Cl^- level in the urine between plain water and banana isotonic drink while the significant difference of Cl^- in the blood is found in plain water and banana isotonic drink group (p = 0.029). Excreted urine volume is higher in plain water group compared with banana isotonic drink. According to Maughan and Murray (2001), the consumption of plain water cause a decrease in sodium concentration. Decrease of sodium inhibit the release of arginine vasopressin (ADH), stimulates urine output and delay the process of rehydration. Banana isotonic contain sodium that indirectly increase the release of ADH. Therefore the urine production in banana isotonic drink group is not as much as plain water (Afriani, 2011). Levels of chloride in the urine is comparable to sodium level excreted through (p<0.05). When the sodium decreased, the chloride should decreased. Chloride is an anion which always accompany sodium in extracellular tissues (Born, 2005). After consumption of plain water, Na^+ retention and absorption occurs by kidneys due to hyponatremia occurred at the beginning of consumption.

After consumption of banana isotonic drink, the Na^+ decline was greater than plain water because the plain water pulled the Cl^- into intracellular to keep the body osmolarity. Levels of potassium was not significantly different in the blood and urine after consumption plain water and banana isotonic because the body compensated levels of potassium in blood and urine. Hence, the levels of potassium in the body especially in CES kept in a stable state (Siregar, 2006; Mardiana, 2009).

Based on the result, the amount of K^+ in blood and urine is higher than after consumption plain water (p>0.05) (Afriani *et al*., 2012). Because, levels of potassium in banana isotonic drink is higher than plain water. Potassium in urine can describe the level of potassium in the blood. High potassium in blood will spur expenditure aldosterone that stimulate expenditure of K^+ by the kidneys to maintain levels of normal K^+ in the blood (Bray *et al*., 1999; Silverthorn *et al*., 2001).

The most fundamental differences in both kinds of drinks-plain water and banana isotonic drink is the ability to deprive of thirsty sensation, to increase volume of urine, to maintain electrolyte levels and to rehydrate of body. While beverages containing an electrolyte and carbohydrates deprive thirsty sensation longer than plain water (Casa *et al*., 2000). The difference of electrolytes level between plain water with banana isotonic is very small. It showed that banana isotonic drink is not able to give a meaningful effect compared with plain water when compared in the same individual, especially in Na^+ and Cl^- levels. Therefore, this study needs further formulation related to the composition and type of electrolyte used in the manufacture of these isotonic drinks. In this case, it can be said that banana isotonic drink can be used for dehydration intervention, but there were no significant differences between plain water and banana isotonic drink.

The weakness of this study is that it did not measure other variables that can be used as an indicator of hydration state, such as serum osmolarity and thirsty hormone. This study could get more valid results if subject was asked about the habit of food and fluid consumption.

Conclusion and recommendations: Banana isotonic drink was effective to maintain level of electrolyte in the body by decreasing excreted electrolyte in urine. However, it need further assessment in blood electrolyte level due to serum osmolarity.

REFERENCES

Afriani, Y., 2011. Pengujian klinis hasil pengembangan produk minuman isotonis alami berbasis tepung pisang kepok kuning (Musa paradisiaca formal typical) terhadap rehidrasi cairan tubuh: pendekatan nilai elektrolit urin. Skripsi. Yogyakarta: UGM.

Afriani, Y., K.R. Putri, M.H.S.T. Penggalih, I. Kandarina and Z.M. Sofro, 2012. Banana Isotonic Drink Maintain Body Fluid Hydration in Voluntary Dehydration Subject Through Urine and Blood Electrolyte Assessment. 3rd International Symposium on Wellness and Healthy Lifestyle. Kelantan: Nutrition Program, School of Health Sciences, Universiti Sains Malaysia.

Born, S., 2005. Electrolyte Replenishment. Retrieved from http://www.hammernut.com on12 Juli 2010.

Bray, J.J., A.A. Cragg, A.D.C. Macknight and R.G. Mills, 1999. Lecture Notes on Human Physiology, 4th Edition, Blackwell Science, Australia.

Casa, J.D., E.L. Armstrong, K.S. Hilmann, J.S. Mountain, V.R. Reiff, E.B. Rich, O.W. Roberts and J.A. Stone, 2000. National Athletic Trainers Association Posision Statement: Fluid Replacement for Athletes. J. Athletic Training, 35: 212-222.

Cheuvront, S.N. and M.N. Sawka, 2005. Hydration Asessment of Athletes. Sport Sci. Exc., 97: 18-22.

Ekawati, Y., 2008. Suhu Panas and Bunuh Diri Meningkat, 2008. Retrived from http://www.kompas.com on 17 Mei 2010.

Gonzales, J.A., C.L. Heaps and E.F. Coyle, 1992. Rehydration after Exercise with Common Beverages and Water. Int. J. Sports Med., 13: 399-406.

Hardinsyah, 2009. 46.1% Dari 1.200 Penduduk Indonesia Alami Dehidrasi Ringan. Retrieved from http://www.nusantara-news.com/on12 Juni 2010.

Julianingsih, S., 2005. Ekuitas Merek Pocari Sweat di Kota Bogor dan Depok. Thesis. Bogor: Magister Manajemen Agribisnis, Institut Pertanian Bogor.

Mardiana, N., 2009. Disorder of Potassium Metabolism. In Book of Annual Meeting Pernefri. Jakarta: Pernefri.

Maughan, R.J. and R. Murray, 2001. SPORTS DRINKS: Basic Science dan Practical Aspects. CRC Press: Boca Raton London, New York, Washington DC.

Penggalih, M.H.S.T., F.L. Widiyani and R. Aurelia, 2008. Pengaruh Ketepatan Pemberian Kalori Diit Pada Atlet Sepak Bola Secara Individu dengan Peningkatan Stamina Tubuh di PERSIBA Bantul. Poster Presentation in National Workshop of Food of Nutrition IX Jakarta, 26-27 Agustus, 2008.

Penggalih, M.H.S.T., M. Gardjito and Z.M. Sofro, 2012. Banana isotonic drink improves orthostatic tolerance in voluntary dehydration subject. Int. Food Res. J., 19: 883-887.

Schroeder, C., V.E. Bush, L.J. Norcliffe, F.C. Luft, J. Tank, J. Jordan and R. Hainsworth, 2002. Water drinking acutely improves ortostatik tolerance in healthy subjects. Circulation, 106: 2806-3281.

Soenarto and S. Suparyati, 1986. Larutan Tepung Beras-Garam dan Tepung Pisang Garam Sebagai Terapi Rehidrasi pada Anak Diare. Yogyakarta: Lembaga Penelitian UGM.

Silverthorn, A.C., C.W. Garisson and W.C. Ober, 2001. Human Physiology on Integrated Approach Second Edition, Prentice Hall, New Jersey.

Siregar, P., 2006. Gangguan Keseimbangan Cairan dan Elektrolit. Dalam: Buku Ajar Ilmu Penyakit Dalam. Edisi 4, Jilid I. Jakarta: Pusat Penerbitan Ilmu Penyakit Dalam FKUI.

Weasley, J., 2006. Sport Hydration: '07. Originally Presented as Endurence Sports,Rehydration, Cerebral Edema dan Death at NEAFS (Northeastern Association of Forensic Scientists) Annual Meeting, Rye Brook NY, November 2, 2006.

Wotton, K., K. Crannitch and R. Munt, 2008. Prevalence, Risk Factors dan Strategies to Prevent Dehydration in Older Adults. Contemp. Nurse, 31: 44-56.