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INCORPORATION OF APPLE JUICE AND WATERMELON JUICE IN COMPOSITION OF SPORTS DRINKS

Kiril Filev[a], Marijan Stevanovski[a], Natasha Gjorgovska[b], Daniela Belichovska[a*]

[a]*MIT University, blvd. Treta Makedonska Brigada bb, 1000 Skopje, R. Macedonia*
[b]*Institute of Animal Science, Ss. Cyril and Methodius University, blvd. Ilinden 92-a, 1000 Skopje, Republic of Macedonia*
[*]*Corresponding author: daniela.belichovska@gmail.com*

Abstract

Athletes need more fluid to maintain their ability to regulate internal temperature and to keep the body cool. Most energy released during exercises appears immediately as heat. The production of heat in contracting muscles can rise up to 20 times above that of resting muscles. Athletes must avoid dehydration for athletic performance, heat exhaustion, heat cramp, and prevention the potentially fatal heat stroke. Drinking fluid during exercise, when possible, should be adequate to minimize body weight loss, and to prevent dehydration. Following this practice is good idea even when sweating can go unnoticed, during the winter, to replace fluid lost in sweat, regulate body temperature, prevent dehydration and low blood sodium levels. Sports drinks are adequate solutions of electrolytes, sodium, potassium and chlorine, good sources of energy, carbohydrates and water. Apple and watermelon juices are also very good sources of potassium, carbohydrates, vitamins and natural flavor. They should be good substitution of mono potassium phosphate, artificial flavors, vitamins, glucose-fructose syrup and a special source of carotenoids (lycopen, lutein, zeaxanthin, cryptoxanthin) very strong antioxidants.

Keywords: sports drink, electrolyte, watermelon, apple, juice

1. Introduction

The needs of fluid for average adult people are about 9 cups per day for women and 13 cups for men [1]. Athletes generally need more water to maintain the body ability to regulate internal temperature and to keep cool. Most energy released during metabolism goes out immediately as heat. Heat production in contracting muscles can rise up 15 to 20 times above that of resting muscles [2]. Unless this heat is quickly dissipated, heat exhaustion, heat cramps and deadly heatstroke may ensue.

Athletes must avoid becoming dehydrated not only for the sake of athletic performance, but to prevent heat exhaustion, heat cramp and potentially fatal heatstroke. Fluid intake during exercise, when possible, should be adequate to minimize body weight

loss [3]. Following this practice is a good idea even when sweating can go unnoticed, such as when swimming or during the winter. To replace fluids lost in sweat, regulate body temperature and prevent dehydration and low blood sodium levels it is recommended appropriate fluid intake before, during and after physical activity. Fluid and electrolyte needs vary widely, so an athlete should aim to replace the total amount of fluid lost during exercise [4].

This can be accomplished by knowing their body's hourly sweat rate, which can be calculated from: the weight lost during exercise per hour, plus the fluid consumed during exercise per hour. The recommended fluid status goal is a loss of no more than 2% of body weight during exercise, especially in hot weather. Athletes first calculate 2% of their body weight and then by trial determine how much fluid they must take in, to avoid losing more than this amount of weight during exercise [5]. This determination will be most accurate if they are individually weighed before and after a typical work-out.

For every 0.5 kg lost of weight 0.75 liters of water should be consumed during exercise or soon afterwards. If the weight change can't be monitored, urine color is another measure of hydration status. Urine color should be no more yellow that lemonade. Thirst is not a reliable indicator because it is a late sign of dehydration. Athletes need to replace fluid during exercise. An athlete who drinks only when thirsty, needs 48 hours to replenish fluid losses. After several days of training, an athlete relying on thirst as an indicator can build up a fluid debt that will impair performance. The following fluid replacement in approach can meet an athlete's fluid needs in most cases [1]:

- freely drink beverages during the 24-hours' period before an event, even if not thirsty;
- drink 1.5 to 2.5 cups of fluid (400–600 ml) 2–3 hours before exercise;
- during events lasting more than 30 minutes, consume 0.5 to 1.5 cups.

2. Material and methods

2.1. Experimental procedures

The experiment was performed with the following material:

1. Powder drinks' mix, Quaker oats, Gatorade was used in our experiment, and 16 grams diluted in drinking water (182 ml). Powder should be flavored. The amount was enough for preparing of 200 grams ready-to-drink solution. From the data of analyzed

powder, it was found that the drinking solution will be sufficient in calories, and total sugars (sucrose and glucose). But there was lack of Na and K (10 mg) which is 11 times less than needed amount of daily value (110 mg). The similar situation is with content of K which should be 1% of daily value per serving (serving size 240 ml).

The sodium content is needed 110 mg per serving, and the K warred from 15 – 90 mg (tab3).

The powder drink was dissolved in the drinking water.

2. Adding juices

In the composition of the drink was added apple juice 20% or watermelon juice 20%. Both of them are very rich in potassium (K), so it is no need to use mono- potassium phosphate as a source of K. They are also rich in other organic antioxidants and other useful substances, amino acids, lipids, minerals and vitamins (Table 2). Juices could be filtered by water vacuum pump and filter paper.

3. Adding salt

Salt should be added as a source of sodium in amount very close to physiological electrolyte solution, 10 g per liter, 2.5 g for serving of 250 ml. Juices were prepared by power juicer, and the salt was solved by mixing in the drinking water.

The formula for mixing sports drinks for serving of 250 ml:

1. Drinking water with salt:	181.5 g	(72.6%)
2. Powder sports drink:	16 g	(6.4%)
3. Juice 1 or 2:	50 g	(20.0%)
4. Salt:	2.5 g	(1.0%)
Total:	250.0g	(100%)

4. Composition of the autochthonic juices and diluted powder

For the realization of the aim of project were used two autochthonic (apple and watermelon) juices and diluted powder of Gatorade sports drink .The composition of them is performed on table 1.

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Table 1. Composition of powder type diluted sports drink, and autochthonic juices from apples and watermelons

Nutrient	Type of drink		
	Diluted powder 200 ml	Apple juice 50 ml	Watermelon juice 50 ml
Total, ml	200	50	50
Energy, kcal	62	24	15
Energy, kJ	259	99	64
Proteins, g	–	0.03	0.30
Lipids, total, g	0.20	0.06	0.07
Ash, g	0.34	0.11	0.13
Carbohydrates, by difference, g	15.06	5.81	3.77
Dietary fibers, total, g	–	0.10	0.20
Sugar, total, g	12.80	5.45	3.10
Sucrose, g	9.58	–	0.60
Glucose, g	3.20	–	0.79
Fructose, g	0.03	–	1.68
Lactose, g	0.03	–	0.00
Maltose, g	0.03	–	0.03
Galactose, g	–	–	0.00
Starch, g	–	–	0.00
Calcium (Ca), mg	6.00	4.00	4.00
Iron (Fe), mg	0.05	0.19	0.12
Magnesium (Mg), mg	0.00	2.00	5.00
Phosphorus (P), mg	19.00	4.00	6.00
Potassium (K), mg	5.00	60.00	56.00
Sodium (Na), mg	10.00	2.00	–
Zinc (Zn), mg	0.01	0.01	0.05
Copper (Cu), mg	0.040	0.014	0.021
Manganese (Mn), mg	0.008	0.057	0.019
Selenium (Se), µg	–	0.1	0.2

Vitamin C, total as ac., mg	0.1	20.8	4.0
Thiamine, mg	0.002	0.011	0.017
Riboflavin, mg	0.128	0.009	0.011
Niacin, mg	0.035	0.050	0.089
Pantothenic acid, mg	0.009	0.032	0.111
Vitamin B_6, mg	0.004	0.015	0.022
Folate, total, µg	–	0.00	2.00
Vitamin B_{12}, µg	–	0.00	0.00
Vitamin A, IU	–	1	285
Vitamin E, α-tocopherol, mg	–	0.01	0.03
Vitamin K, phylloquinone, µg	–	0.00	0.10
Fatty acids, saturated, total, g	–	0.009	0.008
16:0, g	–	0.007	0.004
18:0, g	–	0.001	0.003
Fatty acids, monounsaturated, total, g	–	0.003	0.018
16:1, g	–	0.001	0.000
18:1, g	–	0.002	0.018
Fatty acids, total			
Polyunsaturated, g	–	0.017	0.025
18:2 undifferentiated, g	–	0.014	0.025
18:3 undifferentiated, g	–	0.003	0.000
18:4 undifferentiated, g	–	0	0
Carotene, beta, µg	–	0.00	152.00
Carotene, alpha, µg	–	0	0
Cryptoxanthin, beta, µg	–	0	39
Lycopene, µg	–	0.00	22.66
Lutein+Zeaxanthin, µg	–	8.00	4.00
Phytosterols, µg	–	–	1.00
Triptophan, g	–	–	0.004
Threonin, g	–	–	0.014

Isoleucine, g	–	–	0.009
Leucine, g	–	–	0.009
Lysine, g	–	–	0.031
Methyonine, g	–	–	0.003
Cystheine, g	–	–	0.001
Phenylamine, g	–	–	0.007
Tyrosine, g	–	–	0.006
Valine, g	–	–	0.008
Arginine, g	–	–	0.029
Histidine, g	–	–	0.003
Alanine, g	–	–	0.009
Aspartic acid, g	–	–	0.020
Glutamic acid, g	–	–	0.032
Glycine, g	–	–	0.005
Proline, g	–	–	0.012
Serine, g	–	–	0.008

3. Results and discussion

After the mixing of powder drink with juices and salt it where made two types of enriched sports drinks with apple juice and with watermelon juice. The composition of two types of drinks is performed in tab. 2.

From the data in the tab. 2 can be noticed that the energy value in one service of 250 ml is similar and close to the optimum for this type of drinks needed for energy with carbohydrate origin. The composition of carbohydrates become mainly from sugar (sucrose, glucose and fructose) easy digestible types of sugar, not from starch (amilose end amilopectin) slower digestible types... Because of this the drinks are convenient for keeping high level of energy during the hard working of athletes. This type of drinks cans bi taken when it is possible during the game.

Table 2. Composition of sports drinks enriched with fruit juice

Nutrient	Type of enriched drinks	
	with apple juice	with watermelon juice
Water, ml	250	250
Energy, kcal	86	77
Energy, kJ	358	323
Proteins, g	0.03	0.30
Lipids, total, g	0.26	0.27
Ash, g	0.48	0.47
Carbohydrates, by difference, g	20.87	18.83
Dietary fibers, total, g	0.10	0.20
Sugar, total, g	18.33	15.98
Sucrose, g	9.58	10.18
Glucose, g	3.20	3.90
Fructose, g	0.03	1.68
Lactose, g	0.03	0.00
Maltose, g	0.03	0.03
Galactose, g	0.00	0.00
Starch, g	0.00	0.00
Salt, g	2.50	2.50
Sodium (Na) (from salt), mg	100.00	100.00
Sodium, total, mg	110.00	112.00
Calcium (Ca), mg	10.00	10.00
Iron (Fe), mg	0.24	0.17
Magnesium (Mg), mg	2.00	5.00
Phosphorus (P), mg	23.00	25.00
Potassium (K), mg	65.00	61.00
Chlorine (Cl), mg	150.00	150.00
Zinc (Zn), mg	0.02	0.05
Copper (Cu), mg	0.05	0.06

Manganese (Mn), mg	0.065	0.027
Selenium (Se), µg	0.10	0.20
Vitamin C, total as a.c., mg	20.90	4.10
Tia mine, mg	0.013	0.019
Riboflavin, mg	0.137	0.139
Niacin, mg	0.085	0.124
Pantothenic acid, mg	0.041	0.120
Vitamin B_6, mg	0.019	0.026
Folate, total, µg	0.00	2.00
Vitamin B_{12}, µg	0	0
Vitamin A, IU	1	285
Vitamin E, α-tocopherol, mg	0.01	0.03
Vitamin K, phylloquinone, µg	0.00	0.10
Fatty acids, saturated, total, g	0.009	0.008
16:0, g	0.007	0.004
18:0, g	0.001	0.003
Carotene beta µg	-	152
Cryptoxanthin beta µg	-	39
Lutein+zeaxantin µg	8	4
Phytosterols µg	-	1

Electrolyte content, sodium and chlorine become from the salt NaCl (mineral sours) but the potassium from natural sours of juices. The content of water, carbohydrate, and minerals (Na, K, Ca, P) are keeping hydration of the body, hydrogen potential, body cooling and athletic performances during the game. The suphitiant is the level of vitamin C, and the other vitamins of B group are present in natural origin. Carotene beta and cryptoxantine are present in large amount when watermelon juice is present in the drink, lutein and zeaxantin are present in both drinks, and phitosterol is found in watermelon juice. A lot of amino acids are also found in the juice of watermelon and some fatty acids in both juices.

Comparing the content of different sports juices with the energetic juice Red bull it was found that the energy level and carbohydrate are the highest in energy – Red bull. But there was absent potassium, primary electrolyte together with the sodium.

Table 3. Content of sampling of sports drink

DRINK	SPORTS With apple juice	SPORTS With water melon	GATORADE endurance	ACELERADE Pac..HL inc.	RED bull GmbH
Serving size, ml	250	250	240	240	240
Calories	86	77	50	80	106
Carbohydrate, g	20	18	14	15	27
Sodium, mg	110	112	200	120	193
Potassium, mg	65	61	90	15	-
Calcium, mg	10	10			
Iron, mg	0.24	0.17			
Magnesium, mg	2	5			
Protein, g	0.03	0.3		a	
Vitamins	B1,B2,B3, B5,B6,A Carotenoids	B1,B2,B3, B5,B6 Carotenoids, Lycopene	-	E	B3,B5,B6, B12
Caffeine, mg	-	-	-	-	77
Taurine, Inositol, Glukuronolaktons, L-carnitine, Genseng, Ginko					a

a – The amount is not specified on the table

The sports drinks produced by big manufacturers have a deficiency of very important vitamins and some macro and micro minerals [6]. Sports drinks made with natural juices are rich with vitamins, micro minerals and other strong antioxidants [7]. Protein and amino acids in sports drinks can be used, if a good source of protein is unavailable in the food of athletes. Immediately after prolonged vigorous exercise is needed for muscle recovery [8]. Low fat milk is a good option for use as a post exercise protein – recovery drink [9].

Caffeine and other stimulants can enhance physical performance by increasing aerobic endurance and strength, improving reaction time, and delaying fatigue [10].

However, these effects are extremely variable and not studied in adolescents. Caffeine is structurally similar to adenosine and can bind in its place to membrane receptors which results in subsequent block of adenosines actions. The effects of caffeine on various organ systems include increases in heart rate, blood pressure, speech rate, motor activity, attentiveness, gastric secretion, diuresis, and temperature [11]. It is also known to play a role in triggering arrhythmias [12]. A lethal dose of caffeine is considered to be 200 to 400 mg/kg [13]. Energy drinks, typically contain stimulants (caffeine and guarana) with varying amount of carbohydrate, protein, amino acids, vitamins, sodium, and other minerals.

With young athletes, careful consideration is necessary when selecting a beverage to hydrate: - before, during, or after exercise. Outside of physical activity, have to prevent them from:-excessive sugar and caloric intake that can cause dental erosion overweight and obesity.

4. Conclusions

On the basis of the studied subject of sports drinks needed for optimization of athletic performance, (replacement of fluid and electrolytes lost in sweat, boosting of energy, decreasing fatigue, enhancing concentration, and mental alertness) the drinks with incorporated apple and watermelon juices were designed. The following can bi concluded:

a) Sports drinks are different then energy drinks.

b) They are beverages that contain carbohydrates, minerals, electrolytes (Na, K, Ca, Mg), and sometimes vitamins or other nutrients but not *stimulants.*

c) Carbohydrates and minerals are dissolved in water and juices.

d) Dissolving medium made with water and autochthonic juices where made, to make the fluid rich in potassium, vitamins, minerals and many other nutrients and flavors.

e) Watermelon juice and apple juice can participate in the composition of sports drinks.

f) The level of many minerals (K, P, Ca) can participate in nutrient composition as natural constituents from the juices.

g) Flavor also belongs to apples and watermelons.

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