Carbohydrate and Electrolyte Contents in Commercial Fruit Juices

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Abstract

Forty kinds of commercial fruit juices sold in Thailand were analyzed for types and contents of carbohydrates, electrolytes as well as osmolarity and pH. Each juice was analyzed three times and the results were averaged. A few kinds of fruit juices have high sorbitol contents (> 10 g/L). There are some juices which have a high fructose to glucose ratio (> 1.5:1). Sodium contents in juices ranged from 19 to 1405 mg/L. The osmolarity of the juices ranged from 500 to 1200 mOsmol/L. Most juices have acid pH which ranged between 2.8 and 5.0. It is concluded that each fruit juice has a unique set of properties. Consumers should know the properties of each juice because chronic intake and large amount intake of the juice could have detrimental effects on the health of the consumer.

Key word : Fruit Juices, Sucrose, Fructose, Sorbitol, Osmolarity, pH

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Fruits have been part of daily diets in most countries since ancient times. Fruits provide consumers not only with water, vitamins and fiber, but also sugars and electrolytes. Taste as well as nutritious content are also different among various kinds of fruits. While consumption of moderate amounts of fruit juice does not generally cause harmful effects to the consumer, but for some people, for example those who suffer from hypertension, or kidney dysfunction, consumption of juice in moderate amounts may cause awful effects. Nevertheless, most young children consume only about 80 per

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Table 1. Carbohydrate contents, osmolarity and pH of 40 kinds of fruit juices.

Type of juice	Sucrose g/L	Glucose g/L	Fructose g/L	Sorbitol g/L	Osmolarity mO/sm/L	pH
Orange (TIPCO)	28	31	36	2	979	3.75
Orange (IVY)	14	27	35	0	871	3.92
Orange (A-TIP)	98	54	5	0	624	3.46
Apple (TIPCO)	5	32	72	7	923	3.55
Apple (MALEE)	0	30	51	0	824	2.91
Grape red (TIPCO)	0	36	43	0	1,123	3.52
Grape red (IVY)	0	36	57	0	1,000	3.4
Grape red (UFC)	2	52	68	2	109	2.88
Grape white (TIPCO)	0	36	42	0	1,044	3.51
Grape white (30% UFC)	0	52	65	17	1,031	2.78
Grape white (40% UNIF)	0	38	51	0	970	3.23
Black currant (40% IVY)	2	36	54	0	884	3.1
Pineapple (TIPCO)	34	40	36	0	807	3.84
Pineapple (SINGHA)	33	41	39	0	794	3.8
Pineapple (UFC)	20	48	54	0	963	3.68
Pineapple (50% MALEE)	40	40	54	0	866	3.58
Guava (TIPCO)	4	36	40	0	782	3.29
Guava (25% SINGHA)	4	30	44	0	812	3.52
Red Guava (25% SINGHA)	7	31	58	0	837	3.67
Guava (25% UFC)	2	49	61	2	999	2.94
Guava (25% MALEE)	20	20	32	0	802	3.47
Guava (30% Doikum)	28	36	42	0	802	3.85
Okra (SINGHA)	8	57	64	0	1,092	2.73
Okra (A-TIP)	49	46	37	3	786	3.12
Okra (25% MALEE)	1	30	45	0	806	3.61
Litchi (25% PIGEON)	9	23	47	0	629	3.52
Litchi (25% FREEZE)	0	33	75	0	956	3.19
Prunes (VETA)	0	78	64	149	1,214	4.0
Prunes (DELMONTE)	42	40	48	67	1,453	3.83
Prunes (25% SINGHA)	5	50	52	0	1,189	3.11
Prunes (25% Doikum)	0	43	53	0	1,119	2.95
Kiwi (IVY)	15	40	45	0	913	3.36
Apricot (IVY)	15	30	57	0	814	3.59
Pear (IVY)	12	34	63	14	809	3.61
Pear (40% IVY)	11	28	40	10	902	3.34
Peach (IVY)	32	44	42	1	981	3.47
Longan (SINGHA)	112	38	17	0	545	5.76
Passion fruit (PIGEON)	0	30	63	0	859	3.18
Mango (25% PIGEON)	23	21	34	0	578	3.68
Honey dew (IVY)	59	58	54	0	667	4.32

cent of the recommended fruit serving per day[1]. Low intakes of fruits is associated with inadequate intakes of vitamin A and vitamin C.

Nowaday, fruit juices which are manufactured in factories and distributed in cans are becoming more popular. Subar et al[2] found that low nutrient dense foods, including fruit juices are major contributors of energy, fats and carbohydrates to young children. This compromises intakes of more nutritious foods and may impede compliance with current dietary guidance.

Some juices in cans from different factories have different contents in terms of carbohydrates and electrolytes. Most manufacturers do not label their juice cans with nutrient information, even though it is essential for consumers to know all the contents of these juices. Some parents who have much influence on their children's fruit juice intake have poor knowledge about the contents in fruit juices. Additional information and education are required in these areas[3]. Thus, we studied the carbohydrate contents, electrolyte contents, osmo-

Table 2. Juices contain sorbitol.

Type of juices (Brand)	Sorbitol content g/L
Prune (VETA)	149
Prune (DELMONTE)	67
Grape (UFC)	17
Pear (IVY)	14
Pear 40% (IVY)	10
Apple (TIPCO)	7
Honey dew (A-TIP)	3
Orange (TIPCO)	2
Red grape (UFC)	2
Guava 25% (UFC)	2
Peach (IVY)	1

larity and pH of 40 kinds of fruit juices sold in the Thai market. The results of the study will benefit consumers as well as physicians by allowing people to consume juices wisely.

MATERIAL AND METHOD

Forty kinds of commercial fruit juices packed in small packages with prices ranging between 10-70 baht were bought for analysis. Each juice was divided into 3 parts for analysis of

a) types and contents of carbohydrates
b) types and contents of electrolytes
c) osmolarity and pH

A. Analysis of Carbohydrates

Types and contents of carbohydrates were analyzed by High Performance Liquid Chromatography (HPLC) equipment which is driven by a minipump metering pump, model Consta Metric 4,100, LDC Analytical, USA. The machine can differentiate types of monosaccharides and disaccharides by using Interaction CHO-620 column.

B. Analysis of Electrolytes

Sodium, potassium, calcium and magnesium contents in each fruit juice were analyzed by the atomic absorption test[4]. Chloride and phosphate contents in the juices were analyzed by the colorimetric method[5,6].

C. Analysis of osmolarity and pH

Osmolarity of the juices were measured by measuring the freezing piont by Osmomat 030. pH of the juices was measured by a pH meter.

RESULTS

Table 1 demonstrates types and contents of carbohydrates, electrolytes, osmolarity and pH of 40 kinds of fruit juices. Sucrose, glucose, fructose and sorbitol are common sugars found in fruit juices.

Table 2 shows fruit juices which contain sorbitol in its content. Prune juice has the largest sorbitol content (149 g/L).

Table 3 exhibits fruit juices which have high fructose contests and high fructose : glucrose ratio. Litchi juice has the highest fructose content as well as fructose : glucose ratio.

Table 4 demonstrates electrolyte contents in 21 kinds of juices. All juices have a sodium content higher than 100 mg/L. White grape juice from TIPCO has the highest sodium content (1,400 mg/L). Some juices have a high potassium content such as apple juice from TIPCO which contains 1,035 mg/L of potassium. Some have high calcium con-

Table 3. Juices with high fructose and fructose : glucose ratio.

Type of juices	Glucose g/L	Fructose g/L	Fructose : Glucose Ratio
Litchi (25% FREEZE)	33	75	2.27
Apple (TIPCO)	32	72	2.25
Passion fruit (25% PIGEON)	30	63	2.10
Litchi (25% PIGEON)	23	47	2.04
Apricot (IVY)	30	57	1.90
Red guava (25% SINGHA)	31	58	1.87
Pear (IVY)	34	63	1.85
Apple (MALEE)	30	51	1.70
Mango (25% PIGEON)	21	34	1.62
Guava (25% MALEE)	20	32	1.60
Red grape (IVY)	36	57	1.58

Table 4. Electrolyte contents in the fruit juices analyzed. All samples have sodium contents higher than 100 mg/L.

Brand	Type of juice	Na (mg/L)	K (mg/L)	Cl (mg/L)	Ca (mg/L)	Mg (mg/L)	P (mg/L)
TIPCO	White grape	1,405	62	45	13	10	88
TIPCO	Guava	861	410	1,770	19	22	16
A-TIP	Orange (100%)	810	90	515	37	9	18
Doikum	Passion fruit (25%)	699	511	995	28	26	22
TIPCO	Red grape	530	570	130	93	63	133
UNIF	Grape (40%)	403	29	35	18	9	149
A-TIP	Okra	331	160	90	76	29	10
PIGEON	Passion fruit (25%)	319	308	135	20	15	23
MALEE	Litchi (25%)	271	29	20	39	7	104
PIGEON	Mango (25%)	266	237	70	24	22	10
IVY	Red grape	176	427	180	111	82	64
FREEZE	Litchi (25%)	158	132	65	62	15	11
TIPCO	Apple	144	1,035	60	57	54	190
SINGHA	Longan	143	366	55	11	8	26
SINGHA	Okra	131	225	75	136	44	20
PIGEON	Litchi (25%)	126	278	75	23	16	32
MALEE	Apple (25%)	126	109	25	22	15	1
SINGHA	Guava (25%)	126	534	115	20	15	15
UFC	Red grape	115	120	100	27	14	92
MALEE	Guava (25%)	109	340	55	18	12	17
MALEE	Pineapple (50%)	100	815	40	101	80	46

tent such as okra juice from SINGHA which contains 130 mg/L of calcium.

Table 5 demonstrates electrolyte contents in 19 kinds of juices. All juices in this table have a sodium content less than 100 mg/L. Some juices have high potassium such as prune juice from VETA which contains 3,879 mg/L of potassium. Some juices have high calcium contents such as pineapple juice from TIPCO which contains 155 mg/L of calcium.

DISCUSSION

Increasing fruit consumption is an important health behaviour. Socio-economic status and educational level, nutritional knowledge and beliefs influence fruit intake in each community. Fresh fruits are popular among people around the world due to their good taste. Since the produce of fruits comes out mainly during the season, fruit juice in a can is another method to prop up the fruit price during the season. The process of making fruit juice reduces the nutritional value of the juices, especially in terms of heat sensitive vitamins, such as vitamin B and vitamin C[7]. Though fruit juices are now gaining popularity, consumers should have some knowledge about the contents of the juices. From our study, it was found that total carbohydrate contents in most juices are in between 7-15 g per cent. Some have high sucrose, usually added by the manufacturers during processing. Hence, consuming fruit juices in cans will give consumers different nutrients than consuming the natural juices. Fructose and glucose are always the constituents of the juices. Glucose is absorbed in the GI tract *via* active transport. The process of glucose absorption will result in an influx of water into the body. Consequently, fructose will follow glucose into the body after active transport of glucose by the ratio of 1:1 molar ratio. Any juice that has a higher than 1:1 of fructose : glucose ratio will result in cathartic effect to the consumer[8]. From our study, juices from litchi, apple, passion fruit and apricot have a high fructose : glucose ratio. If these juices are consumed in large amounts, it will cause diarrhea to the consumers. Sorbitol, likewise, has to be absorbed *via* passive transport which is a slow process. If sorbitol is consumed in large amounts, it will also result in catharsis, just as fructose. Prune, grape and pear, for example, have a high sorbitol content. Caution is advised, especially for young children, in taking these juices.

Most juices will provide consumers with extra energy, in addition to other foods consumed. Consumption of more than 12 fl oz/d by young

Table 5. Electrolyte contents in the fruit juices. All samples have sodium contents less than 100 mg/L.

Brand	Type of juice	Na (mg/L)	K (mg/L)	Cl (mg/L)	Ca (mg/L)	Mg (mg/L)	P (mg/L)
IVY	Pear (40%)	98	528	120	45	23	30
UFC	Guava (25%)	95	353	60	13	10	11
SINGHA	Passion fruit (25%)	94	564	50	26	31	24
IVY	Orange	88	1,366	95	52	35	109
VETA	Prune	87	3,879	1,260	176	275	214
TIPCO	Pineapple	82	1,750	145	155	135	78
SINGHA	Red guava (25%)	81	613	90	22	17	6
IVY	Honey dew	71	882	10	32	34	108
DELMONTE	Prune	67	3,096	520	153	160	114
Doikum	Green guava (30%)	66	713	100	30	25	37
UFC	Grape (30%)	65	58	40	21	6	33
UFC	Pineapple	59	834	60	125	127	38
IVY	Peach	56	624	25	44	37	43
IVY	Pear	48	595	30	60	40	33
IVY	Apricot	45	60	20	41	28	42
IVY	Black currant (40%)	40	97	85	57	24	38
IVY	Kiwi	36	719	55	84	40	36
TIPCO	Orange	22	1,697	145	79	80	106
SINGHA	Pineapple	19	1,411	105	91	115	71

children is associated with obesity and even short stature[9,10]. Skinner et al disagreed with limiting the intake of fruit juice to less than 12 fl oz/d. They found that there is no consistent relationship between children's fruit juice intake and growth parameters[11].

Mineral contents including Na, K, Cl, Ca, P and Mg varied among the juices studied. These micronutrients in the juices contribute at least more than 20 per cent of the recommemended daily intake[12]. Fluids high in sodium should be consumed cautiously by adults, especially those who have hypertension, cardiovascular disease and renal diseases. Moreover, some fruit juices are very high in potassium. It is advised that people who have renal disease must be cautious in consuming these juices. Furthermore, some juices have a high calcium content. Calcium concentration can be about $^1/_4$ of that found in milk. In this context, there is benefit in taking fruit juices.

Osmolarity and pH of the fruit juices must also be considered by consumers. High osmotic fluids should be consumed carefully, especially by young children. These fluids can produce drastic diarrhea in consumers. It is advised to dilute these fluids or consume only small amounts at a time to prevent diarrhea.

SUMMARY

Fruit juices which were studied have varying carbohydrate contents, mineral contents and high osmolarity. Consumers should study the composition and characteristics of each individual juice carefully before regular consumption. Physicians, likewise, should be fully aware of the characteristics of the juices in order to advise their patients appropriately.

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การวิเคราะห์หาคาร์โบไฮเดรทชนิดต่าง ๆ เกลือแร่ ออสโมลาริตี้ และ ค่าพีเอชในน้ำผลไม้ที่มีจำหน่ายในประเทศไทย

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คณะผู้รายงานได้ศึกษาชนิดและปริมาณของคาร์โบไฮเดรท เกลือแร่ ออสโมลาริตี้ และค่าพีเอชของน้ำผลไม้ที่มีจำหน่ายในประเทศไทยจำนวน 40 ชนิด พบว่าส่วนใหญ่จะมีน้ำตาลซูโครส กลูโคส และ ฟรุคโตส เป็นส่วนประกอบ โดยมีปริมาณรวมกันประมาณ 70–150 ก./ล. น้ำผลไม้บางชนิดมีน้ำตาลซอร์บิทอลสูง และบางชนิดมีปริมาณน้ำตาลฟรุคโตสสูงกว่าปริมาณน้ำตาลกลูโคส โซเดียมในน้ำผลไม้แตกต่างกัน ตั้งแต่ 19–1405 มก./ล. ค่าออสโมลาริตี้ แตกต่างกันระหว่าง 500 ถึง 1,200 มิลลิออสโมล/ล. ค่าพีเอชแตกต่างกันตั้งแต่ 2.8–5 กล่าวโดยสรุปน้ำผลไม้แต่ละชนิดมีคุณสมบัติที่แตกต่างกัน ผู้บริโภคจึงควรรู้ข้อมูลของน้ำผลไม้แต่ละชนิดให้ดีเพราะการบริโภคน้ำผลไม้บางชนิดเป็นจำนวนมากและเป็นเวลานานอาจจะทำให้เกิดผลเสียต่อสุขภาพได้

คำสำคัญ : น้ำผลไม้, น้ำตาลทราย, ฟรุคโตส, ซอร์บิทอล, ค่าออสโมลาริตี้, พีเอช

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