Oral fluid therapy: sodium and potassium content and osmolality of some commercial "clear" soups, juices and beverages

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Analysis of nearly 90 commercial "clear" fluids, including soups, juices, fruit-flavoured drinks and ices, carbonated beverages and gelatins, showed a range of 0.1 to 251 mmol of sodium and 0.0 to 65 mmol of potassium per litre; the osmolality ranged from 246 to more than 2000 mOsm/kg of water. Knowledge of these values is useful in the home or hospital management of patients for whom control of fluid and electrolyte intake is indicated. The results of the analyses are presented in tabular form for use by physicians and nutritionists when counselling patients to ingest clear-type fluids for various illnesses. Examples are given using these data to show how clear-fluid therapy can be tailored in one such illness — gastroenteritis (infectious diarrhea).

L'analyse de près de 90 liquides "clairs" commerciaux, y compris des soupes, des jus, des boissons et des glaces à saveur de fruits, des boissons gazeuses et des gélatines, a révélé un écart de 0.1 à 251 mmol de sodium et de 0.0 à 65 mmol de potassium par litre; l'osmolalité variait de 246 à plus de 2000 mOsm/kg d'eau. La connaissance de ces données est utile dans le traitement à domicile ou à l'hôpital des patients chez qui on doit contrôler l'apport en liquide et en électrolytes. Les résultats de ces analyses sont présentés sous forme de tableaux à l'intention des médecins et des nutritionistes qui doivent aviser leurs patients d'ingérer des liquides clairs pour certaines maladies. À l'aide de ces données on donne des exemples pour illustrer comment un traitement aux liquides clairs peut être ajusté à l'une de ces maladies, la gastro-entérite (diarrhée infectieuse).

Commercial clear-type fluid preparations are often recommended in the home management of certain illnesses; for example, a common treatment for gastroenteritis in infancy is the deletion of milk from the diet and the substitution of "clear fluids". The physician may suggest that carbonated beverages, juices and soups such as chicken and beef broth be given. With no other guidance the parent is expected to make a therapeutic choice from a large variety of products instead of the usual choice based on taste preference, budget limitations and nutritional adequacy. Therefore, we thought it important to analyse various commercial clear-type fluid preparations for their sodium and potassium content and osmolality to allow physicians to determine their therapeutic usefulness in specific illnesses.

Materials and methods

Samples of clear-type fluid products were purchased in the Toronto area from two national grocery chain stores. The brand names were common to both stores or were available at one and also at small neighbourhood shops.

During the summer of 1977 and the winter of 1977–78 the products were analysed. Fluids made up from concentrate or from powder or crystals were prepared according to package directions with household measuring utensils. The tapwater used was analysed each day of testing. Beverages prepared from crystals were not analysed until the sugar had dissolved. Sherbets, popsicles and gelatins were analysed in the liquid state. Products containing obvious particulate matter (e.g., noodles, pulp or onions) were passed through a household sieve before analysis.

Each sample was shaken well immediately before it was poured into the glassware used for analysis and was analysed in duplicate right away; mean values for the duplicate analyses are reported. Sodium and potassium concentrations were measured with a flame photometer (model 143; Instrumentation Laboratory, Inc., Lexington, Massachusetts) and osmolality was determined by measuring the freezing-point depression with a wide-range osmometer (Advanced Instruments, Inc., Needham Heights, Mass.).

Within-group comparisons were made (e.g., of seven chicken-broth products) to determine differences due to variation in ingredients. When two or more lot numbers of the same product were available, samples from all were analysed and the data were compared. The manufacturers of some products provided information about sodium and potassium content, and we compared this with the results of our analyses. None reported osmolality.

Results

The tap water samples contained a range of 0.0 to 1.0 mmol of sodium and 0.0 to 0.5 mmol of potassium per litre; the osmolality ranged from 48 to 50 mOsm/kg of water.

Analysis of clear-type soups showed considerable variation in the sodium and potassium concentrations and the osmolality, and some differences from manufacturers' data (Table I). The sodium values were somewhat higher and the potassium values were slightly lower in chicken "broth" than in beef "broth". The sodium content was usually highest in Lipton Cup-a-Soup products. Soups prepared from crystals had slightly higher osmolality values than those prepared from liquid concentrate.

The sodium and potassium values for individual natural fruit juices were generally consistent with those

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given in standard food-composition tables[1] and manufacturers' data (Table II). No product had a sodium concentration of more than 10 mmol/l or a potassium concentration of less than 24 mmol/l. The sodium content was greater and the osmolality less in lemon juices than in other fruit juices, and the potassium content was greatest in orange juices. The osmolality of grape juices far exceeded that of other fruit juices.

According to the information on their labels, most fruit-flavoured drinks, carbonated beverages and ices contained little or no natural fruit juice. Whereas none of the natural fruit juices contained less than 24 mmol of potassium per litre (Table II), none of the fluids in Table IIIA (those with a sodium concentration of less than 8 mmol/l) contained more than 12 mmol of potassium per litre; in Table IIIB (fluids with a sodium concentration of 8 mmol/l or more) the maximum potassium concentration was 6 mmol/l. All the beverages with potassium concentrations of 3.0 mmol/l or more (e.g., Honeydew orange, cranapple drink and Welchade) contained natural juice. Most fruit-flavoured drinks prepared from crystals had a higher sodium and a lower potassium content and a lower osmolality than those prepared from concentrate or packaged ready for use. Analysis of four fruit-flavoured sherbets showed similar sodium and potassium concentrations and exceedingly high osmolalities (Table IV).

Discussion

In liquids categorized as clear-type there was a wide

Table I—Analysis of commercial clear-type soups

Soup	Formulation*	Sodium concentration (mmol/l)		Potassium concentration (mmol/l)		Osmolality ($mOsm/kg\ H_2O$), actual‡
		Expected†	Actual‡	Expected†	Actual‡	
Beef broth						
Campbell's beef consommé	CO	123 (a)	114, 126, 135	13-15 (a)	11, 11, 8.0	351, 304, 326
Carmel (kosher)	CR	–	169	–	2.5	332
Knorr Swiss	CR	–	114	–	3.4	362
Lipton's Cup-a-Soup						
Beef noodle	CR	222 (a)	248	–	11	543
Onion	CR	188 (a)	219	–	17	474
Oxo cube, beef-flavoured	CR	150-200 (b)	173	10-15 (b)	5.5	386
Chicken broth						
Campbell's chicken noodle	CO	357 (a)	251	10 (a)	8.2	501
Croyden House (kosher)	CR	–	206	–	2.7	450
Knorr Swiss	CR	–	188	–	1.5	507
Lipton's chicken noodle	CR	155 (a)	238	–	7.0	464
Lipton's Cup-a-Soup, chicken	CR	251 (a)	251	–	4.8	494
Manischewitz (kosher)	CO	–	140, 148	–	4.9, 2.0	293, 291
Oxo cube, chicken-flavoured	CR	150-200 (b)	174	10-15 (b)	2.2	377

*CO = from concentrate; CR = from powder or crystals. Both types of preparation require dilution before use.
†According to manufacturer's information (a) or Watt and Merrill[1] (b).
‡Multiple values are for samples from different lots.

Table II—Analysis of natural fruit juices

Juice	Formulation*	Sodum concentration (mmol/l)		Potassium concentration (mmol/l)		Osmolality ($mOsm/kg\ H_2O$), actual‡
		Expected†	Actual‡	Expected†	Actual‡	
Apple juice						
Allen's	R	0.4 (a)	0.4, 0.5	26 (a)	32, 30	734, 725
Bright's	R	tr-1.0 (b)	0.1	20-35 (b)	24	708
Martin's	R	tr-1.0 (b)	0.8, 0.9	20-35 (b)	26, 27	733, 720
Sun-Pac	R	tr-1.0 (b)	2.7, 3.5	20-35 (b)	29, 30	654, 681
Grape juice						
Welch's						
Purple	R	1.4 (a)	1.3, 0.8	32 (a)	31, 44	1175, 1190
Red	R	2.2 (a)	2.8	28 (a)	36	1167
Lemon juice						
Realemon	R	5-10 (b)	9.0	20-30 (b)	27	485
Sunkist	R	5-10 (b)	10.0	20-30 (b)	29	506
Orange juice						
Delmonte	R	tr-1.0 (b)	0.5, 0.8	40-60 (b)	47, 41	553, 542
Dominion (frozen)	CO	tr-1.0 (b)	0.8	40-60 (b)	51	668
Libby's	R	tr-1.0 (b)	2.5, 0.1	40-60 (b)	54, 51	703, 649
Martin's	R	tr-1.0 (b)	0.6	40-60 (b)	46	579
Minute Maid (frozen)	CO	tr-1.0 (b)	0.7, 1.3	40-60 (b)	53, 65	649, 710
Old South (frozen)	CO	tr-1.0 (b)	1.3	40-60 (b)	56	672

*R = ready to use; CO = from concentrate (dilute before use).
†According to manufacturer's information (a) or Watt and Merrill[1] (b); tr = trace.
‡Multiple values are for samples from different lots.

range of values for the sodium concentration (0.1 to 251 mmol/l), the potassium concentration (0.0 to 65 mmol/l) and the osmolality (246 to more than 2000 mOsm/kg of water). For all three indices, fluids prepared from crystals and concentrate showed the greatest variance from ready-to-use preparations.

Differences from manufacturers' data and variation in values for samples from different lots of the same product could be due to the uneven mixing of ingredients (e.g., sugars and salts) before analysis or before packaging at the factory. Even greater differences can occur at home if there is incomplete emptying of a package, loss of ingredients or water in transfer or incorrect measuring of the product or water. Therefore, when a person prepares a product from concentrate or crystals (i.e., unscientifically) greater variation in electrolyte concentration and osmolality can be expected. Moreover, the concept that "if a little is good, a lot is better" could mean that extra powder or concentrate or less water might be added; the result in either instance could be a potentially hazardous liquid. This concept could prove lethal if applied during the preparation of a commercial soup.

The order in which ingredients are listed on package labels is significant: by federal law all ingredients must be listed according to their relative liquid volume or dry weight. If a sodium compound is the second ingredient listed, one would expect its concentration to be greater than if it were the sixth ingredient listed. This is particularly significant for people in whom dietary restriction of certain food ingredients (e.g., sodium or sugar) is indicated.

Table IIIA—Analysis of fruit-flavoured drinks, carbonated beverages and ices containing less than 8 mmol of sodium per litre

Product	Formulation*	Sodium concentration (mmol/l)		Potassium concentration (mmol/l)		Osmolality (mOsm/kg H_2O), actual‡
		Expected†	Actual‡	Expected†	Actual‡	
Apple drink						
FBI	R	–	0.7, 1.0	–	1.1, 2.0	699, 699
Hi-C	R	–	2.4	–	5.0	816
Carbonated beverages						
C-plus (orange)	R	2.8	3.8	0.0	1.4	647
Canada Dry ginger ale	R	0.0	2.7, 0.8	0.0	0.1, 1.5	515, 557
Coca Cola	R	1.1	1.7	0.0	0.1	601
Grape Crush	R	4.2	2.3	0.2	0.1	823
Orange Crush	R	6.5	5.9	1.0	2.7	751
Pepsi Cola	R	0.1	1.3	0.7	0.1	591
Wilson's ginger ale	R	–	2.7	–	0.1	560
7-UP	R	0.0	5.0, 5.5	–	1.0, 2.0	523, 548
Cranapple drink						
Ocean Spray	R	1.1	3.3, 4.2, 3.8	5.1	9.0, 7.5, 7.2	1212,1173, 1106
Cranberry cocktail						
Ocean Spray	R	1.5	2.6	5.0	8.0	888
Freshie						
Orange						
Unsweetened; sugar added	CR	–	0.7, 0.8, 0.6	–	0.4, 1.9, 1.0	246, 455, 298
Sweetened	CR	–	0.7, 1.3	–	0.0, 0.6	259, 248
Strawberry (unsweetened; sugar added)	CR	–	0.7	–	0.1	400
Fruit punch						
FBI	R	–	1.0	–	5.7	785
Wyler's	CR	–	1.3	–	0.3	405
Grape drink						
Allen's	R	–	3.6	–	0.8	687
FBI	R	–	1.6	–	3.0	598
Neilson's	CR	–	6.2	–	2.4	266
Sun-Pac	R	–	4.7	–	0.5	741
Welchade	R	4.5	3.1, 4.0	4.8	6.8, 8.5	644, 725
Welch's (frozen)	CO	–	1.0, 1.3, 1.8	–	6.5, 6.5, 6.0	644, 794, 756
Fruit Juicy Red drink						
Hawaiian Punch	R	–	1.5, 2.0	–	5.6, 4.0	653, 647
Kool-Aid						
Cherry (unsweetened; sugar added)	CR	0.1	1.0, 0.9	–	0.2, 0.4	407, 465
Orange (unsweetened; sugar added)	CR	0.1	0.9, 1.1, 1.1	–	0.1, 0.8, 1.5	594, 374, 276
Strawberry (unsweetened; sugar added)	CR	0.1	0.5, 1.2	–	0.1, 1.8	509, 325
Tropical punch (sweetened)	CR	–	0.9, 1.1	–	0.1, 1.0	256, 251
Lemon drink						
Realemon	CR	–	6.4	–	0.0	297
Tang	CR	5.5	7.5, 5.5	–	0.8, 2.0	459, 492
Orange drink						
Honeydew	CO	–	2.4	–	12.0	498
Neilson's	CR	–	4.9	–	0.1	491
Rise'N Shine	CR	–	5.7	–	2.1	415
Swing	CR	–	5.7, 5.6, 8.3	–	0.2, 3.0, 0.0	343, 426, 515
Very Berry drink						
Hawaiian Punch	R	–	1.6, 2.3	–	3.0, 5.0	727, 659
Popsicles						
Cherry	R	–	4.7	–	0.5	719
Orange	R	–	4.9, 5.6	–	0.6, 2.0	665, 667

*R = ready to use; CR = from powder or crystals; CO = from concentrate. The last two types of preparation require dilution before use.
†According to manufacturer's information.
‡Multiple values are for samples from different lots.

The high sodium content of soups reflects the addition of sodium as both a flavouring agent (as sodium chloride, monosodium glutamate or sodium citrate, or a combination) and a preservative (as sodium benzoate or disodium guanylate or both) as well as its existence in meat and meat extracts. The main sources of potassium in soups are meat, meat extracts, potato starch, vegetables, yeast extract and caramel flavouring. The osmolality of soups is a direct reflection of their sodium and potassium content.

The natural fruit juices analysed contained minimal levels of sodium (except pure lemon juice) and high levels of potassium. By contrast, all the fruit-flavoured drinks contained relatively low levels of potassium, and many had relatively high levels of sodium. The osmolality of the products listed in Tables II and III appears to reflect mainly the quantities and types of sugar (sucrose, fructose and glucose); sodium and potassium contributed minimally. Commercial sherbets are a complex mixture of water, sugars, dairy products, concentrated fruit juice, etc., all of which contribute to the unusually high osmolalities observed.

The data in these tables can be used by physicians and nutritionists or adapted for use by patients or their parents to treat specific fluid and electrolyte disorders. For example, if gastroenteritis is to be treated by fluids closely approximating 0.2% normal saline solution,[2] which has a sodium concentration of about 30 mmol/l, the fluids in Table IIIB provide an adequate selection. On the other hand, because of their extraordinarily high sodium content, none of the commercial soups tested is suitable.[3-5] Homemade soups with no added sodium would be more acceptable: however, carbohydrate supplements would probably be necessary for adequate energy intake. Further, because glucose transport from the intestine may be limited or the availability of disaccharide enzymes reduced, or both, the sugar content of the replacement fluid should be low, otherwise the unabsorbed sugar will draw water into the intestinal lumen and worsen the diarrhea.[6] Similarly, any solutions given that are hypertonic relative to serum will worsen the diarrhea.[7]

Table IV—Analysis of fruit-flavoured sherbets*

Sherbet	Sodium concentration (mmol/l) Expected†	Sodium Actual	Potassium concentration (mmol/l) Expected†	Potassium Actual	Osmolality ($mOsm/kg\ H_2O$), actual
Lime					
Sealtest	–	20	–	23	> 2000
Borden	–	23	–	20	> 2000
Orange					
Sealtest	14	20	18	25	> 2000
Borden	–	19	–	19	> 2000

*Supplied ready to use.
†According to manufacturer's information.

Table IIIB—Analysis of fruit-flavoured drinks, carbon ated beverages and gelatin products containing 8 mmol or more of sodium per litre

Product	Formulation*	Sodium concentration (mmol/l) Expected†	Sodium Actual‡	Potassium concentration (mmol/l) Expected†	Potassium Actual‡	Osmolality ($mOsm/kg\ H_2O$), actual‡
Apple drink						
Allen's	CR	–	13	–	3.0	483
Neilson's	CR	–	18	–	0.7	393
Carbonated beverages						
Monarch (cola)	CR	–	28	–	0.1	277
Grape drink						
Hawaiian Punch	CR	–	12, 11, 11	–	0.9, 0.7, 1.0	445, 442, 355
Quench	CR	–	14	–	0.2	361
Tang	CR	27	18, 28, 23	0.1	0.0, 0.6, 1.0	519, 609, 366
Fruit Juicy Red drink						
Hawaiian Punch	CR	–	13	–	1.0	451
Lemon drink						
Neilson's	CR	–	8.3	–	0.3	473
Quench	CR	–	9.0	–	0.5	502
Swing	CR	–	11	–	0.2	371
Orange drink						
Allen's	R	–	23	–	4.4	673
Hi-C	R	–	13	–	6.0	768
Tang	CR	9.7	10	0.01	2.0	575
Wyler's	CR	–	11	–	0.2	430
Strawberry drink						
Allen's	R	–	11	–	0.4	674
Very Berry drink						
Hawaiian Punch	CR	–	12	–	1.0	440
Wildberry drink						
Allen's	R	–	13	–	0.3	713
Gelatins						
Carmel (kosher)						
Orange	CR	–	33	–	3.0	847
Strawberry	CR	–	30, 31	–	2.3, 2.0	758, 796
Jell-O						
Orange	CR	24	24, 22	0.1	1.3, 2.0	644, 576
Strawberry	CR	24	27	0.1	1.3	594

*CR = from powder or crystals (dilute before use); R = ready to use.
†According to manufacturer's information.
‡Multiple values are for samples from different lots.

Thus, fluids with a high osmolality should be diluted appropriately.

"Clear" fluids should not be prescribed without consideration of their constituents. In the management of disorders such as acute and chronic renal failure, cardiac failure and pyrexia one should select a fluid that will balance the patient's needs for sodium, potassium and water and thus not be detrimental. To meet the energy needs of certain medical conditions a fluid might be selected on the basis of its sugar content.

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Five-year survival of women with breast cancer in northern Alberta

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Five-year survival rates for all 519 women with breast carcinoma in northern Alberta in 1971 and 1972 were analysed with the use of data from the computerized northern Alberta breast registry and the Alberta cancer registry. The relative 5-year survival was 73%, which is higher than most rates reported from other centres. Lymph node involvement was significant as a prognostic factor, with the relative 5-year survival falling from 92% in the group without lymph node involvement to 58% in the group with three or more involved nodes. The prognosis was also significantly affected by the stage of the disease according to the 1973 TNM classification: the 5-year survival rates ranged from 88% for patients with stage 1 disease to 17% for those with stage IV disease. Women 40 to 59 years of age had a higher survival rate (79%) than those under 40 years (65%) or over 60 years (66%) of age. Analyses by 5-year age groups showed that women 35 to 39 years old had a particularly poor survival rate (59%). Postmenopausal women less than 55 years old had a higher survival rate than did perimenopausal or premenopausal women in the same age group. Further follow-up is indicated to correlate possible high-risk factors with survival.

Les taux de survie après 5 ans des 519 femmes porteuses d'un carcinome du sein et provenant du nord de l'Alberta en 1971 et 1972 ont été analysés avec les données du registre sur ordinateur du sein pour le nord de l'Alberta et du registre du cancer de l'Alberta. La survie relative après 5 ans a été de 73%, ce qui est supérieur à la plupart des taux signalés par les autres centres. L'atteinte lymphatique a constitué un élément de pronostic significatif, alors que le taux relatif de survie après 5 ans a baissé de 92% dans le groupe n'ayant pas d'atteinte lymphatique à 58% dans le groupe ayant une atteinte de trois ganglions ou plus. Le pronostic était aussi affecté de façon significative par le stade de la maladie établi d'après la classification TNM de 1973: la survie après 5 ans a varié de 88% pour les patientes atteintes de la maladie à stade I à 17% pour celles atteintes de la maladie au stade IV. Les femmes âgées de 40 à 59 ans ont eu un taux de survie plus élevé (79%) que celles de moins de 40 ans (65%) ou de plus de 60 ans (66%). L'analyse par tranches d'âges 5 ans a révélé que les femmes de 35 à 39 ans avaient un taux de survie particulièrement faible (59%). Les femmes de moins de 55 ans qui avaient eu leur ménopause ont accusé un taux de survie plus élevé que les femmes du même âge avant ou pendant la ménopause. Des post-observations ultérieures devraient être faites pour établir une corrélation entre les facteurs de risque élevé éventuels et la survie.

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