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The *Asian Journal of Exercise and Sports Science* (AJESS) is the official publication of the Asian Council of Exercise and Sports Science (ACESS). The journal publishes empirical and theoretical contributions that enhance knowledge in the art and science of human movement. Areas of interest include: adapted physical education, anatomy and physiology, biomechanics, dance science, exercise and sports psychology, exercise physiology, health and fitness, history and philosophy of sport, measurement and evaluation, motor control and learning, motor development, nutrition, sociology of sport, sport management and administration, sport medicine, and sport pedagogy.

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Asian Journal of Exercise & Sports Science

Characteristics of ACESS

The Asian Council of Exercise and Sports Science (ACCESS) is a nonprofit educational, professional organization. ACCESS is an international organization consisting of professors, researchers, students, and other membership groups in exercise and sports science in Asian regions.

Purpose of ACESS

There has been a phenomenal and rapid development in the fields of exercise and sports science. The ACCESS is founded in recognition of the need to address the specific concerns of Asia. Therefore, the purpose of the ACCESS is to promote communication, interaction, and cooperation among exercise and sports science professionals and students in Asian educational, scientific, and research institutions. In particular, the ACCESS seeks to promote and facilitate communication among young researchers and students in Asian regions. In these ways, the ACCESS seeks to make a contribution to the enhancement of the quality of life among Asians in particular, but also for the rest of the world.

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- Promoting research in the areas of exercise and sports science and facilitating international exchanges among researchers and students in the Asian regions.
- Assisting young scholars/graduate students in conducting applied research in exercise and sports science.
- Organizing conferences on exercise and sports science.
- Publishing resources on exercise and sports science.
- Establishing links with other institutions and organizations involved in exercise and sport science activities.

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Original Article

Coconut Water as a Sports Drink and Its Effects on the Fitness of Aging Athletes

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Abstract: The purpose of this study was to investigate the effectiveness of fluid replacement in the instance of aging athletes engaging in physical activity. The first requirement is to comprehensively determine an ideal hydration drink, and the second is to compare the effects of fresh young coconut water to a commercially available carbohydrate-electrolyte beverage (CEB) during 6 months of endurance training and determine the impact on enhanced maximal oxygen uptake (VO_{2max}). Forty-eight healthy male joggers, aged 45–55, undertook 6 months of endurance training that involved training sessions 3 days per week, 60–90 minutes per session at 70% VO_{2max} . Before and after the training programs, all subjects performed a complete VO_{2max} protocol (cardiopulmonary fitness) using the MedGraphics CPX/D St. Paul, MN, Cardio O_2 ™ System, which combines ECG/ VO_2 systems simultaneously, real-time 12 lead ECG with incremental bicycle testing until exhaustion to determine the ventilatory threshold and the VO_{2max} . The results revealed the superiority of coconut water when compared to a commercially available CEB, as a sports drink and as sports drink to improve endurance power (VO_{2max}). We concluded that coconut water is preferential to other sports drinks as a first choice rehydration drink for aging athletes engaged in recreational sport activities.

Keywords: *Natural, isotonic, fluid, healthy, cardiopulmonary*

Introduction

Over the next 50 years the European population will age substantially, straining both social services and health care systems. Hence, the promotion of regular physical activity in our daily lives is a good strategy against the onset of age-related diseases and disabilities. "Healthy aging," as defined by Rowe and Kahn (1998), means pursuing regular physical activity while maintaining a lowered risk of disease. There is increasing evidence to suggest that physical activity has a protective effect on brain function in aging people (Rolland, Abellan van Kahn, & Vellas 2010), and evidence is accumulating from basic research, suggesting an improvement of cognitive function in persons involved in aerobic programs (Angevaeren, Aufdemkampe, Verhaar, Aleman, & Vanhees, 2008).

According to Hartman-Stein and Potkanowicz (2003), achieving a low risk of disease in conjunction with sports activity in healthy aging requires adapting the nutritional and fluid intake in light of physiological changes, which occur when physical activity is regularly pursued. After age 45, physiological changes also correlate to the decline of body mass and the subsequent decrease of strength per unit of muscle mass. These changes can be successfully counteracted by aerobic activity, which improves cardiovascular fitness (Ryan, 2010). Therefore, appropriate nutritional intake can benefit the aging subject, and, as an added benefit, will help enhance a healthy athletic performance (Hartman-Stein & Potkanowicz, 2003).

The Sports Science Unit at the Universiti Sains Malaysia (Saat, Singh, Siringhe, & Nawawi, 2002) has demonstrated the superiority of natural fresh young coconut water compared to commercially available electrolyte beverages (CEB) and plain water as a rehydration drink for elite athletes. They highlighted the considerable value of coconut water in causing less nausea, fullness, and stomach upset; natural coconut water had a better taste than CEB and was easier to consume in a large amount when compared to the consumption of CEB and water.

The American Dietetic Association, Dietitians of Canada, and American College of Sports Medicine (2009) recommend that aging individuals participate in some form of endurance training to develop and maintain cardiorespiratory fitness. Aging results in a progressive decline of the functional capabilities in various body systems. It is well documented (Arnaud, 2002) that aging adults have problems associated with fluid and electrolyte balance during physical activity. These aging adults experience a reduced thirst sensation and a reduced potential to dissipate body heat (Kenney & Hodgson, 1987; Kenney & Fowler, 2003; Mack et al., 1994). As a consequence, aging people engaging in physical activities are at increased risk of experiencing exercise-induced dehydration, resulting in a significant impact on the level of performance while exercising. Therefore, fluid replacement is very important for aging people compared to young athletes.

The position of the American College of Sports Medicine (1996) highlights that fluid replacement before and during sports activities is unlikely to be sufficient to offset the ongoing fluid loss: age-related heat injury/volume loss in the aging would be effective and would support the contention that fluid replacement is "more important" in aging athletes. Age-related dehydration is attributed to insensible water loss through skin and respiration (Dmitrieva & Burg, 2011) and, consequently, elevated heart rate and rise of core body temperature. Hartman-Stein and Potkanowicz (2003) and Noakes (1993) have confirmed this theory. Undoubtedly, aging athletes are continuously faced with the potential of becoming significantly dehydrated in the course of sports activity.

For aging people to avoid a negative net water and electrolyte balance while exercising, a decision must be made concerning the pre-exercise hydration strategy. The aggressive drinking policy protocol, as prescribed by the American College of Sports and Exercise Medicine (1996), seems to be a strenuous procedure when applied to aging people. The primary reason is because aging people have difficulties with such demanding voluntary ingestion prior to and during sports activities. While exercising, aging people experience significant changes in their respiratory rate, even without ingesting large amounts of fluid that will consequently lead to a sensation of epigastric fullness during exercising. Therefore, it is most improbable that aging athletes will drink the adequate amount of fluids necessary to maintain optimal hydration while exercising on a regular basis.

A study that compared coconut water to both plain water and a rehydration drink containing about four times more sodium but far less potassium than coconut water found that all three provided adequate rehydration (Saat et al., 2002). However, blood sugar levels were restored faster with coconut water and the rehydration drink than with water (Saat et al., 2002). This advantage gave us the impulse to compare coconut water and CEB in the aging population. We chose coconut water not because it replenishes fluids well, but rather because its exercise-enhancing properties are not well understood.

The purpose of the present study was to compare the two drinks, fresh young coconut water and carbohydrate-electrolyte beverage, in terms of (a) palatability/acceptability of the respective drink during training and (b) improvements in pre-performance hydration status and subsequent performance in people aged 45–55 who do sports on a recreational basis. Coconut water, a natural drink, is compared to a commercially available carbohydrate-electrolyte solution (Gatorade®) to assess the effectiveness of the natural sports drink in improving the hydration status and consequently the endurance performance of aging athletes.

Methods

Subjects

Forty-eight healthy male volunteers, between 45 and 55 years old, engaged in regular physical activity (jogging) on a recreational basis but not specifically trained for endurance running. All subjects signed a written consent form, were residents of the same city district, and were accustomed to the same altitude.

Cardiopulmonary Fitness Testing

Each subject completed a VO_{2max} protocol as follows: Cardiopulmonary fitness was assessed by a maximal, symptom-limited exercise tolerance test using the MedGraphics CPX/D, St. Paul, MN, Cardio O_2 ™ System, which combines ECG/ VO_2 systems simultaneously, real-time 12 lead ECG and directly measures VO_2 data in one unique system. Tests were performed with electronically braked bicycle ergometers, and the testing protocol comprised a 3-minute, 20-watt step-by-step linear increase of work load (Ergoline bicycle ergometer).

Respiratory gas exchange was measured through the breath-by-breath method using a flow device with a bidirectional pressure pre-Vent-Pneumotac, with a range of ± 18 L/s, accuracy $\pm 3\%$ or 50 ml, resolution 8.64 ml/s, dead space < 20 ml, as well as O_2 and CO_2 analysis. The pre-Vent-Pneumotac measures the maximal oxygen uptake, defined as the highest value for the plateau in oxygen uptake in VO_2 ($\Delta VO_2 \leq 50$ ml.min⁻¹ at VO_2 peak and

the closest neighboring data point), with increases in external work, which meet the criteria of maximal respiratory exchange rates ($RER \geq 1.1$).

Prior to testing, the pre-Vent-Pneumotac was calibrated with 10 samples from a 3 L calibration syringe. The gas analyzers were also calibrated before each test according to the room air and medically certified calibration gases (12.29% O_2 , 5.12% CO_2). Heart rate and blood pressure were recorded throughout the exercise tests. The subjects completed a physical examination to determine and record their personal height and weight. The seat and handle bar heights of the bicycle ergometer were set according to the subject's specifications, and gas exchange data at rest were measured and recorded. Subjects were instructed to maintain a pedal cadence between 70 and 75 rpm during exercise and to pursue exercise until volitional fatigue. Termination of the test occurred when the subject was unable to maintain a pedaling cadence of 40 rpm. The Ventilatory Threshold (VT) was measured according to established criteria, which include the determination of VE/VO_2 , VE/VCO_2 , $PETCO_2$, and $PETCO_2$ from a 15-second computer analysis plotted against time in minutes. The 15-second time span was selected because it measured VT most clearly. The criteria used to determine VT were systematic increases in both VE/VO_2 and $PETCO_2$ without corresponding increases in VE/VCO_2 and $PETCO_2$. The VO_2 that corresponded to the VT was then divided by VO_{2max} to express VT as a percentage of VO_{2max} .

Training

After completing the initial cardiopulmonary fitness test, the subjects began their endurance training. Training volume was similar for all subjects: 3 days a week, 60–90 min/session, 70% VO_{2max} . All subjects were issued telemetric heart rate monitors with the purpose to exercise according to their training protocol. All subjects started their training the same day after finishing their testing, and training was performed on the same weekdays. During training, all subjects were wearing sport clothes and underwear made of identical texture and issued solely by one company. They were instructed to record their body weight (without clothes) before and after each training day. Pre- and post-training cardiorespiratory fitness (VO_{2max}) were measured in all subjects. The training period was devised over a span of 6 months. All subjects were subsequently submitted to a second VO_{2max} protocol testing.

Fluid Replacement Trial

This trial was designed to investigate the effects of two different carbohydrate-electrolyte solution replacement fluids on the adaptive response of maximal aerobic power (VO_{2max}) during endurance exercise training in aging people. All subjects were instructed to record their drinking volume before and during exercise. They were randomly divided into two groups of 24 subjects each. For each group the drink was kept in an unidentified bottle, and for 6 months of the testing period they only drank their respective drink on exercise days. They all ate a normal well-balanced healthy diet, and no ergonomics or nutraceuticals were allowed. The same drink was used for post-exercise rehydration. Table 1 describes the nutrient composition of both drinks. One group ingested a natural carbohydrate-electrolyte solution extracted from the fruit of *Cocos nucifera*—a tropical palm tree—and the other group ingested a commercially available artificial carbohydrate-electrolyte solution (Gatorade®). All subjects were instructed to make a note on every training day of episodes of gastrointestinal discomfort, muscle cramps, as well as the palatability sensation of the drink.

Fluid Intake Protocol

Pre-Event Hydration: One hour pre-exercise, all subjects were instructed to voluntarily ingest their respective test drink at the ratio of 1.0 ml/kg of body mass. They then performed a urine sample for urine color measurement (Aution test strip for urine-menarini diagnostics®) to monitor hydration status. Urine color was compared to the standard criteria of urine specific gravity as well as the osmolality on a seven-grade color chart (1000 to 1030 as specific gravity test stick). They were instructed to drink a bolus of 1.0 ml/kg of their respective drink until urine specific gravity dropped below 1010. Repeated ingestion of

Table 1

Nutrient Composition and Osmolality of Natural Coconut Water (CW) and CEB USDA National Nutrient Database for Standard Reference

	CW	CEB
Carbohydrate (g 100 ml-1)	4.20	6.0
Sodium (mmol l-1)	4.57	18
Potassium (mmol l-1)	6.39	3
Chlorid (mmol l-1)	1.11	0
Magnesium (mmol l-1)	1.03	0
Calcium (mmol l-1)	0.60	0
Iron	Trace	0
Phosphorus (mmol l-1)	6.46	0
Zinc	Trace	0
Copper	Trace	0
Manganese	Trace	0
Selene	Trace	0
Osmolality (mosmol kg-1)	340	330–340

boluses of their respective drink was dependent on each urine test result. During exercise, serial drinking of 0.5 ml/kg body weight was ingested every 15 min. Post-exercise hydration was ad libitum.

Statistical Analysis

All anthropometric values of health-related variables and physiological tests were expressed as means and standard deviations (SD). Analysis of variance (ANOVA) with repeated measures followed by a multiple comparison test was performed to find out the significant difference in selected variables among the training phase. In each case, the significance level was chosen at 0.05. For all calculations, a statistical software package (SPSS) was used.

Results

Table 2 shows the demographic characteristics of both groups in terms of age, height, weight, and BMI (Body Mass Index) and reveals no noteworthy difference. Table 3 demonstrates a significant increase in endurance capacity ($p < 0.05$) for the coconut water group after 6 months of the endurance training period. The ventilatory threshold (VT) for

coconut water group showed considerable improvement compared to the CEB group. The data recording the number of periods of gastrointestinal discomfort as shown in Table 4 demonstrate the superiority of coconut water in causing less nausea, fullness, and stomach upset compared to the CEB. Furthermore, as demonstrated in Table 4, coconut water was easier to consume in large amounts due to its pleasant taste. The volume of ingestion was also higher in the coconut water group than in the CEB group, and subjects in the coconut water group experienced no muscle cramp during the 6-month training period.

Discussion

The present work shows that coconut water, compared to the commercially available CEB, is a superior hydration drink not only for fluid replenishment but also for improved VO_{2max} over a 6-month endurance training strategy for aging joggers engaged in recreational activity. One reason that coconut water is superior as a sports drink compared to CEB is because coconut water seems to restore blood glucose levels faster than CEB and keeps the levels within the physiological range as has been previously demonstrated by Saat et al. (2002), though in a population of young athletes.

Table 2

Demographic Characteristics of Both Groups of Joggers Drinking Either Natural Coconut Water (CW) or Commercially Available CEB

	Total	CW group	CEB group
Participants (male)	48	24	24
Age range (years)	45–55	46–55	45–51
Mean age	49.4	49.6	50.1
Height (cm)	177 (±3)	177 (±3)	178 (±2)
Weight (kg)	77 (±4)	77 (±3)	76 (±3)
BMI	24.55 (±0.45)	24.70 (±0.01)	23.97 (±0.41)

Table 3

Mean Values of VO_{2max} (ml/kg/min) and VT Between CW and CEB

	VO_{2max} pre-training	VO_{2max} post-training	VT pre-training (in % VO_{2max})	VT post-training (in % VO_{2max})
CW group	34.6*	41.1*	65.6*	78.1*
CEB group	34.7	36.5	66.5	65.1

* p < 0.01

Table 4

Data on Number of Gastrointestinal Discomfort and/or Muscle Cramps During Training in the 6-Month Period Tests for Joggers Drinking CW vs. CEB as Hydration Drink

	CW group (n=24)	CEB group (n=24)
Gastrointestinal discomfort	2	26
Exercise-associated muscle cramps (EAMC)	None	54
Palatability/Sweetness		
Very good	21	1
Good	3	11
Middle taste	0	12
Medium amount ingested 1 hr before training (ml)	922	522

Besides that, one of the greatest advantages of coconut water was its palatability. Subjects found it sweeter than the other drink, and it was less likely to produce stomach upsets. In the setting of the aging population, people who have reduced thirst sensation, the use of coconut water as a sports drink is a better choice because it has allowed better compliance. Coconut water as a sports drink has been praised not only for the quantity ingested as fluid replacement but also for its quality as natural food product.

Saat et al. (2002) discovered a new "old" sports drink that showed greater effectiveness as a rehydration drink when compared to CEB. This sports drink is more palatable, it replenishes quite gently fluid and electrolyte losses without causing stomach upset or fullness, and it is easier to consume in larger amount. The new "old" sports drink is a liquid endosperm contained in the fruit called *Cocos nucifera L.* The fruit contains a clear liquid with a sweetish taste. This liquid called "coconut water" is a pleasant and refreshing drink. As a matter of fact, during World War II, when intravenous solution was scarce, coconut water would be directly siphoned as an IV solution into the veins (Campbell-Falck, Thomas, Falck, Tutuo, & Clem, 2000; UN News Centre, 2000). Because coconut water is the only natural isotonic drink available in nature, we have compared it to a commercially available CEB (Gatorade®).

The absence of exercise-associated muscle cramp (EAMC) among the coconut water group, in contrast to the CEB group, is another interesting finding because the occurrence of EAMC is quite common among endurance athletes. The etiology of EAMC is not thoroughly understood, yet Schweltnus (1999) has demonstrated a relationship between EAMC and abnormal spinal control of motor neuron activity, in particular when a muscle contracts in a shortened position and when the incidence of EAMC seems directly related to muscle fatigue. The role of inflammation during exercise-induced muscle injury has not yet been clearly assessed. It is possible that the inflammatory response may be responsible for initiating or amplifying skeletal muscle injury. The involvement of cytokines as an anti-inflammatory factor in response to stress to the muscle fiber has already been demonstrated

in pertinent and relevant literature (Appell, Soares, & Duarte, 1992). As a matter of fact, coconut water is acknowledged as one of the best sources of cytokines (kinetin) found in nature (Ge et al., 2005).

Intentionally, the ambitions of the current study are to replicate what occurs in the real world (i.e., training after coming back home from work or after waking up in the morning) and to educate those who work with the aging population group with actual pertinent data from the perspective of sport science. This study underlines the growing international dimension of medicine applied to the shared endeavor of aging successfully. The findings support recommendations on the pertinent fluid intake protocol that are particularly designed to meet the specific needs of aging athletes. Training techniques to improve VO_{2max} and enhance performance have limited application because aging athletes do not necessarily strive to achieve the highest level of training. For this reason, we focus on the pre-hydration strategy at its full potential to induce an improvement in the hydration status during exercise and also to enhance endurance capacity (VO_{2max}). The taste of the drink plays an important role in this regard as the taste profile can encourage volitional fluid ingestion prior to training while avoiding gastrointestinal distress.

The main significance of this research was to compare fresh young coconut water with a commercially available CEB, over an extended observation period, in aging athletes engaged in jogging on a regular basis. The aging population group deserves special attention because of a poor adaptive physiological response to dehydration, such as a reduced thirst sensation and a reduced potential to dissipate body heat and increased insensible water loss. This population group may be at risk of having heat stroke due to complications associated with fluid and electrolyte imbalance during exercise. Hyperthermia, hypovolemia, hypoglycemia, electrolyte imbalance, and gastrointestinal distress are factors that contribute to quick fatigue, thus limiting exercise performance. Hydration strategies should aim at interventions that can positively influence these processes. The findings of this initial study demonstrate the superiority of fresh young coconut water versus a commercially available CEB not only as a hydration drink but also as a way to improve aerobic capacity of aging athletes. We argue that an additional positive effect of coconut water is the faster restoration of blood sugar levels than other drinks, subsequently leading to volitional intake that is higher in volume. Saat et al. (2002) also witnessed these findings in a group of young athletes.

Lindstedt et al. (1998) postulated that the principle mechanism to improve VO_{2max} relies on the mitochondrial ability to extract and process oxygen in the muscle cell. Skeletal muscle will therefore be able to assimilate large amounts of oxygen, resulting in an adequate muscle adaptation. This muscle adaptation mechanism results in higher levels of mitochondrial enzymes. The physiological muscle adaptation of aging people evidenced in the course of this current research will be the subject of the next study. Furthermore, fatigue as a functional sign of muscle damage (structural damage) will be observed after exercise, more specifically with the phenomenon of eccentric contractions resulting in mechanical stress to the fiber (Appell et al., 1992).

Aerobic capacity is the ability to produce energy by utilizing fuel in the presence of oxygen and is a function of maximal oxygen uptake (VO_{2max}). This represents the body's maximum total aerobic metabolic rate. To more cohesively interpret the findings of this investigation regarding the function of coconut water, compared to commercially available CEBs, in improving the aerobic capacity of aging athletes, we assessed other important factors that might impact on improving endurance, for instance muscle adaptation. Contemporary

viewpoints of factors affecting $\text{VO}_{2\text{max}}$ tend to identify multifactorial mechanisms including the pulmonary system, cardiovascular system (central), and the oxygen delivery system (peripheral) mechanism (Cain, 1995).

Maughan and Murray (2001) stated there is a biological continuum of integrated control of voluntary fluid intake. The neuro-hormonal, sensory, psychological, social, and cultural elements that compose the milieu in which we find ourselves combine together to determine the blend of beverage choice and level of fluid intake, which occurs during physical activity. To increase the motivation to drink, we designed a new strategy of self-check of the athletes' individual hydration status, paying greater attention to the fluid intake strategy before the start of physical activities, an important element in reducing the risk of inadequate hydration and in maintaining peak physiological functions and performance. Palatability is of particular importance in the instance of voluntary intake because it pertains to the concept that a beverage consumed in great quantity is, by definition, a palatable one. Extensive ingestion research conducted by Rolles (1991) showed evidence of the relationship between taste and drinking consumption in animal and human populations and concluded that the taste of the available drink is the major determinant in the amount consumed. Passe, Horn, and Murray (2000) highlighted the importance of taste in contributing to voluntary fluid intake and suggested that a powerful interaction exists between flavor, palatability, and exercise status. While most of the published research on the topic of taste and voluntary intake has examined the positive impact of palatable flavors, less attention has been given to how to optimize flavor for voluntary intake. To this intent, we chose coconut water because of its great value as a "natural thirst quencher" that provides the body with the same physiological electrolyte composition as seen in the intracellular space. These healthy properties arise from coconut water's well-balanced chemical composition, rendering it a natural isotonic solution, with a pleasant flavor and relatively low carbohydrate content (2.6%).

The Austrian Institute of Sport Medicine (Minehan, Riley, & Burke, 2002) concluded that enhanced fluid balance will consequently result in better performance and that this can be achieved by using flavored drinks rather than water. However, the results of our study also indicated that the choice of sports drink can significantly affect the result of endurance training performance. The physiological benefits of being well hydrated prior to exercise are beyond doubt. Commercially available CEB has been used with the intent of maintaining fluid-electrolyte balance during exercise. Most of the research conducted on hydration has been carried out with rehydration protocols comparing CEB drinks to a plain water control group, with CEB as the best choice of rehydration fluids. This current research is based on the premise that a status of suboptimal hydration prior to exercise is detrimental to performance, and therefore we concentrate on improving the efficiency of training by focusing on the quality of the drink rather than the quantity of fluid ingested.

Our results allowed us to conclude that the quality of coconut water compared to commercially available CEB is superior as a sports drink for recreational endurance sport activity of aging athletes. The international consensus recommends regular physical activity for adults to maintain mental and physical health. Focusing on the aging population group, the present study is designed to develop pertinent recommendations, which can positively influence the exercise performance of aging recreational athletes. Stefancik (2001) has demonstrated that for aging people the maintenance of healthy weight is more strongly associated with the level of regular physical activity than with caloric intake. In addition

to maintaining a healthy weight, recreational athletes exercise for enjoyment and for the derived positive effects of maintaining a healthy weight, thus diminishing the risk of age-related disabilities while retaining high mental and physical functionality, which is nowadays defined as “healthy aging.”

Research in the field of aging (Ehsani, Ogawa, Miller, Spina, & Jilka, 1991; Thomas, McCormick, Zimmerman, Vadlamudi, & Gosselin, 1992) has shown that an increase in maximal training can successfully enhance cognitive functions, enhance cardiopulmonary fitness, and improve the quality of life and suggests that early intervention contributes significantly to the reduction of age-related disease and disabilities. In reality, intensive educational advice has not shown much success in improving volitional fluid intake prior to exercise (as evidenced through personal experience). Choosing the right drink will certainly influence volitional intake, yet the drink must achieve the nutritional requirements for water and electrolytes to avoid dehydration, hypoglycemia, hyperthermia, muscle glycogen depletion, and electrolyte imbalance. Furthermore, the drink should be pleasing to the palate to induce greater intake of fluid.

Notwithstanding the importance of physical changes that occur in the course of chronological aging, many popular misconceptions still remain, which reflect, in part, the limited availability of reliable information. Most research regarding fluid intake prior to, or during, exercise has been conducted in young well-trained athletes or sport students and does not accurately reflect the physiological status of an aging athlete. Recently Kallman, Feldman, Krieger, and Bloomer (2012) compared coconut water with CEB on measures of hydration and physical performance in exercise-trained men. They concluded that little difference was noted between coconut water to water and CEB in markers of hydration and exercise performance and that additional studies with more demanding dehydration protocols will be needed.

Fresh young coconut water, which offers an unusual blend of nutrients, is especially rich in potassium, sodium, and magnesium and small amounts of phosphorus and natural sugar. Surprisingly, coconut water is relatively low in calories compared to typical fruit juice. Many commercially available bottled coconut water drinks are significantly different from fresh young coconut water. Most of them are made from mature coconuts and do not contain the important composition of nutrients. Kallman et al.'s (2012) and Saat et al.'s (2002) studies could have different results because of the use of two different types of coconut water.

We emphasize here that fresh young coconut water used in aging athletes has greater benefits when compared to CEB with regard to improving exercise endurance. Of particular interest for future studies will be to explore the exactly how fresh young coconut water promotes this enhancement of endurance in aging athletes during recreational sports activity.

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