INFLUENCE OF BOTTLED WATER ON HYDRATION FOLLOWING A DEHYDRATING BOUT OF EXERICSE

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RESEARCH ABSTRACT

Background
The purpose of this study was to compare the ability of two types of bottled water to rehydrate cyclists following a dehydrating bout of cycling exercise. It was hypothesized that rehydration would occur faster and/or more completely following the consumption of bottled glacier water supplemented with Alka-PlexLiquid™ (experimental condition) as compared to a highly filtered bottled water (placebo condition).

Methods
Ten male cyclists (Mean±SD: 40±5 years age, 51.3±7.8 ml/kg/min maximal oxygen uptake) performed two trials (1-week apart) of stationary cycling in a warm room (27.5-28.5 °C, ≥50% relative humidity) for 75-105 minutes at a power output that initially elicited 70-80% of maximal heart rate. Subjects exercised until dehydrating to -2.5% of pre-exercise nude body weight. Each cycling bout was followed immediately by the consumption of either the experimental (Akali; Glacier Water Company, LLC; Auburn, WA USA) or placebo (Aquafina; PepsiCo Inc., Purchase, NY USA) bottled waters (counterbalanced order, double-blind design) in a volume equivalent to body weight lost. Blood and urine samples, as well as nude body weight, were measured at fixed time points: immediately pre- and post-exercise, and 30, 60, 90, 120, and 180 minutes post-exercise. Urine samples were analyzed for volume output and specific gravity, while changes in total serum protein were determined from the blood samples. Data were evaluated with paired t-tests and repeated measures ANOVA with planned contrasts at the 0.05 alpha level.

Results
Neither absolute (Mean±SE; -2.00±0.05 and -1.95±0.07 kg) nor relative (-2.6±0.1 and -2.5±0.1%) amounts of body mass lost differed between placebo and experimental dehydration (P>0.05), respectively. Urine output was significantly higher at time points ≥60 minutes post ingestion: 103.5±24.4 versus 58.4±14.0 mls, 183.1±33.1 versus 125.2±33.4 mls, 198.7±35.9 versus 97.7±25.5 mls, 234.5±53.0 versus 107.6±21.6 mls, for 60, 90, 120, and 180-min post ingestion, respectively (P<0.05). At the same time points, urine specific gravity tended to be higher for the experimental (1.014-1.012) than placebo water (1.005-1.008;P=0.02-0.08). Lastly, serum protein tended to be less concentrated in the blood for the experimental water trial than for the placebo water trial at 120-minutes (7.7±0.03 versus 6.7±0.2 g/L; P=0.08) and 180-minutes (7.8±0.3 versus 6.7±0.2 g/L; P=0.08) post ingestion. Water retention at the end of the 3-hour recovery period, calculated as 1 minus the ratio of total urine volume (TUV) to ingested water volume (IWV) as a percentage ([1-(TUV/IWV)]x100)), was significantly higher for the experimental water trial (79.2±3.9%) than for the placebo water trial (62.5±5.4%; P<0.05).

Conclusions
Consumption of the experimental water resulted in significantly less urine output, a tendency for more water to be retained in the blood, and a higher overall water retention rate over the placebo water. Collectively, these results indicate that consumption of the experimental bottled water following a dehydrating bout of exercise provided faster and more complete rehydration to cyclists than the highly-filtered bottled water. It is likely that the Alka-PlexLiquid™ supplement, the high pH of 10.0, or some other unidentified component of the experimental water, was responsible for these observations.

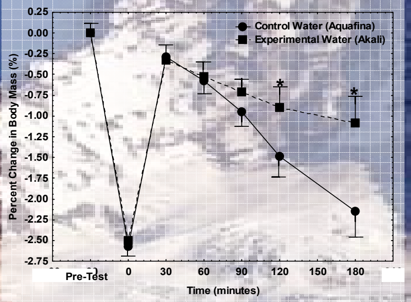

Figure 1. Change in body mass as a percent relative to body mass just prior to the start of stationary cycling protocol (i.e., Pre-Test). Subsequent measures at times 0 mins (immediately post cycling) through 180 mins were recorded during 3 hrs of rehydration recovery at rest following urine collection. All values expressed as Mean±SE where single (*) and double stars (**) indicate significance at the 0.05 or 0.10 alpha levels, respectively.

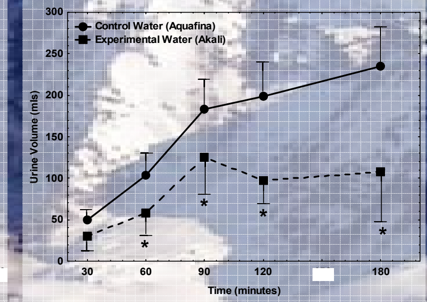

Figure 2. Urine volume at each of five time points during 3 hours of rehydration recovery following a dehydrating bout of stationary cycling. All values expressed as Mean±SE where single (*) and double stars (**) indicate significance at the 0.05 or 0.10 alpha levels, respectively.

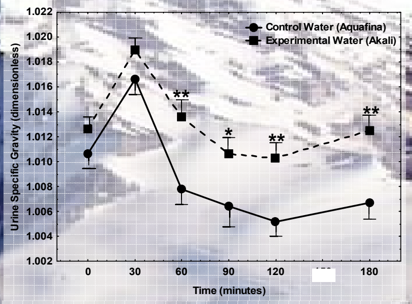

Figure 3. Urine specific gravity at each time point during 3 hours of rehydration recovery following a dehydrating bout of stationary cycling. All values expressed as Mean±SE where single (*) and double stars (**) indicate significance at the 0.05 or 0.10 alpha levels, respectively.

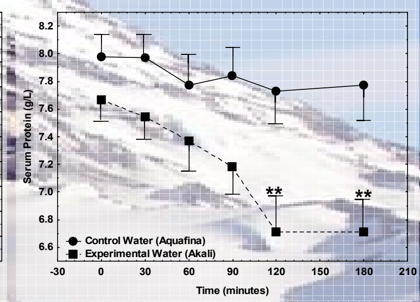

Figure 4. Serum Protein at each time point during 3 hours of rehydration recovery following a dehydrating bout of stationary cycling. All values expressed as Mean±SE where single (*) and double stars (**) indicate significance at the 0.05 or 0.10 alpha levels, respectively.

METHODS

Subjects
Trained male cyclists / triathletes between 18-55 years of age were recruited from local area.

Procedures
All subjects signed an Informed Consent Document approved by the Montana State University Internal Review Board (IRB).

All subjects visited the Movement Science / Human Performance Lab (MSL) for 3 separate tests.

- **Visit #1**: Cycling-based VO_{2MAX} test to measure VO_{2MAX} (descriptive measure only) and maximal heart rate (HR_{MAX}). A computed value of 80% of HR_{MAX} was used as basis for establishing an initial cycling workload for subsequent vists.

- **Visit #2**: First submaximal cycling test – Using each subjects own bicycling mounted to a stationary trainer, subjects cycled for 75-120 mins in a warm and humid room (27.5-28.5 °C, ≥50% RH) with a goal of losing ≥2.5% of their pre-test nude body mass. Next, subjects consumed an amount of water equivalent to the body mass just lost through cycling. Subjects consumed EITHER the experimental water OR the placebo water, but neither the subject nor researchers were aware of the condition being tested. Subjects were given 20 mins to consume the entire bolus of water after which began a 3-hr recovery period. At fixed time points (0, 30, 60, 90, 120, & 180 mins), urine samples were collected to quantify changes in urine output and urine specific gravity, as well as a 10 ml blood sample via forearm venous catheter to measure serum protein concentration. Lastly, nude body weight was also measured at each of these same time points.

- **Visit #3**: Second submaximal cycling test – This visit was identical to the previous visit except that each subject was given the second water condition. The order of conditions tested was counterbalanced across subjects. NOTE: Subjects were tested in groups of 5-10 at a time.

Statistical Analyses
All data were evaluated using a combination of paired t-tests and 2-Factor repeated measures ANOVA at 0.05 alpha level.

BOTTLED WATER PROPERTIES

EXPERIMENTAL CONDITION
Akali water (Glacier Water Company, LLC; Auburn, WA) contains several naturally occurring trace minerals (silica, calcium, potassium, magnesium, selenium) in amounts ranging from 0.1-23.0 mg/L. When compared with public water sources, this mineral content is relatively high, though it is not uncommon for unfiltered glacier water melt. In fact, Akali water is one of several product lines from the same company which has sole bottling rights to the runoff from the Carbon Glacier on Mt. Rainier, WA. In addition to these minerals, Akali water also contains an unknown amount of Alka-PlexLiquid™, a proprietary blend of minerals and electrolytes said to be the primary active ingredient driving the water's unusually high pH of 10.0, as well as the proposed enhanced rate of absorption into the body.

CONTROL CONDITION
Aquafina water (PepsiCo Inc., Purchase, NY USA) bottlers use a variety public water sources across the U.S. and a trademarked purification process called HydRO-7™ that is said to remove all measureable traces of any particles that can influence water taste, including naturally occurring minerals. In fact, according to the Aquafina label, this purified water contains no significant minerals or electrolytes whatsoever.

ADDITIONAL TESTING
Using samples of both Akali and Aquafina from previously unopened bottles, our lab measured the specific gravity of each water at exactly 1.000.

DISCUSSION / CONCLUSIONS

- Water retention at the end of the 3-hr recovery period was (Mean±SE) significantly higher for the experimental (79.2±3.9%) than placebo water (62.5±5.4%; P<0.05) conditions. This determination is consistent with the changes in body mass during recovery (Figure 1). Supporting these observations, urine specific gravity (Figure 3) was significantly higher AND serum protein concentration (Figure 4) tended to be lower for the experimental water versus the placebo water.

- Collectively, these observations suggest that the experimental water was more readily absorbed by the body in the intestines. This, in turn, resulted in better rehydration (and thus recovery) following a dehydrating bout of cycling exercise.

- These observations are likely due to either the Alka-Plex Liquid™ supplement added to the glacial water, the mineral sediments naturally occurring within the glacial water, or possibly an interaction between these factors.