

## Comparing Hyperhydration Resulting From The Ingestion Of Glycerol, Carbohydrate And Saline Solutions

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**Introduction:** Glycerol and water ingestion can induce a significant increase in hydration (hyperhydration) compared to water or low concentration saline solutions (2,3). Results also indicate that high concentration saline solutions (60-100 mEq/L) improve hydration compared to water (4). Research is needed that compares previously recommended solutions for improving hydration so that an “optimal” regimen can be recommended.

**Methods:** Eight subjects completed six trials in a Latin Squares design. Pre-trial controls included no exercise (> 30 min) in the previous 24 hrs, no caffeine or other diuretics in the previous 48 hrs, the ingestion of 40 mL/kg of liquid/24 hrs for the preceding two days, and a standardized liquid breakfast the morning of the trial (2 hrs before trial). Each trial required subjects to complete a 5 hr protocol as detailed in Table 1. **Statistics:** A two-way ANOVA with repeated measures was used to examine differences between each of relative body weight change ( $[\text{sample (kg)} - \text{baseline (kg)}] / \text{baseline (kg)} \times 100$ ), urine volume (mL), and plasma osmolality (mOsmol/kg). Significant differences between means were identified using Tukey's post-hoc HSD test. Statistical significance was set at 0.05, with an estimated power >0.8 for a relative body weight mean difference of 0.39% and a SD =  $\pm 0.3\%$ .

**Results:** Peak hydration occurred at 2.5 hrs for trials B, C, D and E, at 1.5 hrs for trial A, and at 1.0 hrs for trial F (Figure 1). Peak hydration was similar for trials B and D, and trials A and F induced similar hydration but were less than trials B, C, and D. Trials C and E produced similar moderate hydration. At 5 hrs, trials B, C, D and E provided for a similar sustained hydration. Trials A and F produced a significant dehydration at this time compared to trials B, C, D and E. Urine volumes mirrored a reciprocal of the data for body weight change. Plasma osmolalities were no different at any time between trials A, E and F. Plasma osmolality significantly increased over time in trials B, C, and D, reaching peaks of  $298 \pm 5$  (3.0 Hrs, C),  $300 \pm 6$  (1.5 Hrs, D) and  $317 \pm 11$  (3.5 Hrs, B) mOsmol/kg, respectively.

**Discussion:** Gatorade was no better than distilled water for improving hydration. Greatest hyperhydration occurred with glycerol ingestion, and there was no added benefit by ingesting a glycerol solution after an initial bolus of 1.5 g/kg. The electrolyte solution improved hydration more than water or Gatorade, but was not similar to any glycerol regimen. The ingestion of 1.5 g/kg of glycerol will improve hydration beyond that provided by equal volumes of Gatorade, an electrolyte solution, or water.

**References:** 1. Gisolfi CV and SM Duchman. Med. Sci. Sports Exerc. 24(6):679-687, 1992. 2. Freund BJ et al. J. Appl. Physiol. 79(6):2069-2077, 1995. 3. Riedesel ML et al. J. Appl. Physiol. 63(6):2262-2268, 1987. 4. Maughan RJ et al. Eur. J. Appl. Physiol. 69:209-215, 1994

Drink Codes	Drink (Total=26 mL/kg)	Data Collection
A=DW	Distilled water	Blood sample
B=Gbol+G	1.5 g glycerol/kg (40% sol'n) @ 0 + same dose as Gsol for 0.5-2.0	Urine collection
C=Gsol	1.5 g glycerol/kg (5.75% sol'n)	Nude body weight
D=Gbol	1.5 g glycerol/kg (40% sol'n) @ 0 + DW for 0.5-2.0	Symptom/Drink
E=E	80 mEq Na <sup>+</sup> Cl <sup>-</sup> + 20 mEq K <sup>+</sup> Cl <sup>-</sup> + Aspartame + Flavoring	Questionnaire
F=CE	Gatorade	

Ingestion @ 0, 0.5, 1.0, 1.5, 2.0; Data collection every 0.5 hrs, 0- 5.0

