SHORT-TERM ORAL LIQUID INGESTION DECREASES HUMAN MILK OSMOLALITY

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BACKGROUND

- Exclusive breastfeeding is the appropriate feeding practice during the first 6 months of life.
- Elevated osmolality in infant diets poses several risks, including slowed gastric emptying and mucosal injury.
- Water adequate intakes increase in 900mL for lactating women.
- Failure to consume recommended water intake would have implications for lactation performance, and exposes women to adverse consequences of hypo-hydration.
BACKGROUND

Up to 8-h water restriction

Osmolality increases significantly

Up to 8-h *ad libitum* water repletion

Osmolality decreases

Never an undershoot below the original level.

BACKGROUND

Milk collection during 14.5 hours of Ramadan fasting

Preservation of milk osmolality

Never out of normal range

OBJECTIVE

To determine whether the milk osmolality (Mosm) responses to short-term water restriction and acute water ingestion, were symmetrical or asymmetrical in terms of the tightness of their homeostatic regulation.
SETTING

- Quetzaltenango, Guatemala
- Western Highlands

- 220 km
- 1953 km²
- 2357 masl
- 624,716 hab
- Spanish, K'iche', Mam
STUDY SITES

Quetzaltenango Health Center
Garibaldi, Quetzaltenango
Pacajá, Quetzaltenango
Espumpujá, San Juan Ostuncalco, Quetzaltenango
SUBJECTS

• **Inclusion Criteria**
  • To be resident of the areas of interest
  • To have a healthy nursing infant (exclusively or partially)
  • Infant age between 3-6mo (12-26wks)
  • To provide signed consent form for the dyad

• Study approved by the Human Studies Committee of CeSSIAM
PROCEDURES AND METHODS

**GROUP 1** (n=13)
- **Tx 1**: water ingestion (4-glasses). -- Final full sample of urine and milk
- 90 minutes

**GROUP 2** (n=13)
- **Tx 2**: Liquid restriction. -- Final full sample of urine and milk
- 90 minutes

**Arrival:**
- Urine sample (empty bladder)
- Milk sample (empty breast not involved in last nursing)

**2–21 days interval**

**n=26**
PROCEDURES AND METHODS

• Aliquoting
  • Two 2-5mL aliquots of each sample

• Storage
  • -20°C

• Measurement
  • Brought to room temperature
  • 100µL sample
  • Vogel Löser 815 (Geissen, Germany)
RESULTS: DEMOGRAPHIC CHARACTERISTICS

- **26 lactating mothers**
  - Median Age: 22 years old
  - Limits: 17-32

- **26 nursing infants**
  - Infant median age: 18 weeks
  - Limits: 12-28
  - 15 boys – 11 girls
RESULTS: BREAST MILK STUDIES

Table: Descriptive statistics and comparisons for human milk variables across time and between treatments (paired t-test).

<table>
<thead>
<tr>
<th>Phase</th>
<th>Median</th>
<th>Mean±SD</th>
<th>Limits</th>
<th>Median</th>
<th>Mean±SD</th>
<th>Limits</th>
<th>P value</th>
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<td>Baseline</td>
<td>Endline</td>
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<td>Milk volume (mL)</td>
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<tr>
<td>Tx1</td>
<td>24</td>
<td>35±33</td>
<td>4-122</td>
<td>22</td>
<td>25±18</td>
<td>4-64</td>
<td>0.061</td>
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<tr>
<td>Tx2</td>
<td>16</td>
<td>23±18</td>
<td>3-71</td>
<td>15</td>
<td>23±20</td>
<td>3-78</td>
<td>0.927</td>
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<td>P value</td>
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<td>0.515</td>
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<td>Milk osmolality (mOsm/kg)</td>
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<tr>
<td>Tx1</td>
<td>284</td>
<td>285±14</td>
<td>262-305</td>
<td>277</td>
<td>275±16</td>
<td>223-296</td>
<td>&lt;0.001</td>
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<tr>
<td>Tx2</td>
<td>282</td>
<td>284±16</td>
<td>254-312</td>
<td>280</td>
<td>283±18</td>
<td>238-314</td>
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<td>P value</td>
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<td>0.016</td>
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**RESULTS: BREAST MILK STUDIES**

**Figure:** The arithmetic mean and SD of baseline-to-endline changes in milk osmolality compared across treatments (paired t-test).
RESULTS: URINARY OSMOLALITY AND HYDRATION

Table: Descriptive statistics and comparisons for urinary variables across time and between treatments (paired t-test).

<table>
<thead>
<tr>
<th>Phase</th>
<th>Median</th>
<th>Mean±SD</th>
<th>Limits</th>
<th>Median</th>
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<th>P value</th>
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<td>Baseline</td>
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<td>Endline</td>
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<td>Urine volume (mL)</td>
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<tr>
<td><strong>Tx1</strong></td>
<td>80</td>
<td>112±78</td>
<td>10-300</td>
<td>120</td>
<td>177±137</td>
<td>22-600</td>
<td>0.020</td>
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<tr>
<td><strong>Tx2</strong></td>
<td>50</td>
<td>74±50</td>
<td>20-190</td>
<td>50</td>
<td>65±49</td>
<td>15-230</td>
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<tr>
<td>P value</td>
<td>0.030</td>
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<tr>
<td>Urinary osmolality (mOsm/kg)</td>
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<tr>
<td><strong>Tx1</strong></td>
<td>628</td>
<td>635±296</td>
<td>184-1464</td>
<td>248</td>
<td>310±211</td>
<td>80-849</td>
<td>&lt;0.001</td>
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<tr>
<td><strong>Tx2</strong></td>
<td>632</td>
<td>649±292</td>
<td>105-1375</td>
<td>655</td>
<td>691±351</td>
<td>114-1712</td>
<td>0.252</td>
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<td>P value</td>
<td>0.773</td>
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<td>&lt;0.001</td>
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## RESULTS: URINARY OSMOLALITY AND HYDRATION STATE

**Figure:** Serial pie-graph representation of the percentage of urine samples exceeding 900 mOsm/kg

<table>
<thead>
<tr>
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<th>Baseline</th>
<th>Endline</th>
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<tbody>
<tr>
<td><strong>Tx 1</strong> Water ingestion</td>
<td><img src="image" alt="Pie Chart" /></td>
<td><img src="image" alt="Pie Chart" /></td>
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<td>8% 92%</td>
<td>0% 100%</td>
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<tr>
<td><strong>Tx 2</strong> Liquid Restriction</td>
<td><img src="image" alt="Pie Chart" /></td>
<td><img src="image" alt="Pie Chart" /></td>
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<tr>
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<td>8% 92%</td>
<td>12% 88%</td>
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</table>
**RESULTS:** URINARY OSMOLALITY AND HYDRATION

Figure: Baseline urinary osmolality for both treatments.

- Linear $R^2 = 0.377$
- Spearman Rho = 0.606
- P-value = 0.001
CONCLUSIONS: MILK OSMOLALITY STUDIES

• In the short term, restricting liquid intake results in a conservation of Mosm, confirming the findings in women of Prentice et al., (1984), and contrasting with the bovine experience of Bjerg et al., (2003).

• In addition, we provide novel documentation of Mosm expansion with acute oral liquid ingestion.
CONCLUSIONS:
URINARY OSMOLALITY STUDIES

• As expected, the Uosm was dramatically reduced by acute oral ingestion, and slightly elevated with restriction.

• More important is the observation of preexisting baseline hypo-hydration states in lactating women, which raises the specter of an unrecognized public health problem in Guatemala.
ACKNOWLEDGEMENTS

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Thank you!