EFFECTS OF WATER CONSUMPTION ON URIC ACID ELIMINATION: ELIMINATION OF STOCKED URIC ACID BY BEER CONSUMPTION.

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Abstract
In this work, a simple method to eliminate stocked uric acid was investigated. For this purpose, a sample of 10 students consumed 216 cl of beer Primus. Ten minutes after they consumed water, the content of uric acid in their eliminated urine was then determined. The results showed that consumption of 216 cl of beer Primus inhibits uric acid excretion and about 974.67 µmol/l of uric acid are then stocked in organism. Consumption of 2 l of water helps to eliminate such stocked uric acid. About 416.63 µmol/l can be eliminated after consumption of beer and water whereas the whole quantity of stocked uric acid can be excreted if one drinks water only. This work shows that it is possible to consume beer without hyperuricemia.

Keywords: Water, uric acid, beer, elimination, urine.

INTRODUCTION
Many several disorders such as gout and Lesch–Nyhan syndrome are usually associated with abnormal levels of uric acid (UA), the principal end product of purine metabolism (Harper, 1977). Gout occurs when sodium urate crystals are deposited in the joints, soft tissue, bursae and tendons (Murray et al. 2011). Lesch–Nyhan syndrome is an X-linked chromosome disorder that results in the absence of the enzyme hypoxanthine–guanosine phosphoribosyltransferase (HGPR). Hyperuricemia (elevated concentrations of UA) may indicate other medical conditions such as kidney injury (Heptinstall et al. 1966), leukemia (Krackoff et al. 1965) and pneumonia (Puig and Mateos, 1994 [5]). The determination of the UA is therefore very important. Recently, a sensitive determination of UA has been carried out (Ndamanisha and Guo, 2008).

Among consumed beers in Burundi, the one called Primus is cheaper than others. However, the association between consumption of that beer and risk of some diseases is not well known. It has been observed that the drinking of large amounts of ethanol leads to an elevation of serum uric acid concentration (Lieber et al., 1962; Yamamoto et al., 2005; Yamanaka, 1996; Stibůrková et al. 2014). Moreover, we are experiencing many cases of gout and other diseases related to hyperuricemia in Bujumbura city where Primus is consumed. Some results have proved that alcohol intake is strongly associated with an increased risk of gout (Choi et al. 2014). Moreover, it has recently been noted that local banana wine which is also consumed in Bujumbura has important effects on health. The results of the study indicated that consumption above 67.5 cl of alcohol drinks inhibits uric acid excretion (Ndamanisha and Nkuririmana, 2016). However, Burundians like to take alcohol drinks and it is very difficult for them to limit high volumes of these drinks (Sommers, 2013). In that case, uric acid continues to be stocked in organism. That is why it is then important to eliminate it from the human body. Few studies showed how stocked uric acid (after consumption of ethanol) can be eliminated.

In the present work, effects of water on uric acid elimination after consumption of 216 cl of beer Primus are studied. This volume is selected because consumption of 202.5 cl of banana wine showed a drastic reduction of uric acid elimination (Ndamanisha and Nkuririmana, 2016).

MATERIALS AND METHODS
A sample of 10 students (males) with age ranging between 26 to 36 years was selected. The students were living at University of Burundi and agreed to observe discipline in their diet. For this, during experiment they should avoid taking milk, meat, or peanuts. As they lived at the same campus they took the same meal before consumption of beer Primus. Those students were labeled as A, B, C, D, E, F, G, H, I, J, K, L. The alcohol degree of the beer primus is 4.5 % (V/V).

The collection of sample urines was as follows:
1. Day 1: Before drinking beer, every student of the group should collect a small amount of urine every time he went to urinate from 20:00 to 6:00. He mixed its urine and gave the sample to us.
2. Day 2: After consumption of 216 cl of Primus, every student did the same process of collecting urine as before drinking.
3. Day 3: Urine was also collected with the same procedure after drinking 216 cl of the beer and 2 l of water. Water was drunk ten minutes after taking beer.
4. Day 4: Urine was collected with the same procedure after drinking 2 l of water only.

The given water is distributed by the Régie de Production et de Distribution d’eau et d’électricité (REGIDESO) and is considered as drinking water.

Uric acid content in different urine samples was determined using the enzymatic spectrometric method (Hamzah et al. 2013). 1000 µl of uric acid liquocolor reagent were added to 20 µl of urine. The solution was left for 15 minutes at room temperature to allow the reaction to be completed. 20 µl of uric acid (476 µmol/l) was used as a standard solution. The measurements were carried out at 520 nm using a spectrophotometer, type HUMALIZER 3500 (Centre Hospitalo-Universitaire de Kamenge, University of Burundi).

RESULTS AND DISCUSSION
It is known that measuring uric acid after drinking should be expressed per g of creatinine in urine in order to correct for dilution errors (Kumi et al. 2015). However, as we are working in the same conditions before and after drinking, effects on uric acid elimination can be studied using concentration of uric acid. Table (1) shows the different concentrations of eliminated uric acid in urine. One can note that, after drinking 0 cl of beer Primus, uric acid concentrations are...
different from one student to another. This can be attributed to individual metabolism of purines and uric acid that is different from one student to another (Neuman et al. 2002). Moreover, the catabolism of ethanol is also different (Marshall and Bangert, 2005).

Table (1) Concentrations of eliminated uric acid in the urine (µmol/l).

<table>
<thead>
<tr>
<th>Student label</th>
<th>Day 1 (before consumption of beer)</th>
<th>Day 2 (after consumption of 216 cl of beer)</th>
<th>Day 3 (after consumption of 216 cl of beer and 2 l of water)</th>
<th>Day 4 (after consumption of 2 l of water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1143.8</td>
<td>262.1</td>
<td>789.3</td>
<td>1188.6</td>
</tr>
<tr>
<td>B</td>
<td>1426.6</td>
<td>426.0</td>
<td>660.9</td>
<td>1521.2</td>
</tr>
<tr>
<td>C</td>
<td>2170.0</td>
<td>807.7</td>
<td>921.9</td>
<td>1289.1</td>
</tr>
<tr>
<td>D</td>
<td>1323.8</td>
<td>458.2</td>
<td>597.0</td>
<td>815.0</td>
</tr>
<tr>
<td>E</td>
<td>1517.0</td>
<td>473.1</td>
<td>714.6</td>
<td>1781.8</td>
</tr>
<tr>
<td>F</td>
<td>1270.0</td>
<td>301.7</td>
<td>509.0</td>
<td>1413.5</td>
</tr>
<tr>
<td>G</td>
<td>1425.3</td>
<td>346.0</td>
<td>1021.9</td>
<td>1824.6</td>
</tr>
<tr>
<td>H</td>
<td>1120.3</td>
<td>386.6</td>
<td>1100.6</td>
<td>1713.1</td>
</tr>
<tr>
<td>I</td>
<td>1023.7</td>
<td>336.3</td>
<td>1008.9</td>
<td>2210.8</td>
</tr>
<tr>
<td>J</td>
<td>1434.8</td>
<td>316.3</td>
<td>950.8</td>
<td>2014.9</td>
</tr>
<tr>
<td>Mean</td>
<td>1385.53</td>
<td>410.86</td>
<td>827.49</td>
<td>1570.56</td>
</tr>
</tbody>
</table>

Fig (1) Variation of uric acid concentration in urine after consumption of different quantities of drinks (beer and water)

After drinking 216 cl of beer Primus, the uric acid concentrations decrease drastically. Uric acid is not easily soluble in water and the solubility will decrease with introducing other acids in the medium. The ethanol in the organism is transformed in pyruvic acid and lactic acid according to the following equation:

\[ C_2H_5OH \rightarrow CH_3COCOOH \rightarrow CH_3CHOHCOOH \]

(Moussard C. 2007)

If a higher quantity of ethanol is transformed, this will result in the increase of concentrations of produced acids. Therefore, uric acid becomes more insoluble in the organism and difficult to

eliminate in the urine (Di Castelnuovo et al. 2002). The phenomenon has been recently observed with local banana wine (Ndamanisha and Nkuririmana, 2016).

Table (2) shows uric acid concentrations that can be stocked or eliminated after consumption of beer and water respectively.

Table (2) Uric acid concentrations stocked in organism or eliminated in urine.

<table>
<thead>
<tr>
<th>Student label</th>
<th>C_{J2} – C_{J1}</th>
<th>C_{J3} – C_{J2}</th>
<th>C_{J4} – C_{J3}</th>
<th>C_{J4} – C_{J1}</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>- 881.7</td>
<td>+ 527.2</td>
<td>+ 399.3</td>
<td>+ 44.8</td>
</tr>
<tr>
<td>B</td>
<td>- 1000.6</td>
<td>+ 234.9</td>
<td>+ 860.3</td>
<td>+ 94.6</td>
</tr>
<tr>
<td>C</td>
<td>- 1362.3</td>
<td>+ 114.2</td>
<td>+ 367.2</td>
<td>- 880.9</td>
</tr>
<tr>
<td>D</td>
<td>- 665.6</td>
<td>+ 138.8</td>
<td>+ 218</td>
<td>- 508.8</td>
</tr>
<tr>
<td>E</td>
<td>- 1043.9</td>
<td>+ 241.5</td>
<td>+ 1000.2</td>
<td>+ 197.8</td>
</tr>
<tr>
<td>F</td>
<td>- 968.3</td>
<td>+ 207.3</td>
<td>+ 904.5</td>
<td>+ 143.5</td>
</tr>
<tr>
<td>G</td>
<td>- 1084.7</td>
<td>+ 681.3</td>
<td>+ 802.7</td>
<td>+ 399.3</td>
</tr>
<tr>
<td>H</td>
<td>- 733.7</td>
<td>+ 714.0</td>
<td>+ 612.5</td>
<td>+ 592.8</td>
</tr>
<tr>
<td>I</td>
<td>- 687.4</td>
<td>+ 672.6</td>
<td>+ 1201.9</td>
<td>+ 1187.1</td>
</tr>
<tr>
<td>J</td>
<td>- 1118.5</td>
<td>+ 634.5</td>
<td>+ 1064.1</td>
<td>+ 580.1</td>
</tr>
<tr>
<td>Mean</td>
<td>- 974.69</td>
<td>+ 416.63</td>
<td>+ 743.07</td>
<td>+ 185.03</td>
</tr>
</tbody>
</table>

where:
- C_{J1} is the uric acid concentration before consumption of beer Primus;  
- C_{J2} is the uric acid concentration after consumption of 216 cl of beer Primus;  
- C_{J3} is the uric acid concentration after consumption of 216 cl of beer Primus and 2 l of water;  
- C_{J4} is the uric acid concentration after consumption of 2 l of water only.  

In that case:
- C_{J2}–C_{J1} shows the effect of consumption of beer on uric acid elimination;  
- C_{J3}–C_{J2} shows the effect of water on uric acid elimination after consumption of beer;  
- C_{J4}–C_{J3} indicates the elimination of uric acid which is remaining in the organism;  
- C_{J4}–C_{J1} shows the effect of water on uric acid elimination.

Negatives values indicate concentrations of uric acid which is stocked in organism whereas positive values show eliminated uric acid. One can figure out that, after consumption of 216 cl of beer, the whole sample shows the decrease of uric acid concentrations. That is why the values corresponding to C_{J2}–C_{J1} are negative.  It is also easy to note that a mean of 974.67 µmol/l is stocked in organism. The raisons are given above (Neuman et al. 2002, Marshall and Bangert, 2005).

C_{J2}–C_{J1} values are all positive. This indicates the effect of water on uric acid elimination. About 416.63 µmol/l which were stocked in the organism because of the consumption of beer are eliminated after consumption of 2 l of water. The effect of water is very clear when considering C_{J4}–C_{J3}. All the values are positive and they indicate additional elimination of uric acid. In fact, all quantity of stocked uric acid is now eliminated. Also, if we make comparison between uric acid concentration after consumption of water only (C_{J4}) and that corresponding to 0 cl of beer, it is clear that consumption of water
makes uric acid elimination easier. This phenomenon can be attributed to the fact that urates are more soluble in much water and they become easy to be eliminated in urine (Benhamou, 2002).

Except the students C and D, C11-H11 values are positive and they show the effect of water on uric acid elimination (even without taking beer). For those students, the discipline was not strictly respected because one took another quantity of beer whereas the other was not able take water after beer.

It is then possible to consider the general behavior which indicates that uric acid concentrations decrease after consumption of 216 cl of beer Primus and increase after consumption of water. This phenomenon is clear in Figure (2) where the mean of uric acid concentration is calculated.

**CONCLUSION**

In order to see how stocked uric acid can be eliminated after consumption of beer, this drink has been given to sample of 10 students who lived in the same conditions at University of Burundi at the time of the study. Ten minutes after drinking 216 cl of beer Primus, 2 l of water was given to the students. To see the effect of water, the same quantity was taken without drinking beer. This indicates that, even if we don’t consume alcohol, it remains necessary to drink water to make uric acid elimination easier.

Therefore, if uric acid is not eliminated it will be deposited and will cause the phenomenon of hyperuricemia. That is why we looked for a simple method to eliminate it. Our findings show how it is possible to drink beer without hyperuricemia. In that case, we will avoid many medical conditions.

**Acknowledgement**

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**References**

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