THE ROLE OF MgO FOR USE IN ANTACID

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Introduction

It is generally explained for antacid applied to gastro that a mild antacid effect can be obtained as a result of $Mg(HCO_3)_2$ formed by addition of MgO to $NaHCO_3$.
Now a consideration is made to discuss the effect of chemical equilibrium between gastric juice and $NaHCO_3$/MgO being ingested together.

Discussion

$$NaHCO_3 + HCl \longrightarrow NaCl + H_2O + \overset{gas}{CO_2 \uparrow}$$

(gas forms partially into aqueous solution)

CO_2 gas liberates mostly out of the reaction phase, which results in non-equilibrium with the above-mentioned reaction.
In the presence of excess $NaHCO_3$, the reaction is continued as long as HCl is consumed.
(The reaction velocity is extremely rapid because of an ionic reaction.)

Take, for example, 0.01 mol $NaHCO_3$ excessively given against 100cc gastric juice, the concentration of HCl becomes 0.1 mol/1.
If $NaHCO_3$ is then 100% dissociated, Na's ratio is given by 0.1 mol/1 which converts to:—

$$pH = -\log(H^+) = 13 \qquad (OH^-) = 0.1 \text{ mol/1}$$

When, on the other hand, MgO is dissolved in water, one part of which is slightly dissociated in accordance with:—

$$\underset{\text{(precipitated)}}{MgO} \longrightarrow \underset{\text{(dissolved in water as molecule state)}}{MgO} \longrightarrow \underset{\text{(ionized)}}{Mg^{++} + 0^{--} + 2H^+ + 20H^-} \longrightarrow Mg^{++} + 20H^-$$

And solubility product of $Mg(OH)_2$ at 18°C being;

$$(Mg^{++})(OH^-)^2 = 1.2 \times 10^{-11}$$

The consequent result is obtaind as below.

$$(Mg^{++}) = \sqrt[3]{(4.946)^3 \times (10^{-3})^3} = 4.946 \times 10^{-3} \fallingdotseq 5 \times 10^{-3} \text{ mol/1}$$

The value of $(OH^-) = 0.1$ mol/1 remains unchanged, when considering form the presence of excess $NaHCO_3$ given by the above.
Consequently, (Mg^{++}) is reduced by the equilibrium with this ion to:—

$(Mg^{++}) = 1.2 \times 10^{-11}/0.1 \times 0.1 = 1.2 \times 10^{-11}/10^{-2} = 1.2 \times 10^{-9}$

and forms precipitant due to the dissolved molecule being already saturated.

Quantitatively, (Mg^{++}) under this state becomes reduced approximately a hundred-thousandth.

The precipitant obtained thereby is supposed to be $Mg(OH)_2$, not MgO.

On account of existance of (OH^-) produced by $NaHCO_3$, the concentration of (Mg^{++}) becomes trace and presence of $MgCl_2$ could be retained within a degree of this concentration.

A simultaneous result will also be obtained with $MgCO_3$.

〔$Mg(HCO_3)_2$ is not tabled, nor is $Ca(HCO_3)_2$ mentioned either, these are probably of unstable matters.〕

Even if the degree of dissociation of $NaHCO_3$ were considered to be at 10%, the resultant value alters only to $(Mg^{++}) = 1.2 \times 10^{-7}$ which provides the meaning of slight change through-out the arguments of the correlation between these chemical equilibriums.

Consequently, these observations, from which there derive the facts that scarce change of pH is shown in the presence of excess $NaHCO_3$ and no chemical reaction can be considered, seem to be rather of no use if MgO is not taken into the other phase of consideration. The formation of $Mg(HCO_3)_2$ is not expected, but the role of MgO with $NaHCO_3$ will not always deny the fact of medical effect.