Asian Journal of Chemistry Vol. 22, No. 4 (2010), 2579-2584

Studies on Sorption Tendency and Permeability of Different Cold Drinks Across Urinary Bladder Membranes

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Density, viscosity, pH, absorbance, water contents and hydrodynamic permeability of Aqua guard water, Aqua fina water, Mountain dew, Mirinda, Pepsi and Thums up have been measured across urinary bladder membranes of goat. It has been found that different coloured permeants are absorbed in the membrane texture and produce decisive effects in the permeability of the urinary bladder membranes. By keeping the permeants for a few hours in the urinary bladder, Mirinda and Mountain dew colourize the bladder surface with their colours while blackish colour is observed for Pepsi and black brownish tinge is observed in Thums up. Practically no change in colour is observed when bladder is immersed in urine solution. Absorption in the bladder surface will have adverse effects in structural properties of the bladder. Since urinary process may be defined as a process of development of pressure, sustenance of pressure and finally release of pressure, such studies are expected to be a great use in predicting physiological behaviour of the membrane in diverse situations.

Key Words: Urinary bladder membrane, Water content, Hydrodynamic permeability, Adsorption.

INTRODUCTION

Cold drinks (Pepsi, Thums up, Mirinda, Mountain dew *etc.*) and mineral water (generally packaged drinking water) are quite popular in the country. Water influences many of the functions and activities of human body. The various tissues within the body differ significantly in water content.

Cold drinks generally contain sweetened carbonated water caffine, flavours, permitted natural colours, preservatives, antioxidants, *etc.* Use of cold drinks occasionally may not be so much harmful but its regular use must be avoided. Soft drinks contain large number of calories but they do not have nutritionally beneficial components, soft drinks use predominantly three types of sweeteners-saccharine or aspartame in the diet type of sugar, cane syrup or corn syrup in the regular drinks. These subtances enhance taste appeal and come touted as "refreshing" and "high energy". Saccharine has been shown to cause cancer in laboratory animals and nutra-sweet

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and equal are linked to convulsions, depression, insomnia, irritability, weakness, dizziness, migraine, headache and mental retardation. A common problem that is associated with consumption of large number of soft drinks in increase acid levels throughout the body. All the soft drinks are very acidic. There is stronk correlation between acids increasing the risk of disease. Gastronomic distress is characterized by increased stomach acid levels. It may cause inflammation of the stomach and erosion of stomach lining.

Most carbonated beverages contain caffeine. Caffeine is a drug that acts as stimulant to the central nervous system. Large amounts of caffeine consumption can cause diseases and disorders such as insomnia, nervousness, anxiety, irritability and deviations from normal heart rate. A major conern about caffeine is that it increases excretion of calcium in urine, which increases the risk of osteoporosis. Dental cavities and tooth enamel erosion are products of carbonated beverages[1].

The bubbles and fizz in soft drinks can potently born human inside which as caused by phosphoric acid and carbon dioxide. The phosphorus in the acid upsets the body's calcium phosphorus ratio and dissolves out of bones.

Bulk of our food must under go profound chemical changes[2], before resulting molecules can be absorbed. The small intestine is the principal organ of absorption. In large intestinal, water absorption occurs. Normally litlle or no absorbable food remains in the intestinal content by the time it reaches this organ. Intestinal absorption may be active or passive. Active absorption occurs against concentration gradient and is dependent upon metabolically obtained energy. In man, absorption of carbohydrates from sites other than small intestine is neglible. Under normal circumstances, only monosaccharides are abosrbed.

Functional disturbances of body organs[3] and acute renal failures[4] lead to poor absorption of water. Regulation of water content of blood[5] and urine is normally carried out by kidneys, which in turn are controlled by secretion of antidiuretic hormones by neuro-hypophysis, this regulates reabsorption of water in the distinct renal tubule. Changes in cellular water content[6] are significant factor in biological and clinical behaviour of cells. Since process of urination is development of pressure[7], sustenance of pressure and finally release of pressure, hydrodynamic permeability measurements are of immense importance.

Theoretical: Membrane permeability involves a discountinous transition. Phenomenological equations relating to flows and forces are as follows[8,9].

$$J_V = L_P\Delta P + L_{PD}\Delta\pi \quad (1)$$

$$J_D = L_{DP}\Delta P + L_D\Delta\pi \quad (2)$$

where J_V and J_D represent volume flow and diffusional flow, respectively. When the concentration of solution is the same, on both sides of membrane, $\Delta\pi = 0$, then

$$J_V = L_P\Delta P \quad (3)$$

where L_P is coefficient of mechanical filtration capacity of the membrane or permeability coefficient. From eqn. 2, it may also be inferred that hydrostatic pressure at $\Delta\pi = 0$ can produce not only volume flow but also diffusional flow.

$$(J_D) = L_{DP}\Delta P \qquad (4)$$
$$\Delta\pi = 0$$

The coefficient L_{DP} is measure of ultra filteration properties of the membrane.

EXPERIMENTAL

Choice of permeants: Three set of permeants have been chosen: (i) Aqua guard water and Aqua fina water (Pepsi brand), (ii) Light coloured permeants *i.e.*, Mountain Dew and Mirinda, (iii) Highly coloured permeants such as Pepsi and Thums up.

The permeants were purchased from the market. Aqua guard water is free from impurities and micro organisms Aqua fina, (Pepsi brand) has zero values of calories, fat, carbohydrate and proteins. Other permeants used are sweetened carbonated water, contain no fruits but caffine and have emulsifying and stabilizing agents. These permeants have permitted natural colours, flavours, antioxidants, *etc*. Then amount of sugar added differs in each case.

Choice of membrane: Membrane chosen for experimental study is urinary bladder membranes of goat. It was chosen due to its easy availability and capacity to withstand high pressure. The membrane was isolated and preserved by formalin alcohol (100 parts water, 125 parts 95 % alcohol and 10 parts 40 % formaldehyde) solution as described earlier[10,11]. The effective cross sectional area of the membrane is 3.14 cm^2.

Hydrodynamic permeability is measured by noting the change in liquid level in a horizontal capillary tube as described earlier[10]. Variation of hydrostatic pressure is brought about by raising the level of pressure head across one side of the membrane, the difference in height is noted by cathetometer. A plot of volume flow against pressure difference gives permeability coefficient.

Measurement of water content: Water content is a measure of degree of sorption in the membrane texture[12] is calculated as

$$\text{Water content} = \left(\frac{\text{Wet weight} - \text{dry weight}}{\text{Wet weight}} \right)$$

The membrane is conditioned by immersing it for a few hours in the permeant. For ion exchange membrane, it may be up to 24 h while for biological membranes, a few hours are sufficient. It depends upon the saturation state of the membrane.

It is then removed from the permeant, blotted with filter paper to remove excess permeant and weighed, its weight is recorded as wet weight. The membrane was thoroughly dried and weighed. It weight was recorded as dry weight.

Measurements of absorbance: Absorbance/optical density of various permeants have been measured by UV-visible spectrophotometer at 420 nm using specord-200 of the company analytica Jena.

RESULTS AND DISCUSSION

The permeability of the membrane depends upon molecular size of the permeant, the pores in the membrane, the physiological state of the membrane, the density and viscosity of the permeant, the association in liquid state, the solubility of the permeant in the membrane, the number of hydrogen bonds, *etc*. In other words, permeability coefficient is a measure of complexity of the membrane. Table-1 gives an idea of these variables.

TABLE-1
VALUES OF DIFFERENT PROPERTIES OF PERMEANTS

Permeant	Density $Kg\ m^{-3} \times 10^{3}$	Viscosity $NS\ m^{-2} \times 10^{-3}$	pH	Absorbance	Permeability coefficient per unit area Lp/A $(m^{3}\ s^{-1}\ N^{-1} \times 10^{-9})$	Water content
Aqua guard water	0.9991	0.7958	7.06	–0.002	0.302	0.029
Aqua fina water	0.9841	0.7900	6.86	–0.001	0.438	0.062
Mountain water	1.0417	1.0749	4.09	0.357	0.066	0.120
Mirinda	1.0364	1.1136	3.98	1.861	0.035	0.140
Pepsi	1.0366	1.0230	3.70	1.836	0.238	0.120
Thums up	1.0349	1.0289	3.64	2.064	0.258	0.095

The result of photograph may be summarized as follows: (i) Practically no change occurs when bladder is immersed in preservative and in water (ii) Mountain dew and Mirinda colourize the bladder with their colours. Mountain dew slightly less intense than Mirinda (iii) Blackish colour is observed for Pepsi and black brownish ting is observed in Thums up (iv) Practically no change, in colour is observed when bladder is immersed in urine solution.

It is surprising to note urine produces no change while Pepsi, Thums up, Mirinda and Mountain dew have their effects on the bladder.

Standard technique for colour determination is measurement of absorbance value at 420 nm using spectrophotometer. The molar absorbency index depends upon the wavelength, tempeature and solvent. If several solutes absorb independently, the absorbance are additive[13]. From Table-1, it is apparent that Thumsup has more absorbance as compared to other permeants.

Urinary bladder is an example of transitional epithelial tissue which has elastic muscular walls and membranous folds[13]. Transitional epithilia are found in urethra, the renal pelvis, the ureter and urinary bladder. It may be supposed to be a continuous membrane phase where concept of pores through which solute and solvent move is of limited use. In the case of urinary bladder, lateral intercellular spaces present a common pathway of permeation. Urine a multi-component system interacts with urinary bladder interface and produces micturition waves as a result of development of pressure, sustenance of pressure and finally release of pressure[7].

In order to verify if a difference of concentration exists across the membrane, measurements of density, viscosity and refractive index were made before and after the experiment. It was found that no significant change occurs in these properties.

Thus difference of concentration across the membrane is ruled out. The pressure required for ultra filtration[7] of urine through kidney glomeruli is much higher whereas in the case of urinary bladder applied pressure is up to 50 cm of liquid column. Therefore chances of ultra filtration through the membrane which consist of serveral layers is ruled out.

Since the membrane was studied *in vitro*, it can not be said that its characteristics will respond fully to *in vivo* characteristics. However, it may be said that it has retained some of them, as supported by following observations: (i) Lowest filtration tendency of urine[14] among its constituents[15] (ii) Electro-osmosis[16] of urine and their components from outer to inner side only. Inner side means the portion which remains in touch with urine (iii) Highest polarizable behaviour[17] of urine with bladder interface as compared to other constituents of urine (iv) Anisotropic and non linear behaviour with all electro kinetic properties[18,19] (v) Highest energy conversion values[20] for urine as compared to other permeants of urine.

From the Table-1, it is appearent that permeability coefficient and water content have inverse relationship. Colour produce by permeants persists for longer time or not is the subject matter of speculation. If the absorbed material persists for longer time, it is bound to affect visco eleastic behaviour of urinary bladder membrane. It may lead to stasis of urine, which may be a factor for stone formation due to infection.

Conclusion

Water content which is measure of degree of sorption in the membrane texture have been calculated for Aqua fina water, Aqua guard water, Pepsi, Thums up, Mountain dew and Mirinda, respectively. It has been found that different coloured permeants are abosrbed in the membrane texture and produce decisive effects in the permeability of urinary bladder membranes. It is very surprising to note that urine produces no change while coloured permeants have their effects on bladder. Such studies are expected to be of very great use in abnormal functioning of body organs and acute renal failures.

ACKNOWLEDGEMENTS

The authors are thankful to college authorities and laboratory personnel for their keen interest in this work. The authors are also thankful to Prof. K.D.S. Yadav of Deen Dayal Upadhyay University, Gorakhpur for providing laboratory facilities for measurements of absorbance of differnet permeants.

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(*Received*: 4 March 2009; *Accepted*: 9 December 2009) AJC-8169