CHEM.OSMOL.3.0 OSMOMETRY BY FREEZING POINT FISKE MICRO OSMOMETER

PRINCIPLE

Fiske Osmometers are devices for the determination of the concentration of solutions by means of freezing-point measurement. High-precision thermometers are utilized to sense the sample temperature, to control the degree of super-cooling and freeze induction, and to measure the freezing point of the sample. They can routinely determine differences of ±1 mOsm/kg H2O.

The quickest and most precise way to measure the freezing point of a solution is to supercool it several degrees below its freezing point. It is unstable in this state, and a mechanical agitation induces crystallization. The heat of fusion suddenly liberated causes the sample temperature to rise toward a plateau temperature, where liquid/solid equilibrium occurs. The equilibrium temperature is, by definition, the freezing point of the solution. Managing the plateau temperature for precise measurement is the basis for several patents issued to Augustus Fiske.

The time over which liquid/solid equilibrium develops and is maintained, is a function of the speed with which the heat-of-fusion is liberated vs. the speed it is transferred away, or absorbed, by the surrounding environment. This ratio can be slowed and the equilibrium time stretched, to give a distinct plateau height measurable to 0.0010C.

Sensitive thermistor probes monitor the sample temperature and control the thermoelectric cooling element. Microprocessor control and automated operation minimize imprecision due to operator technique.

CLINICAL SIGNIFICANCE

Osmolality is a useful tool in the laboratory assessment of body hydration. It is related to the osmotic pressure that would develop across a membrane and is most commonly referred to in terms of milliosmoles per kilogram of water, or mOsm/kg.

Serum values for osmolality are decreased in cases of water intoxication. This can result from excessive water administration or from inappropriate retention of water by the kidneys. The latter is quite often associated with the syndrome of inappropriate ADH secretion, in which ADH continues to be secreted even after the stimulus for its secretion has been removed. Increases in serum osmolality are seen in dehydration, alcohol intoxication, hyperglycemia, hypercalcemia, uremia, and diabetes insipidus and following the administration of osmotically active drugs such as mannitol.

Urine osmolality values may vary widely, depending on water intake and the circumstances of collection. It is generally decreased in diabetes insipidus and polydipsia.

A clinically more useful set of data can be obtained by calculating both urine and serum osmolality values and calculating the ratio of the two. Decreases in this urine:serum ratio are due to diabetes insipidus, renal tubular disease, and water intoxication from excessive administration.

DOCUMENT OWNER

Manager, St Vincent Anderson Regional Hospital

SPECIMEN

A. Patient preparation: No special patient preparation is necessary.

B. Specimen type:

1. Serum or urine are the only acceptable specimens.
   ***The use of plasma is not recommended because of the possibility of introducing osmotically active substances to the specimen from the anticoagulant.
2. Standard collection techniques should be utilized.
3. Hemolysis does not interfere.
4. No preservative is necessary for urine collections.

C. Preparation of sample:

1. Serum should be separated from the cells soon after collection.
2. Specimens should be at room temperature before analysis to aid the complete solution of any precipitated substances.
3. Specimens collected in tubes that do not have a gel separating device should be centrifuged twice to lessen the possible presence of particulate matter.
4. Urine specimens should be centrifuged to remove gross particulate matter.

D. Sample stability:

1. Specimens should be tested as soon as possible after collection in order to obtain accurate osmolality results.
2. Serum specimens—when immediate processing of serum specimens is not possible, samples can be refrigerated (2-8°C) or stored at room temperature for up to forty-eight (48) hours and can be tested for osmolality without significant bias.
3. Urine specimens—when immediate processing of urine specimens is not possible, samples can be refrigerated (2-8°C) or stored at room temperature for up to twenty-four (24) hours and can be tested for osmolality without significant bias.

REAGENTS

50 mOsm/kg Calibration Standard
850 mOsm/kg Calibration Standard
Clinitrol 290 Reference Solution

Urine Controls: BioRad Urine Chemistry Controls
Serum Controls: BioRad Unassayed Chemistry Controls

EQUIPMENT

Fiske®Model 210 Osmometer
Disposable Tubes and Probe Cleaners
20 uL pipette

CALIBRATION

A. Calibration is required in the following cases:
   1. After probe replacement.
   2. If 290 Standard fails to read 290±2.
   3. Every 6 months.

   Direct-reading calibration of the Fiske Model 210 is a simple procedure that requires no adjustment of the instrument by the user. Simply run the menu-driven calibration program, which requires the testing of standard at two calibration points.

B. Calibration Procedure:
   1. When the display reads "Osmometer Ready", press the [NEXT] button until [CALIB] appears over the left button. Press it to initiate the calibration procedure. Calibration can be canceled without changing the existing calibration by pressing the [EXIT] button.
   2. Display will briefly read "50 mOsm Calibration" and then prompt the user to insert a 50 mOsm calibration standard. Follow the prompts on the instrument display. When the instrument completes the test and reports the result, raise the measuring head and clean the probe, as described in Chapter 2 - Instrument Operation. Continue testing 50 mOsm calibration standards until this calibration point is complete.
   3. The calibration program will now briefly read "850 mOsm Calibration" and then prompt the user to insert as 850 mOsm calibration standard. Again, follow the prompts on the instrument display. Continue testing 850 mOsm calibration standards until this calibration point is complete.
   4. If the calibration is successful, the instrument displays "Calibration Complete".
   5. Verify the calibration by running a Clinitrol 290 Reference Solution, in duplicate, before testing unknown samples.

C. Calibration Notes:
   1. The model 210 will retain its previous calibration data until it completes a new calibration, and the display read “Calibration Complete”.

2. If the instrument has calibration information in memory, the results displayed during the calibration procedure will be close to the nominal value of the standard used. **If the instrument has no calibration information in memory, or if a probe has been replaced**, the result display may be far from nominal value of the standards used. If the display values repeat consistently, the calibration will automatically adjust when the calibration sequence is complete.
3. The calibration procedure may be terminated at any time by pressing [EXIT]. The instrument will display "Calibration Canceled", and beep twice. The previous calibration will be retained. The user will be prompted again to insert the appropriate calibration standard.

QUALITY CONTROL

A. To verify system performance, analyze control materials:
   1. After calibration
   2. At least once every 24 hours (24 hours = 1 run)
   3. After specified service procedures are performed

B. Analyze quality control materials in the same manner as patient specimens. Document in Sunquest.

C. Two (2) levels of Urine controls are required when running a urine specimen and two (2) levels of serum controls are required for serum specimens. See Reagent section of this procedure for control names.

D. If control results fall outside the acceptable range, investigate the cause before deciding whether to report patient results.

PROCEDURE

Run two samples of a **fresh** Clinitrol 290 Reference Solution at the beginning of each run to check instrument performance and confirm stability of calibration. **<u>These results must be 290±2.</u>** If not, calibrate.

A. Draw a sample of the fluid to be tested into a 20 µL pipette.
B. Insert the pipette tip fully into the bottom of a sample tube. Smoothly eject the sample without splashing or spraying it.
C. Visually inspect the sample. If there are any voids or bubbles in the sample, or if the sample is sticking to the side of the tube, tap the tube lightly to unite the sample at the bottom of the tube. ***You may need to repeat sampling procedure to ensure a bubble-free sample***.
D. Gently place the loaded sample tube into the sample well.
E. Fully lower the measuring head into the sample tube.
F. Initiate the test by pressing the [**TEST**] button as indicated on the user interface.
G. Wait approximately 90 seconds for the test to complete. The display will show the result in the format "Osmolality xxx mOsm". Record the result and raise the operating head to the positive stop.

H. Lift the sample probe. Use a probe cleaner to clean any residual sample from the probe by placing the probe cleaner in the sample tube. Lower the measuring head into the cleaner and wait 5 seconds. Lift.
I. Remove the sample tube from the cooling chamber and discard.
J. Rerun the sample in duplicate. They must match within 10%.
K. Run controls on day of use. Document in Sunquest.
L. Repeat the 290 Reference Solution at the end of series, if more than one sample is analyzed. It must be 290±2.

NOTE: Wipe the probe promptly after each test, using a probe cleaner. If sample is allowed to dry onto the probe, it may be necessary to clean the probe tip with distilled water or alcohol, and then wipe the probe as described above.

NOTE: When wiping the sample probe, do not push or pull on either the tip or the body of the probe, or damage could occur.

IMPORTANT NOTE: Do not leave the probe in a test sample or in a probe cleaner. Between test sessions, **place a clean tube in the chamber and lower the probe.**

RESULT REPORTING

A. Reference Ranges:
   1. Serum: 280 – 303 mOsm/kg
   2. Urine: 50-800 mOsm/kg
B. Analytic Measurement Range (AMR)
   1. 0-2000 mOsm/kg
   2. Specimens with a result greater than 2000 mOsm/kg should be reported as >2000 mOsm/kg
C. Computer Entry:
   1. Manual entry:
      Function: MEM
      Worksheet: MANAN
      Test Code: OSMB
      OSMU
   2. Results are entered directly into the LIS and written in the logbook.
   3. On-line entry: Not available
   4. If the HIS or LIS systems are not functional, see Computer Downtime Policy.
   5. Report osmolality results in whole numbers.
D. If the analyzer is inoperable, then the specimen will be referred to the MACL Regional Laboratory.

REFERENCES

A. Fiske® Model 210 Micro-Osmometer User's Guide. Norwood, MA. Advanced Instruments, Inc.

B. Clinical Chemistry Principle, Procedures, Correlations. Michael Bishop, 1985.