Your Power for Health

Bio-One Lab Minute

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Plasma or Serum?

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EDITORIAL

By centrifuging the whole blood the cellular components are removed. Blood drawn in a tube containing an anti-coagulant yields blood plasma containing fibrinogen and other clotting factors. Coagulated blood (clotted blood) yields serum without fibrinogen, although some clotting factors remain.

The blood plasma makes up about 55% (about 50-59% for men and 54-73% for women) of our total blood volume. Blood plasma has a density of approximately 1.025 kg/l and makes up about 5% of the body weight. It is mostly water (93% by volume) and contains dissolved proteins, glucose, clotting factors, mineral ions, hormones and carbon dioxide (plasma being the main medium for excretory product transportation).

It is a liquid yellow (due to bilirubin) component of our blood. Blood plasma is the intravascular fluid part of extracellular fluid (all body fluid outside of cells).
Blood plasma is prepared by spinning a tube of fresh blood containing an anticoagulant in a centrifuge until the blood cells fall to the bottom of the tube or a separator moves upward to form a stable barrier separating plasma from cells.
Blood serum is blood plasma without fibrinogen or the other clotting factors (i.e., whole blood minus both the cells and the clotting factors).
Serum is the component that is neither a blood cell (serum does not contain white or red blood cells) nor a clotting factor; it is the blood plasma with the fibrinogens removed. Serum includes all proteins not used in blood clotting (coagulation) and all the electrolytes, antibodies, antigens , hormones , and any exogenous substances (e.g.,drugs and microorganism).
The study of serum is serology. Serum is used in numerous diagnostic tests, as well as in blood typing.

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Electrolytes

Ion	Proportion
Na^+	136 - 146 mmol/l
K^+	3,8 - 5,2 mmol/l
Ca^{2+}	2,3 - 2,7 mmol/l
Mg^{2+}	0,8 - 1,2 mmol/l
Cl-	96 - 106 mmol/l
HCO_3^-	24 - 28 mmol/l
PO_4^{3-}	1,0 - 1,4 mmol/l

Source: Wikipedia

Chemical components

Component	Proportion
Plasmaproteins	60 - 80 g/l
Glucose	4,5 - 5,5 mmol/l
Non protein Nitrogen	15 - 30 mmol/l
Urea Nitrogen	3,5 - 7,0 mmol/l
Anino acid nitrogen	3 - 5 mmol/l
Creatinine	70 - 140 µmol/l
Creatine	25 - 70 µmol/l
Uric acid	150 - 400 µmol/l
Lipids (total)	4,5 - 8,5 g/l
Triglyceride	0,6 - 2,4 mmol/l
Cholesterine (total)	4,0 - 6,5 mmol/l
Free	0,25 - 0,35 mmol/l
Esterified	0,65 - 0,75 mmol/l
Phosholipids	2,0 - 3,0 mmol/l
Free fatty acids	0,3 - 0,9 mmol/l
Organic acids	4 - 6 mmol/l
Lactat	1 - 2 mmol/l
Pyrovat	0,1 - 0,2 mmol/l
Citrate	0,1 - 0,2 mmol/l
Ketone	0,3 - 0,5 mmol/l

PRODUCT STUDIES

The choice between serum and plasma for chemistry testing is an area of great interest in terms of specimen selection. Earlier on, serum was the conventional standard for most chemistry tests. Today, the choice between serum and plasma is a decision based mainly on the unique requirement and priorities of the individual lab. [3]

Although serum and heparinized plasma specimens are considered equivalent for many assays, there have been reports of differences in results between these two sample types for several chemistry analytes. [4] Significant differences between serum and heparinized plasma results have been reported for example for albumin, alkaline phosphatase, creatine kinase, glucose, lactate dehydrogenase (LDH), inorganic phosphate, potassium and total protein etc. [4] (see illustration) [1]

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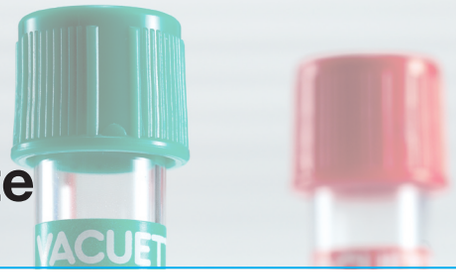

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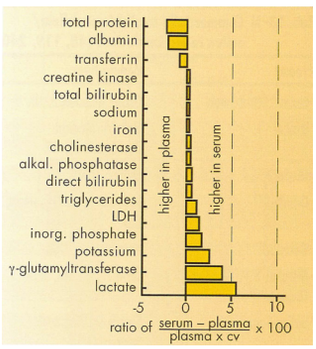

Serum/plasma differences

A study was conducted by Miles et al. to compare the results from serum and heparinized plasma samples for 45 different chemistry tests. Twenty apparently healthy volunteers who had been fasting for 12-14 h had serum and lithium heparin specimens collected. Differences in the mean values for the two sample types were compared by paired t-test. The data obtained by the study suggest that serum and heparinized plasma samples give results that differ enough to alter clinical decision-making for some analytes. [4]

When the priority is TAT (turnaround time), plasma has a clear advantage since it can be centrifuged immediately upon collection. [3] A study was carried out to test different centrifugation conditions on Clinical Chemistry test results for VACUETTE® Lithium Heparin Separator Tubes. The study investigated 74 parameters in samples from 44 patients on a Roche Cobas 6000 system, to see whether there was a significant difference between results from specimens centrifuged 15 min at 2180g, 10 min at 2180g or 7 min at 1870g. The analyses were performed within 3 hours after collection with the exception of the parameters for infectious diseases, which were examined within 48 hours. The study concluded that a centrifugation time of 7 min or 10 min showed identical test results as with the recommended 15 min at 2200g. [5] Therefore the study showed that plasma gel tubes can be centrifuged at around 1800g for 10 min as it is also recommended for serum gel tubes.

As a conclusion the VACUETTE® lithium heparin gel tubes were found to be a suitable and comparable alternative to serum gel tubes in regards to centrifugation time.

Ensuring the right sample type – serum or plasma – is collected for a given test is essential to ensuring measurement accuracy. Phlebotomists need to be properly educated and have handy information on correct reference interval information when drawing blood. Labs should establish standard procedures for sample collection. [2]

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[2] Hoffman, J. (2010). Serum versus Plasma Specimens. Advance for Medical Laboratory Professionals. Access on 14.04.2011 at http://laboratorian.advanceweb.com/Features/Articles/Serum-vs-Plasma-Specimens.aspx
[3] Chronolab. The Clinical Chemistry – Point of Care. Access on 14.04.2011 at http://www.diagnosticsample.com/point-of-care/introduction-text.php3?id=50&lang=en
[4] Miles, R. (2004). Comparison of Serum and Heparinized Plasma Samples for Measurement of Chemistry Analytes. Clin Chem. DOI: 10.1373.
[5] Minder, E. (2009). Effects of Different Centrifugation Conditions on Clinical Chemistry and Immunology Test Results. Abstract.

TROUBLESHOOTER

Plasma:

- Directly after blood collection, thorough mixing of the venous blood with the anticoagulant must be achieved by inverting the tube 5-10.
- Tubes can be centrifuged immediately.
- Do not re-centrifuge Plasma Gel Tubes. The debris under the barrier might contaminate the supernatant.

Serum:

- Directly after blood collection, thorough mixing of the venous blood with the SiO2 must be achieved by inverting the tube 5-10 times.
- Wait until the clotting process is completed. Normally, the waiting time for blood to clot is 30 minutes. However, patients who are on anticoagulant therapy or those with coagulation defects will have delayed clotting in serum tubes.
- Do not re-centrifuge Serum Gel Tubes. The debris under the barrier might contaminate the supernatant.

Don‘t forget:

- After cleansing of venipuncture site, allow the area to air dry.
- Never draw blood through a haematoma.
- Release the tourniquet as soon as blood begins to flow into the first tube (best ≤ 1 minute).

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