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## Effect of Different Blood Collection Tubes on Evaluated Potassium Test

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### Abstract

Accurate laboratory testing requires an understanding of the interactions between blood samples and collection tubes, which can absolutely affect the precise of laboratory test results and that influence in the diagnosis of disease. Potassium is an essential electrolyte that plays important roles in blood pressure, nerve system, kidney failure and cardiovascular diseases. The aim of the study is to investigate the effect of different blood collection tubes on potassium test also to minimized interference in a clinical assay. 10 ml blood collected without tourniquet from twenty healthy male volunteers with age 19 - 32 years and divided the blood into five major different tubes (a) White tube without any additive as a standard (B) two types of gel separator tubes with clot activator. Type one (SSGT Vacuum Lab) and type two (SSGT marked ALS) (C) K2EDTA tube (D) Sodium citrate tube. (E) Lithium heparin tube. The results show that no significant change results in gel tube type-1 (SSGT vacuum lab), sodium citrate and lithium heparin tubes comparing with the White tube, while there are significant decreases in gel tubes typs2 (SSGT marked ALS) comparing with the standard tube, furthermore, there are significant increases in K2EDTA tube. The conclusion of this work is not recommended for Gel tubes and EDTA while, the white tube is the best choice, furthermore can use a heparin and sodium citrate when we use plasma to measure the potassium level.

**Keywords:** Accurate laboratory tests, Potassium level, Blood collection tubes, Potassium test.

### 1-Introduction



A potassium test is used to measure the amount of potassium level in the blood and urine. Also determine as one of the most frequently tests analyses in the clinical laboratory, Because of its critical role in the body, laboratory errors that cause inaccurate potassium results can significantly affect patient safety (Stankovic and Smith 2004). Potassium (K) is an electrolyte that is essential for proper muscles, nerve function, blood pressure, cardiovascular disease and kidney failure(He and MacGregor 2008). furthermore, even minor decreases or increases in the amount of potassium in the human body can result in serious health problems.

### **1.1 Blood collection tubes**

1-White tubes (Plain without any additive) are used in blood collection and storage for biochemistry, immunology and serology tests in the medical inspection.

2-Serum separator gel tubes (SST) are huge widely used in a clinical laboratory including biochemistry, toxicology, endocrinology, immunology, and microbiology. This tube is containing two agents; silica particles and serum separating gel. The silica particles work to activate clotting and cause the blood to clump together while; the gel is used to separate the serum from the blood cells by physical barrier during centrifugation(Gigliello and Kragle 1975, Lin, Cohen et al. 2001).

3-Potassium ethylenediaminetetraacetic acid (K<sub>2</sub>EDTA) is a sample tube anticoagulant used for many laboratory analyses especially in hematology and complete blood count (Sharratt, Gilbert et al. 2009). Furthermore the EDTA act by binding to calcium in the blood to prevent clotting (Kumura, Hino et al. 2000, Bowen, Hortin et al. 2010).

4-Sodium Citrate tubes with the blue bottle are used for hematology tests such as prothrombin time and partial thromboplastin time and make inactivated whole blood for analysis, and that contain a sodium citrate as a buffered that acts as a reversible anticoagulant by binding to calcium ions in the blood and subsequently disrupting the clotting cascade(Bowen, Hortin et al. 2010).

5-Lithium heparin tubes also called plasma separator tube (PST) are used for biochemistry tests requiring separated heparins plasma and that contain lithium heparin as an anticoagulant. Furthermore the lithium act on block thrombin activation cascade and prevent fibrin formation into fibrinogen(Jones and Honour 2006, Bowen, Hortin et al. 2010).

Hadi et al. reported under titled, gel blood collection tube affecting test results, she works on the investigation the effect of gel collection tubes on 25-OH vitamin D and vitamin A then used HPLC method to determine the variable between the tests. Furthermore, she concludes that there is found interference in vitamin A and vitamin D when measured in gel tube comparative with plain tube and recommends the gel tube maybe affect inaccurate laboratory tests(Hadi 2016).

There are many researchers published in the effects of different times and temperatures in many biochemical tests included potassium, in order to measure the stability and sensitivity of common tests in different conditions compared with a zero hour. They concluded that a significant change in results included potassium level (Ono, Kitaguchi et al. 1981, Chu and MacLeod 1986, Rehak and Chiang 1988).

Zhang et al. studied the effect of serum-clot contact time on clinical chemistry laboratory results. A total of 63 analyses were studied included potassium test. The blood collection tubes divided into two group,



firstly as control, the serum separated from the clot within 30min. Secondly, the other tubes incubated at 32 °C and the serum separated at 3,6 and 24 h from the clot the stored at 4°C. Furthermore, They reported that the serum potassium level increased with the time depending on incubation temperature and the change become clinically significant by 3h at 32 °C. The researchers concluded that the potassium is a least stable compared with others tests (Zhang, Elswick et al. 1998).

Sharratt et al. studied the prevalence of potassium EDTA contamination causing false results included spurious hyperkalemia .they taken four parameters from 31 samples and measured the difference between them to explain the unexplained hyperkalemia, hypocalcemia, hypomagnesemia, and hypozincemia. The researchers concluded that contaminated samples by EDTA can causes a spurious decreased in calcium, zinc, magnesium and increased in potassium(Sharratt, Gilbert et al. 2009).

In this study, I investigated the effect of different blood collection tubes that influence on potassium tests and that included a plain (White), K2EDTA, Heparin, Sodium citrate and gel separator tubes. The specimens were collected from a twenty healthy men donors to avoid any conditions that may be interference with results. Furthermore, to improve that the best tubes can be used in our labs to get a more accurate diagnosis and reduce the interference between the reagents and content of tubes that due to minimize the error in the test results.

### **3- Materials and Methods**

#### **3.1 Data Collection**

10 ml blood was collected without tourniquet from twenty healthy male volunteers with age 19-32 years and divided the blood into five different tubes (a) White (Plain) plastic tubes gradient up to 10 ml volume without any anticoagulants (B) two types of gel separator tubes with clot activator type 1 , (SSGT Vacuum Lab) tubes 5 ml manufactured by liuyang SANLI medical technology department co, Ltd and type 2 serum separator gel tube( SSGT marked ALS) clot activator with gel 6ml (C) K2EDTA glass tubes( 1.0 ml ,13\*75 mm) manufactured by liuyang SANLI medical technology department co, Ltd (D) Sodium citrate tubes(Pt glass tubes 2ml, 13\*75 mm marked Al-Rawan) .( E)Lithium heparin glass tubes marked ARTH AL. RAFIDAIN FOR LAB (3ml, 13\*75 mm).After that mixed the blood tubes gently for 10 times in room temperature and leaved tubes for 30 min to complete clot the blood and centrifuged for 5 min at 10000 RPM.

#### **3.2 Procedure of Test**

Potassium was estimated by the turbidometric method according to AGAPPE Diagnostics Switzerland GmbH procurer .1000 µ of potassium reagent (sodium tetraphenyl boron ) were added into disposable plastic tubes and add 25 µ of serum/ plasma, then incubated for 5 min at room temp. After that, I measured the absorption of samples against absorption of standard immediately by semi-auto chemistry analyzer (Mindray BA-88A is a trademark of Shenzhen Mindray biomedical electronics co. Ltd.) at a wavelength 578 nm and recorded the results. The extent of turbidity was proportional to potassium concentration and was measured photometrically.

### **4- Results and Discussions**



In this project I measured the potassium level in different tubes included many types of anticoagulants and two type of gel tubes, in order to know the appropriate tubes may use in our lab as alternative tubes “ if not available suitable tube (white tube)“ for more accurate results, also to minimize the mistakes during pre-analytical procurers.

Table 1: shows the value of potassium level for twenty male volunteers with different tubes.

	age	White tubes	Vacuum lab gel Tubes	ALS gel tubes	K2 EDTA	Sodium Citrate	Heparin	Unit
1	25	5.6	6.0	1.7	18.3	5.0	5.4	mmo/L
2	27	5.1	5.5	1.5	19.5	4.8	4.8	mmo/L
3	26	5.7	5.8	1.6	19.3	5.3	5.6	mmo/L
4	19	5.0	5.2	1.3	17.3	4.4	4.7	mmo/L
5	21	3.5	3.8	0.8	15.5	3.4	3.7	mmo/L
6	21	4.1	4.5	1.1	15.4	4.2	4.2	mmo/L
7	21	4.3	4.7	1.3	15.9	3.7	4.0	mmo/L
8	22	4.2	4.8	1.3	13.5	3.7	4.2	mmo/L
9	21	3.6	3.4	1.1	14.4	3.0	3.2	mmo/L
10	29	4.1	4.1	1.1	14.9	3.5	3.8	mmo/L
11	30	4.6	4.1	1.3	16.3	4.2	4.8	mmo/L
12	31	4.4	4.7	1.4	15.6	4.0	4.3	mmo/L
13	20	4.3	4.5	1.2	17.2	3.9	4.3	mmo/L
14	20	4.5	4.2	1.2	17.2	3.9	4.1	mmo/L
15	32	4.7	4.7	1.3	16.1	4.2	4.5	mmo/L
16	21	4.0	4.1	1.0	16.7	3.8	3.8	mmo/L
17	21	4.0	4.7	1.0	15.2	3.8	4.0	mmo/L
18	24	4.4	4.4	1.3	15.2	3.8	4.3	mmo/L
19	21	3.7	3.8	0.9	13.9	3.1	3.6	mmo/L
20	21	3.4	3.9	0.7	15.8	3.2	3.6	mmo/L

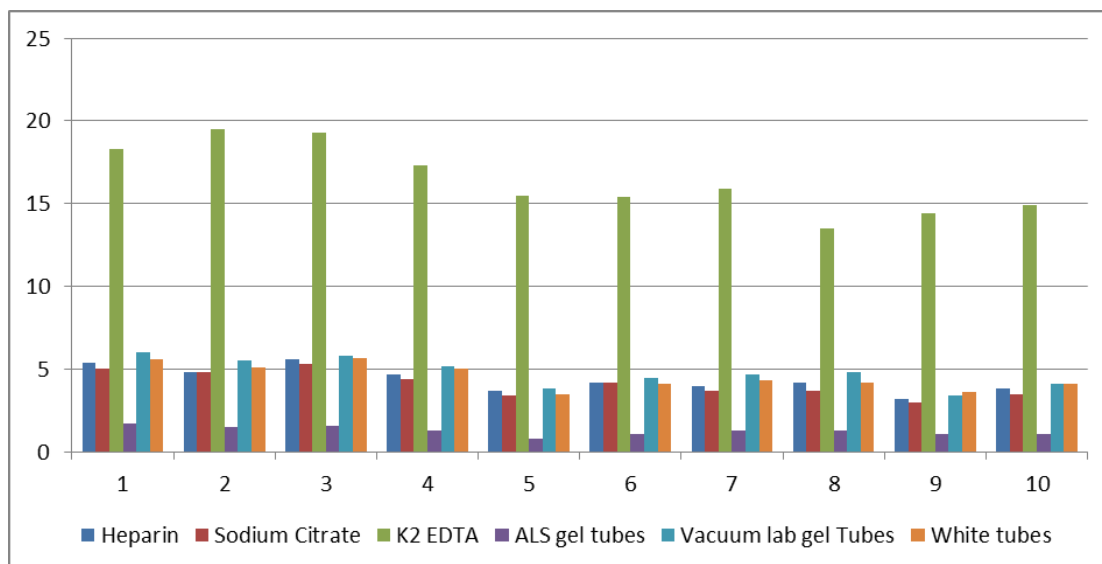


Figure 1 Different values of potassium level measured by different tubes from 1-10 sample

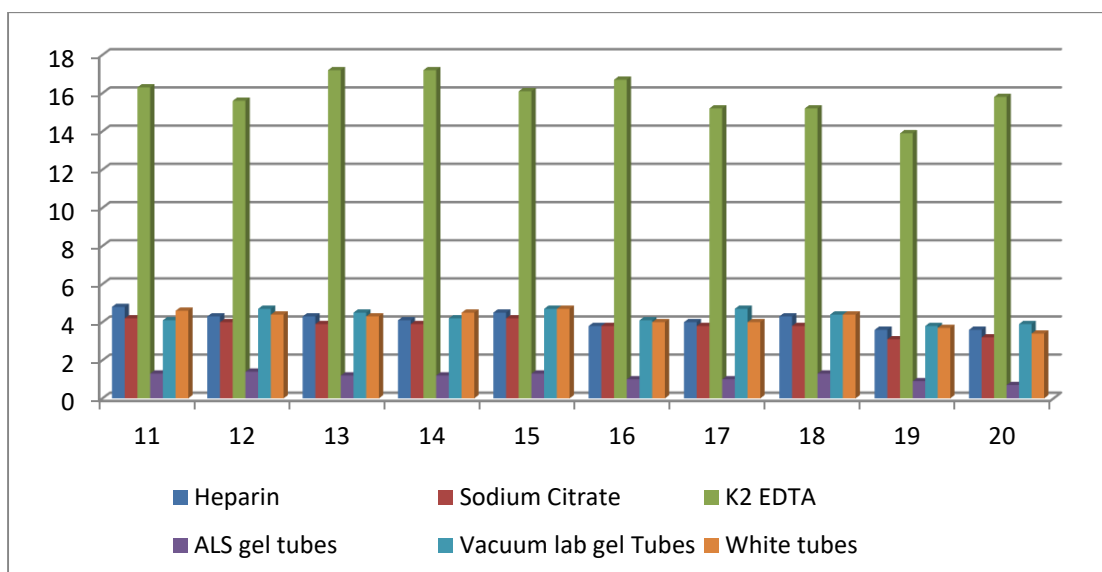


Figure 2 Different values of potassium level measured by different tubes from 11-20 sample

The measurement of potassium level in gel tube compared with the white tube as a control (without any additive) sees figures 1 and 2. The results appeared different in values; ALS gel tubes showed significantly decreases with mean 3.15 mmol/L compared with white tube, while the Vacuum lab gel Tubes showed a slightly increased with mean 0.185 mmol/L compared with standard tube, and that due to variation in gel tube depend on manufactured, so that may be because a different the types of gel, variation of specific gravity, also depend on density of material that used in tubes. Furthermore, maybe the tubes released an oil that interference with results as increased or decreased.



When measured a potassium level by anticoagulants tubes must be taken appropriate tubes, and must know the different viscosities between serum and plasma and that due to slightly lower in potassium level, because the plasma contains a fibrinogen and clot factors.

The heparin tubes slightly decreased with 0.115 mmol/L when compared with white tube value (standard), while the sodium citrate lowered with mean 0.415 mmol/L.

Finally, the K2EDTA showed a huge difference in value as increased with mean 11.8 mmol/L, compared with standard and that name as a contaminated sample because the tube contains a potassium as an anticoagulant, furthermore that called a pseudohyperkalemia and that due to false result and error in diagnosis.

## **5- Conclusion**

I conclude that the best choice to check the potassium value is a white tube (without any additive), so the gel tube is not suitable because a big variation between manufactured of companies, in addition when used a plasma to measure the potassium level the heparin tube is the first, sodium citrate coming secondly, and the K2EDTA is a forbidden. Finally, the gel tube not recommended because the variation in manufactured so must be check before uses.

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