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DIFFERENCES IN FASTING BLOOD GLUCOSE LEVELS BETWEEN SERUM AND EDTA PLASMA

PERBEDAAN KADAR GLUKOSA DARAH PUASA MENGGUNAKAN SERUM DAN PLASMA EDTA

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Abstract

Blood glucose testing is influenced by the type of specimen used. Serum is generally used in clinical chemistry testing, whilst EDTA plasma is used less frequently and is generally restricted to specific conditions. Previous studies have predominantly compared random blood glucose levels; therefore, a specific study on fasting blood glucose is required. The aim of this study was to determine the differences in fasting blood glucose levels between serum and EDTA plasma. This quantitative study, employing an analytical observational design and a cross-sectional approach, was conducted at the Prameka Clinical Laboratory between November 2025 and March 2026, with samples collected in February–March 2026. The sample comprised 30 adult patients aged 18–59 years, selected using purposive sampling. Serum and EDTA plasma samples were obtained from each respondent. Glucose testing was carried out using the GOD-PAP method with a Dirui CS-T180 analyser. Analysis was performed using SPSS via the Shapiro–Wilk test and the Paired Sample t-test. The mean fasting blood glucose level in serum was 105.120 mg/dL, whilst in EDTA plasma it was 110.993 mg/dL. The Paired Sample t-test yielded a t-value of −13.839 and p = 0.000, indicating a significant difference between the two specimen types. The conclusion of this study is that fasting blood glucose levels in EDTA plasma tend to be higher than those in serum. Consistency in the use of specimen types is required to avoid discrepancies in the interpretation of laboratory results and to support the accuracy of clinical monitoring.

Keywords : Fasting Blood Glucose, Serum, EDTA Plasma, GOD-PAP Method, Specimen Type.

Abstrak

Pemeriksaan glukosa darah dipengaruhi oleh jenis spesimen yang digunakan. Serum umumnya digunakan dalam pemeriksaan kimia klinik, sedangkan plasma EDTA lebih jarang digunakan dan

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umumnya terbatas pada kondisi tertentu. Penelitian sebelumnya lebih banyak membandingkan kadar glukosa darah sewaktu, sehingga diperlukan kajian khusus pada glukosa darah puasa. Penelitian ini bertujuan untuk Mengetahui perbedaan kadar glukosa darah puasa menggunakan serum dan plasma EDTA. Metode penelitian ini kuantitatif dengan desain observasional analitik dan pendekatan potong lintang dilakukan di Laboratorium Klinik Prameka pada November 2025–Maret 2026, dengan pengambilan sampel pada Februari–Maret 2026. Sampel terdiri atas 30 pasien dewasa berusia 18–59 tahun yang dipilih menggunakan purposive sampling. Dari setiap responden diperoleh spesimen serum dan plasma EDTA. Pemeriksaan glukosa dilakukan dengan metode GOD-PAP menggunakan alat Dirui CS-T180. Analisis menggunakan SPSS melalui uji Shapiro–Wilk dan Paired Sample T-Test. Rata-rata kadar glukosa darah puasa pada serum sebesar 105,120 mg/dL, sedangkan pada plasma EDTA sebesar 110,993 mg/dL. Uji Paired Sample T-Test menunjukkan nilai t sebesar −13,839 dan p=0,000, sehingga terdapat perbedaan yang signifikan antara kedua jenis spesimen. Kesimpulan dari penelitian ini adalah Kadar glukosa darah puasa pada plasma EDTA cenderung lebih tinggi dibandingkan serum. Konsistensi penggunaan jenis spesimen diperlukan untuk menghindari perbedaan interpretasi hasil laboratorium dan mendukung ketepatan pemantauan klinis.

Kata Kunci : Glukosa Darah Puasa, Serum, Plasma EDTA, Metode GOD-PAP, Jenis Spesimen.

1. INTRODUCTION

Diabetes mellitus (DM) is a health problem whose prevalence is steadily increasing and which requires attention due to the high number of people affected and the high mortality rate from complications of the disease. Indonesia is among the countries with the highest number of people with diabetes, so appropriate laboratory tests are required to support the diagnosis and monitoring of the disease (Kementerian Kesehatan Republik Indonesia, 2020). Glucose is the body's primary source of energy, derived from carbohydrates and stored as glycogen in the liver and muscles. Blood glucose levels are regulated by the hormone insulin; if insulin production or action is insufficient, glucose can accumulate in the bloodstream. Consequently, measuring blood glucose levels is one of the key tests in the diagnosis of diabetes mellitus (Agung et al., 2017).

One of the parameters used in the diagnosis of diabetes mellitus is fasting blood glucose. This test is carried out after a person has fasted for 8–12 hours to assess the body's ability to regulate glucose levels at baseline, without the direct influence of food intake (Andreani et al., 2018). The accuracy of fasting blood glucose test results is influenced not only by the method of analysis, but also by the type of specimen used. Inconsistent specimen selection can lead to variations in test values and may result in differences in the interpretation of laboratory results.

The specimens commonly used in blood glucose testing are serum and plasma. Serum is the liquid component of blood obtained after the clotting process, and therefore does not contain fibrinogen, whilst plasma is obtained from blood to which an anticoagulant has been added to prevent clotting (Subiyono et al., 2016b). One of the most widely used anticoagulants is ethylenediaminetetraacetate (EDTA), which works by binding calcium ions, thereby preventing the clotting process (Fatmawati et al., 2025). The use of EDTA plasma allows specimens to be processed immediately without having to wait for the blood to clot. Therefore, EDTA plasma can be used for tests that need to be carried out, particularly when glucose testing is performed alongside routine haematology tests (Apriani & Umami, 2018).

Serum remains the primary specimen for clinical chemistry tests, including blood glucose tests. In contrast, the use of EDTA plasma in blood chemistry tests is relatively rare and is generally limited to specific conditions (Apriani & Umami, 2018). Serum and plasma have different biological characteristics. Serum is obtained after the blood has clotted, whilst plasma still contains fibrinogen and can interact with anticoagulants. Although the differences in results between serum and plasma may appear minor, these variations have the potential to influence clinical interpretation, particularly in the case of glucose levels that are close to the diagnostic threshold (Frank et al., 2012). This situation

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demonstrates that the selection and consistency of specimen types are key to maintaining the quality of laboratory test results (Cadamuro et al., 2022).

Blood glucose levels can be measured using an enzymatic method that converts glucose into a specific product and produces a colour change which can be measured by colorimetry (Firgiansyah, 2016). One widely used method is the Glucose Oxidase–Aminoantipyrine Peroxidase (GOD-PAP) method (Firgiansyah, 2016). One widely used method is the Glucose Oxidase–Aminoantipyrine Peroxidase (GOD-PAP) method. This method offers high accuracy and selectivity for glucose, is able to minimise interference from other reducing agents in the blood, and produces a stable colour that is easy to analyse (Kustiningsih et al., 2017). The use of the same method on serum and EDTA plasma specimens allows differences in test results to be assessed based on the characteristics of the specimen type used.

A study by Ramadhani et al *(2019)* showed that the mean random blood glucose level was 100.3 mg/dL when measured using serum, whilst it was 113.5 mg/dL when measured using EDTA plasma. A study by Fatmawati et al *(2025)* also showed that the average random blood glucose level in EDTA plasma was 103 mg/dL, which was higher than the 89.7 mg/dL recorded in serum. Both studies demonstrated differences in glucose levels depending on the type of specimen, but they still focused on random blood glucose testing. Consequently, further research is needed that specifically compares fasting blood glucose levels using serum and EDTA plasma.

The novelty of this study lies in the comparison of fasting blood glucose levels using serum and EDTA plasma, in contrast to previous studies which focused on random blood glucose. It is hoped that this study will provide scientific information on the effect of specimen type on fasting blood glucose test results and serve as a basis for laboratory staff to ensure consistency in specimen selection. In theory, the findings of this study may support the development of the field of Medical Laboratory Science, whilst in practice they may serve as a reference for improving the quality and accuracy of laboratory test interpretation. The aim of this study is to measure fasting blood glucose levels using serum and EDTA plasma, and to analyse the differences in test results between these two types of specimen.

2. RESEARCH METHOD

This quantitative study employed an analytical observational design with a cross-sectional approach and was conducted at the Prameka Clinical Laboratory, Denpasar, from November 2025 to March 2026, with data collection taking place in February–March 2026. The sample comprised 30 adult patients aged 18–59 years, selected using purposive sampling based on inclusion and exclusion criteria. Two fasting blood samples were taken from each respondent: serum in a red tube and EDTA plasma in a purple tube. The independent variable in this study was the type of specimen, whilst the dependent variable was the fasting blood glucose level. The specimens were centrifuged at 3,000 rpm for 10 minutes, then analysed using the GOD-PAP method with a Dirui CS-T180 chemical analyser following daily quality control procedures. This study received ethical approval from the Health Research Ethics Committee of the Wira Medika Bali College of Health Sciences, under reference number 837/E1.STIKESWIKA/EC/VII/2026. Prior to specimen collection, participants were provided with an explanation of the study and signed an informed consent form. The data were analysed using SPSS version 26 via descriptive analysis, the Shapiro–Wilk normality test, and the Paired Sample T-Test. if the data are normally distributed, or the Wilcoxon test if the data are not normally distributed, with a significance level of 0.05.

3. RESULT AND DISCUSSION

The study involved 30 adult respondents aged 18–59 years who underwent a Medical Check-Up at Prameka Clinical Laboratory. Each respondent provided two specimens, namely serum and EDTA plasma, resulting in a total of 60 specimens for fasting blood glucose testing. The characteristics of the respondents based on sex and age group are presented in Table 1.

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Table 1. Characteristics of Respondents

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	15	50
Female	15	50
Age Group		
Young adults, 18–39 years old	13	43,3
Middle-aged adults, 40–59 years old	17	56,7
Total	**30**	**100**

Table 1 shows that the numbers of male and female respondents were equal, with 15 respondents (50.0%) in each group. Based on age, most respondents were in the middle adulthood group, accounting for 17 respondents (56.7%), while 13 respondents (43.3%) were in the young adulthood group.

The descriptive analysis of fasting blood glucose levels based on specimen type is presented in Table 2.

Table 2. Mean Fasting Blood Glucose Levels by Specimen Type

Specimen Type	Number of Samples (n)	Mean (mg/dL)
Serum	30	105,12
Plasma EDTA	30	110,99

Table 2 shows that the mean fasting blood glucose level in EDTA plasma was higher than that in serum. The mean difference between the two specimen types was approximately 5.8 mg/dL.

The Shapiro–Wilk normality test was performed to determine the distribution of fasting blood glucose data in serum and EDTA plasma. The test results are presented in Table 3.

Table 3. Results of the Normality Test for Fasting Blood Glucose Levels

Specimen Type	Shapiro–Wilk Statistic	n	p-value
Serum	0,956	30	0,244
Plasma EDTA	0,962	30	0,35

Table 3 shows that the p-values for both serum and EDTA plasma were greater than 0.05. Therefore, the fasting blood glucose data for both specimen types were normally distributed, and the analysis was continued using a paired-samples t-test.

The difference in fasting blood glucose levels between serum and EDTA plasma was analyzed using a paired-samples t-test. The results of the hypothesis testing are presented in Table 4.

Table 4. Results of the Comparison Test for Fasting Blood Glucose Levels

Comparison	t-value	p-value	Decision
Serum and plasma EDTA	−13,839	<0,001	H_0 rejected and H_a accepted

Table 4 shows that there was a significant difference in fasting blood glucose levels between serum and EDTA plasma, with a t-value of −13.839 and $p < 0.001$. Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted. The results indicated that fasting blood glucose levels in EDTA plasma tended to be higher than those in serum.

This study showed that fasting blood glucose levels measured using EDTA plasma were higher than those measured using serum, with a statistically significant difference ($p < 0.001$). These findings indicate that the study objective was achieved and that the alternative hypothesis, stating that there is a difference in fasting blood glucose levels between serum and EDTA plasma, was accepted.

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Therefore, specimen type should be considered because it may produce different fasting blood glucose results even when specimens are obtained from the same respondents and analyzed using the same method and instrument.

The difference in test results may be associated with the characteristics and processing procedures of each specimen type. Serum is obtained from blood without anticoagulant and must be allowed to clot for 15–30 minutes before centrifugation. During the clotting process, blood cells continue to metabolize glucose through glycolysis, which may lead to a decrease in glucose levels (Apriani & Umami, 2018). In contrast, EDTA plasma is obtained from blood containing an anticoagulant; therefore, no clotting time is required, and the plasma can be separated immediately from blood cells by centrifugation. Faster separation may reduce the contact time between glucose and cellular components, resulting in higher glucose levels in EDTA plasma than in serum (Frank et al., 2012)

Frank et al (2012) explained that blood glucose levels may decrease by approximately 5–7% per hour at room temperature due to glycolytic activity by blood cells. This condition may explain the findings of the present study, as serum specimens require a certain period before separation, whereas EDTA plasma can be processed immediately after homogenization. Although EDTA primarily functions by binding calcium ions to prevent coagulation, the use of EDTA tubes in this study allowed plasma separation to be performed more rapidly (Liu et al., 2018). Therefore, differences in the pre-analytical processing of serum and EDTA plasma may be one of the factors affecting blood glucose measurement results.

The findings of this study are consistent with those of Ramadhani et al (2019) , who reported that random blood glucose levels in EDTA plasma were higher than those in serum. Similar findings were also reported by Fatmawati et al (2025), showing that blood glucose levels measured using EDTA plasma were higher than those measured using serum. These consistent findings strengthen the evidence that specimen type may influence blood glucose measurement results. However, both previous studies focused on random blood glucose testing, whereas the present study examined fasting blood glucose. Therefore, this study extends previous findings to fasting conditions in which respondents had fasted for 10–12 hours (Kaban & Priandhana, 2019)

The use of the GOD-PAP method for both specimen types enabled the measurements to be performed using the same analytical principle. This method has high selectivity for glucose, can minimize interference from other reducing substances in the blood, and produces a stable color for analysis (Kustiningsih et al., 2017). Therefore, the differences observed in this study were more likely related to specimen type and specimen processing rather than differences in the analytical method.

These findings also highlight the importance of controlling the pre-analytical phase, particularly clotting time, specimen separation time, centrifugation procedures, and storage conditions before analysis. Although the difference between serum and EDTA plasma may appear relatively small, such variation may affect clinical interpretation in patients with glucose levels close to the diagnostic thresholds for normal conditions, prediabetes, or diabetes mellitus (Frank et al., 2012). Results obtained from different specimen types should not be compared directly without considering their specimen characteristics. Consistency in specimen type is therefore important, particularly in repeated testing and blood glucose monitoring, so that changes in results more accurately reflect the patient's condition rather than variations caused by specimen processing.

The strength of this study lies in the use of two specimen types collected simultaneously from the same respondents. Serum and EDTA plasma were analyzed using the GOD-PAP method, the Dirui CS-T180 analyzer, and the same analytical procedures, allowing direct comparison between the two specimen types. This study also specifically examined fasting blood glucose, unlike the previous studies cited in this manuscript, which mostly investigated random blood glucose. Therefore, this study provides additional empirical evidence in the field of Medical Laboratory Technology regarding differences in test results based on specimen type.

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This study has several limitations. First, glucose measurements were not performed in duplicate. Repeated measurements of the same specimen are needed to assess the consistency and precision of the results, although internal quality control was performed before testing in this study. In addition, pre-analytical variation may still have occurred due to differences in specimen processing time after blood collection and storage temperature before analysis. These variations may affect glucose levels as a result of ongoing glycolysis and should be considered when interpreting the study findings.

Theoretically, the findings of this study reinforce the understanding that the biological characteristics and pre-analytical handling of serum and EDTA plasma may influence blood glucose measurement results (Subiyono et al., 2016a). Practically, clinical laboratories should maintain consistency in specimen type and standardize specimen separation time, centrifugation procedures, and storage temperature to minimize result variation (Institute, 2023). Future studies are recommended to perform measurements in duplicate or triplicate, use larger sample sizes, and compare serum and EDTA plasma with other specimen types, such as sodium fluoride plasma. Further research should also control specimen separation time and storage temperature more strictly to improve the precision and validity of the results.

4. CONCLUSION

This study aimed to determine the difference in fasting blood glucose levels between serum and EDTA plasma. The results showed that fasting blood glucose levels in EDTA plasma tended to be higher than those in serum, with a significant difference between the two specimen types. These findings confirm that specimen type and pre-analytical handling can influence fasting blood glucose measurement results. Therefore, clinical laboratories are advised to use specimen types consistently and standardize specimen separation time, centrifugation procedures, and storage temperature. Future studies are recommended to perform measurements in duplicate or triplicate, involve larger sample sizes, and compare serum and EDTA plasma with other specimen types, such as sodium fluoride plasma.

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