MEDIA PENELITIAN DAN
PENGEMBANGAN KESEHATAN
Vol 35 No 3, September 2025

e-ISSN: 2338-3445
p-ISSN: 0853-9987

EFFECT OF MEAL TIME BEFORE BLOOD DONATION ON PLASMA LIPEMIC LEVELS AND IN LIQUID PLASMA (LP)

Pengaruh Waktu Makan Sebelum Donor Darah dengan Tingkat Lipemik Plasma pada Komponen Darah Liquid Plasma (LP) pada Donor Sehat

Della Hashfi Anzhari[1], Ni Ken Ritchie[2,3]
[1]Departemen Sains Transfusi, Program Studi Magister Ilmu Biomedik, Fakultas Kedokteran, Universitas Indonesia, Jakarta, Indonesia
[2]Program Studi Teknologi Bank Darah, Akademi Bakti Kemanusiaan PMI, Jakarta, Indonesia
[3]Unit Transfusi Darah, Palang Merah Indonesia, Jakarta, Indonesia
*Email: dellahashfi@gmail.com

ABSTRAK

Kondisi meningkatnya kadar lemak dalam darah akibat asupan makanan dapat mengindikasikan hiperlipidemia. Peningkatan kadar lemak dalam darah pasca makan merupakan respons fisiologis normal terhadap asupan lemak dari makanan. Lemak di dalam tubuh akan mengalami metabolisme dan membutuhkan waktu kembali ke keadaan basal. Hal ini dapat menyebabkan lipemik yang disebabkan oleh tingginya lipoprotein yang terdapat pada darah. Penelitian ini bertujuan untuk mengevaluasi pengaruh waktu makan sebelum donasi terhadap kadar trigliserida dan kejadian lipemik pada komponen LP. Metode studi eksperimen dilakukan pada 28 responden yang dibagi menjadi dua kelompok berdasarkan waktu makan terakhir (2 dan 3 jam sebelum donor). Darah donor yang terkumpul dibuat menjadi komponen darah Liquid Plasma (LP) dan Packed Red Cell (PRC) leukodepleted dilakukan pemeriksaan lipemik, kadar kolesterol,dan kadar trigliserida. Hasil penelitian menunjukkan tidak ditemukan pengaruh waktu makan 2 jam dan 3 jam terhadap kenaikan kadar kolesterol sebelum donor dengan darah donor maupun komponen LP (p=0,946, P=0,431). Ditemukan pengaruh waktu makan 2 jam dan 3 jam terhadap kenaikan kadar trigliserida sebelum donor dengan darah donor maupun komponen LP (p=0,002, p=0,003) dimana berdasarkan nilai mean selisih kenaikan cenderung lebih tinggi pada waktu makan 3 jam sebelum donor. Terdapat hubungan antara kadar trigliserida dan lipemik (p=0,000). Namun, tidak terdapat hubungan antara kadar kolesterol dengan lipemik yang terjadi pada komponen LP (p=0,229).

***Kata kunci**: darah donor, kolesterol, plasma lipemik, trigliserida, waktu makan*

ABSTRACT

The condition of increased blood fat levels due to food intake can indicate hyperlipidemia. Increased blood fat levels after eating are a normal physiological response to fat intake from food. Fat in the body will undergo metabolism and take time to return to basal conditions. This can cause lipemia caused by high lipoproteins in the blood. This study aims to evaluate the effect of meal time before donation on triglyceride levels and lipemic events in LP components. The experimental study method was carried out on 28 respondents who were divided into two groups based on the last meal time (2 and 3 hours before donation). The collected donor blood was made into Liquid Plasma (LP) and packed red cell (PRC) leukodepleted blood components, lipemic, cholesterol levels, and triglyceride levels were examined. The results showed that there was no effect of 2-hour and 3-hour meal times on the increase in cholesterol levels before eating with donor blood and LP components (p = 0.946, p = 0.431). It was found that the effect of meal time of 2 hours and 3 hours on the increase in triglyceride levels before eating with donor blood and LP components (p = 0.002, p = 0.003) where based on the mean value, the difference in increase tended to be higher at meal time 3 hours before donation. There was a relationship between triglyceride levels and lipemic (p= 0.000). However, there

https://doi.org/10.34011/jmp2k.v35i3.3121

e-ISSN: 2338-3445
p-ISSN: 0853-9987

was no relationship between cholesterol levels and lipemic that occurred in LP blood components (p = 0.229).

Keywords: *blood donor, cholesterol, lipemic plasma, triglycerides, meal timing*

INTRODUCTION

One of the basic needs of every individual is food. Food is very beneficial for the body and requires proper management[1]. After being consumed, food in the digestive tract will undergo a digestion process where food ingredients are broken down into nutrients needed by the body[2]. There are two sources of fat in the body: food and fat produced by the liver, which is stored as energy reserves in fat cells. Fat obtained from food is broken down into cholesterol, triglycerides, phospholipids, and free fatty acids. Cholesterol, triglycerides, phospholipids, and free fatty acids are absorbed from the intestines and then packaged as chylomicrons to enter the bloodstream.[3].Fats are insoluble in blood plasma; in the bloodstream, they are transported by binding to specific proteins to form soluble macromolecular complexes. The bonds between fats—including cholesterol, triglycerides, and phospholipids—and proteins are called lipoproteins. Lipoproteins are classified into chylomicrons, very low-density lipoproteins (VLDL), low-density lipoproteins (LDL), and high-density lipoproteins (HDL) based on their composition, density, and mobility[4].

After consuming food that enters the body within 3 to 4 hours, there is an increase in fat levels in the blood[5], [6]. There was a study conducted with 1000 participants who were given food containing 50g of fat and 85g of carbohydrates, and blood fat levels were checked for 6 hours after feeding, it was found that there was a slight increase in blood fat levels in the 2nd hour and increased further in the 3rd to 6th hour[7]. Chylomicrons can still be detected in plasma for approximately 6-12 hours after ingestion of food containing fat[8].

Increased blood fat levels due to dietary intake can indicate hyperlipidemia. This can cause the blood plasma to appear cloudy, known as a lipemic sample. High levels of any type of lipoprotein in the blood can cause cloudiness in the blood plasma[9]. The white color of plasma can be influenced by, among other things, triglyceride levels in the blood. Triglycerides are the main lipids in food, and nearly 90%–95% of the energy produced by fat comes from them. The amount of triglyceride intake from food is a determining factor in obesity and metabolic disease. Postprandial hyperlipidemia is a normal physiological response to dietary fat intake[10].

Hyperlipidemia is classified into two types, namely primary and secondary hyperlipidemia[11]. Diet is one of the causes of secondary hyperlipidemia, alongside many other conditions such as obesity, hypertension, and others. The prevalence of hyperlipidemia worldwide is approximately 45%, with figures in Southeast Asia ranging from 30% to 35% in Indonesia, according to the World Health Organization (WHO)[12]. The development of modernity in lifestyles that occurs in society has led to an increase in the consumption of foods that contain a lot of fat, which can increase fat levels in the blood[13], [14] Apart from diet, other factors influence the presence of lipemic conditions in blood plasma, namely smoking, obesity, and lack of activity such as exercise[8]. In addition, lipemia can originate from various pathophysiological conditions such as multiple myeloma, diabetes mellitus, acute pancreatitis, kidney failure, or hypothyroidism[15].

Donor blood components such as Liquid Plasma (LP) or Thrombocyte Concentrate (TC) that are lipemic must be discarded and destroyed[16]. The loss incurred due to lipemic plasma for one bag of blood is 250,000 per bag[15]. Lipemic plasma can complicate plasma separation during the processing of donor blood components. Lipemic blood components can lead to complications during blood transfusion, such as fat embolism syndrome and transfusion-related acute lung injury (TRALI)[17].

https://doi.org/10.34011/jmp2k.v35i3.3121

e-ISSN: 2338-3445
p-ISSN: 0853-9987

In the Minister of Health Regulation No. 91 of 2015 there is a requirement that the donor's last meal time is at least 3 hours. Meanwhile, it is known that triglyceride levels in the blood decrease again after around 10 to 12 hours [18]. Therefore, it is important to understand the effect of mealtime before donation on plasma lipemic levels. This study analyzed two mealtime variations before donation: 2 and 3 hours, based on the increase in blood lipids after time, and the donor requirements stipulated in Minister of Health Regulation No. 91 of 2015.

METHODS

This research was an experimental study using 28 respondents who donated blood at the UDD PMI DKI Jakarta and Branches who have agreed to participate in the research through informed consent. This research was conducted from August to December 2024. This research has passed the Ethics Review of the Faculty of Medicine, University of Indonesia - Dr. Cipto Mangunkusumo General Hospital. Letter Number: KET-1748 / UN2.F1 / ETIK / PPM.00.02 / 2024.

Respondents included in this study had inclusion criteria, namely being 18-65 years old, weighing 45-90 kg, and having HB ≥ 12.5 g/dL, with exclusion criteria for donors with DM, donors taking cholesterol-lowering drugs, obese donors (BMI >30), and donor blood that did not meet the requirements to be processed into blood components (hemolysis).

Respondents fasted for ± 10 hours (still drinking water), then a 3 mL blood sample was taken, and then given a complete meal intake of ± 700 calories with a composition of 225 grams of carbohydrates, 80 grams of vegetable protein, 80 grams of animal protein, and 80 grams of vegetables. After being fed, fast again for 2 hours or 3 hours before donating blood. Respondents donated donor blood with a double bag and took samples simultaneously as much as 3 mL during a blood donation procedure. The sample was processed into serum, and the resulting donor blood was processed into leukodepleted PRC blood components and LP. Serum samples and LP components will be examined for cholesterol and triglyceride levels, LP products will be visually analyzed by comparing them with non-lipemic LP controls and placing the LP tube on the LP component label barcode to see the presence of lipemia and taken through the tube as much as ± 1 mL for triglyceride and cholesterol examination after becoming a blood component. Cholesterol and triglyceride examinations were performed using a colorimetric method using a spectrophotometer with normal cholesterol levels of 200 mg/dL and triglycerides of 180 mg/dL. After obtaining the results, statistical analysis was performed using a t-test using statistical software.

RESULT

By providing food treatment 2 hours and 3 hours before blood donation, the research results were obtained, which are presented in the following graph.

https://doi.org/10.34011/jmp2k.v35i3.3121

e-ISSN: 2338-3445
p-ISSN: 0853-9987

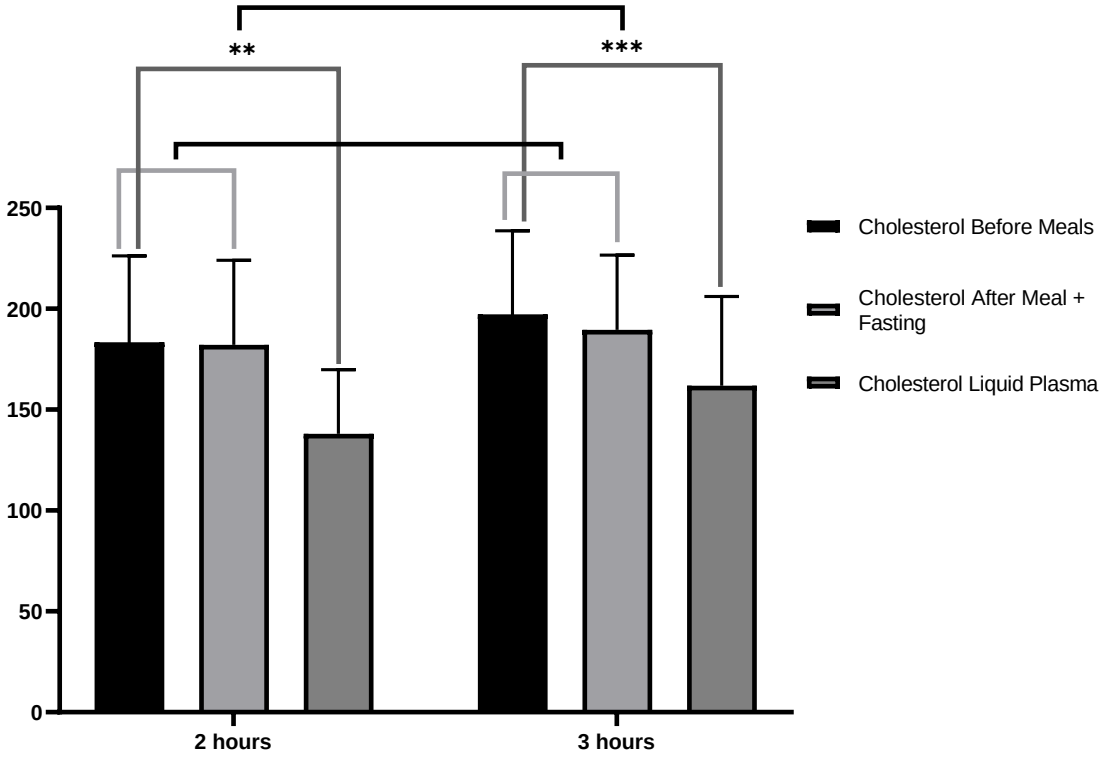

Figure 1. Comparison of Average Cholesterol Levels

Figure 1 shows no significant difference between cholesterol levels before donation and after donation in the group that ate 2 hours before donation (p = 0.856). However, there is a significant difference in cholesterol levels between before donation and LP components of the group fed 2 hours before donation (p = 0.001). The results show that cholesterol levels before donation and donor blood in the group eating 3 hours before donation did not show any significant difference (p = 0.474), and there significant difference in cholesterol levels between before donation and LP components of the group eating 3 hours before donation (p = 0.000). It is known that there is no significant difference between the difference in cholesterol increase before donation and donor blood between the group eating 2 hours before donation and 3 hours before donation (p = 0.946) and it is known that there is no significant difference between the difference in cholesterol increase before donation and LP components between the group eating 2 hours before donation and 3 hours before donation (p = 0.431).

Figure 2 shows the results of research on triglyceride levels, which found a significant difference between triglyceride levels before donation and blood donors in the eating group 2 hours before donation (p = 0.013). There is no significant difference in triglyceride levels between before donation and LP components of the group eating 2 hours before donation (p=0.331). There was a significant difference between the triglyceride levels before donation and the blood donors in the group who ate 3 hours before donation (p = 0.000). The triglyceride levels between before donation and the LP components of the group who ate 3 hours before donation showed the results. There is a significant difference(0.011). From these data, there is a tendency for the group eating 3 hours before donation to have a smaller p-value.

There was a significant difference in the difference in triglyceride increase before donation and donated blood between the group eating 2 hours before donation and 3 hours before donation (p = 0.002). The increase in triglyceride levels was seen in the

https://doi.org/10.34011/jmp2k.v35i3.3121

e-ISSN: 2338-3445
p-ISSN: 0853-9987

treatment group eating 3 hours before donation, where the mean value of the difference in increase was 67.14, while in the group eating 2 hours before donation, it was 24.07. In addition, there was a significant difference in the difference in triglyceride increase before donation and LP components between the group eating 2 hours before donation and 3 hours before donation (p = 0.003). The increase in triglyceride levels was seen to be higher in the treatment group that ate 3 hours before donation, where the mean difference in increase was 40.07, whereas in the group eating 2 hours before donation it was 11.00.

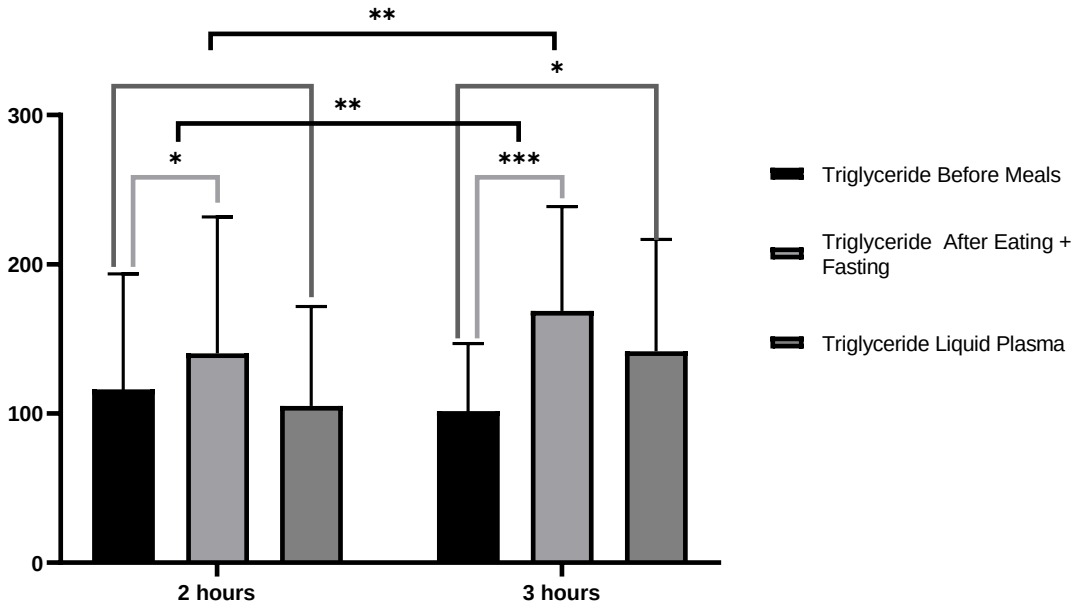

Figure 2. Comparison of Average Triglyceride Levels

Table 1. Lipemic Result Data on Liquid Plasma Components

Group	Lipemic Data		Amount (%)
	Lipemic (%)	Non-Lipemic (%)	
Eat 2 Hours Before Donating	3 (21.4%)	11 (78.5%)	14 (100%)
Eat 3 Hours Before Donating	5 (35.7%)	9 (64.2%)	14 (100%)
	8	20	28

Table 1 shows the results where there is no significant relationship between cholesterol levels and lipemia (p = 0.299), and there is a significant relationship between triglyceride levels and lipemia (p = 0.000).

DISCUSSION

The research conducted shows there was no significant difference between cholesterol levels before donation and donor blood in the diet group 2 hours and 3 hours before donation (p=0.856, p=0.474). The cholesterol level examination conducted in this study used an enzymatic method by quantitatively calculate total cholesterol in blood serum. As stated in the examination principle, the form of cholesterol ester is examined. Cholesterol in the intestine is primarily derived from food and bile. Some animal-derived foods, such as organ meats, shrimp, dairy products, and egg yolks, are known to contain high levels of cholesterol. More than 85% of the cholesterol in these foods is present in the non-esterified form, while the remainder is present as cholesterol esters. Cholesterol esters need to undergo enzymatic hydrolysis to become free cholesterol in the digestive

https://doi.org/10.34011/jmp2k.v35i3.3121

e-ISSN: 2338-3445
p-ISSN: 0853-9987

tract before they can be absorbed in the small intestine.[19].The results showing no significant difference are likely due to the fact that the cholesterol ester form in food is not as much as the non-esterified form.

In the research conducted, it was shown that there was a significant difference in cholesterol levels between before donor and LP components in both variation groups (p=0.001, p=0.000). The results of cholesterol level examinations between donor blood and LP components should not be different because the sampling time of the respondents was the same. However, in this study, cholesterol levels after becoming components tended to be lower. This could occur because the cholesterol level examinations were conducted at different times, where the component samples were first processed blood components that were carried out approximately 24 hours, even though the kit insert stated sample stability of 5 to 7 days with a storage temperature of 2-8˚C. Errors in storage and transportation affect a decrease in cholesterol levels. Research conducted by Imanuel in 2018 found a difference in the decrease in cholesterol levels using the immediate serum and the four-hour delay enzymatic method CHOD-PAP[20]. Poor sample handling, such as exposure to sunlight, changes in storage temperature, can affect the decrease in cholesterol levels[21]. In this study, temperature monitoring was considered carefully, as sample transportation was carried out in a cool box. However, this does not rule out the possibility of temperature changes occurring during transportation or the blood component manufacturing procedure. Delays in testing that lead to decreased cholesterol levels can be influenced by an imbalance in the composition of enzymes in the serum/plasma, such as lipase. Prolonged storage can reduce the water content in the serum/plasma. This reduced water content can inhibit the activity of the lipase enzyme in breaking down fat. Therefore, storage should be done not for too long to prevent decreased cholesterol levels. [22].

This study showed no significant effect (p = 0.473,p = 0.431)meal times 2 hours and 3 hours before donation on increased cholesterol levelsboth between the levels before donation and donor blood, as well as between the cholesterol levels before donation and LP components.In the study, most respondents had no history of high cholesterol. The main factors that can increase blood cholesterol levels are a diet high in cholesterol, or excessive saturated fat and calories. The collection of cholesterol in the liver is tightly regulated and reflects dietary cholesterol intake, cholesterol biosynthesis, cholesterol secretion and absorption from plasma lipoproteins, cholesterol conversion to bile, and the reabsorption of bile cholesterol and bile acids from the intestine to the liver.[23]

Blood cholesterol concentration in normal fasting humans is the result of cholesterol metabolism from exogenous and endogenous sources. Environmental factors such as dietary fatty acids, metabolic disorders like diabetes and obesity, and genetic factors also influence blood cholesterol levels[23].In this study, these factors were reduced by the criterion of respondents who were not obese (BMI <30). Research conducted by Langsted et al. also found no response in total cholesterol and LDL cholesterol levels when there was a normal food intake. After 3 to 4 hours of food intake, there was no change in total cholesterol and LDL levels. Therefore, total cholesterol and LDL levels did not change in response to a normal food intake after adjusting for albumin levels.[24]

In the research conducted it was shownthere was a significant difference between triglyceride levels before donation and donor blood in the diet group 2 hours and 3 hours before donation (p=0.013, p=0.000). The difference in triglyceride increases between the groups eating 2 hours before donation and those eating 3 hours before donation was significant (p=0.002), with a tendency for higher triglyceride levels in the group eating 3 hours before donation.

Triglycerides are the main lipids in food, and nearly 90%–95% of the energy produced by fat comes from triglycerides. The amount of triglyceride intake from food is a determining factor in obesity and metabolic disease. Postprandial hyperlipidemia is a

https://doi.org/10.34011/jmp2k.v35i3.3121

e-ISSN: 2338-3445
p-ISSN: 0853-9987

normal physiological response to triglyceride intake from food.[10].As in the study by Langsted et al., an increase in triglycerides and a decrease in HDL cholesterol were observed in response to food intake, even after correction for albumin levels and hemodilution due to fluid intake. Therefore, the decrease in triglyceride levels is most likely caused directly by dietary fat intake[24].

A study by Li x and colleagues in obese individuals also confirmed that consuming 40 g of fat can increase post-meal plasma triglyceride concentrations. These residual fats in the circulation can significantly impact cardiovascular disease, obesity, and metabolic diseases. In patients with insulin resistance (IR), elevated serum triglycerides are often found in the non-fasting state[10]. In this study, respondents were individuals who were not obese (BMI < 30), did not have diabetes, and most of them did not have a history of high cholesterol[10].

The triglyceride levels between before donation and the LP components of the group that ate 2 hours before donation obtained a p-value of 0.331, which shows that there was no significant difference. Triglyceride levels between before donation and LP components from the group eating 3 hours before donation obtained a p value of 0.011, indicating that the results is a significant difference. In the difference in the increase in triglycerides is influenced by the times 2 hours and 3 hours before donation on increased triglyceride levels in donor blood, both between cholesterol levels before donation and donor blood, and between cholesterol levels before donation and LP components.. There was a higher increase in the treatment group that ate 3 hours before donation compared to the treatment group that ate 2 hours before donation. In this study, the 225 grams of carbohydrates, 80 grams of vegetable protein, 80 grams of animal protein, and 80 grams of vegetables where this composition contains 52.21g of fat, 90.88g of carbohydrates, and 34.62g of protein. These results are in line with previous research, where food consumption can increase blood fat levels around 3 to 4 hours after food intake.[5], [6]. There was a study conducted with 1000 participants who were given food containing 50g of fat and 85g of carbohydrates, and blood fat levels were checked for 6 hours after feeding. It was found that there was a slight increase in blood fat levels in the 2nd hour and increased further in the 3rd to 6th hour[7]. Chylomicrons in blood plasma are still detected 6 to 12 hours after fatty food intake into the body[8].

Triglyceride elevations can occur not only due to dietary fat intake but also due to the influence of carbohydrate intake. High carbohydrate consumption causes insulin to increase, thereby increasing the rate of lipogenesis. Excess carbohydrates are converted to acetyl-CoA and then synthesized into triglycerides. These triglycerides are then transported as VLDL into the bloodstream. Previous research has shown that low-fat and high-carbohydrate diets can increase plasma triglyceride concentrations by up to 60%. This suggests that the source of fatty acids for VLDL-TG synthesis is significantly influenced by diet composition[25], [26], [27].

The results of the triglyceride level test between before eating and after becoming a component showed a difference that should not be different because the sampling time was the same for the respondents. However, in this study, the triglyceride level after becoming a component tended to be lower. This could be because the triglyceride level test was conducted at a different time, where the component sample was first processed for blood component production, which was carried out for approximately 24 hours, even though the kit insert stated sample stability for 5 to 7 days with a storage temperature of 2-8°C. Data analysis of the differences in triglyceride levels showed a decrease in triglyceride levels. Studies have shown a difference in triglyceride levels between immediate and delayed tests, with a decrease of 2.42% with a delay of 0 to 8 hours, and a decrease of 4.34% with a delay of 0 to 12 hours. The decrease in triglyceride levels can occur due to a hydrolysis reaction. The reaction will occur more quickly when the

https://doi.org/10.34011/jmp2k.v35i3.3121

e-ISSN: 2338-3445
p-ISSN: 0853-9987

temperature increases during the storage process[28].This is the basis for the difference between the results of triglyceride levels after eating and after becoming a component.

Miguel de Oliveira in 2022 found that dietary composition plays a major role in post-meal triglyceride concentrations. An acute fat intake of 40–50 g can cause moderate plasma lipemia with peak concentrations 3–4 hours after eating[29]. This is in line with the results of research conducted, where is a significant difference in the average between triglyceride levels in the components and lipemic levels in the components, and there is a relationship between triglyceride levels and lipemic events. Lipemia is the accumulation of excess lipoprotein particles, such as chylomicrons or VLDL, in the blood, causing the blood to become cloudy and milky white. The largest lipoprotein particles, chylomicrons, measuring 70-1000 nm, have the greatest potential to cause cloudiness[15].

In the research conducted, LP components that experienced lipemia had triglyceride levels above 157 mg/dL, while in other research, lipemia was seen when serum triglyceride levels were more than 200 mg/dL[30]. This can occur due to differences in the observed plasma volume. In this study, observations were conducted in two ways: observing the entire plasma product bag and observing the tube placed on the barcode. However, there was a difference when the tube still looked clear, but when viewed throughout the plasma product in the bag, turbidity was already visible. In large plasma volumes, lipemia was more visible. Lipemia is caused by very high lipid concentrations in blood plasma. The higher the lipoprotein levels in plasma, the more lipemic it appears, and this phenomenon is more pronounced in plasma samples with larger volumes. Therefore, analysis of the lipemic state in blood bags is best done by observing the entire plasma in the bag[31], [32].

Wongsena and colleagues stated that plasma turbidity increased significantly with triglyceride levels but was inversely proportional to cholesterol levels[33]. This is in line with the results of the research conducted, where there was a significant average difference between cholesterol levels in components and lipemic, however, there was no relationship between cholesterol levels and lipemic events.

This study had limitations, such as the lack of grouping between donors with a history of hyperlipidemia and those without. Furthermore, the sample size was limited, preventing a greater diversity of lipemic levels. Furthermore, the study did not independently transport and process blood components, so other factors cannot be ascertained and may have influenced the results.

CONCLUSION

From the results of the research that has been conducted, it can be concluded that there is no effect of meal times of 2 hours and 3 hours on the increase in cholesterol levels before donation with donor blood or LP components. There is an effect of meal times of 2 hours and 3 hours on the increase in triglyceride levels before donation with donor blood or LP components, where the difference in increase tends to be higher at meal times 3 hours before donation. There is a relationship between triglyceride levels and lipemic, however, no relationship was found between cholesterol levels and lipemic that occurs in LP blood components.

ACKNOWLEDGMENT

This research was funded by the Indonesian Red Cross Humanitarian Service Academy Grant.

REFERENCES

[1] F. Nahdiyani, A. F. Rangkuti, F. Kesehatan, and A. Dahlan, ‘The Relationship of Sanitation Hygiene and The Use of Personal Protection Equipment by Traders with Physicial Contaminants of Tradisional Snacks in The Legi Market of Kotagede

https://doi.org/10.34011/jmp2k.v35i3.3121

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Yogyakarta in 2021', *Menara Journal of Health Science*, vol. 1, no. 2, 2022, [Online]. Available: http://jurnal.iakmikudus.org/index.php/mjhs
[2] B. Nainggolan, N. Susanti, and A. Janiar, 'Uji Kelayakan Minyak Goreng Curah dan Kemasan yang Digunakan Menggoreng Secara Berulang', *Jurnal Pendidikan Kimia*, vol. 8, no. 1, 2016.
[3] A. Guyton and J. E. Hall, *Buku Ajar Fisiologi Kedokteran*, 9th ed. Jakarta: EGC, 2007.
[4] J. M. F. Adam, *buku ajar Ilmu Penyakit Dalam 'Dyslipidemia'*, IV. Jakarta: Interna Publishing, 2009.
[5] J. E. Lambert and E. J. Parks, 'Postprandial metabolism of meal triglyceride in humans', *Biochimica et Biophysica Acta (BBA) - Molecular and Cell Biology of Lipids*, vol. 1821, no. 5, pp. 721–726, May 2012, doi: 10.1016/j.bbalip.2012.01.006.
[6] R. N. Chavez–Jauregui, R. D. Mattes, and E. J. Parks, 'Dynamics of Fat Absorption and Effect of Sham Feeding on Postprandial Lipema', *Gastroenterology*, vol. 139, no. 5, pp. 1538–1548, Nov. 2010, doi: 10.1053/j.gastro.2010.05.002.
[7] S. E. Berry *et al.*, 'Human postprandial responses to food and potential for precision nutrition', *Nat Med*, vol. 26, no. 6, pp. 964–973, Jun. 2020, doi: 10.1038/s41591-020-0934-0.
[8] M. L. Bishop, *Clinical Chemistry:Tecniques, Principles, Correlations.* . United State: Wolter Kluwer Health, 2010.
[9] S. Piyophirapong, W. Wongtiraporn, and . K Sribhen, 'Factitious Results in Clinical Chemistry Tests Caused by Common Endogenous Interferents', *Siriraj Med J*, vol. 62, no. 4, pp. 185–188, 2020.
[10] X. Li, Q. Liu, Y. Pan, S. Chen, Y. Zhao, and Y. Hu, 'New insights into the role of dietary triglyceride absorption in obesity and metabolic diseases.', *Front Pharmacol*, vol. 14, p. 1097835, 2023, doi: 10.3389/fphar.2023.1097835.
[11] R. Suhadi, P. Hendra, D. M. Virginia, C. H. Setiawan, and Y. Linawati, *Seluk-Beluk Hiperlipidemia: Peningkatan Partisipasi dan Kompetensi Farmasis dalam Pencegahan Penyakit Kardiovaskuler*. Yogyakarta: Sanata Dharma University Press, 2021.
[12] World Health Organization (WHO), 'Global Hiperlipidemia Report 2019', 2019.
[13] Nur. Khasanah, *Waspadai Beragam Penyakit Degeneratif Akibat Pola Makan*, Satu. Yogyakarta: Penerbit Laksana. , 2012.
[14] A. Ramali and Pamoentjak, *Kamus kedokteran*. Jakarta: Djambaran, 2005.
[15] N. Nikolac, 'Lipemia: Causes, interference mechanisms, detection and management', 2014. doi: 10.11613/BM.2014.008.
[16] W. Health. Organization, World Health Organization, World Health Organization. Blood Transfusion Safety, Centers for Disease Control and Prevention (U.S.), and World Health Organization, *Blood Donor Selection : Guidelines on Assessing Donor Suitability for Blood Donation.* World Health Organization, 2012.
[17] N. D. Knuth and J. F. Horowitz, 'The Elevation of Ingested Lipids within Plasma Chylomicrons Is Prolonged in Men Compared with Women', *J Nutr*, vol. 136, no. 6, pp. 1498–1503, Jun. 2006, doi: 10.1093/jn/136.6.1498.
[18] Meteri Kesehatan Republik Indonesia, 'Peraturan Menteri Kesehatan Republik Indonesia No 91 Tentang Standar Pelayanan Transfusi Darah', Jakarta, 2015.
[19] L. Zhang, Y. Shi, B. Liang, and X. Li, 'An overview of the cholesterol metabolism and its proinflammatory role in the development of MASLD', *Hepatol Commun*, vol. 8, no. 5, May 2024, doi: 10.1097/HC9.0000000000000434.

https://doi.org/10.34011/jmp2k.v35i3.3121

e-ISSN: 2338-3445
p-ISSN: 0853-9987

[20] Imanuel, 'Perbedaan Kadar Kolesterol Serum Segera Dan Tunda 4 Jam', Universitas Muhammadiyah Semarang, Semarang, 2018. [Online]. Available: http://repository.unimus.ac.id
[21] Departeman Kesehatan Republik Indonesia, *Pedoman Praktik Laboratorium Kesehatan Yang Benar (Good Laboratory Practice)*. Jakarta: Perpustakaan Depasrtemen Kesehatan RI : Katalog dalam terbitan (KDT), 2008.
[22] A. Suranto, *Terapi Enzim*. Jakarta: Penebar Plus, 2011.
[23] D. R. Arnold and P. O. Kwiterovich, 'CHOLESTEROL | Absorption, Function, and Metabolism', in *Encyclopedia of Food Sciences and Nutrition*, Elsevier, 2003, pp. 1226–1237. doi: 10.1016/B0-12-227055-X/00225-X.
[24] A. Langsted, J. J. Freiberg, and B. G. Nordestgaard, 'Fasting and nonfasting lipid levels influence of normal food intake on lipids, lipoproteins, apolipoproteins, and cardiovascular risk prediction', *Circulation*, vol. 118, no. 20, pp. 2047–2056, Nov. 2008, doi: 10.1161/CIRCULATIONAHA.108.804146.
[25] N. I. Nasruddin, J. Saimin, and R. Tosepu, 'Korelasi indeks massa tubuh terhadap rasio trigliserida dan high-density lipoprotein-cholesterol pada wanita usia subur dengan obesitas', *Jurnal Gizi Klinik Indonesia*, vol. 18, no. 3, p. 126, Jan. 2022, doi: 10.22146/ijcn.69245.
[26] N. D. Yanti, S. Suryana, and Y. Fitri, 'Analisis asupan karbohidrat dan lemak serta aktivitas fisik terhadap profil lipid darah pada penderita penyakit jantung koroner', *AcTion: Aceh Nutrition Journal*, vol. 5, no. 2, p. 179, Nov. 2020, doi: 10.30867/action.v5i2.183.
[27] E. J. Parks, R. M. Krauss, M. P. Christiansen, R. A. Neese, and M. K. Hellerstein, 'Effects of a low-fat, high-carbohydrate diet on VLDL-triglyceride assembly, production, and clearance', *Journal of Clinical Investigation*, vol. 104, no. 8, pp. 1087–1096, Oct. 1999, doi: 10.1172/JCI6572.
[28] D. Guna, M. Sebagian, S. Mencapai, G. Sarjana, and T. Kesehatan, 'Analisis Kadar Kolesterol Dan Trigliserida Pada Serum Kontrol Komersial Berdasarkan Lama Penyimpanan', Yogyakarta, 2022.
[29] M. de Oliveira, M. Antunes, and M. Amil, 'Plasma lipemia: When the blood donor becomes a patient', *Transfusion and Apheresis Science*, vol. 61, no. 1, p. 103294, 2022, doi: 10.1016/j.transci.2021.103294.
[30] Michael D. Willard and Harold Tvedten, *Small Animal Clinical Diagnosis by Laboratory Methods*, Fifth. ELSEVIER, 2012.
[31] M. E. , et al. Bassiouni, 'The Role of Lipemia in Laboratory Diagnostics', *Journal of Clinical Chemistry*, vol. 64, no. 9, 2018.
[32] D. D. , et al. Bailey, 'he Impact of Lipemia on Laboratory Tests', *J Clin Pathol*, vol. 67, no. 8, 2014.
[33] W. Wongsena and R. P. Sranujit, 'Risk Factors for Lipemic Plasma in Blood Donors', *J Hematol Transfus Med*, vol. 27, pp. 117–125, 2017, [Online]. Available: https://www.researchgate.net/publication/318323645

https://doi.org/10.34011/jmp2k.v35i3.3121