

ASSESSMENT OF PLATELET INDICES, BETA-THROMBOGLOBULIN AND PLATELET FACTOR IV IN PLATELET CONCENTRATE AT UNIVERSITY OF ILORIN TEACHING HOSPITAL, NIGERIA

Olatunbosun, Luqman Olayinka,^{1,2*5} Muhibi Musa Abidemi,^{2,3} Oke Olusegun Taiwo,² Babatunde Abiola Samuel¹, Ademosun Abdulwaheed Adewale,^{4,5} Olalere, Fatai Dayo,^{1,5} Sanni, Emmanuel Oladipo⁶, Kareem, Mutiat Aina⁵, Azeez Rasheed Taiwo⁵, Adebayo Fatai Kayode¹, Yusuf Mubarak Abubakar¹, Uthman Roheemot Damilare,⁵ and Idris Aasiyah Oyinkansola⁵

¹Department of Haematology and Blood Transfusion, University of Ilorin Teaching Hospital, Ilorin, Nigeria.

²Department of Haematology and Blood Transfusion, Faculty of Medical Laboratory Science, Achievers University Owo, Ondo State.

³Department of Medical Laboratory Science, Faculty of Applied Health Sciences, Edo University, Uzairue, Edo State.

⁴Department of Hematology and Blood transfusion, Obafemi Awolowo University Teaching Hospital Complex, Ile-Ife, Osun State, Nigeria.

⁵Department of Medical Laboratory Science, Faculty of Health Sciences, Al-Hikmah University, Ilorin, Nigeria.

⁶Department of Hematology and Blood Transfusion, Faculty of Basic Clinical Sciences, Nile University of Nigeria, Abuja.

Corresponding Author:

Dr Luqman Olayinka OLATUNBOSUN

Department of Haematology and Blood Transfusion Science, University of Ilorin Teaching Hospital, Ilorin, Nigeria and Faculty of Medical Laboratory Science, Achievers University, Owo, Nigeria

E-Mail Address: deluy008@gmail.com

Phone Number: +2348030467510

ABSTRACT:

OBJECTIVES: Platelet concentrate transfusion remains a major therapeutic care for patient with hematological disorders. However, optimal therapeutic effect has been a major challenge. Blood donor characteristics and processing procedure remain major areas of research. Hence, this research assessed the platelet functional parameters, beta-thromboglobulin and Platelets factor IV in donors and platelet concentrate.

MATERIALS AND METHODS: The study was a cross-sectional descriptive study among prospective blood donors for platelet concentrate. Seventy-one prospective blood donors were recruited for this study with mean age of 34.8. Whole blood and aliquot from concentrate were collected for platelet functional parameters using Semi-automated Haematology analyzer, pH using potentiometric method while Beta-thromboglobulin and Platelet factor IV using ELISA-based assays.

RESULTS: There was high quality prospective blood donors recruited for platelet concentrate for the current study. Furthermore, there was significant increase (P-value <0.00) in platelet count, plateletcrit (PCT), β -thromboglobulin (BTG), Platelets factor IV (PF4) and platelet large cell concentration (PLCC) in the first 12 hours of harvest and running through 5 days of storage as pre-transfusion relative to the baseline values. Conversely, there was significant decrease in Mean platelet volume (MPV), platelet distribution width coefficient of variation (PDW-CV) and Platelet large cell ratio (P-LCR). Interestingly, fall in pH for the first 12h was significant compared to 5 days longitudinal drop in pH. These findings indicate a slight but steady increase in platelet activation markers as storage time progresses.

CONCLUSION: Platelets in Platelet concentrates were of low therapeutic quality due to significant platelet activation however, transfusion within 2 hours of harvest and not more than 6 hours post-harvest can guarantee better patient outcome. The study further established significance of including pH in evaluating platelet concentrates pre-transfusion to optimize transfusion outcome if transfusion is delayed beyond 6 hours post-harvest.

KEYWORDS: Platelets, Beta-thromboglobulin, Factor IV, Platelet Concentrates

INTRODUCTION:

Transfusion science since 17th century continues to evolve, with significant scientific and clinical advances from transfusing whole blood to utilizing only its components such as packed red blood cells (RBC), platelets, rarely white blood cells (WBC), fresh frozen plasma, and plasma-derived products for selective indications¹. Platelet is a scarce resource, partly because of their short shelf life of 5 days, and it is classified in the World Health Organization's (WHO) list of "Essential Medicine"². Platelet concentrate are complex multi-component products to treat thrombocytopenia or as prophylaxis for those at serious risk of bleeding³. Furthermore, Platelets concentrates (PC) are widely used to support patients with severe thrombocytopenia in patients with hematologic malignancy, bone marrow failure or other immune and non-immune causes of platelet destruction, though rarely cases could warrant transfusion in patients with normal platelet counts⁴. Platelet transfusion is a common practice in thrombocytopenic patients for preventing or treating hemorrhages. About 230,000 platelet component transfusions are given in Spain, and approximately two million of platelet components are transfused in the United States annually⁵. More than 50% of platelets concentrate are transfused to patients diagnosed of oncohaematological diseases and/or undergoing hematopoietic stem cell transplantation with the aim of helping physicians to take the most accurate decisions on platelet transfusion. Some guidelines have been developed based on the current-scientific evidence⁶. Platelet performs the function of optimization of haemostasis and minimization of blood loss by initiating coagulation cascade⁷. The manufacturing and storing of concentrated platelet components need to pay attention to standards and quality control because during storage period, changes in the structure and function of platelets can occur, which may result in damage to the components of concentrated platelet⁸. In vitro storage of platelet can stimulate changes in biochemical and platelet function called platelet storage lesion⁹. Although technical advances have been made in the field of transfusion medicine to maintain the viability and the shelf-life of platelets during preparation and storage, still a lot of work remains uncovered⁴. Platelets are often transfused without respecting the ABO compatibility due to the limited stock availability, however, influence of this practice on platelet transfusion outcome is not well established¹⁰. However, there are some controversial issues and available scientific evidence is still not enough to solve them. There is little information about which is the best platelet product to be transfused: random platelets or single donor apheresis platelets, and plasma-suspended or additive solution-suspended platelets¹¹. There is currently no routine testing of platelet quality such as percentage of active platelets and quality of therapeutic outcome that is negatively affected by prolonged storage times¹². Platelet quantity (platelet functional parameters) is determined by assessing certain parameters such as MPV, PDW, PT, INR, volume of platelet, platelet count and pH⁸. Currently, from literature search, little or no research has been conducted

on Beta-thromboglobulin and PF4 more specifically in prospective blood donors recruited for platelet concentrate. Against this background, our study wishes to evaluate the platelet product chain of processes from donor characteristics to the point of release for final transfusion. Platelet contains several bioactive proteins in the granules such as (Von Willebrand Factor, P-selectin, beta-thromboglobulin, Platelet Factor 4, fibrinogen). These factors can be used to assess platelet quality for therapeutic efficacy ¹². Beta-thromboglobulin are specific platelet alpha granule that are released upon platelet activation and they are useful markers of platelet activation ¹⁰. It has been observed from previous studies that, platelets undergo various storage changes starting from collection, processing to storage and the underlying conditions within the patients, which may affect the therapeutic benefit to the recipient ¹³. Over time, changes in both Platelets and their storage medium occur, with an accumulation of bio reactive substances ¹⁰. Extension of platelets storage duration may expose patients to potential decreases in platelets transfusion efficacy as well as possible increases in adverse events in addition to transfusion-associated sepsis, such as inflammation and/or immune-mediated events ². Platelet storage lesions develop during platelets concentrates preparation and storage. Mechanical and biochemical forces during platelets concentrates preparation induce platelet activation which persist throughout storage duration¹⁶. There is currently no routine testing of platelet quality and as changes in structure and function of platelet can occur both from the donor and the preparation process thus, affecting platelet concentrate negatively ¹⁶. The demand for platelet transfusion appears to be increasing, and there has been little attention paid to therapeutic efficacy of platelet transfusion particularly in the areas of donor quality and process, thereby resulting in non-uniform transfusion outcomes. Premised on these, this study was designed to evaluate PF4, pH, Beta-thromboglobulin, and platelets functional parameters as essential biomarkers for platelet vitality and therapeutic quality.

MATERIALS AND METHODS:

This study is descriptive experimental research conducted at University of Ilorin Teaching Hospital (UITH). A total of 71 subjects were recruited as prospective blood donors for platelet concentrate and were assessed pre-donation, post-harvest and pre-transfusion for the quality of platelet concentrate. Ethical clearance was obtained from the Health Research Ethics Committee, Ministry of Health, Ilorin and Ethical committee, University of Ilorin Teaching Hospital, Ilorin (NHREC 02/05/2010). Informed consent was obtained from all subjects on sample collection and data usage in compliance with the institutional ethical committee approval condition.

Study design: Donors were assessed at pre-processing, and platelet concentrates were assessed post-harvest and pre-transfusion to determine the quality and quantity of platelets to validate quality of donors, effects of processing and storage on platelet concentrates in order to guarantee effective platelet transfusion to recipient. The major inclusion criteria for the prospective donors include: no systemic illness; seronegative for Transfusion Transmitted Infections (TTIs);

normotensive; non-febrile, and no history of previous hospital admission in the last six (6) months. The exclusion criteria were as follows: hypertensive; coagulation defects; history of recurrent signs of systemic infection, and the use of medications affecting platelet functions such as aspirin, acetylsalicylic acid. The following data were collected from donors: age, gender, marital status, occupation, sleep duration, education, religion, ethnicity (tribe), daily stress, cigarette consumption, alcohol consumption, donor category (first time donor, second, third or regular donor), frequency of blood donation, reasons for donation, and use of analgesics and hematinics.

Blood Samples Analyses: Blood analyses including the assessment of platelet functional parameters were carried out using a 5-part Haematology Autoanalyzer Swelab Lumi Analyser (Spanga, Sweden), and the parameters were recorded as follow: Platelet count (PLT) count, $150\text{--}400 \times 10^9/\text{L}$; Plateletcrit (PCT), 37–52%; Mean Platelet Volume (MPV), 7.4–10.4 fl; Platelet Distribution Width (PDW); PDW-CV=Platelet Distribution Width as Coefficient of Variation; PDW-SD= Platelet Distribution Width as Standard Deviation; P-LCC=Platelet-Large Cell Concentration; and P-LCR=Platelet-Large Cell Ratio; and for platelet activation biomarkers: pH; Beta-thromboglobulin (BTG); and Platelet Factor 4 (PF4) were evaluated.

Procedure For Preparation of Platelet Concentrate: Whole blood from donor was bled into triple blood bag containing CPD-A anticoagulant and platelet concentrate harvested by two centrifugation steps (soft spin and hard spin) using Biobase BKC-BB6 JINAN Biobase Biotech Blood Bag Cold centrifuge. The triple blood bag was spun in a cold centrifuge at 2000g for 7 minutes at 22°C to obtain platelet-rich plasma. Plasma extractor was used to transfer platelet-rich plasma into the first satellite blood bag, then spun at 4000g for 10 minutes. Plasma extractor was used to transfer the supernatant plasma back to the third satellite blood bag leaving about 65-70mls of the sediment which forms the platelet concentrate. Platelet concentrate was placed on agitator at 22°C in order to avoid clumping and platelet activation.

Sample Collection and Processing: A volume of 4.5mL whole blood was collected from the prospective blood donors (Pre-donation) and dispensed into EDTA sample bottle for platelet functional parameters assay. The concentrate in main bags with varying yield between 65mL and 70 mL was stored at 22 °C and an aliquot of 10mL was transferred into another empty satellite blood bags where 2mL was used each day for assays consecutively for 5 days while the remaining volume were used for transfusion purpose. All methods were performed in accordance with the relevant guidelines and regulations with strict compliance to standard operating procedure (SOP).

Procedure For Beta Thromboglobulin Assay: A volume of 100uL of standard and sample was added to each well and was incubated for 90 minutes at 37°C. Liquid from each well was decanted and immediately 100uL of biotinylated Ag/Ab detection was added and incubated for 1hour at 37°C. Solution from each well was decanted and 350uL of wash buffer was added and washed 3 times. A volume of 100ul of HRP conjugate was added to each well and incubated for 30min at

37°C. It was aspirated and washed 5 times. A volume of 90uL of substrate reagent was added and incubated for 15minutes at 37°C. A volume of 50uL of stop solution was added to each well and optical density of each well was determined at once with a micro plate reader set at 450nm.

Calculation of result: To obtain averaged curve, the duplicate readings for each standard and samples calculated and then subtract the average zero standard optical density. A Plot of a four parameters logistic curve on log-log graph paper with standard concentration on the X-axis and OD on Y-axis. If the OD of the sample surpasses the upper limit of the standard curve, it was re-tested with appropriate dilution. The actual concentration is the calculated concentration multiplied by the dilution factor

Estimation of Factor IV (ELABSCIENCE, 2024): Platelets Factor IV was performed by Enzyme Linked Immunosorbent Assay (ELISA) according to the manufacturer's instructions, (Elabscience® Human PF4 (Platelet Factor 4) ELISA Kit, USA). This kit uses the sandwich-ELISA principle. Briefly, the principle is based on the simultaneous binding of the PF4 to two monoclonal antibodies, one immobilized on microwell plates and the other conjugated with horseradish peroxidase (HRP). After incubation, the separation bound fraction reacts with the substrate and substrate develops a color that changes when the Stop Solution was added. The optical density (OD) was measured spectrophotometrically at a wavelength of 450 ± 2 nm. The color intensity (OD) reported as proportional to the concentration of PF4 in the sample.

Statistical Methods: The Data was entered into and analyzed by the Statistical package for social sciences (SPSS), version 18.0 software (SPSS Inc., Chicago, IL, USA). Variables were assessed for normality, expressed as the mean $\pm$ standard deviation of normally distributed numerical variables and differences in the means of variables were determined by student 't' test and F-test as appropriate. Continuous variables were compared using the appropriate tests (paired t-test for parametric data, Mann-Whitney U test for non-parametric data. Differences were considered to be statistically significant when the p-value is < 0.05 .

RESULTS

Table 1: Socio-demographic characteristics of prospective donors for blood products

Frequency			Percent (%)	Frequency			Percent (%)
Parameters	Mean			Parameters			
AGE (Years)	34.75			EDUCATION			
<=30		24	33.8	Secondary	25		35.2
31-40		29	40.8	Tertiary	46		64.8
> 40		18	25.4	RELIGION			
SEX				Christianity	68		95.8
Male		68	95.8	Islam	3		14
Female		3	4.2	TRIBE			
MARITAL				Yoruba	65		91.5
Single		29	40.8	Others	6		8.5
Married		42	59.2	DAILY STRESS			
OCCUPATION				No Stress	21		29.6
Civil Servant		14	19.7	Rarely	44		62.0
Trader		11	15.5	Often	6		8.5
Student		9	12.7	CIGARETTE			
Unemployed		37	52.2	Yes	3		4.2
SLEEP				No	68		95.8
>6 hours daily		52	73.2	ALCOHOLISM			
< 5 hours daily		14	19.7	Yes	10		14.1
< 4 hours daily		5	7.0	No	61		85.9

A total of 71 adult males (95.8%) and female (4.2%) prospective blood donors for platelet concentrate were recruited with mean age of 34.8; 40.8% were between the age range of 31-40 and 33.8% were ages below 30 years. High percentage of the participants were married (59.2%); unemployed (52.2%); acquired Tertiary education (64.8%); Christianity by faith (95.8%) and Yoruba by tribe (91.5%). Proportionally, 62.0% rarely experienced stress in their daily activities; **95.8%** non-cigarette smokers; **85.9%** non-alcohol drinkers and usually with sleep pattern of more than 6 hours per day (73.2%) on routine basis.

Table 2: Clinical and Demographic Variables of Prospective Platelet Concentrate Blood Donors

Parameters	Frequency	Percent (%)	Parameters	Frequency	Percent (%)
CATEGORIES			REASONS FOR DONATION		
First time donors	21	29.6	Relative	42	59.2
Second time donor	13	18.3	Voluntary non-remunerated	29	40.8
Third Time donor	3	4.2	ANALGESIC		
Regular Donors	34	47.9	Regular	3	4.2
FREQUENCY PER YEAR			Occasional	68	95.4
1-2	58	81.7	HEMATINIC		
3-4	10	14.1	Regular	13	81.3
More than 4	3	4.2	Occasional	3	18.8

According to the analysis of clinico-demographic characteristics of donation pattern: 47.9% regularly donate platelet concentrate; 29.6% donate for the first time; 18.3% donate for the second time, and 4.2% donate for the third time. Most donors donate at most twice a year (81.7%); relatives donate (59.2%); occasionally use analgesics (95.4%) and regularly use hematinics (81.3%) (Table 2).

Table 3: - Mean difference in platelet functionality parameters in prospective platelet concentrate blood donors immediately after donation and the post donation platelet concentrate during storage before transfusion

Parameters	Pre donation (Whole Blood) Mean $\pm$ SD	Post Harvest (Platelet Concentrate) Mean $\pm$ SD	t-test	p-value
PLT ($\times 10^9/L$)	184.30 $\pm$ 54.52	244.25 $\pm$ 7.57	84.259	0.001
MPV (fL)	10.25 $\pm$ 1.19	9.14 $\pm$ 0.19	59.612	0.001
PDW-CV (fL)	0.14 $\pm$ 0.02	0.13 $\pm$ 0.01	54.423	0.001
PDW-SD (fL)	15.71 $\pm$ 4.20	17.53 $\pm$ 6.87	3.607	0.060
PCT (%)	1.70 $\pm$ 0.74	2.21 $\pm$ 0.07	40.440	0.001
P-LCC ($\times 10^9/L$)	48.58 $\pm$ 24.36	55.66 $\pm$ 3.93	5.851	0.017
P-LCR (%)	0.31 $\pm$ 0.07	0.23 $\pm$ 0.01	67.785	0.001

PLT, PDW-SD, PCT & P-LCC were found to increase from pre-donation to post harvest (Concentrate). However, the increase was only statistically significant for PLT & PCT. Conversely, MPV, PDW-CV & P-LCR were found to decrease from pre-donation to post-harvest, the decrease was statistically significant with P-value of (0.001) respectively. CHANGE TO: According to t-test PLT, PDW-SD, PCT & P-LCC were found to increase from pre-donation to post harvest (Concentrate). However, the increase was only statistically significant for PLT & PCT. Conversely, MPV, PDW-CV & P-LCR were found to decrease from pre-donation to post-

harvest, the decrease was statistically significant with P-value of (0.001) respectively (Table 3).

Note: PLT=Platelets; MPV=Mean Platelet Volume; PDW-CV=Platelet Distribution Width as Coefficient of Variation; PDW-SD= Platelet Distribution Width as Standard Deviation; PCT= Plateletcrit; P-LCC=Platelet-Large Cell Concentration; P-LCR=Platelet-Large Cell Ratio

Table 4: Comparison of pH, beta-thromboglobulin and PF4 in platelet concentrate longitudinally from pre-donation to pre-transfusion

Parameters	Pre donation (Whole Blood) Mean $\pm$ SD	Base Line (Platelet Concentrate) Mean $\pm$ SD	5th Day (Platelet Concentrate) Mean $\pm$ SD	F-test	p-value
pH	7.44 $\pm$ 0.11	7.43 $\pm$ 0.04	7.35 $\pm$ 0.10	2.354	0.097
BTG (ng/mL)	123.52 $\pm$ 13.19	142.32 $\pm$ 46.55	314.04 $\pm$ 64.46	139.340	< 0.001
PF4 (ng/mL)	24.93 $\pm$ 3.29	25.70 $\pm$ 2.45	27.44 $\pm$ 5.38	7.695	< 0.001

According to F-test pH and PF4 decreased from day 0 (Base-line) to 5th day (Post-harvest), however the decrease was not statistically significant for pH but significant for PF4. Conversely, beta-thromboglobulin increases from day 0 (Base-line) to 5th day (Post-harvest) and this increase was statistically significant at P-value of (0.001 (Table 4).

Note: BTG=Beta-Thromboglobulin (β -Thromboglobulin); PF4= Platelet Factor 4

Table 5: Changes in pH, Beta-thromboglobulin and PF4 in platelet concentrates in the first six hours after harvesting

HOURS AT POST HARVEST (Mean $\pm$ SD)					
	3	9	12	F-test	p-value
pH	7.41 $\pm$ 0.04	7.40 $\pm$ 0.05	7.39 $\pm$ 0.04	3.373	0.040
BTG (ng/mL)	146.58 $\pm$ 32.83	155.38 $\pm$ 49.96	180.18 $\pm$ 45.66	3.089	0.052
PF4 (ng/mL)	26.12 $\pm$ 2.61	26.17 $\pm$ 2.00	26.18 $\pm$ 2.00	0.315	0.731

According to F-test Beta-thromboglobulin and PF4 concentrations increased progressively as hours of harvest increases proportionately with statistically nonsignificant P-value (Table 5). Contrariwise, there was a progressive decrease in pH crescively as hours of harvest time increases with no statistically significant mean difference (P-value< 0.05) (Table 5).

Note: BTG=Beta-Thromboglobulin (β -Thromboglobulin); PF4= Platelet Factor 4

Table 6: Changes in pH, Beta-thromboglobulin and PF4 in platelet concentrates during the shelf life of five days

DAYS AT POST HARVEST (Mean $\pm$ SD)

	2	3	4	5	F-test	p-value
pH	7.39 ± 0.04	7.37 ± 0.40	7.36 ± 0.00	7.35 ± 0.10	2.741	0.050
BTG (ng/mL)	182.84 ± 46.59	206.44 ± 40.30	230.24 ± 21.32	314.04 ± 64.46	0.699	0.556
PF4 (ng/mL)	26.18 ± 2.00	26.55 ± 1.23	27.28 ± 1.95	27.44 ± 5.38	0.524	0.668

According to the F-test, pH was found to decrease progressively as days of storage increases over the period of 5 days pre-transfusion but the decrease was not statistically significant (P-value = 0.050). Inversely, Beta-thromboglobulin and PF4 were found to increase progressively as days advances but with no statistically significant p-value. (Table 6).

Note: BTG=Beta-Thromboglobulin (β -Thromboglobulin); PF4= Platelet Factor 4

Table 7: Mean difference in pH, Beta-thromboglobulin, and PF4 in platelet concentrate prospective blood donors between post-harvest and pre-transfusion.

Parameters	Base Line (Platelet Concentrate) (Mean ± SD)	5th Day (Platelet Concentrate) (Mean ± SD)	% diff	t-test	p-value
pH	7.43 ± 0.04	7.35 ± 0.10	1.08	6.259	< 0.001
BTG (ng/mL)	142.32 ± 46.55	314.04 ± 64.46	87.10	18.198	0.001
PF4 (ng/mL)	25.70 ± 2.45	27.44 ± 5.38	9.58	2.480	0.014

According to t-test, pH decreased from day 0 (Base-line) progressively to 5th day (Pre-transfusion). However, the decrease was not statistically significant, while Beta-thromboglobulin and PF4 increased from day 0 (Base-line) progressively to 5th day (Pre-transfusion) and this increase was statistically significant (p=0.001). (Table 7).

Note: BTG=Beta-Thromboglobulin (β -Thromboglobulin); PF4= Platelet Factor 4

DISCUSSION: Platelet transfusion is a critical component of modern healthcare, particularly in the management of patients with hematological disorders, cancer, and those undergoing surgical procedures. The quality of platelet concentrates is important for ensuring effective transfusion outcomes and minimizing adverse reactions. It is of great interest that the study assessed platelet functional parameters, Beta-thromboglobulin levels, pH and platelet factor 4 in platelet concentrates stored at room temperature on constant agitation for 5 days pre-transfusion at the University of Ilorin Teaching Hospital's Blood Bank and as well the socio-demographic factors of prospective blood donors for the concentrate. Recruited donors in this current study were apparently healthy youth, well-educated, non-cigarette smokers, non-alcohol drinkers and voluntary non-remunerated regular blood donors. Furthermore, most donors are relative non-remunerated donors with donation interval of at most twice a year (81.7%) who occasionally use analgesics but regularly use hematinics (Table 1 & 2). The findings revealed high quality socio-demographic characteristics of the recruited prospective blood donors for platelet concentrates in

this current study. Additionally, the baseline platelet functional parameters were within the normal threshold of an apparently healthy individual however, when compared with values post-harvest, the platelet count, plateletcrit (PCT), Platelet-large cell concentration (P-LCC), and platelet distribution width-standard deviation (PDW-SD) were higher relative to baseline values. This is consistent with the report of Maurer *et al.*,⁷, Sahoo *et al.*,¹⁷ and Nayak *et al.*,¹⁸ stating that the increase in platelet count in the post-harvest phase is likely due to the efficiency of the harvest technique, which selectively collects platelets while returning other blood components in the satellite blood bag. Conversely, there was a significant decrease in mean platelet volume (MPV) and platelet distribution width coefficient of variation (PDW-CV) as recorded in this study which equally in agreement with existing studies reported independently by Nayak *et al.*,¹⁸ and Wang *et al.*,¹⁹. Antithetically, the study by Zhao *et al.*,²⁰ was at variance to our current finding which reported minimal changes in P-LCR after platelet donation. Justification for this incongruous could be equipment or technical standardization used in different studies, as well as potential differences in donor characteristics. This study further assessed biomarkers of platelet activation and platelet storage lesions under the heading: pH, beta-thromboglobulin (BTG) and platelet factor 4 levels in platelet concentrate at three key stages: pre-donation, post-harvest, and at 5th day storage. The pH level was found to longitudinally declined significantly at interval of three (3) hours in three consecutive clusters (the first 12 hours) of preparation but when compared with daily pH drop recorded over 5 days, the difference in the fall was not statistically significant. This implies rapid fall in the pH potentiating early onset of platelet lesion during processing. This finding contradicts the outcome in previous research which reported stability of pH in stored platelet concentrates as reported by Mokhtar *et al.*,²¹. As regards other platelet activation biomarkers, a non-significant progressive increase in BTG level and PF4 was recorded in the initial first twelve (12) hours of storage but the strength of increase in BTG level and PF4 over the five (5) days storage was statistically significant. This provided insights into the metabolic and activation changes that occur in platelets during storage and preparation for transfusion. This study aligned with the report previous investigators,^{10,21,25} that platelet activation markers, such as BTG, increase during storage, primarily due to the stress exerted on platelets during the harvesting process and subsequent storage. This is also supported by the findings of Chaudhary *et al.*,²², that platelet activation tends to accumulate over time during storage, leading to the progressive release of activation markers such as BTG. This progressive activation can impair the functional quality of platelets and potentially lead to poorer clinical outcomes following transfusion^{10,14,23,24,25}. It has been observed that, certain contents of platelet concentrate like platelets factor IV are also altered during preparation which affect the estimation of these and quality of platelets concentrates which maybe as a result of platelets activation processes¹⁵

CONCLUSION:

This study revealed significant platelet activation during processing and storage. Hence, assessment of platelet functional parameters should be considered a priority in platelet concentrate and more attention should be given to platelet concentrate processes and storage in order to enhance positive clinical outcome and reducing adverse reactions.

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DATA AVAILABILITY STATEMENTS:

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request. All data generated or analyzed during this current study are included in this submitted article for publication.

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