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Evaluating Laboratory Centrifuges for Platelet-Poor Plasma Preparation: A Comparative Study of Performance and Usability

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Executive Summary

This study compares two centrifuges, the Drucker Diagnostics DASH-4 and Beckman Coulter StatSpin® Express 2, for preparing platelet-poor plasma (PPP), which is essential for accurate diagnostic testing. Centrifugation is a critical step in stabilizing blood samples, and the quality of PPP directly impacts diagnostic accuracy.

Blood samples from 24 donors were processed using both centrifuges, and the results showed that both devices consistently produced PPP with platelet counts below 10 $x10^3$ platelets/µL, meeting clinical requirements. The performance of the DASH-4 and StatSpin® Express 2 was statistically equivalent, making both suitable for use in hospital laboratories.

Both centrifuges are compact, user-friendly, and comply with international safety standards, offering reliable performance for high-quality PPP preparation. This ensures that laboratory professionals can confidently use either device for accurate diagnostic results.

Introduction

Each year, approximately 2 billion blood samples are collected in the United States, influencing an estimated 70% of medical decisions[1]. Despite the importance of these samples, improper preparation, stabilization, handling, and quality control remain significant contributors to inaccurate diagnostic outcomes, potentially delaying or obstructing timely treatment[1].

The standard process for in vitro diagnostic testing of blood samples starts with collection at locations like hospitals, blood draw centers, and physician offices. Centrifugation is the most efficient and cost-effective method for stabilizing pre-analytic blood samples, with many assays requiring stabilization within two hours of collection. Since diagnostic assays commonly use serum or plasma, it is critical to achieve clean separation of these components to ensure reliable and reproducible results. For anticoagulated specimens, the goal of centrifugation is to produce platelet-poor plasma, which requires reducing platelet counts from approximately 300 $x10^3$ platelets/µL to below 10 $x10^3$ platelets/µL to avoid interference with subsequent diagnostic tests. The generally accepted definition of PPP is plasma with a platelet count below 10 $x10^3$ platelets/µL. Achieving this requires precise and reliable equipment, as the centrifuge used directly impacts the quality of PPP, and therefore, the accuracy of diagnostic results[2].

Even with optimal equipment, certain medical conditions may hinder the creation of high-quality PPP due to their effects on blood composition, clotting factors, and the physical properties of blood components. Conditions that could impact PPP production include clotting disorders (e.g., hemophilia or disseminated intravascular coagulation), hyperlipidemia, thrombocytosis, polycythemia, inflammatory conditions, and the use of anticoagulant therapies such as heparin or warfarin. These conditions present challenges to achieving optimal platelet removal through centrifugation[3,4,5,6].

Methodology

The DASH-4 and StatSpin® Express 2 centrifuges are commonly used in the preparation of platelet-poor plasma (PPP) due to their specifications, performance, and widespread adoption in the industry. This study was conducted to provide a comprehensive comparison of these centrifuges in their ability to process PPP. A rigorous protocol was followed, including sample collection, centrifugation, preparation, delivery, analysis, and statistical assessment.

Blood samples were collected from 24 volunteer donors, with each providing blood samples in multiple lithium heparin plasma separator tubes (BD part number 367884). The tubes were labeled with anonymized donor identifiers and a numerical designation to indicate the order of collection. Within five minutes of phlebotomy, the tubes were centrifuged individually, balanced with a control tube, using either the DASH-4 or StatSpin® Express 2 at 4,440 xg for three minutes. The draw order was balanced between the two centrifuges to prevent bias.

Following centrifugation, PPP was carefully extracted from above the gel barrier and transferred into additive-free collection tubes (Red Top Tube, BD part number 366703). The samples were stored at room temperature until all were processed, then packed in an insulated carrier with cold packs and shipped overnight for analysis. Platelet (PLT) counts in the PPP samples were measured twice using the Sysmex XN-1000 Hematology Analyzer, employing the fluorescence platelet method (PLT-f) for its clinical accuracy and reproducibility in low-platelet samples[7,8]. The results from the two measurements were averaged to ensure consistent and reliable readings with the average results shown in Table 1.

Comparative Analysis

The comparative analysis demonstrated that the Drucker Diagnostics DASH-4 and StatSpin® Express2 centrifuges produced statistically equivalent results in PPP preparation. Both devices consistently generated PPP with platelet counts below 10 x103 platelets/µL, as illustrated in *Figure 1* based on data in Table 1.

Although four samples, two with identical results, exceeded this threshold, the platelet counts remained within a comparable range for both centrifuges. An ANOVA analysis confirmed the equivalence between the two units, as shown in *Figure 2* PLT-f One-way ANOVA Results, with a p-value greater than 0.05 from the Sysmex PLT-f method, indicating no significant difference in mean platelet counts produced by the DASH-4 and the StatSpin® Express 2.

Further comparisons, including a paired t-test and difference analysis, are presented in *Figure 3*, reinforcing that the mean values are statistically equivalent. Together, these results indicate that both centrifuges perform similarly and effectively in PPP preparation.

Figure 1 – PLT-f Test Results

One-way ANOVA: PLT-f versus Centrifuge

Method

Null hypothesis	All means are equal
Alternative hypothesis	Not all means are equal
Significance level	α = 0.05

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Centrifuge	2	DASH-4, StatSpin Express 2

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Centrifuge	1	0.880	0.8802	0.09	0.766
Error	46	452.365	9.8340		
Total	47	453.245			

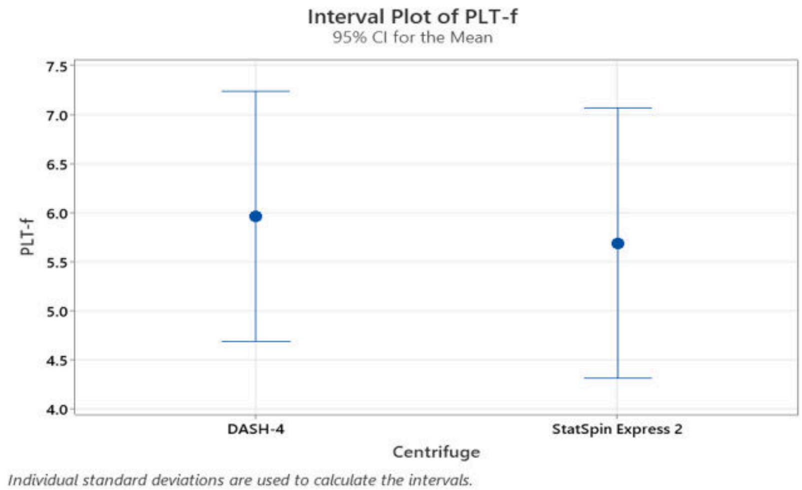

Figure 2 – PLT-f One-way ANOVA Results

Paired T-Test and CI				
Sample	N	Mean	StDev	SE Mean
DASH-4	24	5.96	3.02	0.616
StatSpin Express2	24	5.69	3.25	0.663

Estimation for Paired Difference				
Mean	StDev	SE Mean	95% CI	
0.27	0.96	0.195	0.674	-0.133
Difference is population mean of DASH - StatSpin				

T	T-Test (1 sided)	T-Test (2 sided)
1.360	0.089	0.178

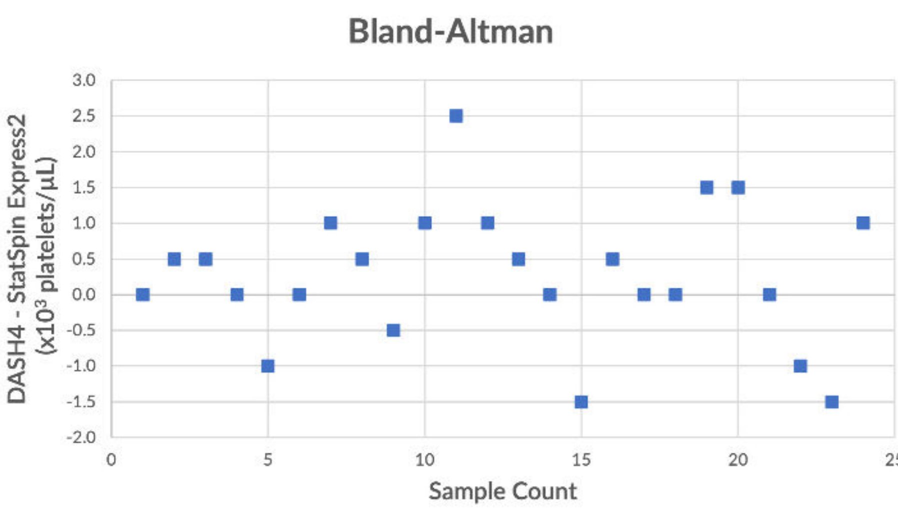

Figure 3 – Paired T-Test, Difference Analysis, and Bland Altman Plot

Unit Comparison

The Drucker Diagnostics DASH-4 and the Beckman Coulter StatSpin® Express 2 are both compact centrifuges designed for the efficient preparation of PPP in laboratory settings. Below is a detailed comparison of their features and specifications:

1. Design and Build:

DASH-4: The DASH-4, shown in *Figure 4*, is a compact, high-speed benchtop centrifuge designed for rapid separation in collection tubes. It weighs 4.3 lbs. and has dimensions of 7.2 (W) x 6.8 (D) x 6.9 (H) inches. The simple two-button interface allows for easy cycle selection and preset locking for repeatability. The DASH-4 is built with a clear shatter-proof lid for safe sample observation and optical speed checks.

StatSpin Express 2: The StatSpin® Express 2, shown in *Figure 5*, is slightly larger, weighing 5.0 lbs., and measures 6.6 (W) x 8.6 (D) x 6 (H) inches. It features similar compactness and is designed to enhance laboratory productivity through quick processing times. The StatSpin® Express 2 also has a clear shatter-proof lid for safe sample observation and optical speed checks.

Figure 4 – DASH-4

Figure 5 – StatSpin Express 2

2. Performance:

Both centrifuges operate at a maximum RCF of 4,440 xg and a speed of 8,500 RPM, offering similar preset cycles. Each device is powered by a brushless DC motor, ensuring reliable operation under heavy workloads. Both centrifuges accept up to 5 mL blood tubes (13 x 75 mm), Monovette syringe tubes and smaller tube formats.

3. Safety and Compliance:

Both units comply with US, Canadian, and European safety standards[9], feature automatic lid locks, and are supported by two-year warranties.

Conclusion

Accurate blood sample preparation is crucial to delivering reliable diagnostic results that influence medical decisions. Centrifugation is the most efficient method for stabilizing pre-analytic blood samples, particularly when preparing PPP for coagulation tests. The results of this study demonstrate that both the Drucker Diagnostics DASH-4 and Beckman Coulter StatSpin® Express 2 centrifuges produce equivalent PPP, ensuring reliable performance. Thus, both centrifuges can be confidently used in clinical settings where high-quality PPP is required.

Appendix

Table 1 Comparison Data Results

**Avg PLT-f (x10^3 platelets/µL)*

Donor	Centrifuge	Draw Order	Avg. PLT-f*
1	DASH-4	2nd Tube Drawn	3.0
2	DASH-4	2nd Tube Drawn	4.5
3	DASH-4	2nd Tube Drawn	9.0
4	DASH-4	2nd Tube Drawn	4.0
5	DASH-4	2nd Tube Drawn	9.5
6	DASH-4	2nd Tube Drawn	3.0
7	DASH-4	2nd Tube Drawn	3.0
8	DASH-4	2nd Tube Drawn	4.0
9	DASH-4	2nd Tube Drawn	8.5
10	DASH-4	2nd Tube Drawn	5.0
11	DASH-4	2nd Tube Drawn	8.5
12	DASH-4	2nd Tube Drawn	9.0
13	DASH-4	2nd Tube Drawn	9.5
14	DASH-4	1st Tube Drawn	3.5
15	DASH-4	1st Tube Drawn	5.5
16	DASH-4	1st Tube Drawn	9.0
17	DASH-4	1st Tube Drawn	1.5
18	DASH-4	1st Tube Drawn	12.0
19	DASH-4	1st Tube Drawn	3.5
20	DASH-4	1st Tube Drawn	3.0
21	DASH-4	1st Tube Drawn	2.0
22	DASH-4	1st Tube Drawn	9.5
23	DASH-4	1st Tube Drawn	6.0
24	DASH-4	1st Tube Drawn	7.0

Donor	Centrifuge	Draw Order	Avg. PLT-f*
1	StatSpin Express 2	1st Tube Drawn	3.0
2	StatSpin Express 2	1st Tube Drawn	4.0
3	StatSpin Express 2	1st Tube Drawn	8.5
4	StatSpin Express 2	1st Tube Drawn	4.0
5	StatSpin Express 2	1st Tube Drawn	10.5
6	StatSpin Express 2	1st Tube Drawn	3.0
7	StatSpin Express 2	1st Tube Drawn	2.0
8	StatSpin Express 2	1st Tube Drawn	3.5
9	StatSpin Express 2	1st Tube Drawn	9.0
10	StatSpin Express 2	1st Tube Drawn	4.0
11	StatSpin Express 2	1st Tube Drawn	6.0
12	StatSpin Express 2	1st Tube Drawn	8.0
13	StatSpin Express 2	1st Tube Drawn	9.0
14	StatSpin Express 2	2nd Tube Drawn	3.5
15	StatSpin Express 2	2nd Tube Drawn	7.0
16	StatSpin Express 2	2nd Tube Drawn	8.5
17	StatSpin Express 2	2nd Tube Drawn	1.5
18	StatSpin Express 2	2nd Tube Drawn	12.0
19	StatSpin Express 2	2nd Tube Drawn	2.0
20	StatSpin Express 2	2nd Tube Drawn	1.5
21	StatSpin Express 2	2nd Tube Drawn	2.0
22	StatSpin Express 2	2nd Tube Drawn	10.5
23	StatSpin Express 2	2nd Tube Drawn	7.5
24	StatSpin Express 2	2nd Tube Drawn	6.0

Appendix

[1] Committee on Diagnostic Error in Health Care; Board on Health Care Services; Institute of Medicine; The National Academies of Sciences, Engineering, and Medicine; Balogh EP, Miller BT, Ball JR, editors. Improving Diagnosis in Health Care. Washington (DC): National Academies Press (US); 2015 Dec 29. 3, Overview of Diagnostic Error in Health Care. Available from: https://www.ncbi.nlm.nih.gov/books/NBK338594/

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[6] Souto JC, Almasy L, Borrell M, et al. "Genetic Determinants of Thrombophilia." *Circulation*. 2000.

[7] https://pubmed.ncbi.nlm.nih.gov/24045545/

[8] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4619826/

[9] Complies with UL61010-1/CSA C22.2 No. 61010-1 and IEC61010-2-020

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