

Fat Graft Processing Using the REVOLVE ENVI™ System Versus Decantation: In Vitro Properties and Tissue Quality

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OBJECTIVE

Evaluate the in vitro properties and tissue quality of fat grafts processed with the REVOLVE ENVI 600 System compared with decantation (ie, gravity filtration) and evaluate the properties of REVOLVE ENVI waste products

CONCLUSIONS



REVOLVE ENVI concentrated graftable fat and removed more waste (free oil, excess fluid, and red blood cell debris) than decantation



Fat grafts processed by REVOLVE ENVI demonstrated greater viability and better fat quality than grafts processed by decantation



REVOLVE ENVI produced more SVF CFU/cc graft, which are rich in actively proliferating progenitor cells, than fat grafts processed by decantation



These findings suggest that use of REVOLVE ENVI for large-volume fat processing improves graft quality compared with the decantation method

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References

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- Fang C, et al. *Plast Reconstr Surg Glob Open*. 2020;8(8):e3010.

INTRODUCTION

Background

- Autologous fat transplantation is used in a variety of grafting applications for soft tissue filling and augmentation in reconstructive and aesthetic surgery procedures^{1,2}
- Fat harvesting typically generates graft contaminants, such as free oil, blood cells, cellular debris, stringy collagen fibers, and excess fluids; if not removed before transplantation, these can lead to inflammation, tissue necrosis, suboptimal volume retention, and poor injectability²
- Several fat processing methods (eg, decantation, centrifugation, and filtration) are available for use in liposuction/fat-grafting procedures,² and an evaluation of the relative benefits of these methods would be useful for aiding clinicians in their decision-making processes
- The REVOLVE ENVI™ 600 System (Allergan Aesthetics, an AbbVie Company) is an investigational, filtration-based fat processing device that can process up to 600 cc of lipoaspirate (the currently available REVOLVE™ System [Allergan Aesthetics] processes up to 350 cc of lipoaspirate)

METHODS

Fat Graft Preparation

- Lipoaspirate procedures were conducted per standard surgeon protocol, then transferred for fat processing and in vitro testing of final grafts. Harvested lipoaspirate (750 cc from each of 6 patients) was warmed to 37°C, gently mixed to create a homogenous suspension, then divided into 2 portions to reduce any variability (1 portion for the REVOLVE ENVI system and the other portion for decantation)
- REVOLVE ENVI:** Lipoaspirate samples were processed according to the instructions for use and tested at maximum fill volume of 600 cc lipoaspirate with 3 to 4 separate washes of lactated Ringer’s solution for a final 1:3 total tissue-to-wash solution volume ratio. Wash solution was filtered through the device and drained into wash containers per instructions for use
- REVOLVE ENVI waste:** Containers used to collect waste from REVOLVE ENVI fat processing were maintained at room temperature until fluid and adipose tissue layers separated (≈5 minutes). The adipose layer was then collected for particle size analysis. For adipocyte counts, the remaining adipose layer was homogenized prior to sampling
- Decantation:** Lipoaspirate (150 cc) was aspirated into a sterile container and maintained at room temperature for at least 20 minutes to allow for phase separation. Once phase separation was achieved, the visible aqueous fluid and free oil layers were removed by aspiration. The remaining adipose layer was homogenized and used for testing
- The table below summarizes the tests performed on the lipoaspirate. For more details about the assays used, please scan the QR code

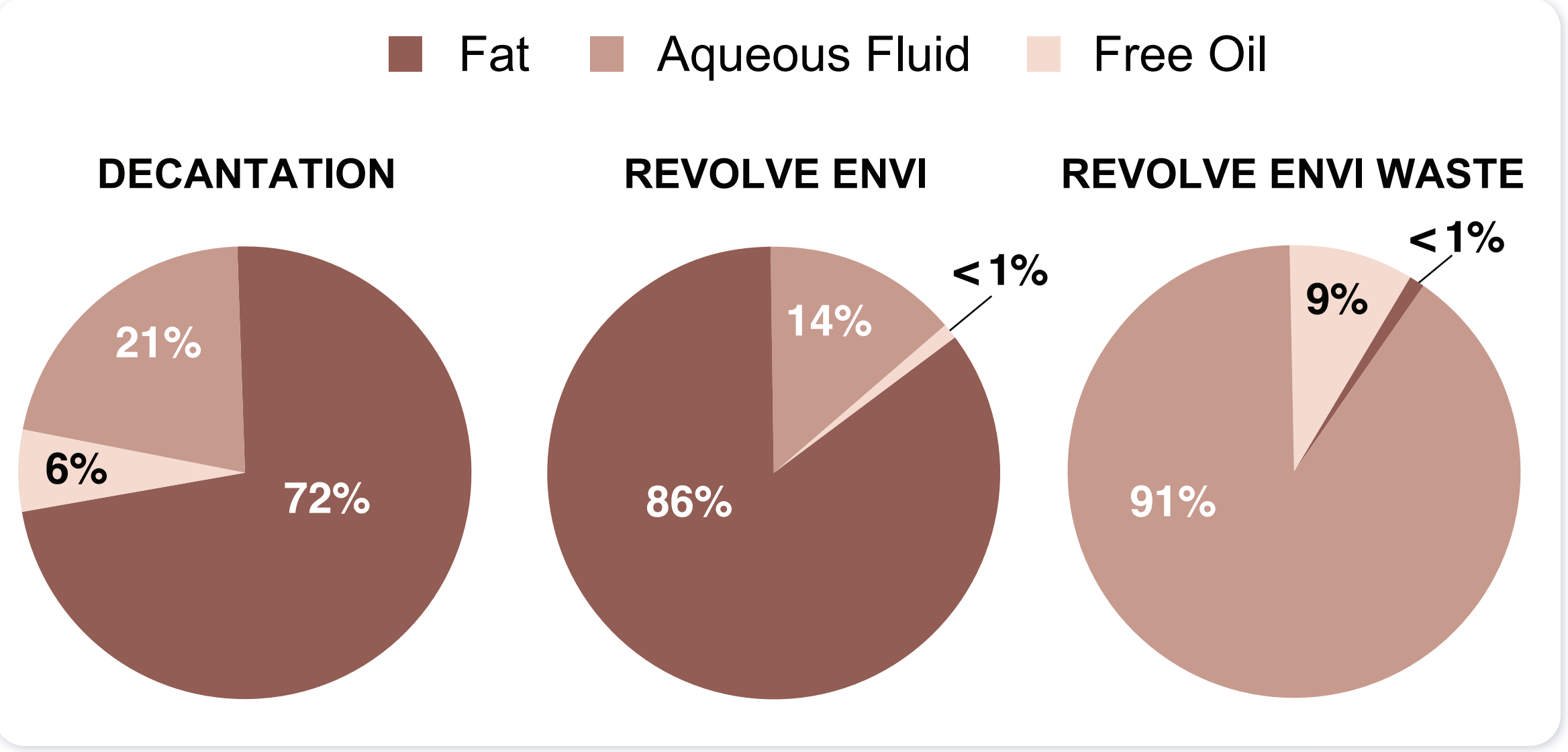
Test Performed on Lipoaspirate Samples

Tests	Assessments/Output
Volume composition	Percentage of fat, aqueous fluid, free oil, and cellular debris
Hematocrit	Red blood cells in graft
Particle size and macrostructure	Size of adipose tissue fragments
Viable adipocyte count (calcein AM)	Number of viable adipocytes in graft (10 ⁵ cells/cc)
Adipocyte activity (lipolysis assay)	Graft viability (µg of glycerol/cc)
FACS analysis of SVF	CD45/CD31/CD34 ⁺ cells/cc of graft
CFU culture of SVF	SVF proliferative progenitor cells/cc of graft

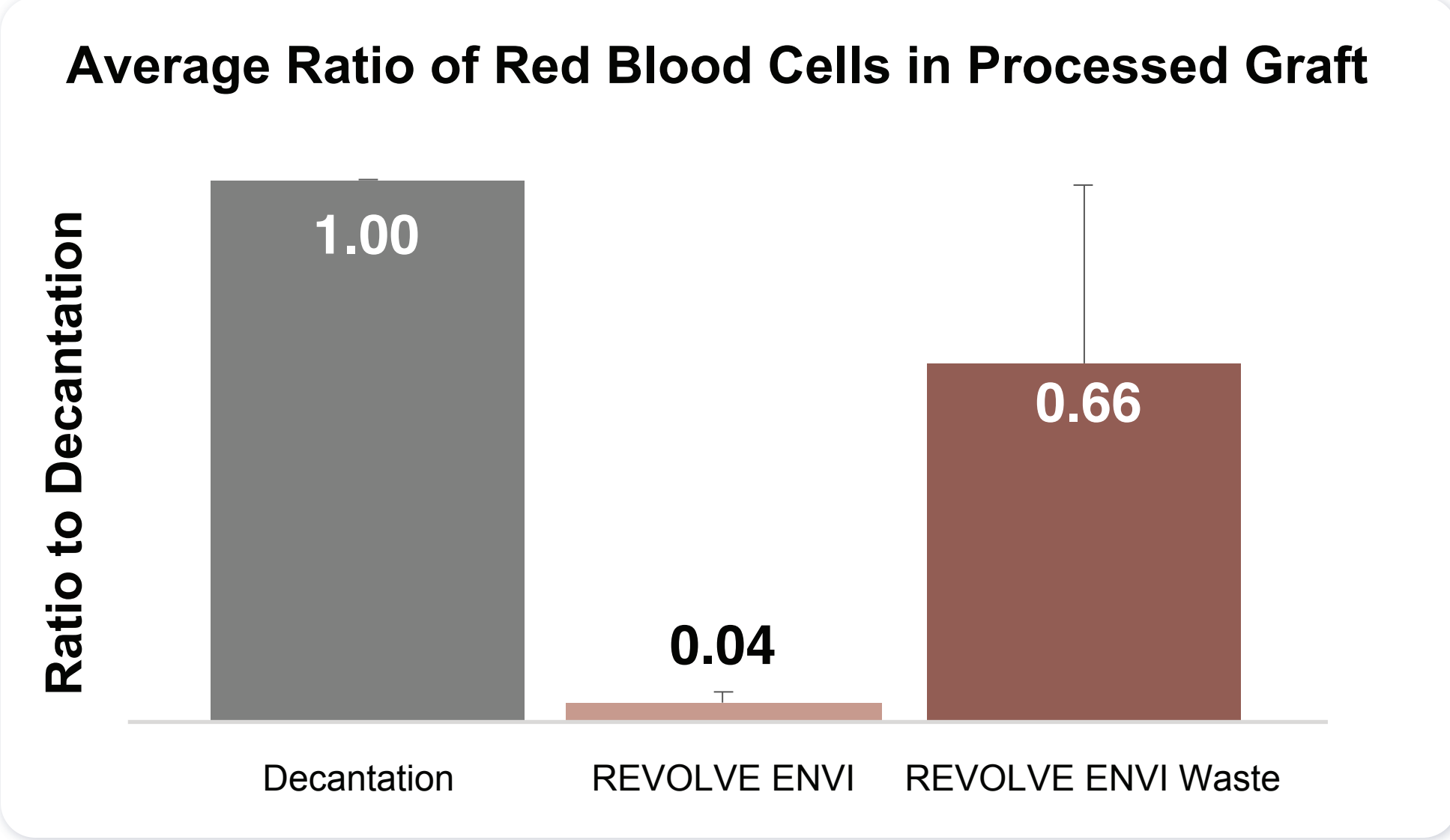
AM, acetoxymethyl; CFU, colony-forming units; FACS, fluorescence-activated cell sorting; SVF, stromal vascular fraction.

RESULTS

REVOLVE ENVI Grafts Had Higher Fat Content (86%) Than Decanted Grafts (72%)

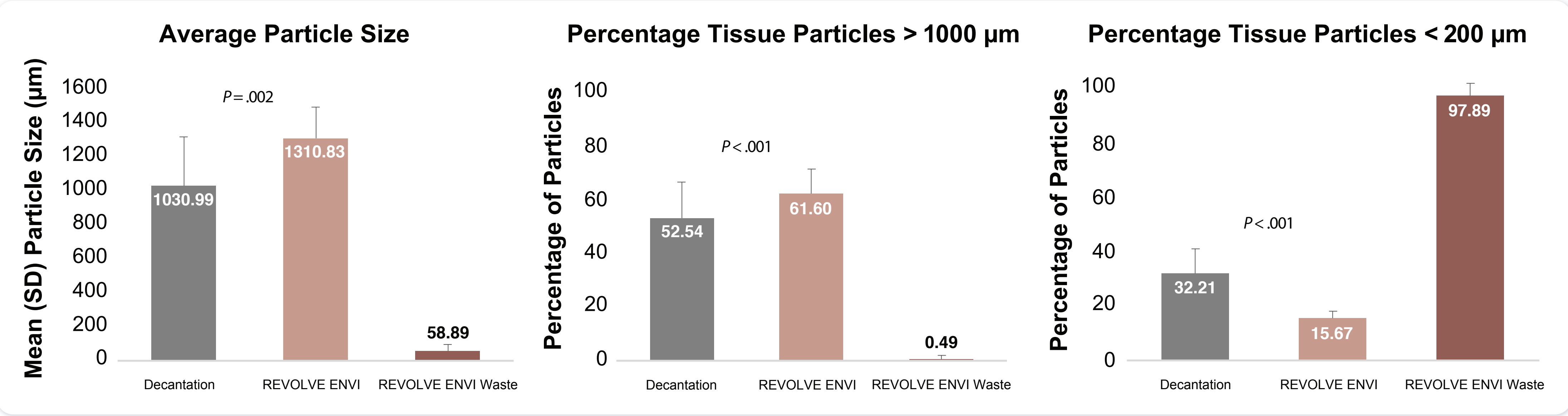


REVOLVE ENVI Grafts Had Significantly Fewer Red Blood Cells Than Decanted Grafts



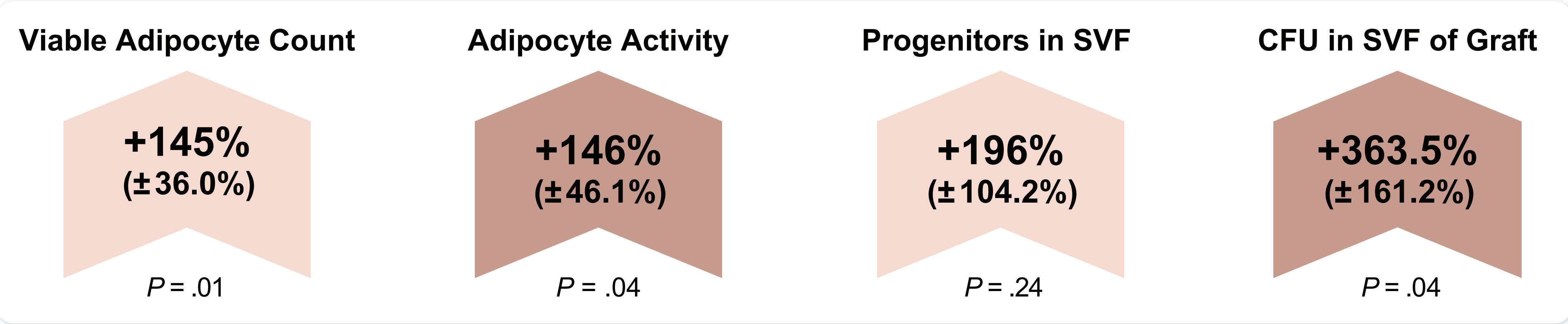
- REVOLVE ENVI grafts had a higher mean (±SD) fat content than decanted grafts (85.6% ±6.1% vs 72.1% ±4.0%; $P<.001$)
- REVOLVE ENVI grafts had negligible free oil (0.4% ±1.1%) compared with decanted grafts (6.2% ±3.6%) and little to no cellular debris (<0.1% vs 0.37% ±0.40%, both $P<.001$)
- REVOLVE ENVI waste contained primarily aqueous fluid (91.0% ±2.2%) with negligible viable fat

REVOLVE ENVI Grafts Contained Significantly More Large Fat Globules Than Decanted Grafts or REVOLVE ENVI Waste



- The percentage of tissue particles > 1000 µm was highest for REVOLVE ENVI grafts at 61.60% ±9.15% versus 52.54% ±13.35% for decanted grafts ($P<.001$), and the percentage of particles <200 µm was lowest for REVOLVE ENVI grafts at 15.67% ±2.65% versus 32.21% ±8.94% for decanted grafts ($P<.001$)

Relative to Decantation, REVOLVE ENVI Produced More Viable Adipocytes With Greater Activity, More Progenitors in SVF, and More CFU in SVF of Graft



CFU, colony-forming units; SVF, stromal vascular fraction.